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ABSTRACT BOOK

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Impact of the full-scale invasion on the mental health of the population of the country in a state of military conflict: a study of regional trends in anxiety, depression, early symptoms of acute stress disorder and post-traumatic stress disorder

Anastasiia K. Shkvarok¹, Yaroslava V. Korost¹, Daria V. Turchak¹, Giorgi Tedoradze², Kristina Tatvidze³

¹BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

²TBILISI STATE MEDICAL UNIVERSITY, TBILISI, GEORGIA

³THE NATIONAL MENTAL HEALTH CARE, KHONI, GEORGIA

ABSTRACT

Aim: To evaluate subjective distress caused by the invasion and examine the relationship between regional residency and mental health indicators.

Materials and Methods: Descriptive statistics, a cross-sectional observational analysis. Data were collected through an online questionnaire comprising demographics, anxiety and depression assessment (HADS), and trauma impact evaluation (IES-R). Statistical analysis was conducted using MedStat software, with statistical analysis incorporating descriptive statistics, tests for normality and correlation analysis (Pearson's correlation).

Results: The highest depression (39.36%) and anxiety (48.94%) rates were recorded in Ivano-Frankivsk Oblast, while the lowest were in Dnipropetrovsk (26%) and Lviv (26.83%) Oblasts. No significant correlation was found between proximity to the frontline and depression ($r=0.107$, $p=0.615$) or anxiety ($r=-0.106$, $p=0.622$). The highest trauma impact (IES-R) was observed in Kherson (37.14%), Donetsk (36.36%) and Mykolaiv (35.29%) Oblasts. No significant correlation was found between distance from the frontline and the severity of acute stress disorder or post-traumatic stress disorder symptoms ($r=-0.307$, $p=0.145$).

Conclusions: Mental health outcomes were not significantly linked to geographical proximity to the frontline. The highest rates of depression and anxiety were found in Ivano-Frankivsk Oblast, while the most severe trauma impact was observed in Kherson, Donetsk, and Mykolaiv Oblasts.

KEY WORDS: anxiety, depression, post-traumatic stress disorder, frontline proximity

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INTRODUCTION

Research indicates that war refugees and veterans frequently experience neuropsychiatric conditions such as depression, PTSD, and anxiety, which can profoundly alter their emotional responses and leave lasting psychological effects [1]. The civilian population, which is not in a constant state of readiness for military attacks, is exposed to all elements of war. For instance, a 2024 study found that civilian students exhibited significantly higher rates of moral injury, PTSD, depression, and anxiety compared to a sample of active-duty military personnel [2]. Additionally, research from 2023 emphasized that these mental health disorders among civilians contribute to greater risks for physical health issues [3]. Thus, mental health becomes a root cause of deteriorating somatic well-being, worsening chronic disease management, and other health complications. During the presentation of our initial findings on the

increase in cardiovascular complaints among Ukrainian students amid heightened situational anxiety during martial law [4], we received an intriguing question at the 18th Warsaw International Medical Congress regarding whether proximity to the frontline influences the development of mental health issues due to wartime conditions. It is important to understand that modern warfare is not the clichéd image retained in the minds of many, where infantry and close-range weaponry dominate the battlefield. While such tactics are still used today, the primary focus has shifted toward long-range weaponry, including guided air missiles, unmanned aerial vehicles, ballistic missiles – some of which are intercontinental – and so on. These weapons can cover thousands of kilometers, often evading air defense systems and, inevitably, impacting civilian populations as well. This article aims to explore this question widely.

Table 1. Number of Respondents with Corresponding Levels of Anxiety and Depression Levels in Ukraine According to HADS

Oblast	Anxiety				Depression			
	Normal, n	Subclinical, n	Clinically significant, n	Total, n	Normal, n	Subclinical, n	Clinically significant, n	Total, n
Vinnytsia	16	14	18	48	19	14	15	48
Volyn	16	11	10	37	16	10	11	37
Dnipropetrovsk	18	16	16	50	21	16	13	50
Donetsk	10	10	13	33	11	10	12	33
Zhytomyr	10	11	10	31	10	11	10	31
Zakarpattia	11	10	12	33	11	10	12	33
Zaporizhzhia	12	12	13	37	13	12	12	37
Ivano-Frankivsk	20	28	46	94	31	26	37	94
Kyiv	21	16	34	71	31	19	21	71
Kirovohrad	11	12	11	34	12	12	10	34
Lviv	14	16	11	41	13	12	16	41
Mykolaiv	10	11	13	34	11	11	12	34
Kyiv (city)	68	54	74	196	80	58	58	196
Odesa	18	14	21	53	22	14	17	53
Poltava	11	12	14	37	13	12	12	37
Rivne	10	13	10	33	12	11	10	33
Sumy	12	13	13	38	14	13	11	38
Ternopil	11	12	14	37	16	11	10	37
Kharkiv	11	10	14	35	11	13	11	35
Kherson	12	11	12	35	13	11	11	35
Khmelnyskyi	10	11	12	33	11	10	12	33
Cherkasy	11	10	12	33	11	10	12	33
Chernivtsi	13	10	11	34	14	10	10	34
Chernihiv	15	12	20	47	19	16	12	47
Total, n			434	1154			367	1154

AIM

To assess subjective distress caused by the traumatic event in the population of the country that has suffered an invasion from a neighboring country. To analyze the association between regional residency and the severity of stress responses. To assess the correlation between heightened anxiety and depression levels with stress reactivity.

MATERIALS AND METHODS

This study is a cross-sectional observational analysis assessing the impact of the full-scale invasion on the mental health of the Ukrainian population, focusing on regional variations in anxiety, depression, and trauma-related symptoms. Data was gathered through online surveys using Google Forms, chosen for its accessibility, rapid distribution, and ability to reach a broader respondent pool. Additionally, this method was selected for its

environmental benefits, reducing paper use and carbon emissions. The online questionnaire was divided into three sections. The first section contained general demographic questions, including gender, age, the region where the respondent was located at the time of the survey, and the region where the respondent had spent the longest period in Ukraine since February 24.02.2022. The Hospital Anxiety and Depression Scale (HADS) was used to assess levels of anxiety and depression in the second section. The third section included the Impact of Event Scale-Revised (IES-R), where the traumatic event was defined as the onset of the full-scale invasion. A total of 1154 respondents participated in the survey, representing all regions of Ukraine except Luhansk Oblast. Respondents were between the ages of 15 and 84, including 958 female respondents (83%) and 196 male respondents (17%). The survey which was conducted anonymously from 10.12.2024 to 26.01.2025 with informed consent obtained from all participants regarding

Table 2. Percentage of clinically significant anxiety and depression in every oblast of Ukraine included in the study

Oblast	Intra-Oblast Anxiety Rate	Intra-Oblast Depression Rate
Vinnitsia	37,50%	31,25%
Volyn	27,03%	29,73%
Dnipropetrovsk	32,00%	26,00%
Donetsk	39,39%	36,36%
Zhytomyr	32,26%	32,26%
Zakarpattia	36,36%	36,36%
Zaporizhzhia	35,14%	32,43%
Ivano-Frankivsk	48,94%	39,36%
Kyiv	47,89%	29,58%
Kirovohrad	32,35%	29,41%
Lviv	26,83%	39,02%
Mykolaiv	38,24%	35,29%
Kyiv (city)	37,76%	29,59%
Odesa	39,62%	32,08%
Poltava	37,84%	32,43%
Rivne	30,30%	30,30%
Sumy	34,21%	28,95%
Ternopil	37,84%	27,03%
Kharkiv	40,00%	31,43%
Kherson	34,29%	31,43%
Khmelnyskyi	36,36%	36,36%
Cherkasy	36,36%	36,36%
Chernivtsi	32,35%	29,41%
Chernihiv	42,55%	25,53%

the use of their provided data. The sample included only those respondents who reported continuous residence in Ukraine from 24.02.2022 until the date of completing the online questionnaire. This survey format is validated from the previous studies. MedStat software were used for data processing, with statistical analysis incorporating descriptive statistics, tests for normality and correlation analysis. The Shapiro-Wilk W-test confirmed that the data followed a normal distribution, ensuring the validity of subsequent statistical tests. To examine the correlation between mental health indicators and proximity to the frontline, Pearson's correlation coefficient was calculated for depression, anxiety, and trauma impact scores in relation to the distance between the respondent's regional center and the nearest frontline point.

RESULTS

Out of all 1,154 respondents from across Ukraine, 434 (37.6%) respondents scored on the HADS questionnaire at a level indicating clinically significant anxiety, while

367 (31.8%) scored at a level indicating clinically significant depression (Table 1).

The proportion of individuals with clinically significant depression was calculated separately for each oblast in Ukraine based on the total number of respondents within that oblast. Similarly, the percentage of individuals with clinically significant anxiety was determined for each oblast. These measures were labeled as the Intra-Oblast Depression Rate (IODR) and the Intra-Oblast Anxiety Rate (IOAR). The highest IODR was recorded in Ivano-Frankivsk Oblast (39.36%), followed by Lviv (39.02%), Donetsk (36.36%), Zakarpattia (36.36%) and Khmelnytskyi (36.36%) Oblasts, while the lowest IODR values were found in Dnipropetrovsk (26%) and Chernihiv (25.53%) Oblasts. Ivano-Frankivsk also had the highest IOAR (48.94%), followed by Kyiv (47.89%), Chernihiv (42.55%), Kharkiv (40%), Odesa (39.62%), Donetsk (39.39%) and Mykolaiv (38.24%) Oblasts. The lowest IOAR values were observed in Rivne (30.30%), Volyn (27.03%) and Lviv (26.83%) Oblasts (Table 2).

Table 3. Levels of traumatic event impact, assessed by IES-R, in each oblast of Ukraine and the intra-oblast indicator of the pronounced impact of a traumatic event

Oblast	Low atress response (<30 points)	Moderate stress response (30-50 points)	Severe stress response (>50 points)	Total	Intra-oblast indicator of the pronounced impact of the traumatic event
Vinnytsia	17	19	12	48	25.00%
Volyn	19	12	10	37	27,03%
Dnipropetrovsk	21	16	13	50	26.00%
Donetsk	10	11	12	33	36.36%
Zhytomyr	10	11	10	31	32,26%
Zakarpattia	10	12	11	33	33.33%
Zaporizhzhia	14	11	12	37	32.43%
Ivano-Frankivsk	25	49	20	94	21,28%
Kyiv	23	36	12	71	16.90%
Kirovohrad	13	11	10	34	29.41%
Lviv	16	13	12	41	29.27%
Mykolaiv	10	12	12	34	35.29%
Kyiv (city)	70	105	21	196	10.71%
Odesa	18	22	13	53	24.53%
Poltava	11	14	12	37	32.43%
Rivne	13	10	10	33	30.30%
Sumy	12	15	11	38	28.95%
Ternopil	14	13	10	37	27,03%
Kharkiv	12	12	11	35	31.43%
Kherson	11	11	13	35	37,14%
Khmelnyskyi	10	13	10	33	30.30%
Cherkasy	11	12	10	33	30.30%
Chernivtsi	10	11	10	31	32.26%
Chernihiv	12	28	10	50	20,00%
Total				1154	

The Shapiro-Wilk W test was used to evaluate the normality of data distribution, revealing no significant deviation from normality for IODR (n=24, W=0.947, p>0.1) and IOAR (n=24, W=0.951, p>0.1). To examine the correlation between IODR and IOAR values and the distance of respondents from the frontline, a linear correlation analysis (Pearson’s coefficient) was performed using the following variables: (1) IOAR and IODR percentages and (2) distance, where Point A represented the administrative center of each oblast and Point B was the nearest frontline point to that center as of February 2025 (Hlyboke, Hola Prystan, Enerhodar) in kilometers. The DeepStateMap resource was used to determine Point B (13.02.25). The only

exception was made for Donetsk, whose administrative center has been under occupation since 2014; for this oblast, the distance was recorded as zero. For border oblasts adjacent to the aggressor state, the direct distance to the nearest border checkpoint was calculated (e.g., Sumy). The normality test for these distances showed no significant deviation from normal distribution (n=24, W=0.926, p=0.08). The analysis of the linear correlation between IOAR and distance showed that there was no significant linear correlation (r=0, p=0.622). Similarly, the correlation between IODR and distance indicated that no significant linear relationship was found (r=0, p=0.615). The intra-regional indicator of the pronounced impact of the traumatic

event (IRIPITE) was determined as the ratio of the number of respondents in each oblast who scored more than 50 points on the IES-R to the total number of surveyed individuals in that oblast. The highest levels of IRIPITE were recorded in Kherson (37.14%), Donetsk (36.26%), Mykolaiv (35.29%), Zakarpattia (33.33%) and Zaporizhia (32.43%) Oblasts. To confirm or refute the hypothesis regarding the relationship between the distance from the front line and the scores obtained on the IES-R, the collected data were analyzed based on the following parameters: the first parameter – IPRITE and the second parameter – the distance from the regional center to the nearest point of the front line. The distribution did not differ from normal for both variables. A significance test for the linear correlation was conducted for the two samples using Pearson's correlation coefficient. Statistical analysis revealed no significant correlation between proximity from the place of permanent residence to the frontline and the severity of acute stress disorder (ASD) and post-traumatic stress disorder symptoms (PTSD) ($r=-0,307$, $p=0,145$) (Table 3).

DISCUSSION

The identified indicators suggest high levels of anxiety, depression, as well as signs of ASD and PTSD in each of the regions of Ukraine that were included in the study. We present the experience of Georgia for comparison. The 2008 summer war, which resulted in the occupation of Abkhazia and South Ossetia, was a major shock for the country, which at the time had not yet fully recovered from the civil war. The collective trauma of that period was a significant source of stress for society [5]. To date, there are relatively few studies examining the mental health status of the Georgian population from 2008 to the present. However, there are representative data on the psychological well-being of internally displaced persons (IDPs) from Abkhazia and South Ossetia. Previous studies recorded levels of presumed PTSD, depression, and anxiety at 23.3%, 14.0%, and 10.4%, respectively [6]. These findings highlight the persistence of PTSD symptoms, particularly among those displaced during the conflicts of the 1990s. Additionally, the data indicate significantly better mental health outcomes among returnees compared to long-term IDPs from the 1990s. Higher rates of mental disorders among displaced populations align with prior research on the impact of forced displacement on mental health [7]. Studies emphasize the enduring presence of PTSD among conflict-affected individuals in Georgia and the need for a comprehensive approach to addressing

trauma-related and common mental disorders, as well as their impact on daily functioning [6]. Interestingly, in our current study, individuals with IDP status appear to have played a role in the lack of correlation between predominant location after February 24, 2022, and the severity of anxiety, depression, ASD and PTSD symptoms. Those who have experienced displacement or the loss of their homes show higher mental health impact scores, despite residing in areas considered relatively safe and far from the frontline (e.g., Zakarpattia, Lviv Oblast). As previously mentioned, there is a significant difference between modern warfare and how war was perceived a decade ago. A review of the literature, as well as the personal recollections of the study's co-authors, found no evidence that the aggressor country used drones or missiles capable of crossing Georgia's entire territory during the 2008 war. In contrast, since 2022, such weapons have been actively used to strike across all of Ukraine. This has likely contributed to the increase in mental health impact scores, regardless of respondents' distance from the frontline as defined on the map. Another contributing factor to these increased levels may be military mobilization. Although many respondents remained within a single oblast throughout the war, some were undergoing military training or actively serving in the armed forces. Thus, even prolonged residence in a relatively safe area did not guarantee lower mental health impact scores at the time of the survey for this population group. To enhance the robustness of the study, it would be beneficial to explore potential confounding variables that might influence the observed results. For example, the pre-existing mental health conditions of respondents could play a significant role, as individuals with prior anxiety or depression diagnoses may report higher symptom severity regardless of external stressors. Additionally, socioeconomic conditions, including income level, employment status and access to healthcare, could be crucial in shaping mental health outcomes and should be controlled for in further research. Another potential confounder is the extent of social support available to respondents, as those with strong family or community networks may experience lower stress levels compared to individuals who lack such support systems. Furthermore, differences in media exposure, particularly the consumption of war-related news, may contribute to varying degrees of psychological distress. Incorporating these factors into the analysis would allow for a more comprehensive interpretation of the findings and improve the study's reliability. Considering regional differences, mental health interventions should be adapted based on the availability

of medical services, the level of trauma experienced by the population and cultural characteristics. In regions most affected by military actions, such as Kherson, Donetsk and Mykolaiv oblasts, it is essential to strengthen the provision of emergency psychological assistance, expand crisis centers and conduct specialized training for healthcare professionals and social services. For residents of relatively safe regions who still experience high levels of anxiety and depression, it is important to implement stress-reduction programs such as group-based cognitive-behavioral therapy, educational campaigns on mental health preservation, and initiatives to reduce social isolation. Additionally, in rural areas where access to specialists is limited, telemedicine consultations and mobile psychological support teams should be introduced. To enhance the effectiveness of these interventions, it is crucial to

consider the cultural and social characteristics of each region, making mental health support more acceptable to the local population and reducing the stigma associated with seeking psychological help.

CONCLUSIONS

The highest rates of depression (39.36%) and anxiety (48.94%) were observed in Ivano-Frankivsk Oblast, the lowest were in Dnipropetrovska (26%) and Lviv (26.83%) Oblasts. No significant correlation was found between proximity to the frontline and the prevalence of depression, anxiety or the severity of ASD and PTSD symptoms. The highest trauma impact was recorded in Kherson, Donetsk and Mykolaiv Oblasts. These results suggest that mental health outcomes are not directly linked to geographical proximity to the frontline.

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CONFLICT OF INTEREST

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CORRESPONDING AUTHOR

Anastasiia K. Shkvarok

Bogomolets National Medical University
13 Taras Shevchenko Boulevard, 01601 Kyiv, Ukraine
e-mail: shkvarok.anastasiia@gmail.com

ORCID AND CONTRIBUTIONSHIP

Anastasiia K. Shkvarok: 0000-0002-8308-7206 **A** **B** **C** **D**

Yaroslava V. Korost: 0000-0003-0992-6515 **A** **E** **F**

Daria V. Turchak: 0000-0001-8799-0817 **B**

Giorgi Tedoradze: 0009-0007-1030-5907 **B**

Kristina Tatvidze: 0009-0005-0598-2925 **B**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Stromal opacification of cornea: morphological assessment of its condition in chronic dystrophic diseases

Natalia K. Greben, Irina V. Gavryliak, Alla I. Zadorozhna

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To evaluate the morphological changes in the cornea in stromal opacification, revealed by a comparative analysis of the results of confocal microscopy and optical coherence tomography on the example of clinical cases of stromal keratitis.

Materials and Methods: We examined 16 patients (20 eyes), including 7 men and 9 women aged 42 to 72 years. All patients underwent a standard ophthalmologic examination.

Results: In 95% of cases (19 eyes), there was an impoverishment of the nerve fibers of the subbasal nerve plexus (SNP), their thinning and change in configuration. The AS-OCT images showed in all cases (100%) a higher reflexivity of the posterior stroma in the area. In 61.5% (16 eyes), there was a decrease in corneal thickness due to stromal thinning and the appearance of a demarcation zone.

Conclusions: Confocal microscopy and optical coherence tomography have diagnostic value for determining the structural organization, thickness, shape of the cornea, its changes, and to assess the effectiveness of treatment.

KEY WORDS: keratitis, innervation, neovascularization, stromal keratitis, opacification, confocal microscopy, optical-coherent tomography

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INTRODUCTION

Stromal opacification of cornea is one of the leading causes of vision loss and even blindness, which has a significant impact on the quality of life of patients. This pathological process can develop as a result of keratitis, traumatic injuries and degenerative corneal diseases. The lack of effective methods of prevention and treatment of this condition, as well as the need for corneal transplantation in severe cases, determine the relevance of studying the mechanisms of its occurrence and morphological changes in the corneal structure [1-3].

Corneal opacification, which develops as a result of keratitis, is a complex multifactorial process involving chronic inflammation, fibrosis, extracellular matrix degradation, and neovascularization. The development of keratitis has preclinical and clinical phases, and corneal infiltration begins in the preclinical period. The actual tissue damage is a consequence of inflammatory phenomena, mainly from neutrophils, which are the basis of the cellular component at all stages of the pathogenesis of stromal keratitis. It is the massive cellular infiltration, especially of neutrophils, with

inflammatory mediators produced by immune cells that is responsible for corneal edema and damage. The immune-inflammatory state of the cornea, which develops as a response to the action of a pathogenic factor, activates many pathological processes, causing scarring, progressive corneal opacification due to infiltration of inflammatory cells, angiogenesis, and nerve ending dystrophy [4-6].

In recent decades, the role of corneal innervation in corneal injuries, inflammatory diseases, and the restoration of corneal integrity and homeostasis has been actively studied. The cornea is innervated by the terminal branches of the ophthalmic part of the trigeminal nerve and is the most densely innervated tissue in the body. The nerve fibers penetrate the cornea through the deep layers of the peripheral stroma radially, and then move forward, passing parallel to the surface of the eye and forming a subbasal nerve plexus between the Bowman layer and the basal epithelium. The corneal innervation plays a key role in maintaining trophic processes, ensuring the integrity of the epithelial layer, as well as in regulating cell proliferation and wound healing [3,7,8].

Confocal microscopy is a non-invasive method that allows assessing the condition of the corneal subbasal nerves and can be effective for monitoring small fibers in diabetic and other peripheral neuropathies [9-11]. Due to the high resolution of confocal microscopy, it is possible to estimate the nerve fiber density (NFD), nerve branch density (NBD), nerve fiber length (NFL), and corneal nerve fiber tortuosity or tortuosity ratio.

Studies have shown that *in vivo* confocal microscopy is an effective method for monitoring the dynamics of changes in intracorneal nerves in diabetic neuropathy, epithelialization of the damaged cornea and neurotrophic keratitis, as well as for differential diagnosis of keratitis of various etiologies. In addition to the analysis of corneal nerves, confocal microscopy is widely used to study the structure of the cornea. The method allows you to visualize epithelial cells, stromal keratocytes and endothelial cells with high resolution, assessing their morphological features and density. In addition, confocal microscopy allows you to control resident immune cells, which is important for the diagnosis of inflammatory processes and degenerative changes in the cornea [10-12].

Another modern research method used to visualize the structure of the anterior segment of the eye is optical coherence tomography (AS-OCT). This method uses low-coherence interferometry to visualize and evaluate the morphological structure of the cornea, which results in a high-resolution cross-section of the tissue. Due to its almost histological resolution, AS-OCT allows you to improve the assessment of structural changes and plays a role in clinical decisions regarding the choice of treatment tactics for degenerative corneal diseases, keratitis, and surgical interventions of the anterior segment of the eye. In particular, with keratitis, AS-OCT can determine the area of opacity, the depth of stromal infiltration, assess the edges of the inflammation surface, and monitor corneal epithelialization in the dynamics. AS-OCT provides non-contact, highly informative visualization of the cornea *in vivo*, allowing to assess its structural changes, but does not allow to analyze tissues at the cellular level. On the contrary, confocal microscopy allows for detailed study of corneal microstructures, but has a limited field of view and only 2D grayscale images, which cannot completely replace histological diagnosis [2,8,13-15].

The combination of confocal microscopy and AS-OCT allows for a comprehensive assessment of changes, providing both detailed visualization at the cellular level (IVCM) and analysis of the overall tissue structure (AS-OCT). The use of these methods in combination contributes to accurate differential diagnosis, prediction of the course of the disease and selection of optimal treatment tactics.

AIM

To evaluate the morphological changes in the cornea in stromal opacification, revealed by a comparative analysis of the results of confocal microscopy and optical coherence tomography on the example of clinical cases of stromal keratitis.

MATERIALS AND METHODS

We examined 16 patients (20 eyes), including 7 men and 9 women aged 42 to 72 years. The average age of patients was 51.9 ± 1.7 years. Exclusion criteria were: patients with restored visual functions, without complications (primary dystrophy, congenital corneal malformations, keratoconus, keratoglobus, degenerative retinal diseases, uveitis, pseudoexfoliation syndrome, etc.), acute infectious diseases, chronic hepatitis C, hepatitis B, syphilis, HIV infection, somatic diseases (bronchial asthma, autoimmune diseases, etc.), the absence of which was confirmed by a survey and analysis of medical records. The control group consisted of 12 patients (15 eyes), 5 men and 7 women, with an average age of 59.5 ± 1.2 years without corneal pathology.

All patients underwent a standard ophthalmologic examination: visometry, perimetry, tonometry, biomicroscopy, ophthalmoscopy, keratorefractometry, confocal corneal biomicroscopy and optical coherence tomography of the anterior segment of the eye. The studies conducted fully comply with the legislation of Ukraine and meet the principles of the Helsinki Declaration of Human Rights, the European Convention on Human Rights and Biomedicine, as well as ethical and moral requirements in accordance with the current legislation of Ukraine.

The study results were processed using the Statistica software package (10). The data obtained were expressed as the average standard deviation and range. The difference between the compared series with a probability level of 95 % ($p < 0.05$) was considered reliable.

RESULTS

The biomicroscopic examination of patients revealed a persistent epithelial defect in the central and paracentral zones, which was stained with fluorescein, stromal opacification, and deep neovascularization of 50% (in 10 eyes). All patients had photophobia, decreased corneal sensitivity, decreased visual acuity, and minor conjunctival injection. Figure 1 shows the biomicroscopy and CMR data of patients with corneal stromal changes.

Table 1. Distribution of parameters studied during corneal confocal microscopy

Parameters	Main group n=20 eyes	Control group n=15 eyes
Changes in the nerve fibers of the SNP (impoverishment, thinning, configuration changes)	95%	15%
Absence of nerve fibers	10%	0
Abnormalities of corneal nerve fiber density	85%	12%
Visualization of hypo and hyperreflective foci	20%	0
Single microaneurysms	15%	0
Visualization of poorly modified, confluent keratocytes	25 %	12%
Absence of keratocytes in the stroma	90%	0
Accumulation of dendritic Langerhans cells	80%	10%
Endothelial changes	15%	0

Note: Reliability of the difference in indicators between the parameters of the main and control groups at $p < 0.05$

CONFOCAL MICROSCOPY

The study revealed common characteristic features in patients with stromal corneal opacification. In 95% of cases (19 eyes), there was an impoverishment of the nerve fibers of the subbasal nerve plexus (SNP), their thinning and change in configuration. In 90% of cases (18 eyes), keratocytes were not identified in the stroma due to an intense fibrous process formed as a result of an inflammatory disease. The accumulation of dendritic cells (inflammatory Langerhans cells) were detected in 80% of cases (16 eyes). At the same time, in 85% of cases (17 eyes), endothelial cells remained unchanged.

Visualization of hypo- and hyperreflective foci of diffuse nature in 20% of cases (4 eyes), visualization of poorly modified, confluent keratocytes in 25% (5 eyes). In patients with corneal opacification and neovascularization (postoperative condition, postburn corneal degeneration), single microaneurysms were detected in 15% (3 eyes), and absence of nerve fibers of the subbasal nerve plexus in 10% (2 eyes) (Fig. 1, Table 1).

OPTICAL-COHERENT TOMOGRAPHY

The AS-OCT images showed in all cases (100%) a higher reflexivity of the posterior stroma in the area of opacification compared to the intact area. By localization, hyperreflectivity was limited to the posterior stroma in 76.9% (20 eyes) and did not extend into the Bowman's layer, while the corneal epithelium remained intact and intact in all cases (100%). Corneal opacities and infiltrates are equally reflected by hyperreflective areas, but are differentiated by certain features. Corneal infiltrates have ill-defined, rounded borders with an ascending epithelial defect or intact opaque epithelial layer. Whereas corneal opacification has clearly defined sharp

edges without an epithelial defect. Corneal infiltration is also characterized by an upper epithelial defect or epithelium thickened in the healing stage.

In 61.5% (16 eyes), there was a decrease in corneal thickness due to stromal thinning and the appearance of a demarcation zone. In 15.4% (4 eyes), necrotic areas in the form of cystic spaces and changes in the convexity of the posterior corneal surface are observed. (Fig. 2, A).

The AS-OCT image of the cornea of the control group (Fig. 2, B) shows its normal histologic structure. The following layers are clearly distinguishable: tear film, epithelium, basement membrane, Bowman's layer, stroma, and descemet-endothelial complex. The epithelium is visualized as a low-reflective layer overlying a hyperreflective tear film. The basement membrane is represented by a highly reflective line between the epithelium and the stroma, which is consistent with its histological features, in particular the content of collagen types IV and VII. The hyporeflexive line located under the basement membrane corresponds to the Bowman' layer. The stroma has a homogeneous, homogeneous structure due to the ordered arrangement of type I collagen fibers. The descemet-endothelial complex looks like a hyperreflective line directly adjacent to the stroma. OCT visualization, compared with the histological characteristics of the cornea, allows you to accurately determine the depth and area of the lesion, which is critically important for the choice of therapeutic tactics and the prognosis of treatment.

CLINICAL CASE

A 32-year-old patient was admitted for examination with stromal corneal opacity due to herpetic keratitis. At the initial examination, visual acuity was 0.02, bio-

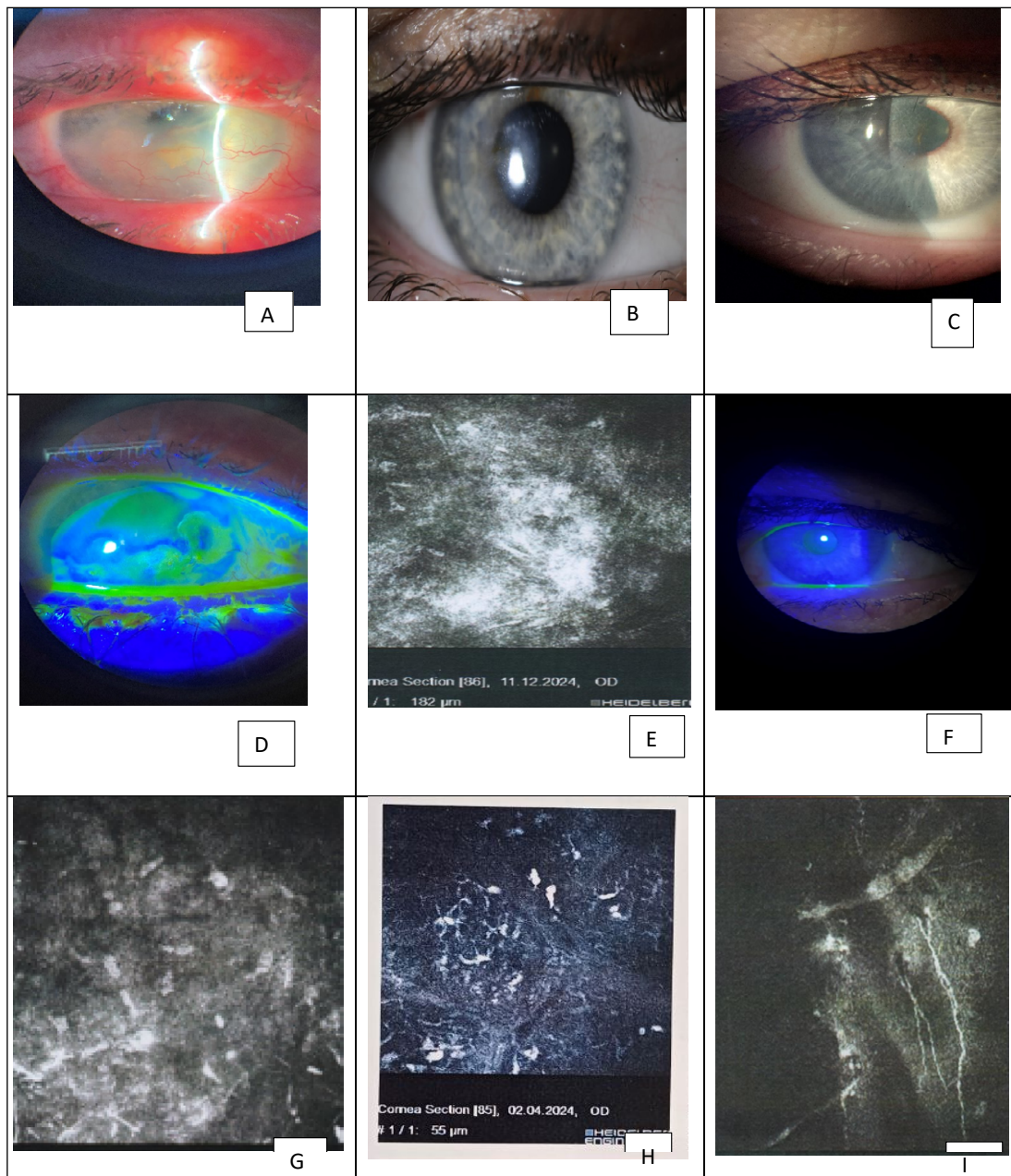


Fig.1. Anterior segment photographs, fluorescein staining, confocal microscopy of patient with stromal opacification. A,B,C – epithelial defect, stromal infiltration, pigmentation, neovascularization, decrease of transparency; D,F - fluorescein staining of the cornea, staining of the epithelium, stroma; E,G,H,I - confocal corneal microscopy: E – subbasal nerve plexus is absent, G-violation of the architectonics of the nerve, hyperreflective structures; H- keratocytes are not detected in the stroma; I – fresh dendritic cells, microneurinomas

microscopically, central disc-shaped opacification with corneal neovascularization deep in the stroma. AS-OCT revealed stromal thinning, which led to a decrease in corneal thickness to 487 μm , while maintaining homogeneity and epithelial thickness of 52 μm . Hyporeflexive areas were also detected against the background of overall corneal hyperreflectivity, which corresponds biomicroscopically to the area of neovascularization deep in the stroma. The edges of the infiltrate were clearly defined, sharp, and no inflammatory changes were detected in the anterior chamber (Fig. 3).

According to the results of confocal microscopy, the patient's scan near the defect shows hyperreflective, dotted rounded inclusions against the background of polymorphologically altered epithelial cells (C), in the subepithelial layers – hyperreflective burden, subbasal nerve plexus – nerve fibers are not identified (D), general reflection is determined in the stroma. On the periphery, nerve fibers are thinned, tortuous, single microneurinomas, atypical nerve fibers are visualized at the level of 92 μm , a small number of old dendrites (inflammatory Langerhans cells) are determined (Fig. 3).

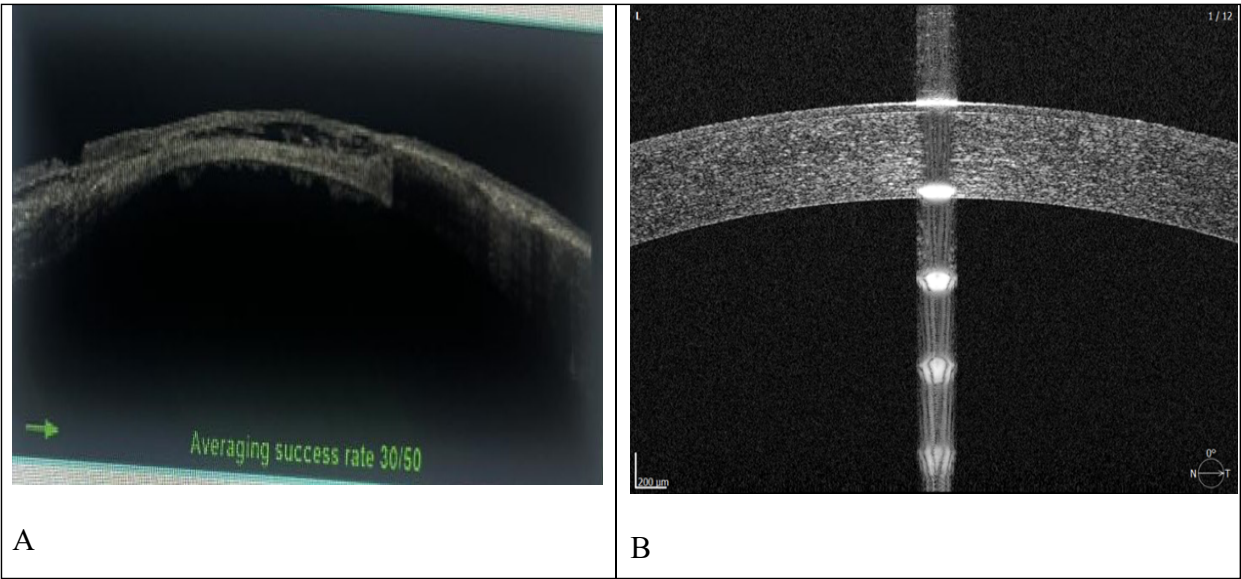


Fig. 2: A. AS-OCT corneal image of a patient with stromal opacification. B. AS-OCT cornea of control groups (healthy eye)

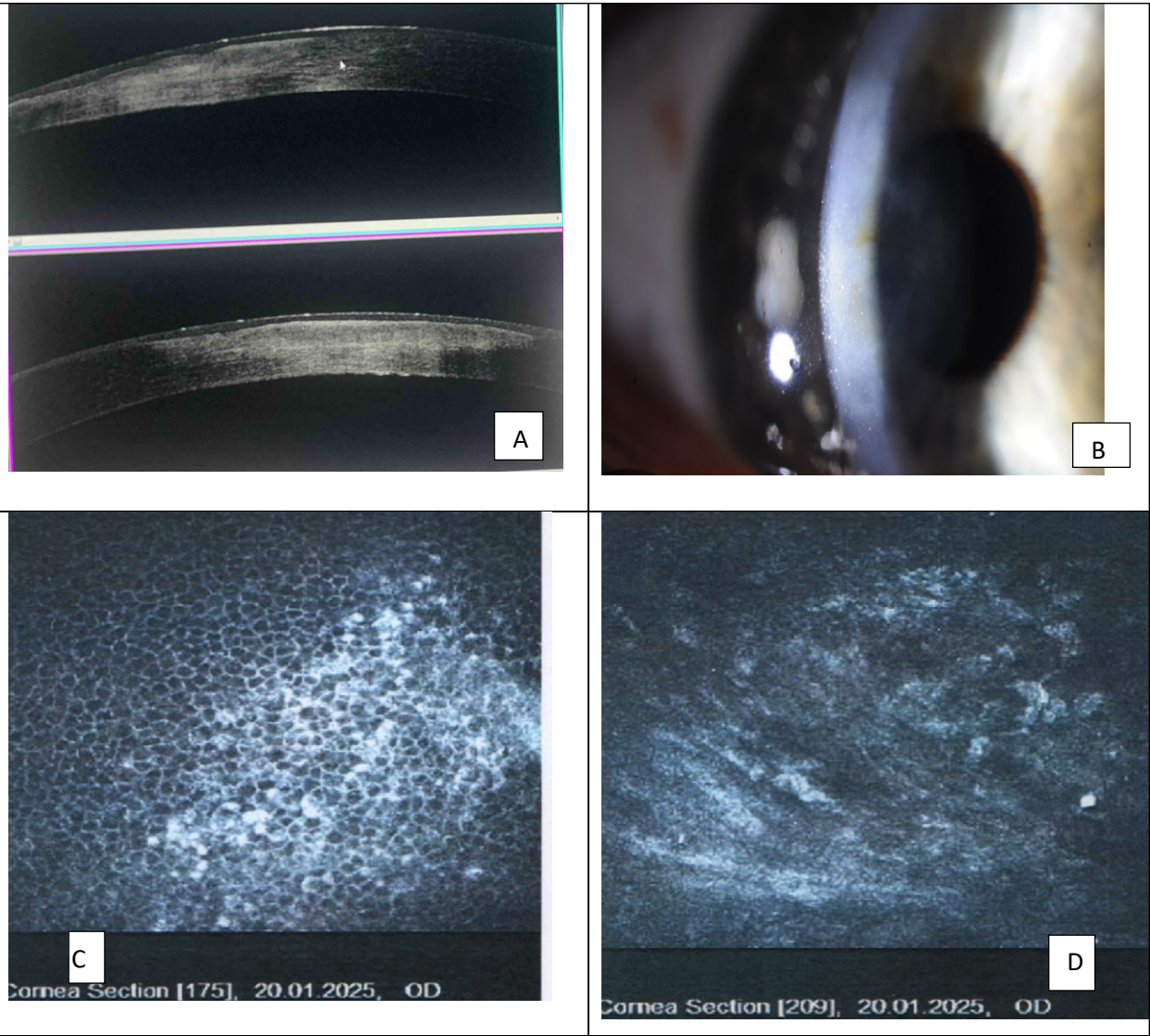


Fig. 3. According to the data AS-OCT – A, biomechanical B, Confocal microscopy of the patient 32 years, with stromal opacification of the cornea due to herpetic keratitis – C, D

DISCUSSION

This clinical case highlights the diagnostic capabilities for assessing patients with keratitis and its sequelae. Biomicroscopic examination of the cornea enables the evaluation of morphological changes, neovascularization, opacity, and the presence of pigmentation. However, the assessment of ophthalmic symptoms remains inherently subjective. Therefore, AS-OCT data demonstrate corneal thickness, its changes, hyperreflective stromal areas, epithelial defects or their absence, shape and area of the infiltrate. The data obtained coincide with the signs of stromal keratitis described in the literature, namely, an infiltrate with fuzzy and rounded borders, intact epithelium. Whereas corneal opacification is characterized by clearly defined sharp edges without an epithelial defect [12,13,16].

Furthermore, confocal microscopy offers detailed insights into corneal microstructure, including the condition of the epithelium, keratocytes, and endothelium. It plays a crucial role in assessing corneal innervation, identifying neurinomas, and detecting inflammatory Langerhans cells. This modality is particularly valuable for evaluating neurotrophic keratopathy, corneal sensitivity disorders, and the regenerative potential of nerve fibers [17-19].

Our findings underscore the effectiveness of modern imaging techniques in diagnosing severe corneal conditions, such as stromal opacities, neovascularization, and neurotrophic keratopathy. Notably, the visualization of dendritic cells, changes in keratocyte density, and the presence or absence of confluent keratocytes

provide insights into the fibrotic processes following inflammation. The depletion of subbasal nerve plexus fibers, along with alterations in their configuration or complete absence, reflects corneal deinnervation and the extent of nerve fiber damage [8,19,20].

In cases of corneal opacification, 61.5% of patients exhibited corneal thinning due to stromal atrophy and the formation of a demarcation zone. Additionally, 15.4% of cases displayed necrotic areas, characterized by cystic spaces and alterations in the posterior corneal surface convexity. These findings emphasize the structural and functional consequences of keratitis, reinforcing the importance of advanced imaging techniques in guiding clinical management and therapeutic decision-making.

CONCLUSIONS

Thus, the research questions using confocal microscopy demonstrate qualitative and quantitative changes in the cells and nerve fibers of the cornea, depending on the type of keratopathy, is a promising modern direction in understanding and predicting the course of the inflammatory process in the cornea.

The study of the possibilities of restoring the corneal structure remains relevant and is supplemented by new facts, and confocal microscopy and optical coherence tomography have diagnostic value for determining the structural organization, thickness, shape of the cornea, its changes, and to assess the effectiveness of treatment.

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CORRESPONDING AUTHOR

Nataliia K. Greben

Bogomolets National Medical University
13 T. Shevchenko Boulevard, 01601, Kyiv, Ukraine
e-mail: nkgreden@ukr.net

ORCID AND CONTRIBUTIONSHIP

Natalia K. Greben: 0009-0001-9049-6374    

Irina V. Gavryliak: 0009-0001-9049-6374  

Alla I. Zadorozhna: 0009-0008-9537-8749  

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Problems of antimicrobial resistance in the primary health care system (results of the sociological study)

Valery M. Lekhan¹, Nadiia V. Puchkova², Mykola I. Zaiarskyi¹

¹DNIPRO STATE MEDICAL UNIVERSITY, DNIPRO, UKRAINE

²DEPARTMENT OF HEALTH OF THE DNIPROPETROVSK REGIONAL STATE ADMINISTRATION, DNIPRO, UKRAINE

ABSTRACT

Aim: To assess the level of awareness of primary health care physicians regarding the problem of antimicrobial resistance and identify the main obstacles to the rational use of antibiotics in practice.

Materials and Methods: A sociological survey was conducted among primary health care physicians using a specially designed questionnaire containing questions on knowledge, antibiotic prescribing practices, and ways to address the problem of antimicrobial resistance. The survey was conducted in January 2025. Descriptive and analytical statistics were used to analyze the results obtained from 221 respondents.

Results: Most respondents (about 90%) encountered cases of antimicrobial resistance in their work. The respondents named the following as the main reasons: the use of antibiotics without a prescription (87.8% of respondents), their excessive use (80.1%), and non-compliance by patients with the course of treatment (77.8%). Analysis of the responses shows that respondents sometimes prescribe antibiotics from the watch and reserve groups (53.4% and 29%, respectively), regularly prescribe antibiotics without a prescription (14%), use injectable antibiotics (21% of respondents); 54.3% note that patients often take antibiotics on their own.

Conclusions: The survey results show that antimicrobial resistance is a serious problem in the primary healthcare system. Primary care physicians often do not follow recommendations for selecting and prescribing antibiotics. Effectively solving the problem requires a comprehensive approach, which should include improving antibiotic stewardship, increasing the level of knowledge of medical professionals, and widely informing the population about their proper use.

KEY WORDS: antimicrobial resistance, antibiotics prescription, antibiotic stewardship, primary health care

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INTRODUCTION

Universal health coverage is one of the world's key sustainable development goals. The World Health Organization (WHO) believes that its achievement is impossible without ensuring access to appropriate antimicrobial treatment and reducing the risks of the emergence and spread of antimicrobial resistance (AMR) [1].

It has been established that most antibiotics are prescribed in primary healthcare (PHC) facilities, as this is where doctors are most likely to encounter bacterial infections that are treatable with these drugs [2]. According to the US Centers for Disease Control and Prevention, in 2022, 80-90% of patients receive antibiotics in outpatient settings [3], with at least 30% of such prescriptions being unjustified [4]. The WHO report "Antimicrobial Resistance and Primary Health Care" [5] highlights the two-way relationship between PHC and the development of AMR. On the one hand, quality PHC provision helps reduce the unreasonable use of

antibiotics through infection prevention, rational drug prescribing, and monitoring of treatment adherence. On the other hand, with shortcomings in the work of the PHC system (overprescription of antibiotics, use of broad-spectrum drugs, and insufficient monitoring of treatment), PHC can contribute to the spread of AMR.

In Ukraine, active work on optimizing the use of antibiotics began relatively recently in connection with the growing threat of AMR. The main regulatory documents in this area are the Government Decree of 06.03.2019 No. 116-r on the approval of the National Action Plan to Combat AMR, orders of the Ministry of Health of Ukraine dated 03.08.2021 No. 1614 "On the organization of infection prevention and infection control in healthcare facilities and institutions providing social services/social protection of the population" and dated 23.08.2023 No. 1513 "On approval of the Medical Care Standard "Rational use of antibacterial and antifungal drugs for therapeutic and prophylactic purposes." However, no regulatory acts currently exist in Ukraine

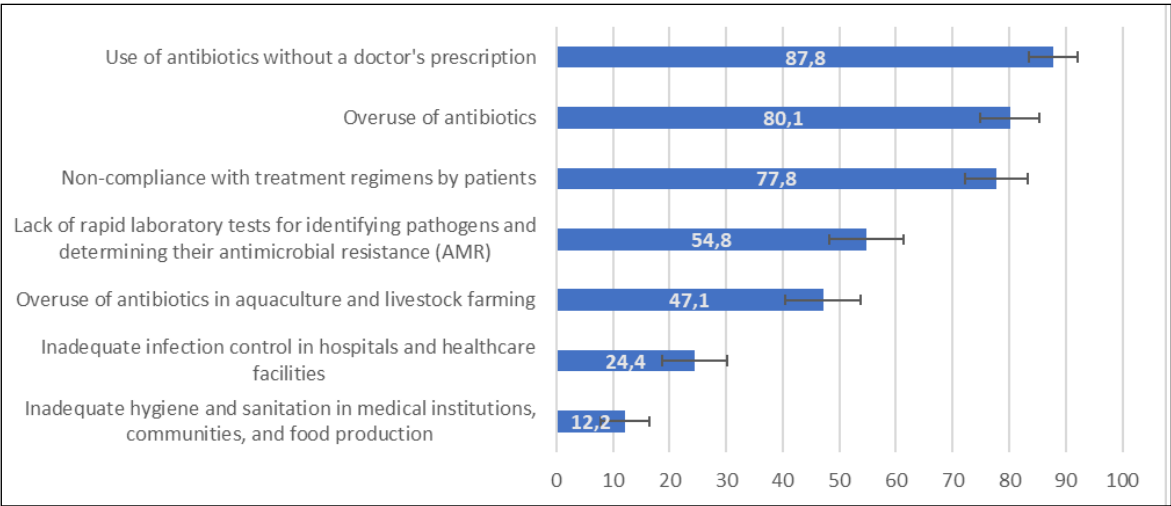


Fig. 1. Contributing factors to antimicrobial resistance as reported by primary health care physicians (%; 95% CI)

regulating antibiotic stewardship in PHC facilities and their consumption.

AIM

To assess the level of awareness regarding the problem of antibiotic resistance and identify the main obstacles to ensuring the rational use of antibiotics in the practice of primary care physicians.

MATERIALS AND METHODS

The sociological survey of doctors in PHC facilities was conducted using a specially developed questionnaire to study the practice of antibiotic therapy. The structured questionnaire contained questions related to knowledge and self-assessment of the practice of prescribing antibiotic therapy in the PHC system, the state of antibiotic stewardship at the primary level, as well as ways to solve the problem of AMR. The questionnaire was available to any member of the Family Medicine Association registered on the social network Facebook. The questionnaires were filled out by doctors once during January 2025.

The minimum required sample size was 184 people, and 221 doctors were interviewed. Among those interviewed, 82.4% were women, 17.6% were men. The average age of the respondents was 52 (37-62) years. By specialty – 80.5% of the respondents were general practitioners, 12.7% – doctors of other specialties, and 5.0% – health care managers. The average work experience of the involved specialists was 19 (6-34) years. The majority of respondents (73.8%) served urban residents, 26.2% – rural residents.

The Biomedical Ethics Commission of the Dnipro State Medical University concluded that the study complies

with the principles of bioethics and medical deontology (protocol No. 25 of February 19, 2025).

Statistical analysis was performed using STATISTICA 6.1 software (StatSoftInc., Serial number AGAR909E-415822FA). Asymmetric distribution was described by median and interquartile range (25%; 75%). For relative values, a 95% confidence interval (CI) was determined by the adjusted Wald method. Differences were assessed by the Mann-Whitney test (unrelated samples) and Pearson chi-square test (χ^2) for nominal characteristics. The relationship between variables was determined by Spearman's correlation coefficient (r_s). The critical value of statistical significance for all types of analysis was taken at the level of $p<0.05$.

RESULTS

Among all respondents, 90.5% (86.6–94.4) consider AMR a significant problem in the modern healthcare system. No significant differences in views between different groups of respondents (general practitioners, doctors of other specialties, health care managers) were recorded ($p>0.05$). Almost all respondents (87.8%; 83.5–92.1) have encountered cases of ineffective antibiotic treatment of infectious diseases and their complications. Frequent manifestations of AMR (within 20–40% of all cases of antibiotic treatment) were noted by 19.0% (13.8–24.2) of respondents, not very frequent (in 10–15% of cases) – 38.0% (31.6–44.4), and rare (in 5% of cases and less) – 30.8% (24.7–36.9).

Most respondents named several factors contributing to the development of AMR. Among the most common, respondents highlighted (Fig. 1): the use of antibiotics without a doctor's prescription (87.8%; 83.5–92.1), their excessive use (80.1%; 74.8–85.4), and patients' failure to comply with the recommended course of treatment

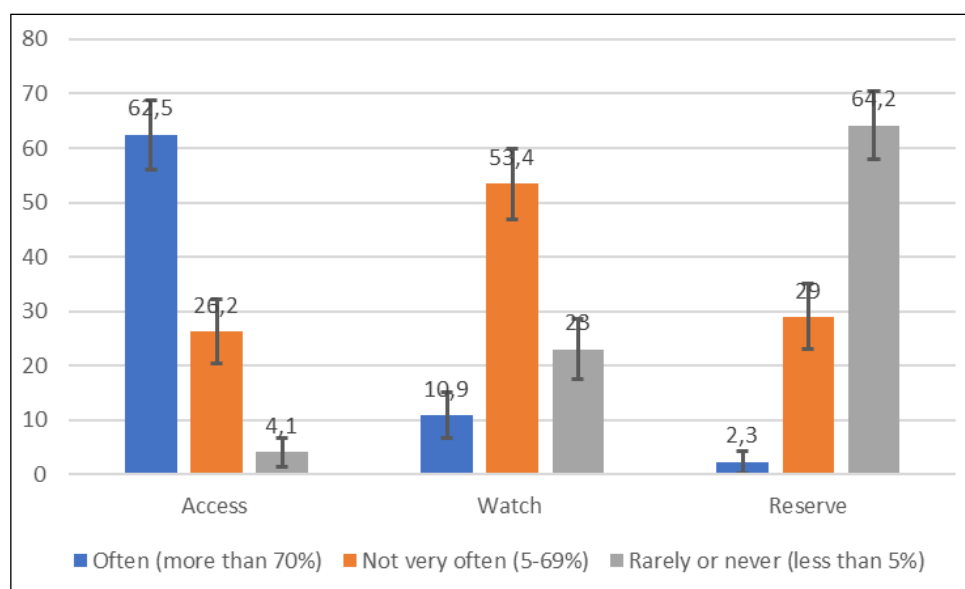


Fig. 2. Frequency of antibiotic use by primary care doctors as the starting antibacterial therapy from different groups (access, watch, and reserve) (based on survey data %; 95% CI)

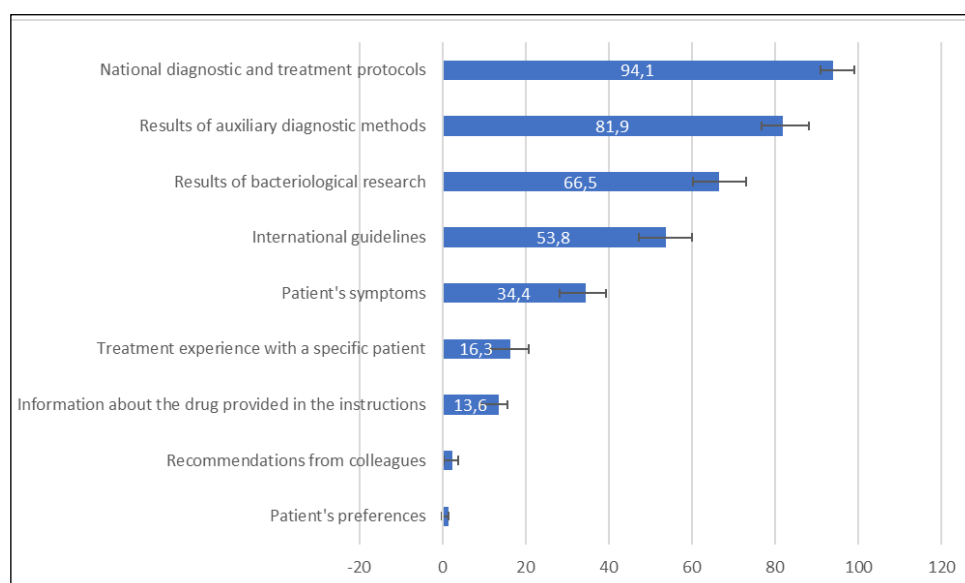


Fig. 3. Factors influencing antibiotic prescribing decisions by primary health care physicians (%; 95% CI)

(77.8%; 72.3-83.3). In addition, more than half of respondents (54.8%; 48.2-61.4) drew attention to the lack of rapid and convenient laboratory tests for identifying the causative agent of the disease.

The vast majority of respondents (84.6%; 79.8-89.4) stated that they are familiar with and use the WHO-adopted "Access, Watch, and Reserve" (AWaRe) classification of antibiotics in their practice [6], which was approved by the medical care standard for the rational use of antibacterial drugs (hereinafter – the Standard) [7]. At the same time, respondents noted that at the PHC level, antibiotics from all three groups are used as started antibacterial therapy, although with different frequencies (Fig. 2). Differences in the frequency of prescribing antibiotics from different groups by PHC doctors are significant ($\chi^2 = 25.71$; $p = 0.0003$) about 2/3 of respondents often prescribe antibiotics from the access group and rarely or never prescribe antibiotics from the

reserve group (62.5%; 56.1-68.9 and 64.2%; 57.9-70.5, respectively). Antibiotics from the watch group are often and not very often prescribed by a significant proportion of respondents (64.3 %; 58.0-70.6). No correlations between the results obtained and the characteristics of the respondent group (gender, age, specialty, territorial affiliation of the attached contingent) were found ($r_s > 0.05$). The declared frequency of prescribing antibiotics from different groups corresponds to the general vector of antibiotic use but differs significantly from that recommended by the Standard.

According to the respondents, the selection and prescription of antibacterial drugs by the attending physician are almost always carried out following the approved national protocols for the diagnosis and treatment of diseases (94.1%), taking into account the results of auxiliary examination methods (radiological, laboratory, etc.) (81.9%), the results of bacteriological

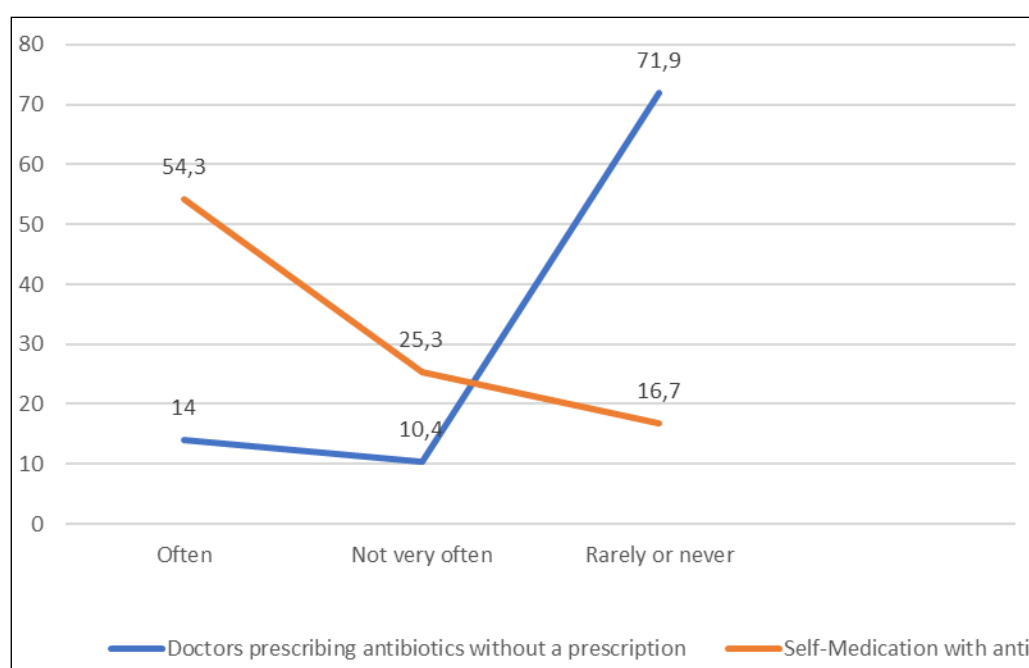


Fig. 4. Frequency of doctors prescribing antibiotics without a prescription and patients self-medication with antibiotics according to respondents

examination (66.5%), international recommendations (53.8%) and patient symptoms (34.4% of respondents) are also taken into account. Recommendations of colleagues and wishes of patients practically do not affect the prescription of antibiotics (Fig. 3). More than half of respondents (58.2%; 51.7-64.7) take into account the patient's socioeconomic status when prescribing antibiotics.

The success of treatment and the appropriateness of the decision to continue it is assessed 48-72 hours after antibiotic administration by 41.2% (34.7-47.7) of respondents. The rest use different terms to assess the success of the prescribed treatment, most often 72 hours after the appointment (48.0%; 41.4-54.6 respondents), which may be late in the case of progressive deterioration of the patient's clinical condition. In the absence of the expected result from taking an antibiotic or in the event of adverse reactions during treatment in a patient taking an antibiotic, the vast majority of study participants (86.0%; 81.4-90.6) chose the tactic of replacing the drug. The results of our study show that only a third of physicians (33.5%; 27.3-39.7) never prescribe two or more antibiotics to patients at the same time, and every fifth (20.8%; 15.4-26.2) uses intramuscular injectable forms of antibacterial drugs. It is worth noting that the frequency of responses regarding the prescription of injectable antibiotics shows a certain connection with the place of residence of patients – in rural areas more often than in urban areas ($r_s = 0.27$; $p < 0.05$).

All respondents noted that antibacterial drugs are prescribed to patients by filling out prescription forms in electronic or paper form. At the same time, 18.1% (13.0-23.2) of the surveyed doctors indicated that they

also provide patients with written recommendations on taking antibiotics without a prescription, which is prohibited by the Standard and in some way blurs the procedure for prescribing antimicrobial drugs.

When asked directly about doctors prescribing antibiotics without a prescription, 54.8% (48.2-61.4) of respondents answered positively, and 14.0% (9.4-18.6) indicated that they do so regularly. The situation is also complicated by the fact that patients take antibiotics on their own. The statement that people prescribe antibacterial therapy to themselves without consulting a doctor was supported by 96.4% (93.9-98.9) of respondents, and more than half (54.3%; 47.7-60.9) indicated that such cases occur often (in 20-40% of situations) (Fig. 4).

Only 25.3% (19.6-31.0) of respondents noted that they regularly receive complete and detailed information about antibiotics prescribed to patients from other healthcare facilities. At the same time, 18.1% (13.0-23.2) of respondents reported a complete lack of access to such data, and others received information fragmentarily or in a limited volume.

Most of the surveyed doctors (89.6%; 85.6-94.6) believe that they sufficiently explain to patients the prescription, choice of antibiotics, and procedure for their use. Consultations take place both during personal appointments and remotely, using the phone (73.3%; 67.5-79.1 respondents), messengers (Viber, Telegram, WhatsApp) (59.7%; 53.2-55.2), and in some cases – telemedicine consultations (11.3%; 7.1-15.5).

At the same time, respondents do not see a connection between informing patients and their adherence to prescribed antibiotic treatment (according to the Mann-Whitney U-test $p > 0.05$). Only 42.5% (36.0-49.0) of

Table 1. Measures to increase the effectiveness of antibiotic therapy and prevent AMR at the PHC level (respondents' suggestions, %; 95% CI)

Suggestions	% of respondents (95% CI)
Increase the level of knowledge of medical personnel regarding the rational use of antibiotics	61.5 (55.1-67.9)
Ensure that antibiotics are prescribed to patients only in cases of proven need	75.1 (69.4-80.8)
Strengthen control over the prescription of antibiotics	50.2 (43.6-56.8)
Increase patient awareness and understanding of antibiotic compliance and the dangers of their misuse	51.1 (44.5-57.7)
Develop and implement a standard operating procedure for PHC facilities regarding antibiotic stewardship	31.2 (25.1-37.3)

doctors reported that patients fully followed the course of treatment, 55.7% (49.1-62.3) noted partial violation of recommendations, and 1.8% (0.5-3.5) noted that patients completely ignored the doctor's prescription.

Antibiotic stewardship in the PHC sector remains generally disorganized. Among respondents, 58.4% (51.9-64.9) believe that responsibility for the rational use of antibiotics lies with physicians, 8.6% (4.9-12.3) with medical directors, and 29.9% (23.9-35.9) indicated responsibility for several officials in various combinations (e.g., physicians and medical directors, etc.).

Respondents proposed several measures to increase the effectiveness of antibiotic therapy and prevent AMR at the primary level (Table 1). Among these, the most prominent were: enhancing the professional development of medical personnel (both in theoretical knowledge and practical application), raising public awareness about the importance of responsible antibiotic use, and implementing organizational strategies to support antibiotic stewardship.

DISCUSSION

As a result of the study of the views of PHC physicians on the use of antimicrobial drugs in their practice, three key conclusions were made: 1) physicians are aware of the importance of the AMR problem in PHC; 2) they are generally familiar with the recommendations on the selection and use of antibiotics for the treatment of common infections; 3) however, in practice, these recommendations are often violated.

Among the surveyed doctors, 90.5% recognize AMR as one of the biggest problems of modern healthcare, and 88% have encountered ineffective antibiotic therapy in practice. The main factors contributing to AMR development in the PHC system align with the list of causes identified in a special WHO report [5], suggesting a strong understanding of the key drivers of resistance.

Most doctors do not always adhere to the Standard for selecting antibiotics, which stipulates that at the PHC level, at least 95% of patients should receive antibiotics from the Access group, no more than 5% from the

Watch group, and the prescription of antibiotics from the Reserve group is not provided for at all [7]. However, according to survey data confirmed by analytical studies of the pharmaceutical market [8], antibiotics from all three groups are used in the PHC sector, with the consumption of Watch and Reserve group drugs remaining significant.

The study also identified several shortcomings in antibiotic prescribing within the PHC system. Specifically, 14% of doctors regularly prescribe antibiotics without a prescription; 21% use injectable antibiotics; and 66.5% sometimes prescribe multiple antibiotics to treat a bacterial infection of a single localization, which is prohibited by the Standard.

Only 41.2% of doctors assess the effectiveness of antibiotic therapy according to recommendations – within 48-72 hours.

Insufficient information sharing between primary care and other healthcare settings hinders effective antibiotic stewardship. In particular, the flow of information about prescribed antibiotics is often incomplete and inconsistent. Our survey found that only 25% of respondents receive comprehensive information about their patients' antibiotic regimens from other healthcare settings, indicating a significant communication gap that can negatively impact outcomes and contribute to the development of antibiotic resistance.

Additionally, 57.5% of doctors reported low patient adherence to antibacterial treatment, and 54.3% believe that patients often self-medicate with antibiotics, which is a significant factor in the development of adverse reactions and increased AMR [9].

Respondents were unable to identify facility officials are responsible for the rational use of antimicrobials, indicating a lack of clear coordination and administration of antibiotic stewardship in the PHC system.

The measures proposed by participants to prevent antibiotic resistance align with WHO recommendations from the 2023 country self-assessment on antibiotic resistance, particularly regarding the need for primary-level antibiotic stewardship [10]. Doctors in our study also emphasized professional development for

medical staff and patient education on responsible antibiotic use.

Longitudinal studies are necessary to monitor these changes over time.

LIMITATIONS AND PERSPECTIVES

The sample for this study was gathered through social networks, which limits its representativeness since not all doctors have access to or use these platforms. Additionally, the short timeframe for implementing systemic measures to reduce the frequency of antimicrobial resistance (AMR) in the country does not allow for a reliable assessment of their impact on treatment practices among primary care physicians.

CONCLUSIONS

The survey results show that antimicrobial resistance is a serious problem in the primary healthcare system. Primary care physicians often do not follow recommendations for selecting and prescribing antibiotics. Effectively solving the problem requires a comprehensive approach, which should include improving antibiotic stewardship, increasing the level of knowledge of medical professionals, and widely informing the population about their proper use.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Valery M. Lekhan

Dnipro State Medical University
9 Volodymyr Vernadsky St., 49044 Dnipro, Ukraine
e-mail: v.n.lexan@gmail.com

ORCID AND CONTRIBUTIONSHIP

Valery M. Lekhan: 0000-0003-2953-3 292 **A** **B** **C** **D** **E** **F**

Nadiia V. Puchkova: 0009-0008-8777-8611 **B** **D** **F**

Mykola I. Zaiarskyi: 0000-0003-2351-5755 **B** **D** **F**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Analysis of the burden of cardiovascular diseases morbidity and mortality for the period 2018-2023

Arkadii H. Shulhai, Oleksandr A. Terenda, Nataliia Y. Panchyshyn, Yurii M. Petrashyk

IVAN HORBACHEVSKY TERNOPIL NATIONAL MEDICAL UNIVERSITY, TERNOPIL, UKRAINE

ABSTRACT

Aim: To analyze the morbidity from cardiovascular diseases, in particular coronary heart disease, angina pectoris and acute myocardial infarction in Ukraine in 2018-2023.

Materials and Methods: The study uses data from the Center for Medical Statistics of the Ministry of Health of Ukraine on hospitalizations and average duration of care for CHD, angina pectoris, and AMI patients in Ukraine during 2018-2023. The epidemiological method and the method of estimating dynamic series were used.

Results: For 2018-2023, a decrease in hospitalization rate of CHD (growth rate 65.3%), angina pectoris (GR 69.7%) and a slight decrease in patients with AMI (GR 98.5%) patients was found. 2020-2022 saw a decrease in hospitalization rates for CHD and angina patients, which arose as a result of reduced access to care. In AMI, hospitalization rate decreased slightly, but the proportion of all its forms among all hospitalized patients increased in 2020-2022, while hospitalization for CHD and angina decreased. The decrease in the hospitalization rate in 2020-2022 indicates a reduced level of diagnosis of AMI and a possible lack of seeking specialized medical care and lack of adequate treatment for its atypical forms, which confirms the increase in the hospitalization rate of patients with AMI in 2023, when pandemic-related restrictions were lifted.

Conclusions: During 2018-2023, the hospitalization rate for CHD, angina pectoris, and AMI patients decreased in Ukraine. It changed the most during 2020-2022 as a result of reduced access to medical care during the COVID-19 pandemic.

KEY WORDS: coronary heart disease, angina, acute myocardial infarction, COVID-19 pandemic, hospitalization rate

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INTRODUCTION

The Sustainable Development Goals aim to eliminate inequality, reduce poverty, and ensure peace and prosperity for all by 2030. One of the Goals, Goal 3, aims to ensure good health and well-being [1]. One of the tasks to ensure the well-being of the population is to reduce the burden of cardiovascular disease. This pathology causes a significant burden of morbidity, contributes to a decrease in average life expectancy and has been a leading cause of death and disability among persons of working age in recent decades both globally [2, 3] and in Ukraine [4, 5].

Atherosclerotic diseases, especially coronary heart disease (CHD), including acute myocardial infarction (AMI), and cerebrovascular diseases, including cerebral stroke, account for approximately 80% of all CVD deaths. At the same time, there is a tendency for deaths to increase in low-income countries and decrease in high-income countries. Globally, deaths from CVD account for about 1/3 of all deaths [6, 7].

The development of CVD is influenced by many different factors, including behavioral, socioeconomic, and biological ones. According to a number of researchers, the COVID-19 pandemic had a significant impact on the growth of CVD, including AMI [8, 9]. Myocardial lesions occurred more frequently in patients, mostly older and with comorbidities (19-40 %). There were manifestations of myocarditis, AMI, venous thromboembolism, and arrhythmias.

The growing burden of CVD is especially relevant in the context of an aging population, the COVID-19 pandemic, the significant impact of psychological and environmental factors associated with Russia's full-scale attack on Ukraine, and requires constant monitoring.

AIM

To analyze the incidence of cardiovascular diseases, in particular coronary heart disease, angina and acute myocardial infarction (AMI) for the period 2018-2023.

Table 1. Hospitalized coronary heart disease (I20-I25) patients among the adult population in 2018-2023 in Ukraine

Year	Number of patients, discharged and died (absolute)	% of all diseases	Hospitalization rate per 100,000 people
2018	716,765.00	10.82	2,071.13
2019	706,002.00	10.93	2,052.10
2020	409,300	8.86	1,196.82
2021	371,813	7.45	1,094.89
2022	390,268	7.99	1,159.81
2023	455,229.00	7.57	1,352.87

MATERIALS AND METHODS

The study used data from the Global Burden of Disease Database, Center for Medical Statistics of the Ministry of Health of Ukraine on the level of hospitalization and average treatment duration for patients with CHD, angina, and AMI in Ukraine and its oblasts in 2018-2023. The indicators are calculated for the population excluding the temporarily occupied territories. The epidemiological method was used to analyze the proportion of mortality and the total burden of disease (DALYs) with an indication of the confidence interval and the method of estimating dynamic series with the determination of the growth rate (GR). The study was conducted in compliance with the principles of the World Medical Association's Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects" (2000).

RESULTS

Cardiovascular diseases continue to be the leading pathology in terms of prevalence, morbidity and mortality in Ukraine.

According to the Global Burden of Disease (GBD Compare) database [10], the proportion of patients who died of CHD in 2018 was 15.16% (95% CI 14.09-15.85%) worldwide. Looking at a number of developed economies, it was 13.12% (95% CI 11.75-13.77%) in the UK, 9.73% (95% CI 8.31-10.51%) in France, 8.73% (95% CI 7.11-9.62%) in Japan, 16.89% (95% CI 14.72-18.01%) in the USA, and 16.54% (95% CI 14.43-17.82%) in Germany. In Ukraine, the proportion of deaths from CHD was 3.2 times higher than the global rate—48.86% (95% CI 46.16-50.65%).

In 2021, there was a tendency to decrease the proportion of deaths from CHD in the total number of deaths. It amounted to 11.13% (95% CI 9.84-11.73%) in the UK, 8.71% (95% CI 7.36-9.49%) in France, 8.57% (95% CI 6.9-9.47%) in Japan, 14.21% (95% CI 12.42-15.16%) in the USA, 14.94% (95% CI 12.79-16.16%) in Germany, and 13.25% (95% CI 12.27-13.87%) in the world. In Ukraine, this indicator was 3.0 times higher than the global level—39.89% (95% CI 36.5-43.09%).

In 2018, the total disease burden (DALYs) of CHD was 6.93% globally (95% CI 6.23-7.56%). In the leading coun-

tries of the world, these data fluctuated. For example, in the United Kingdom, CHD DALYs were 6.77% (95% CI 5.9-7.61%), France 4.60% (95% CI 3.97-5.2%), Japan 4.71% (95% CI 3.97-5.46%), the United States 7.76% (95% CI 6.75-8.77%), and Germany 8.42% (95% CI 7.19-9.54%). In Ukraine, this number was 3.8 times higher than the global level—26.5% (95% CI 23.72-29.08%).

In 2021, there was a tendency to reduce the burden of CHD. The DALYs rate in the UK was 5.91% (95% CI 5.18-6.64%), in France 4.22% (95% CI 3.63-4.77%), in Japan 4, 63% (95% CI 3.88-5.39%), in the USA 6.93% (95% CI 6.09-7.79%), in Germany 7.65% (95% CI 6.58-8.71%), and in the world 6.55% (95% CI 5.9-7.17%). In Ukraine, this figure was 3.4 times higher than the global level—22.57% (95% CI 19.28-25.42%).

Over the period 2018-2023, a decrease in the hospitalization rate of CHD patients from 2,071.13 to 1,352.87 per 100,000 people (GR 65.3%) was found in Ukraine. Their proportion among all diseases also decreased from 10.82% to 7.57%. Since 2020, there has been a decrease in the hospitalization rate with the lowest rate in 2022—1,159.81 per 100,000 people (Table 1).

A similar trend was found in the hospitalization of angina patients. Thus, during the period 2018-2023, the hospitalization rate for angina patients decreased from 757.60 to 528.40 per 100,000 people (GR 69.7%). Their proportion among all diseases also decreased from 3.96% to 2.96%. A significant decrease in the hospitalization rate of angina pectoris patients was observed in 2020-2022, with the lowest rate in 2021—424.53 per 100,000 people (Table 2).

When hospitalizing patients with acute myocardial infarction (AMI), there was a slight decrease in the hospitalization rate for the period 2018-2023 from 133.42 to 131.40 per 100,000 people (GR 98.5%) and a significant decrease in this indicator in 2020-2022. Also, in the period 2020-2022 increased, the proportion of patients with AMI among all diseases, as well as in general for the study period (Table 3).

The rate of hospitalization of AMI patients with ST segment elevation in 2019-2023 slightly decreased from 92.60 to 91.08 per 100,000 people (GR 98.4%), with the largest decrease in 2020. At the same time, the

Table 2. Hospitalized angina pectoris (I20) patients among the adult population in 2018-2023 in Ukraine

Year	Number of patients, discharged and died (absolute)	% of all diseases	Hospitalization rate per 100,000 people
2018	262,186	3.96	757.60
2019	259,750	4.02	755.00
2020	150,442	3.26	439.90
2021	144,165	2.89	424.53
2022	150,184	3.07	446.32
2023	177,803	2.96	528.40

Table 3. Hospitalized acute myocardial infarction (I21-I22) patients among the adult population in 2018-2023 in Ukraine

Year	Number of patients, discharged and died (absolute)	% of all diseases	Hospitalization rate per 100,000 people
2018	46,172.00	0.70	133.42
2019	47,337.00	0.73	137.59
2020	42,522	0.92	124.34
2021	42279	0.85	124.50
2022	41,190	0.84	122.41
2023	44,215.00	0.74	131.40

Table 4. Hospitalized acute myocardial infarction with ST segment elevation (I21.0-3, I22) patients among the adult population in 2019-2023 in Ukraine

Year	Number of patients, discharged and died (absolute)	% of all diseases	Hospitalization rate per 100,000 people
2019	31,858.00	0.49	92.60
2020	28,825	0.62	84.29
2021	29357	0.59	86.45
2022	29,088	0.60	86.44
2023	30,648.00	0.51	91.08

Notes: Data for 2018 not available

proportion of AMI with ST segment elevation among all diseases increased in 2020-2022 (most of all in 2020) (Table 4).

During the study period the proportion of AMI patients with ST segment elevation among AMI patients was within 2/3 and increased from 67.3% in 2019 to 69.3% in 2023, and it was 70.6% in 2022.

DISCUSSION

Over the period 2018-2021, there was a tendency of reduction of CHD burden, both globally as well as in leading countries and Ukraine. There was also a tendency of reduction of the proportion of patients who died from CHD in the context of the studied countries. However, this dynamics needs to be studied further, as the decrease in this proportion may be due to the COVID-19 pandemic (redistribution of deaths due to patients with coronavirus disease and post-COVID-19 impact on the cardiovascular system in the future [11, 12].

A number of studies have identified the COVID-19 virus as an independent risk factor for various forms of cardiovascular disease: stroke, transient ischemic attack,

heart rhythm disturbances, pericardial and myocardial inflammation, myocardial infarction, and pulmonary embolism [12-14].

The WHO announced the beginning of the COVID-19 pandemic March 11, 2020, and on May 5, 2023, it announced that the disease was no longer a global public health emergency of international concern, but continued to believe that the pandemic was not over yet. The period of 2020-2022 saw a decrease in hospitalization rates for patients with CHD and angina, which arose as a result of reduced access to healthcare: overloading of family doctors with COVID-19 patients, patients' fear of coronavirus infection when visiting medical facilities, and a decrease in the number of cardiology beds due to the re-profiling of departments. This trend has been observed in many countries around the world [12]. A somewhat different situation was observed in the hospitalization of patients with AMI. Given the severity of the condition in some patients and the possibility of fatalities, such patients sought medical care and were hospitalized in specialized departments, as evidenced by the increase in the proportion of all forms of AMI among all hospitalized patients in 2020-2022,

while reducing hospitalization for CHD and angina. However, the decrease in the hospitalization rate in 2020–2022 indicates a reduced level of AMI diagnosis and a possible lack of seeking specialized medical care and lack of adequate treatment for atypical forms of AMI. This hypothesis is confirmed by the increase in the hospitalization rate for patients with AMI in 2023, when pandemic-related restrictions were lifted.

CONCLUSIONS

In 2018–2021, there was a decrease in the burden of CHD and its share of deaths in the total number of

deaths both globally and in economically developed countries. The CHD DALYs were 3.4–3.8 times higher in Ukraine than the global level. The proportion of deaths from CHD in Ukraine exceeded the global level by 3.0–3.2 times.

Over the period 2018–2023, the hospitalization rate for CHD, angina, and AMI patients decreased in Ukraine. It changed the most in 2020–2022 as a result of reduced access to medical care during the COVID-19 pandemic.

During the study period, the proportion of AMI patients with ST segment elevation among AMI patients increased, indicating a more severe course of the disease and requiring further study of AMI risk factors.

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CONFLICT OF INTEREST

The Authors declare no conflict of interests

CORRESPONDING AUTHOR

Yurii M. Petrashyk

Ivan Horbachevsky Ternopil National Medical University

1 Voli Square, 46001 Ternopil, Ukraine

e-mail: yurii.m.petrashyk@tdmu.edu.ua

ORCID AND CONTRIBUTIONSHIP

Arkadii H. Shulhai: 0000-0002-2145-5851 **A** **F**

Oleksandr A. Terenda: 0009-0009-9246-1376 **B** **C** **D**

Nataliia Y. Panchyshyn: 0000-0001-5786-3083 **E**

Yurii M. Petrashyk: 0000-0003-1286-110X **E**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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The impact of the martial law on the rates and structure of outpatient's morbidity

Natalia V. Horach, Lilia M. Yaremenko, Olena O. Shevchenko, Svitlana I. Lekhnitska, Rostyslav F. Kaminsky
BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To determine the features of the rates and the structure of the morbidity of outpatients during the war compared to the pre-war years (period 2020-2024).

Materials and Methods: There were analyzed and summarized scientific research and publications about changes in the morbidity structure and rates of outpatient care to the population during the war years compared to previous years before the full-scale military invasion, as well as the impact of war factors on the health of citizens. For comparison, data from scientometric databases Google Scholar, PubMed, Scopus, Web of Science and other domestic and international scientific sources were used. The results of research are presented the peculiarities of indicators of medical care at the outpatient stage of the consultative and diagnostic polyclinic of the Bogomolets National Medical University Clinic. In the research are used the methods of a systematic approach, bibliosemantic analysis and the method of structural-logical analysis.

Results: The results of research the peculiarities of the rates of medical care provision at the outpatient stage before the full-scale military invasion (2020-2021) and during the war (2022-2024) are presented, the impact of martial law on these rates in comparison with the data of literature sources is assessed. Scientific research and publications are analyzed indicating the changes in the incidence rates of the population at the outpatient stage and the rates of medical care in the work of the consultative and diagnostic polyclinic of the Bogomolets National Medical University Clinic during the war years compared to previous years.

Conclusions: Based on the analysis, the possible ways were proposed to improve the quality of outpatient medical care and the health of the population during martial law.

KEY WORDS: war, morbidity rates, ways to improve the health of the population, outpatient, polyclinic care

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INTRODUCTION

Wars and conflicts are a harsh reality for many countries, where outpatient care is one of the main components of the health system. In such difficult circumstances, outpatient doctors are forced to take on an expanded role, witnessing large-scale physical and mental suffering both for individuals and for entire families, communities and society as a whole [1]. Russia's invasion into Ukraine has displaced about 12.3 million Ukrainians, which is more than 25% of the country's population [2]. Since the beginning of the full-scale invasion, the needs of the population of Ukraine for medical care have changed dramatically. According to literature sources, in the first 40 days of the war, 4 million people left Ukraine for other countries, more than 7 million became internally displaced [3]. Some doctors and medical personnel of medical facilities were evacuated to regions remoted from the war zone or abroad, and also joined the defense of our country.

According to studies conducted in European countries in 2023, Ukrainian refugees may have different

medical needs than local patients in these countries. This is due to differences in the health care systems of Ukraine and different European countries, different levels of prevalence of diseases, features of preventive measures and social programs related to health, as well as psychological consequences of the impact of hostilities (the need to leave their places of residence, loss of relatives, etc.). Therefore, outpatient doctors in countries that received Ukrainian refugees were not ready to provide comprehensive assistance for this category of patients. The urgency of this problem is significant, since more than 7.6 million Ukrainians have registered as refugees/displaced persons in European countries since the beginning of the war [4].

During martial law, the Ukrainian medical system undergoes significant changes, which is due to quantitative and qualitative changes in the composition of medical workers, the loss of medical institutions in the occupied territories and in the frontline regions, the destruction of outpatient clinics and hospitals, and

the mass migration of the population to safer regions of Ukraine and abroad. The National Health Service of Ukraine plays a leading role in the implementation of medical reform and the implementation of the program of medical guarantees in the country. State programs of social protection of the population also have an important function in maintaining the health of the nation. However, the full-scale war has created unprecedented challenges that require prompt and effective solutions. Having just begun to recover from the consequences of the COVID-19 pandemic, the healthcare system of our country is facing a new crisis due to the introduction of martial law in connection with the full-scale invasion [5, 6].

According to the State Statistics Service of Ukraine, the number of outpatient medical institutions and doctors providing outpatient care has significantly decreased. Compared to the pre-war years (2018-2020), this happened mainly due to the regions that are occupied (some regions of Donetsk and Luhansk regions, partially Zaporizhzhia and Kherson regions), regions where hostilities are taking place (Kharkiv, Mykolaiv, Sumy) and frontline (Dnipropetrovsk) regions. As of 2023, in almost all other regions of Ukraine, there was a decrease in the number of general practitioners (family doctors), doctors of narrow specialties, and paramedical personnel, which was probably associated with internal and external migration of the population [5]. In the Kyiv region and the city of Kyiv, these indicators remain stable, even with an upward trend.

According to a study published in the Proceedings of the National Academy of Sciences, overall, the prevalence of diseases among displaced populations was lower than the national (regional) prevalence of diseases before the invasion. However, with the resettlement of refugees from Ukraine, the distribution of diseases has also changed. The results of a statistical analysis combining data on population movement and disease prevalence showed that among people forced to flee their homes due to the war, more than 2.63 million have cardiovascular disease, at least 615,000 suffer from diabetes, and about 98 500 have malignancies, combined with other chronic diseases [2].

The results of the calculations of the State Statistics Service of Ukraine show that in 2023, among persons who were diagnosed with disability for the first time, the distribution by disease classes was as follows: neoplasms – 17.9%, diseases of the circulatory system – 24%, diseases of the musculoskeletal system and connective tissue – 17.8%, injuries, poisoning and other consequences of external influences – 10.8%, endocrine disorders, eating and metabolic disorders – 4.8%, diseases of the nervous system – 5.3%, mental

and behavioral disorders – 4.4%. It was also noted that, due to the military aggression of the Russian Federation against Ukraine and in accordance with the current legislation, the State Statistics Service of Ukraine currently does not have the opportunity to fully obtain administrative data, which is a source of information for calculating the population, its composition and other demographic indicators [5].

AIM

The purpose of the study is to determine the features of the rates and the structure of the morbidity of outpatients during the war compared to the pre-war years (period 2020-2024).

MATERIALS AND METHODS

Analyzed and summarized. scientific research and publications on changes in the morbidity structure and indicators of outpatient care to the population during the war years compared to previous years before the full-scale military invasion, as well as the impact of war factors on the health of citizens. For comparison, data from scientometric databases Google Scholar, PubMed, Scopus, Web of Science and other domestic and international scientific sources were used. The results of research on the peculiarities of indicators of provision of medical care at the outpatient stage of the consultative and diagnostic polyclinic of the University Clinic of the Bogomolets National Medical University (CDP Bogomolets NMU) are presented. The paper uses the methods of a systematic approach, biblisemantic analysis and the method of structural-logical analysis.

The main function of the Bogomolets NMU is to provide highly qualified and specialized consultative and diagnostic medical care for patients in 25 specialties according to the license of the Ministry of Health of Ukraine: obstetrics and gynecology, gastroenterology, dermatovenerology, infectious diseases, cardiology, narcology, neurology, oncology, radiology, surgery, ultrasound and functional diagnostics, etc. Along with the provision of medical care, in the CDP of Bogomolets NMU, during 2020-2024. preventive medical examinations of the attached contingent of the population (about 21000 people) [7], medical examinations of seafarers, for obtaining an international certificate in accordance with DSTU ISO 9001:2015 [8], employees of various specialties working in harmful working conditions [9], medical examinations for obtaining a personal medical book [10], conducting a medical examination of candidates for drivers and drivers of vehicles [11], issuance of certificates for traveling abroad, for visiting

Table 1. The rates of outpatient care

Rates of outpatient care	2024	2023	2022	2021	2020
Number of visits to the doctors of therapeutic diseases	31 349	21 068	17 485	16 100	15 933
Number of visits to the doctors of surgical diseases	15 808	11 932	11 350	4 367	4 433
Total number of medical examinations	3 410	2 396	1 573	43 940	39 200
Total number of visits to doctors in the CDP	50 567	35 396	30 408	64 407	59 566

Table 2. The rates of primary morbidity of the adult population

Names of disease classes	2024	2023	2022	2021	2020
Neoplasms	40,2	28,1	25,1	42,3	30,8
Diseases of the endocrine system	48,1	17,5	12,5	40,5	31,4
Diseases of the nervous system	52,5	26,7	24,5	35,2	19,0
Diseases of the circulatory system	104,6	64,5	55,4	100,2	76,1
Respiratory diseases	162,8	158,1	114,8	221,1	177,1
Diseases of the digestive system	67,3	15,2	14,4	14,5	12,6
Diseases of the female reproductive system	152,6	152,07	130,6	210,2	171,4
Diseases of the skin and subcutaneous tissue	46,1	64,97	58,2	93,5	66,0
Diseases of the musculoskeletal system and connective tissue	118,5	53,0	46,5	61,2	47,0
Diseases of the eye and appendages	85,6	97,2	91,4	72,8	55,7
Diseases of the ear and mastoid process	11,8	11,5	10,5	16,3	14,4

the pool, medical certificates for obtaining a license for the object of the permit system (weapons) [12-14].

RESULTS

The rates of outpatient and polyclinic care of the Bogomolets NMU for 2020-2024 are shown in Table 1.

According to our research (Table 1), in the first year of the war (2022), the total number of visits by patients to the Bogomolets NMU almost halved from 64407 to 30408 almost in 53 %. Such situation can be explained by the mass migration of the population from Kyiv to the more protected regions of Ukraine and abroad due to heavy fighting outside Kyiv. Due to the influence of these factors, the lowest rates were recorded in 2022, at the beginning of the war, with a gradual increase in the following years [15, 16]. The gradual increase in the total number of visits during 2023 and especially 2024 can be explained by the stabilization of the military situation in Kyiv and the Kyiv region, which led to the return of a fairly significant number of the population. Despite the proximity of hostilities, in 2022 the number of patients who sought specialized medical care (the number of visits to doctors for diseases) to doctors of both therapeutic and surgical profile slightly increased. And, secondly, in such stressful situations, patients' priorities change and the issues of their own health and the health of loved ones come first. Also, the positive trend of appeals to the CDP of Bogomolets NMU is influ-

enced by the implementation of state social programs and the Program of Medical Guarantees of the National Health Service of Ukraine.

At the same time, during the war, the number of preventive medical examinations has sharply decreased. This is due to objective reasons, namely mass migration of the population, a decrease in demand for certain services, a change in priorities, a decrease in the number of employees at enterprises in connection with mobilization into the ranks of the Armed Forces of Ukraine [17, 18].

To analyze the structure of diseases, we took indicators of the primary morbidity of the adult population, which are presented in Table 2.

According to Table 2, studying the dynamics of primary morbidity indicators of the adult population during martial law, the lowest rates are observed in 2022, which may probably be the result of a decrease in the total population, the movement of a significant part of people to safer regions (Western Ukraine) and other countries. The growth of indicators in 2023 compared to the data of 2022 is possible, is due to the increase in the number of internally displaced persons in the city, partly due to the return of citizens from other regions and countries to Kyiv. The primary incidence rates of the years before the full-scale invasion also had some dynamics: all data for 2020 were lower than the corresponding indicators in 2021, which is probably due to stricter quarantine restrictions in 2020 during the

COVID-19 pandemic and the gradual easing of these restrictions in 2021.

DISCUSSION

In the process of research, we established the dynamics of appeals and changes in the structure of morbidity in patients of the CDP UC NMU in the years before the full-scale invasion (2020-2021) and (2022-2024) years of martial law. The indicators that we studied are the original statistical data on the work of the CDP UC NMU for the period 2020-2024. The results of our study showed that during the period of active hostilities, the primary incidence of neoplasms, pathology of the cardiovascular, nervous, endocrine systems, digestive organs, musculoskeletal system and connective tissue. These indicators generally correspond to the trend of growth of these diseases according to official statistics for Ukraine [5].

Data from other researchers on the peculiarities of the Ukrainian health care system, which occurred under the influence of hostilities in the frontline regions, demonstrate some problems related to receiving medical care [14]. The medical-demographic, socio-economic, behavioral-biological consequences of the war for public health in the regions that are in the zone of active hostilities are extremely negative [15]. Mental overload and stress lead to an increase in the incidence of cardiovascular diseases, in particular, arterial hypertension, not only among the civilian population, but also among the military [16]. The negative impact of military aggression led not only to an increase in primary morbidity, but also significantly complicated the course of the existing pathology. According to other researchers [17] the crisis course of hypertension has increased by 2.25 times, and the number of people with anxiety disorders has also increased significantly. Studies conducted in regions more remote from hostilities (Chernivtsi region) showed an increase in the number of patients with diabetes mellitus, but there was no clear relationship between the increase in the incidence of arterial hypertension and chronic kidney disease in connection with hostilities [18].

The obtained results showed that the outbreak of a full-scale war at the beginning of 2022 significantly affected the behavior of the population, especially the number of patient visits to the CDP of the CU NMU. The most noticeable decrease was recorded in the first year of war, when the total number of visits was almost halved: the total amount of the total number of visits to doctors in the CDP in 2021 was 64407 and in 2022 – just 30408. This decrease can be attributed, first of all, to the mass migration of the population from Kyiv to safer

regions inside Ukraine and beyond. As the situation gradually stabilized in Kyiv and surrounding areas, the number of patients visits began to increase in 2023 and the rate was 35396 and there was the more significant increase in 2024 – 50567. The return of a significant part of the resettled population played a key role in this recovering. Despite the challenges of wartime conditions, the demand of specialized medical care including both therapeutic and surgical consultations, showed the slight increase even at the end of 2022. The dynamics of primary morbidity indicators for 2024 increased on average by 15% for individual diseases compared to the indicators of the first years of the war (2022-2023) and years before the full-scale invasion (2020-2021): a significant increase in the indicators of primary incidence of neoplasms, diseases of the cardiovascular, nervous, endocrine systems, digestive organs attracts attention, musculoskeletal system and connective tissue. These figures significantly exceeded those in previous years, which is probably due to the long-term chronic stress impact of martial law on public health, a significant decrease in the quality of life of people, and, possibly, difficulties in obtaining medical care at the beginning of the war.

The rates of primary morbidity of the respiratory system, female reproductive system, eye and accessory apparatus, diseases of the ear and mastoid process remain without significant dynamics.

CONCLUSIONS

The war in Ukraine has caused unwanted changes in people's lives – the loss of relatives, houses, jobs, the need to leave their place of residence, which has led to external and internal migration of the country's population. The actual reduction of the existing population in Ukraine under the influence of hostilities contributed to a decrease in the number of requests for medical care.

Thus, the decrease in the total number of visits to doctors of the consultative and diagnostic polyclinic of the University Clinic of the Bogomolets National Medical University at the beginning of the war in 2022 may be a consequence of demographic changes, internal and external migration of the country's population. In the future, after the stabilization of the military situation in Kyiv, the indicators of the total number of visits to the doctors of the polyclinic in 2023 and 2024 gradually increased, but there was a transformation due to an increase in requests for diseases to both therapeutic and surgical doctors, which may have happened due to the negative impact of the consequences of martial law on the health of the population. This trend may indicate a more attentive attitude of the population to

their state of health due to the implementation of social programs and the Program of Medical Guarantees of the National Health Service of Ukraine.

Further implementation of social protection programs at the state level and expansion of the program of medical guarantees of the National Health Service of Ukraine will help reduce the primary morbidity of the population, improve the quality of medical care and the quality of life of our citizens. Peace in Ukraine will be the key to preserving the life and health of our population.

In conclusion, it should be noted that our study highlights the need to improve the systematic approach to the organization of the health care system, improve diagnosis and treatment, as well as statistical data processing in order to improve patient outcomes and reduce the number of medical errors. Further efforts in medical training programs, adherence to modern recommendations for diagnosis and treatment, as well as administrative reforms are important to achieve these goals and will become a topic for further study within the framework of research work.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Natalia V. Horach

Bogomolets National Medical University, Kyiv, Ukraine
13 Shevchenko Boulevard, 01601 Kyiv, Ukraine
e-mail: natagorach@gmail.com

ORCID AND CONTRIBUTIONSHIP

Natalia V. Horach: 0000-0001-9885-4730 [A](#) [B](#) [C](#) [D](#) [E](#)
Lilia M. Yaremenko: 0000-0001-7076-467X [D](#) [E](#) [F](#)
Olena O. Shevchenko: 0000-0002-5547-7936 [D](#) [E](#) [F](#)
Svitlana I. Lekhnitska: 0000-0002-9178-7069 [D](#) [E](#) [F](#)
Rostyslav F. Kaminsky: 0000-0001-8656-5819 [C](#) [F](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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Trends in cervical cancer epidemiology and vaccination coverage in Ukraine

Viktor V. Semenov¹, Lilia V. Kriachkova¹, Adriana E. Boată², Marius M. Geantă²

¹DNIPRO STATE MEDICAL UNIVERSITY, DNIPRO, UKRAINE

²CENTER FOR INNOVATION IN MEDICINE, BUCHAREST, ROMANIA

ABSTRACT

Aim: To evaluate regional aspects of cervical cancer epidemiology and adherence to vaccination in Ukraine.

Materials and Methods: The data about cervical cancer age-standardised incidence rate in 2014–2019 in Ukraine was obtained from the archives of National Cancer Registry of Ukraine. The data about vaccination coverage were obtained from the reports by the Centre of Public Health of Ukraine.

Results: The average cervical cancer age-standardised incidence rate in Ukraine in 2014–2019 was 14.9 per 100,000. Zhytomyr, Khmelnytskyi and Kirovohrad oblasts exhibited values 20% above the national level. The general trend of cervical cancer incidence at the national level in 2014–2019 was declining (from 15.0 to 14.1). Kyiv, Mykolaiv, Sumy and Chernihiv oblasts exhibited increasing trends in age-standardised incidence rate (>20%). The average zero-dose children proportion in Ukraine in 2016–2024 was 30.3%. Vaccination coverage in Ukraine has been improving over the observation period in all oblasts.

Conclusions: Ukraine in 2014–2019 was characterised by the decreasing cervical cancer age-standardised incidence rate. Vaccination coverage in Ukraine in 2016–2024 has been improving, which increases the likelihood of a good response to the planned HPV vaccination campaign. Several regions with deviations from the national levels of cervical cancer incidence and vaccination coverage were identified.

KEY WORDS: Cervical cancer, vaccination, human papillomavirus, prevention, public health

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INTRODUCTION

Cervical cancer is the 5th most common type of cancer and is the 6th among the most common causes of death from cancer in the Ukrainian female population [1]. Importantly, cervical cancer is a highly preventable condition. Multiple studies have shown the beneficial impact of human papillomavirus (HPV) vaccination on cervical cancer epidemiology [2,3], and this made possible plans for the complete elimination of cervical cancer [4]. The current National program of immunisation in Ukraine includes HPV vaccination as a recommended, but not a mandatory intervention [5].

AIM

To evaluate regional aspects of cervical cancer epidemiology and adherence to vaccination in Ukraine.

MATERIALS AND METHODS

The data about cervical cancer age-standardised incidence rate (ASIR) in 2014–2019 in Ukraine was obtained from the

archives of National Cancer Registry of Ukraine [1]. The data were analysed at the national and regional (by oblast) levels. The data from 2020–2021, despite being available, were not included in the study. COVID-19 pandemic has led to the massive disturbances of the healthcare system in Ukraine, which has led to the distortion of cancer epidemiology data [link]. Average 2014–2019 ASIR (per 100,000), annual average growth rate (AAGR) of ASIR in 2014–2019 (%) and deviation from the national average 2014–2019 ASIR (%) at the regional level were calculated. Vaccination coverage was assessed via calculation of zero-dose children proportion in 2016–2024 in Ukraine at the national and regional (by oblast) levels. The data about vaccination coverage were obtained from the reports by the Centre of Public Health of Ukraine [6]. For operational purposes, Gavi, the Vaccine Alliance defines zero-dose children as those who lack the first dose of diphtheria-tetanus-pertussis-containing vaccine (DTP1) [7]. The data was only available about the proportion of children without the first three doses of DTP (DTP3) in Ukraine [6]. Given the data availability, the zero-dose children proportion was calculated from the number of children without the first three doses of DTP (DTP3). Aver-

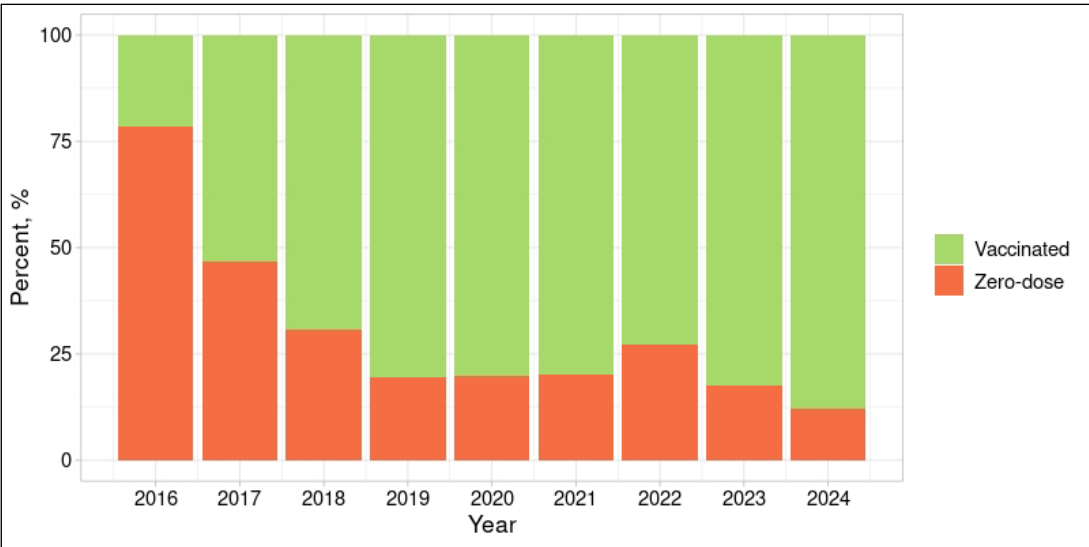


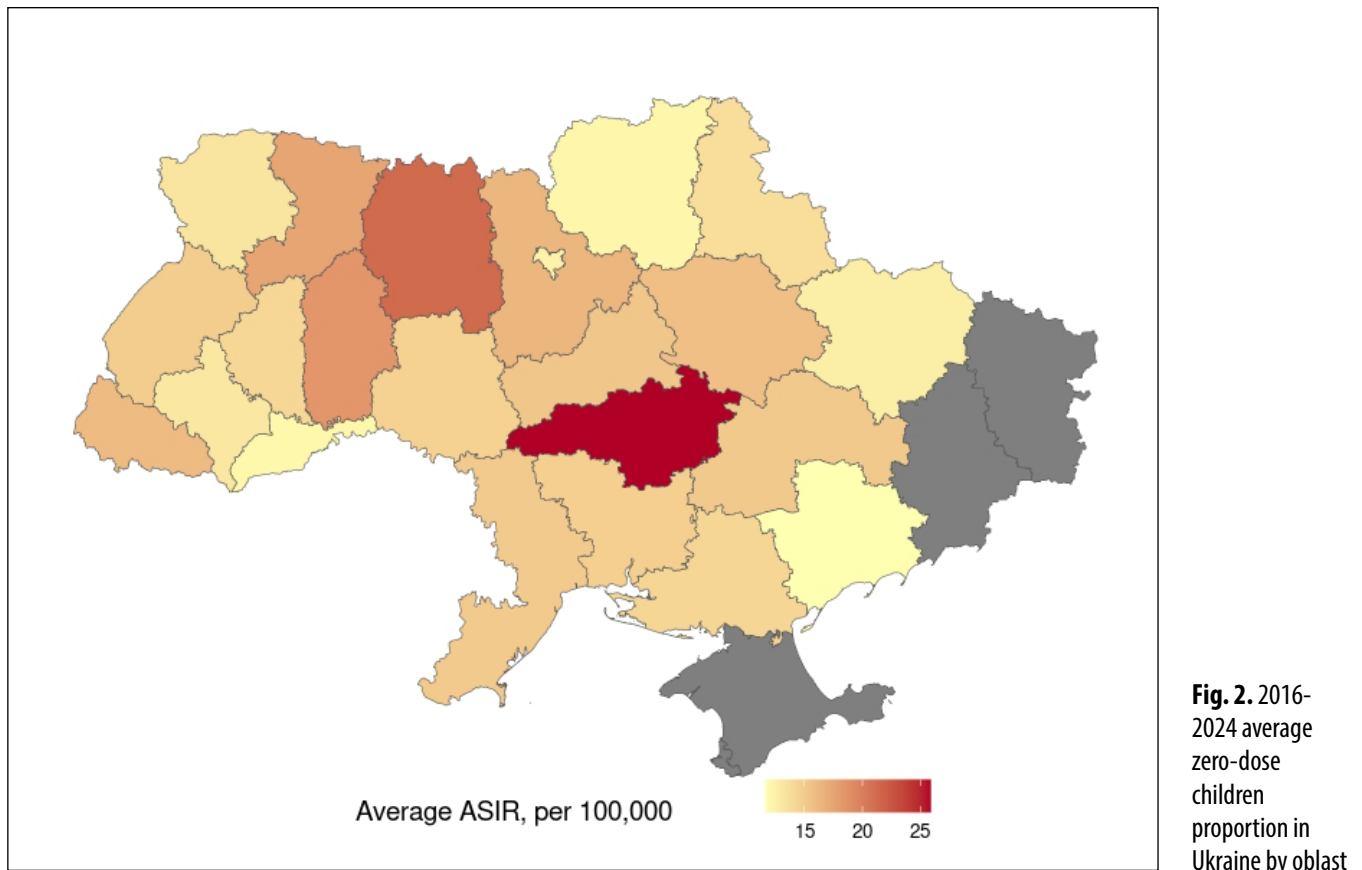
Fig. 1. 2014-2019 average age-standardised cervical cancer incidence rate in Ukraine by oblast

Table 1. Deviation from the national cervical cancer ASIR and its 2014-2019 AAGR by oblast

Oblast	Deviation from the national ASIR, %	2014-2019 ASIR AAGR, %
Crimea	No data	No data
Vinnytsia	-2.1	-37.6
Volyn	-10.7	-26.2
Dnipropetrovsk	1.6	-10.4
Donetsk	No data	No data
Zhytomyr	42.8	-6.7
Zakarpattia	7.3	-9.6
Zaporizhzhia	-21.9	-0.9
Ivano-Frankivsk	-11.8	-9.7
Kyiv	10.1	13.5
Kirovohrad	73.5	-4.5
Luhansk	No data	No data
Lviv	0.1	7.7
Mykolaiv	-0.9	19.7
Odesa	1.1	-30.6
Poltava	6.3	0.0
Rivne	17.7	-23.2
Sumy	-7.4	21.7
Ternopil	-4.6	-15.6
Kharkiv	-14.3	1.7
Kherson	-3.8	6.4
Khmelnyskyi	24.4	9.6
Cherkasy	3.2	1.3
Chernivtsi	-19.0	-40.4
Chernihiv	-17.9	33.3
Kyiv City	-16.8	-2.5

age 2016-2024 zero-children proportion was calculated. Aggregation of oblasts to the country regions was made in the same way as in the study by Sociology Group “Rating”

to make possible the between study comparison [8]. The areas defined were Center, East, South and West. The data were taken from open sources after aggregation. Therefore,

**Table 2.** 2014-2019 average cervical cancer ASIR and 2016-2024 average zero-dose children proportion by region

Parameter	Center	East	South	West	p-value
2014-2019 average ASIR, per 100,000	16.4 (13.5-19.3)	12.8 (NA)	14.2 (13.1-15.3)	15.0 (13.4-16.5)	0.60
2016-2024 average zero-dose children, %	22.0 (17.6-26.4)	35.6 (30.2-41.0)	31.7 (26.3-37.0)	34.5 (31.8-37.2)	<0.01

obtaining personal information from the data in the analysis was not possible and approval of the Ethical Committee was not required.

The data were analysed using LibreOffice and R (version 4.4.2) software [9–11]. Whenever possible, 95% confidence interval for the mean was calculated. The groups were compared using Kruskal-Wallis test. Rank correlation analysis was performed for the values of ASIR and percentage of zero-dose children in Ukraine at the oblast level in 2016-2019, using the method by Hedges and Olkin [12]. In brief, this method implies ranking values of the variables in the study for each oblast, addition of the ranked values into one dataset with a subsequent correlation analysis. Critical value for p was taken <0.05.

RESULTS

The average cervical cancer ASIR in Ukraine in 2014-2019 was 14.9 per 100,000. The map chart with the distribution of cervical cancer ASIR by oblast is presented at Fig. 1. Regional values of cervical cancer ASIR fluctuated between 11.7 and 25.9 per 100,000.

There were oblasts where average ASIR is >20% higher than national level: Zhytomyr, Khmelnytskyi and Kirovohrad oblasts (Table 1). The general trend of cervical cancer incidence at the national level in 2014-2019 was declining (from 15.0 to 14.1, -6.0% AAGR). However, in several oblasts the strong increasing trend was observed (2014-2019 AAGR >10%): Kyiv (13.5%), Mykolaiv (19.7%), Sumy (21.7%) and Chernihiv (33.3%).

The average zero-dose children proportion in Ukraine in 2016-2024 was 30.3%. The map chart with the distribution of zero-dose children proportion by oblast is presented at Fig. 2. Regional values of zero-dose children proportion fluctuated between 10.8% and 39.5%.

The proportion of zero-dose children in Ukraine in 2023-2024 was higher than in 2016-2018 (Fig. 3). This tendency was observed both at national and regional levels. In 2022 the proportion of zero-dose children was higher than in the nearest preceding and consequent years.

The Central region of Ukraine was characterised by the highest average cervical cancer ASIR and the lowest average proportion of zero-dose children (Table 2). Noteworthy, that Kirovohrad oblast had the highest

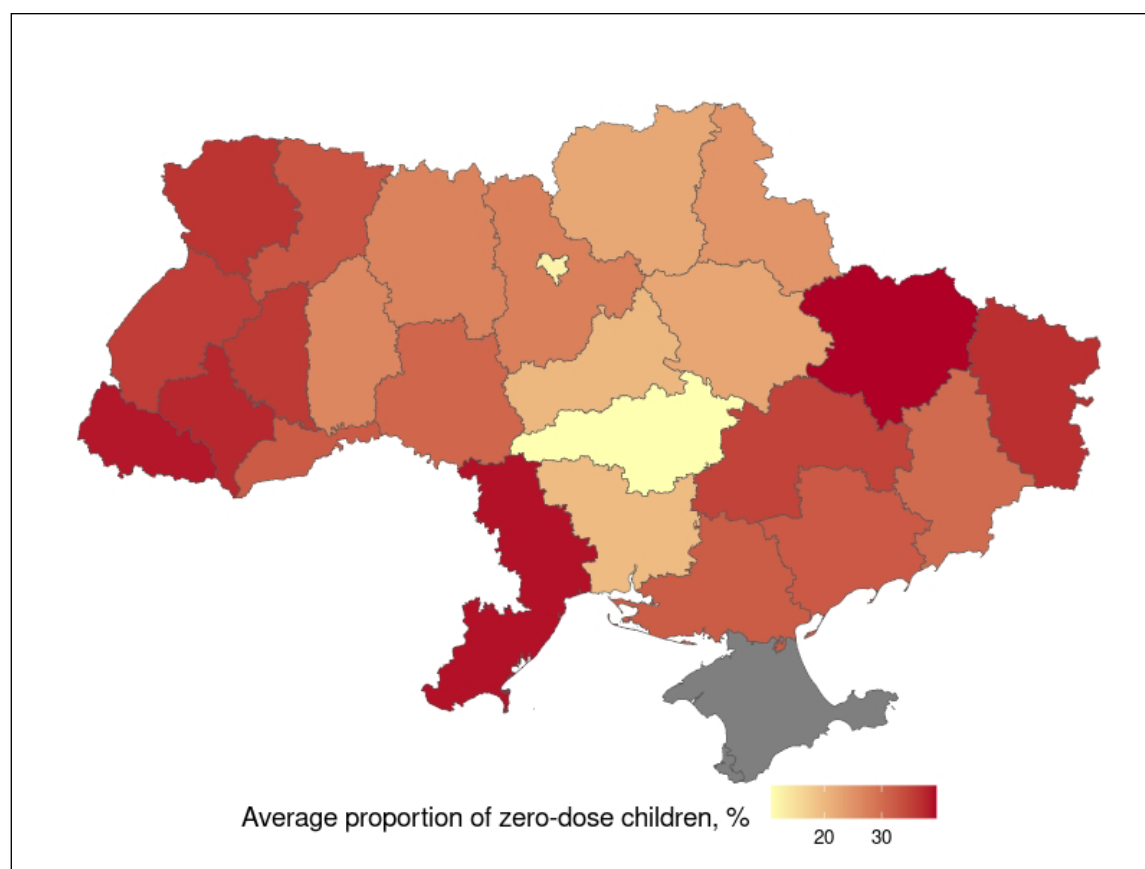


Fig. 3. Proportion of zero-dose children in Ukraine in 2016-2024

average cervical cancer ASIR (25.9 per 100,000) and the lowest average zero-dose children proportion (10.8%). By contrast, the Eastern region demonstrated the lowest average cervical cancer ASIR together with the highest average proportion of zero-dose children. There was a statistically significant difference in the proportion of zero-dose children between the studied regions ($p < 0.01$).

The correlation analysis of cervical cancer ASIR and zero-dose children percentage in 2016-2019 after ranking of the values at the oblast level revealed a weak positive correlation: $r(p) = 0.24$, $p = 0.01$. A heatmap for depiction of the association between the ranks of two variables is at Fig. 4.

DISCUSSION

The presented article summarises the trend of cervical cancer age-standardised incidence rate in 2014-2019 and vaccination coverage in 2016-2024 in Ukraine. At the national level there was a general declining trend in cervical cancer ASIR, as well as the decrease in proportion of zero-vaccinated children over the observed years. Several oblasts and regions that did not fit the described trends were identified.

Similarly to the neighbouring countries, Ukraine experiences the gradual decline in cervical cancer ASIR [13,14]. This is likely due to the ongoing programs for the cervical cancer screening and HPV vaccination that are functioning

in different way in different countries [13–16]. The average cervical cancer ASIR in Ukraine is higher than in Hungary (12.6), Poland (11.3), Republic of Moldova (14.2) or Slovakia (12.9), and is lower than in Romania (21.7, per 100,000) [17]. The understanding of the underlying reasons for these differences will make possible designing mitigation strategies for improving the patients' outcomes.

It is worth mentioning that Ukraine has the ongoing national program of cervical cancer screening and prevention. The recommendations on prevention are regularly updated [18] and aligned with the World Health Organisation position on the subject. The current version of the national vaccination calendar includes HPV vaccination as a recommended one [5]. Moreover, a new redaction of the national vaccination calendar is under preparation [19]. It suggests, among other, mandatory HPV vaccination of children. To address the possible obstacles and timely designing of communication campaigns the Ukrainian Centre of Public Health in cooperation with the U.S. Centre for Disease Control and Prevention launched a survey of HPV vaccination attitudes in Ukraine [20].

Some regions may be dealing more effectively with cervical cancer incidence due to the regional initiatives like in the paper by Kostyuchenko et al. (2018) [21]. While there is a certain degree of autonomy in healthcare politics implementation, all key decisions are made at the national level by the Ministry of Health

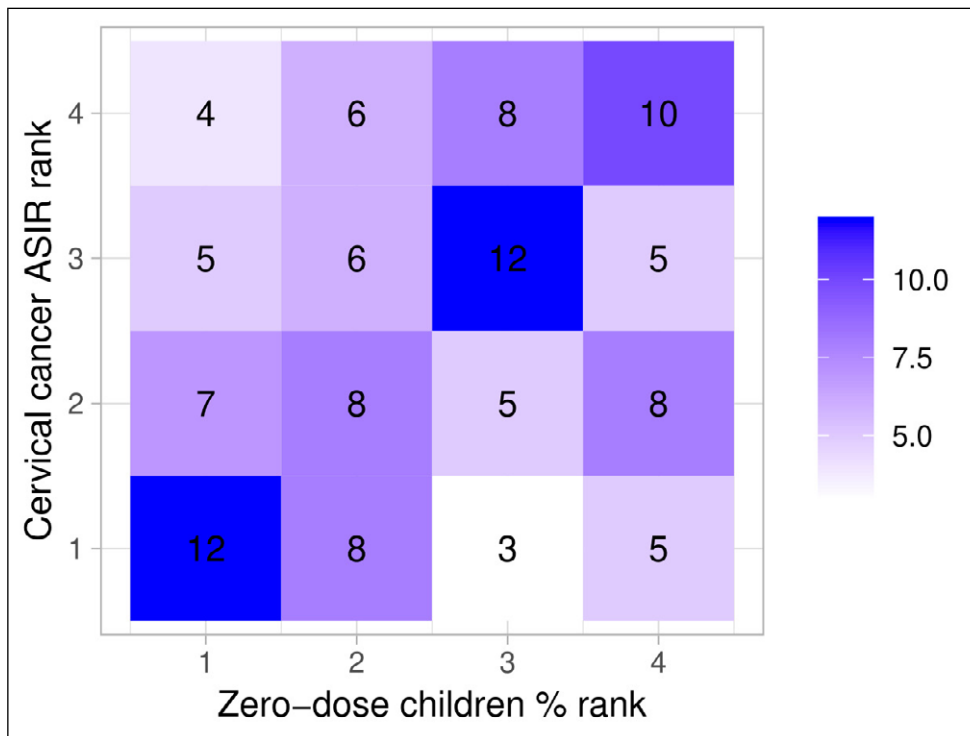


Fig. 4. Heatmap for association between ranked cervical cancer ASIR and ranked zero-dose children percentage in Ukraine in 2016-2019

of Ukraine and National Health Service of Ukraine. Due to that, significant deviation from the national average ASIR and its temporal trend require clarification of its possible causes.

Interestingly, the region with the lowest zero-dose children proportion had the highest cervical cancer average ASIR, and vice versa. However, the authors would like to argue against the possible conclusion about negative association between vaccination and cervical cancer incidence. Firstly, the proportion of zero-dose children may be considered as a proxy marker of vaccination attitude in adults, but is not equivalent to it. Therefore, the results of the announced study of the attitude to the HPV vaccination in Ukraine is to be awaited for more definite conclusions [20]. It is noteworthy that the results of the presented study correspond with the Rating study in 2021, where Southern and Eastern regions exhibited the largest proportion of coronavirus vaccine critics [8]. Secondly, due to the data availability, it was not possible to get the data on vaccination coverage for the period before the data on cervical cancer incidence. Cervical cancer is a chronic condition, and HPV infection is one of its risk factors. Therefore, it would be more accurate to study associations vaccination coverage during years that precede assessment of cervical cancer incidence. Thirdly, vaccination coverage, assessed via zero-dose children proportion, improved over time, approaching the levels of herd immunity (for diphtheria and pertussis) [22] in the latest years. It may be a result of the medical reform in Ukraine [23], when the position of family doctor was introduced. Also, it may be attributed to the successful communication campaign in

response to the drop in vaccination coverage in Ukraine in 2014-2016 [24]. Regardless of the reason, such findings promise a good response to the planned HPV vaccination campaign. An increase of zero-dose children proportion in 2022 (Fig. 3) is likely related to the full-scale russian military invasion of Ukraine. Finally, there was a statistically significant positive association between cervical cancer ASIR and zero-dose children proportion. Despite isolated cases of unexplained discrepancy between cervical cancer ASIR and vaccination coverage, the general trend indicated favourable impact of vaccination on the cervical cancer incidence.

Cervical cancer is a problem of societies where the female population does not have sufficient access to screening programs [25]. In this regard Ukraine has a potential for improvement, as according to 2019 WHO data only 57% of Ukrainian females underwent cervical cancer screening in the last 5 years [26]. Actions for increasing adherence to prevention behaviours are needed together with the HPV vaccination campaign.

CONCLUSIONS

Ukraine in 2014-2019 was characterised by the decreasing cervical cancer age-standardised incidence rate, which was comparable to the neighbouring countries. Vaccination coverage in Ukraine in 2016-2024 has been improving, which increases the likelihood of a good response to the planned HPV vaccination campaign. Several regions with deviations from the national levels of cervical cancer incidence and vaccination coverage were identified.

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CORRESPONDING AUTHOR

Viktor V. Semenov

Dnipro State Medical University
9 Volodymyr Vernadsky St., 49044 Dnipro, Ukraine
e-mail: semenovvikt@gmail.com

ORCID AND CONTRIBUTIONSHIP

Viktor V. Semenov: 0000-0003-3363-0159      

Lilia V. Kriachkova: 0000-0001-7635-2609     

Adriana E. Boată: 0000-0003-3177-2153    

Marius M. Geantă: 0000-0003-1510-8885    

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Effective strategies for the treatment of eyelid diseases in modern ophthalmology

Rimma L. Skrypnik, Nataliia A. Tykhonchuk, Inna D. Skrypnichenko, Alla I. Zadorozhna, Nataliia W. Zhaboedova, Oksana I. Parfonova
BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: Investigate the effectiveness of micellar foam containing tea tree oil and Roman chamomile oil in preoperative eyelid sanitation in patients with blepharitis.

Materials and Methods: The study involved 37 patients with blepharitis, aged 28–62. Patients were split into two groups: 22 who used micellar foam preoperatively and 15 who did not. Diagnoses included chronic, seborrheic, and demodicosis blepharitis. Symptoms and signs were monitored over a ten-day treatment period, showing varied responses to micellar foam.

Results: The study showed a significant improvement in blepharitis symptoms with the use of foam containing tea tree and Roman chamomile oils. Patients reported reduced dryness, scaling, hyperemia, and itching. Microscopic examination showed disappearance of scales and couplings, and reduced hyperemia. Bacterial contamination decreased significantly, with good tolerance to the treatment.

Conclusions: Recent literature and our study indicate that women predominantly suffer from blepharitis, possibly due to their higher medical service utilization. Most cases were mild to moderate, with multifactorial causes and bacterial influence. Eight patients (36.4%) had non-bacterial blepharitis. Understanding blepharitis epidemiology helps in pathogenetically targeted treatment. The innovative micellar foam with tea tree oil and chamomile shows positive results and reduces antibiotic resistance risks.

KEY WORDS: blepharitis, antiseptics, presurgical eyelid treatment, compliance

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INTRODUCTION

Diseases of the eyelids account for about 10% of all eye diseases. The most common is blepharitis, a chronic condition characterized by inflammation of the eyelid margins, with recurrent symptoms of redness, lacrimation, and eye irritation. Patients with blepharitis comprise 25.3% of outpatient care, about 4 million annually in Ukraine [1–3]. The etiology is diverse, involving infections, immune disorders, dermatological diseases, trauma, and other factors.

Various factors can cause blepharitis:

- **Infectious factors:** Staphylococcus aureus is the most common bacterial cause; other bacteria, such as Streptococcus and Haemophilus influenzae, herpes simplex virus (HSV), Varicella zoster virus, and Candida albicans, can also cause blepharitis.
- **Immune factors:** Conditions like atopic dermatitis, contact dermatitis, mucosal pemphigoid, and Stevens-Johnson syndrome affect the eyelids.
- **Ophthalmic diseases:** Refractive errors, such as myopia, hyperopia, and astigmatism.

- **Chronic inflammatory foci:** In the tonsils, oral cavity, and paranasal sinuses.
- **Dermatological diseases:** Rosacea and psoriasis can affect the eyelids.
- **Traumatic factors:** Chemical or thermal burns of the eyelids.
- **Neoplastic processes:** Benign and malignant tumors, such as papillomas, actinic keratosis, sebaceous carcinoma, melanoma, squamous cell carcinoma, and basal cell carcinoma, can cause blepharitis [4–7].

Blepharitis can occur due to the activity of the Demodex folliculorum mite, found in 30% of patients with chronic anterior blepharitis. This mite is present in over 75% of adults over 70 and contributes to blepharitis, as shown by symptom improvement with therapy. Demodex prevalence increases with age and should be considered in differential diagnoses [8,9]. Demodex brevis affects the meibomian glands and is associated with posterior blepharitis, leading to tear film integrity issues, inflammation, and glandular dysfunction [10]. Blepharitis is often caused by multiple pathogenic factors [5,7].

Several types of blepharitis are distinguished by inflammation localization: anterior, posterior, and mixed. Anterior blepharitis is associated with staphylococcal infection and seborrhea, characterized by redness, dilated capillaries, and dry, brittle scales at the base of the eyelashes [2,4,5].

In turn, posterior blepharitis is mainly caused by rosacea, dysfunction or inflammation of the meibomian glands, which are responsible for the production of the lipid layer of the tear film (TF), which prevents the evaporation of tear fluid from the corneal surface. Clinically, meibomian gland dysfunction is characterized by stagnation of the meibomian gland lipid secretion, and obstruction of the gland excretory ducts is caused either by keratinization of the duct during a prolonged inflammatory process (chronic blepharoconjunctivitis) or by qualitative changes in the lipid composition of the secretion (metabolic disorders).

Today, there are several classifications of blepharitis, which reflect different types and etiological factors of this disease.

In 2002, Dr. Peter Foulks proposed a classification according to which all blepharitis can be divided into two main categories [11]:

1. Anterior blepharitis:

- Acne blepharitis: The most common type associated with sebaceous gland hyperactivity and bacterial overgrowth.
- Seborrheic blepharitis: Associated with seborrheic dermatitis, a chronic skin condition that affects the hair follicles.
- Atopic blepharitis: Associated with atopic dermatitis, a chronic inflammatory skin disease.
- Contact blepharitis: It is caused by allergens or irritants that come into contact with the eyelids.
- Infectious blepharitis: Caused by bacteria, viruses or fungi.
- Other: Rare causes such as psoriasis, rosacea, and chemical burns.

2. Posterior blepharitis:

- Meibomian gland dysfunction (MGD): The most common type associated with dysfunction of the meibomian glands, which produce lipids that are part of the TF.
- Demodicosis: Associated with microscopic Demodex mites that naturally live on our skin.
- Others: Rare causes such as autoimmune diseases and inflammatory conditions.

The next step was the International Workshop on MGD held in 2007, which proposed an updated classification of blepharitis that takes into account both clinical manifestations and etiology [12].

The classification includes:

I. Anterior blepharitis:

1) Anterior infectious blepharitis:

- Acute: characterized by sudden onset of redness, swelling, eyelids, itching, scaling and crusting;
- Chronic: characterized by a long course with periods of exacerbation and remission.

2) Anterior non-infectious blepharitis:

- Seborrheic: associated with excessive sebaceous gland production;
- Atopic: associated with atopic dermatitis;
- Rosaceous: associated with rosacea;
- Psoriatic: associated with psoriasis.

II. Posterior blepharitis:

1) Meibomian gland dysfunction:

- Mild: characterized by meibomian gland dysfunction without visible changes in the eyelids.
- Moderate: characterized by dysfunction of the meibomian glands with the formation of scales and crusts on the eyelids.
- Severe: characterized by dysfunction of the meibomian glands with thickening of the eyelid margins, eyelid reverse side and corneal ulcers.

III. Mixed blepharitis: a combination of anterior and posterior blepharitis.

Blepharitis is a complex, multifactorial disease affecting not only the eyelid margins but also structures like the meibomian glands, bulbar and tarsal conjunctiva, and cornea. This impacts homeostasis and functioning, leading to a chain reaction of complications. Changes in meibomian gland secretion destabilize the TF, causing evaporation and tearing, inflammation, and irritation. Dysfunction of the meibomian glands also alters the TF microflora, promoting pathogenic microorganisms [13].

Studies show that posterior blepharitis has a distinct eyelid and conjunctival microflora, with more bacteria like coagulase-negative staphylococci, *Corynebacterium* species, and *Cutibacterium acnes* [14,15]. These bacteria produce lipase, breaking down TF lipids and altering its composition [16]. Blepharitis causes discomfort and can affect surgical outcomes by being a source of pathogenic microflora. Anterior blepharitis often involves staphylococcal and streptococcal infections, causing postoperative complications, while atypical mycobacteria can cause issues post-LASIK surgery [17-19].

Instability of the TF can disrupt reparative processes after corneal access cataract surgery or keratorefractive surgery, and worsen secondary dry eye syndrome after LASIK. A stable TF is crucial for reliable keratometry data before cataract surgery and accurate corneal topography before refractive surgery [20-23].

Preoperative eyelid sanitation is essential to reduce postoperative infectious complications, enhance TF stability, and improve visual function recovery. Antiseptics

play a vital role in modern ophthalmology, used to treat and prevent infectious diseases of the eyelids and conjunctiva, prevent postoperative infections, and manage injuries. The choice of an antibacterial drug depends on the disease, its severity, and the pathogen's sensitivity. The issue of antibiotic resistance highlights the need for newer broad-spectrum antimicrobial agents [24,25].

The new formula for preventing and treating eyelid diseases is an innovative micellar foam. It contains tea tree oil (*Melaleuca Alternifolia*) 0.02%, Roman chamomile essential oil (*Anthemis Nobilis*), D-panthenol, allantoin, and taurine. Tea tree oil has powerful antiseptic, acaricidal, anti-inflammatory, and analgesic properties, effective against *S. aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Candida albicans* [25-27]. Roman chamomile essential oil has anti-inflammatory, antiseptic, analgesic, and soothing properties. D-panthenol stimulates regeneration and strengthens collagen fibers. Allantoin and taurine provide anti-inflammatory, protective, moisturizing, and keratolytic effects.

The foam's unique composition allows for quick penetration at low concentrations. It offers prolonged release of pharmacological components, reducing the need for frequent application. The foam is comfortable to use, evenly distributed, and reduces irritation for sensitive eyes. It also eliminates microbial contamination, making it ideal for patients with chronic eye diseases and those leading active lifestyles [28-31].

AIM

To investigate the effectiveness of micellar foam containing tea tree oil and Roman chamomile oil in preoperative eyelid sanitation in patients with blepharitis.

MATERIALS AND METHODS

The study examined 37 (74 eyes) patients aged 28 to 62 years. The inclusion criteria were a diagnosis of blepharitis confirmed by ophthalmologic examination and planned eye surgery. Exclusion criteria were ophthalmic diseases other than blepharitis, the presence of systemic diseases that have a negative impact on the eyes, and allergy to the components of micellar foam.

Patients were divided into two groups. The first group included 22 patients, 10 men and 12 women, with blepharitis, who received preoperative eyelid sanitation with micellar foam for 10 days before surgery. The second group included 15 patients, 7 men and 8 women, with blepharitis who did not receive preoperative eyelid sanitation.

Among them, 15 patients (40.5%) were patients with chronic blepharitis with uncorrected ametropia; 9 patients (24.3%) had seborrheic blepharitis; 13 pa-

tients (35.1%) had demodicosis blepharitis confirmed by microscopic examination of eyelashes. The average duration of blepharitis in group 1 was 1.5 ± 1.2 years, and in group 2 – 1.3 ± 1.1 years ($p > 0.05$).

Before treatment, all patients underwent an ophthalmologic examination, swabbing of the eyelid conjunctiva for bacteriologic examination, ametropia correction and gastroenterologist consultation, if indicated.

According to the study, the patients were diagnosed with mild (21 patients, 56.8%) to moderate (16 patients, 43.2%) blepharitis. The predominant symptoms of blepharitis were itching, burning, foreign body sensation, edema, eyelid margin hyperemia, plaque formation, scales and/or meibomian gland enlargement at the time of examination.

All patients in group 1, while observing all the necessary hygiene rules during the treatment of blepharitis, applied micellar foam to the eyelids twice a day. The patients were explained the method of application: the foam was to be sprayed onto clean fingers, then, with the eyes closed, the eyelashes and eyelid margin were rubbed with foam for 60-90 seconds. After each application, the eyes and eyelids were rinsed thoroughly with clean water. The total treatment period was a ten-day course. The signs and symptoms of blepharitis were assessed at each visit before treatment, on the 3rd, 7th and 10th day of treatment based on the results of changes in clinical signs of the disease.

The research was conducted in compliance with the basic norms of bioethics and the requirements of the Helsinki Declaration on Human Rights and Biomedicine (1977) and the relevant laws of Ukraine.

RESULTS

The analysis of the results of clinical observation of patients with blepharitis showed that at the end of the therapy, a pronounced positive dynamics was noted against the background of active therapy with foam containing tea tree oil and Roman chamomile oil. Patients reported significant relief of the condition, reduction of discomfort and the feeling of a foreign body in the eyes. The therapeutic effect was manifested not only by a reduction in the main subjective symptoms, such as dryness, peeling, eyelid flushing and itching, but also by a marked improvement in the objective picture, which was confirmed by microscopy. There was a complete or partial disappearance of scales and couplings at the root of the eyelashes, a decrease or complete elimination of hyperaemia of the marginal eyelid margin. In addition, patients significantly improved the condition of the eyelid skin, reduced the severity of the inflammatory process, and normalised

Table 1. Results of changes in clinical signs in patients before and after treatment

Clinical signs	Before treatment	Day 3 of treatment	Day 7 of treatment	Day 10 of treatment
Redness	Explicit	Redness reduction	Minimal or absent	No redness
Edema	Explicit	Edema regression	Limited or absent	No edema
Scaling	Explicit	Minimal scaling	Minimal or absent	No scaling
Itching	Severe or moderate	Itching relief	Minor or absent	Excluded
Burning	Intense	Minimal burning	Minimal or absent	No burning
Sticking of eyelids	Present	Minimal sticking	Absent	Absent

the structure of the ciliary margin, which contributed to long-term remission of the disease. The results of the changes are presented in Table 1.

The assessment of clinical manifestations of blepharitis was carried out on the basis of a special scale that allowed a comprehensive analysis of both the subjective feelings of patients and objective biomicroscopic signs of the pathological process. For this purpose, a 3-point rating system was used, which reflected the severity of symptoms. In particular, the scale included an assessment of the level of subjective discomfort experienced by patients, as well as the identification of changes recorded during biomicroscopic examination of the eyes. Each of the parameters was assessed using a three-point scale, where:

- +++ significantly pronounced symptoms,
- ++ moderately pronounced symptoms,
- + slightly pronounced symptoms,
- complete absence of symptoms.

By the end of the study, all patients in the first group noted a significant improvement in their health and a reduction in the severity of blepharitis symptoms. In particular, they reported a decrease in light sensitivity, pain, and discomfort during visual activities such as reading, driving in the dark, and working with electronic devices with screens.

The results of bacteriological analysis showed that at the beginning of the study, 14 patients (63.6%) in the first group had bacterial contamination of the conjunctiva, with *Staphylococcus aureus* being the main causative agent of blepharitis. However, after the treatment, the level of bacterial contamination decreased significantly, with only two patients (9%) still having conjunctival contamination.

The treatment was generally well tolerated by the patients. The only exception was one case: one patient developed contact dermatitis, which required additional medication changes.

DISCUSSION

Diseases of the eyelids account for approximately 10% of all eye diseases, with blepharitis being a prevalent

chronic condition characterized by inflammation of the eyelid margins [1-3]. The multifactorial etiology of blepharitis includes infections, immune disorders, dermatological diseases, trauma, and neoplastic processes [4-7]. Our study revealed a significant improvement in symptoms with the use of micellar foam containing tea tree and Roman chamomile oils. These findings align with previous research, which also highlighted the role of bacterial and Demodex mite involvement in blepharitis pathogenesis [8-9].

Patients with blepharitis are common in outpatient care, comprising about 25.3% of such visits in Ukraine. The prevalence of Demodex mites increases with age and is a notable factor in both anterior and posterior blepharitis. The study showed the efficacy of micellar foam in reducing symptoms, improving the objective microscopic picture, and decreasing bacterial contamination [10-14].

Despite these positive outcomes, our study had potential methodological limitations, including a small sample size and short follow-up period. Future research should focus on larger patient groups and long-term effects to confirm these findings. The observed reduction in antibiotic resistance and patient discomfort suggests that micellar foam is a viable alternative treatment for blepharitis [15-19].

Our results show on blepharitis treatment, emphasizing the importance of innovative therapies in managing this complex, multifactorial disease. Further studies should explore the combined effects of different treatment modalities to enhance patient outcomes [20-25].

The presence of blepharitis can lead to physical, cosmetic, and social discomfort, affecting the quality of life of patients and the outcomes of ophthalmic surgeries. Preoperative eyelid sanitation is crucial for reducing postoperative infectious complications and ensuring the stability of the tear film. The innovative micellar foam, with its unique composition and prolonged effect, shows promise in managing blepharitis and mitigating antibiotic resistance risks, enhancing patient comfort and treatment compliance [26-31].

CONCLUSIONS

Literature sources of recent years have shown that women predominate among patients with blepharitis. The same trend was observed in our study. This may be due to the fact that women seek medical services more often than men.

According to the classification adopted in this study according to the severity of blepharitis, most of them were mild to moderate, which indicates that the disease does not often manifest itself so aggressively.

In general, the cause of blepharitis is not always possible to establish, given its multifactorial nature, and with a probable bacterial influence. In its pathogenesis, bacterial lipase alters the secretion of the meibomian gland, promoting the growth and reproduction of bacteria.

It should be borne in mind that patients may often have several etiologic factors. However, not all cases are associated with infection. In the study population, our study showed that 8 (36.4%) patients did not have blepharitis associated with bacterial colonization.

Understanding the epidemiologic characteristics of blepharitis allows for pathogenetically targeted

treatment. The importance of preoperative eyelid sanitization to minimize the risk of postoperative infectious complications remains significant. The rise in antibiotic resistance among microorganisms, including in ophthalmology, has become a growing concern in recent years. Therefore, the early administration of potent, broad-spectrum antimicrobials is necessary.

An innovative micellar foam containing tea tree oil, Roman chamomile essential oil, D-panthenol, allantoin, and taurine is suitable for the prevention and treatment of eyelid diseases. This formulation achieves notable positive outcomes, reducing patients' subjective complaints and improving the objective clinical picture of the disease. The micellar foam form offers additional benefits, allowing twice-daily use with maximum eyelid coverage and comfortable tolerability.

The combined antiseptic, disinfectant, and anti-inflammatory effects of the drug make it highly recommended for clinical practice. These effects help mitigate and avoid the risks associated with antibiotic treatment, such as the development of bacterial resistance or hypersensitivity reactions, and increase patient compliance.

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CORRESPONDING AUTHOR

Rimma Skrypnyk

Bogomolets National Medical University
13 Shevchenko Boulevard, 01601 Kyiv, Ukraine
e-mail: rimmaskrypnyk@gmail.com

ORCID AND CONTRIBUTIONSHIP

Rimma L. Skrypnyk 0000-0002-8463-1701 **A**

Nataliia A. Tykhonchuk 0009-0008-5712-4780 **B**

Inna D. Skrypnychenko 0009-0001-3749-7474 **D**

Nataliia W. Zhaboedova 0009-0006-5275-5837 **E**

Alla I. Zadorozhna 0009-0008-9537-8749 **C**

Oksana I. Parfonova 0000-0003-0603-5135 **F**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Analysis of accessibility of medical care at a specialized center in the capital for people with thyroid diseases

Nataliia Ya. Kobrynska¹, Oryna Z. Detsyk², Olha L. Burak²

¹V.P. KOMISARENKO INSTITUTE OF ENDOCRINOLOGY AND METABOLISM OF THE NATIONAL ACADEMY OF MEDICAL SCIENCES OF UKRAINE, KYIV, UKRAINE

²IVANO-FRANKIVSK NATIONAL MEDICAL UNIVERSITY, IVANO-FRANKIVSK, UKRAINE

ABSTRACT

Aim: To analyze the availability of medical care at a capital's specialized center for patients with thyroid diseases according to their demographic and socio-economic characteristics.

Materials and Methods: There was conducted a survey of a representative sample of 600 people with thyroid diseases – patients of the capital's specialized endocrinology center.

Results: The most accessible services of the capital's specialized endocrinology center were for urban residents (76.0%), including the capital's ones (46.3%), of working age (84.8%) with university education (64.8%), and, accordingly, less accessible – for rural residents (24.0%). Up to 40% of the patients of the capital's specialized endocrinology center were representatives of vulnerable groups: retirees (16.6%), unemployed (12.5%) and people with disabilities (12.2%), more so among women and rural residents. This emphasizes the importance of any form of universal coverage and the prospect of further access to health care improvement with the inclusion of such specialized centers in the State Medical Guarantee Program 2025. The use of specialized care could be influenced by wartime and the need to confirm readiness for military service, as indicated by the higher proportion of young people among male patients (26.7% aged 30-39 years vs. 19.8% among women) and their lower level of education (59.3% with university education vs. 66.5%, respectively).

Conclusions: The obtained data should be taken into account in developing organizational measures to improve access to specialized care for people with thyroid diseases at the state, regional and community levels.

KEY WORDS: Thyroid diseases, accessibility, medical care, specialized care, health care management

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INTRODUCTION

Thyroid diseases are the most common endocrine disorders after diabetes, affecting about 2% of the world's population [1].

Hypo- and hyperthyroidism, thyroiditis, nodular and non-nodular goiter, cancer and other thyroid diseases are chronic non-communicable diseases, the morbidity, disability and mortality from which tend to increase worldwide [2-4]. The need for long-term treatment, often surgical, and rehabilitation requires high progressive expenditures of medical resources [5], and, accordingly, puts a significant burden on health care systems [6-11]. In particular, according to Sahli ZT et al, the financial burden on hospitals associated with thyroid treatment continues to grow by 4.3% annually [12].

In Ukraine, the number of thyroid diseases has increased fivefold in recent years [13, 14]. Scientists explain this as a natural iodine deficiency in many regions

of the country [14-16], as well as the consequences of the Chernobyl accident in 1986 [17, 18].

It is well known that reducing the burden of disease requires integrated efforts of all stakeholders and comprehensive management measures aimed at prevention, early detection, adequate treatment and rehabilitation. Their results directly depend on the availability of not only primary but also specialized medical care for the population [19]. Since 2018, the State Medical Guarantee Program (MGP) has been operating in Ukraine, procuring medical and rehabilitation services from communal and private providers [20], as well as the government's reimbursement program "Available Medicines", which includes thyroid drugs [21]. However, highly specialized and high-tech endocrinological care in Ukraine is provided by another state center of the Ministry of Health of Ukraine and two state institutes of the National Academy of Medical

Sciences of Ukraine, which, in addition to diagnostic and treatment, also have supervisory functions to coordinate this type of specialized care in the country, and carry out scientific research [22]. These centers were being financed through a subvention from the state budget until 2025, and thus did not fully cover all their needs. In connection with the transition to new funding mechanisms – procurement of services within the framework of the MGP [23], it is important to understand which segments of the population received care in these highly specialized centers, how accessible it is to all patients who need it. This is especially true in the current socio-economic and political circumstances, when the availability of all types of care in Ukraine has significantly decreased as a result of the full-scale invasion of the Russian Federation [24].

AIM

To analyze the availability of medical care at a specialized center in the capital for patients with thyroid diseases according to their demographic and socioeconomic characteristics.

MATERIALS AND METHODS

During 2023–2024, a cross-sectional survey was conducted on the basis of the outpatient department of the V.P. Komisarenko Institute of Endocrinology and Metabolism of the National Academy of Medical Sciences of Ukraine, randomly selected from among the persons who agreed to participate in the study by signing the relevant informed consent.

To obtain a representative sample of the survey, it was determined that the study group would consist of no less than 381 respondents. The size of the research group was calculated taking into account: the estimated size of the fraction: 50%, significance level (α 5%), population size 42714 (based on the annual report of this healthcare facility, 2023), and permissible error 5%.

More than a sufficient number of people responded to the survey – 600. The inclusion criteria were: non-toxic multinodular goiter, non-toxic nodular goiter, toxic adenoma, Graves' disease, chronic autoimmune thyroiditis, thyroid malignancies, primary hyperparathyroidism. Exclusion criteria were: patients without pathological changes in the thyroid gland according to ultrasound and with normal levels of thyroid and parathyroid hormones.

A specially designed author's program was used to conduct the survey. The questionnaire was initially validated on 15 people to evaluate the clarity and comprehensibility of the questions, the required sur-

vey duration, and to make necessary corrections. The questionnaire contained issues related to demographic, socioeconomic, socio-psychological, behavioral, internal determinants, patient's medical pathway, etc.

The design and program of the study were reviewed and approved by the Bioethics Committee of the V.P. Komisarenko Institute of Endocrinology and Metabolism of the National Academy of Medical Sciences of Ukraine (Protocol No. 52-KE of 22.10.2024).

The data were processed on the basis of a database created using Microsoft Excel. The rate of signs per 100 respondents and its standard error ($\pm m$) were calculated. The reliability of their differences in observation groups (men-women, urban-rural, age groups) was assessed by the chi-square (χ^2) test.

RESULTS

It was found that three quarters of the examined patients of the specialized endocrinology center with thyroid diseases were women (75.7%), the rest were men (24.3%).

The same ratio was observed by place of residence in favor of urban residents: 76.0% vs. 24.0% of rural residents. Moreover, according to the annual report of this facility for 2023, almost half (46.3%) of the patients were residents of the capital.

Most patients of the highly specialized endocrinology center were of working age – 84.8% (Fig. 1).

In particular, the largest shares were in the age groups of 40–49 (28.5%), 50–59 (22.3%) and 30–39 (21.6%).

There was a significant difference in the age distribution of men and women ($p < 0.001$) and urban and rural residents ($p < 0.05$). Thus, among men, the proportion of people aged 30–39 was significantly higher (26.7% vs. 19.8% among women). In the age distribution of rural residents, the share of people aged 50–59 was the highest (30.6% vs. 19.7% among urban residents) and the lowest – under 30 (6.3% vs. 14.5%, respectively).

The interviewed patients had a fairly high level of education (Fig. 2).

About 65% (64.8%) had a university graduation, another 23.1% had a college degree, and 12.1% had a high school education.

There were also significant differences in the level of education by gender ($p < 0.01$) and residence ($p < 0.01$). Among women, the proportion of people with university degrees was significantly higher (66.5% vs. 59.3% of men) and the proportion of people with high school educations was lower (9.7% vs. 20.0%, respectively). Among urban residents, there were significantly more people with university degrees (70.5% vs. 47.2% of rural residents), and among rural residents – with high

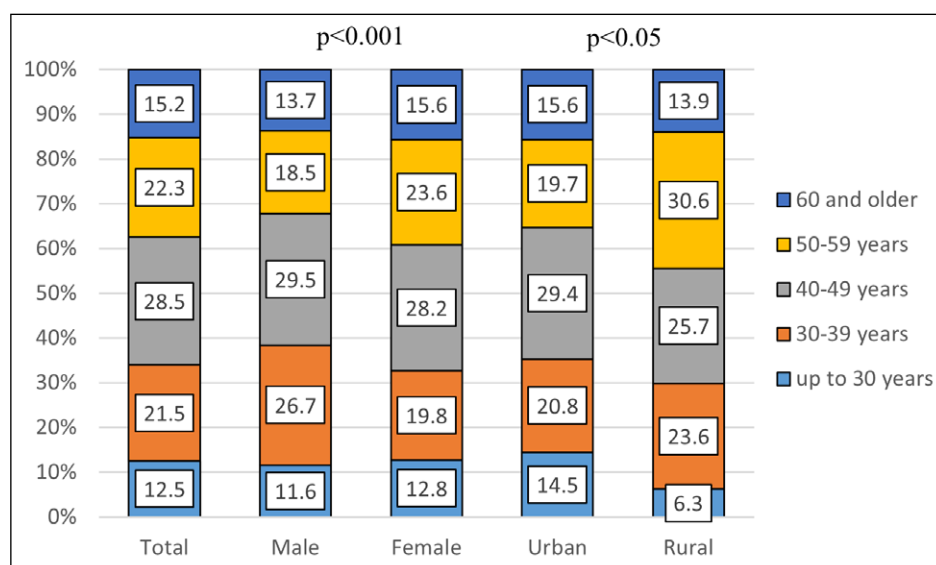


Fig. 1. Distribution of respondents by age

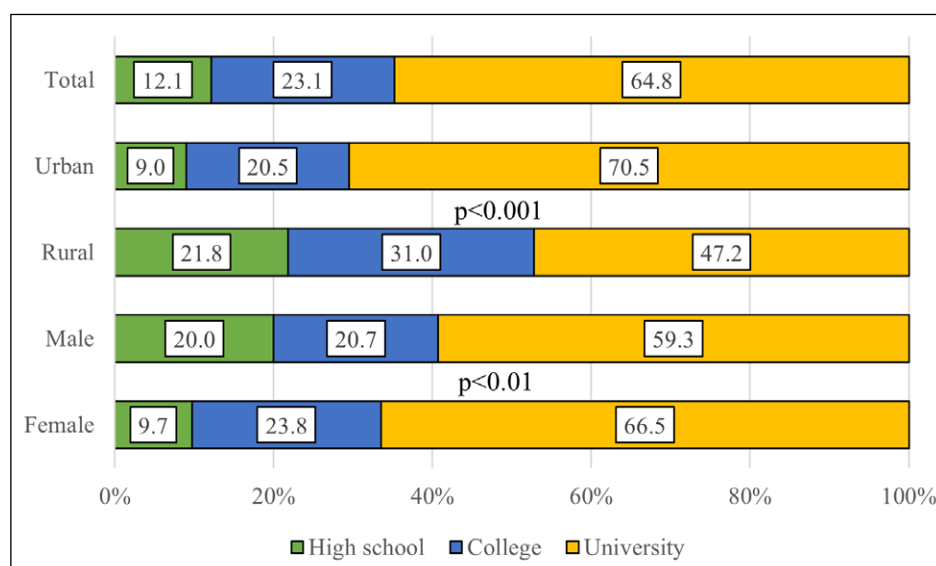


Fig. 2. Distribution of respondents by education

school education (21.8% vs. 9.0% of urban residents) and college education (31.0% vs. 20.5%, respectively).

Employment and social categories of respondents are presented in Table 1.

More than half of the respondents had civilian jobs (56.7 ± 2.1 per 100 respondents), and another 4.2 ± 0.9 per 100 respondents were military servicemen. At the same time, the rest, which is almost 40% of patients, belonged to vulnerable groups: retirees ($16.6 \pm 1.6\%$), unemployed ($12.5 \pm 1.4\%$), people with disabilities ($12.2 \pm 1.4\%$) and internally displaced persons ($4.2 \pm 0.9\%$).

The employment rate differed by gender ($p < 0.001$) and place of residence ($p < 0.001$). Among men, there were more employed and military servicemen, and among women, more retirees, unemployed and people with disabilities. The proportion of employed people in urban and rural areas was almost the same, but urban residents had higher shares of military servicemen and internally displaced persons, and rural residents had

higher shares of retirees, unemployed, and people with disabilities.

The majority of the surveyed patients (67.5%) had an income per family member higher than the government-approved minimum wage. However, in 8.1% of cases, it was below the subsistence minimum, and in 24.5% of cases, it was above the subsistence level but below the minimum wage (Table 2).

At the same time, when asked to estimate their income level, 8.3% of respondents recognized it as low, which is almost identical to the percentage of those who objectively have income per family member below the subsistence level. In the rest of the answers, respondents subjectively evaluated their incomes better than the objective data indicated. Thus, only 13.1% considered their income to be below average. The share of those who considered themselves middle class was the highest (67.8%). 9.5% of respondents estimated their incomes to be higher than average, and only 1.2% – as high.

Table 1. Employment and social categories of respondents

Social category	Male		Female		Urban		Rural		Total	
	%	±m	%	±m	%	±m	%	±m	%	±m
employed people	61.9	4.3	55.2	2.4	57.5	2.5	54.4	4.3	56.7	2.1
military servicemen	14.3	3.1	1.2	0.5	5.2	1.1	1.5	1.0	4.2	0.9
retired people	13.5	3.0	17.5	1.9	15.2	1.8	20.6	3.5	16.6	1.6
unemployed	9.5	2.6	13.4	1.7	10.1	1.5	19.9	3.4	12.5	1.4
people with disabilities	5.6	2.0	14.1	1.7	11.3	1.6	14.7	3.0	12.2	1.4
internally displaced persons	4.0	1.7	4.3	1.0	5.4	1.1	0.7	0.7	4.2	0.9
p	<0.001				<0.001					

Table 2. Distribution of respondents by income (%)

Characteristics of respondents' income	Male	Female	Urban	Rural	Total
Income per family member					
Total	100.0	100.0	100.0	100.0	100.0
below the subsistence minimum	8.5	7.9	6.8	11.7	8.1
below the minimum wage, but above the subsistence level	22.6	25.1	19.7	37.8	24.5
above the minimum earnings	68.9	67.0	73.5	50.5	67.5
p	>0.05		<0.001		
Respondents' assessment of their own income					
Total	100.0	100.0	100.0	100.0	100.0
low	6.4	8.9	5.4	17.8	8.3
lower than average	13.6	13.0	13.1	13.3	13.1
average	70.7	66.9	70.2	60.0	67.8
above average	7.9	10.0	9.7	8.9	9.5
high	1.4	1.1	1.6	0.0	1.2
p	>0.05		<0.001		

As can be seen from Table 2, there was no difference in income between men and women ($p>0.05$). However, there were significant differences between urban and rural residents. The income of urban residents was significantly higher both objectively and subjectively (according to self-assessment) ($p<0.001$).

DISCUSSION

The study confirms that women are three times more likely to suffer from thyroid pathology than men [13]. It was also confirmed that the territorial accessibility of medical care is important [25, 26]. The hypothesis is supported by the three times lower proportion of rural residents among patients of the capital's specialized center. In addition, half of the center's patients were from the capital. The study reveals that the vast majority of patients at the capital's specialized endocrinology center were of working age and had a high level of education. On the one hand, this confirms the burden that chronic thyroid

disease poses to society [2-4]. 3 On the other hand, the 5.6 times smaller share of elderly people (15.2% vs. 84.8%), who are known to be vulnerable, indicates that this type of care is likely to be less accessible to them. At the same time, there were slightly fewer employed people among the patients of this specialized center than people of working age (61.0%), and the share of all vulnerable groups (pensioners, unemployed, people with disabilities, internally displaced persons) reached almost 40%. The highest proportions of retirees, unemployed, and people with disabilities were observed among women and rural residents, who also belong to vulnerable groups at risk of inequality in access to health care. At the same time, the higher proportions of men aged 30-39, employed and military servicemen against the background of a lower level of education than women are most likely related to the need to undergo an enhanced medical check-up for military readiness in wartime [24]. It was found that 32.5% of respondents were low-income, which is slightly less than the total share of the

unemployed. The highest proportion of low-income people was recorded among rural residents, which coincides with their lower employment rates than urban residents and higher shares of retirees, unemployed and people with disabilities.

In general, the fairly significant percentage of vulnerable groups among the patients of the capital's specialized endocrinology center emphasizes the importance of any form of universal coverage to ensure access to health care [20, 23, 25, 26]. Therefore, the inclusion of such facilities in the State Medical Guarantee Program from 2025, in our opinion, will contribute to even better access to specialized care, in particular for vulnerable groups of the population [23].

LIMITATIONS

The study was conducted during the full-scale invasion of the Russian Federation, which could have had a negative impact on the availability of medical care in general, on the structure of patients and their motivation for treatment.

Prospects for further research will be to develop a set of organizational measures to improve the availability of endocrinological care for people with thyroid disease at the state, regional and community levels.

CONCLUSIONS

It was found that the most accessible services of the capital's specialized endocrinology center were for urban residents (76.0%), including the capital's ones (46.3%), of working age (84.8%) with university education (64.8%), and, accordingly, less accessible – for rural residents (24.0%).

It was established that up to 40% of the patients of the capital's specialized endocrinology center were representatives of vulnerable groups: retirees (16.6%), unemployed (12.5%) and people with disabilities (12.2%), more so among women and rural residents. This emphasizes the importance of any form of universal coverage and the prospect of further access to health care improvement with the inclusion of such specialized centers in the State Medical Guarantee Program 2025.

It was shown that the use of specialized care could be influenced by wartime and the need to confirm readiness for military service, as indicated by the higher proportion of young people among male patients (26.7% aged 30–39 years vs. 19.8% among women) and their lower level of education (59.3% with university education vs. 66.5%, respectively).

The obtained data should be taken into account in developing organizational measures to improve access to specialized care for people with thyroid diseases at the state, regional and community levels.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Nataliia Ya. Kobrynska

V.P. Komisarenko Institute of Endocrinology and Metabolism of the NAMS of Ukraine
69 Vyshgorodska st, 04114 Kyiv, Ukraine
e-mail: nataliakobrynska@gmail.com

ORCID AND CONTRIBUTIONSHIP

Nataliia Ya. Kobrynska: 0000-0001-8698-9793 **A** **B** **F**

Oryna Z. Detsyk: 0000-0003-3975-9455 **A** **C** **D**

Olha L. Burak: 0000-0002-1332-2127 **C** **E**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Microbiological monitoring of the hospital environment: risk assessment and strategies in infection control systems

Olena V. Zublenko, Tetiana V. Petrushevych

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To investigate the role and prospects of microbial environmental monitoring in a healthcare facility, to evaluate strategies for controlling microbial contamination, to identify the species composition of microorganisms and factors that pose a threat to creating a safe environment in the facility.

Materials and Methods: A retrospective analysis of microbiological monitoring at a 200-bed healthcare facility (2020–2023) was conducted. Over 15,500 swab samples were collected from high-touch surfaces. Microorganism cultivation followed standard methods, with fungi grown on Sabouraud medium. Procedures complied with DSTU EN ISO 15189:2015 standards. The statistical reliability of relative indicators was calculated using a formula that included the standard error calculation.

Results: Microorganisms were detected in 0.8–1.9% of samples, with 162 positive environmental tests during the observation period. *Staphylococcus aureus* was the most common pathogen ($37\pm3.5\%$), followed by *Enterococcus* spp. ($28.4\pm3.2\%$) and *Escherichia coli* ($16.1\pm2.8\%$). The surgical department showed the highest contamination rate ($43.2\pm3.8\%$), with medical equipment in treatment rooms accounting for $61.8\pm3.8\%$ of positive results.

Conclusions: The findings confirm that healthcare environments act as reservoirs for pathogens associated with healthcare-associated infections (HAIs). The surgical department exhibited the highest microbial burden, emphasizing the need for stricter infection control in high-risk areas. The predominance of *Staphylococcus* highlights its role in surgical site infections, with contaminated medical equipment serving as a key transmission factor. Strengthening disinfection protocols and routine monitoring is essential to mitigate microbial contamination risks.

The implementation of microbial monitoring in Ukraine depends on national standards. Routine sampling is not mandatory, with most hospitals conducting surface monitoring only during outbreaks, limiting systematic infection control efforts.

KEY WORDS: healthcare facility, Healthcare-Associated Infections (HAIs), microbiological monitoring, microorganisms, disinfection

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INTRODUCTION

Healthcare-associated infections (HAIs) are one of the greatest threats to patient safety worldwide, as they lead to increased mortality, morbidity, and length of hospital stay. The hospital environment can be a reservoir for pathogens that can persist on surfaces of medical equipment, patient environments (beds, tables, doorknobs, etc.), and on the body surfaces of patients and healthcare workers. The main cause of HAIs is poor hand hygiene among healthcare workers, with workers more likely to contaminate their hands after touching the patient environment than after direct patient contact. The main pathogens of HAIs in the hospital environment include gram-positive cocci, such as *Staphylococcus aureus* (including MRSA) and coagulase-negative staphylococci (CoNS), as well as gram-negative microorganisms, including *Escherichia coli* (*E. coli*), *Pseudomonas aeruginosa* (*P. aeruginosa*), *Klebsiella pneumoniae* (*K. pneumoniae*), and *Citrobacter* spp.

Highly virulent pathogens, such as *Staphylococcus aureus* (methicillin-resistant *Staphylococcus aureus* or MRSA), coagulase-negative staphylococcus (CoNS), *Enterococcus* species (vancomycin-resistant enterococcus), *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Clostridium difficile*, and *Acinetobacter baumannii*, can persist for some time on contaminated inanimate surfaces and medical equipment, significantly increasing the risk of infection transmission in healthcare settings [1].

Surfaces and engineering features of hospital wards, as well as medical equipment or other frequently used equipment, pose a risk of transmission of microorganisms in the hospital environment [2]. Surfaces in close proximity to patients are frequently contaminated by the hands of both patients and healthcare workers and are classified as high-contact surfaces [3]. Bacterial contamination of high-contact common surfaces (medical charts, doorknobs, white coats, telephones, computer keyboards/mice, handwashing sinks) and medical

equipment (blood pressure cuffs, ventilators, portable radiographic equipment, ultrasound equipment, and stethoscopes) is a serious problem in the management and treatment of patients [1,4]. Bacterial contamination of surfaces and equipment is a problem because they can serve as reservoirs for an indefinite period of time through gradual cross-transmission of pathogens and subsequent contact with patients and healthcare workers during treatment [5]. Bacterial contamination can be caused by a variety of microorganisms, including both Gram-positive and Gram-negative bacterial isolates, as well as fungal species.

Factors that contribute to the transfer of microorganisms from one surface to another include the type of organisms, the nature of the surfaces, the level of humidity, the size of the inoculum, poor hand hygiene by healthcare personnel, the number of colonized patients, and the characteristics of antibiotic administration – these factors significantly affect the risk of spreading infections in healthcare settings. According to Lucia Bonadonna Gram-negative bacteria persist longer than Gram-positive bacteria. Humidity increases the resistance of several types of bacteria (e.g., *Chlamydia trachomatis*, *Listeria monocytogenes*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, and *Escherichia coli*), while only *Staphylococcus aureus* persists longer at low humidity [6].

According to literature data 40–60% of infectious diseases developing in the intensive care unit are caused by endogenous flora, 20–40% are transmitted through contaminated hands of healthcare workers, 20–25% are due to changes caused by antibiotics, and 20% are potentially caused by environmental pollution [7]. When identifying pathogens circulating in different surgical departments, a predominance of staphylococci was found [8].

Until 2022, regular microbiological monitoring of the hospital environment was carried out in Ukraine as part of an ongoing risk assessment. The purpose of microbial monitoring of the patient's environment can be twofold: to monitor hygiene standards, namely how well a surface has been cleaned, and to investigate the presence of specific pathogens that may cause HAI outbreaks.

AIM

To investigate the role and prospects of microbial environmental monitoring in a healthcare facility, to evaluate strategies for controlling microbial contamination, to identify the species composition of microorganisms and factors that pose a threat to creating a safe environment in the facility.

MATERIALS AND METHODS

A retrospective analysis of the results of microbiological monitoring at a state security institution for the period 2020 – 2023 to assess the level of prevalence of microorganisms in different departments and the quality of cleaning and disinfection. The healthcare facility is designed for 200 inpatient beds and has an outpatient department, providing assistance to adults and children. The facility provides a full range of medical care, including primary, specialized, highly specialized, emergency, and urgent medical care.

The medical institution conducted environmental monitoring by sampling washouts from environmental objects. In total, for the period 2020 – 2023, 15,500 microbiological samples were analyzed. Samples were taken using an indirect method using tampons after cleaning hospital surfaces or medical equipment. The objects of the study were critical points that could be contaminated during the work process, in particular those places that medical personnel most often touched with their hands.

Samples were taken from surfaces that medical personnel most frequently touched with their hands. The samples were delivered to the laboratory, where each swab was placed in a liquid nutrient broth (MPB) and incubated at a temperature of $37 \pm 1^\circ\text{C}$ for 18 hours. After incubation, the broth was used for inoculation onto Petri dishes with a solid medium (blood agar) and incubated again at $37 \pm 1^\circ\text{C}$ for 48 hours. Following this, the number, appearance, size, and color of microbial colonies were evaluated. For further analysis, each type of colony was purified by subculturing on a new medium (PCA). Microorganism identification was performed using classical biochemical methods and API tests (Biomerieux, France). Sabouraud medium was used for fungal cultivation.

All stages of the study, including quality control of media, reagents, distilled water, equipment, sterilization, and laboratory conditions (temperature, humidity), were conducted by the requirements of the international standard DSTU EN ISO 15189:2015 "Medical laboratories. Requirements for quality and competence."

The statistical reliability of relative indicators was calculated using a formula that included the standard error calculation. The results were considered statistically reliable at $p < 0.05$.

RESULTS

Environmental objects in healthcare facilities can be transmission factors for HAIs, especially for facilities that provide inpatient medical care, as there is a possibility of infection of both patients and medical staff.

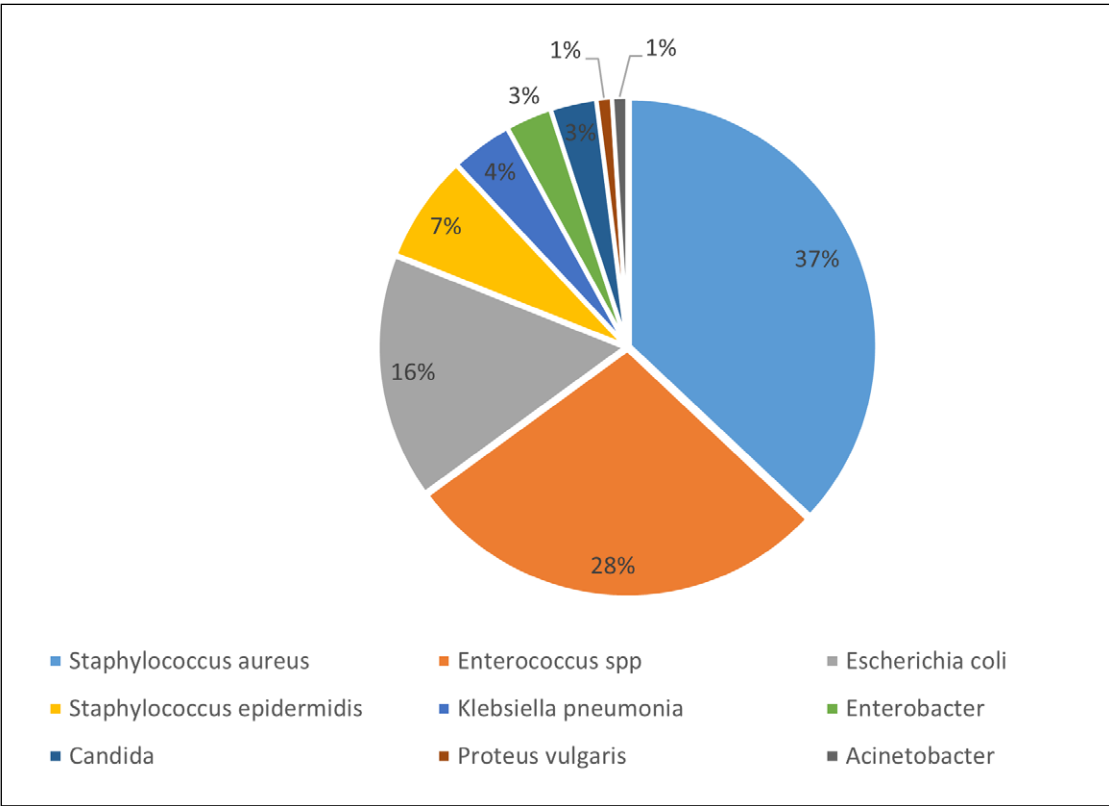


Fig. 1. Structure of identified pathogens in the hospital

The safety of the hospital environment is a critically important aspect that encompasses several areas to protect the health of patients, medical staff, and visitors. Proper cleaning and disinfection requires the removal of dirt and pathogens to minimize the risk of infection to patients in the hospital environment. An important component of effective cleaning in hospitals until 2022 was the microbiological monitoring of the effectiveness of the cleaning and disinfection methods used. Visual assessment is usually the recommended tool for monitoring cleaning effectiveness. Monitoring environmental cleaning using visual assessment is insufficient in practice. Microbiological monitoring of surfaces provided information for optimizing sampling scenarios, an algorithm for high-quality cleaning and disinfection of the most contaminated surfaces.

As a result of microbiological studies, positive results were found, namely opportunistic pathogens. It should be noted that no pathogenic pathogens were detected. In total, 162 positive results were detected during environmental studies during the observation period (2020–2023). The number of positive results in the environment in 2020 was $1.9 \pm 0.4\%$ of the total number of studies conducted, in 2021 – $1.0 \pm 0.3\%$, in 2022 – $0.8 \pm 0.2\%$ and in 2023 – $1.5 \pm 0.3\%$. In the structure of detected pathogens, the largest share is *Staphylococcus aureus* – $37 \pm 3.5\%$, in second place is *Enterococcus spp.*

– $28.4 \pm 3.2\%$, *Escherichia coli* – $16.1 \pm 2.8\%$, *Enterobacter* – $3.1 \pm 1.3\%$, *Klebsiella pneumonia* – $4.3 \pm 1.5\%$, *Proteus vulgaris* and *Acinetobacter* $0.6 \pm 0.2\%$ each, *Staphylococcus epidermidis* – $7.4 \pm 2.01\%$ and fungi *Candida* – $2.5 \pm 1.2\%$. (Fig. 1).

An analysis of positive results was conducted according to the profile of structural units, which were divided into 4 groups: surgical hospital with operating and intensive care units; children's hospital; maternity ward and outpatient department. In the structure of positive results, it was found that the most positive results were obtained in the surgical hospital – $43.2 \pm 3.8\%$, in the children's hospital – $15.4 \pm 2.7\%$, in the maternity ward – $12.9 \pm 1.6\%$ and in departments where outpatient reception is carried out – $28.4 \pm 3.3\%$ (Fig. 2)

An analysis of the species composition of pathogens was carried out according to different profiles of the departments (Table 1) and it was established: in the surgical hospital, *Staphylococcus aureus* prevails – $30 \pm 5.4\%$ and *Enterococcus spp.* – $24.3 \pm 5.1\%$; in the maternity hospital – *Enterococcus spp.* – $42.6 \pm 7.3\%$; in the children's hospital – *Staphylococcus aureus* – $52 \pm 9.7\%$ and in the departments where outpatient admission is carried out – *Staphylococcus aureus* – $45.7 \pm 7.3\%$.

Analysis of the annual dynamics of the detection of microorganisms in the hospital environment showed that the majority of positive results were detected in

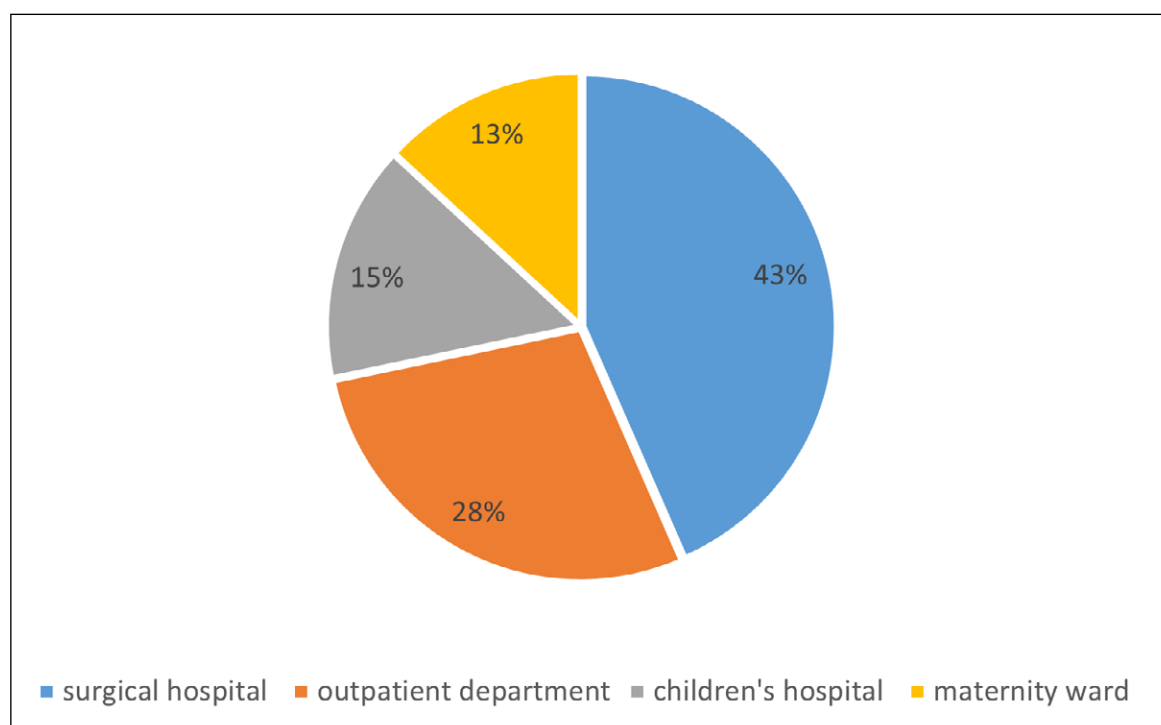


Fig. 2. Distribution of detected pathogens by structural units

Table 1. Distribution of microorganisms by hospital structural unit profiles (%)*

	surgical hospital n-70	maternity ward n-21	outpatient department n-46	children's hospital n-25
<i>St.epidermitis</i>	15.7±1.8	–	–	4.0±0.7
<i>E. coli</i>	15.7±1.8	23.9±5.1	10.9±1.5	20.0±3.8
<i>St. aureus</i>	30.0±3.5	23.9±5.1	45.7±6.6	52.0±10.3
<i>Enterobacter</i>	1.4±0.1	9.5±1.9	2.2±0.1	4.0±0.7
<i>Enterococcus spp.</i>	24.3±2.8	42.6±9.2	36.9±5.4	12.0±2.3
<i>Kl. pneumonia</i>	7.1±0.8	–	–	8.0±1.5
<i>Candida albicans</i>	2.9±0.3	–	4.3±0.5	–
<i>Acinetobacter</i>	1.4±0.1	–	–	–
<i>Proteus vulgaris</i>	1.4±0.1	–	–	–

* The results were considered statistically reliable at $p < 0.05$

the warm season. Namely, 41% of microorganisms were detected in June and 10% in July and October. It should be noted that in August the number of patients in the institution decreases.

The objects on which microorganisms were detected were conditionally divided into three groups: medical equipment located in treatment rooms and operating rooms (medical tables, medical cabinets, panmeds, bixes, examination chairs, refrigerators, etc.); medical equipment located in the wards where patients are (bedside tables, tripods, table, bedside table); medical clothing and hands of staff. Analysis of the results showed that the most positive results were found on medical equipment in treatment rooms – $61.8 \pm 3.8\%$, in the wards – $20.8 \pm 3.1\%$, on medical clothing and

hands of staff – $17.2 \pm 2.9\%$ ($7.9 \pm 2.1\%$ on clothing and $9.3 \pm 2.3\%$ on hands).

DISCUSSION

The study suggests that the hospital environment can potentially facilitate the transmission of pathogens HAIs. Although the proportion of detected microorganisms in environmental objects in the hospital for 2020–2023 is insignificant and amounted to 0.8% to 1.9%. In total, 162 isolated microorganisms were detected, which indicates the presence of potential risks. Analysis of the detected pathogens showed that the most *Staphylococcus aureus* – $37 \pm 3.5\%$, which coincides with the results of other studies, in which up

to *Staphylococcus* belonged to 40%. In second place, *Enterococcus spp* detected – $28.4 \pm 3.2\%$, which does not coincide with the literature data, where the share of this microorganism is 3% [9]. In third place is *Escherichia coli* – $16.1 \pm 2.8\%$. Also found were *Enterobacter*, *Klebsiella pneumonia*, *Proteus vulgaris*, *Acinetobacter*, *Staphylococcus epidermidis* and fungi *Candida*. According to literature data, these pathogens are present in the hospital environment [8, 9].

Regarding the distribution of microorganisms by profiles of hospital structural units: the largest number of microorganisms was detected in a surgical hospital with operating and intensive care units – $43.2 \pm 3.8\%$, in the maternity ward $12.9 \pm 1.6\%$ were isolated. The distribution of microbes by profiles established that *Staphylococcus aureus* prevailed in all structural units, except for the maternity ward, where the largest proportion was *Enterococcus spp*.

We observed a pronounced seasonality from June to October with a peak in June, which accounted for 41% of all microbes detected. This situation may lead to an increase in the number of HAI cases. According to other studies, during the summer months there is an increase in the average infection rate at 28% [10].

Regarding the objects on which microorganisms were detected, $61.8 \pm 3.8\%$ were in rooms where operations, dressings and other medical manipulations are performed, namely on medical tables (anesthesiologist's table, nurse's table) microorganisms were detected in $23.2 \pm 3.1\%$ among medical equipment objects. According to other studies, microorganisms were also found on medical equipment, including in 10% of cases on the medical table [11].

CONCLUSIONS

The study confirmed that the hospital environment can be a reservoir of pathogens associated with the provision of medical care. The largest number of pathogens was found in the surgical hospital, which emphasizes the need to strengthen control over the hospital environment objects in high-risk areas, especially during the period of seasonal increase in the activity

of microorganisms. Information was obtained on the species composition of microorganisms circulating in the department of various profiles, the identification of which revealed the predominance of *Staphylococcus*, which can cause infection of the surgical site.

Medical equipment contaminated with microorganisms can be transmission agents for HAIs.

Pathogens Healthcare-associated infections that occur in the hospital environment should be monitored in epidemiological surveillance programs. Infection control programs focus on epidemiological surveillance of microorganisms recognized as pathogenic, both on biotic and abiotic surfaces; however, infections can continue to evolve. Thus, understanding the species composition of microorganisms in the hospital environment can help identify variations that contribute to the development of infection, including predicting the risk of outbreaks. These efforts can be part of what, together with epidemiological surveillance, surface cleaning, disinfection and proper hand hygiene programs, and the implementation of antibiotic stewardship programs, will provide effective approaches to prevent healthcare-associated infections.

Strategies to control microbial contamination should include regular cleaning and disinfection of surfaces, training of healthcare staff in hygiene practices, especially hand hygiene, use of modern disinfectants, and implementation of monitoring systems to assess the effectiveness of the measures taken. This will minimize the risk of infection and create a safe environment for patients and staff.

The prospects for the implementation of microbial monitoring in Ukraine are related to national standards. Currently, microbiological monitoring is not mandatory, and samples from hospital facilities are usually taken only in the event of an outbreak of infections. Routine sampling is not provided for in medical institutions, since microbiological monitoring of surfaces is not enshrined in regulatory acts. Hospitals that decide to conduct such studies are guided by internal recommendations, which limits a systematic approach to infection control in the hospital environment.

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The study was conducted within the framework of a research project of the Bogomolets National Medical University “Studying the impact of the Russian-Ukrainian armed conflict and the COVID-19 pandemic on morbidity and mortality in the Ukrainian population” (2025-2027, No state registration 0125U001645).

CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Olena Zublenko

Bogomolets National Medical University
34 Prospect Beresteiskyi, 03680, Kyiv, Ukraine
e-mail: olena.zublenko@gmail.com

ORCID AND CONTRIBUTIONSHIP

Olena V. Zublenko: 0000-0003-4682-6484 [B](#) [C](#) [E](#)

Tetiana V. Petrushevych: 0000-0003-1256-2273 [A](#) [D](#) [F](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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Association of soluble vascular cell adhesion molecule -1 (sVCAM-1) with cardiovascular disease and glycemic control among type 2 diabetic patients

Iman Jabbar Kadhim¹, Suaad Muhammed Rasheed¹, Falah Abdulhasan Deli², Shaymaa Abdullateef Alfadhul¹

¹COMMUNITY MEDICINE, FACULTY OF MEDICINE, UNIVERSITY OF KUFA, KUFA, IRAQ

³INTERNAL MEDICINE, WARITH ALANBYAA COLLEGE OF MEDICINE, BAGHDAD, IRAQ

ABSTRACT

Aim: This study aimed to assess the Association of sVCAM-1 with type 2 diabetes mellitus and the impact of cardiovascular disease and glycemic control on its level.

Materials and Methods: This is a study of sVCAM-1 level in 57 patients with type 2 Diabetes mellitus in Al-Najaf/Iraq in comparison with normal control, the level of sVCAM-1 was analyzed also according to parameters of age, sex, smoking, body mass index (BMI), presence of systemic hypertension and cardiovascular diseases (ischemic heart disease and heart failure), Poor diabetic control (Hemoglobin A1C ≥ 7) and the mean of 2 days postprandial blood sugar

Results: All parameters except smoking were associated with higher levels of sVCAM-1, however the differences weren't significant statistically, there was no linear correlation between the mean 2 days post prandial blood sugar and sVCAM-1

Conclusions: sVCAM-1 is important to be assessed in diabetic patients and recommended to establish cutoff values of normality

KEY WORDS: Type 2 Diabetes mellitus; sVCAM-1; glycemic control; HbA1c

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INTRODUCTION

Diabetes mellitus is an important medical problem globally with significant morbidity and mortality impact that differs in severity between different communities, the adverse outcome related primarily to the state of control and consequently the acute and most importantly the chronic complications, situation is becoming more concerning as the number of affected individuals approaches half a billion [1]. Immune and inflammatory processes had been well elucidated in type 1 Diabetes mellitus, whereby several autoantibodies are incriminated to be the primary cause of islet cell destruction and consequently hyperglycemia due to insulin deficiency, but more notably is the rapidly emerging discovery of several inflammatory mediators that contribute to multi-organ damage, primarily affecting the vascular system, including both microvascular and macrovascular structures and these vascular changes are the important causes for morbidities as blindness, atherosclerotic cardiovascular diseases and renal involvement and mortality, these inflammatory processes are not restricted to type 1 diabetes mellitus but are

also well documented in type 2, and the problem is more serious as type 2 is more prevalent and it has a preclinical or premorbid state than can be prolonged for more than a decade, during this period where the diabetes is out of control, vascular changes can progress hence the patient may have end organ damage at time of diagnosis [1,2].

Animal studies in the twentieth century revealed clearly the association of different inflammatory markers and diabetes, hyperglycemia as well as obesity were found to increase the markers like tumor necrosis factor -alpha, human studies as well documented this association and several other markers are incorporated including different interleukins, cytokines, plasminogen activator inhibitor 1 and C reactive protein [3]. Important markers promoting vascular damage are the adhesion molecules including vascular cell adhesion molecule-1 (VCAM-1) and the selectins (P and L types) these are increased in expression by TNF- α , consequently this will increase the interaction between cells of endothelium and leucocytes [4].

sVCAM-1 belongs to immunoglobulin superfamily which includes also auto antibodies and receptors of T

lymphocytes, sVCAM-1 has an important role in pathogenesis and progression of atherosclerosis and found to be increasing in different autoimmune disorders like rheumatoid arthritis where it was presumed to be enrolled in increasing disease severity and cardiovascular complications [5].

sVCAM-1 expression was found to be increased in diabetic patient with different types of vasculopathy, microvascular occlusion by recruited and adhered leucocytes and platelet aggregate to capillary endothelium with the resultant increased capillary permeability ultimately leads to progression of diabetic retinopathy [6-8].

In other diabetic vasculopathy sVCAM-1 and selectins were also increased in expression and these includes diabetic nephropathy, diabetic neuropathy and diabetes mellitus in association with coronary heart disease and systemic hypertension [9-11].

AIM

This study aimed to assess the Association of sVCAM-1 with type 2 diabetes mellitus and the impact of cardiovascular disease and glycemic control on its level.

MATERIALS AND METHODS

STUDY DESIGN, SETTING, AND POPULATION

This is a case control study done at Alsadr teaching hospital / AL Najaf/ during the period from January till July 2024, 57 patients with type 2 diabetes mellitus who are on medical treatment for at least 3 years , and 47 age, sex and body mass index (BMI) matched non diabetic healthy persons were taken as a control group , all the included study population were initially assessed regarding age, sex, duration of the disease, the presence of documented and treated systemic hypertension and the history of cardiovascular disease including ischemic heart disease (IHD) and heart failure (HF), all patients were assessed by a physician and their previous medical reports were analyzed thoroughly

STUDY SIZE ASSESSMENT

The study size was assessed by the department of CME and scientific research of the Faculty of Medicine/ University of Kufa after analysis of the proposal of the study

Table 1. Serum sVCAM-1 mean level among type 2 diabetic patients and healthy controls

	Cases –control comparison		<i>P value</i>
	Patients n = 57	Healthy control n = 47	
sVACAM-1 (pg/ml)			
Mean± SD	6.75± 3.40	5.84± 1.22	0.086 †
Range	5.00 – 29.00	1.67-8.02	

Table 2. The mean serum levels of sVCAM-1 regarding sociodemographic and clinical characteristics of diabetic patients

Characteristics	N	Mean	SD	P
Age groups	< 50 years	7	6.32	0.729 a
	50-59 years	15	6.27	
	≥ 60 years	35	7.03	
Sex	Male	33	6.30	0.247 †
	Female	24	7.36	
Smoking	Positive	18	6.16	0.378†
	Negative	39	7.02	
Duration of disease	< 10 years	22	6.13	0.238†
	≥ 10 years	35	7.13	
BMI	None obese	29	6.17	0.197†
	Obese	28	7.34	

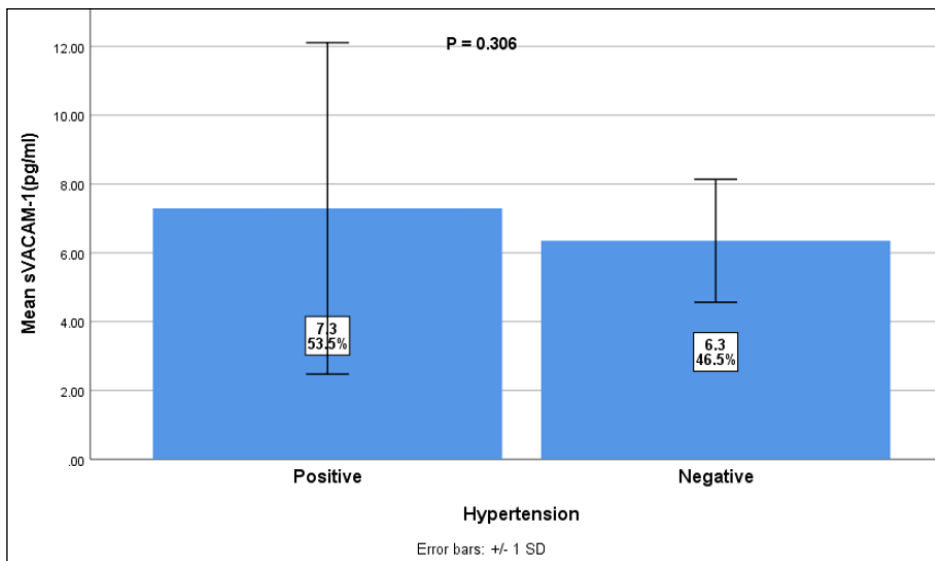


Fig. 1. Mean serum VACAM-1 level difference regarding hypertension among diabetic patients

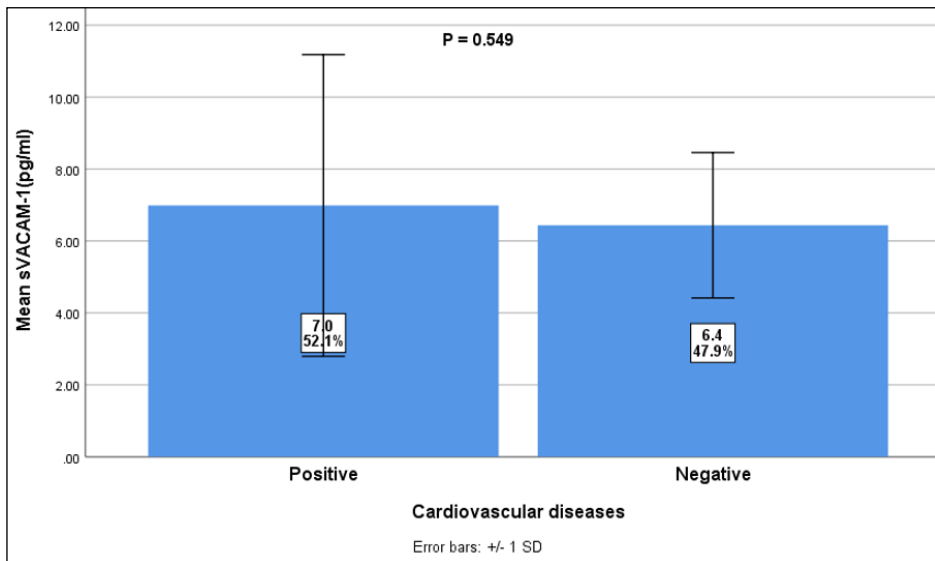


Fig. 2. Mean serum VACAM-1 level difference regarding cardiovascular diseases (ischemic heart disease and heart failure) among diabetic patients

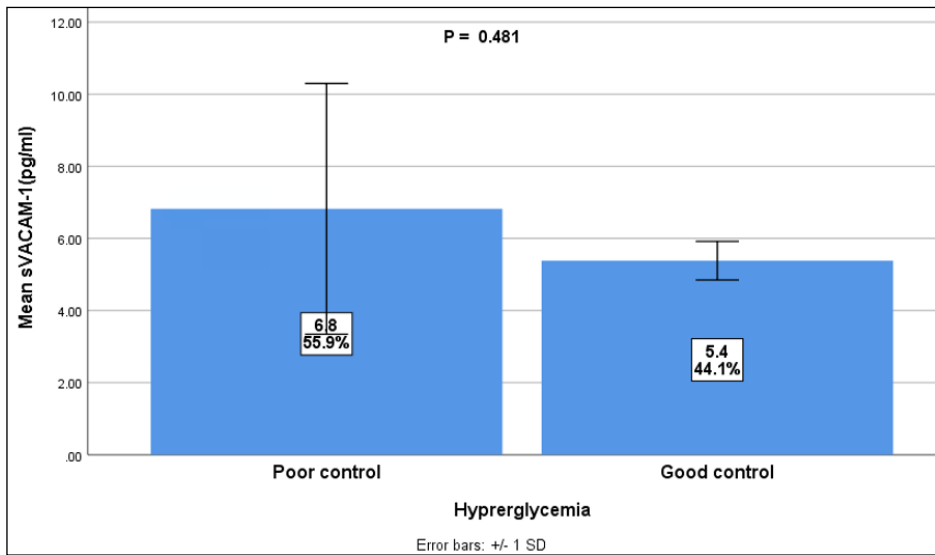


Fig. 3. Mean serum VACAM-1 level difference regarding glycemic control among diabetic patients

STUDY EXPOSURES

BMI was calculated using the application MD+CALC based on BMI=weight (kg)/square height (meter)

The following blood tests were done
1- Hemoglobin A1C for both groups, uncontrolled diabetes was defined as HbA1C ≥ 7% [1]

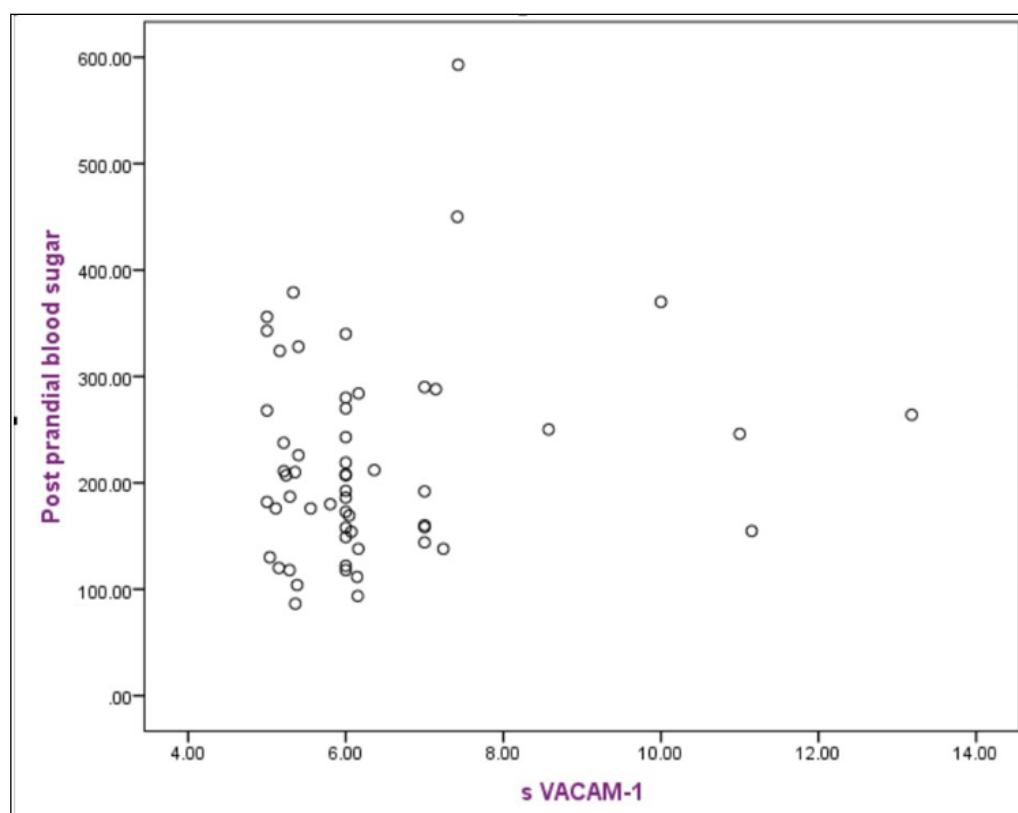


Fig. 4. Linear correlation between 2 days mean postprandial blood sugar and sVACAM-1

- 2- Two samples of blood sugar of 2 hours post usual breakfast for the patients' group and one fasting and one 2 hours post breakfast samples for the control group
- 3- Serum sVACAM-1 for each group was assessed by a single test for each participant applying kits of BT LAB (Bioassay Technology Laboratory)

STATISTICAL ANALYSIS

Statistical analysis was done utilizing SPSS of IBM version independent Student's t-test and Pearson's linear correlation were applied at appropriate places and P values were considered significant at level <0.05

ETHICAL CONSIDERATION

Ethical approval for the study was obtained from the Ethical Committee of the Faculty of Medicine, University of Kufa. Verbal consent was obtained from all participants.

RESULTS

In this study the mean sVACAM-1 was higher in diabetic patients (6.75 ± 3.40) compared to control group (5.84 ± 1.22), however, these differences were not statistically significant, (table 1).

Age above 60 years, Female sex, increased duration of the disease and obesity were associated with higher

S VACAM-1 among diabetic patients, the differences were not significant statistically as shown in table 2, nonsmokers had less s VACAM as compared to smokers in this study, also the difference was not significant (table 2).

According to Fig. 1, the presence of hypertension in diabetic patients was associated with a noticeable but non-significant increase in sVACAM-1. A similar trend was observed in diabetic patients with cardiovascular diseases (IHD or HF) (Fig. 2)).

Regarding diabetic control, patients with HbA1C $\geq 7\%$ had higher sVACAM-1 levels, but the difference was not statistically significant (Fig. 3). No linear correlation was found between the 2-day mean RBS and sVACAM-1 (Fig. 4)).

DISCUSSION

Diabetes mellitus, a common and rapidly growing medical problem, especially in developing countries, is a multisystem disease [13]. Long-term complications and survival are largely determined by glycemic control—tighter control leads to better outcomes in terms of morbidity and mortality. Long-standing inadequate control and prolonged hyperglycemia affect several homeostatic mechanisms, impacting multiple tissues, organs, and systems, primarily due to glycation end products [14].

Vascular endothelial dysfunction plays a crucial role in this process, as it is linked to accelerated atherosclerosis,

ultimately leading to atherosclerotic cardiovascular diseases, including systemic hypertension and ischemic heart disease. Endothelial injury is associated with increased release of various adhesion molecules, including sVCAM-1, as well as L- and P-selectins. These molecules contribute to the aggregation and adhesion of inflammatory cells such as lymphocytes, macrophages, neutrophils, and platelets to the vascular endothelium, thereby exacerbating damage.

Several researchers have documented increased levels of these adhesion molecules in diabetic patients and, moreover, a possible further increase with prolonged disease duration, worsening diabetic control, and the presence of complications. However, due to the novelty of these markers and the lack of clearly established cutoff values, studies are limited, and results remain conflicting.

Ousamha A. Saterr et al. found increased sVCAM-1 levels in diabetic patients compared to healthy controls, with a significant further increase in those with cardiovascular diseases. Their study focused on patients with type 1 diabetes mellitus, and, surprisingly, serum VACAM-1 levels were extremely high, which was not observed in our study [15].

In this study, female gender, disease duration of more than 10 years, and obesity were associated with higher sVCAM-1 levels. However, these differences were not statistically significant, possibly due to the previously mentioned issue of the lack of an established cutoff value, which affects statistical analysis. Smoking, on the other hand, increases the level of sVCAM-1 and which possibly reflects the atherosclerotic potential of smoking on vessels. Surprisingly no such finding had been reported in this study! [16,17].

Most researchers agree on the effect of concomitant hypertension and cardiovascular diseases on the level

of sVCAM-1 in diabetics, the same effect was found in this study, however, the differences were not significant statistically [18]. Despite the nonsignificant association between high HbA1C, a marker of inadequate diabetes control, and the level of sVCAM-1, the difference is worth considering, and this is consistent with most other studies. The rise in HbA1C reflects the state of diabetes control over an extended period of 2-3 months. An important observation in the current study is the acute loss of control, as shown by the mean RBS of two postprandial readings. This has no relation to an increase in sVCAM-1 levels. Therefore, it can be concluded that changes in this marker are related to subacute and chronic variations in diabetes control. We found no related studies on this issue in the literature review.

CONCLUSIONS

1. sVCAM-1 is important for assessment in diabetic patients with emphasis to assess the relation of control and cardiovascular issues on its levels.
2. A thorough workup is needed to better define the cutoff values of sVCAM-1 in different patients' population.

WHAT IS ALREADY KNOWN ON THIS TOPIC

sVCAM-1 is increased in diabetic patients.

sVCAM-1 levels are related to state of diabetic control.

WHAT THIS STUDY ADDS

sVCAM-1 is not related to smoking in diabetic patients. The need for standardization of sVCAM-1 cutoff levels.

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CORRESPONDING AUTHOR

Iman Jabbar Kadhim

University of Kufa

Imad Sukar, block 18 H 2, 3101, Najaf, Iraq

e-mail: iman.alghizzi@uokufa.edu.iq

ORCID AND CONTRIBUTIONSHIP

Iman Jabbar Kadhim: 0000-0002-4733-8485 [A](#) [B](#) [C](#) [D](#) [E](#) [F](#)

Suaad Muhammed Rasheed: 0000-0003-1654-9076 [A](#) [B](#) [C](#) [D](#)

Falah Abdulhasan Deli: 0000-0002-7605-4529 [A](#) [B](#) [E](#) [F](#)

Shaymaa Abdullateef Alfadhul: 0000-0002-8466-8344 [B](#) [C](#) [F](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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Method of conservative treatment of chronic venous insufficiency and post-thrombophlebitic syndrome of the lower extremities

Anatolii B. Zubakha, Serhii V. Malyk, Iryna O. Chorna, Oleksii V. Storozhenko, Mykola I. Kravtsiv, Tetiana A. Skotarenko, Roman A. Yaroshenko
POLTAVA STATE MEDICAL UNIVERSITY, POLTAVA, UKRAINE

ABSTRACT

Aim: To develop of a new complex of conservative techniques that eliminate clinical manifestations of chronic venous insufficiency, preserve the ability to work and improve the quality of life of patients, being the main method of preoperative preparation and postoperative rehabilitation in some patients.

Materials and Methods: The article describes clinical and practical recommendations for the diagnosis and treatment of patients with chronic venous insufficiency (CVI) and post-thrombophlebitic syndrome (PTS) of the lower extremities. The treatment of these pathologies should take into account the variability and combination of symptoms, comorbidities, as well as the patient's work activity and socioeconomic factors that may affect the modification of classical treatment regimens.

Results: The examination and treatment of patients with this pathology has been carried out at the surgical department of the Poltava Central District Clinical Hospital since 2019 year. On the basis of a complex ultrasound examination with the determination of reflux in the deep and superficial veins of the lower extremities and horizontal reflux in the perforating veins, patients were divided into two groups. The first group consisted of 28 (57.1%) patients with superficial and the second group of 16 (42.9%) patients with deep venous hypertension.

Conclusions: The main component of the conservative treatment of this pathology (CVI and PTS) is compression therapy, venotonics, medicines that improve microcirculation in the affected tissues, laser therapy, salves and gels were used locally, depending on the phase of the wound process, in case of trophic changes.

KEY WORDS: chronic venous insufficiency, post-thrombophlebitic syndrome, venotonics, laser therapy, regenerative degenerative index

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INTRODUCTION

Vein diseases are an extremely important medical and social problem. Epidemiological studies conducted at the initiative of the Association of Angiologists and Vascular Surgeons have shown a high prevalence of chronic lower extremity vein disease (CLVD) in Ukraine [1, 2]. CVI of the lower extremities is characterised by symptoms such as pain, heaviness in the legs, cramps, paresthesias, swelling of the extremities, and lower extremity fatigue syndrome. The cosmetic problems of CVI include telangiectasia, reticular varicose, edema and skin changes such as pigmentation, dermatitis and, ultimately, the formation of trophic ulcers [3, 4].

The incidence rate is dominated by women. In the United States, 23% of adults have varicose veins, of which 6% have severe signs of chronic vein disease, including skin lesions in the form of trophic ulcers [5, 6].

Varicose veins are a common manifestation of CVI, resulting from pathological stretching of the connective

tissue in the vein wall. Primary varicose dilatation with valve damage develops without preceding deep vein thrombosis (DVT), secondary varicose dilatation is a consequence of DVT and, rarely, thrombophlebitis [6, 7].

Recanalisation can give rise to relative obstruction and reflux in deep, superficial and perforating veins. Approximately 30% of patients with deep venous reflux develop valve failure [5, 8].

The incidence of post-thrombotic syndrome after DVT in 3-4 years is 35-70% and 50-95% in 5-10 years, depending on the extent and location of thrombosis and treatment [7, 9, 10].

The significant social and economic problem of CVI is caused by the number of patients, the high cost of research and treatment, and the consequences of the disease such as disability and reduced quality of life. The problem is exacerbated by the fact that CVI is a progressive disease with a strong tendency to relapse [8, 9, 10].

The proposed method of complex treatment of a certain pathology is based on clinical effectiveness and financial cost-effectiveness.

AIM

The development of a new complex of conservative techniques that eliminate clinical manifestations of CVI, preserve the ability to work and improve the quality of life of patients, being the main method of preoperative preparation and postoperative rehabilitation in some patients.

MATERIALS AND METHODS

The examination and treatment of patients with this pathology has been carried out at the surgical department of the Poltava Central District Clinical Hospital since 2019 year.

On the basis of a complex ultrasound examination with the determination of reflux in the deep and superficial veins of the lower extremities and horizontal reflux in the perforating veins, patients were divided into two groups. The first group consisted of 28 (57.1%) patients with superficial and the second group of 16 (42.9%) patients with deep venous hypertension.

In patients with deep venous hypertension, the size of trophic ulcers was greater (Table 1).

The actuality of CVI therapy is due to the following aspects:

- 1) most patients require only conservative treatment;
- 2) secondary prevention of relapse and complications of the disease secondary prevention of relapse and complications of the disease.

The treatment was based on the elimination of the following pathological factors:

- reduction in the volume of the venous bed
- elimination of pathological refluxes
- macro- and microcirculatory disorders
- leukocyte activation and inflammation
- correction of haemodynamic conditions
- disorders of lymphatic discharge
- local treatment of trophic ulcers

The main focus was also on compression treatment, regardless of the degree of venous insufficiency and its etiology. The results of the effectiveness of the proposed treatment were evaluated by the dynamics of local changes in the wound process and cytological studies of trophic ulcers according to the regenerative degenerative index (RDI) [1, 2].

$RDI = (\text{band neutrophils} + \text{segmented neutrophils}) / \text{degenerative neutrophils}$.

If the RDI is less than 1, the wound process is characterised by a significant inflammatory process, and vice

versa, if the RDI is greater than 1, the inflammatory process enters the phase of granulation tissue formation and scarring of trophic ulcers.

RESULTS

The programme of conservative treatment of decompensated CVI includes physiotherapy and sanatorium treatment, a gentle regime with the lower limbs necessarily elevated at the beginning of treatment. Local treatment depending on the phase of the injured area and trophic skin changes. Compression bandage, after nutrition – elastic knitwear.

The main tasks of conservative therapy in CVI and its complications.

The combination of a large number of methods of medical and functional treatment of the pathology under study is described in Table 2. It is very important to treat all symptoms of the disease with correct methods and to combine them correctly. To correct micro- and macro-circulatory disorders of rheology and lymphatic drainage, venotonics Detralex (LES LABORATOIRES SERVIER INDUSTRI, France, diosmin, hesperidin) and Escuzan (ESPARMA GMBH, Germany, Horse Chestnut Seeds Extract) were used. To increase the tonus and resistance of the vascular wall, venous bed and stimulate lymphatic drainage, Detralex (1000 mg) was prescribed once a day, as well as the Ukrainian drug Normoven. Trental (CHINOIN PHARMACEUTICAL AND CHEMICAL WORKS PRIVATE CO. LTD., Hungary, pentoxifylline) and Rheopolyglucine (YURIA-PHARM LLC, Ukraine, dextran) have also been used to improve blood circulation and improve the rheological properties of blood. Troxevazin (BALKANPHARMA-RAZGRAD JSC, Bulgaria, troxerutin) has been used for anti-inflammatory and antioxidant purposes (Table 2).

Local treatment of trophic changes should be performed taking into account complications. Types of complications and combinations of medications used in the study are shown in Table 3.

Miramistin (PRJSC «PHARMACEUTICAL FIRM «DARNITSA», Ukraine, miramistin), Cadefort spray powder (PAVIA FARMACEUTICI SRL, Italy, silicon dioxide in combination with silver ions and chlorhexidine), Tyrosur gel (ENGELHARD ARZNEIMITTEL GMBH & CO. KG., Germany, thyrotricin) are used for cleaning and regeneration and have a bacteriostatic or bactericidal effect. The use of antiallergic therapy in the form of Tavegil (TAKEDA AUSTRIA GMBH, Austria, clemastine fumarate) together with antifungal drugs Intracon (FARMAK JSC, Ukraine, intraconazole), Mycoseptin (ZENTIVA, Czech Republic, undecylenic acid) or Clotrimazole (DELPHARM POZNAN S.A., Poland, clotrimazole) is an important

Table 1. Sizes of trophic ulcers in patients with deep venous hypertension

Diameter of trophic ulcer (DTU), cm	first group (28 patients)	second group (16 patients)
2<DTU<5	22 (79%)	4 (25%)
5<DTU<10	4 (14%)	6 (37,5%)
DTU>10	2 (7%)	6 (37,5%)

Table 2. Objectives of therapy in CVI

Objectives	The main treatment measures
Exclusion of risk factors	Correction of lifestyle, nutrition, rational employment
Improvement of phlebohemodynamics	Therapeutic exercise, compression therapy
Normalisation of venous wall function	Pharmacotherapy, compression treatment
Correction of micro and macro circulatory disorders of rheology and lymphatic drainage	Venotonics (Detralex, Escuzan), Pharmacotherapy (Trental, Rheopolyglucin), Flavoids, Physiotherapy.
Reduction of inflammatory changes	Rutosides (Troxevasin). Local laser therapy.

Table 3. Local treatment of trophic ulcers

Trophic ulcer without complications	Complicated trophic ulcers	
	Allergic contact dermatitis	Microbial eczema
For cleansing and regeneration (Miramistin, Cadefort spray powder, Tyrosur gel)	Medications with antihistamines (Tavegil). Topical treatment - Methylene blue solution around the ulcer, Boric acid lotions around the ulcer. Topical glucocorticosteroids - Flucinar, Lorinden. Laser therapy.	Antihistamines. Antimycotic drugs - Intracon. Topical antimyotics: Mycoseptin, Clotrimazole. Laser therapy.
Compression therapy	Compression therapy	Compression therapy

combination in the treatment of complications of trophic ulcers (Table 3).

In patients with trophic ulcers on the background of CVI, local laser therapy was used with the MIT-1 apparatus using red laser irradiation of 0.65 μm and infrared laser irradiation of 0.8-0.86 μm.

Laser irradiation locally restores the permeability of nerve endings, activates blood circulation and metabolism in tissues.

All of this together makes it possible to prepare patients for surgical correction of pathological reflexes, but also forces them to change their lifestyle, using the permanent pharmacotherapy offered.

DISCUSSIONS

Some researchers in the treatment of chronic venous insufficiency and post-thrombophlebitic syndrome prefer conservative treatment. Intermittent pneumatic compression (IPC) and topical wound care is important in venous stasis ulcer management. Unna dressings (zinc oxide-impregnated bandages), compression dressings and occlusive dressings (e.g. hydrocolloids such as aluminium chloride) provide an environment for wound healing and promote new tissue growth; they can be used for ulcers with light to moderate exudation [11, 12]. But we should not forget about more radical methods of treatment such

as percutaneous transluminal venoplasty and ultrasound–accelerated thrombolysis. These methods led to successful recanalisation of chronic venous obstruction with improved post-thrombotic syndrome severity and quality of life, and the results were stable for 1 year after the procedure. It should be noted that the primary pathological effects were major bleeding episodes within 72 hours and symptomatic pulmonary embolism [6]. The study comparing endovenous laser ablation (EVLA) and n-butyl cyanoacrylate (NBCA) interventional techniques in terms of benefits, efficacy and patient satisfaction is quite interesting. The liquid embolic system based on n-butylcyanoacrylate is a modern and aggressive method used in the peripheral circulation for embolisation of vascular and lymphatic pathology, arterial pseudoaneurysms, endoleaks and vascular tumours. This method has unpredictable complications, including off-target embolisation, venous migration, microcatheter blockage and catheter retention. Therefore, before using it, it is necessary to compare the clinical effectiveness of its use with the possibility of developing severe pathological effects [4]. Functional treatments and physiological methods of investigation include kinesotaping and determination of ankle-brachial pressure index (ABPI), Duplex scan and tcPO2 measurements [8]. However, despite the large number of conservative and surgical methods of treating chronic venous insufficiency, we studied the combination

of conservative medical methods of treating the underlying and concomitant pathology, taking into account a specific laboratory indicator. RDI (regenerative-degenerative index) is a predictor of cytological changes in the wound process.

$RDI = (\text{band neutrophils} + \text{segmented neutrophils}) / \text{degenerative neutrophils}$.

If $RDI < 1$, then the wound process was characterized by significant inflammatory responses, and vice versa, if $RDI > 1$, the inflammatory process passed into the regeneration phase. Counting cells on wound impression preparations was performed by D.M. Steinberg (1948) [2].

CONCLUSIONS

1. The main component of conservative treatment of chronic venous insufficiency in the stage of decompensation, regardless of the form of venous hypertension, is compression therapy.
2. The complex of treatment methods used made it possible to significantly reduce the treatment time.
3. Venous trophic ulcers complicated by contact dermatitis and microbial eczema require special treatment with antihistamines, topical glucocorticoids and antimycotic drugs.

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CORRESPONDING AUTHOR

Tetiana A. Skotarenko

Poltava State Medical University

23 Shevchenko St, 36024, Poltava, Ukraine

e-mail: skotarenko.tatyana@gmail.com

ORCID AND CONTRIBUTIONSHIP

Anatolii B. Zubakha: 0000-0002-2528-6805 **D**

Serhii V. Malyk: 0000-0001-9453-4406 **A**

Iryna O. Chorna: 0000-0002-0371-8072 **B**

Oleksii V. Storozhenko: 0000-0003-4061-1650 **C**

Mykola I. Kravtsiv: 0000-0002-9602-4714 **E**

Tetiana A. Skotarenko: 0000-0002-3467-8990 **F**

Roman A. Yaroshenko: 0000-0002-5948-1916 **B**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Development and validation of a new diagnostic tool for identifying burnout syndrome

Oleg S. Chaban, Olena O. Khaustova, Vitaliy Yu. Omelyanovich

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To creation the first Ukrainian burnout syndrome diagnostic scale and confirm the quality of its psychometric characteristics.

Materials and Methods: The study was conducted using a newly developed questionnaire administered to 1,405 academic staff members of higher educational institutions in Ukraine. Test validation was carried out using exploratory factor analysis, Spearman's rank correlation coefficient, Ferguson's δ coefficient, Cronbach's α coefficient, Guttman's split-half coefficient, and the Spearman-Brown equivalent forms coefficient.

Results: The criterion validity was assessed through factor analysis, yielding 10 factors. Consequently, the initial version of the questionnaire was reduced by 10 items with the lowest factor loadings. The final version consists of 50 items with a dichotomous response scale. The discriminatory power of the questionnaire, evaluated using Ferguson's δ coefficient, was found to be extremely high (δ -Ferguson = 0.988). Consistency indices also demonstrated high reliability: α -Cronbach = 0.877; Guttman split-half = 0.848; Equal-length Spearman-Brown = 0.857. The concurrent reliability of the questionnaire was assessed using Spearman's correlation analysis, showing statistically significant positive correlations of most questionnaire items with the overall test score (≥ 0.419 ; $p \leq 3.29E-15$).

Conclusions: The obtained results confirm the feasibility of using the first Ukrainian "Questionnaire for Identifying Burnout Syndrome" (© Chaban O.S., 2025) in practical psychology, medicine, and burnout research.

KEY WORDS: burnout syndrome, questionnaire, diagnostic scale, test, psychometric properties, validation, medical psychology

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INTRODUCTION

Burnout has been included in the 11th Revision of the International Classification of Diseases (ICD-11) by the World Health Organization (WHO) [1], but not as a disease or medical condition; rather, it is classified as an occupational phenomenon under the section "Factors influencing health status or contact with health services." The ICD-11 provides the following definition: "Burnout is a syndrome conceptualized as resulting from chronic workplace stress that has not been successfully managed. It is characterized by three dimensions: feelings of energy depletion or exhaustion; increased mental distance from one's job, or feelings of negativism or cynicism related to one's job; and reduced professional efficacy."

Diagnostic criteria for burnout were first structured and described in 1974 by Herbert J. Freudenberger [2], who introduced the term into psychological discourse. However, the term "burnout" was first used five years earlier in a publication on penitentiary psychology by Harold B. Bradley, who applied it to describe the condition of juvenile detention facility guards [3]. Since

then, many standardized diagnostic scales have been developed to identify and measure burnout severity.

The first widely used burnout questionnaire was the "Maslach Burnout Inventory" (MBI) [4], developed in 1981 by Maslach C. & Jackson S.E. According to Maslach's concept, burnout comprises three components: emotional exhaustion, depersonalization, and reduced personal accomplishment. The Utrecht Work Engagement Scale (UWES), developed in 1999 by Schaufeli W. & Bakker A. [5], followed a similar three-component model but measured slightly different aspects: vigor, dedication, and absorption. Another notable scale is the Swedish Shirom-Melamed Burnout Measure (SMBM) by Shirom A. & Melamed S. (2006) [6], which prioritizes emotional exhaustion among its three subscales: physical fatigue, cognitive weariness, and emotional exhaustion. In 2021, Parker G. & Tavella G. introduced the "Sydney Burnout Measure (SBM)" [7], which encompasses exhaustion, cognitive impairment, loss of empathy, social withdrawal, and decreased productivity, alongside symptoms of anxiety, depression, and irritability.

Table 1. Distribution of the study group by gender and years of professional experience

Gender	Men	Women
Mode Age	47	44
Mode Years of Experience	15	20
Minimum Age	18	18
Maximum Age	85	80
Total Participants	352	1053

Additionally, alternative conceptual models of burnout have been proposed. For instance, in 1999, Demerouti E. & Bakker A.B. introduced the “Oldenburg Burnout Inventory” (OLBI) [8], based on a two-component job demands-resources model. The Copenhagen Burnout Inventory (CBI), developed in 2005 by Kristensen T.S., Borritz M., Villadsen E., & Christensen K.B. [9], was also built on a two-component framework, focusing on fatigue and exhaustion.

Currently, three major burnout diagnostic scales are used in Ukrainian-language publications: MBI (adapted by Vodopyanova N.E. & Starchenkova E.S.), Boyko V.V.’s test, and Ilyin Ye.P.’s questionnaire. However, a bibliographic search for validated Ukrainian burnout questionnaires found none, indicating that all tests used in Ukrainian medical and psychological practice, as well as in research, are either direct translations of Russian tests or Russian adaptations of English-language scales, with no independent validation on a Ukrainian sample.

This concerning fact underscores the need for the development of the first domestically designed burnout questionnaire, validated for use in the general Ukrainian population, with psychometric properties confirmed through rigorous statistical analysis.

AIM

The aim of this study was to creation of a new burnout syndrome diagnostic scale and confirmation of the acceptability of its psychometric characteristics.

MATERIALS AND METHODS

The study included 1,405 academic staff members from higher educational institutions in Ukraine, as educators are considered a high-risk group for burnout due to the nature of their profession [10]. The sample comprised 352 men (25.1%) and 1,053 women (74.9%) (Table 1).

A more detailed breakdown of the sample in terms of age, work experience, professional role, and marital status revealed no statistically significant differences between male and female respondents (Table 2). Fisher’s φ^* transformation calculations confirmed the homogeneity of the research group ($\varphi^* \leq 1.314343$; $p > 0.095$).

Test validation was carried out using exploratory factor analysis, Spearman’s rank correlation coefficient, Ferguson’s δ coefficient, Cronbach’s α coefficient, Guttman’s split-half coefficient, and the Spearman-Brown equivalent forms coefficient.

RESULTS

The initial version of questionnaire for identifying burnout syndrome (QIBS) consisted of 60 items with a dichotomous response scale (“yes”/“no”). The items were selected using a dimensional approach by compiling a pool of significant questions based on

Table 2. Descriptive statistics and Fisher’s φ transformation coefficient calculation for age, marital status, years of experience, and managerial positions in the study group

Characteristic	Men (n=352)	Women (n=1053)	φ
Age <30	31 (8.8%)	83 (10.0%)	0.194
Age 30-40	79 (22.4%)	240 (22.8%)	0.450
Age 40-50	105 (29.8%)	428 (36.6%)	1.314
Age 50-60	73 (20.7%)	201 (20.0%)	0.372
Age >60	64 (18.2%)	101 (10.9%)	1.298
Experience <10 years	70 (19.9%)	181 (17.2%)	0.493
Experience 10-20 years	104 (29.5%)	259 (24.6%)	0.960
Experience 20-30 years	77 (21.9%)	383 (36.4%)	2.573
Experience >30 years	101 (28.7%)	230 (21.8%)	1.323
Managerial position	91 (25.9%)	205 (19.5%)	1.213
Faculty position	261 (74.1%)	848 (80.5%)	1.159
Married	238 (67.6%)	689 (65.4%)	0.614
Single	95 (27.0%)	222 (21.1%)	1.129
Divorced	17 (4.8%)	104 (9.9%)	0.750
Widowed	2 (0.6%)	38 (3.6%)	0.319

Table 3. Results of Exploratory Factor Analysis (Rotated Component Matrix after Varimax Rotation with Kaiser Normalization)

Item	Component												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1	-0,59	-0,25	-0,14	-0,14	-0,1	0,057	0,095	-0,03	-0,2	0,002	-0,15	0,22	0,089
2	0,465	0,303	0,325	0,113	0,251	0,016	-0,07	0,077	0,007	0,046	0,224	0,039	-0,11
3	0,162	0,155	0,445	0,171	0,432	0,036	-0,08	0,007	0,071	0,214	-0,02	-0,1	0,087
4	0,095	0,079	0,372	-0,03	0,048	0,082	0,187	0,174	-0,06	0,379	0,277	0,008	-0,13
5	-0,29	-0,64	-0,08	-0,05	-0,07	-0,01	0,078	-0,05	-0,04	-0,09	-0,19	0,137	0,135
6	0,231	0,372	0,222	0,252	0,189	-0,01	0,213	0,094	-0,18	-0,04	0,091	0,14	-0,2
7	0,679	0,207	0,146	0,133	0,154	0,003	0,01	0,043	0,039	0,012	-0,01	0,077	-0,01
8	0,08	0,122	0,064	0,082	0,107	0,168	0,172	0,008	0,037	0,624	0,095	0,081	0,049
9	0,108	0,415	0,32	-0,02	0,093	0,066	0,019	0,226	0,192	0,099	0,159	0,044	-0,24
10	-0,14	-0,04	-0,03	-0,13	-0,06	0,018	-0,01	0,116	-0,7	-0,01	-0,01	-0,01	0,086
11	0,21	0,247	0,24	0,043	0,113	0,031	0,073	0,098	0,609	0,036	0,053	0,071	-0,03
12	0,41	0,152	0,123	0,181	0,57	0,031	0,136	0,087	0,003	0,111	-0,01	-0,03	-0,1
13	0,057	0,045	0,583	0,076	0,281	0,11	0,028	0,069	0,017	0,072	0,026	-0,08	0,091
14	0,107	0,095	3E-04	0,093	0,693	0,041	0,179	0,095	0,046	0,022	-0,05	-0,03	-0,07
15	0,196	0,08	0,264	0,226	0,329	0,028	0,339	-0,07	0,01	0,309	-0,05	-0,13	-0,06
16	0,626	0,259	0,184	0,239	0,265	-0,01	0,027	0,041	0,027	0,06	-0,04	-0,02	-0,02
17	0,294	0,117	0,501	0,232	0,286	0,09	0,014	-0,04	0,015	0,233	0,049	-0,08	-0,01
18	0,008	0,149	0,225	0,134	0,538	0,144	-0,03	0,087	0,045	0,148	0,191	-0,01	5E-04
19	0,069	0,731	0,067	0,042	0,132	0,034	0,119	0,002	0,078	0,001	-0,09	0,013	0,073
20	0,072	0,141	0,799	-0,01	0,008	0,007	0,085	0,037	0,04	0,002	0,035	0,068	-0,02
21	0,037	0,048	0,751	0,096	-0,05	0,081	0,035	-0,02	0,065	-0,09	0,046	0,073	-0,07
22	0,307	0,149	0,172	0,242	0,212	-0,02	0,411	0,072	-0,12	0,149	0,148	0,049	-0,2
23	-0,04	-0,03	-0,02	-0,17	-0,07	0,031	0,09	-0,13	0,047	0,131	-0,11	0,692	0,015
24	0,021	0,059	0,133	0,205	0,101	0,62	0,023	-0,11	0,029	0,069	-0,11	0,126	0,125
25	-0,09	0,098	0,204	0,361	0,139	0,294	0,103	0,037	0,133	-0,09	0,366	0,058	0,102
26	0,023	-0,04	0,015	-0,03	-0,03	0,028	0,002	0,032	-0,1	0,037	0,098	0,027	0,762
27	0,104	0,015	0,145	0,562	0,199	0,021	0,241	0,127	0,075	0,041	0,097	-0,03	-0,02
28	0,051	0,245	0,254	0,424	0,122	0,26	0,035	0,069	0,047	-0,11	0,199	0,065	0,123
29	0,185	0,137	0,128	0,135	0,639	0,071	0,261	0,12	0,099	-0,13	0,015	-0,05	0,007
30	0,099	0,126	0,037	0,293	0,443	0,283	-0,01	-0,11	0,112	0,096	0,03	0,1	0,138
31	0,259	0,328	0,181	0,13	0,149	0,044	0,34	0,135	-0,05	-0,09	0,104	0,111	-0,07
32	0,157	0,153	0,022	0,568	0,075	0,075	0,173	0,179	0,068	0,233	-0,12	-0,01	-0,07
33	0,055	0,03	0,126	0,237	0,18	0,027	0,518	-0,12	0,006	0,251	0,075	0,05	-0,01
34	0,061	0,136	-0,01	0,097	0,106	0,114	0,547	0,099	0,074	0,047	-0,03	-0,11	0,024
35	0,171	0,064	0,564	0,303	0,147	0,132	0,116	0,03	0,096	0,021	-0,04	-0,19	0,064
36	0,274	0,29	0,13	0,495	0,204	0,152	0,042	-0,03	-0,05	0,052	0,08	0,033	-0,06
37	0,166	0,597	0,039	0,308	0,09	0,113	0,096	-0,01	0,029	0,045	0,189	0,012	-0,05
38	0,195	0,072	0,128	0,544	0,194	0,016	0,072	0,158	0,125	0,056	-0,16	-0,22	-0,04
39	-0,01	0,026	0,083	0,046	0,105	0,763	-0,02	-0,02	-0,11	-0,02	-0,06	0,073	0,066
40	0,016	0,086	0,053	-0,01	0,014	0,685	0,112	0,071	0,02	0,02	-0,1	0,006	-0,01
41	-0,04	-0,04	0,018	0,029	0,035	0,669	0,01	0,083	0,052	0,061	0,076	-0,08	-0,14
42	0,007	0,029	-0,01	0,29	0,08	0,142	-0,23	0,199	0,04	-0,11	0,129	0,529	0,016
43	0,085	0,196	0,104	0,313	0,201	0,238	0,306	0,089	-0,01	-0,03	0,271	0,101	0,074

Table 3. Cont.)

Item	Component												
	1	2	3	4	5	6	7	8	9	10	11	12	13
44	-0,31	-0,24	-0,14	-0,21	-0,22	0,091	-0,11	0,102	-0,04	-0,12	-0,17	0,312	0,003
45	-0,28	-0,05	-0,02	0,053	-0,15	0,131	-0,17	-0,12	0,032	0,151	-0,31	0,076	-0,17
46	0,272	0,362	0,205	0,38	0,121	0,015	-0,03	0,028	0,063	0,115	-0,06	-0,05	0,015
47	0,132	0,48	-0,01	0,347	6E-04	0,05	0,266	0,134	-0	0,051	0,105	0,017	-0,05
48	0,257	0,309	0,14	0,256	0,18	0,173	0,186	0,336	-0,04	0,007	0,228	0,033	-0,18
49	0,139	0,175	0,045	0,033	0,067	0,078	0,005	0,611	-0,15	0,005	-0	-0,05	0,039
50	0,134	0,517	0,116	0,181	0,224	0,067	0,223	0,034	-0,02	0,03	-0,17	-0,04	0,087
51	0,207	0,543	0,152	-0,08	0,098	0,028	-0,04	0,231	0,284	0,103	0,095	-0,07	0,026
52	0,065	0,031	0,059	0,278	0,123	3E-04	0,132	0,56	0,095	0,056	0,034	0,019	-0,01
53	0,416	0,271	0,282	0,263	0,137	0,021	0,008	0,083	0,247	0,029	-0,04	-0,03	0,054
54	0,035	0,391	-0	3E-04	0,028	-0,18	0,301	0,232	0,139	0,046	-0,25	0,097	0,225
55	0,212	0,15	0,094	0,042	0,04	-0,03	0,418	0,184	-0,03	0,01	0,031	0,048	0,078
56	-0,49	-0,16	0,138	-0,11	-0,13	0,052	-0,05	-0,05	-0,27	-0,16	-0,21	0,167	-0,22
57	0,076	0,073	-0,08	0,237	0,03	-0,25	-0	0,398	0,126	0,472	-0,15	-0,05	0,103
58	-0,11	-0,06	-0,05	0,01	0,035	0,246	0,007	0,037	-0,06	-0,13	-0,56	0,063	-0,07
59	-0,38	-0,03	-0,05	0,004	-0,26	-0,08	-0,27	-0,09	-0,14	0,24	-0,08	0,242	-0,01
60	-0,67	-0	0,013	-0,04	0,046	-0,02	-0,21	-0,07	-0,12	-0,1	0,014	-0,02	-0,02

clinical interviews with patients reporting emotional, cognitive-mnemonic, and volitional problems, as well as behavioral and eating disorders linked to work-related stressors. Additionally, the items from prototype burnout assessment tools, including the Maslach Burnout Inventory, SVF-120, the Personal Resources Loss and Gain Questionnaire, Q-LS-Q, the Chaban Life Quality Assessment, and the Copenhagen Burnout Inventory, were involved.

The questionnaire includes completion instructions and explains the assessment purpose. Responses were scored dimensionally to reflect burnout severity.

“Yes” responses:

- 0 points: items 5, 10, 23, 44, 45, 56, 59, 60
- 5 points: item 2
- 3 points: items 28, 31
- 2 points: items 3, 6, 7
- 1 point: all others

“No” responses:

- 5 points: items 59, 60
- 3 points: items 5, 10
- 2 points: items 44, 45
- 1 point: items 23, 56
- 0 points: all others

The total score, ranging from 0 to 87, quantifies burnout severity. The final item (post-60) provides additional insights for mental health professionals but is not included in psychometric calculations.

To evaluate the questionnaire’s ability to measure the theoretically identified burnout symptoms, its *construct validity* was assessed through exploratory factor analysis. Factor loadings of 0.3 or higher were considered sufficient, provided that other loadings tended toward zero (Table 3).

Factor analysis identified 13 factors; however, some contained too few items or lacked conceptual coherence. Following factor load analysis, 10 questions with the lowest weight were removed, leaving a 50-item questionnaire. Consequently, three factors (8, 12, and 13) were removed due to low item loading and inconsistent thematic structure. The final model retained 10 factors relevant to burnout:

1. **Professional Dissatisfaction**
2. **Emotional-Volitional Reactions**
3. **Fatigue and Lack of Time**
4. **Depersonalization and Derealization**
5. **Astheno-Depressive Symptoms**
6. **Anxiety Symptoms**
7. **Need for Solitude**
8. **Dissatisfaction with Financial Compensation**
9. **Desire for Increased Rest Time**
10. **Positive Moral Attitudes Toward Work Commitment**

Thus, the questionnaire, after calculating the criterion validity and making appropriate changes, consists of 50 questions) with a dichotomous response scale (“yes” / “no”) (Table 4)

Table 4. QUESTIONNAIRE FOR DETECTION OF BURNOUT SYNDROME (© Chaban O.S., 2025), (English Version*)

Nº	Statement	Yes	No
1	I am completely satisfied with my job.		
2	My job has clearly worsened my mental and physical health.		
3	The psychological atmosphere at work fully suits me.		
4	I feel that my work makes me more harsh, emotionally numb, and overly categorical.		
5	I feel a certain disappointment in my profession.		
6	The best time for me is Friday afternoon, anticipating rest from everyone and everything.		
7	I think I am overloaded at work more than others; I feel this is unfair.		
8	I am fully satisfied with my salary.		
9	My efforts at work are not adequately or fairly compensated (pay, days off, flexible schedule, etc.).		
10	My hobbies and interests have significantly decreased because I don't have time for them.		
11	My hobbies and interests have significantly decreased because I've lost interest in them.		
12	I often want to be alone and take a break from everyone.		
13	I feel I am losing enjoyment in my work.		
14	I often feel "like a squeezed lemon" or "a drained battery" after work.		
15	My sleep is disturbed (difficulty falling asleep, fragmented sleep, early waking, no rest).		
16	Communication at work has become more formal; warmth and trust have disappeared.		
17	I think I work too much.		
18	My family and friends think I work too much.		
19	Working with people increasingly exhausts me; I want solitude or to live in the countryside.		
20	I worry a lot when something doesn't work out at work.		
21	Sometimes I "zone out" at work, thinking about nothing, as if in a stupor.		
22	After work, I keep thinking about work, replaying conversations with colleagues/bosses.		
23	I lose pleasure in everyday life (food, rest, sex, fun, friends).		
24	I've become more anxious and worried about everything.		
25	I feel my job dulls my emotions; I've become dry, emotionally flat, and stopped joking.		
26	My work efficiency depends on my mood.		
27	After coming home, I need time alone without communicating with anyone.		
28	I feel most understood only by my pets (dog, cat).		
29	I constantly feel like there's not enough time for anything, including home duties.		
30	Ordinary situations at work cause me excessive emotions and irritation.		
31	My mood worsens when I think of certain colleagues or managers.		
32	Lately I procrastinate and put off work tasks without any real reason.		
33	I worry a lot about my job.		
34	I fear losing my job and therefore work during off-hours, weekends, and vacations.		
35	I'm afraid of letting colleagues down, so I often help or cover for them.		
36	I start to feel anxious (heartbeat, shortness of breath, nausea) thinking about work.		
37	I feel happy when I see the real results of my work.		
38	I feel that something is wrong at work, but I don't understand what.		
39	I meet people at work who exhaust or irritate me so much that I even silently wish them harm.		
40	I've lost inner peace because of work and started swearing more, especially while driving.		
41	I used to be more open, attentive, and friendly with coworkers.		
42	I'm sure that management doesn't care about people or their health.		
43	Sometimes I feel that my work results are not worth the effort I put in.		
44	I don't care much about coworkers' requests or emotional state – everyone's on their own.		
45	I'm disappointed in working with people and would gladly change to a job with less contact.		

Table 4. Cont.

Nº	Statement	Yes	No
46	I clearly see career prospects at my job and constantly learn and grow.		
47	If there's a chance to slack off or cut time on work, I do so without guilt.		
48	I admire people who fully dedicate themselves to their profession and gain recognition.		
49	Overall, I am a happy person.		
50	If I could go back in time, I would choose my profession again.		

* The questionnaire is an English translation of the original Ukrainian test, included in the publication solely for the purpose of familiarization with its structure and content. The English version of the test cannot be used for diagnostic purposes, since validation was carried out only for its Ukrainian version

Table 5. Keys of the Questionnaire for Identifying Burnout Syndrome (© Chaban O.S., 2025)

Item	Points for "YES"	Points for "NO"	Item	Points for "YES"	Points for "NO"
1	0	3	26	1	0
2	5	0	27	1	0
3	0	3	28	1	0
4	2	0	29	1	0
5	2	0	30	1	0
6	1	0	31	1	0
7	1	0	32	1	0
8	0	3	33	1	0
9	1	0	34	1	0
10	1	0	35	1	0
11	1	0	36	1	0
12	1	0	37	0	2
13	1	0	38	1	0
14	1	0	39	1	0
15	1	0	40	1	0
16	1	0	41	1	0
17	1	0	42	1	0
18	1	0	43	1	0
19	1	0	44	1	0
20	1	0	45	1	0
21	1	0	46	0	1
22	3	0	47	1	0
23	1	0	48	1	0
24	1	0	49	0	5
25	3	0	50	0	5

KEYS AND INTERPRETATION OF THE RESULTS OF THE QUESTIONNAIRE FOR IDENTIFYING BURNOUT SYNDROME (© CHABAN O.S., 2025)

The evaluation follows a dimensional approach, considering the weight and significance of individual self-assessments (responses) in the development and/or manifestation of burnout syndrome. The final result is determined by calculating the total sum of points scored (Table 5).

INTERPRETATION OF THE QUESTIONNAIRE RESULTS

- **0 – 5 points** – No signs of burnout detected. Maintain your current professional strategy, work-life balance, and rest regimen.
- **6 – 21 points** – Low risk, but there is a possibility of developing burnout syndrome. Self-reflection and monitoring for early signs are recommended. Pay attention to psychological hygiene and the

mental ecology of your professional activities. Enhance your knowledge of burnout, its causes, and consequences.

- **22 – 59 points** – Moderate probability of developing burnout syndrome. A consultation with a mental health professional is advisable, such as a family doctor, internist, psychologist, clinical or medical psychologist with expertise in mental health and burnout syndrome. It is recommended to take a responsible approach to your work environment, rest, and burnout prevention strategies.
- **60 – 75 points** – High likelihood of developing burnout syndrome. Consultation (additional assessment) with a mental health specialist, preferably one with expertise in medical psychology, psychotherapy, and/or psychiatry, is necessary. Attention to your health and workplace relationships is strongly advised, as there is a high risk of developing psychosomatic disorders.

DISCUSSION

The discriminativeness of the questionnaire was determined by calculating the coefficient δ – L. Ferguson. As a result of the analysis, it was found that the discriminativeness of the questionnaire is very high (δ -Ferguson=0.988), which indicates the high ability of the test to distribute respondents according to the level of emotional burnout. The reliability of the questionnaire was determined by calculating its consistency and synchronous reliability. The indicators that assess the consistency of the questionnaire during statistical analysis turned out to be very high: α -Cronbach = 0.877; Guttman split-half = 0.848; Equal-length Spearman – Brown = 0.857. This indicates high reliability and internal consistency of the method. The only exceptions were questions 33 ($r = 0.244925$; $p = 4.86E-08$), 35 and 48 ($r = 0.21011$; $p = 3.53E-05$), which, with an extremely high level of statistical significance, had a low level of positive correlation with the final score of the questionnaire. Thus, the synchronous reliability of the questionnaire can be considered acceptable.

During the development of the questionnaire, the assessment of the competitive validity of the test in comparison with similar English-language tests that were adapted for use in Ukraine and have acceptable psychometric characteristics was not carried out due to the lack of adapted derivative tests, and the questionnaire presented by the authors is the first Ukrainian scale for diagnosing burnout.

In terms of content, the questions of the developed test contain symptoms of emotional burnout, according to the concept of K. Maslach, S. Jackson [4]. Comparison of the psychometric characteristics of the questionnaire with the corresponding characteristics of burnout tests developed in the USA (MBI, Maslach C. & Jackson S.E.; UWES, Schaufeli W. & Bakker A.) [4, 5], Sweden (SMBM, Shirom A. & Melamed S.) [6], Australia (SBM, Parker G. & Tavella G.) [7], the Netherlands (OLBI, Demerouti E & Bakker AB) [8], Denmark [9] and Russian-language tests (MDUPV, Boyko V.V.) [12] indicate that the indicators of our new questionnaire are not inferior to similar tests developed in other languages and in other socio-cultural regions.

CONCLUSIONS

Thus, after calculating the criterion validity and implementing the necessary modifications, the final version of the questionnaire consists of 50 items with a dichotomous response scale. Validation of the developed questionnaire confirmed its strong psychometric properties. It demonstrates a high capacity to differentiate respondents based on the severity of burnout, as evidenced by its strong discriminatory power. Additionally, the high internal consistency of the questionnaire was confirmed by an exceptionally high level of reliability. Furthermore, the questionnaire exhibits an acceptable level of concurrent reliability.

All of the above indicates the feasibility of using the first Ukrainian “Questionnaire for Identifying Burnout Syndrome” (© Chaban O.S., 2025) in practical psychology, medicine, and burnout research.

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CONFLICT OF INTEREST

The Authors declare no conflict of interests

CORRESPONDING AUTHOR

Oleg S. Chaban

Bogomolets National Medical University
13 Shevchenko Boulevard, 01601 Kyiv, Ukraine
e-mail: ocs@ukr.net

ORCID AND CONTRIBUTIONSHIP

Oleg S. Chaban: 0000-0001-9702-7629    

Olena O. Khaustova: 0000-0002-8262-5252    

Vitaliy Yu. Omelyanovich: 0000-0001-8587-1312    

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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The role of a family doctor in the formation of a healthy lifestyle of young people in Ukraine

Olena S. Shcherbinska, Nadiia Ya. Zhyllka, Nataliia O. Serohina, Oksana V. Zhdanova

SHUPYK NATIONAL HEALTHCARE UNIVERSITY OF UKRAINE, KYIV, UKRAINE

ABSTRACT

Aim: Highlighting the main problems of forming a healthy lifestyle among the youth of Ukraine and determining the role of the family doctor in solving them.

Materials and Methods: The study used bibliosemantic, statistical, analytical methods and descriptive modeling. Data processing was performed using the Microsoft® Excel® software package (trial version); statistical processing of results was performed using the statistical analysis software package Statsoft® Statistica® ver. 10 (STA999K347156-W) and IBM® SPSS 25.0 (trial version).

Results: According to the results of the study, numerous health problems associated with an unhealthy lifestyle are observed in Ukraine: physical inactivity, bad habits (use of alcoholic beverages and psychoactive substances, smoking), excessive communication on social networks, lack of safe sexual behavior skills. To increase the level of awareness of young people about a healthy lifestyle, we modeled the administration of services for the formation of a healthy lifestyle in the field of primary health care by a family doctor.

Conclusions: One of the main links in the formation of a healthy lifestyle is the professional approach of this family doctor in the framework of performing his direct functions of eliminating habits and behavior that pose a risk to health and forming healthy lifestyle skills. Public administration should ensure the effectiveness of the family doctor in providing services for the formation of a healthy lifestyle through the process of collective adoption and implementation of strategic decisions.

KEY WORDS: youth, health, public administration, legislation

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INTRODUCTION

In Ukraine, according to the Law of Ukraine "On the Basic Principles of Youth Policy (clause 17 of Article 1, section I), "youth – young people are persons aged 14 to 35 who are citizens of Ukraine, foreigners and stateless persons who are legally in Ukraine" [1]. The domestic age graduation is somewhat different from the World Health organization (WHO) definition from 2015, where a person aged 25 to 44 is considered young [2]. To determine the tasks for a family doctor regarding the formation of a healthy lifestyle for Ukrainian youth, it is necessary to take into account the main trends and problems of the health status of young people in Ukraine [3].

AIM

Highlighting the main problems of forming a healthy lifestyle among the youth of Ukraine and determining the role of the family doctor in solving them.

MATERIALS AND METHODS

The study used bibliosemantic, statistical, analytical methods and descriptive modeling. Data processing was performed using the Microsoft® Excel® software package (trial version); statistical processing of results was performed using the statistical analysis software package Statsoft® Statistica® ver. 10 (STA999K347156-W) and IBM® SPSS 25.0 (trial version).

RESULTS

According to a study conducted in 2019 within the framework of the international project "Health and Behavioral Orientations of Student Youth" (WHO), the main rating indicators of youth health. As at the global level, violence and injuries are rating problems for youth health. In Ukraine, unfortunately, aggressive behavior in the adolescent environment manifests itself both in the form of physical violence and in the form of moral

pressure (insults, ridicule, obscene statements). 37.9% of adolescents became victims [3].

Regarding mental health, a significant number (74.5%) of adolescents complain of frequent cases of nervousness or irritability (78.4%), and their frequency progressively increases with age, especially among girls [3]. Adolescent substance use poses a serious challenge to the youth health care system. In Ukraine, the availability of a wide range of psychoactive substances, as well as the lack of awareness among adolescents of the risks associated with the use of these substances, is an extreme problem. While narcotic substances are formally prohibited, alcohol and tobacco remain available, despite restrictions on their advertising and sale to minors. According to the study, alcohol and tobacco consumption is firmly rooted in the cultural practices of the population, especially in the absence of alternatives in the field of leisure and is perceived by young people as quite acceptable. On average, 39.4% of adolescents and 42.8% of 17-year-old young people have consumed alcoholic beverages at least once in their lives. 20.1% of adolescents (24% of boys and 16% of girls) have smoked, and the prevalence of smoking increases with age (from 4.3% of 10-year-olds to 38.8% of 17-year-olds) [3].

A necessary component of a healthy lifestyle with proven effectiveness is physical activity. As the study showed, the required daily rate of physical activity of children and adolescents is not fulfilled in physical education classes [3,4]. Only 23.7% of adolescents are engaged in physical activity for at least an hour a day every day, and the younger the teenager, the higher his level of physical activity – from 30% among 10-11-year-olds to 17% among 16-17-year-olds [3,4]. Low levels of physical activity in childhood, lack of stimulation of the need for daily systematic physical activity and motor exercises, as well as negligence in children's physical education lead to the fact that they enter adulthood with an already formed reluctance to engage in physical exercise and sports. Regression of physical performance, overweight and obesity, musculoskeletal disorders, manifestations of disorders in the shoulder and spinal girdles, characteristic of a sedentary lifestyle lead to long-term diseases. To maintain an adequate level of health and prevent diseases, the WHO recommends 60 minutes of daily physical activity for children and adolescents. The current challenge for the lifestyle of adolescents and young people is a sedentary lifestyle associated with watching television and using various electronic gadgets to watch videos and spend time on social networks – free time up to 3–4–5 and even more than 6 hours a day, more than 6–7 hours a day is used by almost every sixth teenager (17.6%)[3,4]. At the same

time, girls predominate among them (20.0% versus 15.2% of boys). Moreover, the amount of time spent with electronic gadgets increases with age: from 6.8% among 10-year-olds to over 23% among 16–17-year-olds, which is explained by greater parental control over younger children compared to older adolescents. The share of Internet users among people aged 15–29 in Ukraine reached 97% [3,4]. When using the Internet for social networking, adolescents may encounter a variety of risk factors, such as: risk of connection: personal information is available for feedback; persuasion: online experiences can influence personal activities; permanence: posts remain online forever; exploitation: personal information can benefit others; deception: there is a lot of misinformation and distortion of data; victimization: other users can use personal information against the person who posted it; addiction: repeated use can create addictive behavior; isolation: online interactions can reduce communication and socialization in the real world; impulse: it is easy to say things online that you would not say in person.

The results of the study showed that 18.2% of adolescents regularly neglected other activities (hobbies, sports) because they wanted to be on social networks. The most neglected other activities were 16-year-old girls – 26.0% [3-7].

Vision problems associated with electronic gadgets are now quite common among schoolchildren and students. On average, young people spend nine hours a day on smartphones, tablets, LED monitors and flat-screen TVs. Most children over 12 years old need vision correction. Computer vision syndrome, which affects almost all students, is a specific visual impairment (asthenopia). It is believed that this problem occurs daily in 40% of people who work at a computer, and periodically in 92% of users [8]. Analysis of the results of studies conducted in 1990–2023 showed a gradual increase in the total prevalence of myopia in the world from 24.32% to 35.81%. The groups in which myopia is especially common include adolescents (47%) and high school students (45.7%) [9-10].

A balanced diet is also a health-preserving component of a healthy lifestyle. The results of the study showed that the proportion of young people with a normal body mass index increases with age: from 66.3% in 11-year-olds to 75.3% among 17-year-olds. Girls were much more likely to report being underweight – almost every fourth (24.1%) girl aged 11 and every fifth girl aged 13, 15 and 17 years. This situation is a serious problem today, under the influence of the media and the glamorization of lifestyle, predisposing mostly girls to malnutrition, as is the case worldwide. If, according to generally accepted recommendations, it is necessary

Table 1. Dynamics of incidence of sexually transmitted infections among adolescent girls aged 15-17. Ukraine. 2018-2023 (per 100 thousand people)

Type of disease	2018		2019		2020		2021		2022		2023	
	Indicator	Absolute number	Indicator	Absolute number	Indicator	Absolute number	Indicator	Absolute number	Indicator	Absolute number	Indicator	Absolute number
Syphilis	2.86	15	0.94	5	1.08	6	1.92	11	0.73	9	0.67	4
Gonococcal infection	2.67	14	2.62	14	1.26	7	1.74	10	0.57	7	0.85	5
Chlamydia	9.36	49	8.43	45	1.79	10	1.74	10	0.57	7	1.0	6
Trichomoniasis	59.97	314	47.04	251	23.85	133	16.73	96	5.53	68	8.7	52
Ureaplasmosis	21.01	110	15.93	85	2.69	15	2.61	15	1.14	14	2.01	12

to consume 4-5 servings of vegetables and 2 servings of fruit per day, then in Ukraine 51.2% of adolescents consume fruit daily, and 42.2% of adolescents consume vegetables [3,4].

The formation of reproductive health is also an important component of the formation of a healthy lifestyle. It has been established that the issues of human sexuality and sexual behavior continue to bypass secondary and higher education, and also remain outside of journalistic topics. At the same time, sexual ignorance, together with the existing aggressive cult of sex in the media, contribute to the fact that Ukrainian adolescents live and are formed in a high-risk zone, where sex is as dangerous as the use of alcohol, drugs, etc. This is evident when considering the problems of early sexual debut, abortions, sexually transmitted diseases and sexual violence. 18.3% of adolescents had experience with sexual relations: from 3.7% of the youngest (13-year-olds) to 34.2% among 17-year-olds. Moreover, 9.2% of those who had sexual experience had their sexual debut at 12 years of age or younger (12.1% of boys and 3.5% of girls), and 66.8% gained experience of adult life after reaching the age of 15 [5,6,7]. 69.3% of persons used a condom as a means of contraception and protection against sexually transmitted infections at the first sexual contact. Girls in the older age group neglected this preventive measure more often than boys – from a third of 16-year-olds to a quarter of 17-year-olds [5,6,7]. The data obtained indicate an extremely insufficient awareness of adolescents regarding the formation of reproductive health against the background of imperfect communication between educational institutions, healthcare, the media, and parents.

The main source of knowledge about sexual relations for schoolchildren, regardless of age, was the Internet: more than half (58.4%), the second position was occupied by friends and peers, who became a source of information for an average of 41.0% of adolescents. In

32.5%, parents became a source of knowledge about sexual relations, teachers – in 28.9% [3,11].

Therefore, it is believed that young people aged 15–24 are one of the most vulnerable groups of the population at risk of human immunodeficiency virus (HIV) infection due to the lack of HIV prevention information, high early sexual activity, and unprotected sexual relations. For example, in 2024, the highest percentage of detected recent infection was observed among young people aged 18 to 24. At the same time, the analysis more often showed recent HIV in women under 20 years old – 19% of the total number of tested Ukrainian women of this age. The greatest risk factor for recent HIV was unprotected sexual intercourse [12,13].

The formation of reproductive health in adolescents is a basic technology for its implementation in adulthood. About 500 thousand adolescent girls enter the reproductive period annually [12]. The harmonious development of a girl's body during adolescence largely determines the woman's future life and her reproductive potential. As a result of unprotected sexual intercourse, as a result of adolescents' unpreparedness for sexual relations without risk to health, sexually transmitted infections (STIs) primarily occur. The incidence of STIs among adolescents aged 15-17 in Ukraine (Table 1) for the period 2018-2023 has a positive trend: the decrease in the incidence of syphilis is 76.6% (2018- 2.86 per 100 thousand girls aged 15-17, 2023 – 0.67.); for gonococcal infection – 68.2% (2018 – 2.67, 2023 – 0.85); chlamydia – 89.3% (2018 – 9.36, 2023 – 1.0); for trichomoniasis – 85.5% (2018 – 59.97, 2023 – 8.7); for ureaplasmosis – 90.4% (2018 – 21.01, 2023 – 2.01) [14,15]. However, the incidence of the specified types of STIs, except for syphilis, in 2023 increased compared to 2022 (Table 1).

Despite the positive trend, the data indicate problems in the formation of reproductive health in girls, starting from childhood, which is felt throughout a woman's life and negatively affects the realization of reproductive potential in the future.

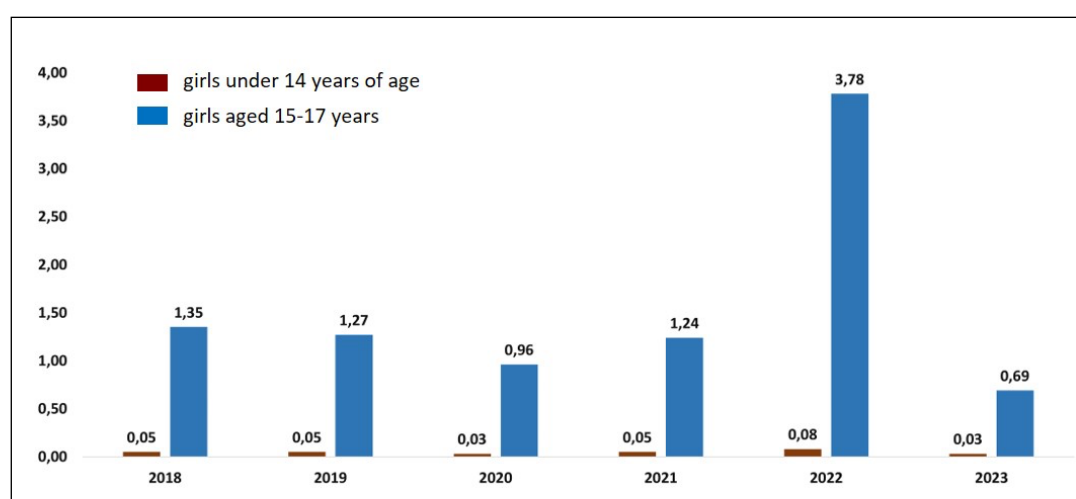


Fig. 1. Dynamics of induced abortions in girls under 14 and 15-17 years old. 2018-2023 (per 1000 girls)

In the absence of sufficient information on the culture of sexual behavior, it becomes risky for the health and social life of the girl. Early and unprotected sexual intercourse causes cases of unwanted pregnancy, which, as a rule, ends with its artificial interruption or, so-called, early childbirth, which also causes violations of the mechanisms of formation and preservation of reproductive health [12]. Unlike developed countries of the world, abortions in childhood and adolescence are still registered in Ukraine (Fig. 1).

Moreover, the trends in the problem of abortion in childhood are extremely negative. Abortions are considered the most destructive factors of reproductive health. Thus, for the period 2018-2023, the number of abortions per 1000 girls under 14 years of age decreased by 40% (2018 – 0.05, 2023 – 0.03), for girls aged 15-17 years the decrease was 48.9% (2018 – 1.35, 2023 – 0.69). In 2023, 14 girls under 14 years of age and 411 – aged 15-17 years resorted to such a dangerous method of solving the problem of untimely pregnancy [12-15].

Early childbirth in girls of childhood also indicates a lack of information on methods of preventing unwanted pregnancy. For the period 2018-2023 the rate of early births has a positive trend: in girls under 14 years of age, the birth rate decreased by 25% (2018 – 0.12 per 1000 girls under 14 years of age, 2023 – 0.09); in adolescents – by 50.1% (2018 – 6.82 per 1000 girls 15-17 years of age, 2023 – 3.40). Nevertheless, the number of girls who gave birth at an early age in 2023 is worrying (under 14 years of age – 98 girls, 15-17 years of age – 2033) and encourages increasing the effectiveness of educational preventive technologies.

Given the above trends, the state of reproductive health in Ukraine has negative signs, which threatens reproductive health in adulthood [16-20].

DISCUSSION

According to numerous scientists, one of the main links in the formation of a healthy lifestyle is precisely the

professional approach of the general practitioner-family doctor within the framework of performing his direct functions of providing advisory assistance aimed at eliminating or reducing habits and behaviors that pose a risk to health (smoking, alcohol use, other psychoactive substances, unhealthy diet, insufficient physical activity, etc.) and forming healthy lifestyle skills, enshrined in the sectoral order of the Ministry of Health of Ukraine dated March 19, 2018 No. 504 “On Approval of the Procedure for Providing Primary Health Care” [21].

The definition of the concept of healthy lifestyle, which was stated at the International Conference on Primary Health Care in 1978, comes from the perspective of understanding the phenomenon of human health. (Alma-Ata): HLS is all types of human activity related to preserving and strengthening health, everything that contributes to the fulfillment of one’s human functions through activities to improve living conditions – work, rest, and everyday life [22].

The formation of a healthy lifestyle is based on certain ideological principles, namely: the idea of the priority of the value of health in the worldview system of human values; the perception of health not only as a state of absence of disease or physical defects, but as a state of complete well-being; the idea of a holistic understanding of health as a phenomenon that inextricably combines its physical, mental, social and spiritual spheres; the idea of redistribution of responsibility, i.e. control of a healthy lifestyle should be carried out by the person himself, who takes personal responsibility for actions, decisions, and their consequences, based on knowledge obtained, in particular, from a family doctor as a doctor of first contact [23]. A concrete example is the proposal in the World Sight Report: a key proposal is to make comprehensive, people-centred eye care integrated into health systems and based on effective primary health care the main model for providing such services

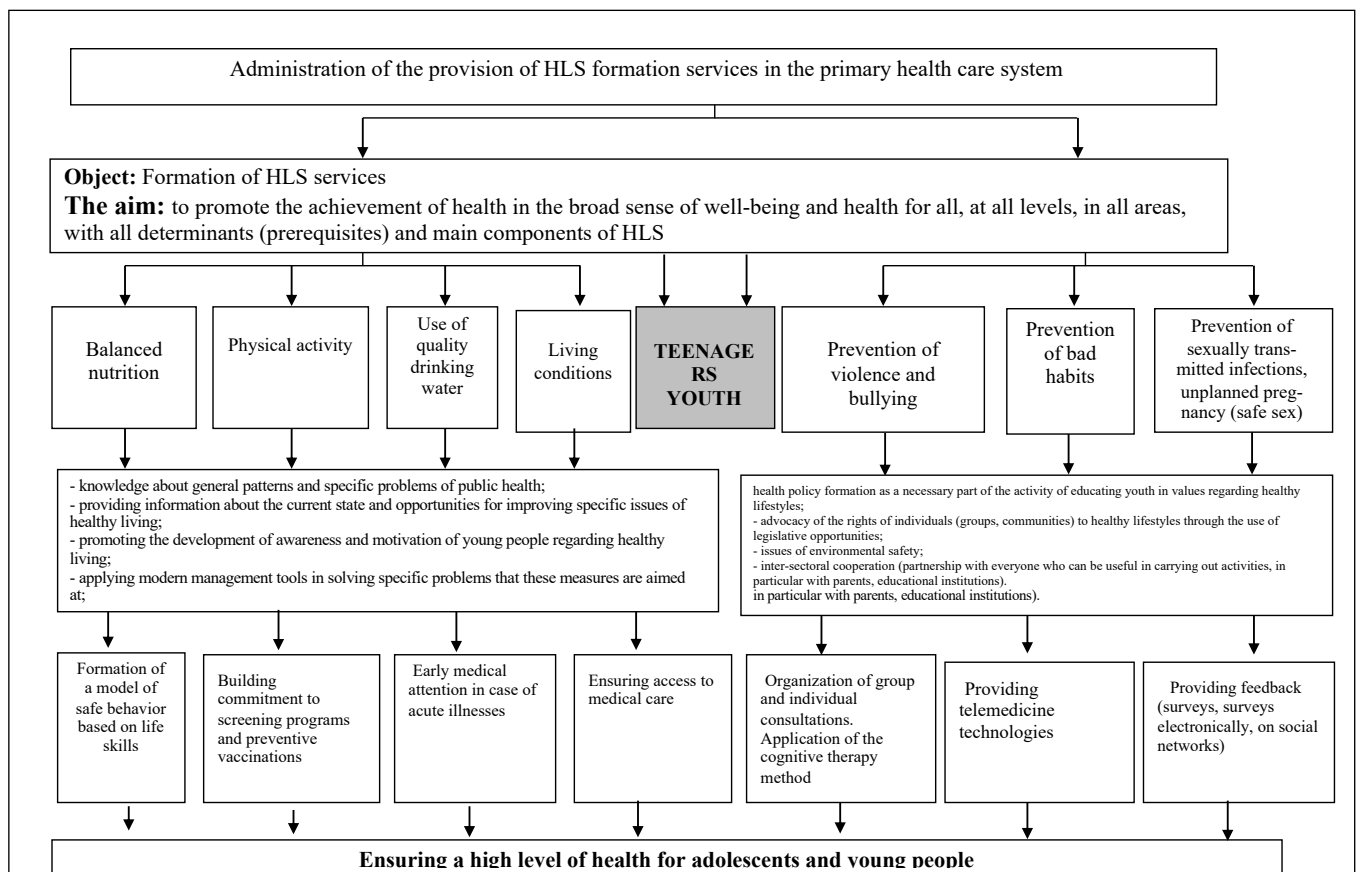


Fig. 2. Administration of the provision of services for the formation of a healthy lifestyle in the field of primary health care

and to scale it up [24]. In the area of adolescent health, the WHO European Office supports countries in three main areas [25]: by proposing integrated, intersectoral and evidence-based approaches to adolescent health; by clarifying and supporting the specific role that the health sector has; by planning actions aimed at reducing inequalities in adolescent health and development, both within and between countries [25].

The modern health care system in ensuring the activities of the GP-FP is the result of public administration as an integral part of the public administration system (Fig. 2), starting with the signing of the Declaration with the doctor, who provides patients with a number of preferences in the direction of personal responsibility for the health of patients, personal interest in the patient's satisfaction with his services, which directly affects his salary and time allocation [26-27].

As shown in Fig. 2, the main goal of forming a healthy lifestyle is to promote the achievement of health in the broad sense of well-being and health for all, at all levels, in all areas, with all determinants (prerequisites). To provide complete information, LZP-SL uses the strategies defined in Figure 2. [23].

The components of a healthy lifestyle contain various elements that relate to all areas of health – physical,

mental, social and spiritual. The most important of them are nutrition, life (quality of housing, conditions for passive and active recreation, the level of mental and physical safety in the territory of life), working conditions (safety not only in the physical but also in the mental aspect), motor activity [23].

Public administration should ensure the effectiveness of the GP-FP in providing services regarding the HLS formation through the process of collective adoption and implementation of strategic decisions based on the agreement and coordination of the goals and actions of all key participants, regulated by laws and other legal acts aimed at: making administrative decisions; providing administrative services; implementing internal administration of the subject of public administration (GP-FP), namely management with the participation of the community, where the GP-FP operates with geosocial features to achieve national goals and interests through the activities of public sector entities, in our case, the GP-FP, as a subject of local government bodies. Public administration is aimed at the effective implementation of rights, freedoms and interests protected by law. And the activities of state bodies are carried out through the implementation of functions – health care of families who have concluded a declaration with a family doctor [26].

CONCLUSIONS

One of the main links in the formation of a healthy lifestyle is the professional approach of this family doctor in the framework of performing his direct functions of eliminating habits and behavior that pose a

risk to health and forming healthy lifestyle skills. Public administration should ensure the effectiveness of the family doctor in providing services for the formation of a healthy lifestyle through the process of collective adoption and implementation of strategic decisions.

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CONFLICT OF INTEREST

The Authors declare no conflict of interests

CORRESPONDING AUTHOR

Olena S. Shcherbinska

Shupyk National Healthcare University of Ukraine
9 Dorohozhytska St., 04112 Kyiv, Ukraine
e-mail: 703alena@gmail.com

ORCID AND CONTRIBUTIONSHIP

Olena S. Shcherbinska 0000-0002-5401-7110      
Nadiia Ya. Zhylyka: 0000-0003-0732-1141      
Nataliia O. Serohina: 0000-0002-4491-4723  
Oksana V. Zhdanova: 0000-0002-4229-4604    

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Teaching clinical communication skills in Ukraine: a cross-sectional study

Iurii L. Kuchyn, Kateryna Yu. Bielka, Olena I. Kefeli-lanovska, Ganna S. Trepet, Lesya V. Lymar
BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To analyze the Ukrainian medical graduates' self-assessment of communicative competence, review the Ukrainian medical education related to teaching clinical communication, and to suggest ways of improving fostering clinical communication skills.

Materials and Methods: A descriptive literature review was done. The authors held a cross-sectional study using a convenience sample study in 2024 with the Bogomolets NMU 190 medical PhD students and practicing physicians, who were questioned to evaluate their clinical communication skills. The participants were offered a 12-item questionnaire regarding the clinical communicative competence, with open- and close-ended questions. The survey results were processed using statistical methods of grouping, generalization (in absolute and relative terms), and comparison. For relative values, standard errors and confidence intervals (95%) were calculated. The probability of difference between observation groups was determined using chi-square test (χ^2). Open-ended questions were analyzed using the qualitative description method.

Results: Among eligible 700 individuals, 190 individuals participated in the study, including 120 medical PhD students and 70 practicing physicians. Total majority could not recollect being taught medical communication during their undergraduate studies. Only 16% have heard about the SPIKES protocol. The analysis of the open-ended questions revealed answer clusters, in which the respondents associated clinical communicative competence with language skills, emotional self-control and polite behavior. This could be caused by learning the communication course at the Language or Psychology Departments.

Conclusions: Clinical communication skills are underestimated in the medical curriculum, taught by non-clinical departments. The Ukrainian education needs integration of the clinical communication course into practice course, to be taught by practicing physicians, which, in its turn, requires training Ukrainian clinical teachers by European communication protocols.

KEY WORDS: clinical communication, medical education, physician

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INTRODUCTION

Clinical communication skills make up an essential component of medical education, as they represent ability of the physician to interact with the patients within the medical environment [1]. Teaching communication skills is a basic component of any European medical school curriculum, where the physician's soft skills are emphasized. In Ukraine, integration of clinical communication skills into medical curricula has historically been less emphasized. However, the clinical communication skills are integrated in the syllabuses of numerous Ukrainian medical courses.

AIM

The aim of the paper is to analyze the Ukrainian medical graduates' (PhD students and practicing physicians) self-assessment of learning the communicative competence, and the communicative competence itself,

review the Ukrainian medical education related to teaching clinical communication, and to suggest ways of improving fostering clinical communication skills during the medical studies.

MATERIALS AND METHODS

The cross-sectional methods study using a convenience sample study was held within the frame of the Bogomolets NMU research. The authors reviewed medical teaching sources and performed a context analysis of the Ukrainian medical schools' curriculums and syllabuses to define the significance of the clinical communication skills development.

In 2024 the authors questioned the former medical students – medical PhDs and practicing physicians to evaluate their self-assessment of the clinical communication skills, their experience of fostering the skills during the undergraduate training. The questions for

Table 1. The clinical communicative competence knowledge and skills, confirmed by the respondents

Question	Medical PhD students (N 120)	Practicing physicians (N 70)	Overall (N190) CI, 95%
1. What is your gender?			
- female	50 (41,7%)	40 (57,1%)	90 (47,4%)
- male	70 (58,3%)	30 (42,9%)	100 (52,6%)
- other	0	0	0
2. What is your age:			
- 20-30	65 (54,2%)	15 (21,4%)	80 (42,1%)
- 30-40	40 (33,3%)	40 (57,1%)	80 (42,1%)
- 40-50	15 (12,5%)	10 (14,3%)	25 (13,1%)
- over 50	0	5 (7,2%)	5 (2,7%)
3. How long ago did you study in the University?			
- less than 10 years	65 (54,2%)	15 (21,4%)	80 (42,1%) [34,9–49,3]
- 10-20 years ago	40 (33,3%)	40 (57,1%)	80 (42,1%) [34,9–49,3]
- 20-30 years ago	15 (12,5%)	10 (14,3%)	25 (13,1%) [8,3–17,9]
- more than 30 years ago	-	5 (7,2%)	5 (2,7%) [0,3–5,1]
4. Do you recollect studying the course about communicative competence in the University?			
- yes	15 (12,5%)	5 (7,2%) *	20 (10,5%) [6,1–14,9]
- no	80 (66,7%)	60 (85,4%) **	140 (73,7%) [67,3–80,1]
- indefinite answer	25 (20,8%)	5 (7,2%)	30 (15,8%) [10,6–21,0]
5. Do you recollect studying the course about communicative competence during your further education?			
- yes	40 (33,3%)	20 (28,6%) **	60 (31,6%) [24,8–38,4]
- no	35 (29,2%)	25 (35,7%)	60 (31,6%) [24,8–38,4]
- indefinite answer	45 (37,3%)	25 (35,7%)	70 (36,8%) [29,8–43,8]
6. Do you know about the SPIKES protocol and what it is?			
- Yes	20 (16,6%)	10 (14,3%) *	30 (15,8%) [10,6–21,0]
- No	80 (66,7%)	60 (85,7%)	140 (73,7%) [67,3–80,1]
- Don't remember	20 (16,6%)	0	20 (10,5%) [6,1–14,9]
7. Do you know the sequence how to tell the patient bad news?			
- Yes	25 (20,8%)	60 (85,7%) ***	85 (44,8%) [37,6–52,0]
- No	45 (37,5%)	2 (2,9%)	47 (24,7%) [18,5–30,9]
- Don't remember	50 (41,7%)	8 (11,4%)	58 (30,5%) [23,9–37,1]
8. Do you know how to resolve conflicts with a patient on the first stage of the conflict?			
- Yes	40 (33,3%)	50 (71,4%) ***	90 (47,4%) [40,2–54,6]
- No	18 (15,0%)	2 (2,9%)	20 (10,5%) [6,1–14,9]
- Don't remember	62 (51,7%)	18 (25,7%)	80 (42,1%) [34,9–49,354]
9. Do you know how to interact with the patients in shock according to the Kubler-Ross staging?			
- Yes	45 (37,5%)	15 (21,4%) **	60 (31,6%) [24,8–38,4]
- No	12 (10,0%)	50 (71,4%)	62 (32,6%) [25,8–39,4]
- Don't remember	63 (52,5%)	5 (7,2%)	68 (35,8%) [28,8–42,8]
10. Assess your clinical communication skills:			
- Bad	2 (1,7%)	2 (2,9%)	4 (2,1%) [0,1–4,1]
- Satisfactory	25 (20,8%)	5 (7,1%)	30 (15,8%) [10,6–21,0]
- Good	68 (56,7%)	33 (47,1%)	101 (53,1%) [45,9–60,3]
- Excellent	25 (20,8%)	30 (42,9%) ***	55 (29,0%) [22,4–35,6]

Chi-square test: * – $p > 0,5$; ** – $p \leq 0,05$; *** – $p < 0,01$

the survey were composed by the group of the authors. The participants were invited to participate in the questioning through the social network. The respondents' informed consent was expressed in the Google Form. The study was conducted in line with the applicable laws and regulations. No further communication was held with the participants regarding the results of the study.

A total of 190 respondents participated in the study, 90 females and 100 males. The participants were offered a 12-item questionnaire regarding the clinical communicative competence, with open- and close-ended questions. They were asked about their gender, age, period after the graduation, and a set of questions about fostering their communicative competence during the undergraduate studies, evaluation of its effectiveness, self-assessment of their personal clinical communication qualities, as well as strong and weak points regarding the communicative competence. Last two questions were open-ended, and the thematic analysis of the open-ended questions about strong and weak communication points was conducted.

The survey results were processed using statistical methods of grouping, generalization (in absolute and relative terms), and comparison. For relative values, standard errors and confidence intervals (95%) were calculated. Open-ended questions were analyzed using the qualitative description method. The open responses were grouped into key themes, based on their recurrent pattern. The respondent's quotes were labeled with alphanumerical codes denoting a respondent (R) and the consecutive number of the answer (R1).

RESULTS

Among eligible 700 individuals (200 medical PhD students and 500 physicians who received invitation to participate in the study), 190 individuals participated in the study, including 120 medical PhD students and 70 practicing physicians (Table 1). The group was relatively equal in gender distribution (47% females against 53% males), and the average age of the sample ranged from 20 to 40 years old (84%). The medical PhDs represented a younger sample, with 87% of 20-to-40-years-old group, while the practicing physicians' group was older.

Total majority ($89,0 \pm 2,3\%$) could not recollect medical communication course during their undergraduate studies. The number of those who could not recollect such courses during postgraduate continuous medical education decreased to $68,4\% \pm 3,4\%$. As for the basics of the clinical communication, only $15,8\% \pm 2,6\%$ have heard about the SPIKES protocol, although $44,8\% \pm 3,6\%$ consider they possess the skills of telling bad news to

the patient. $31,6\% \pm 3,4\%$ know about management of stressful situation with grieving patients according to the Kubler-Ross. Nonetheless, the participants evaluate their clinical communication skills high, as $47,4\% \pm 3,6\%$ stated they could resolve conflicts at the initial stage, and the overall share of those with self-assessed communication skills at excellent and high level makes up $82,1\% \pm 2,8\%$ (Table 1).

The respondents represented two huge groups, the medical students and practicing physicians, which did not differ significantly by size. The group of PhDs showed higher response for the undergraduate clinical communication studies ($12,5\% \pm 3,0\%$ vs $7,2\% \pm 3,1\%$ of physicians, $p > 0,05$), further communication education ($33,4\% \pm 4,3\%$ vs $28,6\% \pm 5,4\%$, $p \leq 0,05$), and they show better results in answering about practical components of the clinical communication, than the physicians. However, they do not evaluate their skills of conflict resolving and communication as high as the physicians.

The participants were also asked to represent their views on their strong and weak points in medical communication. The offered answers were analyzed and grouped according to the basic key words into several clusters (Table 2).

The analysis shows that most participants associate their communicative competence with the skills of sending clear messages during the communication, communicating patiently, without aggression, resolving conflicts and good command of knowledge. Most see no difference between the clinical communicative competence and the knowledge of grammar of the language. They defined their good clinical communication competence as the skills of explaining, speaking correctly and politely, being patient and not rude, being resilient and being able to work under pressure. As for the bad communication competence qualities, they were mostly associated with the language skills and poor emotional self-control, expressed in increased irritability, shouting at the patients and being rude. The recalled characteristics show that the participants have vague notion about the communication competence, mostly associating it with language skills, rude or polite behavior.

DISCUSSION

The issue of the communicative competence derives from the professional competence, which was raised by A. Fitzgerald et al. who included into the professional competence the influence of the interaction [2]. The professional competence qualities grouping by Steiner-Hofbauer et al. includes communication and patient involvement [3]. The study by Petek Šter M et al. stresses on the significance of

Table 2. Strong and weak clinical communicative competence characteristics self-assessment results

Defining in the communication competence:	The answer cluster defined by analysis:	Phrases related to the subgroup and the alphanumerical numbers of respondents
Strong points	Skill to explain medical information correctly to the patients	I can explain medical procedures (R8, R32, R74, R165) I can speak so that the others understand (R7, R34) I use colloquial terms for non-medical people for them to understand (R18, R67, R82) I am a good speaker (R23, R58, R94, R 171) I can explain clearly (R11, R31, R76)
Strong points	Ability to avoid conflicts by resolving on initial stages or not initiating them	I never have conflicts with patients (R2, R47, R152) I always settle any cases if they arise (R15, R62, R91) I am not a conflict person (R22) I am easy in communication (R42, R81, R169) I am a peaceful person (R6) I prevent conflicts (R10, R52, R73, R188)
Strong points	Skills of speaking without making language mistakes	I know language very well (R3, R51, R79, R137) I don't use dialects ("Surzhyk") (R34) I do not make language mistakes (R148, R152)
Strong points	Resilience skills	I can communicate under stress (R35, R78, R111) I speak to my patients even when I am exhausted (R47) I always find time to speak to patients (R88)
Strong points	Ability to tell bad news	I can say about unfavorable diagnosis (R32, R175) I can tell bad news, no matter how hard it is for the patient (R19) I know how to tell the worst information (R36) I am supportive, and I can speak about death (R92)
Strong points Strong points	Patience skills	I can explain the same information to my patients endlessly (R77) I am patient (R13, R34, R66, R163) I do not lose temper with patients (R12, R45)
Strong points	Ability to prove your point of view to any person	I can bring my views to my patients (R18, R50, R179) I can persuade (R 106, R141) I can explain what is needed (R 77)
Strong points	Non-rude behaviour	I do not shout at my patients (R11, R54, R88, R176) I do not swear (R6, R31, R71) I do not use force, even in extreme situations (R24, R35)
Strong points	Skills of working under pressure	I do not lose my temper when I am under pressure (R91) I can communicate even in very nervous circumstances (R67)
Weak point	Rudeness	I am sometimes rude (R29, R55, R183) I can be impolite (R53) I can shout at my patients (R57, R90) I can use obscene lexis, if I am irritated (R49, R74)
Weak point	Inability to remain patient when the other person doesn't understand you	I sometimes lose my temper (R58) I can behave aggressive (R51)
Weak point	Shouting at the others	I can shout without reason, just because of my bad mood (R104) I find emotional control hard and can shout (R40) Sometimes I shout at my nurse (R60)
Weak point	Inability to work with the elderly patients	I avoid communication with the elderly (R33) It's hard for me to speak to the elderly as I get annoyed (R70) I cannot repeat many times to the elderly (R145)
Weak point	Emotional burnout and loss of self-control	Sometimes I have no strength to communicate at work (R44), (R68) Sometimes I feel depressed and do not want to communicate (R40) I feel myself empty inside, and I do not want to communicate in such moments (R93)
Weak point	Mistakes in Ukrainian language when speaking to the patients	I make mistakes in Ukrainian (R11), (R165) I may forget the word in Ukrainian (R31), (R77) I do not use feminitives, and it is bad (R81)

communication for the doctor's personality[4]. C. Kiessling states the communicative competence is an important part of the physician's competence as a motor competence [5]. M. Deveugele et al. states that the good communication skills of a doctor include three basic categories: information giving, paying attention to emotions and shared decision-making [6]. From this, we observe the communication competence as a main quality of a physician which should be fostered during their medical studies.

Teaching the communicative competence to medical students must be, according to Kiessling, based on the transfer: of the knowledge and skills to real-life bedside situations [5] or via digitalization [7]. Similarly, our study showed that the communication skills were underestimated by both practicing clinicians and medical PhD students. Most participants could not define what was meant by the communicative competence, and associated it with language knowledge, emotional stability and polite behavior.

The analysis of the sources regarding the curriculum and syllabuses of medical students shows that the communication in medicine is widely emphasized abroad, but neglected in Ukraine. J. Dec-Pietrowska et al. states that the good communication skills for a physician in Europe are taught at various courses [8]. J. Howick et al. reviewed medical curriculae of the UK, Canada and the USA, where the medical communication skills are taught at the course "Medical humanities"[9]. S. Exenberger et al. states that the issue of the communicative competence is widely studied within the general curriculum [10]. Schildmann et al. found out that in Germany the students assessed teaching medical skills as quite average [11]. Deveugele analyzed a 6-year experience of learning the communication skills and stated three main problems of it: such teaching is usually limited, not systemic, far from reality, and is not implemented during hospital practice [6]. M. Makowska et al. analyzed the effect of the "medical humanities" in the medical schools of Poland and concluded that many students didn't perceive it as an important part of the curriculum [12]. As for the participants in our study, they also stated they knew how to tell the patients bad news, with simultaneous low knowledge parameters. This shows that most communication skills by the participants were based rather on their experience than on receiving education.

So, we observe insufficient emphasis on the communication skills in the medical education. In Ukraine, the communicative competence is mostly considered through a prism of language competence. The communicative competence is usually taught by the Language and Psychology Departments, where, the language departments emphasize correct grammar and vocabulary knowledge [13]. This coincides with the study results, where the participants associated communication competence of a physician with the correct language use. The psychology department emphasizes emotional self-regulation. The communicative skills courses are usually taught to the medical students during their first two years in the University, as the second half of the training is devoted to clinical courses. But it is exactly in the senior study period, during the bedside practice, where the students need the skills. The course should be introduced into the curricula of each clinical course.

The lack of knowledge on clinical communication derives from inappropriate attention to it during medical studies. The communicative competence courses should be embedded in the curricula of all courses, not as a separate course. This could be achieved when the course will be taught not by philologists or psychologists, but the clinicians who apply the knowledge and skills throughout practice.

CONCLUSIONS

The clinical communicative competence is neglected within the medical school curriculum in Ukraine. The attempts to introduce the course by the departments of Language Studies or Psychology, separated from the clinical practice, created incorrect notion about the course content in participants. The study showed that both junior and senior physicians associated clinical communication competence with language skills and emotional self-regulation, showing poor knowledge of essentials of clinical communication. The existing training standards in this regard need improvement, with introduction of the clinical communication during every medical course, taught presumably by the practicing physicians. In its turn, this necessitates training of such physicians in European schools, with further transfer of the experience to the junior colleagues.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Lesya Lymar

Bogomolets National Medical University
34 Prospect Beresteiskyyi, 03680, Kyiv, Ukraine
e-mail: lesyalymar@nmu.ua

ORCID AND CONTRIBUTIONSHIP

Iurii L. Kuchyn: 0000-0002-9667-1911 [A](#) [E](#) [F](#)
 Kateryna Yu. Bielka: 0000-0003-1185-6835 [A](#) [E](#)
 Olena I. Kefeli-Ianovska: 0000-0003-1326-2424 [B](#) [D](#)
 Ganna S. Trepet: 0000-0001-8300-7117 [B](#)
 Lesya V. Lymar: 0000-0002-9407-1066 [B](#) [C](#) [D](#) [E](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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Formation of readiness for professional activity of future dentists on the basis of interdisciplinary integration

Oleksandr A. Kaniura, Natalia V. Stuchynska, Ihor A. Prokhorenko

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To present general approaches to designing a model of interdisciplinary integration of the discipline «Biomechanics of the maxillofacial apparatus. Physical foundations of gnathology».

Materials and Methods: To accomplish the tasks set, the following theoretical and empirical methods of scientific research were used: system analysis, comparison and generalization for the theoretical substantiation of approaches to the organization of the educational process of dental students, bibliosemantic method. In order to design the interdisciplinary integration model, the dot textual graph description language as well as the Graphviz open-source toolkit for graph visualization were used.

Results: According to the established valence of vertex p7, was determined that the practical lesson «Methods of diagnosing dento-maxillary anomalies and deformations. Devices for registering and analyzing movements of the lower jaw. Analysis of occlusion in the articulator» is the most integrated with the complex of educational disciplines. Next, the vertex p9 has the lowest degree of valence. The approach we used made it possible to determine the role and place of each topic of practical classes, to adjust the structure of the educational discipline content and the time allocated to the study of each topic.

Conclusions: Establishing interdisciplinary connections based on the principles of designing a mixed graph makes it possible to identify points of contact in the content of academic disciplines, techniques, and methods of mental and educational activity of higher education students, thereby strengthening the foundation for the formation of professional practice-oriented competencies.

KEY WORDS: biomechanics of the maxillofacial apparatus, physical foundations of gnathology, interdisciplinary integration, dental students

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INTRODUCTION

The analysis of statistical data and scientific research shows that a significant proportion of dental diseases and complications is associated with insufficient understanding of the multifunctional connection between elements and tissues of the dentofacial system in normal and pathological conditions, improper use of the knowledge in reconstructive dentistry, diagnostics, and prevention of dental diseases. Developed and implemented for 221 «Dentistry» specialty, the «Biomechanics of the maxillofacial apparatus. Physical foundations of gnathology» academic discipline is aimed at covering this gap.

One of the important tasks in the process of constructing the content of the academic discipline was the primary orientation to the analysis of trends in the development of modern dentistry and approaching the achievements of modern science and practice. While trying to form holistic systemic knowledge among dental students, ensuring interdisciplinary integration

of fundamental natural and professionally oriented clinical disciplines, it is crucial to remember of its particular importance.

AIM

The aim of the article is to present general approaches to designing a model of interdisciplinary integration of the discipline «Biomechanics of the maxillofacial apparatus. Physical foundations of gnathology».

MATERIALS AND METHODS

To accomplish the tasks set, the following theoretical and empirical methods of scientific research were used: system analysis, comparison and generalization for the theoretical substantiation of approaches to the organization of the educational process of dental students, bibliosemantic method, interviews with students and teachers. In order to design the interdisciplinary integra-

tion model, the dot textual graph description language as well as the Graphviz [1] open-source toolkit for graph visualization were used.

RESULTS

In order to determine the system of interdisciplinary connections of each of the topics of the investigated discipline, the entire complex of academic disciplines studied by students of 221 «Dentistry» specialty was considered. The training system consists of two training cycles: general and professional. The set of disciplines belonging to the specified cycles can be divided into three groups: fundamental professionally oriented, clinical, medical and preventive ones.

The first group includes: Human anatomy, including head and neck anatomy (b1); Histology, cytology, and embryology (b2); Medical biology (b3); Medical and biological physics with the basics of medical informatics (b4); Medical biochemistry, including oral biochemistry (b5); Microbiology, virology, and immunology, including oral microbiology (b6); Physiology, including maxillofacial physiology (b7); Radiology, radiology in dentistry (b8); Pathomorphology, including head and neck pathomorphology (b9); Pathophysiology, including maxillofacial pathophysiology (b10); Pharmacology (b11).

The most numerous group of clinical disciplines consists of: Propaedeutics of internal medicine, including patient care practice in the internal medicine clinic (c1); Preclinical course in pediatric therapeutic dentistry, including nursing practice in dentistry (c2); Prevention of dental diseases, including clinical practice in the prevention of dental diseases (c3); Internal medicine, including endocrinology, epidemiology, infectious diseases, clinical pharmacology (c4); Surgery, including neurosurgery, oncology, patient care practice in the surgical department (c5); General medical training (c6); Orthodontics, including clinical practice in orthodontics (c7); Orthopedic dentistry, including fixed dental prosthetics, removable dental prosthetics, maxillofacial prosthetics, implant prosthetics, clinical practice in orthopedic dentistry (c8); Therapeutic dentistry, including cariesology, endodontics, periodontology, diseases of the oral mucosa, clinical practice in therapeutic dentistry (c9); Surgical dentistry, including tooth extraction, anesthesia and inflammatory diseases of the maxillofacial region, maxillofacial traumatology, maxillofacial oncology, reconstructive maxillofacial surgery, clinical practice in surgical dentistry (c10); Pediatric therapeutic dentistry, including clinical practice in pediatric therapeutic dentistry (c11); Pediatric surgical dentistry, including clinical practice in pediatric surgical dentistry (c12); Emergency and urgent medical care (c13).

Medical and preventive disciplines include Social Medicine, Public health, and fundamentals of evidence-based medicine (d1); Hygiene and ecology (d2).

The abovementioned division of disciplines is conditional, since many of them are closely intertwined in their content. To achieve the set objectives of the research and construction of an interdisciplinary integration model, we will be guided by the mentioned classification of disciplines.

In order to create conditions for the practical application of acquired knowledge, skills and abilities, as well as to provide higher education students with the opportunity to see and evaluate their own results of performing practical tasks, it is necessary to design interdisciplinary connections that would characterize the actual points of contact in the content of disciplines, curricula, and programs. Another aspect here is the common methods formation of intellectual and educational activity of higher education students. To identify the general ideas of the disciplines, it is important to distinguish the essential attributes of the educational elements of each of them. The components of the methodological system of education (goals, methods, forms, means, content of education) of disciplines have their own specific differences; however, for each concept that is common and considered in a particular discipline, it is necessary to highlight a set of common features in accordance with the didactic goals.

To visually represent the model of intersubject connections, a mixed graph was built (Fig. 1), in which:

- the practical classes cluster (with vertex at V_p) consists of the tuple $p_1, p_2, \dots, p_n$ (where p is some practical class), which is connected by oriented edges $p_1 \rightarrow p_2 \rightarrow \dots \rightarrow p_n$;
- the lectures cluster (with vertex at V_l) consists of the tuple $l_1, l_2, \dots, l_n$ (where l is some lecture), which is connected by oriented edges $l_1 \rightarrow l_2 \rightarrow \dots \rightarrow l_n$;
- the fundamental professionally oriented disciplines cluster (with vertex at V_b) consists of the tuple $b_1, b_2, \dots, b_n$ (where b is some fundamental professionally oriented discipline), which is connected by edges $b_1 \rightarrow b_2 \rightarrow \dots \rightarrow b_n$;
- the clinical disciplines cluster (with vertex at V_c) consists of the tuple $c_1, c_2, \dots, c_n$ (where c is some clinical discipline), which is connected by the edges $c_1 \rightarrow c_2 \rightarrow \dots \rightarrow c_n$;
- the medical and preventive disciplines cluster (with vertex at V_d) consists of the tuple $d_1, d_2, \dots, d_n$ (where d is some medical and preventive discipline).

A mixed graph of interdisciplinary integration is a graph in which edges can be both directed and non-directed, $G := (V, A, E)$, where V is a set of vertices, A is a set of (ordered) pairs of distinct vertices (called edges), E

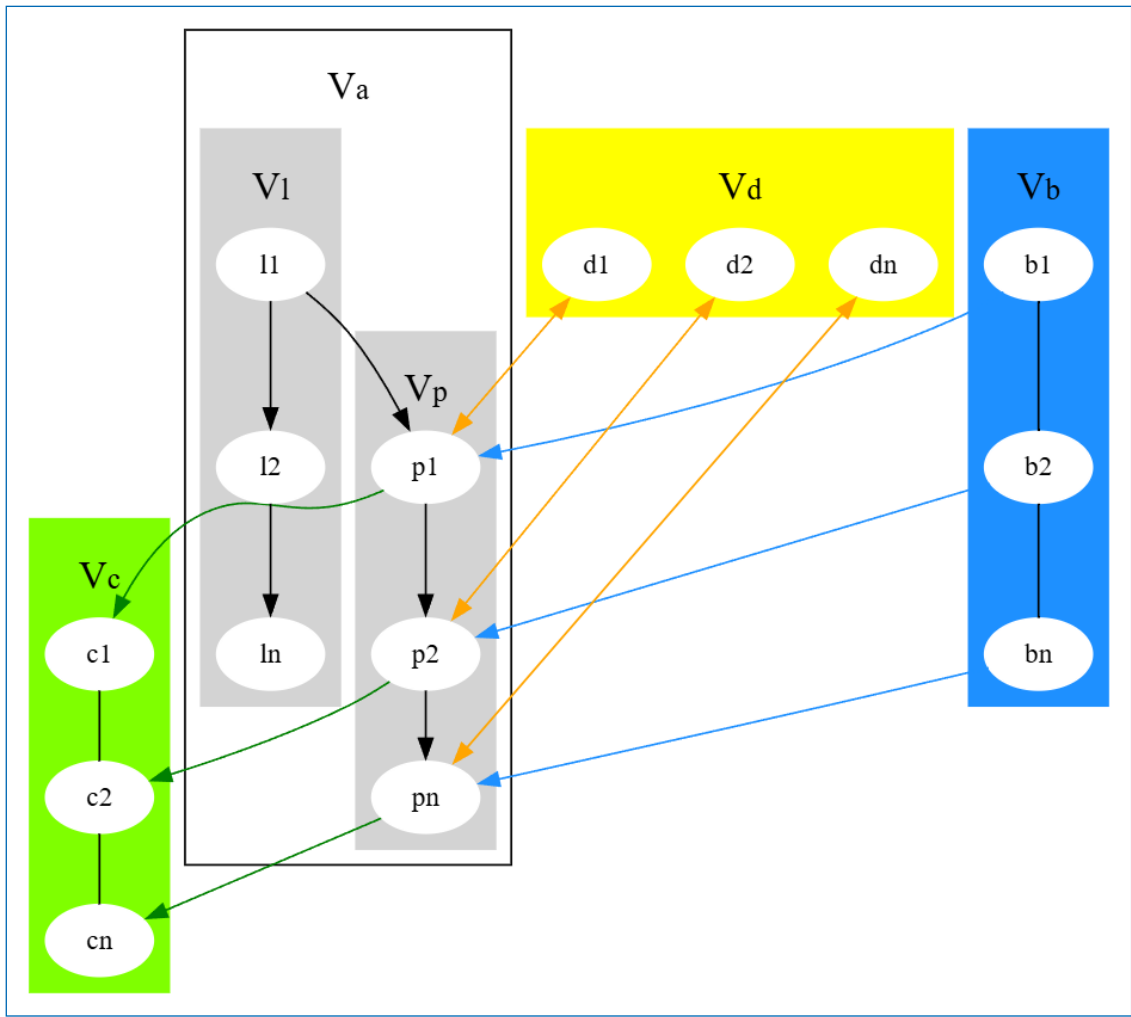


Fig. 1. The example of a mixed graph of interdisciplinary integration

is a set of (unordered) pairs of distinct vertices (called edges). Separate clusters (p1, p2, ..., pn), (l1, l2, ..., ln), (b1, b2, ..., bn), (c1, c2, ..., cn), (d1, d2, ..., dn) are the associations of homogeneous elements, which are considered as independent units with certain properties. The mentioned associations form a subgraph with vertices $V_a(V_p, V_l), V_b, V_c, V_d$ respectively.

Based on the results of the study of the complex of educational disciplines content [2] and the structure of practical classes in the «Biomechanics of the maxillo-facial apparatus. Physical foundations of gnathology» discipline [3], one of the possible graphs of intersubject (integration) connections was designed (Fig. 2).

DISCUSSION

In works [4-6], various aspects of professional training of students of 221 «Dentistry» specialty are considered; in works [7-10] – modern approaches in gnathology and the corresponding principles of diagnostics and treatment, which must be followed in dentistry. Using the conclusions drawn on the basis of the considered

scientific sources and our own practical experience, we will suggest possible relationships between the topics of practical classes (designated as vertices of the graph: p1, p2, p3, ..., p9) with fundamental professionally oriented, clinical, medical and preventive disciplines (through the corresponding vertices and edges of the graph). Next, we will present the relationships between the topics of practical classes:

Vertex p1: b1 is a structure of musculoskeletal joints and their classification; b2 is a microstructure of tissue joints; b4 is physical foundations of force, moment of force, and levers; b7 is biomechanics of the dento-maxillary apparatus; c5 is the use of levers during surgical interventions; c7 is the use of mechanical principles in the design of orthodontic appliances, choice of fulcrum in orthodontic treatment; c8 is a balance of loads in prostheses; c9 is the influence of mechanical load on the periodontium; c10 is the influence of pathological joints on jaw functions; d1 is the influence of correct occlusion on general health; d2 is ensuring hygienic care of orthodontic appliances.

Vertex p2: b4 is foundations of deformation mechanics, elasticity measurement, strain gauge analysis of

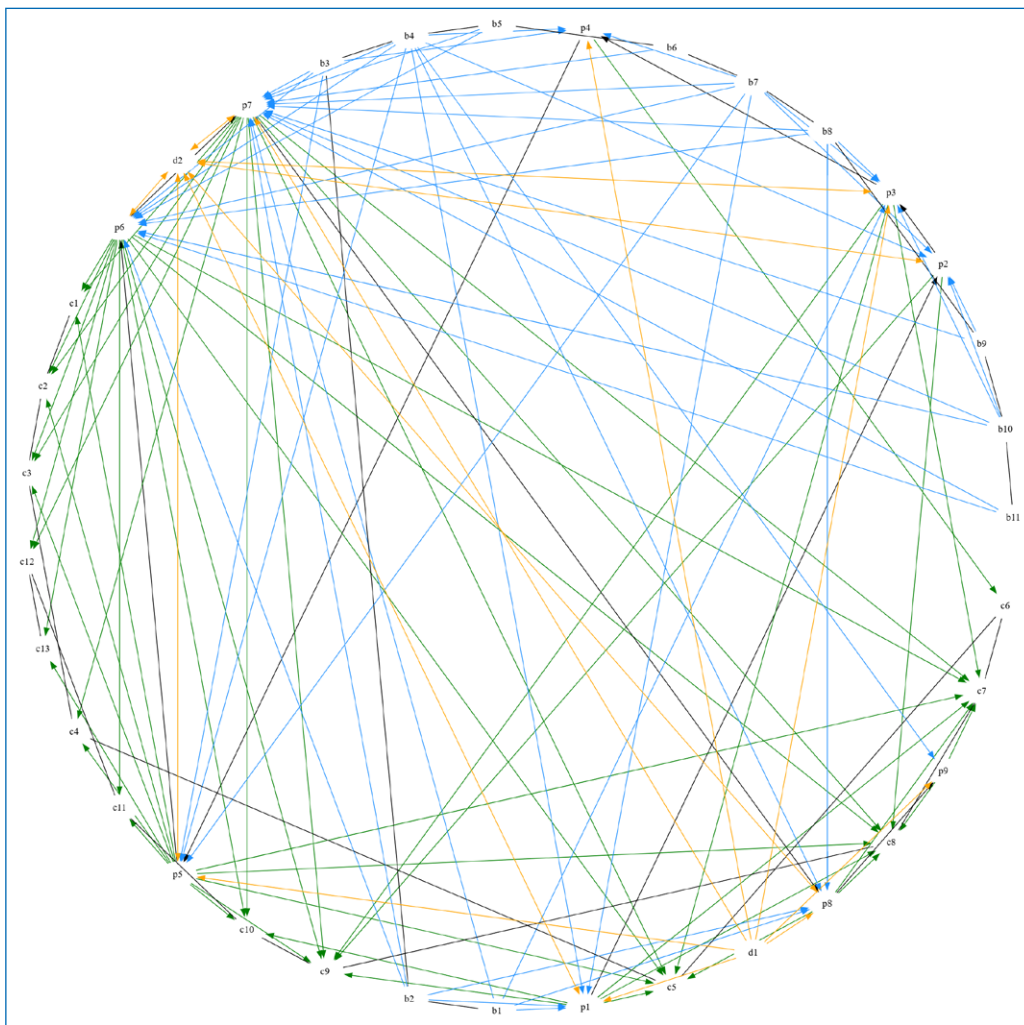


Fig. 2. An example of one of the possible graphs of intersubject (integration) connections

tissues; b7 is a functional adaptation of tissues; b9 is the changes in bone structure in diseases; b10 is pathological changes in deformations; c8 is the determination of load parameters in prosthetics; c9 is the influence of deformations on periodontal diseases; d2 is prevention of deformations.

Vertex p3: b1 is a structure of the lower jaw joints; b7 is biomechanics of the muscles that control jaw movement; b8 is diagnostics of the TMJ condition and visualization of changes; b10 is the causes and consequences of dysfunctions; c5 is surgical elimination of TMJ pathologies; c7 is the study of the effect of occlusion on the TMJ, correction of TMJ disorders; c9 is conservative treatment of disorders; d1 is the consequences of dysfunctions for psychosocial well-being; d2 is hygienic care for TMJ dysfunctions.

Vertex p4: b3 is muscle microstructure; b4 is the processes of muscle contractions; application of models in research; b7 is the analysis of muscle structure and function in movement; c6 (physical rehabilitation) is the assessment of muscle function in pathologies and recovery from injuries; d1 is effect of physical exertion on general performance.

Vertex p5: b3 is cell action potential; b4 is theoretical modeling of biomechanical processes; b7 is muscle contraction in real conditions, mechanisms of impulse transmission; c1 is physiological basis of diseases of the muscular system; c2 is muscle activity of children during dental treatment; c3 is a control of muscle activity of the maxillofacial region; c4 is correction of muscle pathologies; c5 is modeling of muscle contractions in planning operations; c7 is correction of occlusion and function of the masticatory apparatus; c8 is the design of prostheses that do not disrupt the physiological activity of the muscles; c9 is treatment of periodontal and functional pathologies; c10 is reconstructive surgery and tooth extraction; c11 is treatment of children with muscle dysfunctions; c13 is resuscitation measures and elimination of spasms in emergency conditions; d1 is the approaches to assessing the prevalence of muscle pathologies; d2 is the prevention of muscle function disorders through control of professional, environmental, and hygienic factors.

Vertex p6: b2 is tissue changes in the periodontium under the influence of biomechanical factors and processes of orthodontic tooth movement; b3 is genetic and biological foundations of the formation of the

dento-maxillary apparatus anomalies; b4 is physical laws in modeling orthodontic movements, load distribution, and the influence of occlusion; b5 is biochemical processes in periodontal tissues and joints during adaptation to occlusal changes; b7 is adaptation of the dento-maxillary apparatus to load; b8 is visualization of jaw structures; b10 is understanding the mechanisms of development of dento-maxillary apparatus dysfunctions caused by occlusal factors; b11 is the use of drugs to reduce inflammatory processes or relieve pain during correction of occlusal disorders; c1 is care for patients with occlusal disorders; c2 is the influence of occlusion on the development of the dento-maxillary apparatus of children and methods of disorders prevention and correction; c3 is prevention of occlusal anomalies; c5 is surgical treatment of severe occlusal disorders requiring reconstruction or correction of the dento-maxillofacial apparatus; c7 is the influence of occlusion and TMJ dysfunction on the dento-maxillofacial apparatus; c8 is the influence of occlusal relationships on the manufacture of maxillofacial prostheses; c9 is the role of occlusal factors in the development of caries, periodontal diseases, and pathologies of the oral mucosa; c10 is treatment of maxillofacial pathologies caused by or accompanied by occlusion disorders; c11 is early diagnosis and treatment of occlusal anomalies of children; c12 is surgical correction of maxillofacial disorders of children caused by occlusal deformities; c13 is emergency care for injuries of the dento-maxillofacial apparatus that affect occlusion and joint function; d2 is the preventive measures and the influence of environmental factors and hygiene recommendations.

Vertex p7: b1 is the analysis of movements of the lower jaw and occlusal contacts, work with articulators; b2 is the processes occurring in pathologies and anomalies; b3 is biological aspects of growth and development of tissues of the maxillofacial region; b4 is physical principles of operation of devices for recording movements of the lower jaw; b5 is the biochemical processes in tissues of the maxillofacial region; b6 is the role of oral microflora in the formation of anomalies and deformations, the influence of infectious processes on the condition of the dento-maxillofacial system tissues; b7 is physiological mechanisms of movements of the lower jaw, functioning of the TMJ, and occlusion; b8 is the use of radiological methods for diagnosing anomalies and assessing the condition of the maxillofacial region; b9 is morphological changes in tissues in pathologies and deformations; b10 is the analysis of processes underlying dysfunctions of occlusion and movements; b11 is the use of medications for the treatment of maxillofacial pathologies; c1 is identification of systemic diseases that may affect

dentofacial anomalies (for example, endocrine or infectious processes); c2 is the methods for diagnosing anomalies in the development of the dentofacial apparatus of children; c3 is an early detection of dentofacial anomalies at the stage of preventive examinations; c4 is the use of pharmacological agents to correct conditions that complicate diagnosis or treatment; c5 is the diagnosis and treatment of complex anomalies that require surgical correction; c7 is the use of articulators and other devices for occlusion modeling and treatment planning; c8 is the study of the influence of prostheses on the movements of the lower jaw and the state of the TMJ; c9 is identification of changes in the movements of the lower jaw due to diseases; c10 is diagnostics and restoration of functional disorders after injuries or surgical interventions; c12 is detection of anomalies at early stages of development and their correction; d1 is accessibility of modern diagnostic methods for the population; d2 is the safe use of radiation methods in dentistry.

Vertex p8: b1 is understanding the anatomical structures of the head, neck, and maxillofacial region is the basis for interpreting the results of CT, MRI and ultrasound; b2 is understanding the microscopic structure of tissues to assess changes; b4 is physical principles of CT, MRI, ultrasound; b8 is the use of radiological approaches to assess pathologies of teeth, jaws, and TMJ; c5 is the use of CT for planning operations; c7 is the analysis of jaw movements; c8 is articulation in prosthetics; functional assessment; d1 is the development of evidence-based approaches to the prevention of TMJ diseases; d2 is hygienic standards for the use of diagnostic devices, assessment of the impact on the health of patients and doctors when using CT, MRI.

Vertex p9: b4 is the fundamentals of digital data processing, use of virtual reality in dentistry; c7 is the use of 3D technologies for treatment planning; c8 is the use of digital impressions to create prostheses; d1 is an introduction of digital technologies into the healthcare system.

By studying the valence of the vertices of the resulting graph, it was found that the vertex p7 has the highest degree of 23, as evidenced by the number of edges belonging to the vertex. According to the established valence of this vertex, it can be concluded that the practical lesson «Methods of diagnosing dento-maxillary anomalies and deformations. Devices for registering and analyzing movements of the lower jaw. Analysis of occlusion in the articulator» is the most integrated with the complex of educational disciplines. Reliance on the identified relationships is the basis for the formation of systemic knowledge about the structural and functional characteristics of

the dento-maxillofacial system. Indeed, the elements of the dento-maxillary system interact through forces, moments of forces, and levers taking into account the points of support, providing biomechanical processes that are important for correct use in therapeutic, preventive, and reconstructive dentistry. Understanding the essence of deformation processes in bone tissues and the features of muscle contraction is the basis for effective treatment in orthodontics. The approach we used made it possible to determine the role and place of each topic of practical classes, to adjust the structure of the educational discipline content and the time allocated to the study of each topic. Based on the results of the study, the changes made to the structure of the educational discipline confirm its effectiveness.

CONCLUSIONS

Establishing interdisciplinary connections based on the principles of designing a mixed graph makes it possible to identify points of contact in the content of academic disciplines, techniques, and methods of mental and educational activity of higher education students, thereby strengthening the foundation for the formation of professional practice-oriented competencies.

Researching the set of relationships between individual topics of an academic discipline with a complex of academic disciplines using the mixed graph method helps to design (or significantly improve) the structure of the content, sequence, and volume of lecture and practical classes of an academic discipline, ensuring a significant effect from the use of an interdisciplinary approach.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Nataliia V. Stuchynska

Bogomolets National Medical University,
34 Prospect Beresteiskyy, 03680 Kyiv, Ukraine
e-mail: nvstuchynska@gmail.com

ORCID AND CONTRIBUTIONSHIP

Oleksandr A. Kaniura: 0000-0003-2232-8181 **A** **D** **E** **F**
Natalia V. Stuchynska: 0000-0002-5583-899X **A** **B** **C** **D** **E** **F**
Ihor A. Prokhorenko: 0009-0003-6792-8428 **B** **C** **D**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Analysis of the relationship between some medical, social, economic factors and manifestations of the COVID-19 pandemic

Viktoriia V. Korolenko¹, Hennadii A. Mokhort¹, Tetyana V. Petrushevych¹, Volodymyr V. Korolenko²

¹BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

²KROK UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To investigate the statistical relationship between the manifestations of the COVID-19 pandemic and individual medical, social, economic indicators in the regions of Ukraine and to improve further research in this direction.

Materials and Methods: Research methods include epidemiological, medical-statistical, bibliographic. Statistical analysis of data from the Center for Public Health of the Ministry of Health of Ukraine and the State Statistics Service of Ukraine was carried out.

Results: Correlation analysis showed the presence of an average strength of direct correlation ($p < 0.05$) between the incidence of COVID-19 and the number of retired persons; the number of doctors; the prevalence of malignant neoplasms; also, between mortality from COVID-19 and the number of retired persons; the number of doctors; the number of households; the prevalence of malignant neoplasms; gross regional product per capita; the average age of the population. The analysis also showed the presence of an average strength of inverse correlation ($p < 0.05$) between the incidence of COVID-19 and the average age of the population; the unemployment rate; also, between COVID-19 mortality and unemployment rate; case fatality rate and the number of doctors.

Conclusions: Correlation analysis revealed moderate direct correlations between medical, social, economic parameters. These findings are crucial for developing strategies to predict, prepare for, and mitigate pandemics.

KEY WORDS: COVID-19, mortality, prevention, public health, correlations

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INTRODUCTION

In December 2019, a series of pneumonia cases of unknown origin with signs of viral infection were reported in Wuhan City, Hubei Province, China, and rapidly spread throughout China and other countries around the world [1]. On February 11, 2020, the International Committee on Taxonomy of Viruses officially named the novel virus that caused the Wuhan pneumonia outbreak "severe acute respiratory syndrome coronavirus 2" (SARS-CoV-2) [2]. On March 11, 2020, the World Health Organization declared the spread of the disease caused by SARS-CoV-2 a global pandemic [3].

As of the end of April 2023, there were more than 765 million confirmed cases of COVID-19 and over 6.9 million deaths worldwide [4]. As of May 4, 2023, 5,544,969 cases of COVID-19 have been laboratory confirmed in Ukraine, including 112,268 deaths [5].

The COVID-19 pandemic has demonstrated that effective prediction and management of the spread of infectious diseases requires a deep understanding of the complex interrelationships between economic,

social and medical factors. These factors interact at different levels and can significantly affect the speed and extent of the spread of infectious diseases. The study of economic aspects allows us to understand how income levels, economic stability or instability, and the availability of health services can facilitate or hinder the spread of diseases. Social factors and other aspects of social interaction are also critical for the effectiveness of control and prevention measures. In addition, the analysis of medical aspects, in particular access to health services, allows us to understand which population groups are most vulnerable to infections, which allows us to better plan response measures. All this together makes it possible not only to assess the risks of pandemics in different settings, but also to identify the most vulnerable social and economic groups that need special attention and support. Taking these factors into account is a prerequisite for developing effective health strategies, as well as for optimizing resources and ensuring a timely response to epidemics and pandemics.

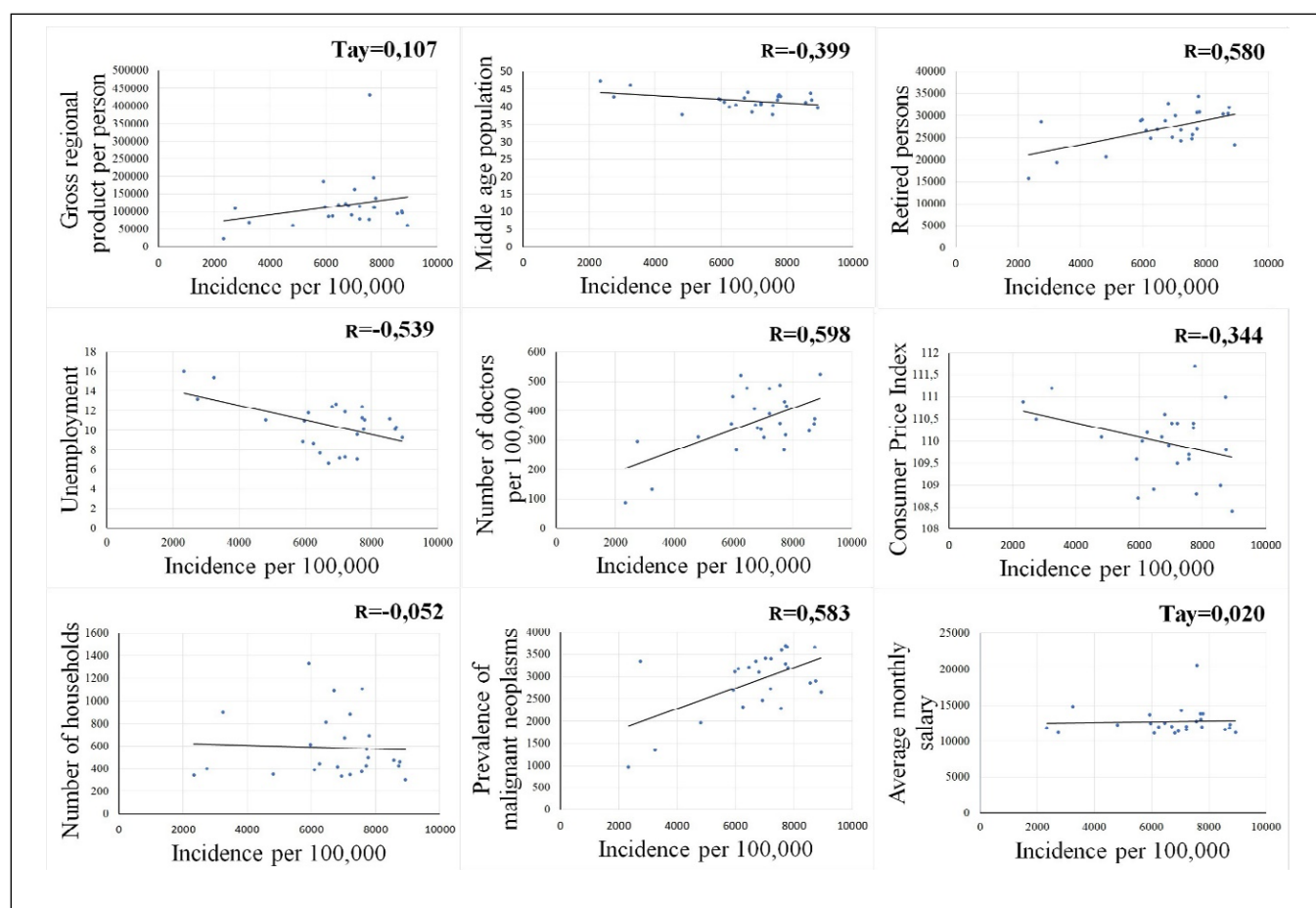


Fig. 1. Correlation fields for COVID-19 incidence and some medical, social, and economic indicators, 2021

AIM

To investigate the statistical relationship between the manifestations of the COVID-19 pandemic and individual medical, social, and economic indicators in the regions of Ukraine and to improve further research in this direction.

MATERIALS AND METHODS

Research methods include epidemiological, medical-statistical, bibliographic.

The objects of the study are individual medical-social indicators and the epidemic process of the new coronavirus infection caused by the SARS-CoV-2.

Information on the number of confirmed COVID-19 cases by region (data for the Autonomous Republic of Crimea, the city of Sevastopol and the temporarily occupied territories are not available) in 2021 was obtained from the "Operational Information on the Main Indicators of COVID-19 Incidence in Ukraine", prepared by Center for Public Health of the Ministry of Health of Ukraine. Data on the number of doctors in 2021 were obtained from reporting form No. 17 "Report on medical personnel for 20__ year". Information on patients with malignant neoplasms in 2021 was obtained from form No. 35-health "Report on patients with malignant

neoplasms for 20__ year". Data on population size, average age of population, number of retired persons, unemployment rate, number of households, average monthly wage per employee, gross regional product per capita, consumer price index by region and number of deaths by causes of death (COVID-19, virus identified U07.1 and COVID-19, virus unidentified U07.2) in 2021 were obtained from the official website of the State Statistics Service of Ukraine.

Statistical processing and analysis of data were carried out using statistical analysis methods in the Biostat statistical analysis package, AnalystSoft Inc. Version 7.3. (USA). An analysis was conducted for the normality of the distribution of data series. The following were calculated: case fatality rate, mortality, incidence, Pearson correlation coefficient (R) and Kendall rank correlation coefficient (Tay).

RESULTS

Correlation analysis showed the presence of a medium strength inverse correlation between the incidence of COVID-19 and the average age of the population ($R = -0.398$ $p < 0.05$) (Fig.1).

The analysis also demonstrated the presence of a medium-strength direct correlation between the inci-

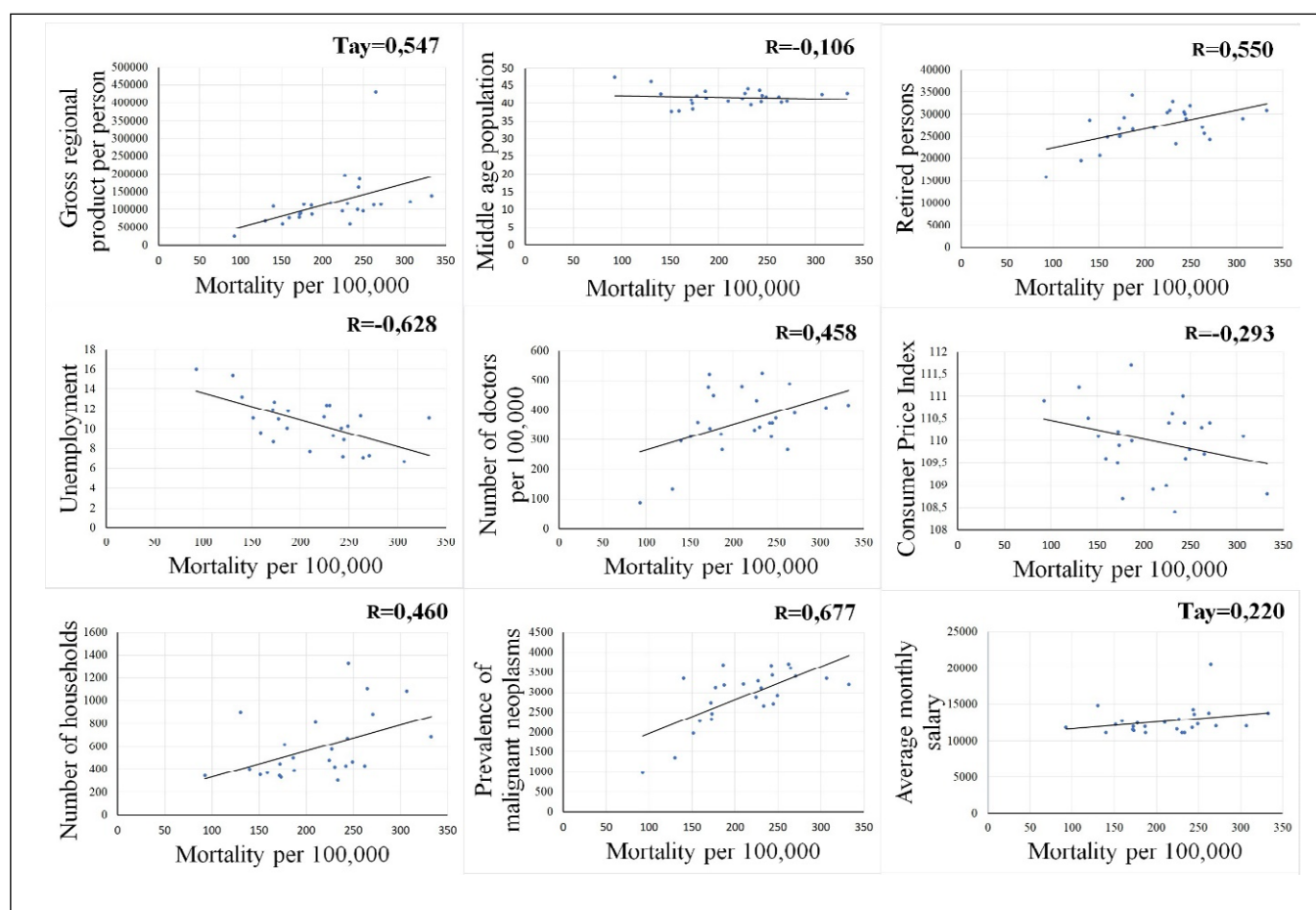


Fig. 2. Correlation fields for COVID-19 mortality and some medical, social, and economic indicators, 2021

dence of COVID-19 and the number of retired persons ($R = 0.580$, $p < 0.05$) (Fig. 1).

Furthermore, correlation analysis showed the existence of a moderate inverse correlation between COVID-19 incidence and unemployment rate ($R = -0.539$, $p < 0.05$). (Fig. 1)

The result of the correlation analysis showed the presence of an average strength of direct correlation between the incidence of COVID-19 and the number of doctors ($R = 0.598$, $p < 0.05$) (Fig. 1).

The correlation analysis also indicated the presence of an average strength of direct correlation between the incidence of COVID-19 and the prevalence of malignant neoplasms ($R = 0.583$, $p < 0.05$) (Fig. 1).

Regarding mortality from COVID-19, the correlation analysis showed the presence of an average strength of direct correlation with the number of retired persons ($R = 0.550$, $p < 0.05$) (Fig. 2).

There is also a moderate inverse correlation between COVID-19 mortality and unemployment ($R = -0.628$, $p < 0.05$) (Fig. 2).

Correlation analysis indicates the presence of a medium-strength direct correlation between COVID-19 mortality and the number of doctors ($R = 0.458$, $p < 0.05$) (Fig. 2).

A medium-strength direct correlation was found between COVID-19 mortality and the number of households ($R = 0.460$, $p < 0.05$) (Fig. 2).

Correlation analysis indicates the presence of a medium-strength direct correlation between COVID-19 mortality and the prevalence of malignant neoplasms ($R = 0.677$, $p < 0.05$) (Fig. 2).

The study of correlations showed the presence of a medium-strength direct correlation between COVID-19 mortality and gross regional product per capita ($Tau = 0.547$, $p < 0.05$) (Fig. 2).

Correlation analysis revealed the presence of a medium strength direct correlation between case fatality rate (CFR) and the average age of the population ($R = 0.462$, $p < 0.05$) (Fig. 3).

According to the results of the correlation analysis, there is a medium-strength inverse correlation between CFR and the number of doctors ($R = -0.412$, $p < 0.05$) (Fig. 3).

The correlation analysis did not reveal significant relationships between the consumer price index and incidence, mortality, and CFR of COVID-19, as well as the average monthly salary of one employee and incidence, mortality, and CFR of COVID-19 (Fig. 1, 2, 3).

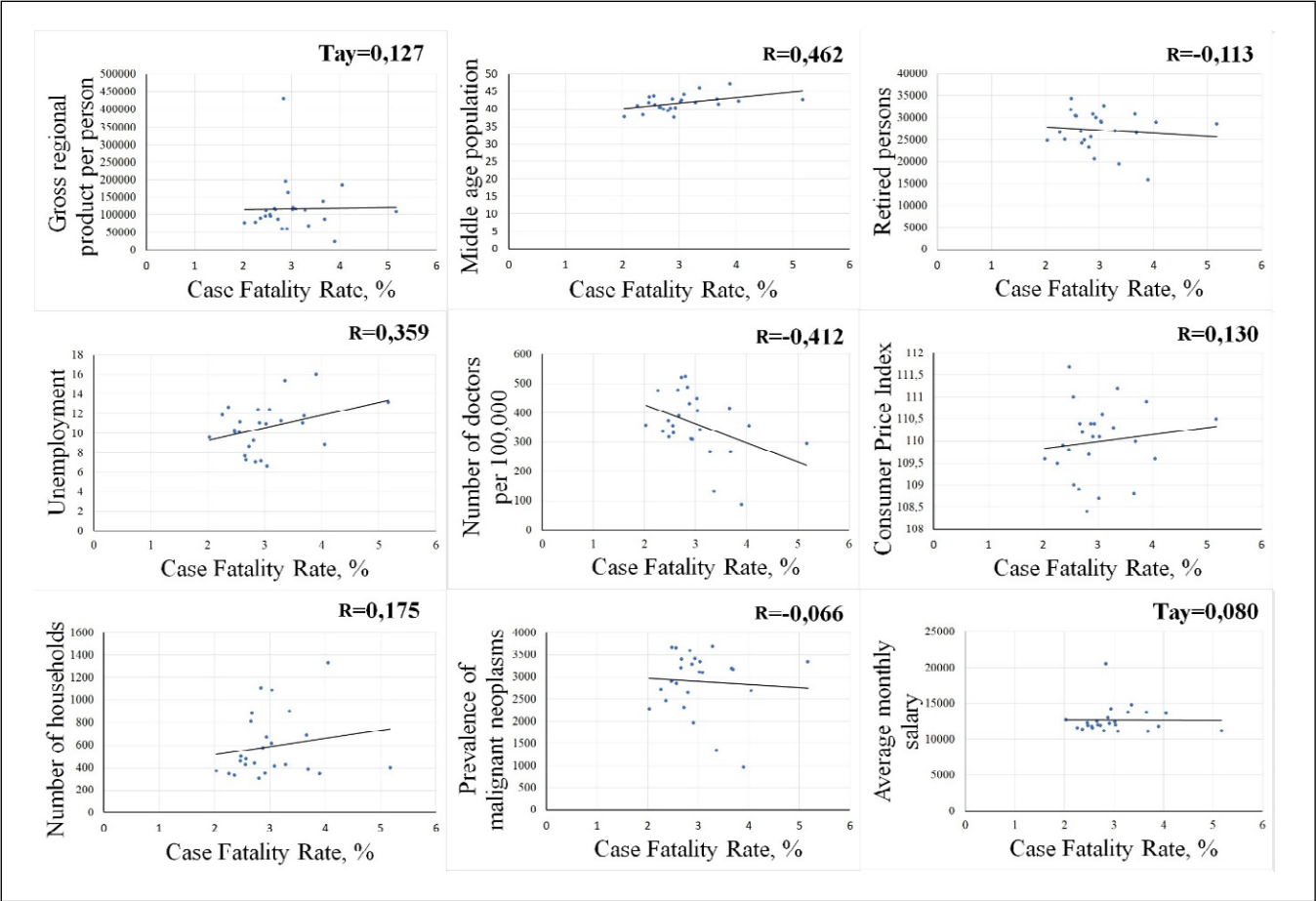


Fig. 3. Correlation fields for CFR of COVID-19 and some medical, social, and economic indicators, 2021

DISCUSSION

The moderate strength of the inverse correlation between COVID-19 incidence and median age is consistent with findings in other countries. Between June and August 2020, the COVID-19 pandemic in the United States affected a greater proportion of younger individuals than it did between January and May, with incidence rates higher among the 40–49 and 50–59 age groups [6]. Europe also saw a similar age shift, as the median age of COVID-19 cases decreased from 46 years in January–May to 35 years in June–July [7]. However, as we found, CFR increases with increasing average age of the population. Thus, according to studies at the regional level, CFR increased with age, in particular, people aged 90+ had a three-fold higher risk of death than 80–89-year-olds, and four-fold higher than 70–79-year-olds [8].

The correlation between COVID-19 morbidity and mortality and unemployment rates can be explained by the likely adaptation of the economy to new conditions and fewer social contacts of the unemployed population. During the first wave of quarantine restrictions in spring 2020, the number of registered unemployed increased by 1.5 times, but in the subsequent waves of 2020–2021, the unemployment rate decreased, while employment in online shopping,

digital banking, food delivery, and remote work increased [9]. However, research also shows that, starting in May 2020, most countries began to gradually ease physical distancing restrictions, leading to an increase in the average number of contacts from 2 to 9 per person per day. However, even after restrictions were eased, contact levels did not reach pre-pandemic levels, with working-age adults having more contacts than older people and children [10].

The presence of a moderate direct correlation between the incidence and mortality of COVID-19 and the number of retired persons is probably due to the fact that they often suffer from chronic diseases, such as cardiovascular diseases, diabetes, lung diseases, and others, which increases the likelihood of developing severe forms of pneumonia, respiratory distress syndrome, and other complications that can lead to fatal outcomes. Thus, studies of COVID-19 among the elderly have revealed a high proportion of severe cases and high mortality [11], and among the most common comorbidities are hypertension and diabetes, which are associated with the severity of the infection. Acute respiratory distress syndrome and acute heart failure may be the main factors complicating the recovery process of patients [12]. Beyond this, there are studies that describe

the impact of the COVID-19 pandemic on access to health services among older adults, and identify mental health and digital health services as key factors influencing their health during the pandemic [13].

The presence of a medium-strength direct correlation between COVID-19 morbidity, mortality and the number of doctors, as well as an inverse correlation between CFR and the number of doctors, can be explained by the fact that due to expanded access to medical services, the diagnosis and registration of disease cases have significantly improved, which has led to an increase in the number of COVID-19 cases [14]. At the same time, timely diagnosis allows treatment to be started at an early stage, which significantly reduces the risk of death. For example, another study showed a significant negative relationship between the number of doctors and CFR of COVID-19, which is consistent with the results of our study [8].

The increase in household size may mean more interactions between household members, especially among seniors with weakened immune systems or chronic illnesses. One study found that individuals who had household contacts with COVID-19 patients with weakened immune systems, as well as those who had diabetes themselves, were more likely to be infected [15]. Studies suggest that diabetes and cardiovascular disease are significant risk factors for disease progression and adverse clinical outcomes in patients with COVID-19 [16].

Many cancer patients have underlying chronic conditions, such as heart, lung, or kidney problems, that can complicate COVID-19. The suppressed immune system of cancer patients increases their risk of infection and serious complications from COVID-19. Studies show that cancer patients are at higher risk of severe infections, need for mechanical ventilation, hospitalization, intensive care, or death, and cancer treatment during COVID-19 infection increases the likelihood of severe complications [17].

Our study's findings of a positive correlation between GDP per capita and COVID-19 mortality are consistent with another study that found a modest positive correlation between GDP per capita and mortality. However, despite the importance of economic wealth for health system financing, this study suggests that there may be other factors, in particular vaccination rates [18], that are associated with levels of economic wealth.

CONCLUSIONS

Correlation analysis demonstrated the presence of an average strength of direct correlation between the incidence of COVID-19 per 100 thousand population and the number of retired persons, the number of doctors, the prevalence of malignant neoplasms, as well as the average strength of inverse correlation between the incidence of COVID-19 per 100 thousand population and the unemployment rate.

In addition, there was an average strength of direct correlation between mortality per 100 thousand population and the number of retired persons, the number of doctors, the number of households, the prevalence of malignant neoplasms, gross regional product per capita, as well as the average strength of inverse correlation between mortality from COVID-19 per 100 thousand population and the unemployment rate.

The results of the correlation analysis also revealed a medium-strength direct correlation between CFR and the average age of the population, and a medium-strength inverse correlation between CFR from COVID-19 and the number of doctors.

The analysis of the impact of medical and social factors on pandemics is critical for predicting their development. This allows for the creation of more effective strategies for preparing for pandemics, responding to them, and, most importantly, preventing or mitigating their negative consequences.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Viktoriia V. Korolenko

Bogomolets National Medical University
34 Prospect Beresteyskyi, 03680 Kyiv, Ukraine
e-mail: viki.epi.2019@gmail.com

ORCID AND CONTRIBUTIONSHIP

Viktoriia V. Korolenko: 0000-0002-5483-4620 [A](#) [B](#) [C](#) [D](#)
Hennadii A. Mokhort: 0000-0002-1743-6885 [D](#) [E](#) [F](#)
Tetyana V. Petrushevych: 0000-0003-1256-2273 [D](#) [E](#) [F](#)
Volodymyr V. Korolenko: 0000-0002-9735-0896 [E](#) [F](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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Using herbal remedies in shelter

Anna (Ganna) P. Megalinska¹, Zhanna I. Bilyk², Olha V. Panchuk³, Valentyna G. Bilyk¹, Ihor St. Chernetskiy², Anita Yo. Szikura⁴

¹ DRAGOMANOV UKRAINIAN STATE UNIVERSITY, KYIV, UKRAINE

² JUNIOR ACADEMY OF SCIENCE OF UKRAINE, KYIV, UKRAINE

³ BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

⁴ FERENC RAKOCZI II TRANSCARPATHIAN HUNGARIAN COLLEGE OF HIGHER EDUCATION, BEREGSZASZ TRANSCARPATHIAN, UKRAINE

ABSTRACT

Aim: The selection and experimental verification of plants that have antibacterial, soothing, and iodine-enriching activity to form the phyto-aid kit in the shelter conditions.

Materials and Methods: Antibacterial activity was studied using the disco-diffusion methods. The iodine strip method was used for iodine deficiency research. To study the anxiolytic effect of plants, the Spielberger-Khanin method was used. Statistical analysis was performed using JASP software.

Results: Among the iodine-containing plants, *Xanthium strumarium* and *Potentilla alba* showed the greatest antibacterial activity. Studies of juices and fruits of fruit plants revealed the strongest antibacterial effect from the fruits of *Schisandra chinensis*. When comparing the iodine-enriching function of the group of iodine-containing plants, all the studied plants showed iodine-enriching activity, with a slight priority from *Zostera marina* and *Lemna minor*. Anxiolytic activity in the conditions of a shelter was also demonstrated by all the studied plants in the following decreasing order, namely *Valeriana officinalis*, *Crataegus ucrainica*.

Conclusions: The use of the studied plants in a shelter phyto-aid kit contributes to a more comfortable and safe stay for people in the shelter.

KEY WORDS: shelter, phyto-aid kit, antibacterial, iodine-enriching and calming plants

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INTRODUCTION

The war on the territory of Ukraine raised a number of urgent questions related to the problems of population civil protection. One of the aspects of civil defence is the functioning of shelters. According to Ryabova S.S. et al [1], most of the existing shelters cannot protect people from weapons of mass destruction and they are characterized by the inability to preserve the mental state of people during a long stay in a shelter. In the work of Kennetha L. et al [2], a thorough analysis of materials describing the effectiveness of the use of bomb shelters during World War II was made, the author proves that the use of bomb shelters saves lives.

Recently, works have appeared that describe the correct parameters of the physical environment that must be maintained in shelters, including temperature and humidity [3]. However, there are no works that describe the contents of aid kit in the shelter.

Historically, shelters had aid kits that contained antibacterial, sedative, iodine-enriching, and anti-radiation

agents. In our opinion, searching for optimal plant components with similar effects to create the aid kit can contribute to a more comfortable and safer stay for people in a shelter, especially during long-term stays in the shelter.

Fatigue causes a person to need rest, which can be realized through relaxation and use of plants with a calming effect. Nervous and mental overstrain can lead to immunodeficiency, and immunomodulatory plants are able to restore the functions of immunocompetent organs. The monotonous interior of the shelter requires a change of impressions, which can be created with the help of herbal smells and teas.

AIM

The main aim of this research is the selection and experimental verification of plants that have antibacterial, soothing, and iodine-enriching activity to form the phyto-aid kit in the shelter conditions.

Table 1. Results of determination of antibacterial activity of iodine-containing plants

Test microorganisms	Zone of inhibition (mm)				
	Type of plant material				
	<i>Zostera marina</i>	<i>Potentilla alba</i>	<i>Xanthium strumarium</i>	<i>Laminaria saccharina</i>	<i>Lemna minor</i>
<i>Escherichia coli</i>	11,1±0,4	19,3±0,1*	29,8±0,3*	7,2±0,4	12,2±0,3*
<i>Staphylococcus aureus</i>	12,2±0,5*	18,4±0,5*	20,1±0,3*	7,2±0,6	9,6±0,7
<i>Proteus vulgaris</i>	11,1±0,4*	13,3±0,4*	11,1±0,2*	-	8,8±0,4
<i>Pseudomonas aeruginosa</i>	14,4±0,2*	14,2±0,9*	13,4±0,5*	11,1±0,3*	10,8±0,6*
<i>Candida albicans</i>	-	8,7±0,2*	8,1±0,3	7,2±0,8	11,1±0,7

Mean values±standard deviation of five independent experiments (n=25). *p≤0.05 compared with control (water), significantly by Student's Test

RESEARCH HYPOTHESIS

Plant raw materials with antibacterial, iodine-enriching, and soothing effects can be a preventive measure against iodine deficiency, stress, and bacterial diseases.

MATERIALS AND METHODS

OBJECT

Plants with antibacterial activity (*Schisandra chinensis* (Turcz.) Baill., *Viburnum opulus* L., *Vaccinium myrtillus* L.), plants with sedative effect (*Valeriana officinalis* L., *Borago officinalis* L., *Crataegus ucrainica* Pojark.), plants with iodine-enriching activity (*Laminaria saccharina* L., *Lemna minor* L., *Xanthium stumarium* L., *Potentilla alba* L., *Zostera marina* L.).

Antibacterial activity was studied by the method of paper discs (disco-diffusion). In Petri dishes, the culture under study was sown with a continuous lawn on the medium. Using sterile tweezers, paper disks (4-5 pieces) were placed on the nutrient medium with culture, which were moistened with a solution of the liquid under study. The sizes of the zones of bacterial growth inhibition determine the degree of sensitivity of the microorganism to the solution under study [4].

All microorganisms were obtained from the Ukrainian Microorganisms collection of the Institute of Microbiology and Virology named after D. K. Zabolotny of the National Academy of Sciences of Ukraine.

The Spielberger-Khanin questionnaire was used to study the sedative potential of plant materials. The method is considered valid because it can be used to determine two types of anxiety (situational and personal). Anxiety was measured by points, according to the gradation of points: up to 30 points – low; 31 – 44 points – moderate; from 45 high [5]. The control group received placebo in the form of 150 ml of boiled tap water.

Considering the psychosomatic connections, in parallel with the measurement of anxiety, we measured the pulse using a pulse oximeter. To determine the iodine-enriching activity, a group of volunteers con-

sumed teas from the studied plants under the control of an iodine test. About 60 students of Dragomanov Ukrainian State University, who were in the same conditions, took part in the experiment.

Each experimental group conducted a preliminary test to detect iodine deficiency, then consumed tea from a certain plant for 15 days, after which the test was repeated. A similar experiment was conducted with respect to the control group.

Iodine deficiency was investigated by applying Lugol's solution to the skin of the forearm [6]. Teas from the studied plants were prepared according to the recommendations [7].

The statistical analysis was performed using JASP software.

The studies were conducted with informed consent from students and in compliance with the rules approved by the Ethics Committee.

RESULTS

As a result of the study, the antibacterial activity of various groups of medicinal plants was screened, both by purpose and by chemical composition. The results of the study are presented in tables 1, 2.

A comparison of the effect of the aqueous extract of iodine-containing plants on *E. coli* shows that the greatest antibacterial effect is exerted by rough cocklebur (inhibition zone was 29.8 mm, which corresponds to the action of such antibiotics as ceftriaxone and cefazolin) and *Potentilla alba* (19.3 mm, which is equivalent to the action of ampicillin and amoxicillin) [8]. Common duckweed shows an inhibition zone of 12.2 mm relative to *E. coli*, such activity can be compared with the action of carbenicillin and ticarcillin. The obtained results can be explained by the fact that *Potentilla alba* and rough cocklebur contain iodates in the composition of raw materials. Eelgrass, common duckweed and kelp have twice as less antibacterial activity. In relation to *St. aureus*, which can accumulate in the air of rooms with a high number of people, the greatest antibacterial

Table 2. Antibacterial property of fruit juices

Test microorganisms	Zone of inhibition (mm)		
	<i>Vaccinium myrtillus</i>	<i>Schisandra chinensis</i>	<i>Viburnum opulus</i>
<i>P. vulgaris</i>	12,1±0,3*	27,3±0,4*	13,2±0,3*
<i>E. coli</i>	10,2±0,1*	23,6±0,2*	7,4±0,4
<i>Ps. aeruginosa</i>	11,4±0,2*	22,1±0,2*	9,2±0,1*
<i>St. aureus</i>	-	14,8±0,1*	11,6±0,2*
<i>C. albicans</i>	8,4±0,5	-	12,1±0,2*

Mean values±standard deviation of five independent experiments (n=25). *p≤0.05 compared with control (water), significantly by Student's Test

Table 3. Results of iodine deficiency study

Respondent	Dependence of iodine deficiency on the duration of tea intake														
	Days of the experiment														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Placebo	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	1 (0%) 1 (50%) 18 (100%)
Zostera marina	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (0%) 18 (100%)	2 (0%) 18 (100%)	2 (0%) 18 (100%)	2 (0%) 14 (100%)	6 (0%) 2 (100%)	18 (0%) 19 (0%)
Potentilla alba	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 10 (100%)	10 (0%) 4 (100%)	16 (0%) 19 (0%)
Xanthium strumarium	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 10 (100%)	10 (0%) 4 (100%)	16 (0%) 19 (0%)
Lemna minor	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (0%) 18 (100%)	2 (0%) 18 (100%)	2 (0%) 12 (100%)	8 (0%) 5 (100%)	15 (0%) 4 (50%)	15 (0%) 1 (50%) 19 (0%)
Laminaria saccharina	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 18 (100%)	2 (50%) 15 (100%)	4 (0%) 1 (50%) 15 (100%)	10 (0%) 10 (100%) 19 (0%)

"100%" is iodine deficiency; "50%" - partial iodine deficiency; "0" – the normal concentration of iodine in the body

activity was found in rough cocklebur, *Potentilla alba* and eelgrass. The action of iodine-containing plants on such as *P. vulgaris* and *Ps. aeruginosa* was found within the inhibition zone of 14-11 mm. Water extract of common duckweed, which has the highest copper content, showed the greatest fungicidal activity against *C. albicans*.

The results of the above-mentioned experiment allow us to recognize the magnolia berry juice the most effective against pathogen bacteria. It was showed the greatest antibacterial effect against *P. vulgaris* (zone of inhibition was 27 mm), which is similar to the effect of the antibiotic ceftriaxone [8]. *Schisandra chinensis* juice demonstrated antibacterial effects against *E. coli* and *Ps. aeruginosa* (inhibition zone was 23 mm and 22 mm in accordance). At the same time, the juices of fruit plants are inferior in their antibacterial activity against *St. aureus* to such iodine-containing plants as *Xanthium strumarium* and *Potentilla alba*. Guelder-rose showed the highest fungicidal activity among the studied fruit plants. Guelder-rose aqueous extract was effective against *St. aureus*. European blueberry aqueous extract

proved to be a more effective antimicrobial agent against *E. coli*, *Ps. aeruginosa* and *P. vulgaris*.

Thus, the conducted experiment allows us to find out that the components of the phyto-aid kit in shelters should be the fruits of magnolia berry, guelder-rose, and among iodine-containing plants, the greatest antibacterial activity is characteristic of rough cocklebur and *Potentilla alba*.

When using nuclear weapons, one of the consequences is the contamination of the environment with short-lived radioactive isotopes of iodine. These isotopes can accumulate in the human body during the metabolism of the thyroid gland. Therefore, iodine-containing plant components can become a protection against the danger of radioactive iodine interference. In order to study the iodine-enriching function of plant components, we studied sea kelp, rough cocklebur, common duckweed, eelgrass and *Potentilla alba*. The results of these studies are presented in table 3.

According to the results of the experiment, all respondents of the control group had iodine deficiency during the 15 days of the experiment, except for one

Table 4. Reliability of iodine deficiency study

Measure 1	Measure 2	Criterion	Statistics	z	df	p
PB	PA	Student	1.000		19	0.330
		Wilcoxon	1.000	1.000		1.000
LB	LA13	Student	2.333		19	0.031 *
		Wilcoxon	15.000	2.023		0.053
LB	LA14	Student	4.158		19	< .001 *
		Wilcoxon	55.000	2.803		0.004 *
LB	LA15	Student	22.584		19	< .001 *
		Wilcoxon	210.000	3.920		< .001 *
RB	RA12	Student	3.390		19	0.003 *
		Wilcoxon	36.000	2.521		0.010 *
RB	RA13	Student	7.094		19	< .001 *
		Wilcoxon	120.000	3.408		< .001 *
RB	RA15	Student	22.584		19	< .001 *
		Wilcoxon	210.000	3.920		< .001 *
NB	NA13	Student	4.158		19	< .001 *
		Wilcoxon	55.000	2.803		0.004 *
NB	NA14	Student	8.110		19	< .001 *
		Wilcoxon	136.000	3.516		< .001 *
NB	NA15	Student	22.584		19	< .001 *
		Wilcoxon	210.000	3.920		< .001 *
PB	PA13	Student	4.158		19	< .001 *
		Wilcoxon	55.000	2.803		0.004 *
PB	PA14	Student	8.110		19	< .001 *
		Wilcoxon	136.000	3.516		< .001 *
PB	PA15	Student	22.584		19	< .001 *
		Wilcoxon	210.000	3.920		< .001 *
ZB	ZA13	Student	6.469		19	< .001 *
		Wilcoxon	105.000	3.296		< .001 *
ZB	ZA14	Student	12.254		19	< .001 *
		Wilcoxon	171.000	3.724		< .001 *
ZB	ZA15	Student	27.606		19	< .001 *
		Wilcoxon	210.000	3.920		< .001 *

PB - before placebo taking; PA- after placebo taking; LB – before Laminaria taking; LA13 - after 13 days Laminaria taking; LA14 - after 14 days Laminaria taking; LA15 - after 15 days Laminaria taking; RB – before Lemna taking; RA12 - after 12 days Lemna taking; RA13 - after 13 days Lemna taking; RA15 - after 15 days Lemna taking; NB - before Xanthium taking; NA13 - after 13 days Xanthium taking; NA14 - after 14 days Xanthium taking; NA15 - after 15 days Xanthium taking; PB - before Potentilla taking; PA13 - after 13 days Potentilla taking; PA14 - after 14 days Potentilla taking; PA15 - after 15 days Potentilla taking; ZB - before Zostera taking; ZA13 - after Zostera taking 13 days ; ZA14 - after 14 days Zostera taking; ZA15 - after 15 days Zostera taking.

* $p \leq 0.05$ compared with control (before), significantly by Student's and Wilcoxon's Tests

respondent who did not have iodine deficiency on the 15th day, which is an error of the study. When consuming *Zoster marine* tea, 10% of the respondents had symptoms of iodine deficiency disappear on the 9th day of the experiment, 10% on the 12th day, 70% on the 13th day, and 10% percent on the 14th day of the experiment, but in most respondents the signs of iodine deficiency disappeared on the 13th day of the

experiment. When drinking common duckweed tea, signs of iodine deficiency disappeared on the 9th, 12th, and 15th days of the experiment in 20% of respondents, and in 40% of respondents on the 13th day of the experiment. When drinking kelp tea, 10% of respondents had symptoms of iodine deficiency disappear on the 11th and 12th day, 20% of respondents – on the 13th and 14th day, and 40% of respondents on the 15th day.

Table 5. Comparison of anxiety levels in people who consumed placebo or teas from different plants

Experiment option	Before		After	
	Level of reactive anxiety	Pulse	Level of reactive anxiety	Pulse
Placebo	38,2±8,1	77,2±9,0	38,0±6,1	78,3±9,0
Valeriana officinalis	41,3±5,4	80,3±15,1	36,4±9,1*	81,1±14,5
Borago officinalis	40,2±8,2	80,4±20,2	36,3±18,5	79,3±7,4
Crataegus ucrainica	40,1±5,3	80,1±10,3	37,2±3,1*	73,3±10,3*

* $p \leq 0.05$ compared with control (before), significantly by Wilcoxon's and Student's Tests

When drinking *Potentilla alba* and rough cocklebur, 50% of respondents had iodine deficiency symptoms disappear on the 13th day, 30% of respondents on the 14th day, and 20% of respondents on the 15th day.

Statistical analysis demonstrated the reliability of the data, which reveals the possibilities for the prevention of iodine deficiency.

All the studied plants have an iodine-enriching effect. *Zostera marina* and *Lemna minor* provide a greater rate of iodine enrichment.

The Spielberger-Hanin experimental results indicate that 16 out of 20 respondents who consumed valerian tea experienced a decrease in situational anxiety (from 3 to 13 units). On average, anxiety across the entire group decreased by 13% (Table 5).

Borage tea reduced situational anxiety indicators (from 1 to 12 units) in 14 out of 20 respondents, however with a certain increase in pulse rate in 14 out of 20 participants (from 3 to 13 units). Nevertheless, on average in the group that consumed Borage tea, the anxiety indicator decreased by 10%. Ukrainian hawthorn tea reduced situational anxiety indicators (from 3 to 8 units) in 18 out of 20 respondents, while also observing a decrease in heart rate in all respondents (from 2 to 12 units). However, the situational anxiety indicator in this group decreased by 8%.

Thus, it has been experimentally proven that all studied plants were effective for overcoming situational anxiety in shelter conditions, but the most effective is tea from Valerian roots (-13%) while maintaining heart rate. Borage tea reduces the situational anxiety indicator by 10% while maintaining the heart rate indicator. Under the influence of Ukrainian hawthorn tea, situational anxiety decreases by 8% while reducing the heart rate.

Statistical processing of the obtained data was performed using JASP software, and the reliability of the results was calculated using Student's and Wilcoxon's coefficients.

According to statistical analysis, some changes in the level of situational anxiety and pulse in individuals who took placebo are not statistically significant. This indicates the absence of suggestion effect on the experiment result. Data on the reduction of anxiety levels in individuals who consumed Valerian tea and Ukrainian

hawthorn tea, as well as the reduction in heart rate, are statistically significant.

DISCUSSION

Our research demonstrates high activity of *Zostera* against *St. aureus*. Similar results were obtained by Choi H.-G., who also demonstrated high antibacterial activity of *Zostera marina* against *Streptococcus epidermidis* and *C. albicans*, and therefore suggests using this plant material to suppress skin pathogens [9]. Grujić-Vasić Jela et al [10] demonstrated high antibacterial activity of *Potentilla alba* against *St. aureus* and *C. albicans*, although our studies show no significant fungicidal effect against *C. albicans*. Antibacterial activity of aqueous and methanolic extracts of *Xanthium strumarium* was demonstrated in the work of Devkota A, the author emphasizes that the most sensitive bacterium is *St. aureus*, and the least sensitive is *E. coli* [11]. Our studies demonstrate a statistically significant inhibition of *St. aureus* growth (inhibition zone was 20 mm), and the absence of a statistically significant zone of inhibition for *E. coli*. The work of Perez MJ et al demonstrated high antibacterial activity of *Laminaria* against *E. coli*, *Salmonella typhimurium*, *St. aureus*, *Bac. cereus*, and we also observed a similar trend [12]. In the work of Esmail Ali Al-Snafi, high antibacterial activity of *Lemna minor* against *St. aureus* was demonstrated (inhibition zone was 25 mm) [13]; in our studies, the inhibition zone was 9.6 mm. The antibacterial properties of the above-mentioned plants are associated by the author with various substances, namely phenols, terpenoids, and others. We suggest that the antibacterial properties of these plants are also associated with iodine-containing substances.

In our work, *Schisandra chinensis* was effective against all studied microorganisms, such as *P. vulgaris*, *E. coli*, *Ps. aeruginosa*, *St. aureus*. Our work correlates with the Liya Song work, which also reveals the mechanism of this phenomenon. It turned out that the extract from *Schisandra chinensis* disrupts the functioning of *St. aureus* $\text{Na}^+/\text{K}^+/\text{Ca}^{++}\text{-ATPase}$ [14].

We have demonstrated high antibacterial activity of aqueous blueberry extract against *P. vulgaris* and *Ps.*

aeruginosa. However, in the work of Miljkovic VM [15], high antibacterial activity of this plant was demonstrated against *Streptococcus epidermidis*, *Streptococcus pyogenes*, *P. mirabilis*, and *St. aureus*, which were isolated from purulent wounds. Nevertheless, Miljkovic VM concludes that there is a difference between the antibacterial activity against museum cultures and isolates from the human body. We have demonstrated high antibacterial activity of aqueous viburnum extract against *St. aureus* and *C. albicans*, which led to the widespread use of this plant for colds [16].

In our work, it was demonstrated that not only *Lam. inaria*, which was studied previously by Chi Y. S. [17], but also other plants can be used for the prevention of iodine deficiency, such as *Lemna minor*, *Potentilla alba*, *Xanthium strumarium*, and *Zostera marina*.

Among plants with a sedative effect, *Valeriana officinalis* proved to be the most effective. Unlike Ukrainian hawthorn, the use of an aqueous extract of this plant does not decrease the frequency and strength of heart contractions. Hattesoil M. argues that valerian,

in addition to its sedative effect, also has an anxiolytic and antidepressant effect, which makes this plant an indispensable addition to a shelter phyto-aid kit [18].

CONCLUSIONS

1. The shelter phyto-aid kit should contain plants with antibacterial properties (preferably combined with an immunomodulatory effect), iodine-enriching plants, and calming plants.
2. According to research, the phyto-aid kit in shelters should be stocked with *Schisandra chinensis*, *Viburnum opulus* and *Xanthium strumarium* as antibacterial and antifungal agents.
3. *Zostera marina* and *Lemna minor* showed the highest iodine-enriching effect. It is rational to have dry herbs of *Zostera marina* and *Lemna minor* in the phyto-aid kit.
4. As a sedative, it is rational to include preparations or roots of *Valeriana officinalis* in the assortment of the phyto-aid kit.

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CORRESPONDING AUTHOR

Anna (Ganna) Megalinska

Dragomanov Ukrainian State University

9 Pirogova St, 02000 Kyiv, Ukraine

e-mail: anna.megalin@ukr.net

ORCID AND CONTRIBUTIONSHIP

Anna (Ganna) P. Megalinska: 0000-0001-8662-8584  

Zhanna I. Bilyk: 0000-0002-2092-5241  

Olha V. Panchuk: 0000-0002-5475-5252 

Valentyna G. Bilyk: 0000-0002-6860-7728  

Ihor St. Chernetskiy: 0000-0001-9771-7830  

Anita Yo. Szikura: 0000-0002-6474-4821  

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Quality of education and labour integration of master's graduates in public health: an insider's perspective

Tetiana S. Gruzieva^{1,2}, Nataliia V. Hrechyshkina¹, Yurii B. Yashchenko², Hanna V. Inshakova^{1,2}

¹ BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

² STATE INSTITUTION OF SCIENCE «CENTER OF INNOVATIVE HEALTHCARE TECHNOLOGIES» STATE ADMINISTRATIVE DEPARTMENT, KYIV, UKRAINE

ABSTRACT

Aim: To determine the opinions of master's graduates in Public Health regarding the quality of the educational process and its impact on employment and further professional activities.

Materials and Methods: The study utilized bibliosemantic, sociological, medical-statistical methods, and content analysis. The research materials included scientific publications, national-level regulatory legal acts, WHO programme documents, and sociological research questionnaires. The programme involved sociological surveys of graduates of the Master's Programme in Public Health. Statistical processing of sociological survey results was carried out by calculating the standard error and confidence interval.

Results: Anonymous surveys revealed that 94.1% of the 2024 graduates of the Master's Programme in Public Health at Bogomolets National Medical University were employed. Their assessment of the quality of educational services was high (82.4%) and fairly high (17.6%), which was ensured by obtaining in-depth theoretical knowledge (93.8%), acquiring essential practical skills (93.8%), and developing the necessary competencies (100%). High learning outcomes were achieved due to the quality of the educational programme content (98.3%), the possibility of forming an individual learning trajectory, modern teaching methods (88.2%), the high qualification of teaching staff (100%), practical orientation (94.1%), integration of education and research (94.1%), adherence to academic integrity (94.1%), an adequate educational environment (82.4%), and comprehensive student support (94.1%–100%). The feedback from master's graduates serves as an essential foundation for improving the training process for public health professionals.

Conclusions: Master's graduates in Public Health highly evaluate the quality of the educational programme and the overall educational process, emphasising their positive and decisive impact on employment. The obtained data allow for a comprehensive assessment of learning outcomes, the dissemination of best practices, and the resolution of problematic issues. Additionally, they help determine ways to improve the Master's Programme in Public Health and the educational process in general to ensure the competitiveness of graduates.

KEY WORDS: public health; quality of education; master's programme; graduates; employment opportunities

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INTRODUCTION

It is well known that achieving the goals set for the healthcare system requires a sufficient workforce, high-quality training, and accessibility for the population. These considerations shape the strategies for developing healthcare human resources, which are outlined in various global, regional, and national-level documents.

The WHO Global Strategy on Human Resources for Health: Workforce 2030, adopted by WHO in 2016, aims to accelerate progress towards universal health coverage and the Sustainable Development Goals by ensuring equitable access to healthcare workers within strengthened health systems. This strategy emphasises the development of human resources as a fundamental

component of the healthcare system and highlights key strategies for effective workforce training, education, and employment [1]. WHO documents state that healthcare workers require safe, healthy, supportive, and dignified working conditions. Their education must incorporate innovative learning approaches and systemic transformative solutions that enable interprofessional collaboration [2, 3].

The need to strengthen and reform the education and training system for healthcare personnel is highlighted in the Resolution on Transforming Health Workforce Education in Support of Universal Health Coverage. Key directions for development include expanding interprofessional education at the community and primary healthcare levels, integrating pre-employment

education with continuous professional development, and implementing accreditation systems for this purpose [4]. Recommendations on health workforce policy increasingly focus on prioritising investments to ensure the effective and efficient use of funding for recruitment and retention, training and professional development, skills formation, job creation, and guaranteeing workers' rights and protection [5].

Effective health workforce strategies encompass education and the development of a wide range of sustainable skills and competencies [6]. In this regard, competency-based learning and workforce regulation are of particular importance. To achieve this, a global system for assessing professional qualities and outcomes has been developed to ensure universal health coverage. Workforce regulation in healthcare plays a crucial role in defining educational standards, ensuring quality assurance, developing professional codes of conduct, and establishing systems for continuous professional growth [7].

In the WHO European Region, several documents address the training of healthcare personnel, including public health professionals. These documents emphasize the need to reform the fundamental training system and the further professional development of healthcare workers. The core component of healthcare systems should be professionals equipped with diverse skills and an innovative approach to work, fostering new forms of collaboration among specialists.

The development of the public health system requires a transformation in service delivery, necessitating a rethinking of training principles and professional education. Training mechanisms and workforce development should focus on creating more flexible human resources capable of effectively addressing challenges arising from epidemiological shifts, collaborating with other sectors on social determinants of health, and more. Emphasis is placed on the need for continuous knowledge and skills updates, the ability to respond to new challenges, and lifelong learning. Existing educational structures must implement modern teaching methodologies, including small group interactions, the use of digital technologies and simulation laboratories, and the organization of distance learning [8–11].

The relationship between education quality and employment opportunities in the field of public health is linked to practice-oriented training, the relevance of educational programs, the integration of higher education institutions with the labour market, their reputation, and the internationalization of the educational process. Practice-oriented training enables students to simulate real-world problem-solving scenarios, such as investigating epidemiological situations within dis-

ease control and prevention centres and public health institutions. It also allows them to tackle practical case studies, such as managing public health programs, analysing and evaluating data, communicating with various stakeholders, conducting individual creative and practically oriented tasks, undertaking internships at leading public health institutions, and participating in research projects. These aspects enhance graduates' competitiveness in the labour market [12–17].

Given the importance of the efficiency of public health professionals, researching the impact of the quality of master's training on employment opportunities and successful career advancement within the public health system is highly relevant.

AIM

To identify the opinions of master's graduates in Public Health regarding the quality of the educational process and its influence on employment and further professional activity.

MATERIALS AND METHODS

The study utilized bibliosemantic, sociological, medical-statistical methods, and content analysis. The research materials included scientific publications, national-level regulatory legal acts, WHO program documents, and sociological research questionnaires. The program involves conducting sociological surveys of graduates of the Master's program in Public Health from the Bogomolets National Medical University, 2024 graduates.

For this purpose, a relevant tool in the form of an anonymous survey questionnaire was developed. The questionnaire included questions on the professional field of activity, overall evaluation of the quality of educational services provided, including theoretical knowledge, practical skills, acquisition of necessary competencies, alignment of the content of the Public Health educational program with the professional profile, the presence of useful and unnecessary subjects in the program, the use of various teaching methods, satisfaction with the practical training, the qualification level of the teaching staff, the practical orientation of the program, the integration of learning and research, adherence to academic integrity, access to electronic resources, the quality of the educational environment, and the availability of educational, consultative, informational, and social support, as well as comments and suggestions.

Statistical processing of the of the sociological survey results was carried out by calculating the standard error and confidence interval.

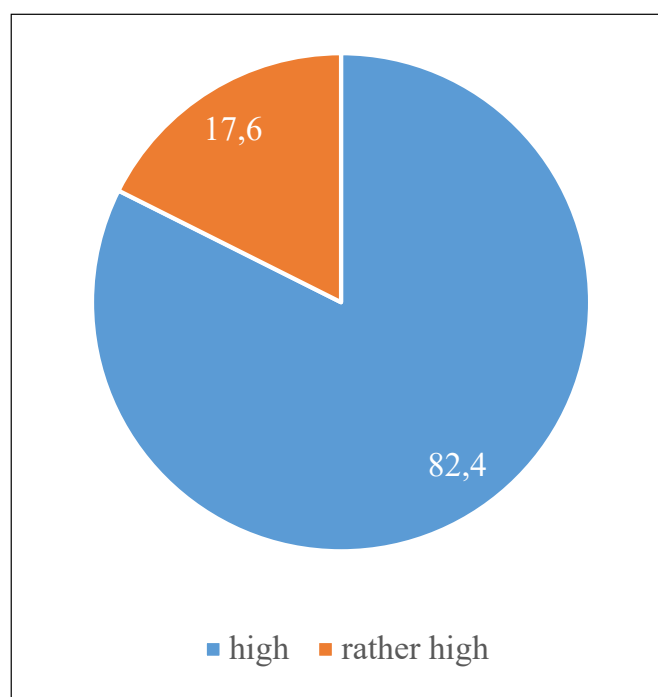


Fig. 1. Evaluation by graduates of the Master's program in Public Health of the quality of educational services (%)

RESULTS

Among the graduates of the Master's program in Public Health who participated in the survey, 31.25% were specialists working in the fields of hygiene and epidemiology, 25.0% were employed in healthcare, 18.75% in education, and 6.25% in each of the following sectors: civil service, laboratory diagnostics, medical tourism, and monitoring and evaluation. At the time of the survey, 35.3% of respondents were working in the field of Public Health, 58.8% in another related specialty, and 5.9% were not employed.

Analysis of the respondents' answers revealed a high evaluation of the quality of the educational process. Specifically, 82.4% [63.9–100.8] of the respondents rated the quality of educational services received during the Master's program in Public Health as high, while 17.6% rated it as rather high. These positive responses indicate the graduates' satisfaction with their education in this program (Fig. 1).

Regarding job search after completing the Master's program in Public Health, only a few respondents actively engaged in this process, as most graduates were already employed and studying part-time. Those who actively searched for a job spent from 7 days to 2 months on the process.

The level of theoretical knowledge gained during the program was considered sufficient for further professional activity by the respondents. 62.5% [38.3–86.7] assessed it as fully sufficient, while 31.3% rated it as rather sufficient. Among the 6.2% of respondents who found it difficult to determine, some expressed a desire for deeper exploration of topics such as working with

personal data, various templates, medical procurement, and practical experience exchange with other countries.

The level of practical skills acquired was similarly rated, with 93.8% [81.6–105.9] of respondents confirming that it was entirely sufficient. An important outcome of the Master's program was the acquisition of necessary competencies for future professional activities, which was confirmed by 100% of respondents.

Three-quarters of the respondents indicated that the content of the educational and professional program "Public Health", based on the list of mandatory and elective courses studied during the program, fully corresponds to the profile of their professional activities (75.0% [53.3–96.7]), while about one-fifth (18.8%) stated that it mostly corresponds.

Regarding the usefulness of studying specific courses for professional training of Master's students in public health, most respondents indicated all of them. The most frequently mentioned courses were "Fundamentals of Public Health", "Biostatistics", "Epidemiology of Infectious Diseases", "Epidemiology of Non-Infectious Diseases", "Law in Public Health", "Prevention", "Informatization in Health Care", and "Quality Management in Health Care".

The ability to form an individual educational trajectory through the free choice of elective components was adequately ensured for 82.4% [63.9–100.8] of respondents, and rather adequately for 17.6%.

Regarding the timeframes for mastering the courses outlined in the educational program "Public Health", 88.2% [72.6–103.9] of respondents considered them sufficient.

The use of modern teaching methods, such as case method, brainstorming, business and role-playing games, etc., was confirmed by 82.4% [63.9–100.8] of respondents.

41.2% [17.3–65.0] of graduates were fully satisfied with the organization of their practical training, while 47.1% [22.8–71.3] were rather satisfied.

All graduates rated the qualifications of the scientific and pedagogical staff who taught the "Public Health" program as fully adequate. The overwhelming majority of respondents highlighted the practical orientation of the training (94.1% [82.4–105.9]) and the combination of education with scientific research (94.1% [82.7–105.5]) (Fig. 2).

Graduates of the Master's program confirmed adherence to academic integrity by participants in the learning process (94.1% [82.7–105.5]) and the provision of opportunities to express their opinions on various aspects of the educational process (100%).

Respondents believe that during their studies, they were generally provided with free access to electronic information resources (94.1% [82.7–105.5]), an adequate educational environment (82.4% [63.9–100.8]), and the highest level of safety (88.2% [72.6–103.9]).

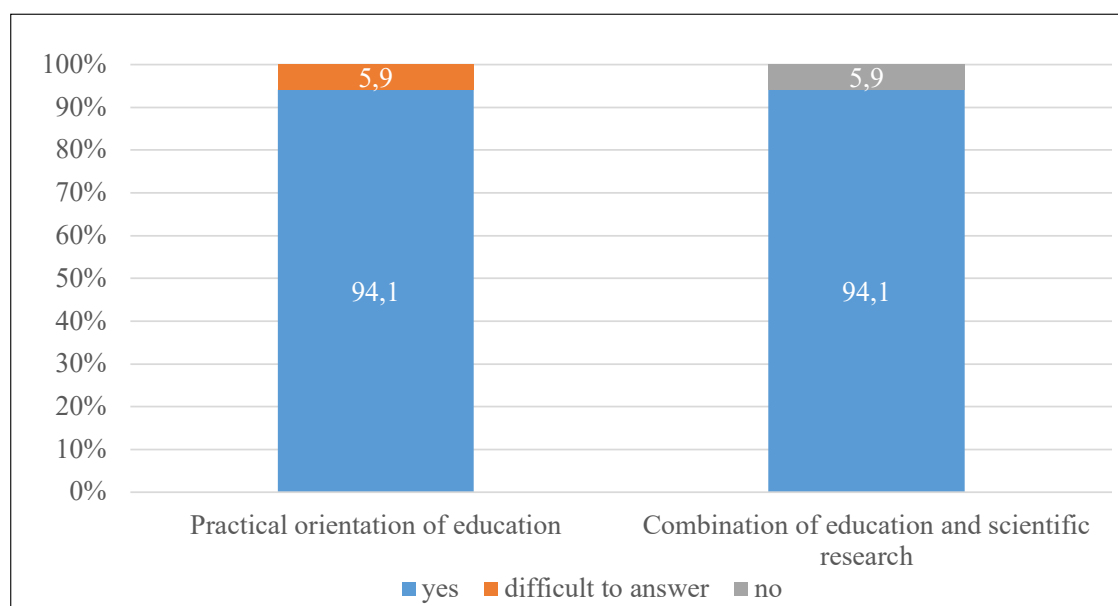


Fig. 2. Evaluation by graduates of the Master's program in "Public Health" of the practical orientation of the training and the combination of education with scientific research (%)

The study results indicate that students received full educational and advisory support from the directorate and academic staff during their studies, as confirmed by 100% of respondents. Sufficient informational support was also provided, as indicated by 94.1% [82.7-105.5] of respondents.

A valuable outcome of the study was the analysis of graduates' suggestions for improving the "Public Health" educational and professional program and the learning process. These included expanding the curriculum to cover pandemics, the impact of climate change and conflicts on public health, and the digitalization of healthcare; enhancing internationalization, increasing student mobility, and expanding international exchange opportunities.

DISCUSSION

The study of graduates' opinions on various aspects of the educational process and its outcomes is crucial for understanding both achievements and challenges, addressing which will enhance education quality and meet the needs of educational service consumers. The importance of such an approach in ensuring the effectiveness of educational activities has been highlighted by several domestic and international researchers. In particular, monitoring and evaluating the quality of the educational process, including the assessment of educational components and graduate satisfaction, are significant mechanisms for improving university education quality [12-14].

Our findings indicate that graduates of the Master's program in Public Health at Bogomolets National Medical University highly evaluated the educational process. The demand for such professionals proved to be high, as almost

all graduates were employed (94.1%). The quality of educational services was rated as high (82.4%) and fairly high (17.6%) by all survey participants. This was ensured by both the acquisition of in-depth theoretical knowledge and the development of necessary practical skills. These factors contributed to the formation of the professional competencies required for employment and further professional activity among Public Health master's program graduates.

The assessment of the quality of the Master's program in Public Health by graduates showed that its content fully aligns with the professional activity profile. Only one respondent identified two subjects they considered less important, while 93.8% confirmed the relevance and necessity of all educational components.

Among the key advantages of this program, graduates highlighted the opportunity to shape an individual educational trajectory through the free selection of elective components, the sufficient time allocated for mastering academic disciplines, the use of modern teaching methods, the practical orientation of training, an adequate level of industrial practice organization, and the integration of education with scientific research.

According to graduates, the quality of the educational process was enhanced by adherence to academic integrity, the opportunity to express personal opinions on various aspects of the learning process, free access to electronic information resources, a supportive educational environment, and comprehensive student support from the administration and faculty. At the same time, studying the opinions of graduates of the Master's program in Public Health has helped identify suggestions for improving the educational and professional program and the learning process, which will form the basis for its optimization.

Our findings are consistent with those of other researchers studying the opinions of Public Health master's program graduates. For instance, graduates of the Master's program in Public Health at the Medical University of Warsaw predominantly (80%) did not intend to pursue third-cycle studies, while a significant proportion engaged in public health practice (37.43%), working in roles aligned with their degree (60.70%), including in the public sector (33.38%) and in managerial positions (23.27%) [15].

A study conducted among graduates of the Master's in Public Health program at the Hanoi School of Public Health revealed that the majority (91%) considered the curriculum to be aligned with the professional requirements of public health specialists. Most respondents (96%) were satisfied with the learning process, 90% were satisfied with the curriculum, and 95% reported acquiring relevant professional skills. Additionally, 73% of respondents believed that the program's structure was balanced and well-designed, while 64.3% were satisfied with full-time faculty and over 83% with guest lecturers. Among public health competencies, graduates emphasized computer skills (66.4%), planning and managing health programs (47.9%), and engaging with communities to mobilize them for health initiatives (43.2%). However, respondents identified deficiencies in data analysis skills, decision-making, intersectoral collaboration, and English proficiency [16].

A survey and in-depth interviews with graduates of the Haifa School of Public Health indicated that 35% of respondents received a promotion in their current positions due to their degree, while 63.8% believed it helped improve their work performance. Most graduates (80.3%) did not change jobs after completing their studies. The Master's program contributed to their personal and professional development by providing a comprehensive understanding of public health and healthcare systems, as well as enhancing their research

skills. Barriers to professional growth included a lack of core competencies, low salaries, and insufficient information on suitable job opportunities. Graduates noted that the degree supported their career advancement, job satisfaction, and leadership development [17].

Our study findings align with existing scientific literature, enabling a critical assessment of the obtained results, addressing challenges, and identifying pathways for improving the Master's in Public Health program and the educational process as a whole.

CONCLUSIONS

The assessment of graduates of the Master's in Public Health program regarding the quality of the educational process and its impact on employment and professional activities demonstrates a positive evaluation of the program and the quality of educational services. Graduates highlight the adequacy of their theoretical knowledge, practical skills, and acquired competencies, ensuring their professional employability and alignment with industry requirements.

The high learning outcomes were achieved through the quality and comprehensiveness of the educational program, the possibility of creating an individual learning trajectory, modern teaching methods, the high qualifications of academic staff, the program's practical orientation, student-centered learning, a well-developed educational environment, and comprehensive support for students.

Graduates' suggestions for expanding the study of pandemic-related issues, the impact of climate change and conflicts on public health, and the digitalisation of healthcare, as well as enhancing internationalisation, student mobility, and international exchange programs, provide a valuable foundation for improving the training process for public health professionals.

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CORRESPONDING AUTHOR

Tetiana S. Gruzieva

National Bogomolets Medical University
34 Prospect Beresteiskyi, 03680 Kyiv, Ukraine
e-mail: gruzieva@ukr.net

ORCID AND CONTRIBUTIONSHIP

Tetiana S. Gruzieva: 0000-0001-9254-7561 [A](#) [B](#) [C](#) [D](#) [E](#) [F](#)

Nataliia V. Hrechyshkina: 0000-0002-9499-4362 [B](#) [C](#)

Yurii B. Yashchenko, 0000-0003-1790-6725 [E](#)

Hanna V. Inshakova: 0000-0002-3984-8864 [B](#) [C](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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Primary outcomes of mhGAP program implementation in higher medical education institutions

Iurii L. Kuchyn, Olena O. Khaustova, Ivanna V. Sakhandia, Andrii O. Burdeinyi, Stanislav O. Stashenko
BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To investigate the effectiveness of introducing a course based on the mhGAP program into the curriculum of students at Bogomolets National Medical University, with the aim of improving the quality of primary medical and psychological care, promoting early identification of mental disorders, and justifying the need for implementing similar educational programs in other medical universities.

Materials and Methods: The study involved 340 fifth-year students from Bogomolets National Medical University, who provided consent for the processing of their data. To assess the effectiveness of the course implementation, a survey method was used. Students were asked to complete the questionnaire twice: at the beginning of the course and after its completion. The survey included questions aimed at determining the initial and final level of knowledge about mental, neurological, and substance use disorders, in order to evaluate the learning outcomes of the mhGAP program.

Results: The study results demonstrated a significant improvement in the level of knowledge among medical faculty students regarding mental disorders and methods of primary psychological intervention after completing the five-day course based on the mhGAP program. The increase in the average score from 9.029 ± 2.805 to 13.568 ± 1.594 ($p < 0.001$) confirms the effectiveness of the course in enhancing students' awareness, reducing the variability of results, and ensuring successful material comprehension. These findings underscore the importance of the mhGAP program in preparing medical professionals to work with mental disorders at the primary care level.

Conclusions: The study confirmed the high effectiveness of the mhGAP program in preparing medical specialists to work with patients with mental disorders. The obtained results can be used to implement educational programs in medical universities, which will improve the quality of primary medical and psychological care and contribute to more effective early identification of mental disorders.

KEY WORDS: mhGAP, mental health, intervention guide, implementation

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INTRODUCTION

The issue of mental and neuropsychiatric disorders is gaining increasing importance within the global medical community, especially in the context of contemporary global challenges, such as the COVID-19 pandemic, armed conflicts, and ongoing stress factors that impact the mental health of populations. The World Health Organization (WHO) predicts that by 2030, mental disorders will be one of the leading causes of disability worldwide [1]. In this regard, it is crucial to ensure the training of medical professionals capable of effectively responding to challenges in mental health care.

The mhGAP (Mental Health Gap Action Programme) was developed by WHO in 2008 to reduce the gap between the need for psychiatric services and their availability, particularly in low- and middle-income countries [2]. This program aims to provide basic mental health care training to general practitioners and other healthcare professionals who are not psychiatrists [3]. It covers a

range of disorders, such as depression, anxiety, epilepsy, substance use disorders, as well as suicide and other critical conditions. One of the key features of mhGAP is the provision of clear and practical guidelines, enabling healthcare workers to offer necessary assistance even in regions with limited access to psychiatric services [3-4].

In Ukraine, the mhGAP program has been actively implemented in recent years, particularly in the context of providing assistance to those affected by the military conflict in the east of the country and due to the increasing number of post-traumatic stress disorder (PTSD) cases among the population. The Ministry of Health of Ukraine, together with partners, including the WHO, is actively working on expanding mhGAP implementation within training programs for general practitioners. This includes the preparation of specialists capable of integrating psychiatric care at the primary healthcare level, which is especially important for regions with limited access to specialized care.

mhGAP has already proven effective in several countries, including Africa, South Asia, and Latin America, where there is a significant shortage of mental health professionals [4-6]. For example, in Zambia, Ethiopia, and Pakistan, the program has significantly expanded access to treatment for patients with depression, epilepsy, and other mental disorders. These successful cases demonstrate that the program's tools are effective in resource-limited environments, and their implementation has a positive impact on treatment outcomes.

The implementation of the WHO-developed mhGAP program in higher medical education institutions is one of the current solutions for preparing doctors who will be able to identify and treat neuropsychiatric disorders at various levels of medical care [7]. The mhGAP program aims to reduce the gap between the need for psychiatric services and their availability, especially in conditions of a shortage of mental health professionals, which is also relevant for Ukraine [8-10].

Given that most physicians graduating from medical institutions may choose specialties not directly related to the treatment of mental disorders, it is crucial to provide them with basic knowledge and skills in this field. This will enable them not only to recognize the primary symptoms of mental disorders in their practice but also to appropriately refer patients to specialists and provide primary psychological support.

The mhGAP program also helps students develop essential communication skills for interacting with patients with mental disorders, which is a necessary component of both primary and specialized medical care. Future doctors, regardless of their specialization, will be better equipped to engage with various population groups, including those suffering from mental disorders, significantly improving the overall quality of healthcare services.

Moreover, the implementation of mhGAP enables medical students to gain a better understanding of the socio-economic and cultural factors that affect mental health, thus fostering a more holistic approach to patient care. Training physicians who recognize the importance of mental health and its impact on a patient's overall well-being is critical for the advancement of the modern healthcare system.

Thus, integrating the mhGAP program into higher medical education institutions is a crucial step in ensuring the appropriate level of training for healthcare professionals who can effectively respond to mental health challenges and contributes to the overall improvement of healthcare quality.

AIM

To investigate the effectiveness of introducing a course based on the mhGAP program into the curriculum of students at Bogomolets National Medical University, with the aim of improving the quality of primary medical and psychological care, promoting early identification of mental disorders, and justifying the need for implementing similar educational programs in other medical universities.

MATERIALS AND METHODS

To evaluate the effectiveness of the implementation of the World Health Organization's global «Mental Health Gap Action Programme» (mhGAP) at the Bogomolets National Medical University, a survey was conducted at the beginning and upon completion of the academic course titled «Fundamentals of Clinical Practice in Mental Health.» The study was conducted at the Department of Medical Psychology, Psychosomatic Medicine, and Psychotherapy of the Educational and Research Institute of Mental Health at the Bogomolets National Medical University. It involved 340 fifth-year students majoring in «Medicine» who consented to the processing of their data. All data were stored in Microsoft Excel 365 and analyzed using the medical research statistical analysis software «JASP» v0.19.1.0 [11]. The level of statistical significance was set at $p < 0.05$, and the confidence interval was 95%.

STUDY DESIGN

The study design was a quasi-experimental «pre-test/post-test» design without a control group, which involved conducting surveys at the beginning of the course «Foundations of Clinical Practice in Mental Health Care» and at the end of the course.

In the first phase, students completed a questionnaire that assessed their initial level of knowledge regarding mental and neurological disorders, as well as substance use-related disorders, in terms of the basic principles of assistance and clinical practice in the field of mental health, diagnostic criteria, and management of patients with mental, neurological, and substance-related disorders.

The second phase included practical sessions focused on developing practical skills, presented through role-playing, clinical cases, and group work methods about Mental, Neurological, and Substance-related disorders (MNS Disorders). Given that the course spans 2 years (on the fifth and sixth years of study), the topics for the first year included: «Mental Health Gap Action Programme (mhGAP)», «Basic Principles of Assistance and Clinical Practice», «Basic Principles of Assistance and Clinical Practice. Stages

of Management of MNS Disorders», «Managing Patients with MNS Disorders Using the mhGAP Tools: Depression», «Managing Patients with MNS Disorders Using the mhGAP Tools: Suicides and Self-Harm», «Managing Patients with MNS Disorders Using the mhGAP Tools: Stress, Acute Stress Disorder, Grief, and Post-Traumatic Stress Disorder» and «Managing Patients with MNS Disorders Using the mhGAP Tools: Anxiety Disorders».

The third phase involved a follow-up survey after the course to assess the level of knowledge gained about mental disorders, according to the mhGAP program modules presented in the second phase.

The surveys at the first and third phases consisted of 15 test questions, which were previously formulated based on the mhGAP modules mentioned in the second phase and were identical in both phases to ensure the reliability of the study results.

IMPLEMENTATION OF THE mhGAP PROGRAM IN THE THEMATIC AREA

Mental health is an integral component of medical education, as the effectiveness of providing care to patients with neuropsychiatric and mental disorders depends on the level of training of future doctors. Considering the importance of this topic, the course was spread over two years, with the fifth year focused on studying the key aspects of the mhGAP program and principles for managing patients with mental, neurological, and substance use disorders.

MENTAL HEALTH GAP ACTION PROGRAMME (mhGAP)

This topic allowed students to become familiar with the WHO's mhGAP program aimed at expanding access to quality psychiatric care, especially in countries with limited resources. The relevance of mental, neurological, and substance use disorders, their prevalence, socio-economic consequences, and impact on public health were discussed. Special attention was given to terminology, diagnostics, methods of initial patient assessment, and management principles in resource-limited settings. The structure and algorithms of mhGAP were also thoroughly studied, which allow doctors to make quick decisions. The development of practical skills helped prepare students for further study of specialized topics.

BASIC PRINCIPLES OF ASSISTANCE AND CLINICAL PRACTICE

Students familiarized themselves with the principles of providing mental health care, including ethical aspects,

communication skills, and methods of supporting patients with mental and neuropsychiatric disorders. Techniques for de-escalation, diagnostic assessment algorithms, and approaches to working with comorbid conditions were studied. Special attention was given to the impact of violence on mental health and strategies for helping victims. The IASC pyramid for structuring psychosocial support in crisis and emergency situations was also discussed.

BASIC PRINCIPLES OF ASSISTANCE AND CLINICAL PRACTICE. STAGES OF MANAGEMENT OF MNS DISORDERS

Students studied the key principles of managing patients with mental, neurological, and substance use disorders, including condition assessment, treatment strategy selection, and an interdisciplinary approach. Special focus was given to psychosocial interventions, psychoeducation, cognitive-behavioral therapy, and family support. Algorithms for referring patients to specialized professionals and social services were explored. The main groups of medications, principles of their safe prescription, and the importance of informing patients about therapy were also studied. This topic helped students acquire a comprehensive approach to treating and supporting such patients.

MANAGING PATIENTS WITH MNS DISORDERS USING THE mhGAP TOOLS: DEPRESSION

Students became familiar with the management of patients with depression according to the WHO mhGAP recommendations, focusing on diagnosis, treatment, and follow-up care. They studied the key symptoms, risk factors, and socio-economic consequences of depression, as well as differential diagnosis with other disorders. Special attention was given to psychosocial interventions, including psychoeducation, stress management techniques, and cognitive-behavioral therapy, as well as the principles of pharmacotherapy, antidepressant selection, and treatment monitoring. Students acquired a comprehensive approach to therapy and long-term support for patients.

MANAGING PATIENTS WITH MNS DISORDERS USING THE mhGAP TOOLS: SUICIDES AND SELF-HARM

Students studied the key principles of managing patients with suicidal and self-harming behavior according to mhGAP, focusing on risk assessment, differential diagnosis, and effective interventions. They explored the differences between suicidal intentions and non-suicidal

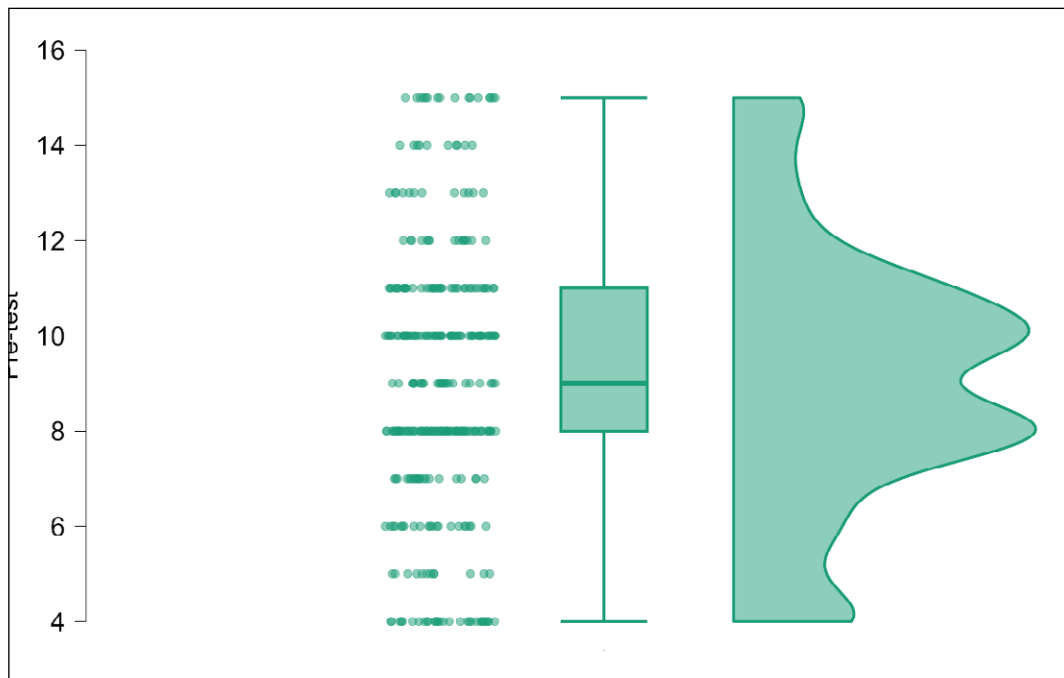


Fig. 1. Distribution of the pre-test results for students (Pre-test)

Table 1. Statistical indicators of the pre-test results for students (Pre-test)

N	Lower Whisker	25th Percentile	Median	75th Percentile	Upper Whisker
340	4.000	8.000	9.000	11.000	15.000

self-injury, key risk factors, and protective factors. They mastered algorithms for assessing suicidal risk and crisis interventions, methods of emergency care, and psychosocial support. Special attention was given to long-term follow-up, relapse prevention, and involving the family and community in the recovery process.

MANAGING PATIENTS WITH MNS DISORDERS USING THE MHGAP TOOLS: STRESS, ACUTE STRESS DISORDER, GRIEF, AND POST-TRAUMATIC STRESS DISORDER

Students studied the management of patients with acute stress disorder, grief, and PTSD, focusing on their clinical presentation, impact on mental and public health, and diagnosis using WHODAS 2.0. They explored psychosocial and pharmacological interventions, including psychoeducation, stress reduction, social support, and medication when necessary. Special attention was given to adaptation strategies and relapse prevention through long-term support for patients to improve their quality of life.

MANAGING PATIENTS WITH MNS DISORDERS USING THE mhGAP TOOLS: ANXIETY DISORDERS

Students examined the key aspects of diagnosing and managing patients with anxiety disorders using

mhGAP. They discussed common symptoms, the impact on quality of life, risk factors, and differential diagnosis. Emphasis was placed on a comprehensive treatment approach, including psychosocial interventions (psychoeducation, self-regulation techniques, social support) and pharmacotherapy (antidepressants, anxiolytics). Ongoing patient support was highlighted as essential for maintaining stability and improving long-term treatment outcomes.

RESULTS

Based on the results of the first stage of the study, we were able to assess the baseline level of knowledge among students regarding mental disorders and primary psychological intervention methods according to the mhGAP modules previously mentioned. The analysis of the pre-test showed that the average score of the students was 9.029 ± 2.805 , indicating a moderate level of awareness before the start of the course (Fig. 1).

At the same time, the significant variability in the results (Table 1) demonstrates the heterogeneity of the students' knowledge levels, which may be related to individual previous learning experiences or self-study of the topic.

The obtained data indicate that a significant portion of students possess only basic knowledge regarding the principles of assistance for mental, neurological, and

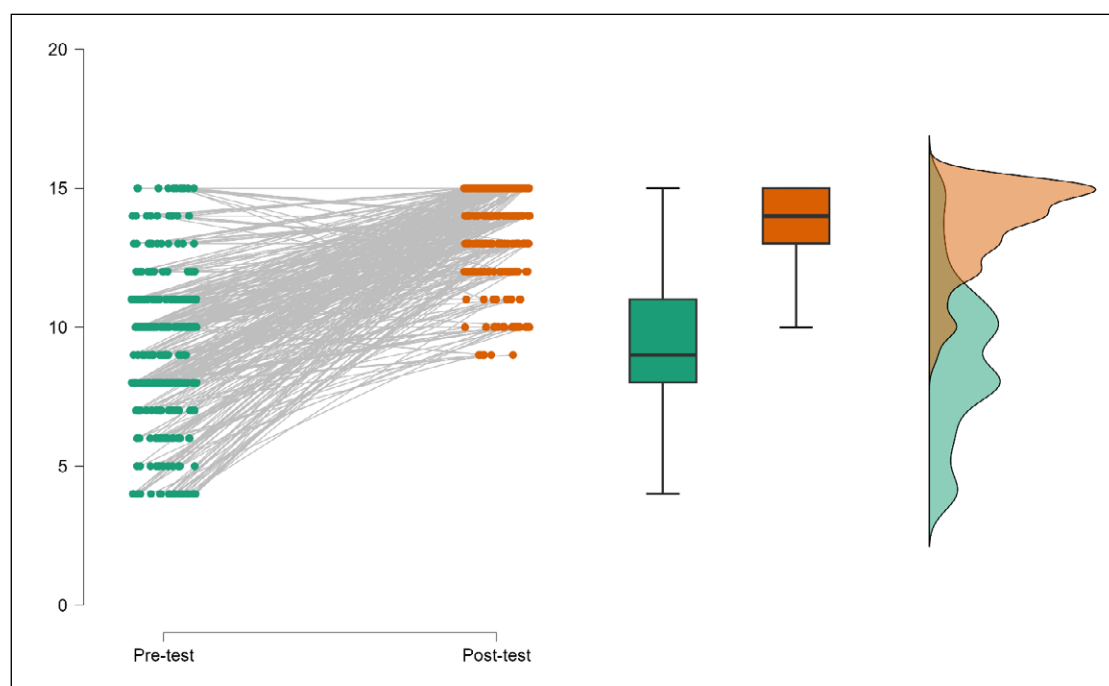


Fig. 2. Dynamics of changes in awareness indicators in the field of mental health according to mhGAP modules at the 1st and 3rd stages

behavioral disorders. This suggests potential gaps in understanding diagnostic criteria and the management of patients with such conditions, despite the importance of this aspect in medical education. The presence of students with high results may be explained by an interest in psychiatry or personal experience.

According to the second stage, students underwent a five-day study of the mhGAP modules, after which a survey was conducted, with results based on post-testing (Post-test). The final evaluation showed a significant improvement in students' knowledge after completing the course. The average score in the final test was 13.568 ± 1.594 , indicating a high level of knowledge after completing the course. The minimum score was 9, and the maximum was 15, suggesting a reduction in the variability of the results and a more homogeneous level of knowledge among students (Table 2).

The comparison of pre-test and post-test results showed a statistically significant improvement ($t = -27.141$, $p < 0.001$), which confirms the effectiveness of implementing the course based on the mhGAP program into the educational process (Fig. 2). The significant increase in the average score indicates the positive impact of the course on students' awareness of mental and neurological disorders and the skills necessary for providing psychological assistance.

DISCUSSION

The implementation of the mhGAP program is not only a mechanism for increasing awareness of mental health

but also an essential tool in reducing the stigma associated with mental disorders. One of the key aspects of the program is the development of essential communication skills among medical university students in their interactions with patients with mental disorders. This is particularly crucial for future doctors, regardless of their specialization, as high-quality medical care requires not only clinical competence but also empathy and an understanding of the unique needs of patients with mental health conditions [6].

Early diagnosis of mental disorders, facilitated by the mhGAP program, can significantly improve the quality of medical and psychological care. The timely identification and assessment of mental disorders in the early stages of their development contribute to more effective intervention and reduce the risk of symptom chronicity. Furthermore, supporting patients with mental and neurological disorders decreases the likelihood of their condition worsening and reduces the risk of social isolation, which often results from societal prejudices against such individuals.

A vital component of mhGAP is the possibility of implementing low-intensity psychological interventions that provide primary psychological support. These interventions not only promote improvements in patients' mental health but also positively impact their overall quality of life, both at the community level and on a national scale [7].

However, certain limitations of this study must be acknowledged. This research covered only the first part of the mhGAP program modules, which presents chal-

Table 2. Statistical indicators of post-test results for students (Post-test)

N	Lower Whisker	25th Percentile	Median	75th Percentile	Upper Whisker
340	10.000	13.000	14.000	15.000	15.000

lenges in comprehensively evaluating its effectiveness. For a more thorough analysis, further studies should be conducted, encompassing all program modules and including long-term follow-up assessments. In particular, an important direction for future research is evaluating the impact of the program one year after its implementation. This would allow for an assessment of the sustainability of the obtained effects and the effectiveness of the educational process in the long-term perspective.

Thus, the mhGAP program opens new opportunities for medical university students, contributing to their professional training and improving the quality of psychiatric care at various levels of the healthcare system. However, further research is necessary to ensure a comprehensive evaluation of its effectiveness and to identify potential ways to optimize the program's implementation.

CONCLUSIONS

The results of the study indicate a significant improvement in the level of knowledge among medical faculty

students regarding mental disorders and primary psychological intervention methods after completing a five-day course based on the mhGAP program. The initial test results (Pre-test) showed an average level of knowledge among students (9.029 ± 2.805), with significant individual differences in the results, suggesting an uneven level of preparation among students before studying the topic.

After the course, a significant improvement in knowledge was observed, as confirmed by the post-test results (Post-test), where the average score increased to 13.568 ± 1.594 ($t = -27.141$, $p < 0.001$). These results indicate the effectiveness of the training course in enhancing students' understanding of the basics of mental disorders and primary medical-psychological assistance methods.

Overall, the study confirmed the high effectiveness of the mhGAP program in preparing medical professionals to work with patients with mental disorders. The results obtained can be used for implementing educational programs in medical higher education institutions, which will improve the quality of primary medical-psychological care and contribute to more effective identification of mental disorders at early stages.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Andrii O. Burdeinyi

Bogomolets National Medical University

13 Taras Shevchenko Blvr., 01601 Kyiv, Ukraine

tel: +380939696543

e-mail: dr.a.burdeinyi@gmail.com

ORCID AND CONTRIBUTIONSHIP

Iurii L. Kuchyn 0000-0002-9667-1911 **A** **E** **F**

Olena O. Khaustova: 0000-0002-8262-5252 **A** **E** **F**

Ivanna V. Sakhandia 0000-0003-4171-5160 **A** **B** **C** **E** **F**

Andrii O. Burdeinyi: 0000-0001-5596-1069 **A** **B** **C** **D**

Stanislav O. Stashenko: 0009-0008-0951-9171 **A** **B** **C** **D**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Motivating academic integrity: utilizing information resources in medical education

Kateryna O. Hololobova, Oksana A. Hrytsenko, Inna I. Kucherenko

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To determine the main approaches to forming principles of academic integrity and motivating higher education students in medical higher education institutions.

Materials and Methods: The study combines quantitative and qualitative methods and was conducted at the Bogomolets National Medical University, Kyiv, Ukraine, in 2024. During the research process, a complex of general scientific and specialized methods was applied. In particular, the logical-analytical method was used to structure information and identify cause-and-effect relationships. Theoretical-logical analysis allowed for the formulation of theoretical propositions and hypotheses. Comparative analysis was applied to compare different approaches and concepts. Quantitative sociological methods, including the collection, systematization, and statistical analysis of information, were used to process empirical data. The method of formalization and generalization facilitated the formulation of conclusions based on the results obtained. The object of the study is medical education students at Bogomolets NMU (N=233). The study involved students of the second master's level (N=172), students of the third educational-scientific level (N=12), and students of professional pre-higher education (N=49), the vast majority of whom are full-time students (N=215). Statistical data processing was performed using the IBM SPSS Statistics software package.

Results: Adherence to academic integrity is an important component of knowledge transfer. Honest teaching, documenting, and disseminating research results contribute to the understanding of information and knowledge between scientists, students, and the public. All these factors improve the quality of higher education and the development of scientific research. Adherence to academic integrity is an important responsibility for every participant in the educational process and contributes to the creation of an honest and progressive academic environment. With the increasing use of AI, more and more questions arise regarding the mechanisms of its correct use and the strengthening of control over compliance with the principles of academic integrity.

Conclusions: Adherence to the principles of academic integrity serves as a key motivator for students and faculty in the context of complying with academic standards. In this regard, a relevant area of scientific research is the development of a methodology for studying the phenomenon of academic integrity in higher medical education institutions. The proposed methodology involves an empirical study of the attitudes of participants in the educational process towards fundamental value orientations, which will provide objective data for further analysis and the development of practical recommendations.

KEY WORDS: academic integrity, values, higher medical education, social research, AI (artificial intelligence), principles of academic integrity

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INTRODUCTION

Adherence to academic integrity is an important component of knowledge transfer. Honest teaching, documenting, and disseminating research results contribute to the understanding of information and knowledge between scientists, students, and the public.

Academic integrity entails commitment to the fundamental values of honesty, trust, fairness, respect, responsibility, and courage [1]. The importance of academic integrity lies in ensuring the trust of both the public and all participants in the educational process in the scientific community, maintaining a high level of research quality, and protecting intellectual property. It is the foundation for the development of science and the acquisition of new knowledge, and the

basis for building trust in the student community and a sense of fairness. Adherence to academic integrity is an important responsibility for every participant in the educational process and contributes to the creation of an honest and progressive academic environment.

What negative consequences can result from violating the principles of academic integrity? Moral impact: Violation of academic integrity can affect the self-esteem and moral attitudes of a student, teacher, or scientist. This can lead to feelings of guilt, stress, and insecurity in one's abilities.

Loss of opportunities: Violation of academic integrity can deprive a student, teacher, or scientist of opportunities they have strived for, such as participation in scholarship or grant programs, the opportunity to publish

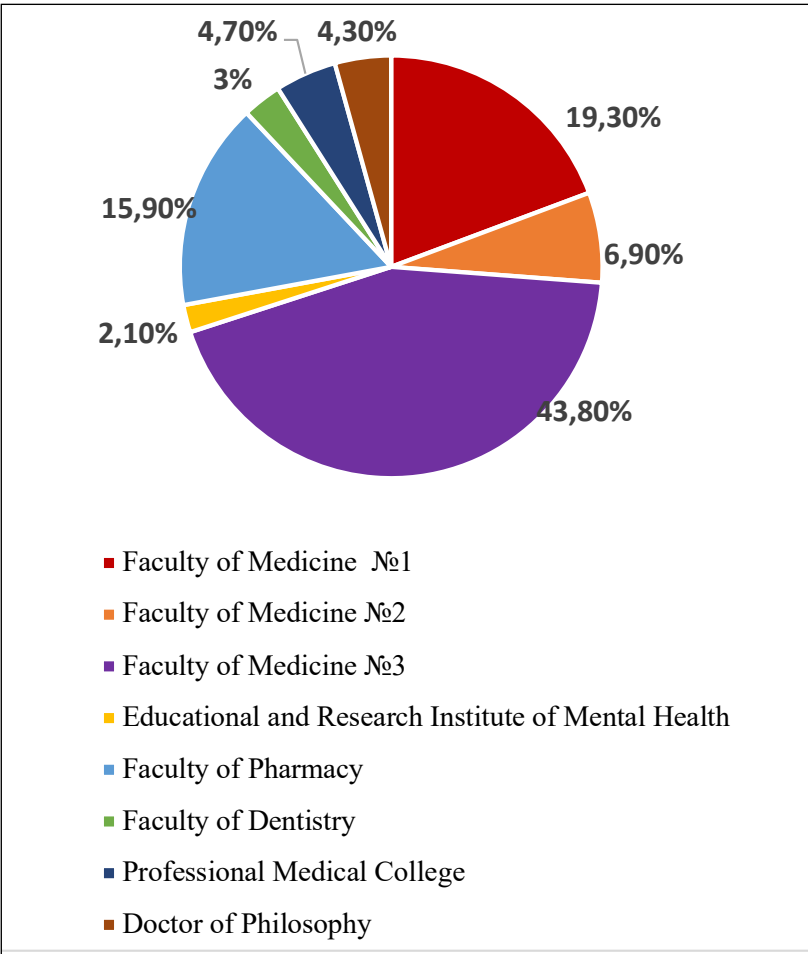


Fig. 1. Distribution of respondents among the faculties and institutes of Bogomolets NMU

research results, and reputational losses that can play a significant role in their career and further development.

Legal consequences: Some violations of academic integrity may have legal consequences. For example, the detection of plagiarism or falsification, fabrication of data may lead to the deprivation of acquired academic degrees or academic titles, and lawsuits.

Therefore, violation of academic integrity can have serious consequences that can significantly affect the life of a student, teacher, or scientist. This underscores the need to adhere to the norms, principles, and values of integrity in the educational and scientific environment.

AIM

To determine the main approaches to forming the principles of academic integrity and motivating higher education students to adhere to academic integrity through the use of information resources in medical higher education institutions.

MATERIALS AND METHODS

The study combines quantitative and qualitative methods and was conducted at the Bogomolets National Medical University, Kyiv, Ukraine, in 2024.

During the research process, a complex of general scientific and specialized methods was applied. In particular, the logical-analytical method was used to structure information and identify cause-and-effect relationships. Theoretical-logical analysis allowed for the formulation of theoretical propositions and hypotheses. Comparative analysis was applied to compare different approaches and concepts. Quantitative sociological methods, including the collection, systematization, and statistical analysis of information, were used to process empirical data. The method of formalization and generalization facilitated the formulation of conclusions based on the results obtained. The object of the study is medical education students at Bogomolets NMU (N=233). The study involved students of the second master’s level (N=172), students of the third educational-scientific level (N=12), and students of professional pre-higher education (N=49), the vast majority of whom are full-time students (N=215). Statistical data processing was performed using the IBM SPSS Statistics software package.

RESULTS

The distribution among the institutes and faculties of Bogomolets NMU followed this principle (Fig. 1). The

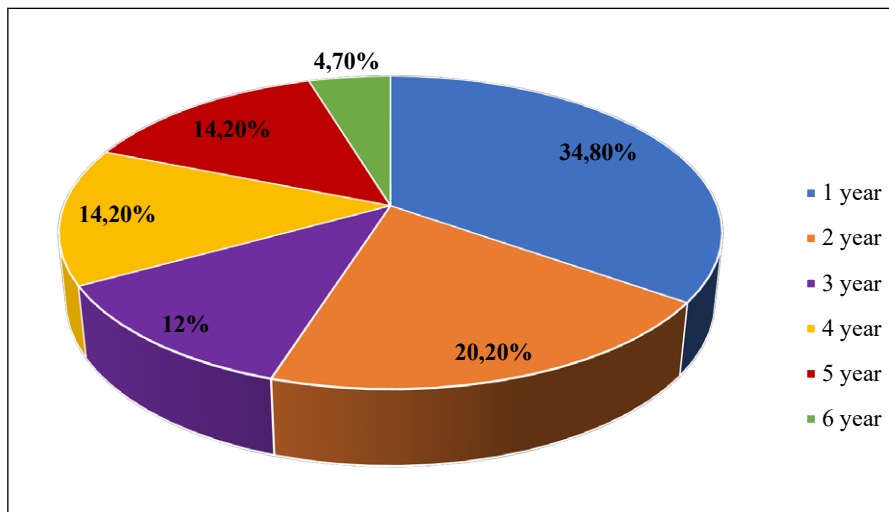


Fig. 2. Distribution of students by year of study

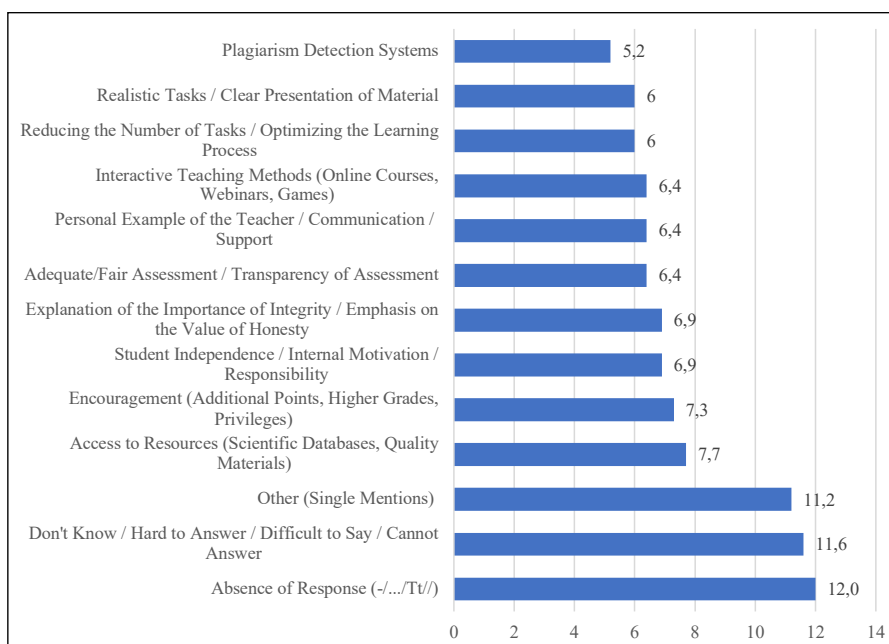


Fig. 3. How to motivate students to adhere to academic integrity using information (per 100 persons)

vast majority of respondents are representatives of the Medical Faculty No. 3 (43.8%, N=102), who are studying in the specialty "Pediatrics".

The distribution of respondents among the year of study was more even (Fig. 2). The largest proportion of respondents are 1st-year students (34.8%, N=81). The proportions of 2nd, 3rd, 4th, and 5th-year students are 20.2% (N=47), 12% (N=28), 14.2% (N=33), and 14.2% (N=33) respectively. The smallest proportion of respondents are in their 6th year (4.7%, N=11)."

According to the survey results, to the question "Are you familiar with the definition of "integrity educational environment" in the context of medical institutions of higher education?" the vast majority of respondents answered "Yes," so it can be concluded that most participants in the educational process are familiar with this definition (88.4%). Among 1st-year students (7.7%, N=18), the answer "Difficult to answer" was also

encountered, which indicates the need for conducting introductory and educational work on academic integrity among them.

To the question "What basic principles of integrity do you think are most important for the educational process in medical (pharmaceutical) institutions?" 233 responses were received, among which individual principles mentioned by respondents can be distinguished (Table 1). The question was open-ended and aimed to form an understanding of which principles students are familiar with in general. The vast majority of senior students (4th, 5th, 6th year) named honesty as the main principles of integrity (37 out of 77 respondents, 48%), transparency (10 out of 77 respondents, 13%), respect for intellectual property (9 out of 77 respondents, 11.7%), and humanity (8 out of 77 respondents, 10.4%)."

Among junior students (1st, 2nd, 3rd year, N=156), the main principles of integrity named were: honesty

Table 1. What are the main principles of integrity that are most important for the educational process in medical (pharmaceutical) institutions

Principle of Academic Integrity	Number of Respondents (N=233)	Rate per 100 respondents ±error	Qualitative Analysis
Honesty	67	28,8±3,0	The main and most frequently mentioned principle, encompassing the avoidance of cheating, plagiarism, and fraud.
Responsibility	27	11,6±2,1	Involves personal responsibility for the learning process, independent completion of tasks, and ethical behavior.
Fairness	23	9,9±2,0	Includes equal treatment of all students, objective assessment, and absence of discrimination.
Ethics	17	7,3±1,7	Includes moral aspects of learning, respect for teachers and colleagues, and compliance with professional standards.
Transparency	14	6,0±1,6	Important for fair assessment, open rules and procedures in the learning process.
Respect for Intellectual Property	14	6,0±1,6	Includes avoiding plagiarism, recognizing the contributions of other researchers, and correctly citing sources.
Objectivity	13	5,6±1,5	Absence of bias in teaching, research, and assessment.
Humanity	12	5,2±1,4	Means benevolence, support, equal treatment, and adherence to ethical standards in communication.
Independence in Learning	12	5,2±1,4	Avoiding cheating, independently completing tests, practical assignments, and research.
Absence of Corruption	8	3,4±1,2	Rejecting bribery, dishonest schemes for obtaining grades and privileges.
Critical Thinking and Self-Development	8	3,4±1,2	Using own knowledge, analytical understanding of information, lifelong learning.
Trust	6	2,6±1,0	Building relationships between students and teachers based on honesty and respect.
Confidentiality	6	2,6±1,0	Protecting personal data, academic information, and research results.
Professionalism	6	2,6±1,0	Adherence to the standards of the medical profession, competence, and ethical responsibility.

(30 out of 156 respondents, 19%), responsibility (24 out of 156 respondents, 15%), fairness (21 out of 156 respondents, 13%), ethics (15 out of 156 respondents, 10%), objectivity (12 out of 156 respondents, 8%).

The responses received from students provide an understanding of how they perceive academic integrity in medical and pharmaceutical educational institutions, according to the respondents. The principle that was mentioned most often is honesty (28.8%, N=67), which indicates that students understand it as a key component of integrity. They associate it with avoiding plagiarism, cheating, data falsification, and the use of dishonest methods to obtain grades. Responsibility is the second most popular principle (11.6%, N=27). Many respondents emphasized personal responsibility for the learning process, which includes independent completion of tasks, thorough preparation for classes, and a responsible attitude towards their future profession. A significant number of responses indicate the need for fair assessment, equal treatment of all students, and the

exclusion of any manifestations of subjectivism or corruption. This underscores the importance of transparent and understandable evaluation criteria. The responses of students demonstrate that ethics, respect for intellectual property, and humanity play an important role in the learning process. They point to the need to adhere to moral standards, properly cite sources, and recognize the contributions of other researchers. Some responses emphasize the importance of independent learning, critical thinking, and continuous self-development. This indicates an awareness among students of the need to develop their own skills and knowledge, which is especially important in medical education. Several responses (3.43%, N=8) directly indicate the unacceptability of corruption, bribery, unjustified grade inflation, or other shadow practices. This also indicates the fact that most respondents do not consider corruption, bribery, and unjustified grade inflation or other shadow practices unacceptable. This once again emphasizes the need for a transparent educational system that operates

Table 2. What information technologies can help ensure fairness in the learning process

No.	Information Technologies	Purpose	Number of Respondents (N=233)	Rate per 100 respondents $\pm$ error
1	Anti-plagiarism systems	Checking the uniqueness of student works	25	10,7 $\pm$ 2,0
2	Electronic testing platforms	Objective assessment of knowledge	25	10,7 $\pm$ 2,0
3	Video surveillance systems	Control over exams	20	8,6 $\pm$ 1,8
4	Educational portals with activity tracking	Monitoring student participation in learning	20	8,6 $\pm$ 1,8
5	Software for analyzing results	Uniform assessment of student achievements	17	7,3 $\pm$ 1,7
6	Chatbots and artificial intelligence (ChatGPT, probably AI)	Automated responses and learning support	15	6,4 $\pm$ 1,6
7	Online learning platforms	Equal access to learning materials, standardized evaluation criteria	14	6,0 $\pm$ 1,6
8	Video surveillance, Moodle, automation of work submission processes	Control and convenient organization of the educational process	12	5,2 $\pm$ 1,4
9	Digital boxes of trust	Quick communication with the rectorate, the Department of Medical Personnel, Education and Science of the Ministry of Health of Ukraine	10	4,3 $\pm$ 1,3
10	Platforms for automatic evaluation	Anonymous evaluation, interactive platforms for feedback, mobile applications for learning	9	3,9 $\pm$ 1,3
	I don't know / Difficult to answer (all other respondents)		86	36,9 $\pm$ 3,2

according to clear and fair rules. And such principles as "trust," "confidentiality," and "professionalism" were considered important only by individual students (6 out of 233 each).

26.6% of respondents have previously used plagiarism detection software, 25% use free programs, which in turn creates risks of copying scientific texts by "predatory" programs and providing biased information.

To the question "What information technologies, in your opinion, can help ensure fairness in the learning process?" the following answers were received (Table 2).

The most popular information technology that, according to students, can help ensure fairness in the educational process is anti-plagiarism systems, which were mentioned by 25 respondents (10.7%).

From these responses, it can be concluded that information technologies can help ensure fairness in the learning process, and their use as technical support will facilitate the work for both students and academic staff of higher education institutions. For the second year in a row, Bogomolets National Medical University has been holding seminars "School of a Competent Teacher," and is also actively implementing "School of Digital Competence for Students," because we are all part of the "digital society" and must keep pace with modern technologies.

36.9% of participants state that technologies greatly help in maintaining adherence to academic integrity, especially when it comes to plagiarism checking, time management, or learning.

Organizing the transparency of the work evaluation process using information resources is an important aspect, as it ensures clarity and accessibility of evaluation criteria, which allows maintaining objectivity and honesty.

Teachers, like students, use information resources, because some may have strict requirements regarding sources of information and plagiarism, while others may be less passionate about this issue. It is important that students are aware of the rules for using information resources and adhere to the requirements for maintaining academic integrity. This needs to be communicated and explained to them from the first day of their studies, and at the beginning of classes, so that they understand the criteria for assessing knowledge.

Our present is closely related to academic integrity, because it is a component of the Law of Ukraine "On Education" and all participants are involved in it, as evidenced by the result of 76.4%.

To the question "Can information technologies contribute to increasing the level of academic integrity?" (57.1%) answered "Yes," information technologies can

contribute to increasing the level of academic integrity when checking for plagiarism, preventing copying of works, for checking the authenticity of scientific works, and can also help in creating educational platforms, courses.

To the question “In your opinion, how can students be motivated to adhere to academic integrity using information resources?” the following answers were received (Fig.3).

The majority of respondents were unable to provide specific suggestions for motivating students to adhere to academic integrity through information resources (11.6%, 27 out of 233 respondents), indicating that a significant proportion of students do not have a clear understanding of how information resources can help support academic integrity, or have difficulty formulating specific suggestions. This may indicate a lack of student awareness regarding available resources and strategies. The most popular suggestion was access to resources (scientific databases, quality materials, educational platforms), which was supported by 7.7% (N=18) of respondents. This suggests that students feel the need for reliable and verified sources of information that would help them complete assignments independently and avoid plagiarism. Suggestions for incentives (extra points, privileges) and creating a supportive environment (adequate assessment, teacher support) indicate that students need positive motivation and support from teachers. It is important not only to control adherence to academic integrity but also to encourage honesty and responsibility. Emphasis on the importance of the teacher’s personal example 6% (N=15), communication, and support indicates that students value interaction with teachers and need their help in shaping the values of academic integrity. Teachers should be not only controllers but also mentors who inspire students to learn honestly. Using interactive methods: Interest in interactive teaching methods (online courses, webinars, games) indicates that students are open to new forms of learning and need more engaging and interactive learning materials. Although plagiarism detection systems are not mentioned as often 5% (N=12), their presence is still important for controlling and teaching students. It is important to use these systems not only to detect violations but also to teach students proper citation and formatting of work.

Analyzing the results of the study, our students, despite high demands or competition, do not use “dishonest methods” (45.1%), and this confirms the fact that information resources cannot always be trusted.

It is important to understand and be able to use AI to avoid negative consequences. Since AI can be an effective “push” for making decisions or finding useful

sources when preparing for a lesson or writing scientific papers. If AI is used as a resource for plagiarism checking, a positive attitude is possible, but it is really difficult to answer, because this information resource has not been fully studied and we do not know its limits.

DISCUSSION

This is not the first study conducted at the Bogomolets National Medical University regarding the problem of academic integrity and the formation of key principles of integrity in a modern University. Thus, in the 2022–2023 academic year, a survey was conducted in which 108 postgraduate students of Bogomolets NMU in the conditions of the ongoing war took part. This study revealed significant challenges in their academic activities. Approximately 70% of students reported experiencing interruptions to their classes due to air raid alerts or shelling, with 68% resuming their studies on the same day. Concentration was significantly impaired for 77% of students, with many attributing this difficulty to emotional distress and bereavement. Despite these challenges, a substantial majority (85%) of applicants maintained a vision of their professional future in Ukraine as physicians, scientists, or educators. The degree of adaptation to emergency conditions varied, with half of the student population demonstrating adequate adjustment, including 12% who indicated complete adaptation to the wartime circumstances [2].

In 2023, a survey was also conducted among full-time medical students of Bogomolets NMU and scientific-pedagogical staff who provide teaching of fundamental, specialized and socio-humanitarian disciplines at the university. In this investigation, data were collected via survey methodology from a cohort of 153 scientific and pedagogical staff members and 472 students. The survey instrument focused on academic integrity, specifically examining the attitudes of educational process participants toward fundamental values and principles. A significant proportion (71.9%) of the surveyed scientific and pedagogical personnel indicated that instructors and students bear equal responsibility for adhering to the tenets of academic integrity. Conversely, a majority (59.7%) of the participating higher education students perceived the primary responsibility for upholding academic integrity as residing with the student [3].

Our research is a continuation of these studies, it focuses not only on the problem of forming the principles of academic integrity, but also on ways to motivate students to adhere to academic integrity through the use of information resources.

Research on academic integrity has also been conducted in other higher education institutions, but it

was not as in-depth. For example, in 2022, Tkachuk S. and Filimonova I. [4]. note that students generally have a positive attitude towards academic integrity. In their study, they note that some students allow certain forms of academic integrity violations, such as cheating. In contrast to our study, where 45.1% of respondents claim that they do not use “dishonest methods”, this may indicate that students of Bogomolets National Medical University are more aware of academic integrity. Our study shows that the most popular information technology for ensuring fairness in the educational process is anti-plagiarism systems (10.7%). This is consistent with the fact that 26.6% of respondents in the Tkachuk S. study had previously used plagiarism detection software. Our study is also consistent with another study by Dorozhko A. [5], which emphasizes the importance of honesty, responsibility, and fairness as the basic principles of academic integrity.

An undeniable complexity of the conducted research is the fact that we are talking about the formation of basic principles of academic integrity in the context of military aggression [6]. While education is recognized for its potential to provide stability and a semblance of normalcy for students in conflict-affected regions, prolonged exposure to conflict often intensifies academic and emotional burdens, ultimately influencing their career aspirations and psychological health [7]. The ongoing war in Ukraine presents a diverse array of challenges for the majority of medical schools, their faculty, staff, and students, as they strive to uphold the standards of medical education [8]. The superposition of armed conflict upon a pre-existing pandemic context generates a climate of uncertainty and instability that exerts a negative influence on mental health outcomes, especially for individuals directly exposed to the exigencies of war [9, 10]. The findings from the experimental investigation into the effects of martial law on the research motivation of doctoral students at Sumy State Pedagogical University named after A.S. Makarenko, specializing in the 011 Educational, Pedagogical Sciences discipline, demonstrated a statistically significant decline in their scholarly drive [11].

Acknowledging that the university educational system was not directly affected by the war, the pre-war efficiency and functionality of educational processes were key in maintaining a quality education during the war [12].

Considering the adoption of the new Law of Ukraine on Academic Integrity, it is promising to create a methodology for a comprehensive sociological study based on the provisions of the law and adapted to the specifics of medical education.

CONCLUSIONS

The survey results indicate that students understand academic integrity not simply as a formality, but as an integral part of quality education and professional ethics. The main emphasis is placed on honesty, responsibility, fairness and independence in learning. At the same time, there is a certain demand for improving transparency and eradicating corruption risks in the educational process.

The information received from students gives us a valuable understanding of their views, needs and problems regarding academic integrity and ways to support it. In general, we have formed a clear understanding that maintaining academic integrity requires a comprehensive approach that includes: raising students' awareness of the values of academic integrity and available resources; providing access to quality learning materials and scientific databases; creating a supportive learning environment where students feel supported and encouraged; optimizing the learning process taking into account the individual needs of students; the use of interactive teaching methods and modern technologies. Given these findings, effective strategies and programs can be developed to support academic integrity in educational institutions.

The conducted research emphasizes the importance of a comprehensive approach to supporting academic integrity. It is not enough to simply proclaim principles – it is necessary to create a favorable environment, provide access to resources, use effective tools, and motivate students to adhere to ethical standards.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Kateryna O. Hololobova

Bogomolets National Medical University

13 Shevchenko Boulevard, 01601 Kyiv, Ukraine

e-mail.: k.hololobova@nmu.ua

ORCID AND CONTRIBUTIONSHIP

Kateryna O. Hololobova: 0000-0003-3343-5978    

Oksana A. Hrytsenko: 0000-0001-8830-4997   

Inna I. Kucherenko: 0000-0002-0734-6544   

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Reflective practicum in the process of training students as a mobilizing factor of personal development and subjective well-being in conditions of information uncertainty and emotional challenges

Tetiana I. Miyer¹, Borys I. Palamar², Svitlana P. Palamar¹, Lyudmyla L. Khoruzha¹, Nataliia V. Vyshnivska¹, Svitlana H. Dubovyk¹, Roksolana I. Shpitsa¹

¹ BORYS GRINCHENKO KYIV METROPOLITAN UNIVERSITY, KYIV, UKRAINE

² BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: Using time-delayed reflection of the day's events, to determine what worries students the most and is perceived by them as informational uncertainty and emotional challenges that negatively affect their health and learning outcomes. Develop and experimentally test in the educational process of higher education institutions the effectiveness of reflective practicum on the gradual transformation of traumatic stress into a mobilizing factor of personal development and subjective well-being in conditions of informational uncertainty and emotional challenges.

Materials and Methods: 1,500 future specialists who studied at the Borys Grinchenko Kyiv Metropolitan University and the Bogomolets National Medical University during the war were involved in the experimental work.

Results: Students associate informational uncertainty and emotional challenges with what is happening in the country (the full-scale invasion of Russian troops into Ukraine has been ongoing for the third year), at work (students combine work with study), as well as during study, in the store, in transport, etc. Students react differently to informational uncertainty and emotional challenges that occur anywhere during the day. 2% of respondents did not feel any changes in their body. The rest of the respondents felt unpleasant changes: 98% headache, 80.2% – increased blood pressure, 78.8% – increased heartbeat, 45.6% – stomach discomfort, 39.4% – body chills, 22.2% – facial redness, 20.8% – body sweating, 12.6% – muscle stiffness, 8.4% – palm sweating, 6.2% – ringing in the ears, 5.6% – decreased blood pressure, 4.2% – darkening in the eyes, 1% – hand tremors. Ignoring these conditions during study reduces the effectiveness of study, since students quickly transition from the process of tension to the process of fatigue.

Conclusions: In order to restore the optimally appropriate course of tension and fatigue processes in students, it is necessary to: 1) find out the duration of these processes; 2) determine factors that cause states of uncertainty and depression mood; 3) conduct five-minute reflective practicum at the beginning of practical and seminar classes, which train in the implementation of reflection, when the identified factors act as its objects; 4) practice the gradual transformation of traumatic stress into a mobilizing factor of personal development and subjective well-being in conditions of information uncertainty and emotional challenges.

KEY WORDS: stress, tension, uncertainty, depression mood, subjective well-being, time-delayed reflection

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INTRODUCTION

In this article, the term “stress” refers to a wide range of states of students that arise as a response to various extreme influences, actions, uncertainty, and challenges. Since among the various states, students can most often experience states of informational and (or) emotional stress, we focused on situations of informational uncertainty and situations that are perceived as emotional challenges. These situations arise constantly from 2022 to 2025, since training is organized in conditions of a full-scale invasion of Russian troops into the territory of Ukraine with the massive deployment

of armed aggression against the Ukrainian people. Informational uncertainty also arises in a situation of information overload or its absence, expectations of an unfavorable development of events, failures in social interaction, unawareness of the source of danger, loss of control over the situation, etc. Instead, students may experience the effect of emotional challenge in the event of excessive excitement, prolonged experience of negative emotions associated with a traumatic event, danger, a certain undesirable set of circumstances, etc. During the study, we took into account that stress can have different effects on both the body of students and

the process of their performance of activities. This effect can be both a positive mobilizing factor of personal development and subjective well-being in conditions of information uncertainty and emotional challenges, and a negative traumatic one that harms the health of students [1, 2].

We chose reflection as a means of research students' attitudes towards information uncertainty and emotional challenges. Reflection satisfies two conditions: it most fully corresponds to the purpose of our study; it is perceived as a modern social priority of personal development and subjective well-being [3]. The Education 2030 Framework for Action of the Education 2030 Agenda [4] is based on reflection on one's actions, in the process of which current and future social, cultural, economic and environmental consequences are taken into account from a local and global perspective. Such reflection makes it possible to act stably in difficult situations, even if this requires searching for new directions, as well as to participate in socio-political processes in order to drive their societies towards sustainable development.

The Education 2030 Framework for Action [4] also states that reflection on one's actions is part of: 1) critical thinking competence (manifested as reflecting on one's own values, perceptions and actions); 2) self-awareness (manifested in the ability to reflect on the role that each person plays in the local community and global society); 3) self-reflective skills, manifested in the ability to reflect on one's health, participate in reflective dialogues about what a healthy and well-being life means, observe and reflect, and keep reflection journals.

The Programme for International Student Assessment (PISA) [5] focuses on developing each student's potential as a constructive and reflective citizen, as reflected in the ability to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately apparent. It includes the willingness to engage with such solutions to achieve one's potential as a constructive and reflective citizen.

In scientific works, the term "reflection" is defined in various ways. These are: a way of thinking; an activity, a development of thinking; thinking about what a person is doing at the moment (reflection in action), thinking as a look back with a reconsideration of the action, activity or events of the day; cognitive and emotional process or activity that is triggered by an unusual or incomprehensible situation Rogers; analysis of responses, beliefs and assumptions through the prism of the current situation [6-11]. The process of engaging in Reflection is the process of engaging with learning and/or professional practice that provides an opportunity to critically analyze and evaluate that learning or practice [12].

In this research, we consider reflection both as a process of self-knowledge by students of their internal acts and states, which are caused by informational uncertainty and emotional challenges, and as a means of gradually transforming traumatic stress into a mobilizing factor of personal development and subjective well-being.

AIM

Using time-delayed reflection of the day's events, to determine what worries students the most and is perceived by them as informational uncertainty and emotional challenges that negatively affect their health and learning outcomes. Develop and experimentally test in the educational process of higher education institutions the effectiveness of reflective practicum on the gradual transformation of traumatic stress into a mobilizing factor of personal development and subjective well-being in conditions of informational uncertainty and emotional challenges.

MATERIALS AND METHODS

A total of 1,500 people participated in the research. These were future teachers and future public health specialists who studied at the Borys Grinchenko Kyiv Metropolitan University and the Bogomolets National Medical University during the war. The work used a set of research methods: general scientific (analysis, comparison, systematization, generalization) and empirical (observation, individual interviews, questionnaires). Indicators were also defined for the research. By the term "indicator" we denoted something that, reflecting the course of processes in the students' bodies, caused a certain state in them, which they not only felt, but also described in words. Also, lecturers distinguished this state based on the direct perception of the students' behavior and posture and made appropriate generalizations about the presence of certain mental states, in particular: positive (confidence, energy) or negative (uncertainty, depressed mood). It is worth emphasizing that students could enter certain mental states (for example, a state of depressed mood) outside the educational institution, but be in this mental state during their studies. The indicators of the study of what worries students the most and is perceived by them as informational uncertainty and (or) emotional challenges that negatively affect their state and reduce the effectiveness of their studies included:

1. PROCESSES THAT OCCUR IN THE BODY OF STUDENTS:

- **Tension** as an intensification of physiological processes to achieve the goal of the activity. Optimal tension causes

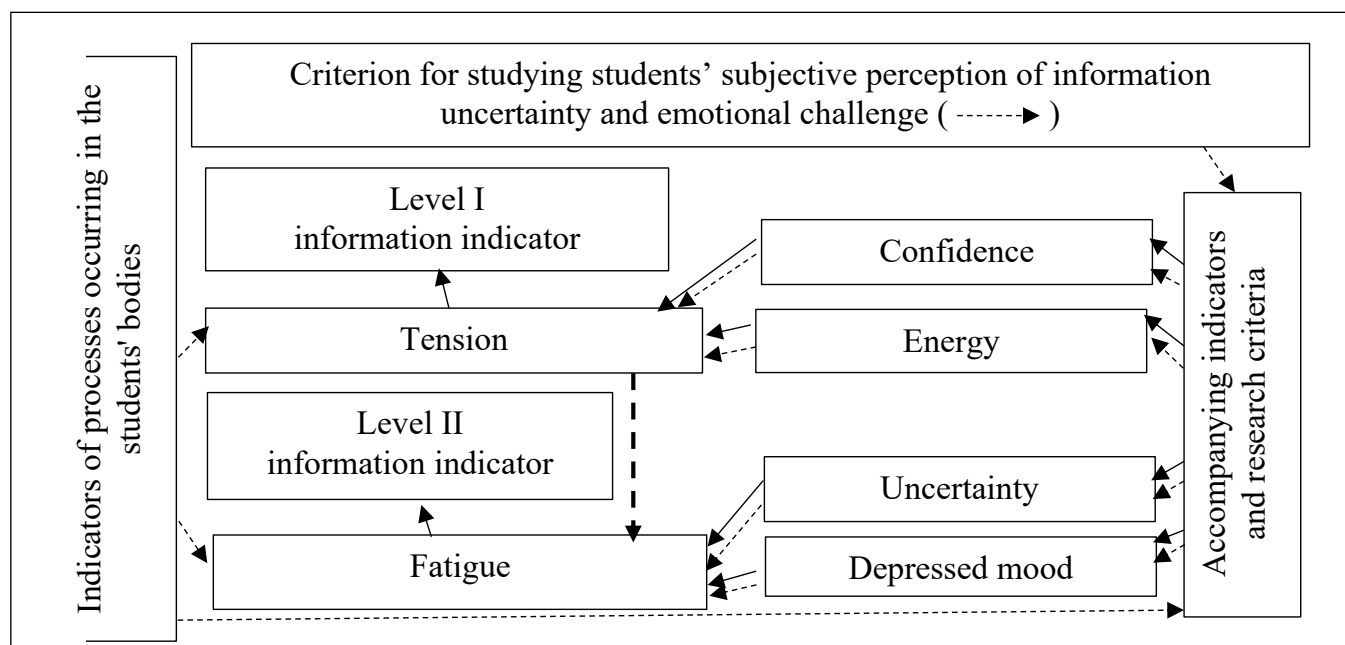


Fig. 1. Indicators of processes occurring in the body of students and criterion for studying reflection as a mobilizing factor of personal development and subjective well-being in conditions of information uncertainty and emotional challenges

optimal performance [13]. Tension is recorded by students as a pleasant feeling, which they describe as follows: "nothing distracts me internally, I want to do it", "I feel strength / energy". We have defined tension as an informative indicator of the first level, which indicates how the student relates to informational uncertainty and emotional challenge and signals a transition from moderate tension to excessive, which will change to fatigue.

- **Fatigue** as the regulation of the functional reserves of the body and the performance of a protective function to protect it from excessive loads and exhaustion [13]. Fatigue is recorded by students as an unpleasant feeling, which they described as follows: "I have no strength", "I am a squeezed lemon". The state of moderate fatigue allows you to achieve the desired result in activity without harm to health. We have defined moderate fatigue as an informative indicator of the second level, which signals that moderate fatigue can turn into excessive, and then into overstrain, which is dangerous for the health of students.

2. POSITIVE AND NEGATIVE MENTAL STATES EXPERIENCED BY STUDENTS:

- Positive mental states: A) Students associate confidence with a willingness to act, as they are sure that they will be successful. B) They explain energy with good health, the presence of energy and associate it with activity. Confidence and energy as accompanying indicators signal the intensification of physiological processes to achieve the goal of the activity, which are perceived by students as positive and pleasant feelings.

- Negative mental states: A) Insecurity – this mental state of constant hesitation in the correctness of one's actions. B)

Depressed mood is recorded by students as an unpleasant feeling, which is accompanied by a deterioration in mood. We attribute uncertainty and depression to accompanying indicators that signal the experience of students of a feeling of loss of control over the situation. As shown in Fig. 1, the indicators we identified served as criteria.

First of all, we note that during the experimental work we oriented students to reflect on events throughout the day, and not just the training process. Deferred reflection on events throughout the day contributed to the isolation of what really worries students. We arranged the results of observations, individual conversations, and questionnaires according to the levels of informative indicators (tension, fatigue).

We divided the students according to the speed of transition from the level I informative indicator to the level II informative indicator. To determine the speed of transition, we took into account the stages of a person's working capacity during the work cycle, which was correlated with the duration of one lecture, seminar or practical session (hereinafter referred to as the session). The "fast transition" indicator indicates the fixation of depressed mood and uncertainty at the beginning of the session and during its 20 minutes, since this time period correlates with two stages: the stage of entering the activity and the stage of optimally high working capacity.

The number of students with a rapid transition from a state of tension to a state of fatigue (in%) was used for calculations. To establish a correlation between the reduction of rapid transitions from a state of tension to a state of fatigue and the implementation of reflective workshops, we used correlation analysis. The parametric Pearson coefficient (of

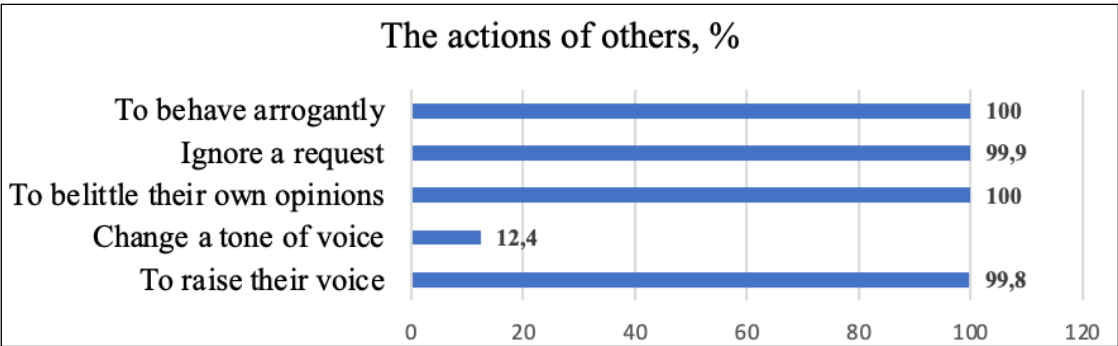


Fig. 2. The actions of others at the levels of production-labor, educational-training, and current-life functions that students perceive as emotional challenges

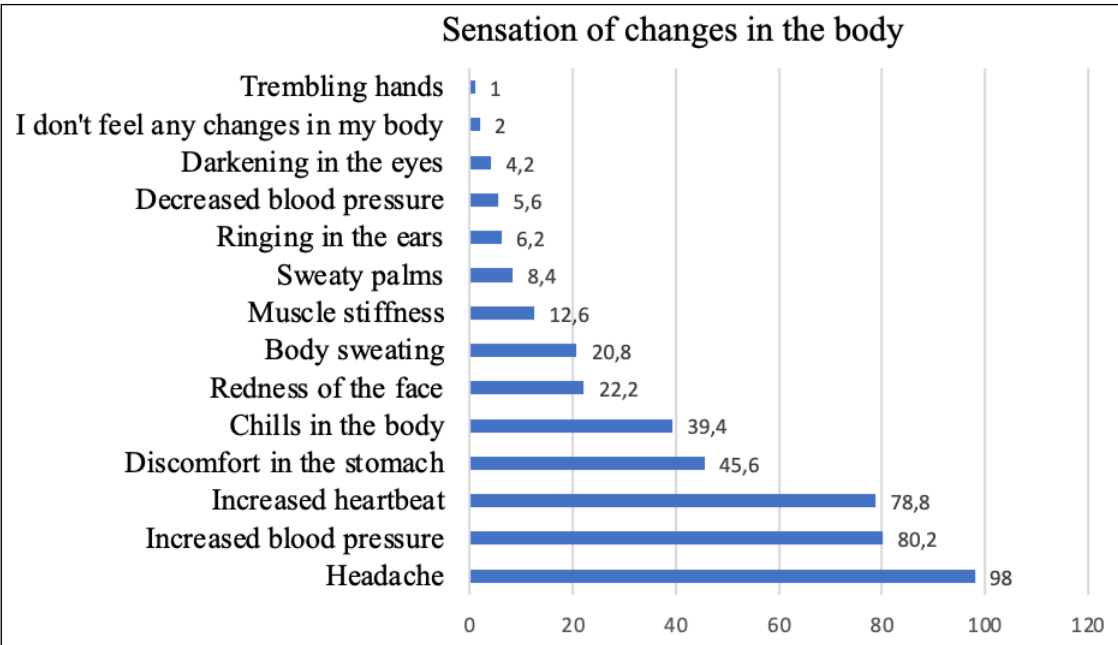


Fig. 3. Feelings of changes in the body of students caused by informational uncertainty and emotional challenges and established as a result of reflection deferred in time; %

0.05 and 0.01 (at $p < .01$ and $p < .05$) was calculated using the SPSS Statistics 27 statistical software package.

RESULTS

We found that optimal tension is subjectively perceived by students as an unstable process, since it is influenced by information uncertainty and various emotional challenges throughout the day. Students associate information uncertainty and emotional challenges with what is happening in the country (the full-scale invasion of Russian troops into the territory of Ukraine has been going on for the third year), at work (students combine work with study), as well as during study, in the store, in transport, etc.

We systematized students’ responses about what they perceive as informational uncertainty and emotional challenges by type of function. Students believe that these are: 1) the actions of others at the level of socio-political func-

tions (such as the massive deployment of armed aggression against the Ukrainian people); the actions of others at the levels of production-labor, educational-training, and current-life functions (when others raise their voices at them, change their tone of voice, belittle their own opinions, ignore them with a request, and behave arrogantly (Fig. 2); 2) the students themselves at the level of personal functions (being late for work, the bus, studying, a meeting).

Students react differently to informational uncertainty and emotional challenges that occur at any point during the day. A very small number of students indicated that they did not record changes in the body, while other students indicated the following changes (Fig. 3): increased heartbeat, trembling hands, chills in the body, headache, increased blood pressure, decreased blood pressure, discomfort in the stomach, sweaty palms, body sweating, muscle stiffness, ringing in the ears, darkening in the eyes, redness of the face.

The way out of informational uncertainty and emotional

Table 1. Gradual change of traumatic stress into a mobilizing factor of personal development and subjective well-being in conditions of information uncertainty and emotional challenges (we developed a table using materials from the article [4], authors Floytlog J.I.J., Rasmussen I.)

Description of successive situations	Lecturer's words	Reflection in action on the gradual change of traumatic stress into a mobilizing factor	Reflection on the content of the question as a mobilizing factor for personal development
The lecturer decides to challenge a student who has not yet spoken.	What are your thoughts, Anna?	By inviting Anna to reflect on a difficult question, <u>the lecturer expresses her faith in Anna's ability to participate productively in the dialogue</u> (Anna is beginning to feel informational uncertainty and emotional challenge)	If Anna and those present in the audience understand that the question is formulated in such a way as <u>to draw attention to the value of Anna's ideas</u> , then Anna's level of informational uncertainty and emotional challenge is not high; if she does not have such awareness, then this level is quite high)
Anna begins to answer the question, but expresses difficulty in explaining.	Tell me more about it	The lecturer continues to invite responses in a way that shows <u>the good points of Anna's response</u> (Anna's level of informational uncertainty and emotional challenge decreases slightly)	If Anna and the audience understand that the request for a statement is formulated in a way that <u>frames Anna's thoughts as relevant</u> , then Anna's level of informational uncertainty and emotional arousal is minimal. If she does not have such awareness, then this level is above average.
Anna makes a gesture during her response, which the lecturer reads as a critical moment in Anna's response. He reacts immediately, transforming the difficulties Anna experiences into an aspect of collective action	Yes, it's hard to explain!	The lecturer continues to discuss the difficult question, involving all the other students, not because Anna was unable to formulate her opinion clearly enough, but because what <u>Anna says is correct</u> (Anna's level of informational uncertainty and emotional challenge is reduced to a minimum)	If Anna and those present in the audience understand that the request for a statement is formulated in such a way as <u>to transform Anna's individual work into a collective matter</u> , then she can effectively switch to a collective discussion, that is, perceive this communication not as traumatic stress, but as a mobilizing factor of personal development. If Anna and those present in the audience have not previously reflected on the content of the question, then Anna will feel a state of overwork and will withdraw from the collective matter

challenges is also not the same. Most students quickly overcome informational uncertainty and emotional challenges by switching attention to something pleasant, distracting (for example, pleasant memories), making an agreement with themselves (I will deal with this at a more convenient time), or reassuring themselves (this state will not yield any results, you need to calm down, accept the situation, and then think about what to do next). In this case, the transition from the process of optimal tension with optimal performance to the process of fatigue is natural and depends on the functional reserves of the body to perform a protective function to protect it from excessive loads and exhaustion.

However, some students think about what happened for a long time. To get out of informational uncertainty and emotional challenges, students begin to cry, drink water, look out the window, observe people, animals, transport, perform breathing exercises, count from one to ten, and then in the opposite direction. In this case, the transition from the process of optimal tension with optimal performance to the process of fatigue occurs rapidly with rapid depletion of the body's functional reserves and contributes to the emergence of a state of overfatigue.

Analysis of the results of observations, individual con-

versations, questionnaires with an emphasis on deferred reflection throughout the day contributed to the formation of a holistic view of informational uncertainty and emotional challenges that are relevant for students and should be taken into account when organizing the learning process.

In order to change traumatic stress into a mobilizing factor for personal development and subjective well-being in conditions of informational uncertainty and emotional challenges, we began to conduct a five-minute reflective practicum at the beginning of practical and seminar classes. For the practicum, we independently developed various cases or transformed the material of scientific articles by other scientists. We drew attention to a scientific article of that discussed the organization of reflective sessions with Talkwall, in which video recordings of lessons were discussed with teachers and researchers. Based on the content of the dialogue, we developed the content of Table 1.

According to the results of the experimental work, we recorded the following positive changes. Conducting five-minute reflective workshops at the beginning of practical and seminar classes influenced students who, before the start of the workshops, almost always began their studies with a process of fatigue, not a process of tension.

During individual conversations, these students explained their condition by the fact that they cannot quickly switch to the learning process, but constantly think about what happened previously in the family, at work, in transport, on the street, in the store, etc. The changes that occurred were the appearance of a process of tension before the process of fatigue. Conducting reflective practicums not only switched attention from previous challenges to considering what was offered during the practicums, but also formed a readiness to act effectively in conditions of information uncertainty and emotional challenges, which, in turn, reduced the time this category of students spent in a state of depressed mood. Students also indicated that conducting reflective practicums prevented them from falling into a state of uncertainty and depressed mood, as they expanded their personal experience with ways to maintain subjective well-being in conditions of informational uncertainty and emotional challenges.

DISCUSSION

According to generalized data covering the pre-war period and the annual period of hostilities on the territory of Ukraine [14], the prevalence of stress among Ukrainians in 2012 was 45%; in 2016 – 50%; in March 2022 – 53%, after the end of the war year – 80%.

By the end of the second year of the war, the prevalence of stress had reached 96%. A traumatic experience typical of all respondents without exception. These are 1) fear of shelling; 2) anxiety in anticipation of night and morning shelling; 3) concern about the condition and life of relatives, friends, acquaintances, and soldiers; 4) increased sensitivity to sounds in the environment; 5) experiences during sleepless nights; 6) loss of self-control during training in the warehouse, constant distractions to information about the state of events during the “air alarm” signal. The third year of the war is also characterized by high levels of stress [1]. In the context of the above, the organization of student education, which, on the one hand, will not generate additional stressful situations, and, on the other

hand, will contribute to the normalization of the mental state of students, becomes relevant [15, 16].

Experimental evidence suggests that reflection during learning is a common phenomenon. During learning, lecturers support students' reflection in various ways. They use reflective circles [12], include reflection as a stage in the educational design process [9], involve students in reflecting on their learning experience and on-the-job practice (consultations with students, parents of students; patients), use reflective diaries, journals, portfolio [12].

According to the results of our study, reflection should be aimed at restoring the optimally appropriate course of tension and fatigue processes that will contribute to the personal development of students and their sense of subjective well-being.

Also, we must emphasize the limitations of our research. This is the coverage of the experiment only by persons who received higher education during the third year of the full-scale military invasion of the territory of Ukraine. Our research did not include other of Ukrainians.

CONCLUSIONS

It has been established that under the influence of informational uncertainty and emotional challenges, students begin to feel uncertainty and depressed mood. Ignoring these states during learning reduces learning effectiveness, as students experience an accelerated transition from the process of tension to the process of fatigue.

In order to restore the optimally appropriate course of tension and fatigue processes in students, it is necessary to: 1) find out the duration of these processes; 2) determine factors that cause states of uncertainty and depression mood; 3) conduct five-minute reflective practicum at the beginning of practical and seminar classes, which train in the implementation of reflection, when the identified factors act as its objects; 4) practice the gradual transformation of traumatic stress into a mobilizing factor of personal development and subjective well-being in conditions of information uncertainty and emotional challenges.

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CORRESPONDING AUTHOR

Borys I. Palamar

Bogomolets National Medical University
13 Taras Shevchenko Blvd, 01601, Kyiv, Ukraine
e-mail: palamar.bi@ukr.net

ORCID AND CONTRIBUTIONSHIP

Tetiana I. Miyer: 0000-0002-2874-2925 A B C D
Borys I. Palamar: 0000-0003-2510-0713 A E F
Svitlana P. Palamar: 0000-0001-6123-241X A E F
Lyudmyla L. Khoruzha: 0000-0003-4405-4847 B C
Nataliia V. Vyshnivska: 0000-0001-7509-2841 B C
Svitlana H. Dubovyk: 0000-0002-4917-5114 B C
Roksolana I. Shpitsa: 0000-0002-9354-0641 B C

A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article

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Formation of digital competence in the medical educational environment

Vadym H. Terentiyk, Pavlo V. Mykytenko, Oleg M. Vlasenko, Darya G. Matukova, Inna I. Kucherenko
BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To present theoretical and practical approaches to the development of digital competence among participants in the medical education environment based on the digitalization of Ukraine's healthcare system.

Materials and Methods: To achieve the research objective, general scientific theoretical and empirical methods were used, including: bibliosemantic method, system analysis method, conversations and interviews with participants in the educational process, modeling of the process of formation of digital competence.

Results: An analysis of self-assessment and the level of digital competence formation among healthcare representatives helped determine the criteria for updating educational programs on digital competence development as a result, steps were taken to introduce comprehensive training in digital competencies, covering previously unaddressed aspects and enabling healthcare professionals to acquire all necessary competencies. Therefore, we presented a model illustrating the interrelation of competency formation and learning outcomes (LOs) through the lens of qualification characteristics and higher education standards for the specialty, interpreted in the information-educational environment model NMU_DIGITAL.

Conclusions: Medical and pharmaceutical education must adapt to modern standards and tools, regardless of whether they relate to treatment, prevention, rehabilitation, or management activities. Developing digital competence and using digital tools should begin at the earliest stages of professional orientation, be thoroughly studied at the pre-higher and higher education levels, and continue through lifelong professional development.

KEY WORDS: digital education, digitalization, digital transformation, electronic healthcare, system, e-Health, digital competence framework of healthcare professionals

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INTRODUCTION

The healthcare system reform in Ukraine has been fully transitioned to digital infrastructure. From now on, all stages – from the allocation of the state budget to direct patient care are conducted using modern information and digital technologies. A key element of this digital transformation is the two-tier Electronic Healthcare System (EHS). This system ensures instant and secure information exchange between medical institutions and government bodies responsible for policy development and healthcare service financing.

The implementation of digital technologies affects not only government agencies and medical professionals but also patients, who are the central element of the healthcare system. Local governments, pharmacies, diagnostic centers, and other stakeholders are also actively involved in this process. However, as practice shows, the importance of education and training in the digital transformation process has been underestimated. Many existing educational programs in medical and pharmaceutical institutions require updates and expansion [1, 2].

Given the rapid changes in the field of electronic healthcare, medical professionals must constantly adapt and master new digital tools and technologies. Therefore, high-quality education and workforce training are critically important for the success of healthcare digital transformation, especially in wartime conditions and workforce shortages.

AIM

The aim of the article is to present theoretical and practical approaches to the development of digital competence among participants in the medical education environment based on the digitalization of Ukraine's healthcare system.

MATERIALS AND METHODS

To achieve the research objective, general scientific theoretical and empirical methods were used, including: bibliosemantic method – analysis of scientific, meth-

odological, psychological, pedagogical literature, and regulatory documents on the research problem, system analysis method – for comparing and generalizing experiences in digitalization and digital transformation, empirical methods – conversations and interviews with participants in the educational process, modeling – for implementing the structure of educational process support at the Bogomolets National Medical University.

RESULTS

Before the implementation of the EHS in practical activities, computer equipment and the use of digital technologies in the healthcare system were minimal or sometimes even absent, indicating insufficient staff preparedness for applying digital technologies in practice. Additionally, the almost complete absence of educational courses and programs for medical and pharmaceutical professionals in vocational pre-university and higher education institutions, as well as in the system of continuous professional development, at the initial stage of EHS implementation led to several problems and obstacles in the effective introduction of electronic healthcare into practical activities [3].

Given the current wartime conditions and security risks at this stage of electronic healthcare development and EHS implementation, it is strategically important to define ways to improve the education of medical and pharmaceutical professionals at all levels. This is necessary to develop digital competencies and enhance human resources as the main driving force behind healthcare digital transformation. The strategic directions of the state in developing the healthcare sector include: creating a unified medical information environment, transitioning from paper to structured electronic medical records, integrating into the global medical information space, implementing international medical and information standards, ensuring public access to aggregated healthcare data, creating a favorable environment for the development of decision-support systems, personalized medicine, telemedicine, big data processing, artificial intelligence (AI), and more. An analysis of self-assessment and the level of digital competence formation among healthcare representatives helped determine the criteria for updating educational programs on digital competence [4] development as a result, steps were taken to introduce comprehensive training in digital competencies, covering previously unaddressed aspects and enabling healthcare professionals [5] to acquire all necessary competencies.

It is essential to follow the Digital Education Matrix principle when developing academic curricula. As stated in [4] the Digital Education Matrix aims to create

a comprehensive system for integrating the Digital Competence Framework into professional education for healthcare professionals. This system covers all education levels (Fig.1), specialties, and professional-educational standards, ensuring effective planning and implementation of digital education activities throughout a medical professional's career – from the beginning of training to continuous professional development.

The Digital Education Matrix provides a holistic approach to planning curricula and programs across specialties and educational standards. These standards, in turn, are based on the qualification requirements of the healthcare sector and will eventually align with professional standards currently under development. The ultimate goal is to create a structured training plan for model curricula and programs for all forms of education, specialties, and educational standards, considering the requirements and content of the Digital Competence Framework [6].

For example, due to the limited number of ECTS credits at Bogomolets National Medical University, not all areas of the digital competence framework can be mastered during the study of the core discipline "Information Technology" (for the specialty "Pharmacy, Industrial Pharmacy"). Therefore, elective courses and certification programs (non-formal education courses) come to the rescue. Additionally, it is crucial to reflect the digital competence matrix in the working programs of academic disciplines, based not only on competencies but also on learning outcomes.

A research team [4] developed a comprehensive table based on education level and specialty. However, it is important to examine the relationship between the Digital Competence Framework and the formation of learning outcomes. Therefore, we present a model (Fig. 2) illustrating the interrelation of competency formation and learning outcomes (LOs) through the lens of qualification characteristics and higher education standards for the specialty, interpreted in the information-educational environment model NMU_DIGITAL [7].

It is evident that the course program cannot be all-encompassing and can only cover certain components of the Digital Competence Framework for Healthcare Workers to form specific competencies and learning outcomes.

As the digitalization of the healthcare sector is an inevitable and irreversible process, the need to train qualified users of medical information systems is increasingly relevant. This drives the development and enhancement of informatics training for students of higher medical (pharmaceutical) education in many developed countries. Ukraine is no exception to these processes. A new driving force emerged in 2016 with

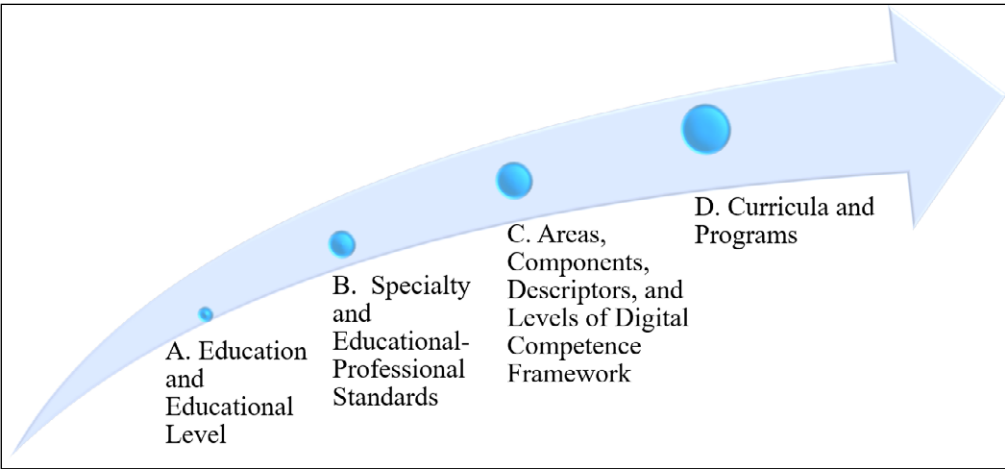


Fig. 1. System of digital education

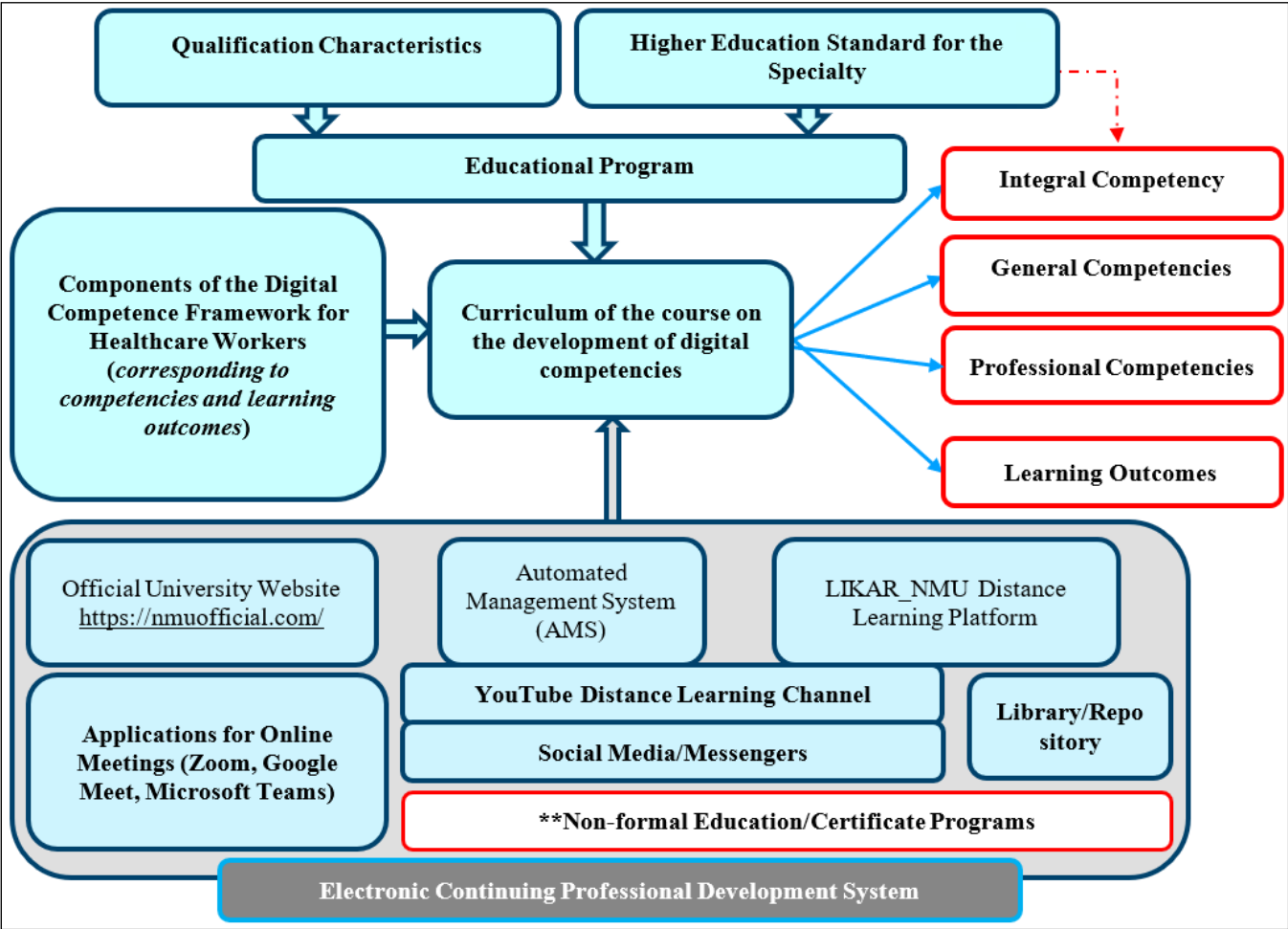


Fig. 2. Interpretation of the digital education matrix in the implementation of a digital competency formation course

the reform of the healthcare sector, which aimed to transition to electronic medicine.

Since 2019, the educational process in Ukrainian higher education institutions has been continuously affected by quarantine restrictions related to the COVID-19 pandemic and, later in 2022, by the introduction of martial law in Ukraine. The national higher medical education system faced a set of challenges related to organizing in-person, distance, and blended learning

formats while ensuring the quality of the educational process. These events have influenced the development of distance learning technologies, particularly in informatics training, and have driven the search for new technologies, tools, and teaching methods.

Currently, to support the educational process, the modular object-oriented dynamic learning platform LIKAR (Learning, Innovation, Knowledge, Assistance, Result) has been integrated into the distance learning system at

Bogomolets National Medical University. It is based on MOCO and MOODLE systems. The functionality of this system is extensive. As an automated information system for learning management, it enables the design, creation, and management of the university's educational resources while providing convenient content management tools and various forms of organizing classes [8].

According to survey results [4], all participants in the educational process require a higher level of digital competence. To master as many components of the Digital Competence Framework as possible and achieve a higher level of digital competence, students, healthcare workers, and university faculty at Bogomolets National Medical University are offered additional elective courses, non-formal education (external platforms), certification programs, and the "Digital Competency School" for all participants in the educational process.

Aims of the Digital Competency School:

- Enhancing digital literacy.
- Developing critical thinking regarding digital information.
- Building skills for safe digital practices.
- Assisting in professional activities.
- Promoting social inclusion.

For academic and research staff working in healthcare institutions, it is crucial to align with the following frameworks:

- The Digital Competence Framework for Ukrainian Citizens [9].
- The Conceptual-Referential Framework for the Digital Competence of Educators and Researchers [10].
- The Digital Competence Framework for Healthcare Workers [5].

DISCUSSION

The Ministry of Digital Transformation of Ukraine, together with its partners, has been researching digital literacy levels of the population, publishing reports in 2019, 2021, and 2023 [11-14]. On the "Diia. Education" platform, documents detailing digital competence frameworks for various professional groups – including librarians, educators, and healthcare workers – are available [5, 9, 10, 15, 16]. The latest development, concerning healthcare workers, was presented in 2023 and is published on the Diia. Education and Ministry of Health of Ukraine websites. According to [17], the digitalization of healthcare is driven by two factors specifically scientific and technological progress, which enables the adoption of new technologies in medicine and also the concept of e-health development, which establishes digital tools as fundamental for the progress and operation of the healthcare sector.

The analysis of these studies has revealed several issues that require further examination. In particular, this concerns the role of education in the development of digital competence and its impact on the digital transformation of the healthcare system. A thorough study of research results and practical pedagogical experience has highlighted the need to create a comprehensive concept for developing digital competence among participants in the medical educational environment based on the digitalization of Ukraine's healthcare system.

Based on the approaches considered within the framework of digital competencies and the results of research on the level of digital literacy of the population, we can note that the modernization of educational programs in medical education is critically important for success in the context of digital transformation. New programs must equip students, medical professionals, and rehabilitation specialists with the necessary skills and knowledge to operate effectively in a modern digital environment. Special attention should be given to education that fosters digital competence in all healthcare system participants throughout their professional lives. Educational programs should incorporate the effective use of digital tools and support the achievement of digitalization goals in healthcare and society as a whole.

Medical and pharmaceutical education must be adapted and synchronized with all external processes and changes in the healthcare sector. The study of disciplines and topics that develop digital competence should begin in the early years of higher education and continue throughout professional careers, while the implementation of digital solutions in universities and healthcare institutions is an essential component of quality [3]. Based on this, the target groups for changes in digital technology education include: students of professional pre-higher and higher education, practicing doctors, pharmacists, and rehabilitation specialists at the postgraduate level, as well as medical workers who use digital tools in electronic healthcare.

In our opinion, knowledge of innovations and new digital technologies in healthcare enables current and future professionals to be well-prepared for implementing modern approaches in management, diagnostics, treatment, rehabilitation, and patient care. The effective and rational use of digital technologies reduces the waiting time for research results, which is particularly important during surgical interventions. Additionally, digitalization, which transforms all public services into convenient online services, allows for the efficient servicing of a large number of patients and contributes to providing quality medical care not only to residents of developed metropolitan areas but also to those in remote regions of the country. Another advantage is

the reduction of medical errors, which are unacceptable since the primary goal of medicine is to preserve and improve human health without causing harm.

CONCLUSIONS

Medical and pharmaceutical education must adapt to modern standards and tools, regardless of whether they relate to treatment, prevention, rehabilitation, or management activities. Developing digital competence and using digital tools should begin at the earliest stages of

professional orientation, be thoroughly studied at the pre-higher and higher education levels, and continue through lifelong professional development.

The development and integration of various components of the educational online environment not only modernize the learning process and change teaching methods but also encourage the acquisition of new competencies for both students and faculty. The university's information-educational environment continues to evolve, integrating new technologies and resources to meet current challenges and needs.

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CORRESPONDING AUTHOR

Inna I. Kucherenko

Bogomolets National Medical University
13 T. Shevchenka Boulevard, 01601 Kyiv, Ukraine
e-mail: innanmu2018@gmail.com

ORCID AND CONTRIBUTIONSHIP

Vadim G. Terentiuk: 0000-0002-7046-4922 **B D E F**
Pavlo V. Mykytenko: 0000-0003-1188-4334 **A B D E**
Oleg M. Vlasenko: 0000-0002-0979-851X **A D E F**
Daria G. Matukova-Yaryga: 0000-0001-7217-8658 **A B D**
Inna I. Kucherenko: 0000-0002-0734-6544 **A B C D E F**

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Analysis of the significance of risk factors in the development of temporomandibular joint dysfunction pain syndrome

Andrii M. Proshchenko, Dina Yu. Shpak, Mariana L. Shemelko, Ljudmila L. Reshetnyk, Kseniya O. Sorokina
BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To perform a statistical evaluation of clinical and anamnestic indicators in patients presenting with functional disturbances of the masticatory system, accompanied by occlusal and articulatory abnormalities, both in the presence and absence of pain symptoms.

Materials and Methods: A total of 150 patients with occlusal disturbances underwent clinical and laboratory evaluation followed by orthopedic treatment. Among them, 90 individuals exhibited functional disorders of the masticatory system without associated pain symptoms (comparison group), while the remaining 60 patients (main group) presented with temporomandibular joint (TMJ) dysfunction accompanied by pain.

Results: The analysis revealed a significant etiological association between the development of TMJ dysfunction pain syndrome and several clinical factors: functionally stable and marked mandibular displacement ($p = 0.000$); increased masticatory muscle tone with hypertrophy ($p = 0.000$); non-stable occlusion ($p = 0.000$); a reduction of interalveolar height ($p = 0.017$); pronounced advanced attritional wear of the occlusal surfaces ($p = 0.039$); presence of audible TMJ sounds, including clicking and crepitus during mandibular movement ($p = 0.548$); reduced range of mouth opening ($p = 0.004$); and the use of direct or indirect restorations with inadequately reproduced occlusal morphology ($p = 0.031$).

Conclusions: The prognostic models developed in the course of this study may be utilized as indicators for identifying the risk of TMJ dysfunction-related pain during the planning phase of orthopedic treatment.

KEY WORDS: predictors, TMJ dysfunction pain syndrome, temporomandibular joint, functional occlusion disorders

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INTRODUCTION

Functional disorders of the masticatory apparatus arise from various components of the temporomandibular joint (TMJ), affecting the masticatory muscles, the joint itself and the structures associated with it. This is a widespread problem worldwide. According to epidemiological studies, up to 50% of the adult population has symptoms associated with TMJ dysfunction [1-3]. And the root cause of TMJ and masticatory muscle dysfunction is considered to be functional occlusion disorders [4-7]. In modern dentistry, it is relevant to study the relationship between various causes of articulation-occlusal relationships and the development of temporomandibular disorders [8-12]. Among them, the greatest attention is paid to pathological types of occlusion, dentition defects, and dentofacial anomalies [12-15].

Pain associated with TMJ dysfunction, as well as impairments in chewing, speech, and other vital functions, often results from internal TMJ disorders [16]. Functional occlusal disturbances and masticatory muscle para-

function are regarded as the primary etiological factors in the development of TMJ and masticatory muscle dysfunction [17]. In this context, identifying reliable predictors of such pathology and developing effective preventive strategies remains a pressing concern. A comprehensive understanding of the underlying risk factors is essential—not only for designing preventive measures but also for informing orthopedic treatment planning and forecasting treatment outcomes.

Functional disorders of the temporomandibular joint (TMJ) are closely associated with disturbances in the anatomical structure of the joint, particularly with the dys-topic positioning of mandibular condyles—both at rest and during mandibular movements [18]. Alterations in joint structure can trigger functional impairments; however, disorders of the dentofacial system are inherently multifactorial. They arise under the influence of both intrinsic and extrinsic, modifiable and non-modifiable factors such as age, sex, occlusal abnormalities, the presence and duration of crown defects, asymmetry in dental arch length, dentofacial deformities, persistent

mandibular displacement, pronounced attritional wear of the occlusal surfaces, traumatic injuries, and systemic muscular pathologies [19].

Given the clear role that occlusal-articulatory disturbances play in the emergence of both painful and non-painful functional disorders of the masticatory system, it remains critical to identify and evaluate these contributing factors. This would enable the development of accurate prognostic models, targeted prevention strategies, and optimization of orthopedic treatment and rehabilitation outcomes [20].

The task of determining the most influential predictors and assessing their relative significance remains a subject of ongoing debate. However, comprehensive knowledge of the underlying risk factors is vital—not only for effective prevention but also for guiding the planning and improving the prognostic accuracy of orthopedic interventions.

AIM

To perform a statistical evaluation of clinical and anamnestic indicators in patients presenting with functional disturbances of the masticatory system, accompanied by occlusal and articulatory abnormalities, both in the presence and absence of pain symptoms.

MATERIALS AND METHODS

A total of 150 patients with different types of occlusal disturbances underwent comprehensive clinical and laboratory assessment, followed by orthopedic treatment. Among them, 90 individuals formed the comparison group, characterized by functional disorders of the masticatory system without any reported pain symptoms. The remaining 60 patients, who comprised the main study group, were diagnosed with temporomandibular joint (TMJ) dysfunction accompanied by pain.

This division, in our view, is appropriate for identifying key predictors associated with the development of pain syndrome. The diagnostic protocol included a thorough review of general and dental anamnesis, clinical examination of the oral cavity, and evaluation for TMJ dysfunction indicators based on the Hamburg protocol during the initial dental consultation.

Inclusion criteria: patient age between 18 and 60 years, the presence of articulatory and occlusal abnormalities accompanied by functional disorders of the masticatory system, and the provision of signed informed consent for participation in the study.

Exclusion criteria: included individuals younger than 18 or older than 60 years, a medical history of maxillofacial trauma or contusions, the presence of serious

systemic illnesses contributing to a premorbid state, and cases where patients declined to participate in the study.

Statistical analysis was conducted using the R programming environment (r-project.org, version 4.0). To evaluate the potential influence of individual factors, univariate binary logistic regression was applied, with odds ratios (ORs) calculated for each predictor. This method allows for the prediction of binary outcomes—such as the presence or absence of a condition—based on a set of independent variables. The outcome variable, representing the predicted event, is binary (typically coded as 0 or 1), while the predictors are referred to as independent variables. Logistic regression relies on binomial probability theory, where the event's likelihood is estimated to fall into one of two categories. The analysis utilizes the maximum likelihood estimation method, which determines the most probable classification of the observed data using regression coefficients. A p-value less than 0.05 was considered indicative of statistical significance. Effect size was expressed as an odds ratio (OR), accompanied by a 95% confidence interval (CI). The OR reflects the relative likelihood of an outcome occurring in one group compared to another. Confidence intervals were calculated using the Katz method. If the CI spans the value of 1, it suggests no statistically significant difference between groups. Conversely, if the entire CI lies above 1, the OR is significantly increased in the group, and if entirely below 1, the OR is significantly decreased.

The study protocol received ethical approval from the Commission on Bioethical Expertise and Research Ethics of Bogomolets National Medical University (Protocol No. 185, dated May 27, 2024). All procedures adhered to ethical principles outlined in the Declaration of Helsinki by the World Medical Association.

RESULTS

An evaluation of clinical and anamnestic data, with consideration of the potential association between functional disturbances of the masticatory system and the presence of pain during the initial patient assessment, revealed the following: in the main group, 42 participants (70.00%) were female, whereas in the comparison group, women accounted for 49 individuals (54.44%). According to univariate analysis, this indicator was on the verge of statistical significance (OR=1.952, 95% CI: 0.988-3.953, $p = 0.058$). The association of age with the development of pain syndrome of TMJ dysfunction was not established. The distribution of examined patients by age was as follows: age 18-39 years – 27 (45.00%) patients in the main group, versus 45 (50.00%) in the

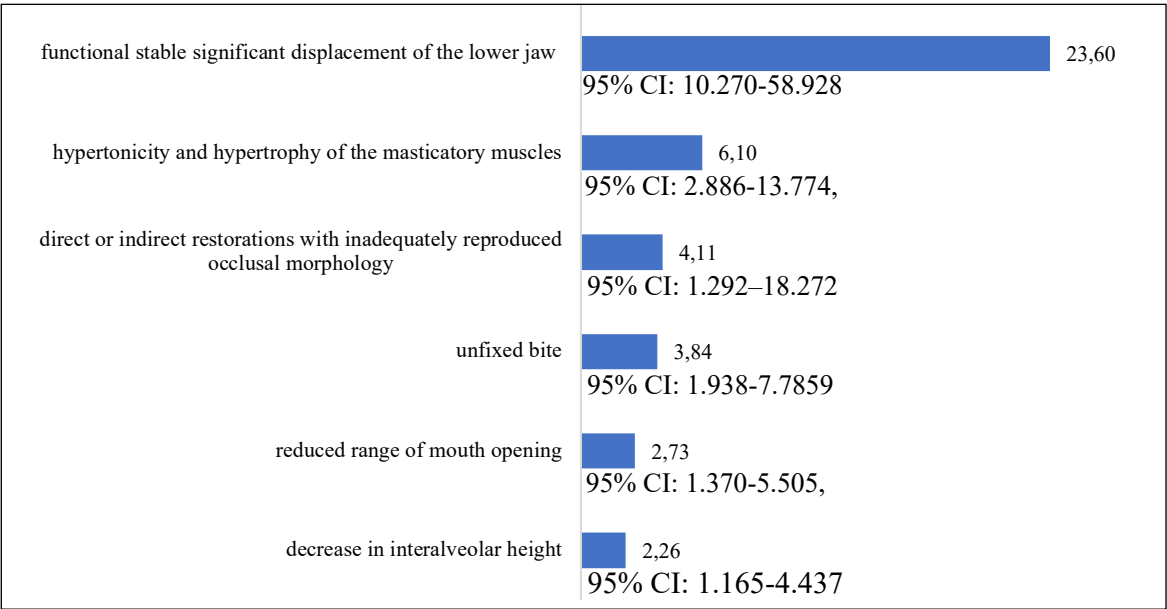


Fig. 1. Odds ratios of risk factors associated with TMJ dysfunction pain syndrome

comparison group (OR=0.818, 95% CI: 0.423-1.574, $p = 0.548$), age 40-49 years – 19 (31.67%) patients in the main group, versus 18 (20.00%) in the comparison group (OR=1.853, 95% CI: 0.874-3.951, $p = 0.106$), age over 50 years – 14 (23.33%) patients in the main group, versus 27 (30.00%) in the comparison group (OR=0.778, 95% CI: 0.365-1.612, $p = 0.504$).

Analysis of dental history revealed the following findings: prior orthodontic treatment was reported in 21 individuals (35.00%) from the main group and in 33 individuals (36.67%) from the comparison group. However, this factor did not show a statistically significant association with the onset of TMJ dysfunction accompanied by pain (OR = 0.930, 95% CI: 0.466–1.833, $p = 0.834$).

On the other hand, orthopedic history revealed that 57 participants (95.00%) in the main group had direct or indirect restorations with inadequately reproduced occlusal morphology, compared to 74 patients (82.22%) in the comparison group. This characteristic was found to increase the likelihood of developing pain-related TMJ dysfunction by approximately four times ($p = 0.031$) (Fig. 1). Based on the results of the dental examination, the statistically significant predictors of TMJ dysfunction with pain syndrome were identified and ranked in order of their predictive strength, from highest to lowest: functional stable significant displacement of the lower jaw ($p = 0.000$); hypertonicity and hypertrophy of the masticatory muscles – 49 (81.67%) participants in the main group, versus 38 (42.22%) in the comparison group ($p = 0.000$); unfixed bite – 38 (63.33%) participants in the main group, versus 34 (37.78%) in the comparison group ($p = 0.000$); decrease in interalveolar

height– 13 (21.67%) patients in the main group, versus 9 (10.00%) in the comparison group ($p = 0.017$); advanced attritional wear of the occlusal surfaces – 37 (61.67%) patients in the main group, versus 40 (44.44%) in the comparison group (OR=2.011, 95% CI: 1.039-3.952, $p = 0.039$); audible TMJ sounds, including clicking and crepitus during mandibular movement – 43 (71.67%) patients in the main group versus 50 (55.56%) in the comparison group (OR=2.023, 95% CI: 1.017-4.137, $p = 0.548$); reduced range of mouth opening – 29 (48.33%) participants in the main group versus 23 (25.55%) in the comparison group ($p = 0.004$).

Thus, the most significant factor in the development of TMJ dysfunction pain syndrome is the displacement of the lower jaw, which is obviously a manifestation of the narrowing of the distal joint space and is confirmed by computed tomography in the sagittal projection.

At the same time, statistical analysis of clinical signs showed that the identified potential factors were not statistically significant: dentofacial deformations – 25 (41.67%) patients in the main group, versus 44 (48.89%) in the comparison group ($p = 0.385$); excessive localized abrasion of the chewing surface of the teeth – 18 (30.00%) patients in the main group, versus 38 (42.22%) in the comparison group ($p = 0.385$); presence of supracontacts – 60 (100.00%) patients in the main group, versus 85 (94.44%) in the comparison group ($p = 0.987$); single defects of the dentition and the crown of the teeth – 23 (38.33%) patients in the main group, versus 34 (37.78%) in the comparison group ($p = 0.945$); occlusion pathology – 26 (43.33%) patients in the main group, versus 29 (32.22%) in the comparison group ($p = 0.168$); parafunction of the masticatory muscles – 15

(25.00%) patients in the main group, versus 18 (20.00%) in the comparison group ($p = 0.469$); deviation or deflection – 26 (43.33%) patients in the main group versus 48 (53.33%) in the comparison group ($p = 0.231$).

DISCUSSION

Thus, the most important factor in the development of pain syndrome of TMJ dysfunction is the displacement of the lower jaw, which is obviously a manifestation of the narrowing of the distal joint space, confirmed by computed tomography in the sagittal projection. At the same time, when conducting a statistical analysis of clinical signs, the identified potential factors did not show their statistical significance: dentofacial deformations – 25 – 41.67% in the main group, versus 44 – 48.89% in the comparison group ($p = 0.385$); excessive localized abrasion of the chewing surface of the teeth – 18 – 30.00% in the main group, versus 38 – 42.22% in the comparison group ($p = 0.385$); presence of supracontacts presence of supracontacts – 60 – 100.00% in the main group, versus 85 – 94.44% in the comparison group ($p = 0.987$); single defects of the dentition and the crown part of the teeth – 23 – 38.33% in the main group, versus 34 – 37.78% in the comparison group ($p = 0.945$); occlusion pathology – 26 – 43.33% in the main group, versus 29 – 32.22% in the comparison group ($p = 0.168$); parafunction of the masticatory muscles – 15 – 25.00% in the main group, versus 18 – 20.00% in the comparison group ($p = 0.469$); deviation or deflection – 26 – 43.33% in the comparison group; vs. 48 – 53.33% in the comparison group ($p = 0.231$).

Temporomandibular disorders are an umbrella term encompassing a group of musculoskeletal conditions characterized by pain and/or functional impairment of the masticatory muscles, the TMJ, and associated anatomical structures [20, 21]. The most common clinical manifestations include orofacial pain, limited mandibular range of motion, and joint sounds such as clicking or crepitus during jaw movements [22]. The first descriptions of TMJ dysfunction date back to the late 19th century by a British surgeon who explored surgical methods for disc displacement. In 1934, James Costen proposed that occlusal disturbances could cause pain in the TMJ and the preauricular region [23]. Currently, various etiopathogenetic mechanisms are considered in the development of TMDs, including the isolated or combined impact of TMJ dysfunction, hyperactivity of the masticatory muscles, occlusal factors, and genetic polymorphisms [24]. In particular, studies have established associations between malocclusions, dental arch defects, and TMJ dysfunction [1]. Another case-control clinical study found that excessive generalized abra-

sion of chewing surfaces of teeth was associated with chronic TMJ dysfunction ($OR = 2.3$), while pathological TMJ sounds during mandibular movements were associated with an OR of 3.4 [25]. These findings align with our results, which demonstrate that decreased interalveolar height, advanced attritional wear of the occlusal surfaces and presence of audible TMJ sounds, including clicking and crepitus during mandibular movement are significantly associated with temporomandibular disorders related pain ($OR = 2.258$; 2.011; 2.023, respectively). Our statistically significant findings suggest that both the muscular-articular component and occlusal-articulatory disturbances, as well as the disrupted interrelationship between them, play an etiopathogenetic role in the development of pain associated with TMJ dysfunction. The most significant occlusal predictors identified were persistent functional mandibular displacement and masticatory muscle hypertonicity with hypertrophy.

Thus, while the theory of the primacy of occlusal-articulatory factors in the onset of TMJ dysfunction is relevant, it remains incomplete. It highlights the necessity for a comprehensive treatment approach that not only addresses pain via occlusal therapy and subsequent prosthetic rehabilitation but also takes into account subclinical intra-articular changes during prosthetic planning. This justifies the importance of thorough diagnosis of functional disorders of the masticatory system prior to treatment. Prosthodontic planning should include measures for diagnosing and correcting functional disturbances and support the individualized application of prosthetic treatment algorithms involving mandibular repositioning, normalization of TMJ and masticatory muscle function, and the establishment of adapted, rational occlusal-articulatory relationships. Given that chronic pain in TMJ dysfunction may be associated with impaired general health, altered emotional status, behavior, and social interactions – as manifestations of central nervous system dysregulation – it can significantly reduce the patient's quality of life [26, 27].

A limitation of the present study is the sample selection, which included only patients seeking dental care, and the use of a univariate statistical approach, which assessed the isolated effect of each potential predictor without accounting for the cumulative influence of factors on the onset of TMJ dysfunction pain. Nevertheless, future research should aim to develop prognostic models using multivariate statistical analyses based on the established ranking of TMJ dysfunction pain predictors. Future research will focus on evaluating and interpreting the prognostic value of identified factors contributing to the development of pain-related dysfunction syndrome. An additional aim will be the development

of a user-friendly online tool for use in clinical practice to support accurate prediction and prevention of this syndrome during the planning of orthopedic treatment.

CONCLUSIONS

The analysis revealed several factors that show a strong etiological association with the development of pain-related TMJ dysfunction. These include: persistent and functionally stable mandibular displacement (OR = 23.597, $p = 0.000$); hyperactivity and hypertrophy of the masticatory muscles (OR = 6.096, $p = 0.000$); un-

stable occlusion (OR = 3.843, $p = 0.000$); a reduction in interalveolar height (OR = 2.258, $p = 0.017$); advanced attritional wear of the occlusal surfaces (OR = 2.011, $p = 0.039$); presence of audible TMJ sounds, including clicking and crepitus during mandibular movement (OR = 2.023, $p = 0.548$); reduced range of mouth opening (OR = 2.725, $p = 0.004$); and the presence of direct or indirect restorations with inadequately formed occlusal morphology (OR = 4.108, $p = 0.031$).

These findings may serve as predictive indicators for the onset of TMJ pain dysfunction and could be effectively utilized during the planning phase of orthopedic treatment.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Andrii M. Proshchenko

Bogomolets National Medical University
13 T. Shevchenko blvd., 01601 Kyiv, Ukraine
e-mail: andrey.proshchenko@gmail.com

ORCID AND CONTRIBUTIONSHIP

Andrii M. Proshchenko: 0000-0002-6368-0440 A B C D E F

Dina Yu. Shpak: 0009-0003-7213-9204 A B C F

Mariana L. Shemelko: 0009-0009-1906-5078 C D E F

Ljudmila L. Reshetnyk: 0000-0001-9295-7800 A B C E

Kseniya O. Sorokina: 0009-0006-1866-2346 B D E

A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article

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Analysis of neuromuscular and occlusal characteristics of the dentition in patients with temporary fixed orthopedic construction on dental implants in case of complete loss of teeth in one of the jaws

Stanislav Y. Vefelev, Nina S. Proshchenko, Olena O. Astapenko, Nadiya V. Chervonna

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To evaluate the neuromuscular and occlusal characteristics of the dentition in patients with complete tooth loss in one of the jaws who were fitted with temporary fixed prosthetic structures for immediate loading of dental implants.

Materials and Methods: Using the method of synchronyography (Teethan system), functional parameters was analyzed in three groups of patients: with structures based on a cast beam, with a welded beam, and with polymethyl methacrylate (PMMA).

Results: The results emphasize the importance of choosing the type of temporary structure depending on the functional requirements, patient characteristics, and long-term prospects for adaptation.

Conclusions: The study emphasizes the importance of choosing the type of construction to ensure effective rehabilitation of patients with complete loss of teeth in one of the jaws and prevention of possible complications. The researchers recommend using cast or welded beams to achieve optimal long-term clinical results.

KEY WORDS: immediate load on implants, Teethan, intraoral welding, complete tooth loss, neuromuscular and occlusal characteristics, cast beam, dental implantation, temporary fixed prosthetic structures

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INTRODUCTION

Tooth loss, especially in the case of complete loss of teeth on one or both jaws, is one of the most common and at the same time the most complex dental problems in modern society, which affects not only the physiological function of chewing and articulation, but also the psycho-emotional state of patients, their social adaptation and overall quality of life [1-3].

Dental implants are a proven and reliable method of restoring teeth in case of complete loss, providing stable and long-lasting results. Temporary fixed orthopedic structures, which are placed on implants for immediate loading, allow patients to restore chewing function immediately after surgery, which is especially important for maintaining quality of life during rehabilitation [4-8].

However, one of the most important aspects is to study the effect of such structures on the neuromuscular function and occlusal characteristics of the dentition. Failure to meet proper standards in restoring occlusion, as well as inadequate load on implants, can lead to masticatory muscle dysfunction, temporomandibular joint (TMJ)

pain, and the development of joint dysfunction [9-11]. Therefore, a thorough study of neuromuscular characteristics and occlusal functions in patients with temporary dental implant prostheses is critical to achieve stable treatment results and prevent possible complications. Insufficient attention to this aspect can lead to disorders in muscle activity, which, in turn, can affect the patient's occlusal functions. It is also important to determine the optimal parameters of the load on the implants during different periods of treatment to reduce the risk of complications, such as bone resorption around the implants, implant mobility with their loss [12-14].

The relevance of this study is also confirmed by the need to optimize approaches to the treatment of patients with complete tooth loss. Due to the development of new technologies and methods, such as digital implant planning technologies and 3D visualization, methods for assessing the functional and anatomical parameters of the dentition are being improved, which can significantly improve the accuracy and effectiveness of treatment [15-21].

In view of the above, the study of neuromuscular and occlusal characteristics in patients with temporary fixed dental implant prostheses is important for the development of more effective and safe methods of rehabilitation of patients with complete tooth loss in one of the jaws and will contribute to the optimal rehabilitation process and reduce the likelihood of complications. This will improve the effectiveness of treatment and the quality of life of patients.

AIM

To analyze the chewing, neuromuscular and occlusal characteristics of the dentition by synchrography (digital Teethan system) in patients who received a temporary fixed orthopedic structure for immediate loading with support for dental implants in case of complete tooth loss in one of the jaws.

MATERIALS AND METHODS

For a comparative assessment of the effect of different implant-supported prosthetic structures for immediate loading on the neuromuscular and occlusal components of the dentition, we chose temporary acrylic prostheses with dentures reinforced with a cast beam, temporary composite prosthetic structures with a welded beam, and temporary prosthetic structures made of PMMA.

Analysis of the occlusal characteristics of the dento-maxillary apparatus was performed using Teethan digital technology. The study is aimed at improving the methods of rehabilitation of patients with complete tooth loss in one of the jaws, which will increase the effectiveness of treatment and reduce the risk of complications.

During the surgical stage, dental implants of the AnyOne system made in Korea with a diameter of 3.5 mm to 4.5 mm and a length of 10 to 13 mm were used.

The study included a comparative assessment of the functional state of the masticatory muscles in 128 patients (59 men and 69 women) prosthodontized with temporary structures supported by 6 implants using three different approaches: 41 patients – temporary acrylic dentures with set teeth reinforced with a cast beam (Cr-Co) (first group), 45 patients – temporary composite orthopedic structures (printed on a 3-D printer) with a welded beam (Cr-Co), which is made by selective laser sintering (second group) and 42 patients with a temporary orthopedic structure made by milling from PMMA (third group).

Five functional indicators were used for the analysis: Poc, Bar, Tors, Impact and Asym, which were measured

at different time points (1 week, 1 month, 3 months, 6 months after prosthetics). To improve the perception of information, we visualized it in the form of graphs (Fig. 1, Fig. 2, Fig.3, Fig. 4, Fig. 5).

RESULTS

At the early stage of adaptation (1 week), there were significant differences between the groups: The group with the cast beam showed the best results in all indices. The Bar index was 1.35 ± 0.12 , and the Asym index was 0.96 ± 0.10 , indicating good structural stability and even load distribution. Group 2 (with a welded beam) showed intermediate values. The Bar index was 1.23 ± 0.15 ($p = 0.048$ compared to the first group), and the Asym index was 1.05 ± 0.11 ($p = 0.038$). This indicates certain “instability” of the structure associated with some inaccuracies during its assembly in the surgical stage, but it is much better than in the third group. The third group (temporary structure made of PMMA) demonstrated the worst performance. The Bar index was 0.92 ± 0.20 and the Asym index was 1.22 ± 0.14 ($p < 0.001$ compared to both groups). This is due to the mobility of the structure and the uneven distribution of the chewing load. Thus, in the first week after prosthetics, the advantages of the cast beam stiffness were obvious, and structures based on intraoral welding proved to be more stable than prostheses made of PMMA. At the stage of 1 month after prosthetics, patients in all groups showed adaptation, but differences persisted. The first group continued to show the best results. The Poc index was 1.25 ± 0.14 , and the Bar index was 1.34 ± 0.10 , which was significantly higher than in the third group ($p < 0.001$).

The second group demonstrated improvement in functional performance. The Poc index was 1.18 ± 0.16 , and Asym decreased to 0.89 ± 0.10 , which was still higher than the first group ($p = 0.034$), but better than the third group ($p < 0.001$). The third group continued to show poor results. The Asym index was 1.12 ± 0.13 , and the Bar index was 1.03 ± 0.18 , indicating insufficient structural stability. Adaptation to structures using cast and welded beams was faster than to lamellar prostheses, as evidenced by significant differences in the Asym and Bar indices.

At 3 months after prosthetics, the differences between the first and second groups began to decrease. The first group showed stable results. The Bar index was 1.34 ± 0.10 , and the Impact index was 1.22 ± 0.11 . These scores remained better than those of the third group ($p < 0.001$). The second group almost equaled the first group in most indices. The Bar value was 1.30 ± 0.13 , and Impact was 1.20 ± 0.12 ($p = 0.092$ compared to the first

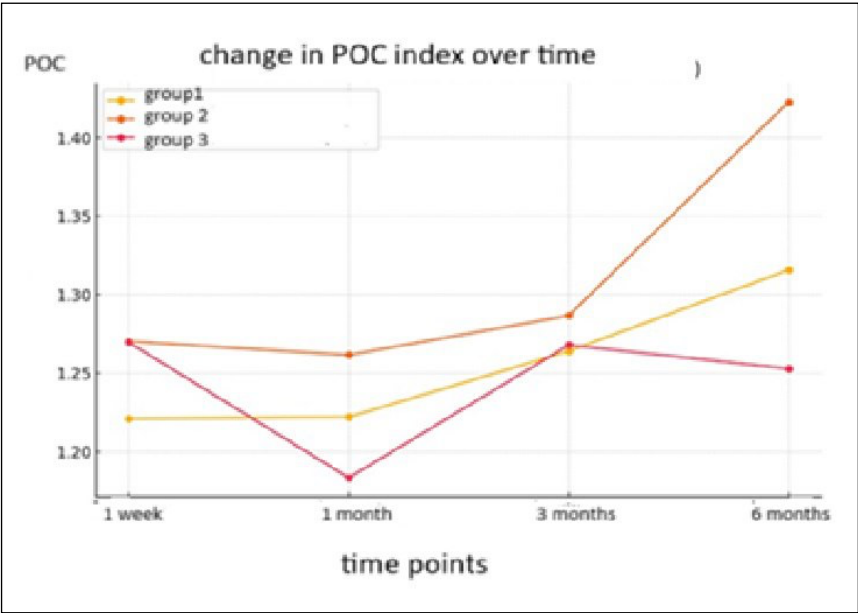


Fig. 1. Graph comparing the Poc index for the three groups at different time points

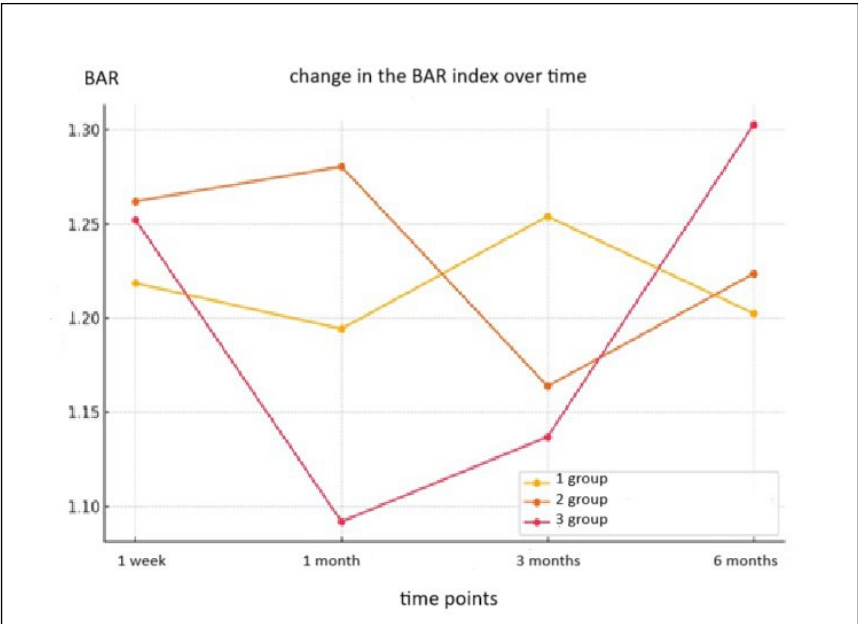


Fig. 2. Graph comparing the Bar index for the three groups at different time points

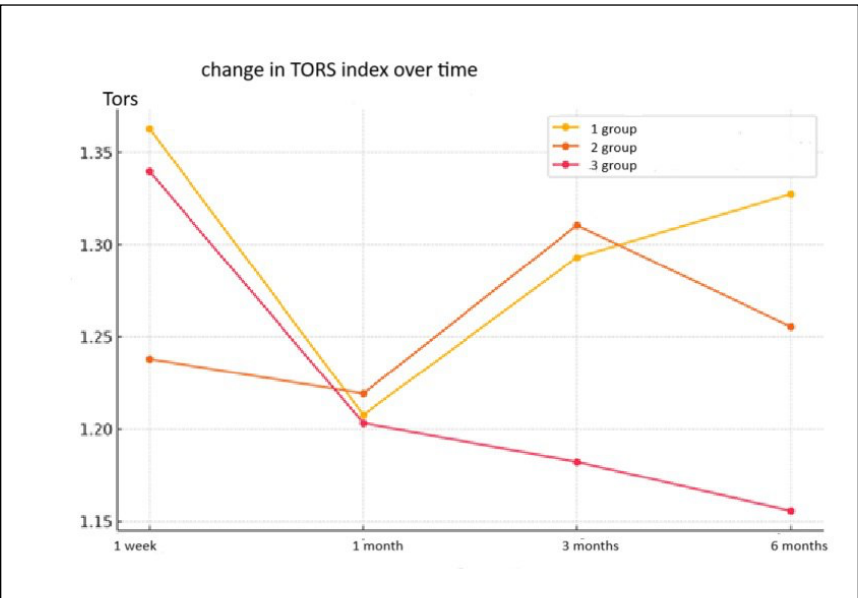


Fig. 3. Graph comparing the Tors index for the three groups at different time points

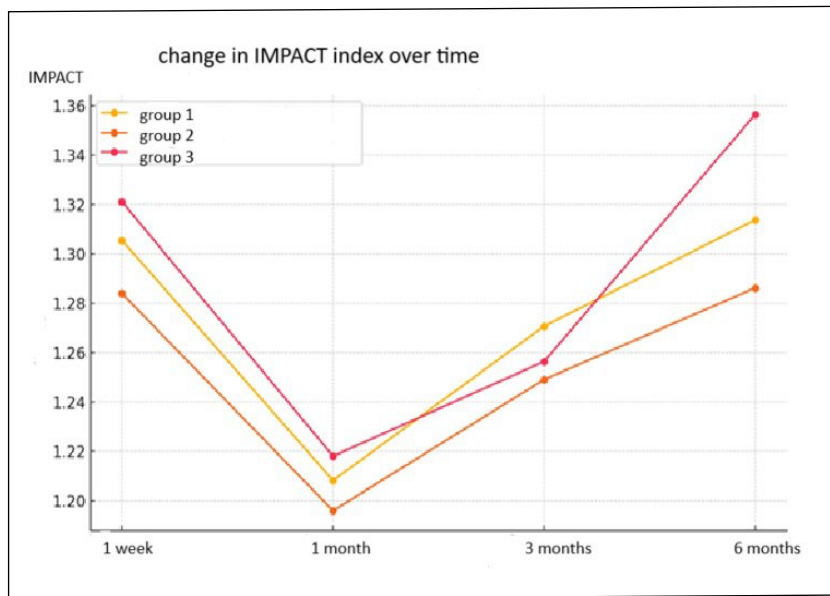


Fig. 4. Graph comparing the Impact Index for the three groups at different time points

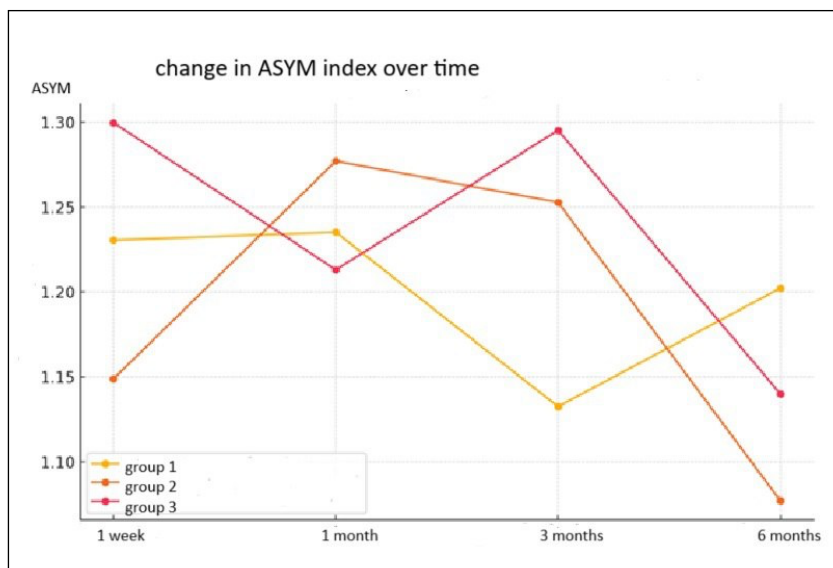


Fig. 5. Graph comparing the Asym index for the three groups at different time points

group). However, Asym index remained slightly higher (0.83 ± 0.08) compared to the first group (0.80 ± 0.07 , $p = 0.062$). The third group showed a slight improvement, but the scores remained the worst. The Asym index was 1.01 ± 0.10 , and the Bar index was 1.05 ± 0.18 , indicating worse adaptation.

The results of the third month show that the cast and welded beam constructions provide similar functional stability, while the PMMA temporary prosthesis remains less effective.

At 6 months after prosthetics, most of the indicators in the first and second groups reached similar values. The first group continued to demonstrate the best results, with the Asym index at 0.75 ± 0.07 and the Bar index at 1.35 ± 0.07 . The second group showed almost identical results. The Bar index was 1.33 ± 0.08 , and the Asym index was 0.79 ± 0.06 ($p = 0.048$ compared to the first group).

The third group showed improvement, but still lagged behind. The Bar index was 1.11 ± 0.15 , and the Asym index was 1.01 ± 0.10 , which confirms poor adaptation and limited stability.

DISCUSSION

An objective analysis of the functional state of the masticatory muscles before and after dental interventions allows for a more accurate assessment of the patient's initial condition, reasonable planning of restoration, and monitoring the effectiveness of treatment, regardless of its form (restorations, implantation, orthodontic intervention, etc.) [10-12].

Our results confirm that the type of temporary orthopedic structure has a significant impact on neuromuscular adaptation and occlusal stability in patients with complete tooth loss. Our study is in line with previous

studies that indicate the importance of stiffness and accuracy of fixation of orthopedic structures to achieve optimal functional outcome [5, 6].

In the study, a group of patients with temporary prostheses on a cast beam demonstrated the best functional results in the early stages, due to the high rigidity of the structure and even load distribution. The second group – with a welded beam – showed similar results to the first group at 3 and 6 months, confirming the effectiveness of this approach. In contrast, PMMA structures were significantly inferior in terms of stability and load symmetry, indicating that their use in such clinical cases is limited.

The data on the superiority of the cast beam over polymeric structures confirm the findings of Doroshenko O and Shepelynskiy O. (2024), who emphasize that stiffer structures contribute to a more even distribution of the masticatory load and reduce the risk of TMJ dysfunction [22]. At the same time, the results of the second group, in which welded beams were used, show that welding is a promising alternative, which is confirmed by the study by Galucci GO. et al. (2018), which states that immediate loading of implants is possible provided the structure is stable [23].

The poor results of PMMA constructions are consistent with the data of Frazer R.Q. et al. (2005), which indicate insufficient stability of acrylic prostheses compared to metal frames [24]. The high Asym index and low Bar in this group confirm the presence of load asymmetry, which can lead to hyperactivity of individual muscles and functional imbalance.

The methodology for assessing neuromuscular activity using digital synchronyography (Teethan) allowed us to objectively assess the functional effectiveness of different types of temporary structures, which is important for individualizing the approach to rehabilitation. Similarly to the study by Saracutu O.I. et al. (2021), we found that digital analysis methods can detect early signs of dysfunction and optimize design solutions [25, 26].

Thus, the results of our study confirm the effectiveness of cast and welded beams as temporary implant structures. They ensure rapid patient adaptation, stability of neuromuscular balance, and reduce the risk of complications. Further studies should be aimed at evaluating long-term results, in particular after the transition to permanent prosthetics.

CONCLUSIONS

1. The study found that the use of a cast beam in temporary structures provides the highest functional stability of the masticatory muscles at all stages of observation. Stiffness of the structure and uniform load distribution contributed to the best performance of the Poc, Bar, Tors, Impact and Asym indices.
2. The welded beam showed comparable results to the cast beam, especially at 3 and 6 months after prosthetics. Slight differences in the Asym index indicate a slightly lower stability of the structure in the early stages of adaptation, however, by the 6 month these differences practically disappear. This makes it possible to consider the welded beam an effective alternative to the cast one.
3. Temporary prostheses made of PMMA showed the worst results for all indices at all stages of observation. The instability of the structure and uneven distribution of the chewing load significantly affected the adaptation of the masticatory muscles, which confirms the limited use of them for temporary prosthetics on implants in patients with complete tooth loss in one of the jaws.
4. Based on the data obtained, it is recommended to use cast or welded beams for temporary implant-supported structures in patients with complete loss of teeth in one of the jaws, as they provide rapid adaptation of patients and stability of the masticatory muscle function. Temporary prostheses made of PMMA should be used only in exceptional cases when other designs cannot be used.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Nina S. Proshchenko

Bogomolets National Medical University

13 T. Shevchenko blvd., 01601 Kyiv, Ukraine

e-mail: khrolnina@gmail.com

ORCID AND CONTRIBUTIONSHIP

Stanislav Y. Vefelev: 0000-0002-6368-0440 **A** **B** **C** **D** **E** **F**

Nina S. Proshchenko: 0000-0001-7317-6590 **A** **B** **C** **E** **F**

Olena O. Astapenko: 0009-0009-1906-5078 **C** **D** **E** **F**

Nadiya V. Chervonna: 0009-0003-4499-5399 **A** **B** **D** **F**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Radiation-induced mucositis and salivary EGF levels in patients with head and neck cancer

Ameer Alturfi¹, Fawaz Alaswad¹, Awf Abdulrahman Sulaiman²

¹DEPARTMENT OF ORAL DIAGNOSIS, COLLEGE OF DENTISTRY UNIVERSITY OF BAGHDAD, BAGHDAD, IRAQ

²DEPARTMENT OF RADIATION ONCOLOGY, BAGHDAD RADIATION ONCOLOGY AND NUCLEAR MEDICINE CENTER, BAGHDAD MEDICAL CITY COMPLEX, MINISTRY OF HEALTH/ENVIRONMENT, BAGHDAD, IRAQ

ABSTRACT

Aim: The present study aims to investigate the correlation between the concentration of salivary epidermal growth factor and the development of radiation-induced mucositis in patients diagnosed with head and neck cancer.

Materials and Methods: A cross-sectional study examined radiotherapy-treated head and neck cancer patients. Saliva samples were collected before radiation treatment, as well as at two weeks and four weeks after starting treatment. The epidermal growth factor levels in saliva samples were measured using enzyme-linked immunosorbent assay (ELISA).

Results: After two and four weeks of radiation, EGF expressions were considerably greater than those in the control group. The optimal cut-off EGF for prediction of oral mucositis after radiotherapy was 502.1 pg/ml.

Conclusions: epidermal growth factor level may affect radiation-induced mucosal healing. In patients receiving regular daily fractions of radiation, higher EGF concentrations reduced the probability of mucositis occurrence. Oral mucositis has decreased compared to prior trials using older radiation delivery technologies.

KEY WORDS: mucositis, epidermal growth factor, radiotherapy, head and neck neoplasms

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ABBREVIATIONS

EGF: Epidermal Growth Factor
RT: Radiation Therapy
EBRT: External Beam Radiation Therapy
VMAT: Volumetric Modulated Arc Therapy
ROC: Receiver Operating Characteristic
IMRT: Intensity Modulated Radiation Therapy

INTRODUCTION

Oral mucositis is a term used to describe lesions that cause painful, erythematous, and ulcerative changes in the mouth and is frequently a side effect of antineoplastic therapy for head and neck cancer treatment [1-2] accompanied by notable discomfort, odynodysphagia (painful swallowing), dysgeusia (altered taste perception), dehydration, malnutrition, and a deterioration in speaking ability, overall oral health, and quality of life [3]. Almost all patients who undergo radiation therapy to the head and neck experience some degree of oral mucositis [4]. The incidence of head and neck cancer is

on increasing numbers, primarily driven by an increase in oropharyngeal cancers. This is in contrast to a decline in the occurrence of head and neck cancer originating from other specific locations [5]. Among individuals who do not use tobacco or alcohol, HPV-positive oropharyngeal squamous cell carcinoma (OPSCC) is more common than HPV-negative OPSCC. However, patients with HPV-positive OPSCC still have a significant history of tobacco and alcohol use, which is linked to poorer outcomes. The global prevalence of HPV-positive oropharyngeal squamous cell carcinomas (OPSCCs) was reported to be 33% in 2021. However, the prevalence varies significantly across different geographical regions, with estimations ranging from 0% in southern India to 85% in Lebanon [6]. According to a five-phase model of mucositis pathogenesis, the initial cause and stimulus for the inflammatory process is the microvascular damage inflicted upon rapidly dividing basal epithelial cells during radiation and chemotherapy. This damage leads to the generation and release of free oxygen radicals, which subsequently activate var-

ious cytokines, including tumor necrosis factor- α primarily produced by macrophages, as well as interleukin-1 and -6. The occurrence of ulcers in the mucosa serves as a foundation for the establishment of bacterial microflora, thereby giving rise to subsequent infections. The final stage, known as healing, is distinguished by the proliferation of epithelial cells, the differentiation of tissues, and the restoration of epithelial integrity [7-8]. Radiation-induced damage to basal epithelial cells begins to occur at cumulative doses of 10-15 Gy, typically becoming evident after approximately 10 days. The seriousness of this condition becomes prominent at 30 Gy, lasting for several weeks or possibly even months [9]. The polypeptide known as epidermal growth factor (EGF) consists of 53 amino acid residues and plays a significant role in the control of cell proliferation. The effects of EGF are mediated through the binding of EGF to the EGF receptor, which is located on the plasma membrane of target cells [10]. The process of binding to epidermal growth factor (EGF) receptors triggers a cascade of biochemical reactions, ultimately leading to the transmission of a signal that induces modifications in gene regulation [11]. Epidermal growth factor is found in the oral environment as a result of its synthesis largely taking place in the salivary glands of humans, even though the kidneys are responsible for the systemic release of EGF. The quantity of EGF present in human saliva is equivalent to 1 ng/ml. This suggests that the administration of EGF may potentially contribute to the maintenance of oral mucosal integrity and expedite the process of wound healing [12-13]. It has been suggested that a decrease in salivary EGF levels may impair the oral mucosa's ability to heal following injury or to withstand injury [14-15]. Salivary EGF has been observed to be detectable in individuals suffering from oral inflammation as well as those diagnosed with head and neck carcinoma. The previous investigations observed a decline in overall epidermal growth factor (EGF) levels in the combined saliva of individuals undergoing radiation therapy (RT) for head and neck carcinoma [16-17]. The determination of plasma parameters is a crucial technique in clinical routine diagnostics, while the utilization of other bodily fluids as supplementary sources is comparatively limited. The collection of saliva specimens is a convenient and straightforward process, characterized by its rapidity, noninvasiveness, minimal stress on the individual, and relatively low cost. In contrast, the acquisition of blood samples necessitates the use of sterile equipment and supplies [18]. The presence of mucositis and other complications imposes a greater economic burden due to the heightened susceptibility to infection and the subsequent rise in morbidity and mortality rates. Furthermore, it serves as a primary fac-

tor contributing to the reduction of therapeutic doses, limitations on the implementation of optimal cancer therapy protocols, and premature discontinuation of treatment for chemoradiotherapy. These factors have the potential to directly reduce the rates of successful treatment and negatively influence the survival rate and the quality of life experienced by patients [19], therefore, developing instruments for healthcare professionals to evaluate the risk of oral mucositis through analyzing EGF levels, so enabling prompt implementation of intervention methods. A more comprehensive comprehension of the biological mechanisms through which EGF levels impact the progression of oral mucositis is required. The complete elucidation of the precise causal pathways and interactions with other molecular factors is still pending. A knowledge gap exists with respect to the efficacy of interventions that rely on the monitoring of EGF levels. The potential impact of modifying treatment regimens for patients with low EGF levels on ameliorating the severity of mucositis or improving outcomes remains uncertain. The objective of this study is to determine the impact of epidermal growth factor (EGF) levels on the occurrence of mucositis in cancer patients who are undergoing radiotherapy. The treatment was administered using the VMAT technique. To the best of our knowledge, this research is the first to assess EGF as it relate to radiotherapy-induced mucositis in Iraqi patients with head and neck cancer. We present this article in accordance with the STARD reporting checklist (available at <https://tro.amegroups.com/article/view/10.21037/tro-23-19/rc>).

AIM

The present study aims to investigate the correlation between the concentration of salivary epidermal growth factor and the development of radiation-induced mucositis in patients diagnosed with head and neck cancer.

MATERIALS AND METHODS

A cross-sectional study was conducted to assess patients undergoing external beam radiotherapy for head and neck tumours. The data was collected between October 2022 and June 2023 in Al-Andalus oncology hospital-Baghdad, utilizing a simple random sampling technique. Fifty-four patients with head and neck cancers were included in the study; diagnosis is confirmed by histopathology in every patient, with certain exclusions made. Patients, who had undergone palliative neck radiotherapy, had neck lymphoma, were in the pediatrics group, or were on-off patients that could potentially affect the interpretation of radiotherapy schedules

were excluded from the study and chosen irrespective of their age, gender, and the particular sub-site of the ailment. All patients should achieve optimal oral health before starting radiotherapy. This involves eliminating dental cavities, addressing gum and periodontal diseases, and managing any existing oral infections. In the study, all patients who participated showed no signs of distant metastasis. They underwent treatment with either a radical or adjuvant approach, receiving a dose of 2 Gy per session, administered five times a week, resulting in a total average dose of 60 Gy. External beam radiation therapy (EBRT) was administered as the sole treatment, without simultaneous chemotherapy. The radiation was delivered using the Volumetric Modulated Arc Therapy (VMAT) technique. Concurrently, patients were given systemic antifungal medication (fluconazole 100mg/day) alongside their radiotherapy. Institutional informed consent was appropriately obtained. Whole resting saliva was obtained through expectoration into graduated centrifuge tubes during 3-minute intervals from a total of fifty-four participants who were divided into three groups for the study:

- The control group consisted of patients had not undergone any radiotherapy.
- Group A included patients had received 10 sessions (20 Gy) of radiotherapy.
- Group B included patients had received 20 sessions (40Gy) of radiotherapy.

The assessment of mucositis was conducted using the World Health Organization (WHO) scoring systems [20]. The oral cavity undergoes a visual and noninvasive assessment, wherein categorization is based on the following parameters:

- Grade 0 signifies the absence of any changes.
- Grade 1 indicates the presence of pain or erythema.
- Grade 2 denotes the presence of both erythema and ulcers.
- Grade 3 signifies the presence of ulcers necessitating a liquid diet only.
- Grade 4 indicates an inability to ingest food.

The measurement of salivary EGF was conducted through the utilization of an enzyme-linked immunosorbent assay (ELISA) technique, employing a commercially available kit from USCN. The experimental procedure was carried out in accordance with the instructions provided by the manufacturer. The kit employs a sandwich enzyme-linked immunosorbent assay (ELISA) technique that specifically identifies human epidermal growth factor (EGF) and exhibits no observable cross-reactivity. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the research ethics committee of the College of Dentistry, University

of Baghdad (NO. 699722). Individual consent for this retrospective analysis was waived.

ETHICAL STATEMENT

The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the research ethics committee of the College of Dentistry, University of Baghdad (NO. 699722) and individual consent for this retrospective analysis was waived. This is an Open Access article distributed in accordance with the Creative Commons Attribution-Non Commercial-No Derivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

RESULTS

This research encompassed a group of 54 individuals diagnosed with head and neck cancer who were subjected to radiotherapy treatment. The participants were divided into three distinct groups. Group A consisted of 16 individuals underwent a course of 10 radiotherapy sessions. Group B comprised 21 subjects who received a total of 20 radiotherapy sessions. In contrast, Group C, serving as the control group, encompassed 17 patients did not undergo any form of radiotherapy treatment.

DEMOGRAPHIC CHARACTERISTICS

The age range of study patients was 18 to 80 years. The mean age was 47.13 ± 23.27 years in group A, 49.43 ± 20.35 years in group B, and 51 ± 21.65 years in group C. The highest proportion of study patients were > 55 years, 7(43.8%) in the group A, 10 (47.6%) in the group B, and 9(52.9%) in the control group, figure.

GENDER

Regarding gender, the proportion of males was higher than females in the group A and B (62.5% vs. 37.5%, and 57.1% vs. 42.9%), respectively, while the proportion of females was higher than males in the control group (52.9% vs. 47.1%). There was no statistically significant difference ($P \geq 0.05$) between the three groups in terms of age and gender.

Table 1. Post hoc analysis (LSD) to confirm the differences in the mean EGF expression between study groups

Biomarker	Study Groups			P – Value*
	Group A Mean ± SD	Group B Mean ± SD	Control Group Mean ± SD	
EGF	430.6 ± 220.9	489.9 ± 275.5	-	0.403
	430.6 ± 220.9	-	111.6 ± 50.73	0.001
	-	489.9 ± 275.5	111.6 ± 50.73	0.001

* Significant difference among three independent means using Post hoc analysis at 0.05 levels

Table 2. Comparison of EGF expressions according to age and gender of the studied groups

Study Groups	Age (Years)	EGF mean ± SD	P-value
Group A	< 40	461.1 ± 138.9	0.193
	40 - 55	341.6 ± 117.6	
	> 55	356.9 ± 150.7	
Group B	< 40	467.2 ± 241.1	0.386
	40 - 55	521.5 ± 221.6	
	> 55	422.2 ± 269.8	
Controls	< 40	133.8 ± 37.69	0.493
	40 - 55	91.41 ± 39.84	
	> 55	106.1 ± 59.54	
Group A	Male	446.2 ± 248.9	0.729
	Female	404.5 ± 183.1	
Group B	Male	553.7 ± 238.1	0.229
	Female	404.7 ± 112.4	
Controls	Male	113.7 ± 50.70	0.884
	Female	109.9 ± 53.76	

COMPARISON OF EGF BETWEEN STUDY GROUPS

The comparison of the mean EGF expressions between the studied groups revealed a statistically significant difference (P= 0.001) in the mean EGF expression between the three groups. Post hoc analysis (LSD) was run to confirm the differences in the mean EGF between the study groups and showed that mean EGF expressions were significantly higher in group A and group B compared with the control group (430.6 and 489.9 vs. 111.6, P= 0.001). No significant difference was found in the mean EGF between group A and group B (430.6 vs. 489.9, P= 0.403) (Table 1).

COMPARISON OF EGF ACCORDING TO AGE AND GENDER OF STUDY GROUPS

It was clear that there were no significant differences (P ≥ 0.05) in the mean EGF expressions according to the age and gender of three groups (Table 2).

COMPARISON OF EGF ACCORDING TO ORAL MUCOSITIS

In-group A, 9 patients (56.2%) developed oral mucositis, of them 4 patients were with grade1, 2 patients

with grade2, and 3 patients with grade3. In the group B, 8 patients (37.1%) developed oral mucositis, of them 4 patients were with grade 1, 2 patients with grade 2, and the remaining 2 patients were with grade3. 52.9% of patient developed mucositis were male, fig 1.

The comparison of the mean EGF level in relation to the oral mucositis status of group A revealed that there were no statistically significant differences (P ≥ 0.05) in EGF expression based on the presence or absence of oral mucositis. On the other hand, within group B, the mean expression of EGF was notably lower in the patients who experienced oral mucositis compared to those who did not (326.3 vs. 590, P= 0.029) (Table 3).

CUT-OFF VALUE OF EGF EXPRESSION

Receiver operating characteristic (ROC) curve analysis was constructed for EGF level as predictor for oral mucositis. The optimal cut-off EGF for prediction of oral mucositis after radiotherapy was 502.1. Hence, EGF level < 502.1 is a predictor for oral mucositis, as a large significant area under the curve (AUC = 79.6%) indicating a significant association between the low-

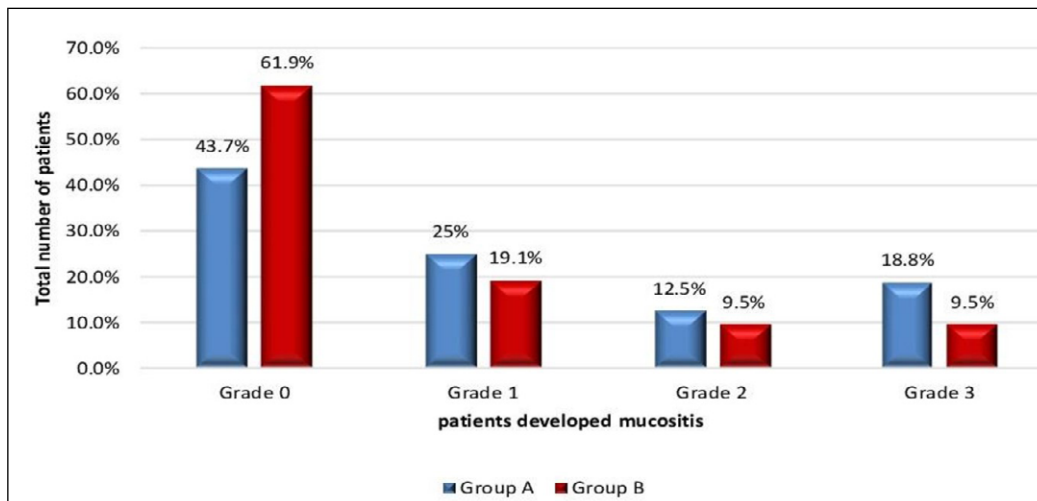


Fig. 1. Distribution of the group A and group B fig according to grading of oral mucositis

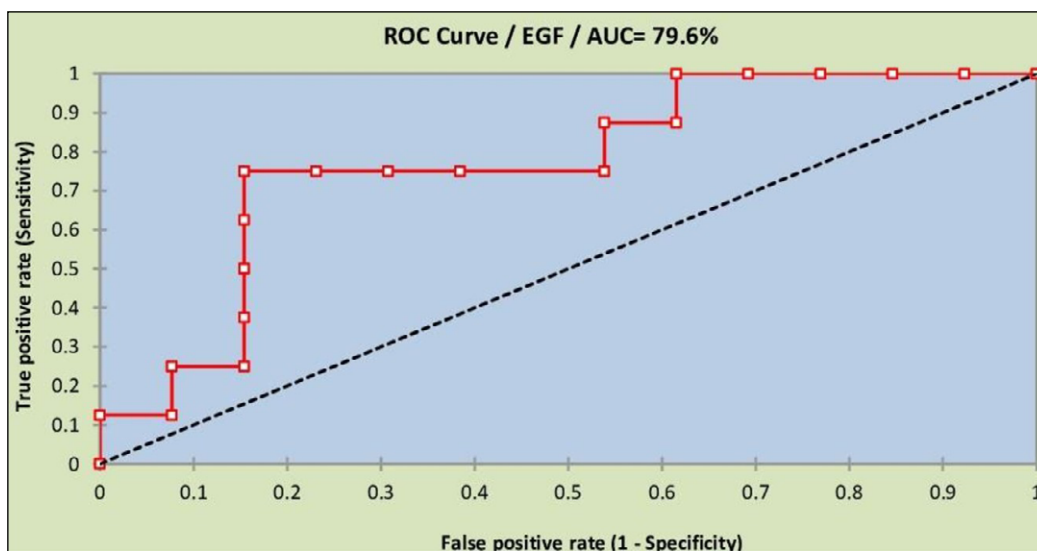


Fig. 2. ROC curve of EGF in predicting oral mucositis

er level of EGF and oral mucositis. This cut-off value obtained a sensitivity of 75% and specificity of 84.6%, with accuracy of 81%. Positive predictive value and negative predictive value of EGF were 76% and 83.6% respectively, fig. 2.

The data was analyzed using Statistical Package for Social Sciences (SPSS) version 25. The data presented as mean, standard deviation and ranges. The categorical data is displayed using frequencies and percentages. The data exhibited a normal distribution. The statistical significance of the difference between two independent means in quantitative data was assessed using a Student t-test. The statistical significance of variations in distinct percentages (qualitative data) was assessed using the Pearson Chi-square test (χ^2 -test), with the implementation of Yate's correction or Fisher Exact test when appropriate. The ability of EGF level for prediction of oral mucositis was evaluated using Receiver operating characteristic (ROC). The optimal cutoff values were determined using the Youden index.

DISCUSSION

Mucositis-related pain may be so severe that only opiate analgesics can relieve it, preventing the person from communicating or ingesting. Difficulties in swallowing can lead to dehydration, weight loss, and the requirement for nutritional assistance [21]. A reduction of function impairment, manifestation of symptoms, and financial burden related to mucositis can be achieved by carrying out of appropriate preventive and therapeutic interventions. Multiple research studies have provided evidence of an occurrence rate of oral mucositis ranging from 50% to 80% during conventional radiation therapy treatment. These findings align with the results observed in the overall population of our current study [22-23]. The occurrence of OM was found to be higher in the male population. Prior research has also identified a greater prevalence of OM in males, with reported rates of approximately 60% [24]. Furthermore, the present study observed that males exhibited a higher incidence of mucositis compared to females. The elevated prevalence among males can be elucidated by the increased

Table 3. Comparison of EGF according to oral mucositis

EGF	Oral Mucositis Mean ± SD	No Oral Mucositis Mean ± SD	t-test	P- Value*
Group A	352.6 ± 227.3	530.8 ± 179.5	- 1.699	0.111
Group B	326.3 ± 254.8	590.5 ± 244.6	- 2.366	0.029

* Significant difference of two means using independent-samples t-test at 0.05 levels

incidence of deleterious behaviors associated with this gender, including suboptimal hygiene practices, tobacco consumption, excessive alcohol intake, and infrequent utilization of dental care services [25].

In this study, oral mucositis was observed in 56.2% of patients who underwent radiation therapy for malignant disease affecting the head and neck region. These finding conflicts with a study conducted in 2016 within Baghdad oncology center, which reported an incidence of oral mucositis in 80% [26]. In the previously mentioned center in Baghdad, another study conducted in 2017 revealed that a total of 72% of patients experienced an incidence of oral mucositis [27].

These studies corroborate the findings of a previously conducted systematic review, which indicated that the incidence of mucositis is approximately 81% [28]. On the other hand, a study conducted in Brazil between January 2008 and December 2017 examined a cohort of 413 patients with head and neck cancer who underwent radiotherapy. The findings revealed that the prevalence of oral mucositis (OM) in the entire sample was 41.9%, with a higher occurrence observed among male patients (78.2%) [29]. The potential discrepancy of these studies may be attributed to a notable degree of heterogeneity observed in the treatments administered to patients across various articles, and even within individual articles, the use of different radiotherapy techniques. Noori et al. and Al-Qalamji et al. employed the 3D conformal forward planned IMRT technique, whereas this study employed the VMAT technique [26-28].

A comprehensive review of the scholarly literature was undertaken to compare the administration of doses through Volumetric Modulated Arc Therapy (VMAT) and Intensity-Modulated Radiation Therapy (IMRT) to patients with head and neck cancer. The findings indicate that the use of VMAT in the treatment of head and neck cancer leads to a decrease in adverse effects on organs at risk. This is especially significant when considering the potential impact on organs that may result in xerostomia, dysphagia, or other side effects that can significantly affect the quality of life for patients [30]. The reduction in the development of mucositis in this study may be attributed to the documented positive impact of administering antifungal medication on the severity of oral mucositis and the pain it is associated with [24].

Notwithstanding the extensively documented elevated incidence of Candida colonization in individuals with head and neck cancer who undergo radiation therapy, as reported in investigations [31-32], the current findings are weakened by the absence of evaluation of fungal status both prior to and following administration of antifungal medication, which can be attributed to practical constraints in daily clinical practice. Epidermal growth factor stands as a highly assessed biomarker in the context of oral mucositis. It is noticed a decline in EGF levels following radiation therapy and a tendency towards lower EGF levels in patients with more severe oral mucositis. These data indicate that patients who have lower levels of EGF before undergoing therapy may have a higher likelihood of experiencing mucosal injury after radiation therapy [33].

Furthermore, experimental studies have shown that the administration of EGF can potentially reduce both the severity and occurrence of oral mucositis [34]. The current study demonstrated that the average expressions of EGF were significantly elevated in both group A and group B when compared to the control group. The concentration of epidermal EGF in saliva at rest exhibited a significant increase within the initial two-week period following irradiation, No significant alterations were observed after four weeks of radiotherapy. This finding goes against a study done in 2000 that examined 18 patients with head and neck cancer.

The study revealed a decrease in the level of epidermal growth factor (EGF) in saliva after a two-week period of radiotherapy [35], which corroborates the findings of a previous study involving a cohort of 16 patients that yielded consistent results [16]. A more recent study assessed the expression of EGF in saliva before and after treatment, revealing a significant increase in EGF levels following radiation exposure [36]. Another study has suggested a potential correlation between salivary EGF levels and the extent of oral mucositis resulting from radiation therapy [33].

Nevertheless, alternative research has yielded inconclusive results, as no substantial disparity in serum or salivary levels of EGF has been observed between individuals suffering from oral mucositis and those who are deemed healthy controls [37]. This study has determined that there is an elevation in EGF levels during radiotherapy; however, it is noteworthy that the

average expression of EGF was significantly reduced in patients who developed oral mucositis, in comparison to those who did not experience this condition. In brief, this study suggests that individuals diagnosed with mucositis are those whose salivary EGF levels persist at a low level subsequent to radiation exposure. To the best of our current knowledge, this study represents the initial attempt to elucidate the cut-off value of EGF in patients with mucositis. The most favorable threshold of EGF for the anticipation of oral mucositis subsequent to radiotherapy was determined to be 502.1(pg/mL).

Therefore, a level of EGF below 502.1(pg/mL) could be predictive of oral mucositis, as evidenced by a substantial and statistically significant area under the curve (AUC = 79.6%). This suggests an interesting correlation between lower EGF levels and the occurrence of oral mucositis. The concentration of EGF in stimulated whole saliva of healthy individuals (2221.53 ± 575.92 pg/ml) was significantly higher than that in resting whole saliva (1832.60 ± 475.86 pg/ml, $P < 0.001$). This suggests that saliva stimulation, which may occur during chewing or other oral activities, plays a role in increasing EGF levels, potentially due to enhanced glandular secretion or other regulatory mechanisms. Furthermore, EGF levels in stimulated saliva were markedly elevated compared to those in serum (262.28 ± 78.06 pg/ml, $P < 0.001$) [38].

This substantial difference between saliva and serum underscores the localized secretion and action of EGF in the oral cavity, where it is likely involved in tissue repair, mucosal protection, and maintaining homeostasis. These findings are consistent with the understanding that saliva serves as a reservoir for biologically active molecules, reflecting both systemic and local physiological processes [38].

It may be difficult to establish a definitive temporal correlation between low levels of EGF and the initiation of mucositis. It is essential to determine if diminished

levels of EGF occur before to the onset of mucositis or are a result of it. The study was carried out with a small sample size or with a lack of variety in terms of patient demographics (age, gender, ethnicity), thus limiting the generalizability of the results to the broader population. The concentration of epidermal growth factor (EGF) in individuals with oral mucositis can exhibit variability based on several factors.

These factors include the specific type and intensity of cancer treatment, which have undergone significant changes over the past two decades. Additionally, the stage and severity of oral mucositis, as well as the methodology employed for measuring EGF, can also contribute to the observed variations. Longitudinal studies are necessary to determine the reliability of EGF levels as a predictor over an extended period and across various phases of radiation. Furthermore, it is imperative to establish a correlation between levels of EGF and clinical outcomes that extend beyond the development of mucositis, including the duration of recovery and the responsiveness to treatment. The results obtained suggest the need for further research involving a larger group and a larger number of analyzed factors.

CONCLUSIONS

The results of the present study indicate that human epidermal growth factor (EGF) could potentially influence the healing process of radiation-induced mucosal damage. Moreover, it was observed that higher concentrations of EGF were linked to a reduced severity of mucositis in patients undergoing radiotherapy with standard daily fractions. Additionally, it is worth noting that there has been a significant decrease in the incidence of oral mucositis when comparing with previous studies that utilized outdated methods for radiation delivery.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Ameer Alturfi

Department of Oral Diagnosis,
College of Dentistry University of Baghdad, Baghdad, Iraq
e-mail: sgahmed1331962@outlook.com

ORCID AND CONTRIBUTIONSHIP

Ameer Alturfi: 0009-0009-6954-5424   

Fawaz Alaswad: 0009-0003-7143-2361    

Awf Abdulrahman Sulaiman: 0000-0003-1157-0300  

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Research of oral cavity microflora virulence factors on the background of experimental opioid exposure

Volodymyr B. Fik¹, Yurii Ya. Kryvko², Orysia A. Kovalyshyn³, Lesia V. Pankevych¹, Ivan M. Ratsyn³, Larysa Ya. Fedoniuk⁴

¹DANYLO HALYTSKY LVIV NATIONAL MEDICAL UNIVERSITY, LVIV, UKRAINE

²ANDREI KRUPINSKI LVIV MEDICAL ACADEMY, LVIV, UKRAINE

³PRIVATE HIGHER EDUCATION INSTITUTION "LVIV MEDICAL UNIVERSITY", LVIV, UKRAINE

⁴I. HORBACHEVSKY TERNOPIL NATIONAL MEDICAL UNIVERSITY, TERNOPIL, UKRAINE

ABSTRACT

Aim: to investigate the factors of bacterial virulence of oral microbiotopes against the background of long-term experimental action of an opioid analgesic.

Materials and Methods: The study was performed on 72 white outbred rats, which were injected "Nalbuphine" with a gradual increase in dose for 12 weeks. The microbial composition and virulence factors of bacteria in the microbiotopes of the oral cavity were studied.

Results: At the end of the 4th week of opioid exposure, the appearance of hemolytic escherichia was noted. At the end of the 8th week the appearance of capsular bacteria Klebsiella was registered, as a virulence factor. The production of staphylococcal virulence factors – lecithinase, was noted. At the end of the 12th week of opioid use, the appearance of phycomycete fungi was noted, Gram-negative diplococci, Klebsiella, Hemolytic Escherichia coli and Pseudomonas aureginosa. These changes indicated the development of dysbiotic changes, as well as the gradual formation of foci of the inflammatory process in the oral cavity.

Conclusions: In the short-term stages of opioid exposure, changes in biocenoses were manifested in an increase in the contamination of certain types of microorganisms. In the long-term effects of the opioid, the activation of bacterial elements of the microbiocenosis was revealed, which were characterized by increased expression of virulence factors. At the later stages of opioid exposure, the predominance of gram-negative microflora and the activation of cytotoxic action against the background of suppressed activity of the body's protective response were established.

KEY WORDS: experiment, oral cavity, microbiotopes, opioid, rats, microorganisms, virulence factors

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INTRODUCTION

Opioid analgesics are indispensable in clinical practice and remain the basis of pharmacotherapy of visceral and somatic pain, which today has no adequate alternative in modern medicine [1-3]. However, uncontrolled or long-term use by patients of opioid drugs in chronic pain causes intoxication of the body, it is a determining risk of tolerance to the opioid effect, the development of withdrawal symptoms and high mortality from overdose [1, 4, 5].

Clinical studies have shown that the use of drugs (including opioids) changes the diversity and composition of the microbiota of the oral cavity and intestines, causing side effects [6]. Analysis of the literature has shown that addicted patients are hypersensitive to bacterial and viral infections, significantly increasing contamination by pathogenic and opportunistic microbiota [7-9]. At the same time, opioids cause the development

of cellular hypoxia, which leads to disruption of oxygen-dependent phagocytosis processes [10].

In drug addicts, the processes of suppression of the body's immune status progress against the background of severe dysbacteriosis in the oral cavity, and the severity of these changes directly depends on the duration of drug use [11-13]. The microbial spectrum in the oral mucosa of addicted patients is reflected in the qualitative diversity, which is dominated by coccal, anaerobic and fungal microflora [14, 15]. Since the interaction of macrophages of the gingival mucosa with the microbiota leads to excessive production of cytokines and toxic substances that cause destruction of periodontal tissues, it is important early diagnosis of dysbiosis in the oral cavity in inflammatory processes [16-21]. According to the professional literature, the leading role in the development of the inflammatory process in the oral cavity belongs to enzymes, exo- and endotoxins that form the immune re-

sponse [22-24]. The effect of endotoxins depends on their concentration, in particular, their toxicity is manifested in much higher concentrations than exotoxins, and in small doses they are able to activate phagocytosis and other protective reactions of the body [24, 25].

According to modern views, an important role in the development of the immune response and immunopathological reactions belongs to the recognition process of conservative molecules of microorganisms "patterns" by TLRs of immunocompetent cells. Conservative bacterial patterns include structures such as peptidoglycan and cell wall lipopolysaccharides, capsule polysaccharides, etc. [26]. TLRs belong to the oldest evolutionary system for recognizing "aliens", which is common to all multicellular organisms, including plants and animals, and is important in the interaction of gram-negative bacteria with TLRs in the pathogenesis of oral diseases [27]. In addition, periodontopathogenic microorganisms of the oral cavity, which appear when the imbalance between the autochthonous and allochthonous microbiota in the area of formed periodontal pockets are quite diverse, which directly depends on the nature and course of the disease [17, 21, 28-31], since the periodontopathogenic microbiota has a pronounced virulence, mechanisms of adhesion to periodontal tissues and aggressive destructive action [24, 32-34]. It should be noted that due to the adhesion of bacteria, biofilms are formed and the production of virulence factors is significantly increased. The pathogenetic role of film formation has been established for oral cavity microorganisms in periodontal lesions and the development of dental caries [35]. These research data indicate that the study of microbiota in the gingival sulcus is important for predicting the inflammatory process, because normally the level of microbial colonization in this microbiotope of the oral cavity is insignificant, it is dominated by facultative gram-positive bacteria [29, 36].

To establish the role of microorganisms as etiopathogenetic factors in the development of inflammatory processes, it is necessary to determine their etiology in experimental animal models [37, 38]. The above literature data indicate the need for research of virulence factors of microorganisms in the study of the pathogenesis of oral cavity diseases. However, in the available professional sources we have not found data on the features of the microbiocenosis and the study of virulence factors of oral bacteria at different terms of opioid exposure in the dynamics.

AIM

The aim is to investigate the factors of bacterial virulence of oral microbiotopes against the background of long-term experimental action of an opioid analgesic.

MATERIALS AND METHODS

The study was performed on 72 white outbred adult male rats, weighing 160 – 270 grams, aged 4.5 – 7.5 months. In the experiment, the animals were divided into two groups. Group I – control rats (18), which were injected intramuscularly with saline during the experiment. Group II – rats (54) at different terms of the experimental action of the opioid analgesic "Nalbuphine" with the active substance nalbuphine hydrochloride (dilution of 1 ml of nalbuphine in 50 ml of 0.9% NaCl solution). The drug was administered intramuscularly, daily, once, for the same period of time for 12 weeks, with a gradual increase in dose every 2 weeks: 1-2 weeks – 0.212 mg / kg, 3-4 weeks – 0.225 mg / kg, 5-6 weeks – 0.252 mg / kg, 7-8 weeks – 0.260 mg / kg, 9-10 weeks – 0.283 mg / kg, 11-12 weeks – 0.3 mg / kg.

The animals were quarantined in the vivarium, on a standard diet in separate cages. Before the experiment, a thorough examination of the animals was performed, paying attention to the condition of the oral cavity in the area of gums and teeth, focusing on the color, humidity and absence of damage to the mucous membrane. The Commission on Bioethics of Danylo Halytsky Lviv National Medical University established that the conducted research meets ethical requirements according with the provisions to the European Convention "for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes" [Strasbourg, 1985], to the order of the Ministry of Health of Ukraine № 231 of 01.11.2000 (Protocol № 5 of 24.05.2021).

Bacterioscopic and bacteriological methods were performed to study the species microbial composition and virulence factors of bacteria of oral microbiotopes – tooth surface in the gingival margin and gingival furrows of rats after 2, 4, 6, 8, 10 and 12 weeks of experiment, as well as in control animals. During bacterioscopic examinations, smears were prepared from colonies typical of morphology and stained by the Gram method. Evaluation of prokaryotic gram-positive and gram-negative microflora was performed on the morphology of cells, the mutual arrangement of cells, the presence of extracellular structures with the participation of different morphotypes of bacteria as elements of the biofilm. Quantitative relationships of the main elements in the smear, the presence of yeast like cells, as well as cellular elements of the tissues of the oral cavity were taken into account.

Simultaneously, sowing was carried out directly on dense media with a loop. Conventional special, differential diagnostic and selective media were used: meat-peptone agar, blood agar, Endo medium, Saburo medium, yolk-salt agar, mannitol salt agar (MSA), as well as tubes with rabbit plasma. Herewith the production

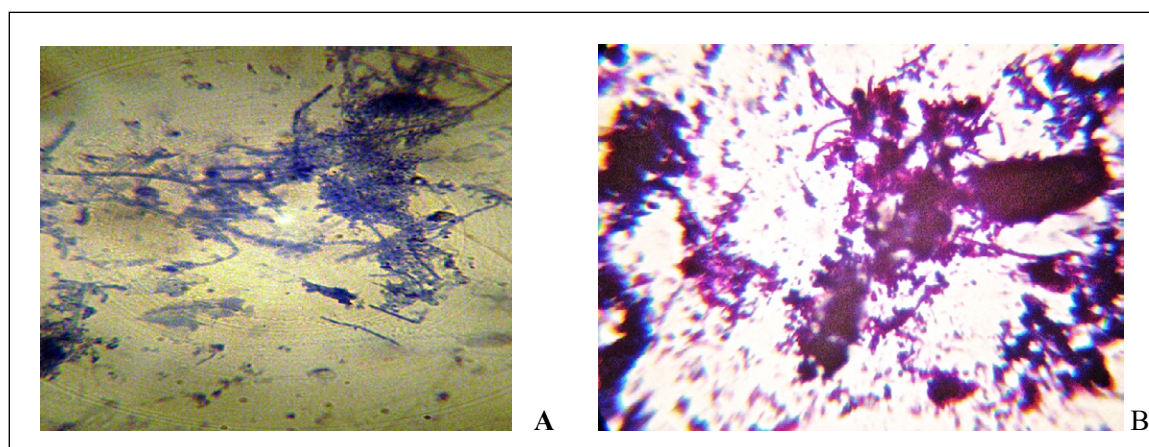


Fig. 1. Morphology of bacteria in the supragingival biofilm of rats after 2 weeks (A. *Staphylococci* and *Leptothrix* filamentous bacteria. 90 x objective 8 x eyepiece.) and 4 weeks (B. Accumulation of gram-positive and gram-negative cocci and their adsorption on *Leptothrix*. 90 x objective 8 x eyepiece.) of opioid exposure

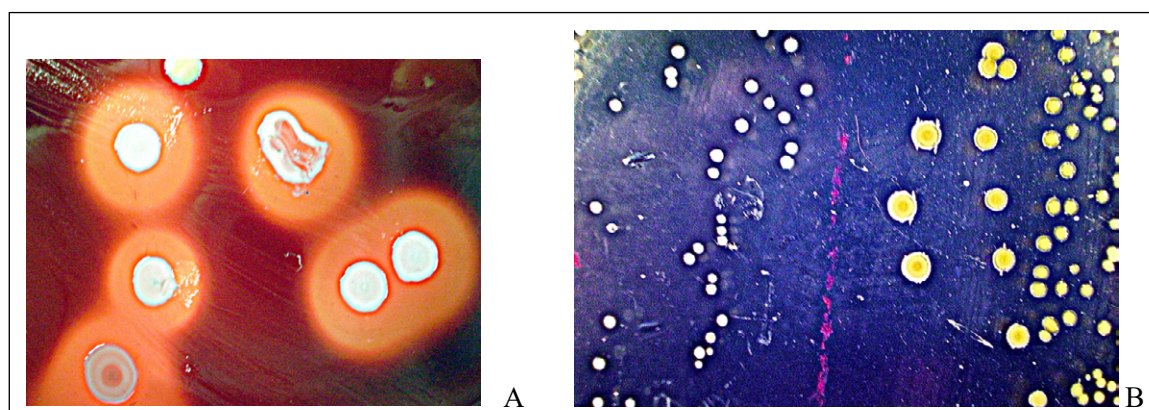


Fig. 2. Bacteriological studies of the microbiota of the supragingival biofilm of rats after 6 weeks (A. 1 – *Staphylococcus aureus* with zones of hemolysis. Sowing was carried out on blood agar. Magnification 1x8.) and 8 weeks (B. *Staphylococcus intermedius* and *Staphylococcus aureus* with lecithinase activity. Sowing was carried out on salt egg yolk agar. Magnification 1x4) of opioid exposure

of hemolysins, plasma coagulase and lecithinase was determined. Identification of isolated cultures was performed by a complex of morphotinctorial, cultural and biochemical properties. Individual species were identified using standard test systems «Apisystem Bio Merieux», France.

Cultivation was carried out under normal atmospheric conditions, as well as under elevated CO₂ levels. Cultures were cultivated in a thermostat at t 37°C, for differentiation of enterococci at t 10° C, at which the growth of other species is delayed. Identification of streptococci was carried out by a complex of tests, namely: α-hemolysis – α-hemolytic streptococci or β-hemolysis – β-hemolytic streptococci, sensitivity to optochin (opt+) and by a complex of biochemical properties – hydrolysis of arginine (arg+), decomposition of esculin (esk+) and mannitol (man+), Foges-Proscauer reaction. As virulence factors of staphylococci, the production of α-hemolysin, plasma coagulase and lecithinase was recorded. In streptococci, the

type of hemolysins was determined (α-hemolysis or β-hemolysis, capsule formation). Hemolysins of *Escherichia*, pyocyanine production of *Pseudomonas aureginosa*, capsule formation in *Klebsiella* were also detected. In order to identify periodontopathogenic anaerobic microorganisms, the material was sown immediately after being taken into Petri dishes on special media for bacteroids – Schedler's agar with erythrocytes, growth factors and an antibiotic (gentamicin). Petri dishes were placed in a Bio Merieux microanaerostat with bags to create the gas composition necessary for anaerobes and cultivated for 48 h at t 37° C.

RESULTS

During bacterioscopic research of the tooth surface in the gingival margin of the I (control) group of rats, the same type of microflora was noted. In general, coccal gram-positive microbiota and gram-positive

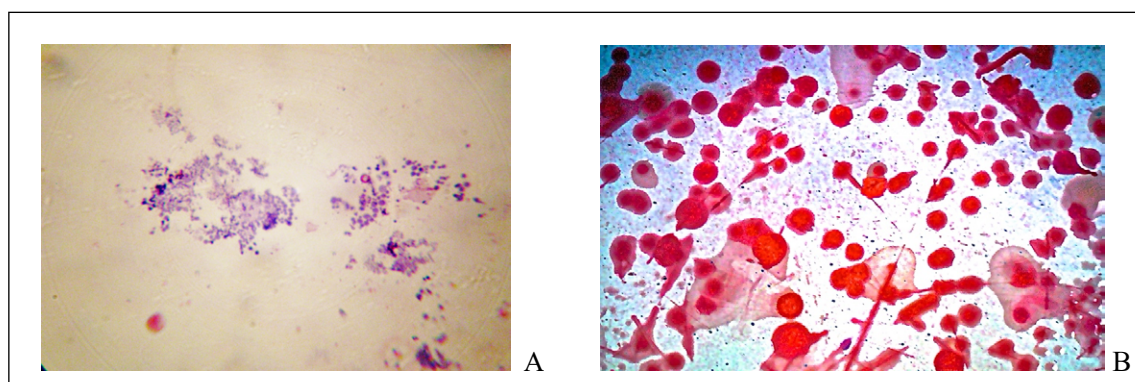


Fig. 3. Morphology of bacteria in the subgingival biofilm of rats after 10 weeks (A. Aggregates of gram-negative polymorphic rods—bacteroids. 90 x objective 8 x eyepiece.) and 12 weeks (B. Adsorption of gram-negative rods on the surface of epitheliocytes, autophagocytosis of erythrocytes. 90 x objective 8 x eyepiece.) of opioid exposure

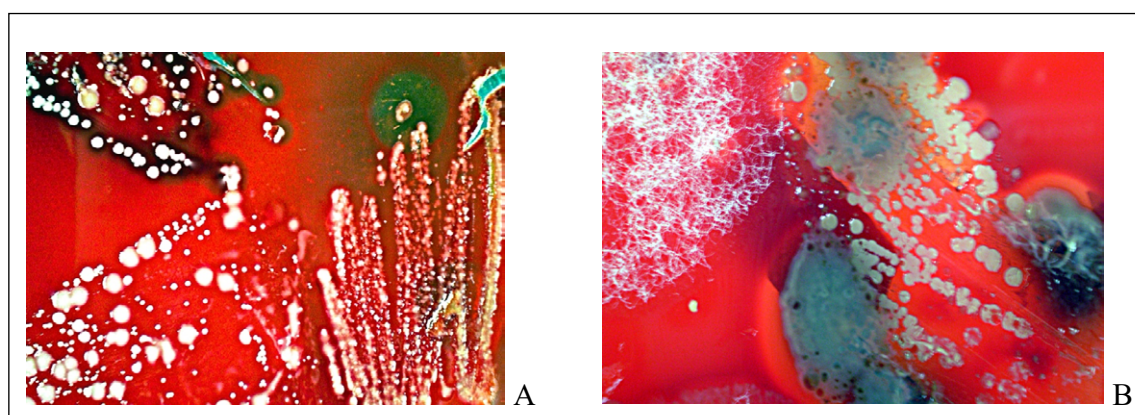


Fig. 4. Bacteriological studies of the subgingival biofilm microbiota of rats after 10 weeks (A. β -hemolytic streptococci, Hemolytic *Escherichia coli*, growth of *Pseudomonas aeruginosa* colonies. Sowing was carried out on blood agar. Magnification 1 x 4.) and 12 weeks (B. Colonies of *Pseudomonas aeruginosa*, fungal microflora. Sowing was carried out on blood agar. Magnification 1 x 4.) of opioid exposure

microorganisms – long filamentous gram-positive *Leptothrix* bacteria were detected, lactobacilli of the genus *Lactobacillus* are also identified by morphological features in smears. In the field of view, the cellular elements were single epitheliocytes and leukocytes. Bacteriological analysis of the microbiota of control animals indicated the dominance of gram-positive species, among which nonhemolytic streptococci and α -hemolytic streptococci, coagulase-negative staphylococci, Enterococci, gram-positive non-spore-forming rods and gram-positive spore-forming rods were distinguished by biochemical and morphotinctorial properties. Single colonies of gram-negative microorganisms – lactose-positive enterobacteria, which were identified as *Escherichia coli*, were detected in cultures on Endo medium.

In Group II animals, during the short-term periods of opioid exposure (2–4 weeks), bacterioscopic examinations of smears of the tooth surface in the gingival margin of rats revealed clusters of coccal gram-positive bacteria and gram-negative rods, which were morphologically similar to enterobacteria. The formation

of supracellular structures in the form of a biofilm was noted, the basis of which was the filamentous *Leptothrix* bacteria with gram-positive coccal microflora organized around them, the so-called “corn cobs” were formed (Fig. 1).

At the end of the 4th week of opioid exposure, bacterioscopic studies revealed supracellular formations in the form of a biofilm with the participation of both gram-positive and gram-negative bacteria. During bacteriological studies, the appearance of hemolytic *Escherichia coli* on nutrient media was noted, the pathogenic properties of which are determined by the ability to dissolve erythrocytes due to the secretion of special enzymes – hemolysins, which was determined by the formation of a zone of hemolysis around the colony when the bacteria were seeded on blood agar. The appearance of *Escherichia coli* with hemolytic properties, which were absent both in animals of the control group and in rats in the end of the 2th week of opioid exposure, indicated the development of dysbiotic changes in the studied microbiotope and the oral cavity in general.

In the long term (6–8 weeks), the formation of supra-cellular structures as a continuous supragingival biofilm was noted as a result of the interaction of a microbial factor (cariogenic species of streptococci) and an organic substrate, namely, microbial polysaccharides, saliva proteins, and cellular elements. Bacteriological studies revealed an increase in the contamination of α -hemolytic streptococci, as well as β -hemolytic streptococci and staphylococci – producers of plasma coagulase. The appearance of capsular bacteria *Klebsiella* was registered, they were characterized by pronounced capsule formation, as a virulence factor that ensures adhesion and antiphagocytic action of bacteria, which also indicated the development of dysbiosis in the oral cavity.

The appearance of coagulase-positive staphylococci – bacterial causative agents of purulent-inflammatory processes – drew attention, as they are characterized by the production of toxins with hemolytic and necrotic effects. The hemolytic properties (the ability to cause hemolysis of rabbit erythrocytes) of *Staphylococcus aureus* were studied to detect α -toxin, which is characterized by dermonecrotic and lethal effects. Lecithinase activity and α -hemolysin production were detected in the selected isolates of *Staphylococcus aureus*.

In particular, colonies of staphylococci with large zones of hemolysis of rabbit erythrocytes were determined on nutrient media, as one of the signs of the virulence of these microorganisms. The production of one of the virulence factors of staphylococci – lecithinase, which destroys the lecithin of cell membranes, causing cell lysis – was also noted. In particular, colonies of two species of the bacterial group of coagulase-positive staphylococci – *Staphylococcus aureus* and *Staphylococcus intermedius* were visualized. A zone of lecithinase activity was observed around the colonies of *Staphylococcus aureus*, however, such a zone was not formed around the colonies of *Staphylococcus intermedius*, which indicated the absence of lecithinase (Fig. 2). It should be noted that hemolysins are one of the most important virulence factors of the aerobic microbiota of the oral cavity. *Staphylococcus* produces several types of hemolysins, among which α -hemolysin, which has cardiotoxic and dermonecrotic effects, is important. In addition, *staphylococci lecithinase*, as a membrane toxin, has a cytotoxic effect on leukocytes.

At the later stages of opioid exposure (10–12 weeks), microscopic examination revealed changes in the morphological types of the constituent supracellular structures (dental plaques). A significant decrease in the relative number of gram-positive coccoid microflora and the appearance of phycomyces fungi was noted. Gram-negative polymorphic microflora formed supra-

cellular structures with the participation of capsular bacteria. In smears from subgingival biofilms in the area of ingival furrows (formation of periodontal pockets), signs of tissue damage were noted – multinucleated epithelial cells, signs of autophagocytosis of erythrocytes (Fig. 3). Among the cells of lymphogenic or hematogenous origin in the gingival fluid, lymphocytes predominated, granulocytes were not visualized, and no signs of bacterial phagocytosis were found. Instead, the adsorption of polymorphic gram-negative rods in the form of small granular structures was found on epitheliocytes. These data indicated the absorption and intracellular placement of microorganisms – bacteroids, which are capable of adsorbing on cells and causing a cytotoxic effect due to the action of the pathogenicity enzyme of these bacteria – phospholipase. The absence of an inflammatory reaction, in particular, the absence of neutrophils and phagocytosis (Fig. 3), also indicated a cytotoxic effect.

At the end of 10 and 12 weeks of opioid exposure, bacteriological studies of the microbiota of supragingival and subgingival biofilms revealed Gram-negative diplococci, as well as *Klebsiella*, hemolytic *Escherichia coli* and *Pseudomonas aureginosa*. Bacteroids were isolated under anaerobic conditions. Virulence factors were found in most bacterial isolates, namely, α -hemolysin staphylococci, which caused hemolysis of rabbit erythrocytes at 37°C, as well as lecithinase. Coagulase-positive staphylococci belonged to two species – *Staphylococcus aureus* and *Staphylococcus intermedius*.

Hemolysis and a high density of microbial colonization of *Streptococcus pyogenes*, a bacterial group of β -hemolytic streptococci (Fig. 4), which produces hemolysin and protein M, which is associated with antiphagocytic and cytotoxic effects on neutrophils, were noted on blood agar. It should be noted that the hemolysins of streptococci are an important taxonomic feature, in particular, the group of α -hemolytic species, among which are identified cariogenic and opportunistic species that cause systemic diseases during immunosuppression. The ability to cause β -hemolysis (O- and S-hemolysins) is a species characteristic of *Streptococcus pyogenes*, and they also have a cytotoxic effect. At the same time, the production of virulence factors significantly increases during the formation of supracellular structures of microorganisms – biofilm, which plays a key role in the pathogenesis of periodontal diseases.

Colonies of *Pseudomonas aureginosa*, which produced the blue-green pigment pyocyanin, were also detected in the *long-term* stages of opioid exposure (Fig. 4). These changes indicated the development of dysbiotic changes, as well as the gradual formation of foci of the inflammatory process in the oral cavity as a

result of the expression of virulence factors by bacteria of various species, primarily staphylococci of the species *Staphylococcus aureus* and *Staphylococcus intermedius*, as well as β -hemolytic streptococci.

Thus, against the background of long-term opioid exposure, the development of dysbiotic changes in the microbiocenoses of the studied biotope was revealed, namely the predominance of gram-negative bacteria, the appearance of microorganisms not characteristic of this biotope – *Klebsiella*, *Pseudomonas aeruginosa* and phycomyces fungi. In the majority of selected isolates, the expression of virulence factors characteristic of certain species was found. The absence of cellular elements characteristic of purulent-inflammatory processes was noted, and signs of cytotoxic action on epitheliocytes and blood cells were also noted.

DISCUSSION

So, the action of opioids in the oral cavity is determined both by their presence in the blood and by their sufficiently high content in the oral fluid and saliva, so the tissues of the gums and periodontium can be considered as “shock tissues” in relation to the action of the opioid. With long-term opioid exposure, systemic changes in the body occur at the cellular level, in particular, disruption of redox processes, which leads to tissue hypoxia [10]. At the same time, mechanisms of immune protection dependent on tissue respiration, in particular phagocytosis, may be suppressed. As a result of the reduction of natural protective mechanisms, there is a shift in the balance between microbial populations in microbiotopes. This balance can be disturbed by the activation of opportunistic microflora, infection by allochthonous microflora, as well as due to an increase in virulence caused by genotypic and phenotypic mechanisms [30]. There is a shift in the balance and the replacement of some microbial populations by others. Therefore, in the oral cavity there is a high risk of the formation of foci of chronic microbial infection, which later become a source of constant pathogenic contamination and sensitization of the alimentary canal and the body as a whole [19].

According to the literature, the role of microbiota in the development of periodontitis is not fully understood, although some “pathogens” individually or in groups can play an important role in the development of the inflammatory process in the oral cavity [17, 19, 29, 36, 38]. Also important is the formation of compound dental biofilms of different composition of bacteria embedded in the matrix of polymers of microbial and salivary origin, which are recognized as a virulence factor of many infectious and inflammatory diseases of

the oral cavity [22, 28, 32, 33, 36] and cause destruction epithelial connection in the area of the gingival sulcus, ensuring the spread of infection in the underlying tissue [17, 34]. Whereas the level of microbial colonization of the oral cavity depends on the duration of drug use, the heterogeneity of microbiocenosis in both qualitative and quantitative composition dominates in opioid-dependent individuals [12, 13]. It is reported that periodontopathogenic bacteria support the dysfunction of the epithelial barrier in the gums by producing several virulence factors [34]. In addition, due to the spread of plaque microflora in the subgingival space, bacterial toxins stimulate the epithelium to produce biologically active mediators with the subsequent involvement of various types of cells in the process. Exo- and endotoxins of microorganisms directly and indirectly cause a number of pathological changes, in particular, toxins from periodontal pockets *penetrate into the bloodstream in significant quantities and without obstacles*, i.e. the state of bacteremia becomes permanent [21, 23, 34].

As a result of the conducted microbiological research, we evaluated the effect of individual bacterial isolates based on the detection of their virulence factors, in particular, cytotoxins. It can be asserted that initial inflammatory changes within the gingival sulcus caused by changes in the microbiocenosis were detected already in the short-term stages of opioid exposure. Thus, during the microscopic examination, acid-producing bacteria – *Leptothrix* with gram-positive coccal microflora organized in relation to them were detected in the short-term stages of opioid exposure. The formation of supragingival biofilm (cariogenic species of streptococci and organic substrate) was determined in the long-term stages opioid exposure.

At the later stages of opioid exposure, the activation of gram-negative opportunistic microflora (*Klebsiella*, *Escherichia*, *Pseudomonas*, *Bacteroids*) led to the development of necrotic changes as a result of the interaction of conservative lipopolysaccharide structures (patterns) with the TLRs of macrophages that penetrated the periodontal pockets at the earlier stages of the development of the inflammatory process caused by gampositive cocci producing exotoxins (α -hemolysins and lecithinase of staphylococci, β -hemolysins of streptococci, phospholipase of *Bacteroides*). This is evidenced by the adsorption of polymorphic gram-negative microflora (bacteroids) on epitheliocytes, autophagocytosis of erythrocytes, and the appearance of multinucleated cells as a result of impaired division processes. In addition, during the destruction of bacterial cells, lipopolysaccharides of gram-negative microflora act as endotoxins, causing both a general

toxic and a local effect on tissues and serve as a key factor in the formation of foci of infection [22].

In the *experimental conditions with the constant action of opioids* disrupt redox processes and cause suppression of cellular protective reactions, in particular, phagocytosis. This process contributes to increased colonization of periodontal tissues and the mucous membrane of the oral cavity, in particular, by phenotypically virulent variants of *Staphylococcus aureus* with a high degree of tropism to the epitheliocytes of the gingival mucosa, which is an extremely negative prognosis [25].

Thus, when comparing the experimental results obtained by us with data from the literature, it can be assumed that with the constant and long-term action of opioid analgesics, dysbiotic changes in the microbiota of the oral cavity develop consistently. In the short-term stages of opioid exposure, these changes were manifested by the activation of autochthonous microflora, which was evidenced by an increase in the density of the colonization of certain types of microorganisms and the formation of supracellular microbial structures as components of the biofilm. Under the conditions of further long-term action of the opioid analgesic, microorganisms that are not characteristic of the natural microbiota of the oral cavity of rats, which are characterized by virulence factors, mainly coccal microflora and hemolytic gram-negative bacteria were detected. In the long-term stages of opioid exposure, the microflora of the studied microbiotope changed towards the predominance of gram-negative aerobic and anaerobic microflora, and necrotic-inflammatory processes developed in periodontal

tissues against the background of signs of inhibition of the body's *protective response*.

CONCLUSIONS

1. Depending on the duration of the experimental action of the opioid in the microbiotopes of the oral cavity (the surface of the teeth in the area of the gingival margin, the gingival groove), changes in the species composition of the biocenosis and the expression of virulence factors by microorganisms were detected.
2. In the short-term stages of opioid exposure, changes in biocenoses were manifested in an increase in the contamination of certain types of microorganisms and the formation of supracellular structures with a predominance of gram-positive bacteria.
3. In the long-term effects of the opioid analgesic, the activation of bacterial elements of the microbiocenosis was revealed, which were characterized by increased expression of virulence factors – hemolysins, coagulase, lecithinase, and cytotoxins.
4. At the later stages of opioid exposure, the predominance of gram-negative microflora and the activation of cytotoxic action against the background of suppressed activity of the body's *protective response* were established, which were manifested in the development of necrotic-inflammatory changes in the tissues of the studied biotope.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Volodymyr B. Fik

Danylo Halytskyy Lviv National Medical University

69 Pekarska St, 79010 Lviv, Ukraine

e-mail: fikvolodymyr@ukr.net

ORCID AND CONTRIBUTIONSHIP

Volodymyr B. Fik: 0000-0002-2284-4488    

Yuriy Ya. Kryvko: 0000-0002-2740-7703  

Orysia A. Kovalyshyn: 0000-0002-9710-0694  

Lesia V. Pankevych: 0000-0001-8687-7628  

Ivan M. Ratsyn: 0009-0008-0980-9275  

Larysa Ya. Fedoniuk: 0000-0003-4910-6888  

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Transformation of pharmaceutical care during the martial state in Ukraine: doctors' perception of interprofessional communication

Natalia A. Bilousova¹, Vasyl M. Mykhalchuk¹, Natalia O. Tkachenko², Liudmyla I. Yakovenko¹, Maryna M. Dolzhenko¹

¹SHUPYK NATIONAL HEALTHCARE UNIVERSITY OF UKRAINE, KYIV, UKRAINE

²ZHAPORIZHZHIA STATE MEDICAL AND PHARMACEUTICAL UNIVERSITY, ZHAPORIZHZHIA, UKRAINE

ABSTRACT

Aim: To investigate the perception of general practitioners of family medicine of the implementation of Good Pharmacy Practice (GPP) standards by pharmacists to determine approaches to interprofessional communication and further integration of pharmacists into primary health care.

Materials and Methods: The study was conducted at the Department of Cardiology of the Shupyk National Healthcare University of Ukraine from March to December 2024 by means of an anonymous online survey using Google Forms. The methods of analysis, deduction, induction, comparison, systematization, generalization, forecasting, statistics and bibliography were used.

Results: The functions of pharmacists in integrated care teams were determined: monitoring and compatibility of medicines, monitoring the effectiveness of pharmacotherapy, dispensing prescription medicines "only on prescription" (72.5% [CI 95% 72.5 ± 0.02, p<0.0001]); joint training in the process of continuous professional development (4.8% [CI 95% 4.8 ± 0.01, p<0.0001]). It was found that the level of clinical competencies of pharmacists (65.3% [CI 95% 65.3 ± 0.03, p<0.0001]) and safe use of medicines (60.7% [CI 95% 60.7, ± 0.03, p<0.0001]) is mediocre.

Conclusions: The high interest of doctors of therapeutic specialties in interprofessional communication with pharmacists as part of integrated care teams was determined (72.5% [CI 95% 72.5 ± 0.02, p<0.0001]). The need for additional training of pharmacists in the process of continuous professional development for work as part of integrated care teams in order to obtain and deepen clinical competencies was substantiated. We see the development of clinical recommendations for community pharmacists in accordance with the ESC/AHA recommendations and taking into account the compatibility of medicines when providing pharmaceutical care to patients with ischemic heart disease with comorbid conditions as a prospect for further research.

KEY WORDS: pharmaceutical care, community pharmacist, ischemic heart disease, interprofessional communication, integrated care team, medication monitoring, pharmacotherapy management

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INTRODUCTION

It is known that the main cause of mortality from non-communicable diseases in Ukraine is ischemic heart disease [1]. Under the influence of socioeconomic factors and mental health disorders caused by the war, the incidence of ischemic heart disease in Ukraine is increasing [2]. This situation leads to an additional burden on medical workers, premature hospitalizations with subsequent disability of the population. In addition, the number of premature hospitalizations is affected by improper adherence to the guidelines for early detection and prevention of cardiovascular diseases proposed by the European Society of Cardiology (ESC) [3]. A number of documents (Clinical Recommendations of the ESC and the American Heart Association (AHA)) are noteworthy, which recommend an integrated care

approach and interprofessional communication in the prevention of ischemic heart disease with comorbid conditions with the participation of doctors, nurses, rehabilitation specialists, dietitians, medical psychologists, pharmacists and social workers [4, 5].

The Resolution of the Framework Agreement for 2023-2030, adopted by the WHO for the European Region, including Ukraine, emphasizes the shortage of medical and pharmaceutical personnel associated with the global aging of the population [6]. To address the issues of improving the quality of medical and pharmaceutical services, it is proposed to create integrated care teams with the participation of pharmacists with the transformation of services in order to provide patient-centered pharmaceutical care. This document highlights the problem of the critical attitude of med-

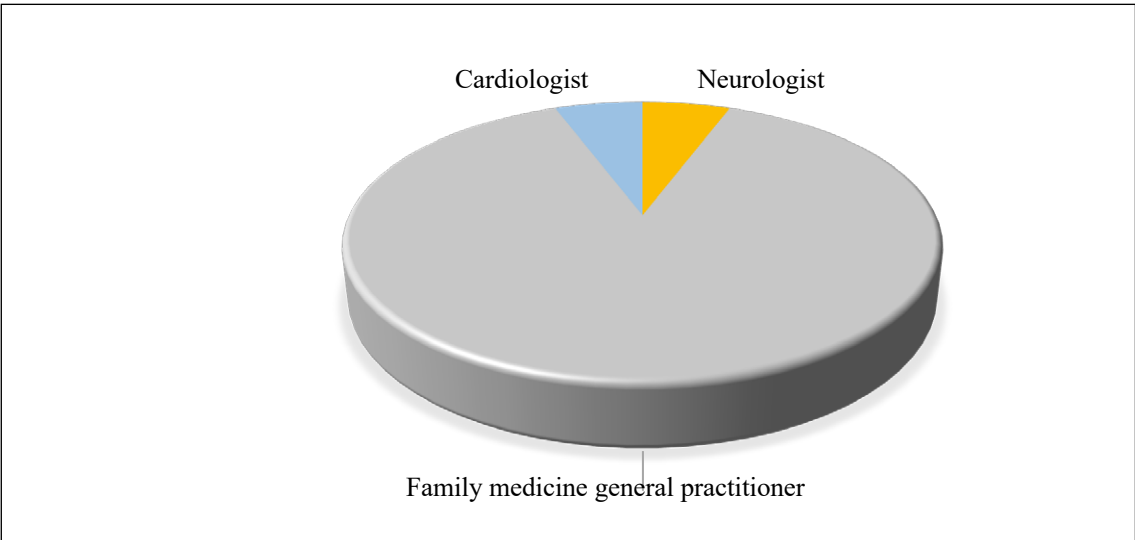


Fig. 1. Distribution of doctors who participated in the survey by specialty

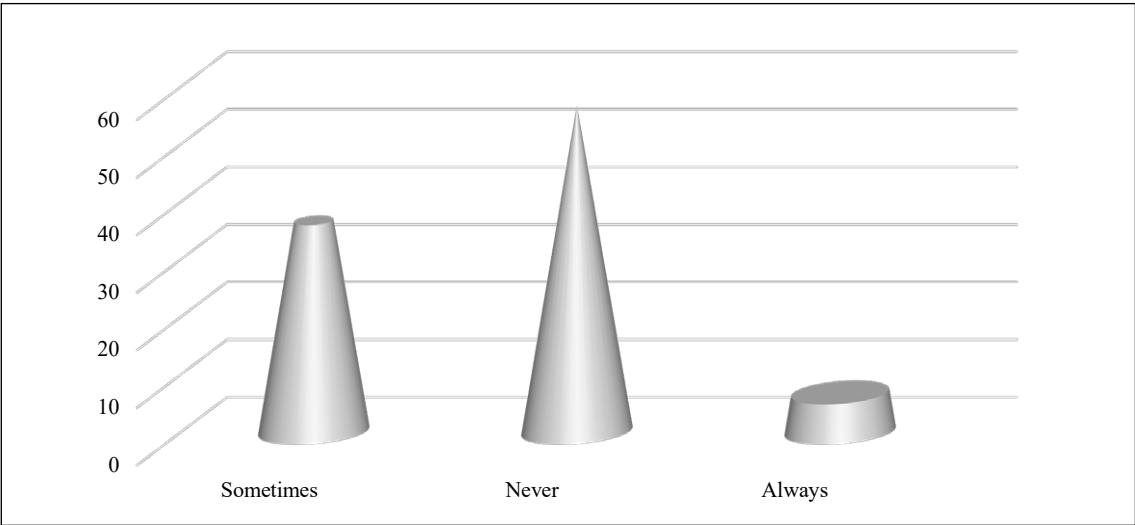


Fig. 2. Frequency of medical recommendations to seek advice from community pharmacists regarding the safe use of medicines

ical personnel in the eastern regions of Europe to the integration of community pharmacists into primary health care, which complicates the transformation processes [7].

Therefore, the study of the perception of general practitioners of family medicine of the implementation of Good Pharmacy Practice (GPP) standards by pharmacists is being updated with the subsequent reorientation of pharmaceutical services from pharmaceutical provision to the provision of patient-oriented pharmaceutical care to patients suffering from ischemic heart disease with comorbid conditions.

AIM

To investigate the perception of general practitioners of family medicine of the implementation of Good Pharmacy Practice (GPP) standards by pharmacists in

order to determine approaches to interprofessional communication and further integration of pharmacists into primary health care.

MATERIALS AND METHODS

The study was conducted at the Department of Cardiology of the Shupyk National Healthcare University of Ukraine from March to December 2024 by means of an anonymous online survey using Google Forms with prior consent indicated in one of the questions of the questionnaire. This survey was distributed through medical communities of doctors in the Viber messenger and the Facebook social network. The questionnaire contained three thematic blocks of 19 questions: doctors' perception of consultations provided by pharmacy pharmacists as part of pharmaceutical care for patients with ischemic heart disease with comorbid conditions

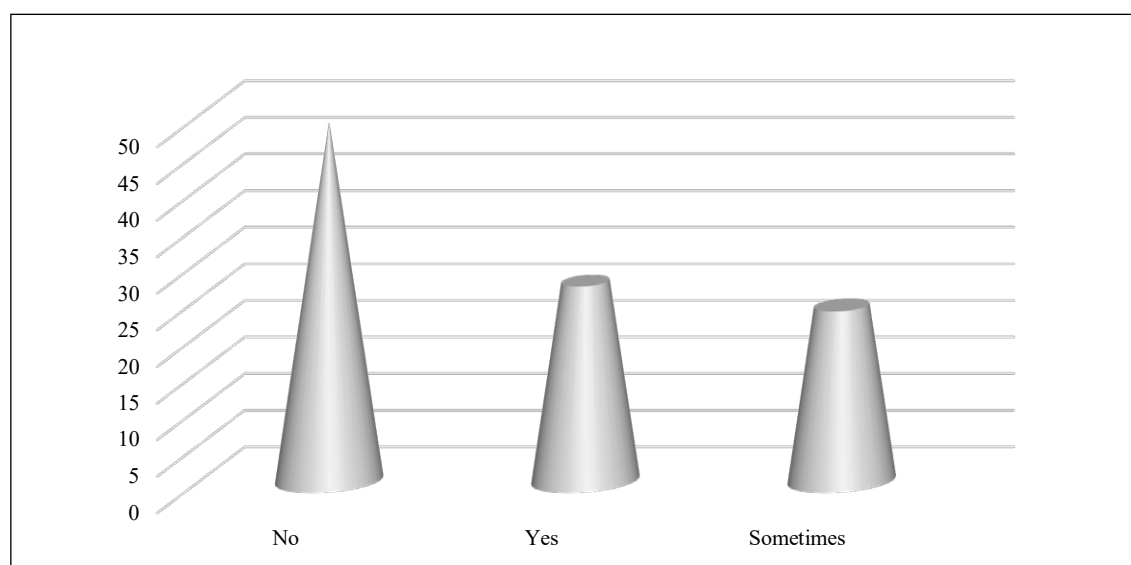


Fig. 3. Attitudes of doctors towards pharmaceutical substitution of medicines by International Nonproprietary Name (INN) within the same molecule

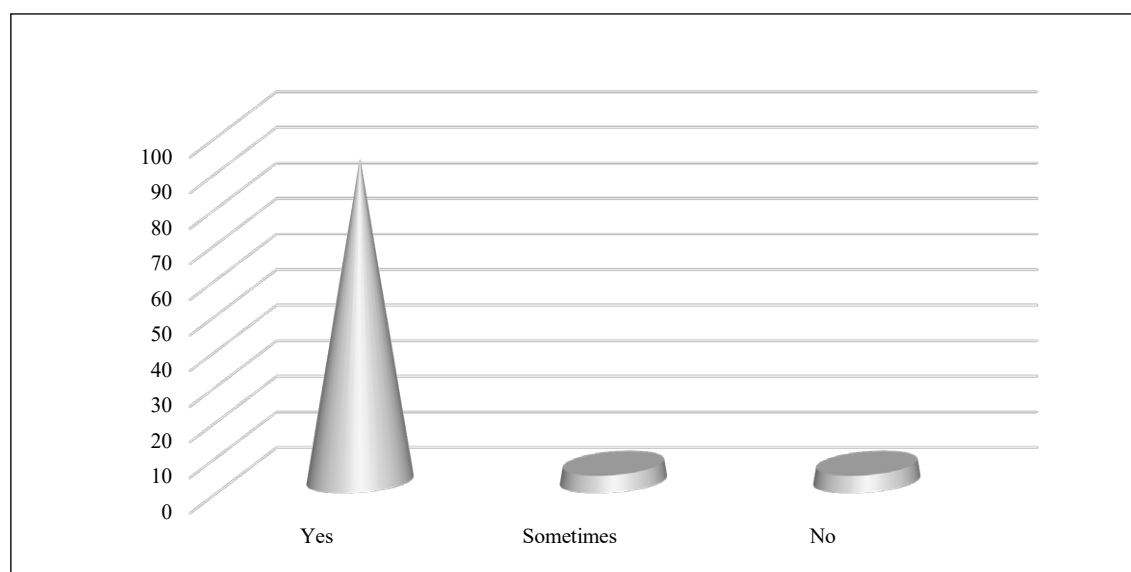


Fig. 4. Frequency of checking for possible medicines interactions when prescribing pharmacotherapy for CHD with comorbid conditions

in accordance with the standards of Good Pharmacy Practice (GPP) [8]; questions to clarify the experience of interprofessional communication between doctors and pharmacists; determining doctors' vision of pharmacists' readiness for interprofessional communication and work in integrated care teams with subsequent integration into primary health care. Incomplete questionnaires were the exclusion criteria.

The methods of analysis, deduction, induction, comparison, systematization, generalization, forecasting, statistical and bibliography were used.

Accumulation, correction, systematization of information and visualization of results were carried out in Microsoft Office Excel spreadsheets. Statistical processing was carried out using the STATISTICA.13 program.

RESULTS

The study was attended by 331 doctors from 22 regions of Ukraine, including frontline territories (Fig. 1), who were divided into general practitioners of family medicine and doctors of therapeutic specialties – cardiologists and neurologists. The average age of the doctors was 54.5 ± 4.0 years.

To determine the perception of physicians of consultations within the framework of pharmaceutical care for patients with CHD with comorbid conditions, we asked to provide answers to the questions based on the definition of the concept of "pharmaceutical care" in accordance with current Ukrainian legislation [9]. The frequency of physician recommendations for patients to seek advice from pharmacists regarding the safe use of medicines that are part of the pharmacotherapy of

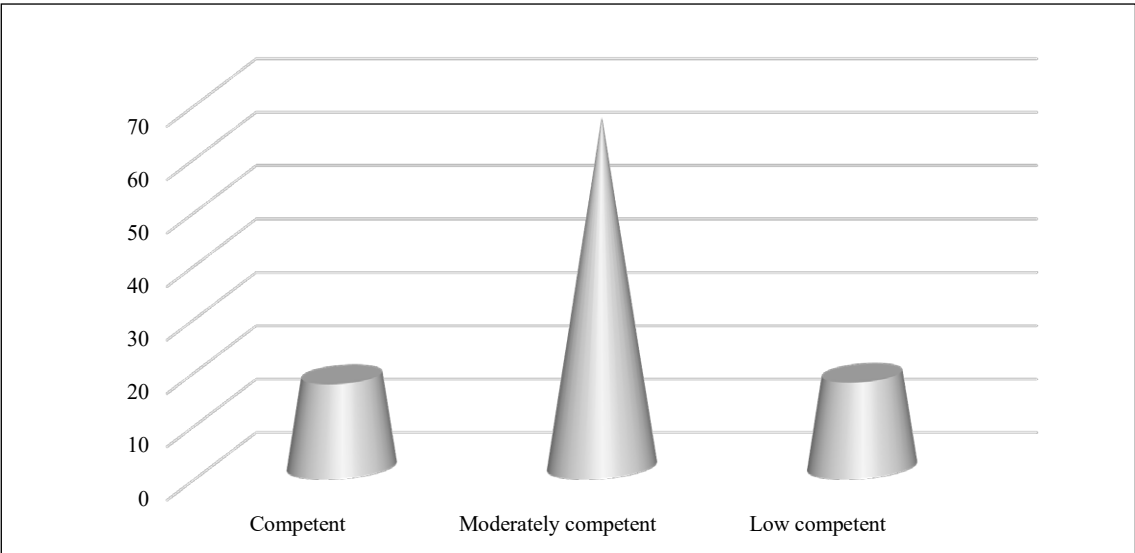


Fig. 5. Doctors' opinion on the clinical competences of community pharmacists

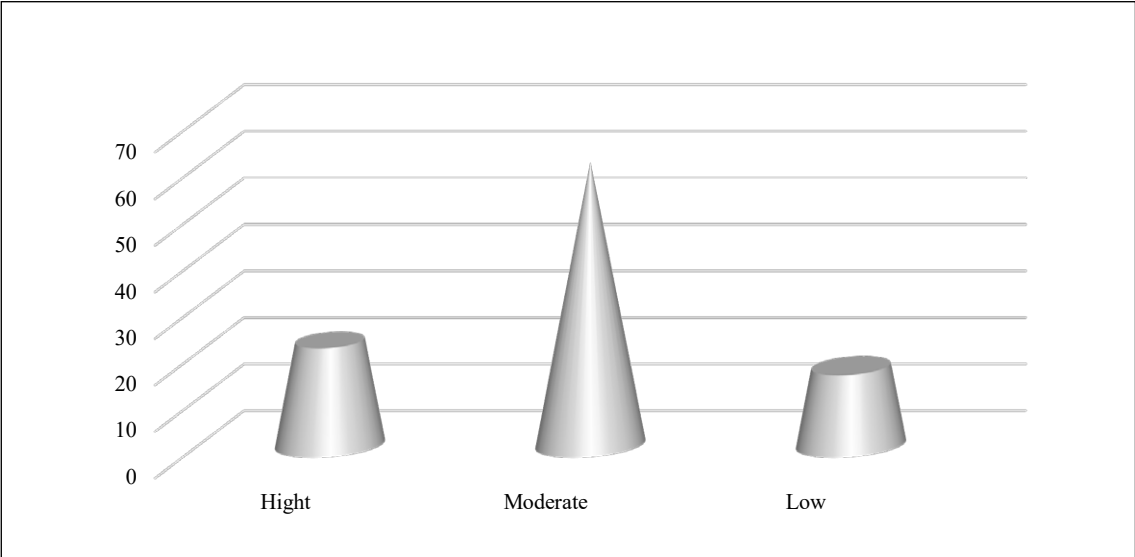


Fig. 6. Doctors' opinion on the level of safety in providing pharmaceutical care to patients with CHD with comorbid conditions

CHD with comorbid conditions, regarding possible medicines interactions and side effects, was determined (Fig. 2). It should be noted that always 6.7% [CI 95% 6.7 ± 0.01, p<0.0001] and sometimes 36.6% [CI 95% 36.6 ± 0.03, p<0.0001] of physicians recommend contacting community pharmacists in pharmacies for advice on medicines compatibility. The remaining 56.5% [CI 95% 56.5 ± 0.03, p<0.0001] of doctors decide these issues on their own and have never provided such advice to patients.

The attitude of doctors to the pharmaceutical substitution of medicines by International Nonproprietary Name (INN) within one molecule was highlighted (Fig. 3). Thus, a negative attitude to the pharmaceutical substitution of medicines prescribed to patients with CHD with comorbid conditions occurs in 48.9% [CI 95% 48.9 ± 0.03, p<0.0001] cases. The second part of the doctors

noted that such actions are sometimes incorrect (23.9% [CI 95% 23.9 ± 0.02, p<0.0001]), and pharmaceutical substitution can be "in agreement with the doctor" in cases where "the medicine is not available in the pharmacy". Other doctors (27.2% [CI 95% 27.2 ± 0.02, p<0.0001]) consider the actions of community pharmacists in pharmaceutical substitution of medicines by INN to be correct and in the absence of the prescribed medicine in the pharmacy, the patient will receive the prescribed pharmacotherapy. This is especially relevant when patients live in rural areas and medicines are not always available in pharmacies.

It was determined that 90.3% [CI 95% 90.3 ± 0.02, p<0.0001] of respondents, when prescribing pharmacotherapy, subjectively believe that they always take into account all medicines (including over-the-counter medicines) and other pharmaceutical products (dietary

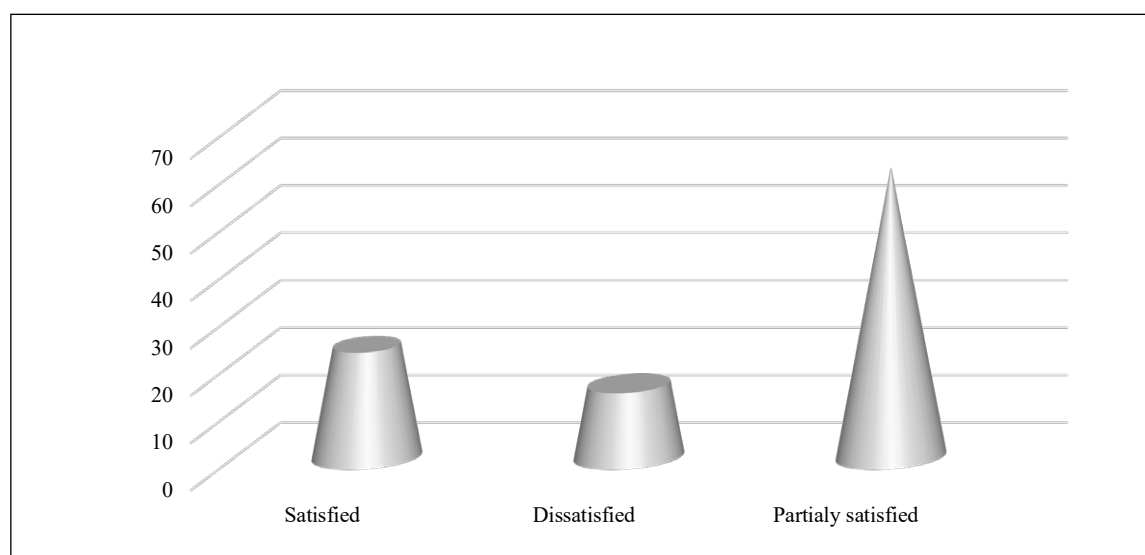


Fig. 7. Physicians' satisfaction with pharmaceutical support aimed at patient education

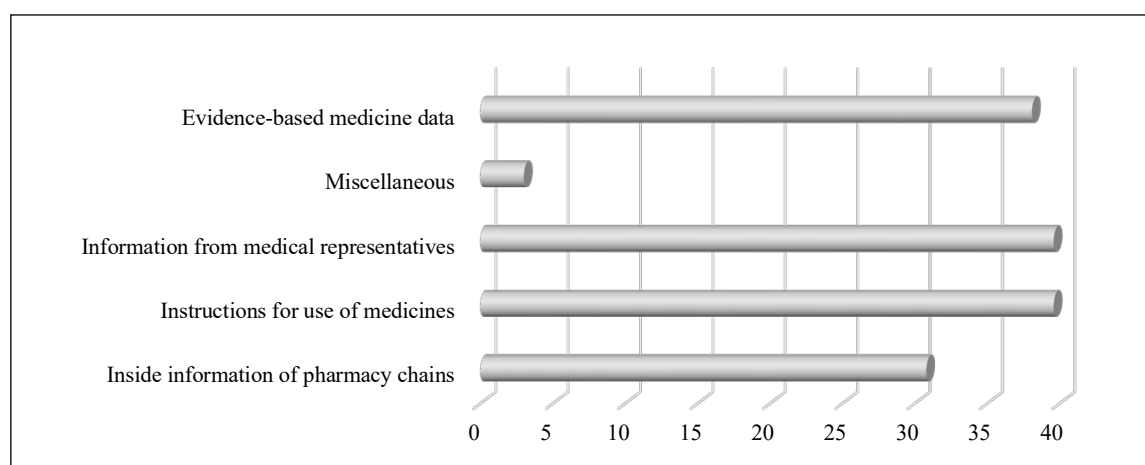


Fig. 8. Opinion of doctors on information provision of pharmacists to improve the practice of providing pharmaceutical care to patients with CHD with comorbid conditions

supplements, medicinal herbal raw materials, vitamin and mineral complexes, etc.) consumed by patients with CHD with comorbid conditions in order to prevent possible medicines interactions (Fig. 4). Other respondents (4.8% [CI 95% 4.8 ± 0.02 , $p < 0.0001$]) occasionally take into account all medications and do not pay attention to the compatibility of medications used by patients with CHD with comorbid conditions.

The opinion of doctors, regarding the clinical competencies of community pharmacists, was clarified (Fig. 5). Thus, 17.2% [CI 95% 17.2 ± 0.02 , $p < 0.0001$] of doctors believe that community pharmacists have sufficient clinical knowledge to provide pharmaceutical care to patients. The second part of doctors 65.3% [CI 95% 65.3 ± 0.03 , $p < 0.0001$] noted that community pharmacists are moderately competent in clinical knowledge and need "joint training with doctors" in the process of continuous professional development. Another 17.5% [CI 95% 17.5 ± 0.02 , $p < 0.0001$] of doctors noted that

pharmacists do not have certain clinical knowledge and skills to provide pharmaceutical care to patients with CHD with comorbid conditions.

The opinion of doctors on the level of safety in providing pharmaceutical care (verification of the correctness of prescriptions, pharmaceutical consultation of the patient regarding rational use, rules of administration, "ineffectiveness", checks for compatibility of medicines) to patients with CHD with comorbid conditions was highlighted (Fig. 6). It was documented that 22.4% [CI 95% 22.4 ± 0.02 , $p < 0.0001$] of doctors consider the level of patient safety in providing pharmaceutical care to be high. The average level of safety was noted by 60.7% [CI 95% 60.7 ± 0.03 , $p < 0.0001$] and the low level was noted by 16.9% [CI 95% 16.9 ± 0.02 , $p < 0.0001$] of doctors.

The satisfaction of doctors with pharmaceutical support aimed at educating patients (training in the correct use of medicines in accordance with dosage, hours of administration, duration of use, compatibility with

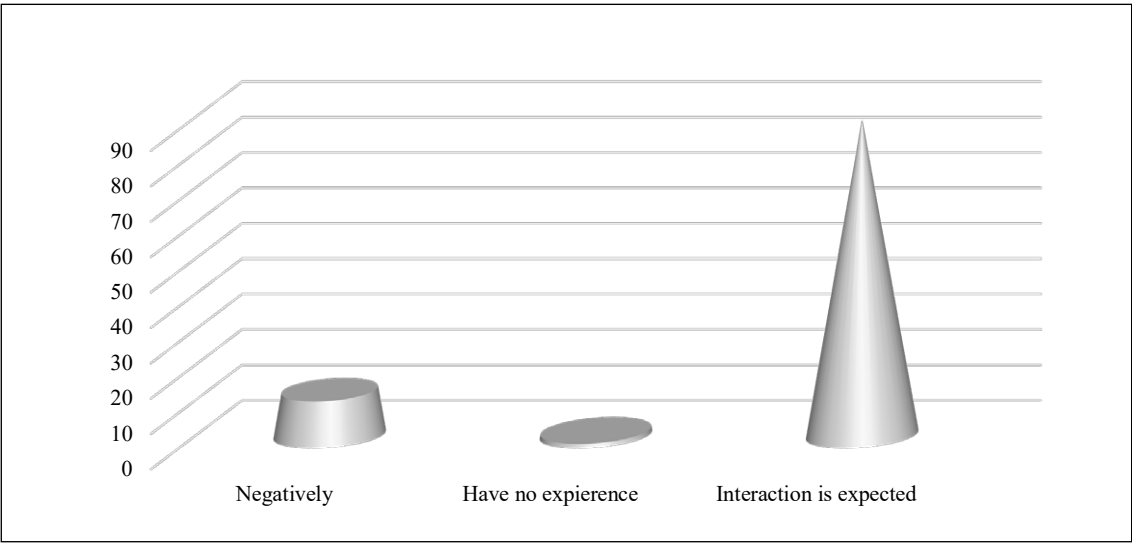


Fig. 9. Physicians’ views on interprofessional communication with pharmacists in integrated care teams.

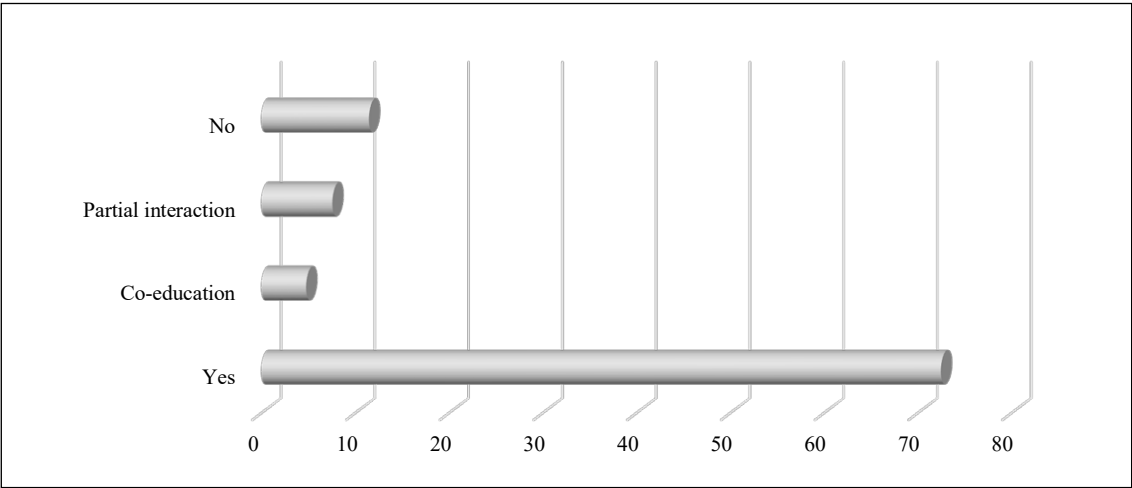


Fig. 10. Doctors’ vision of further interprofessional communication with community pharmacists and patients as part of integrated care teams when providing pharmaceutical care to patients with CHD with comorbid conditions

other medicines and food products, rules for storing medicines) was found out. Thus, 23.6% [CI 95% 23.6 ± 0.02, p<0.0001] of doctors are satisfied and partially satisfied (61.0% [CI 95% 61.0 ± 0.03, p<0.0001]) with pharmaceutical support of patients aimed at educating patients on the proper use of medicines. Dissatisfied 15.3% [CI 95% 15.3 ± 0.02, p<0.0001] of doctors noted that pharmacists should not “interfere in the treatment process,” and the quality of providing such services depends “individually” on each pharmacist (Fig. 7).

The opinion of physicians regarding the information provision of pharmacists to improve the practice of providing pharmaceutical care to patients with CHD with comorbid conditions was documented. The part of physicians (39.6% [CI 95% 39.6 ± 0.03, p<0.0001]) believes that in pharmaceutical practice, community pharmacists use information provided by medical representatives of pharmaceutical companies and data

from the instructions for use of medicines. Another 38.1% [CI 95% 38.1 ± 0.03, p<0.0001] of doctors believe that in everyday practice community pharmacists use information from evidence-based medical databases to provide pharmaceutical care, and internal information of pharmacy chains on pharmacological properties and use of private labels is used in 30.8% [CI 95% 30.8 ± 0.03, p<0.0001] cases. No less interesting were the comments of doctors in the subgroup “other” 3.0% [CI 95% 3.0 ± 0.01, p<0.0001]: “pharmacists use information on the availability of a medicine and its price, offer the most expensive medicines”; “it all depends on the competence of pharmacists”; “I want to believe that they use information from evidence-based medical databases” (Fig. 8).

We investigated that 71.0% [CI 95% 71.0 ± 0.03, p<0.0001] of doctors indicated an existing positive experience of interprofessional communication with

pharmacists in pharmacies in resolving issues when prescribing medicines. It should be noted that in 79.8% [CI 95% 79.8 $\pm$ 0.02, $p < 0.0001$] cases, doctors noted that pharmacists know and follow the rules for dispensing prescription medicines. Another 32.0% [CI 95% 32.0 $\pm$ 0.05, $p < 0.0001$] of doctors indicated that patients with CHD independently purchase prescription medicines used for cardiovascular diseases in pharmacies without a prescription. Doctors also noted that they had to "rewrite prescriptions", "correct incorrectly prescribed dosages of medicines", "to coordinate the pharmaceutical substitution in the absence of a medicine in the pharmacy". It was found that 74.0% [CI 95% 74.0 $\pm$ 0.02, $p < 0.0001$] of doctors consider that community pharmacists in pharmacies properly comply with the rules for storing patients' medical data.

It should be noted that doctors had the opportunity to express their opinion on interprofessional communication with pharmacists in integrated care teams. Thus, 89.1% [CI 95% 89.1 $\pm$ 0.02, $p < 0.0001$] of doctors emphasized that "such communication should occur to monitor the prescribed pharmacotherapy to prevent interactions, adverse medicines reactions and determine the ineffectiveness of the prescribed pharmacotherapy." A negative attitude towards cooperation with pharmacists was expressed by 12.7% [CI 95% 12.7 $\pm$ 0.02, $p < 0.0001$] of doctors, and another 1.2% [CI 95% 1.2 $\pm$ 0.01, $p < 0.0001$] of respondents noted that they "do not have such experience of communication" (Fig. 9).

The vision of physicians for further interprofessional communication with pharmacists and patients in integrated care teams in providing evidence-based pharmaceutical care to further improve patient adherence to treatment, improve their quality of life and life years was highlighted. It was found that 72.5% [CI 95% 72.5 $\pm$ 0.02, $p < 0.0001$] of physicians support the transformation of pharmaceutical practice aimed at patient-centered pharmaceutical care for patients with CHD with comorbid conditions. Physicians emphasized "more active communications by pharmacists for the effective treatment of patients with CHD with comorbid conditions"; "compliance with the requirements for dispensing prescription medicines only on prescription"; "carrying out explanatory work with doctors regarding the specifics of the use of medicines"; "acquiring skills in using clinical knowledge of the impact of medicines on laboratory parameters". Also emphasized are "opportunities for interprofessional communication through electronic health systems"; "unified databases for pharmacists and doctors", positive experience of communication in "internal infection control". Partial interprofessional communication in the provision of medical and pharmaceutical care is seen by 7.6% [CI

95% 7.6 $\pm$ 0.01, $p < 0.0001$] doctors, and the remaining 4.8% [CI 95% 4.8 $\pm$ 0.01, $p < 0.0001$] see such communication in joint learning in the process of continuous professional development. 11.5% [CI 95% 11.5 $\pm$ 0.01, $p < 0.0001$] of respondents disagreed with the practice of interprofessional communication (Fig. 10).

It should be noted that 82.5% [CI 95% 82.5 $\pm$ 0.02, $p < 0.0001$] doctors emphasized the inclusion in the Licensing Requirements [10] of mandatory participation of community pharmacists of all pharmacy establishments in continuous professional development activities (thematic improvement courses, participation in conferences, master classes) with subsequent certification and determination of professional category, which will positively affect the improvement of clinical knowledge and skills of pharmacists based on the principles of evidence-based medicine.

DISCUSSION

Modern achievements in medical practice allow the use of new medical technologies, which, in its turn, allows prolonging the lives of patients by converting acute conditions into chronic ones. Accordingly, there is an increase in the number of chronic diseases with concomitant comorbid conditions. Consequently, there is an increase in the number of elderly and senile people. This is especially relevant in patients with cardiovascular diseases, in particular with CHD [11]. Such patients require the simultaneous use of up to ten medications [4;5], which leads to polypharmacy and requires proper care for patients with CHD and comorbid conditions.

Special attention is required for the quality and approaches to the provision of medical care, primary and secondary prevention of CHD with comorbid conditions. Studies of the impact of compliance with ESC clinical recommendations, principles of primary prevention of ischemic heart disease were shown by observational studies EUROASPIRE IV, V [3,12, 13], which emphasize the need to improve the quality of patient care and compliance with medical recommendations.

It should be emphasized that according to the international documents on integrated care approaches to providing patient-centered medical care in the interprofessional communication of medical professionals, there is a reorientation of pharmaceutical services from pharmaceutical provision to the provision of pharmaceutical care on a global scale [6,7,14]. The effectiveness of the impact of interprofessional communication with clinical pharmacists [15-17] and community pharmacists [18] on the results of treatment of cardiovascular diseases has been proven in various systematic reviews and meta-analyses. International experience shows

that the study of factors affecting the communication of pharmacists and doctors, various models of inter-professional communication in integrated care teams have been proposed [19-22].

Attention is drawn to studies on the opinions of all participants in the process of interprofessional communication between doctors and pharmacists in integrated care teams. Analysis of literary sources allows us to single out some works on studying the opinions of doctors regarding communication with pharmacists and further integration into primary health care [23-25]. These studies determine the expectations of participants in integrated care teams from such communication and contribute to the implementation of clinical recommendations at a qualitative level in the provision of medical and pharmaceutical care to patients with CHD with comorbid conditions and lead to better clinical outcomes.

The results we obtained allow us to determine that, in general, doctors are positively and optimistically disposed towards interprofessional communication within integrated care teams, offering their own mechanisms for setting up communications not only through messengers, phone calls and e-mail, but also electronic health systems.

The opinions of doctors regarding the pharmaceutical substitution of medicines by INN within the same molecule have become controversial, which is explained by the orientation of pharmacies towards pharmaceutical provision, the implementation of the plan for the sale and promotion of private labels of pharmaceutical products through pharmacy chains, marketing agreements of pharmacy chains with pharmaceutical companies and the offer of concomitant and promotional medicines.

The determination by doctors of the mediocre level of clinical competence of pharmacists (65.3% [CI 95% 65.3 $\pm$ 0.03, $p < 0.0001$]), pharmaceutical consultations regarding the safe use of medicines (60.7% [CI 95% 60.7, $\pm$ 0.03, $p < 0.0001$]) and patient education on the correct use of medicines (61.0% [CI 95% 61.0 $\pm$ 0.03, $p < 0.0001$]) allows us to draw the following conclusions. Pharmacists, due to their workload and orientation towards the implementation of the sales plan, do not always provide consultations or pay sufficient attention to patients, so patients make errors in taking medicines, which affects the effectiveness of pharmacotherapy of CHD with comorbid conditions and the results of treatment are not always expected. In addition, pharmacists lack clinical knowledge, which is consistent with data obtained in other studies [23;24]. Given this situation, the majority of doctors took on the functions of checking medicines compatibility (90.3% [CI 95% 90.3 $\pm$ 0.02, $p < 0.0001$]).

It should also be taken into account that doctors can track information on prescriptions of medicines in the e-Health electronic system only by their specialization. Prescriptions by doctors of other specialties are not available, which may lead to undesirable medicines interactions. An example of such medicines interactions may be the use at home by elderly and senile patients of external forms (ointments, liniments, gels) of non-steroidal anti-inflammatory medicines that interact with angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, diuretics. To address such issues, we proposed that pharmacies determine the list of medications that the patient takes in total and, in case of incompatibility, justify and agree with doctors on a pharmaceutical replacement [26,27].

It was studied that patients with cardiovascular diseases do not always have access to medicines and medical care in rural and in front-line areas, therefore, general practitioners of family medicine agree to the pharmaceutical substitution of medicines by INN within one molecule by agreement (27.2% [CI 95% 27.2 $\pm$ 0.02, $p < 0.0001$]).

Our results generally indicate that doctors have already had some positive experience of interprofessional communication and understand the benefits of working as part of integrated care teams. Doctors also clearly define the role and place of pharmacists in providing medical and pharmaceutical care: monitoring of medications taken by patients with CHD with comorbid conditions, checking for medicines compatibility, monitoring the effectiveness of prescribed therapy, dispensing prescription medications "only on prescription" (72.5% [CI 95% 72.5 $\pm$ 0.02, $p < 0.0001$]), joint training in the process of continuous professional development (4.8% [CI 95% 4.8 $\pm$ 0.01, $p < 0.0001$]).

At the same time, doctors were concerned about the insufficient level of clinical knowledge of community pharmacists; financial interest in offering medicines when fulfilling the sales plan under marketing agreements of pharmacy chains with pharmaceutical companies and promoting private labels of pharmaceutical products in chain pharmacies; dispensing Rx medicines without a prescription [28], additional training of pharmacists to work as part of integrated care teams, regulation of current legislation and development of communication mechanisms through electronic health care systems.

CONCLUSIONS

The perception of general practitioners of family medicine of the implementation by community pharmacists of the standards of Good Pharmacy Practice for inter-

professional communication and further integration of pharmacists into primary health care was investigated:

1. The roles of GPP and the place of pharmacists in integrated care teams in the provision of medical and pharmaceutical care were identified by doctors: monitoring of medicines taken by patients with CHD with comorbid conditions, checking for medicines compatibility, monitoring the effectiveness of the prescribed therapy, dispensing prescription medicines "only on prescription" (72.5% [CI 95% 72.5 $\pm$ 0.02, $p < 0.0001$]); joint training in the process of continuous professional development (4.8% [CI 95% 4.8 $\pm$ 0.01, $p < 0.0001$]).
2. A high interest of doctors of therapeutic specialties in interprofessional communication with pharmacists as part of integrated care teams was determined (72.5% [CI 95% 72.5 $\pm$ 0.02, $p < 0.0001$]).
3. It was found that, according to doctors, community pharmacists have an average level of clinical compe-

tencies (65.3% [CI 95% 65.3 $\pm$ 0.03, $p < 0.0001$]) and an average level of safe use of medicines (60.7% [CI 95% 60.7, $\pm$ 0.03, $p < 0.0001$]), requiring additional education in the development of clinical competencies in the process of continuous professional development, which is confirmed by international studies.

4. The need for additional training of pharmacists in the process of continuous professional development for working as part of integrated care teams in order to obtain and deepen clinical competencies is substantiated.

As a prospect for further research we see the development of clinical recommendations in accordance with the ESC/AHA recommendations for the provision of pharmaceutical care to patients with CHD with comorbid conditions, taking into account the compatibility of medicines for pharmacists in pharmaceutical stores.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Natalia Bilousova

Shupyk National Healthcare University of Ukraine

9 Dorohozhytska st, 04112 Kyiv, Ukraine

e-mail: arinatala@gmail.com

ORCID AND CONTRIBUTIONSHIP

Natalia A. Bilousova: 0000-0001-6732-426X **A** **B** **C** **D** **E** **F**

Vasyl M. Mykhalchuk: 0000-0002-5398-4758 **A** **F**

Natalia O. Tkachenko: 0000-0002-8566-5938 **E** **F**

Liudmyla Yakovenko: 0009-0003-8811-8782 **B**

Maryna M. Dolzhenko: 0000-0002-8559-9598 **A** **E** **F**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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Prevalence of comorbidities systemic diseases (CSD) in patients requesting dental care in teaching dental clinic/ Al Muthanna University/ Iraq

Abdulkarem Abdulazeez Mouayd¹, Kumail Ihsan Abdullah², Riyam Abbass Ashour³, Al Salihi Karima Akool³

¹DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY, COLLEGE OF DENTISTRY, AL MUTHANNA UNIVERSITY, AL-MUTHANNA, IRAQ

²DENTISTRY COLLEGE, ALAYEN IRAQI UNIVERSITY, AL-NASIRIYA, IRAQ

³COLLEGE OF DENTISTRY, AL-IRAQIA UNIVERSITY, BAGHDAD, IRAQ

ABSTRACT

Aim: To determine the prevalence of CSD and its relationship to gender, age, and number of missing teeth among patients.

Materials and Methods: Medical history of 526 patients requested dental care were analyzed.

Results: There were 168 (31.939%) with one or more CSD, including 66 (39.28%) and 102 (60.71%) for male and female, respectively. The age group of patients was 67(39.88%), 88(52.38%) and 13(7.73%) for age groups 20-40, 41-60, and >60 years, respectively. The distribution of CSD were 87 (51.78%), 63(37.5%), and 18 (10.71%) for single, double, and multiple, respectively. The percentages of blood hypertension (BH), diabetes Mellitus (DM), others, and cardiovascular diseases (CVD) were 94 (55.95%), 58 (34.52%), 54 (32.14%), and 40 (23.80%) respectively, The 1-4 missing teeth occurred in 127 (75.59%) of patients, including 47 (27.97%) and 80 (47.61%) for males and females, respectively, with significant differences (P-value=0.027).

Conclusions: A high prevalence of CSD was reported among patients seeking dental care. BH, DM, OD, and CVD were the commonly reported CSD, with variations in their percentages involving BH at the top of the list. Understanding the association between systemic diseases and oral health will greatly assist dental healthcare providers in treating patients in the dental department safely and effectively.

KEY WORDS: Dental treatment, Systemic diseases, Teeth extraction

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INTRODUCTION

The quality of life depends on the number of teeth. Nonetheless, more missing teeth could be associated with a relatively inferior quality of life [1]. Some apparently normal individuals request oral treatment but experience serious CSD, and their therapeutic drugs negatively influence dental treatment [2]. Likewise, dentists need comprehensive medical experience in providing dental services to the crowding population of patients. Previous studies reported that numerous patients presented for routine dental treatments may have underlying complex medical conditions unaware of [3]. Diabetes mellitus, systemic hypertension, gastrointestinal condition like peptic ulcer disease, and chronic renal failure are at the top of the systemic problems increasingly reported in dental clinics [4-5]. According to previous studies, a high percentage of the prevalence of hypertension, diabetes mellitus, peptic ulcer, and chronic renal failure was reported at 73% [6], 10 % [7], 34% [8], and 26% [9], respectively. On the other hand, in developing coun-

tries, many patients are unaware of their illness because these conditions do not reveal acute pain. Further, these patients do not seek medical care accompanied by poor access to health care. Understanding the medical problems associated with the development and pathogenesis of the dental problem will help find the necessary dental treatment modifications to achieve the wanted outcomes [10]. Oral health is crucial to systemic health, and medical conditions enormously impact oral health. Furthermore, a previous study determined a positive relationship between surgical site infection and oral lesions [11]. Researchers determined the changing of oral structures due to plaque bacteria associated with many medical conditions [12].

Concomitant oral disorders such as xerostomia, mucositis (chemotherapy), gingivitis, oral ulcerations, and pigmentations may be associated with using or abusing medication to address these systemic problems [13]. The earlier study observed medical problems in more than half (51.2%) dental patients with female sex

Table 1. Shows gender distribution of patients with comorbid diseases

Gender	With comorbid	Without comorbid	Total
	N (%)	N (%)	N (%)
Male	66 (39.28%)	210 (58.6%)	276 (52.47%)
Female	102 (60.71%)	148 (41.34%)	250 (47.52%)
P value	0.000 Sig		
Total	168(31.93%)	358 (68%)	526 (100%)

Table 2. Shows the distribution of the total sample with comorbid by age

Comorbid	Age (Y)	N (%)
With comorbid	20-40	67(39.88%)
	41-60	88(52.38%)
	>60	13(7.73%)
Total		168(100%)

Table 3. Shows the distribution of comorbid diseases

Comorbid diseases	N (%)
Single	87(51.78%)
Double	63(37.5%)
Multiple	18(10.71%)
Total	168 (100%)

Table 4. Shows the distribution of the patients according to the type of comorbid diseases

Groups	N (%)
Blood hypertension	94 (55.95%)
diabetes mellitus	58 (34.52%)
Other diseases	54 (32.14%)
cardiovascular diseases	40 (23.80%)

predilection [14]. Oral lesions and systemic conditions showed a bidirectional relationship according to prior studies [15]. This means that managing oral problems could relieve the underlying systemic problems, and conversely, managing systemic problems may improve oral problems. Researchers perceived improvement in blood sugar levels, stroke, chronic kidney disease, with treatment of periodontal problems [16-17]. There are many dental complications result from undiagnosed or poorly managed comorbidities and medical conditions. Therefore, a preliminary diagnosis should be done for systemic problems for the patients presented for the first time to oral care dentist to make appropriate referrals. A literature review regarding the prevalence of CSD in patients requesting dental treatment in the Al Muthanna governorate revealed scarce publications. Consequently, this study intends to determine the distribution of comorbidities systemic diseases among patients attending the teaching dental clinic at Al Muthanna University/ Iraq.

AIM

To determine the prevalence of CSD and its relationship to gender, age, and number of missing teeth among patients.

MATERIALS AND METHODS

From October (2021) to May (2022), a review of 526 patient reports who requested oral and dental management was done. Patients' data, including age, gender, and number of missing teeth, were recorded according to WHO oral health survey basic methods guideline [18]. The number of teeth was taken as 28, excluding the third molars. History of systemic diseases (cardiovascular, diabetes mellitus, gastrointestinal, rheumatological, blood hypertension, liver and kidney disease, and others) were reported. The patients' ages were categorized into 20–40, 41–60, and 61 years and above.

INCLUSION CRITERIA

All patients' reports attending teaching dental clinic / surgery department / College of Dentistry/ AL Muthanna University, suffering from dental complaints during the year of the study, were included in this study.

EXCLUSION CRITERIA

Patients with ages less than 18 years and patients with incomplete reports were excluded from this study.

STUDY LIMITATIONS

The critical limitations were incomplete reviews, missing data, and inadequate patient reporting. Additionally, COVID-19 limited dental treatment at the time of the study preparation.

ETHICAL CONSIDERATIONS

Ethical principles were taken into consideration during the study. Names and medical history information remained confidential. This study was approved by the Research and Ethical Committee / College of Dentistry/ AL Muthaana University. All patients signed a consent form and agreement to be included in this study.

Table 5. Shows the number of missing teeth accompanied patients with comorbid diseases

Patients N&%		Number of Missing Teeth			P-value
		M =0	M (1-4)	M (5-10)	
Male	No&%	19 (11.30%)	47 (27.97%)	0.0%	0.027 Sig
Female		22 (13.09%)	80 (47.61%)	0.0%	
Total		41 (24.40%)	127 (75. 59%)	0.0%	

STATISTICAL METHOD

Statistical Package SPSS 16.0 was used as a student’s t-test. Test Fisher’s exact for variables gender, presence or absence of comorbid and teeth number.“p” value < 0.05 was considered significant statistically.

RESULTS

Five hundred twenty-six patients were involved in this study. According to gender, the numbers and percentages of males and females were 276 (52.47%) and 250 (47.1%), respectively. Out of 526 patients, 168 (31.939%) were reported having either one or more comorbid diseases, including 66 (39.28%) and 102 (60.71%) for males and females, respectively, with a highly significant (0.000) (Table 1). While the number of patients without comorbid disease was 358, comprising 210 (58.6%) and 148 (41.34%) for males and females, respectively.

Out of 168 patients, there were 67 (39.88%), 88 (52.38%) and 13(7.73%) for age groups 20-40, 41-60, and >60 years, respectively (Table 2).

Out of 168 patients with comorbid diseases or conditions, there were 87 (51.78%), 63(37.5%), and 18 (10.71%) for single, double, and multiple CSD, respectively (Table 3).

The distribution of comorbid diseases was 94 (55.95%), 58 (34.52%), 54 (32.14%), and 40 (23.80%) for blood hypertension, diabetes Mellitus, other diseases, and cardiovascular diseases (Table4).

Out of 168 patients with comorbid diseases, there were 41 (24.40%) revealed zero missing teeth, including 19 (11.30%) and 22 (13.09%) for males and females, respectively. Moreover, the total number of patients with 1-4 missing teeth was 127 (75. 59%), including 47 (27.97%) and 80 (47.61%) for males and females, respectively, with significant differences (P-value=0.027) (Table 5).

DISCUSSION

According to the statement of Seymour, (2007) “Good general health and quality of life are connected with good oral health”. The mouth is considered part of the body [19] and is a link between dentistry and medicine. The individual general health and diseases are integrat-

ed to reflect the oral health status and well – being. A previous study approved a significantly increasing number of periapical lesions, tooth loss, poor quality root canal treatment, and periapical index in patients with previous medical history. Researchers approved the higher significant percentages of poor oral index in patients suffering from anemia, diabetes mellitus, hypertension, prostate disease, and other disabilities, for example, mental retardation and hearing impairment [4]. The past medical patient history is vital to recognize patients complaining of dental or medical problems to ensure safety with appropriate and accurate protective methods. Dental and oral treatment is commonly safe for clinicians and patients when working under the umbrella of high and extensive knowledge related to medical status [20]. The current study emphasizes CSD in the patients requesting dental care and their relationship to gender, age, and missing teeth. Five hundred twenty-six patients were included in this study, comprising 276 (52.47%) and 250 (47.1%) male and female, respectively. Furthermore, 168 patients were reported with single or multiple CSD. For those patients with CSD, there was a highly significant (0.000) relationship to their gender, with a higher percentage (60.71%) in females compared to (39.28%) in males.

These results are compatible with previously published research, showing that females presented the higher severity of depressive symptoms measured by the Patient Health Questionnaire-9 (4.0±4.1 vs. 2.8±3.8; p<0.001) [21, 22]. Moreover, the high percentage of females may be related to hormonal disturbances that surprisingly strongly affect general and oral health status. Hence, hormonal disturbances may also be reflected in oral and periodontal tissues [23]. Various hormones, such as estrogen, progesterone, and androgen receptors, also affect the periodontal structure. Progesterone causes direct and robust effects on periodontium and also has a significant role in bone coupling tissue formation and reabsorption [24]. Thus, tooth mobility is sometimes associated with hormonal disturbances [25]. In contrast, some studies reported no significant differences in mobility and missing teeth with a woman’s hormonal changes milieu [26].

The present study showed an increase in the prevalence of CSD with aging. Most patients with CSD

88 (52.38%) were populated in the 41-60 years age group among patients suffering from certain medical complications, followed by the age group 20-40 year 67(39.88%). These results agree with other previous studies, which focused on the elderly systemic diseases and their implications on dental practice, such as cardiovascular diseases, diabetes mellitus, Alzheimer's disease and Parkinson's disease, osteoporosis, and oral cancer [27]. While other researchers reported the age distribution, and most patients were in the age group 41-50 years followed by 51-60 years [28]. These results are also compatible with observations reported by Chan *et al.* (2021) [29], who concluded a bidirectional relationship between oral and general health. Besides, they mentioned that rheumatoid arthritis, depression, Alzheimer's disease, Parkinson's disease, diabetes, hypertension, rheumatoid arthritis, and depression were the most prevalent diseases that occur with increasing of age, leading to raising the susceptibility of patients to oral diseases because of the side effects of medications [30].

The results of the current study reported high percentages of patients suffering from a single 87 (51.78%) and double 63(37.5%) CSD, compared with patients complaining the multiple diseases, whose occupied the least percentage 18 (10.71%). The results also showed variations in the distribution of these diseases, including 94 (55.95%), 58 (34.52%), 54 (32.14%), and 40 (23.80%) for blood hypertension, diabetes Mellitus, other diseases, and cardiovascular diseases. These results are compatible with a previously reported study in Saudi's Eastern Province [30]. They approved the positive relation between multiple CSD and severity of periodontal disease in relation to increased attachment loss, bone loss, and increased number of missing teeth [30].

Blood hypertension (BH) showed a higher percentage, 55.95%, among all reported CSD in the current study, because blood hypertension is one of the major systemic diseases reported in 1.28 billion adults aged 30-79 years worldwide [31]. Blood hypertension is a major risk susceptibility factor causing cardiovascular complications leading to death. A previous study approved that 1 out of 3 people over 45 years of age showed blood hypertension in Pakistan as recorded by a survey of Pakistan national health [32].

Out of 168 patients with CSD, there were 41 (24.40%) revealed zero missing teeth, including 19 (11.30%) and 22 (13.09%) for males and females, respectively. At the same time, the number of patients with 1-4 missing teeth was 127 (75. 59%), including 47 (27.97%), and 80 (47.61%) for males and females, respectively, with significant differences (P -value=0.027). The mean values of missing teeth of patients suffering from blood

hypertension were higher than other groups. These results may be explained the association between systemic diseases and oral health status, especially periodontitis, which shares common risk factors such as stress, increased age, and socioeconomic factors [33]. These observations are compatible with previous studies of another researcher, who approved the relationship between the number of missing teeth and the occurrence of chronic diseases, specifically myocardial infarction [34]. Furthermore, other previous findings approved the effects of antihypertensive therapy on the oral cavity, like mouth xerostomia, gingival tissue overgrowth, salivary gland swelling and pain, lichenized drugs sensitivity, alteration in taste sense [33, 35-36].

The current study also reported 58 (34.52%) patients with diabetes mellitus as CSD after blood hypertension. Recently, there has been an escalation in the prevalence of diabetes mellitus, commonly type 2, threatening the population, life quality, and economy, accompanied by a high incidence of the disease and its complications [37]. Uncontrolled diabetic patients lead to high caries experiences, periodontal tissue complications, and delayed wound healing related to surgical treatment and teeth mobility [38-39]. Accurate guidelines must be followed to provide oral care during diabetic patient management. The general medical status of patients requires certain modifications during dental and oral treatments [40]. A high percentage of missing teeth was recorded in diabetic patients. These results are compatible with previous studies that mentioned the initiation and progression of periodontal tissue complications due to diabetes mellitus. Moreover, periodontal tissue damage also occurs from a metabolic disorder associated with diabetes Mellitus resulting from long-duration illness as a risk factor that occurs as an extensive and severe irritants factor in the mouth. Likewise, Rajhans *et al.*, (2011) [41] found a significant correlation between glycemic level and teeth mobility, that reported in 43.7% of diabetic patients. However, other researchers reported a high prevalence of teeth mobility in type 2 Diabetes Mellitus compared to non-diabetic individuals [42]. They mentioned the reduction of bone tissue growth aspects with mineralization processing in the absence of insulin.

In conclusion, this study approved the relationship between the prevalence of CSD in patients requesting dental care. Blood hypertension, diabetes mellitus, other diseases, and cardiovascular system diseases were the commonly reported CSD with variations in their percentages of prevalence, and hypertension was at the top of the list. Understanding the association between systemic diseases and oral health will greatly assist dental healthcare providers in treating dental department patients safely and effectively.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Karima Akool AlSalihi

Al-Iraqia University

22 Hibat Katon st, district 308, 7366., Baghdad, Iraq

e-mail: kama18_akool@aliraqia.edu.iq

ORCID AND CONTRIBUTIONSHIP

Abdulkarem Abdulazeez Mouayd: 0009-0005-8491-4487 [A](#) [F](#)

Kumail Ihsan Abdullah: 0000-0001-7398-4475 [B](#) [F](#)

Riyam Abbass Ashour: 0009-0002-2589-3549 [B](#) [C](#) [F](#)

Al Salihi Karima Akool: 0000-0002-5698-2678 [C](#) [D](#) [E](#) [F](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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The analysis of the pharmaceutical market of vitamin remedies for hair, nails and skin in the Ukraine

Liliia O. Hala, Ivanna V. Sakhandia, Yaroslava D. Rafalska, Nataliia M. Sakhnatska, Tetiana P. Khomenkova, Svitlana I. Lekhnitska

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: The research of the range of vitamins for hair, nails and skin on the Ukrainian pharmaceutical market.

Materials and Methods: The market research of vitamins for hair, nails and skin in Ukraine covers an analysis of demand, main manufacturers, competitive environment and consumer preferences. The also observes the pricing trends, distribution channels, and the impact of economic factors on consumer demand. When performing the tasks of the work, the following methods were used: bibliographic, graphic, marketing research, analytical-comparative, mathematical, systematization and generalization.

Results: According to the results of a marketing analysis of the nomenclature of vitamin remedies for hair, nails and skin in domestic pharmacies, it was found that the specific gravity of medicines (drugs) is only 8.3%, and dietary supplements (DD) – 91.7%. Among the dosage forms are dominated capsules (50.8%) and tablets (46.7%). According to the results of the distribution of vitamin remedies producing take the lead such countries as the USA (37.5%), Ukraine (23.3%) and Germany (9.2%). An assessment of the level of physical and economic availability of vitamin remedies for hair, nails and skin for the population proves that these remedies are quite affordable – they are widely represented in the assortment of pharmacies throughout Ukraine, but differ significantly in price.

Conclusions: Based on the analysis of scientific publications was studied the influence of vitamins on the condition of the hair, nails and skin, was conducted a marketing study of the vitamin remedies on the Ukrainian pharmaceutical market, was analyzed the availability for consumers of vitamin remedies for hair, nails and skin.

KEY WORDS: marketing analysis, pharmaceutical market, vitamins, vitamin remedies, medicines, dietary supplements, dosage forms, availability, pharmacists, consumers, pharmaceutical establishments

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INTRODUCTION

Modern scientific research indicates that human beauty comes from within, and the skin appears as a general reflection of the overall health. The knowledge accumulated over the centuries about various biologically active substances and their role in the functioning of the body, in particular vitamins, highlights the necessity and expediency of their use not only as a nutritious dietary supplement to the diet, but also as components of care cosmetics [1, 2].

Vitamins are one of the most common biologically active substances, in addition to ensuring the normal functioning of the body, they support the health of hair, nails and skin. Today, scientists have substantial evidence regarding the prospects of oral use of vitamins both fat-soluble (A, D, E) and water-soluble (B2, B6, B12 and C), particularly in dermatology, including the treatment of psoriasis to reduce potential side effects from systematic use of medications [3, 4].

Vitamins are low-molecular organic compounds with high biological activity, consisting of carbon, oxygen, hydrogen, sulfur, nitrogen, phosphorus and other chemical elements. Compared to macronutrients (proteins, fats, carbohydrates), which are a source of energy or structural material, vitamins act as specific regulators of physiological and metabolic processes in the body, as a result of the balanced work of all organs and systems. The high biological activity of vitamins lies in their participation in the formation of enzyme systems – the so-called coenzymes. Coenzymes are low molecular weight non-protein substances that form a complex with the protein part of enzymes and directly provide chemical reactions that are catalyzed by the corresponding enzyme [5, 6].

Depending on the severity of vitamin deficiency, scientists distinguish three forms of vitamin deficiency: avitaminosis, hypovitaminosis and subnormal vitamin supply. "Avitaminosis" is understood as a pathological condition

of the body, characterized by almost complete depletion of vitamin resources and accompanied by a complex of symptoms characteristic and / or specific to the deficiency of a particular vitamin. Hypovitaminosis is a state of a significant (but not complete) decrease in vitamin reserves in the body, which leads mainly to the appearance of few specific or mildly expressed symptoms, which are considered common for different types of hypovitaminosis (reduced work capacity, loss of appetite, fatigue, etc.). Subnormal vitamin supply represents a preclinical stage of vitamin deficiency and usually manifests as metabolic and physiological disfunction involving a specific vitamin and individual specific microsymptoms. The combination deficiencies of several vitamin is referred as polyhypovitaminosis [7].

The importance of vitamins is essential for maintaining the normal condition of the skin, the key functions of which in the body are to form a barrier between the external environment and the human body, maintain water-electrolyte balance and thermoregulation, protect against pathogens and physical factors, ensure the elimination of substances, etc. Among the common dermatological problems is the skin aging which occurs according to the natural processes over time and external environmental factors (UV radiation, environmental pollution). The skin aging process is characterized by the appearance of wrinkles, pigmentation, dryness, loss of elasticity, color changes, slower regeneration and healing due to insufficient blood supply and nutrition of the skin. However, the additional intake of essential nutrients, including various vitamins, can potentially support the biological processes occurring in young, mature and aging skin [8, 9].

A common problem among both women and men is slight hair loss associated with an insufficient content of vitamins and minerals in the diet of a modern people essential for the normal development of hair follicles. A pharmacy specialist needs knowledge to identify specific micronutrients necessary to prevent hair loss in seeking advice customers. According to the results of the analysis of scientific researches was confirmed the positive effect of vitamins on the growth, regenerative processes of hair, nails and skin and their strength such group as B vitamins (in particular biotin B7 or H), C, A, D, E. At the same time, a balanced diet allows you to provide the daily requirement for these vitamins, but their activity can be affected by the simultaneous intake of medications, a factor that health care professionals should also consider [10, 11].

AIM

The aim of the study is to analyze the range of vitamins for hair, nails and skin on the Ukrainian pharmaceutical market.

MATERIALS AND METHODS

In the course of the study, the following materials were used: data from scientific sources on the research topic; nomenclature of vitamins for hair, nails and skin in the Ukrainian pharmacies; information from the State Register of Medicines of Ukraine regarding the registration status of medicines; data of the aggregator website <https://tabletki.ua> [12, 13].

The following methods were used to accomplish the research tasks: bibliographic and analytical (for studying scientific sources on the research topic peculiarly the effects of vitamins on the body and the consequences of their insufficiency for human health); graphic (for visual representation and schematic illustration of the research findings); marketing research (for evaluating the range of vitamins for hair, skin and nails on the pharmaceutical market, their availability to the consumers); analytical and comparative (for analyzing the nomenclature of vitamins for hair, skin and nails according to various criteria, identifying common and distinctive characteristics); mathematical (for data grouping and analysis to process the obtained results) and systematization and generalization (for summing up the results of the study, forming conclusions and preparing recommendations).

To calculate the level of availability of vitamin remedies for hair, nails and skin for the population, were used the approaches of the World Health Organization (WHO) and the Health Action International (HAI). Physical accessibility is considered to be a share of pharmacies that have a specific medicine (M) or dietary supplement (DS) available on the date of the study. Thus, according to the criteria for assessing availability, scientists have formed the following ranges, mainly a high availability (M or DS are available in more than 80% of pharmacies), quite high (50-80%), low (30-49%) and very low (less than 30% of pharmacies). It is generally accepted regarding the assessment of economic accessibility, that a M or DS is affordable for the consumer or, in other words, has a "moderate cost", if the daily minimum wage is higher than the total cost of treatment (for example, the cost of a monthly course of prevention) and the daily subsistence minimum (according to the WHO – the national poverty line). If the indicator of the additional daily wage rate (ADWR) does not exceed "1", it is considered that a person does not need additional funds for the purchase the medicine (additional daily wage rates) [14, 15]. The calculation was carried out using the following formula:

The calculations were carried out using the information of the Law of Ukraine "On the State Budget of Ukraine for 2024". Starting from April 1, 2024, the minimum wage in Ukraine is UAH 8000, and the subsistence minimum for the working-age category of population is UAH 3028.

Table 1. Characteristics of biotin monosubstances available in pharmacies

Dosage	Number of items	Country of origin	Supplier Company
<i>Medicines (dispensing without prescription) (10 items)</i>			
2.5 mg	1	Germany (1)	mibe GmbH Pharmaceuticals
		Ukraine (1)	Kyiv Vitamin Plant, JSC
5 mg	7	Ukraine (1)	Kusum Pharm
		Poland (2)	Polpharma S.A., FZ
		Germany (1)	mibe GmbH Pharmaceuticals
		Germany (2)	Dr.Gustav Klein GmbH & Co.KG.
10 mg	2	Ukraine (1)	Kyiv Vitamin Plant, JSC
		Germany (1)	Alpen Pharma AG
<i>Dietary supplements (43 items)</i>			
0.15 mg	3	Ukraine (2)	Farmakom, PTF, TOV
		India (1)	Biodeal Pharmaceuticals Private Limited
0.3 mg	4	Ukraine (2)	Marina, PP
		Ukraine (1)	Interchem, ALC
		United States (1)	Solgar, Inc.
0.8 mg	1	United States (1)	21st Century Health Care Inc.
1 mg	4	United States (1)	Solgar, Inc.
		United States (1)	Natrol LLC
		United States (1)	Now Foods
		United States (1)	Country Life LLC
2.5 mg	2	Ukraine (2)	Beauty ta Zdorov'ya, TOV
5 mg	19	Ukraine (1)	Golden-Pharma, TOV
		Ukraine (4)	Marina, PP
		United States (1)	Carlson Labs
		Ukraine (4)	Beauty ta Zdorov'ya, TOV
		United States (2)	Natrol LLC
		United States (3)	Now Foods
		United States (1)	Solaray
		United States (1)	Swanson Health Products
		United States (1)	Country Life LLC
		Slovak Republic (1)	Innopharma s.r.o.
7.5 mg	2	United States (2)	Puritan's Pride
8 mg	1	United States (1)	Thorne Research, Inc.
10 mg	7	United States (1)	Solgar, Inc.
		Ukraine (1)	Marina, PP
		United States (1)	Healthy Origins
		United States (1)	Natrol LLC
		United States (1)	Now Foods
		United States (2)	Puritan's Pride

RESULTS

According to the aggregator site <https://tabletki.ua>, 120 products from the group "Vitamins for hair, nails and skin" were selected for marketing analysis according to the selected criteria, among which, according to the anatomical-therapeutic-chemical (ATC) classification,

only 10 drugs (8.3%) were found (ATC code A11H A05 Vitamins. Other vitamin preparations. Biotin), and the rest (91.7%) of the total amount of vitamins of the selected group are DS.

In Table. 1 presents the characteristics of group 1 – biotin monosubstances, based on content of the

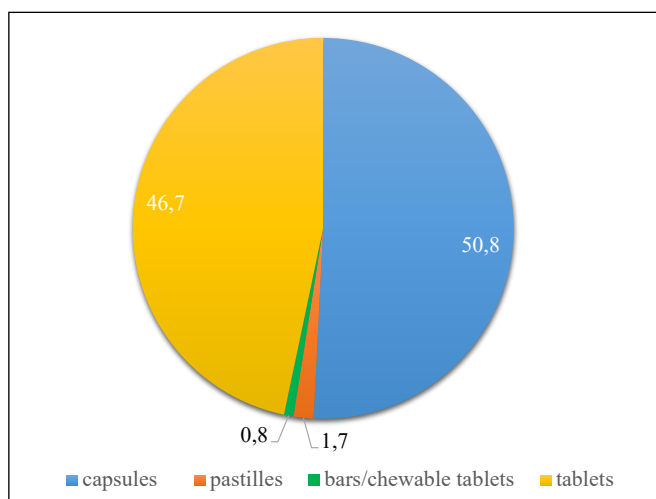


Fig. 1. The share of different dosage forms to the total number of vitamin remedies of the selected group (%)

active ingredient and the manufacturing countries. The dosage of vitamin H in the medicine per dose is in the ranges from 2.5 mg to 10 mg, whereas of DS, the dosage is more varied and ranges from 0.3 mg to 10 mg. Biotin DS are recommended to be taken once daily, sometimes twice daily, with the total daily dose not exceeding 10 mg.

Group 2 – vitamins (including biotin of 2.5 mg and above) in combination with minerals, that in addition to other vitamins (C, B1, B2, B3, B6, B9, B12, choline, pantothenic acid, lipoic acid, A, E), includes biotin in a dosage ranging from 2.5 mg to 15 mg and minerals (calcium, phosphorus, iron, zinc, selenium, silicon, copper, iodine).

Group 3 – vitamins in combination with minerals and LRS – this is DD, which, in addition to vitamins (C, B1, B2, B3, B5, B6, B9, B12, H, pantothenic acid, A, D, E) and minerals (calcium, iron, zinc, selenium, copper, iodine), there are medicinal plant raw materials (MPR), for example, such as milk thistle (fruit extract), Lady's bedstraw (dry extract of roots and stems), Turmeric (standardized dry rhizome extract), Ginger root extract, Nettle leaf extract, Marigold flower extract, Bamboo extract, Grape seed extract, horsetail, Burdock root extract, Chamomile flower extract, Millet seed extract, Aloe vera leaf powder, Green tea leaf extract.

Group 4 – vitamins in combination with minerals are DS that contain vitamins (B1, B2, B3, B5, B6, B8, B9, B12, C, H, choline, A, D, E) and minerals (calcium, iron, magnesium, manganese, silicon, potassium, phosphorus, molybdenum, zinc, selenium, copper, chromium, iodine).

According to the results of the distribution of vitamins for hair, skin and nails by dosage forms presented in pharmacies, it was found that capsules (50.8%) and tablets (46.7%) dominate. The share of pastilles and

chewable tablets is significantly lower, almost negligible. All 10 biotin remedies are presented in the form of tablets. The results of the analysis by dosage forms are shown in Fig. 1.

Based on the results of the distribution of vitamin remedies for hair, nails and skin by producing countries, the following was found: the leaders the USA (37.5%), Ukraine (23.3%) and Germany (9.2%). The share of other producing countries does not exceed 5.0% of the total number of trade names represented. Among the US manufacturers, it should be noted: Puritan's Pride, Now Foods, 21st Century Health Care Inc Solgar, Inc., Country Life LLC, Natrol LLC, for Ukraine – JSC "Kyiv Vitamin Plant", LLC "Beauty and Health", PE "Marina", PE "Euro Plus", for Germany – Queisser Pharma GmbH & Co. KG., Dr. Gustav Klein GmbH & Co. KG., mibe GmbH Arzneimittel, Orthomol pharmazeutische Vertriebs GmbH (Fig. 2).

Table 2 presents the results of the evaluation of the physical availability of medicines (DS) selected for the study group of vitamin remedies in pharmacies in Kyiv. It can be stated that one-third of the vitamin remedies for hair, nails and skin available on the pharmaceutical market have a high and quite high availability, which, in our opinion, is a result of the high demand for these trade names.

The results of the evaluation of the availability of vitamin remedies for hair, nails and skin indicate a sufficient level of the physical availability for the population, however, the economic availability of remedies of the selected group ($ADWR < 1$) varies significantly by price criterion. Most vitamin remedies with $ADWR < 1$ belong to the group of biotin monocomponent remedies which are somewhat more expensive compared to DS. The cost of combined vitamin remedies per one-month treatment course is generally much higher.

All DSs, differ from medicines, are allowed to be dispensed to consumers from pharmacies without a doctor's prescription, in compliance with the general requirements in case of their advertising in accordance with the Law of Ukraine No. 270/96-VR of 03.07.1996 "On Advertising". Thus, it is forbidden to refer to the medicinal properties of DSs. At the same time, due to the oversaturation of the DS market, the unresolved issue of ensuring their quality and safety in the legal field today, regulation of this segment of the "pharmacy basket", increases the responsibility of pharmacists in the sale of vitamin products of the selected group. According to official dietary recommendations (Food and Nutrition Board (USA)) – experts advise obtaining vitamins from food rather than from DS. Most of the population consumes vitamin remedies (medicines or DS) to eliminate or prevent their deficiency. It is

Table 2. Distribution of vitamins for hair, skin and nails by the level of physical availability in pharmacies in Kyiv

Category of remedies (DS) by level of availability	Share of, %
- high (over 80%)	5,0
- quite high (50-80%)	32,5
- low (30-49%)	8,3
- very low (in less than 30%)	54,2
Total	100,0

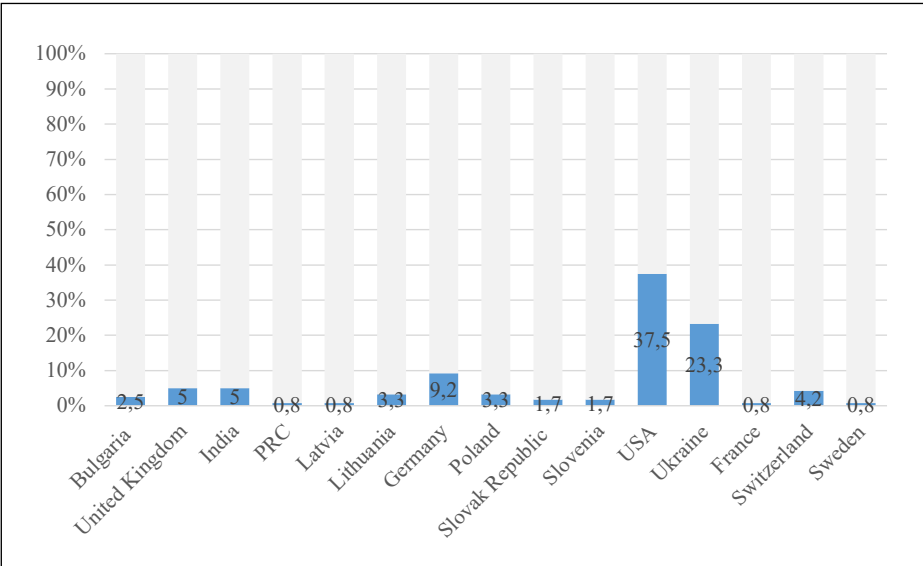


Fig. 2. The share of producing countries in the total number of vitamin remedies (%)

important to know that the use of specific vitamins at specified times of the day can reduce the risk of side effects. Depending on the type of vitamin, taking DS with food can increase its absorption by the body and, as a result, improve its overall health effects. However the results of scientific studies do not support any recommendations for taking vitamins at a specified time, although certain practical advice exists.

DISCUSSION

Under the influence of environmental factors, the Ukrainian pharmaceutical market develops unpredictably, but dynamically. It should be noted that the DS segment is characterized by much higher growth rate of pharmacy sales than for other categories of the “pharmacy basket”. This fact indicates the continuation of a long-term trend in Ukraine, as well as globally, toward the increasing share of DS in the overall structure of the pharmaceutical market. At the end of 2023, the share of DS was 10.4% in monetary terms and 8% in physical volume. While, the volume of pharmacy sales of DS in 2022 decreased by 9.6% compared to 2021, but at the end of 2023, compared to 2022, it increased significantly (by 63.6%), substantially surpassing the indicators of 2021 [16].

According to the research results of Polish scientists, on the market of remedies affecting the condition of

hair, nails and skin, a significant share belongs to the group of combined DSs (77%). The most common ingredients are biotin, vitamin C, vitamin PP (niacin) and trace elements (copper, zinc) [17].

According to the WHO Report “Assessment of the Affordable Medicines Program in Ukraine”, published in 2019, Ukraine’s healthcare expenditures have been low for many years. For example, in 2015, the share of health expenditure in gross domestic product (GDP) was 2.9%, and in 2020 increased to 3.4%, but comparing to the European Region is insignificant, because the average expenditure in Europe is 5.0% of GDP. Thus, the low level of state funding shifts the main share of health care expenses to patients [18, 19].

It should be remembered that according to the requirements of the legislation of Ukraine, DS is not a medicine, therefore can be used only for the purpose of prevention to normalize certain functions of the human body. This problem is also analyzed by scientists from the United States due to the growing popularity of DS for hair, nails and skin among the population and at the same time the lack of regulatory supervision in the country, the absence of a centralized database, due to the possible risks of interaction during their use, the lack of warning labels and the risk of “overdose” of nutrients. Therefore, it is extremely important for doctors and pharmacists draw patients’ attention to potential risks [20, 21].

CONCLUSIONS

According to the scientific literature was studied the effect of water- and fat-soluble vitamins on the health of hair, skin and nails, including the consequences of vitamin deficiency and data on the prospects for the use of vitamins in dermatology.

Using marketing analysis, 120 vitamin remedies for hair, nails and skin were studied, including 10 medicines and 110 DS. The selected remedies were divided into four groups according to the active ingredients content: biotin monosubstances (53 items), vitamins (including biotin at a dose of 2.5 mg or more) in combination with minerals (16 items), vitamins in combination with miner-

als and MPR (10 items) and vitamins in combination with minerals (41 items). Among the studied vitamin remedies for hair, nails and skin 23.3% were of Ukrainian producing and 76.7% – of foreign producing. Among the dosage forms capsules (50.8%) and tablets (46.7%) dominated.

It was found that among the vitamin remedies for hair, nails and skin available in pharmacies, 5.0% have a high level of physical accessibility, 32.5% have a quit high level, 8.3% have a low level, and 54.2% have a very low level. According to the WHO methodology, the ADWR index does not exceed “1” for only 24.2% of selected vitamin remedies, while purchasing most of them requires to spend two or more daily minimum wages.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Ivanna V. Sakhandia

Bogomolets National Medical University, Kyiv, Ukraine

13 Shevchenko Boulevard, 01601 Kyiv, Ukraine

e-mail: sahanda.ivanna@gmail.com

ORCID AND CONTRIBUTIONSHIP

Liliia O. Hala: 0000-0002-0086-2706     

Ivanna V. Sakhandia: 0000-0003-4171-5160   

Yaroslava D. Rafalska: 0000-0002-1047-3114   

Nataliia M. Sakhnatska: 0000-0003-4693-4717   

Svitlana I. Lekhnitska: 0000-0002-9178-7069   

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Effect of Sitagliptin on Micro150-5p in patients with T2DM with left ventricular diastolic dysfunction

Aswer J Abdulkadhium, Bassim I Mohammad

DEPARTMENT OF PHARMACOLOGY AND THERAPEUTICS, COLLEGE OF MEDICINE, UNIVERSITY OF AL-QADISIYAH, AL-QADISIYAH, IRAQ

ABSTRACT

Aim: To clarify Sitagliptin effect on left ventricular diastolic dysfunction in T2DM, to investigate the potential effect of Sitagliptin on epigenetic modulation (Micro RNA150-5P) and inflammatory process.

Materials and Methods: This study was carried out at a single center and is cross-sectional, descriptive, and observational. A specialist cardiologist selected a cohort of sixty individuals who had both left ventricular diastolic failure and type 2 diabetes mellitus (T2DM). The study was carried out at AL-Diwaniyah teaching hospital and the department of pharmacology and therapeutics, school of medicine, university of Al-Qadisiyah, Iraq. Total RNA was isolated using Trizol reagent (Genaid, Korea) and the concentration of RNA was determined. The primer amplification was performed according to the instructions published by AddBio (Korea) for the AddScript RT-qPCR Syber master kit. Transthoracic echocardiography measuring were patients at rest utilizing a commercially accessible ultrasound machine (Vinnu E20; Echo Ultrasound AS, china). Ultrasound imaging acquisitions were automatically saved from at least three following cardiac contractions for subsequent processing. Standard parameters (LVED, LVES, and LVEF) were acquired as previously explained.

Results: Our results indicate a significant down regulation of miR-150-5p in the Sitagliptin treated group ($P < 0.0001$) in comparison with metformin treatment. This was analyzed by Graph pad prizm software (version 8.4.3).

Conclusions: The results of our study indicate that the expression of miR-150-5p is dramatically reduced in the cardiac tissue of individuals with diabetes. Furthermore, reducing the levels of miR-150-5p is linked to an enhancement in the functioning of the left ventricle, partially via reducing the occurrence of programmed cell death in heart muscle cells. Hence, suppressing the activity of miR-150-5p could be a new and effective approach for treating cardiac dysfunction associated with diabetes.

KEY WORDS: Type 2 diabetic mellitus, Left ventricular diastolic dysfunction, MicroRNA, miR-150-5p, Sitagliptin

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INTRODUCTION

About 40% of people with diabetes have diastolic dysfunction, which is linked to insufficient glycemic control. MicroRNAs are a type of small molecules that are approximately twenty two nucleotides long, single-stranded, and have been conserved throughout evolution. MicroRNA modulates gene expression irrespective of alterations in the DNA genome sequence. Increased cardiac expression of miR-150 can potentially prevent ventricular fibrosis and hypertrophy via modulating transcription factor c-Myb and serum response factor. The reduction in the expression of miR-150 in the circulation is associated with left ventricular hypertrophy and ruptures. Non-insulin-dependent diabetes mellitus, often known as adult-onset diabetes, is a metabolic condition characterized by elevated blood glucose levels and reduced insulin sensitivity. This illness is linked to several cardiovascular risk factors, such as dyslipidemia, hypertension, and obesity. Formerly known as type 2

diabetes mellitus (T2DM) [1]. The Middle East has a significant occurrence of type T2DM in men, with Bahrain having a prevalence of about 33%, Saudi Arabia with 29 %, the United Arab Emirates was 25% [2] and Iraq with 13% [3]. Left ventricular diastolic dysfunction (LVDD) is a preclinical state characterized by the left ventricle's inability to adequately fill with blood during relaxation (diastole) at an appropriate pressure. In order to delay or prevent the development of heart failure in people with type 2 diabetes, it is essential to identify the risk factors for LVDD and an early stage of diabetic cardiomyopathy. This is important because this condition is highly prevalent and is associated with significant morbidity and mortality [4] 22 women, mean age 63.7 ± 9.1 years. Metabolic syndrome (MetS) is a group of common cardiovascular risk factors, together with other systemic illnesses that have an inflammatory base, such as chronic obstructive pulmonary disease (COPD), atrial fibrillation (AF), and anemia [5]. Diastolic dysfunction is observed in 40% of

patients with diabetes and is linked to insufficient glycemic control. Investigators typically consider LVDD as the primary sign of cardiac remodeling in persons with diabetes mellitus (DM). LVDD primarily involves impaired relaxation and increased stiffness of the left ventricle. These abnormalities are likely caused by alterations in the quantity or quality of calcium regulatory proteins and the extracellular matrix [6]. T2DM negatively affects important functions, including viability, protective mechanisms against oxidative stress, and secretory capacity. This suggests that T2DM disrupts glucose regulation and insulin sensitivity by reducing the expression of non-coding RNAs (ncRNAs) and promoting apoptosis [7]. MicroRNAs are a type of small molecules that are approximately 22 nucleotides long. They are single-stranded and have been conserved throughout evolution. MicroRNA modulates gene expression irrespective of alterations in the DNA genome sequence. Cardiac miRNAs are recently discovered regulators of gene expression in the heart that have a substantial impact on modulating both transcriptional and post-transcriptional processes in diabetic cardiomyopathy and heart failure. The ability of miR-150 to regulate monocyte accumulation was shown to play a cardioprotective function in a murine model of acute myocardial infarction [8]. Further studies have shown that the heightened production of miR-150 in the heart can hinder the enlargement of cardiac muscle cells and the formation of scar tissue by regulating the function of serum response factor and transcription factor c-Myb. The reduction in the concentration of miR-150 in the bloodstream is linked to the enlargement and bursting of the left ventricle, miR-150 plays a role in left ventricular remodeling (LVR) by suppressing the expression of its target genes, including C-reactive protein and adrenergic receptor beta 1 [9]. The abundant presence of dipeptidyl peptidase-4 in the blood vessels, heart muscle, and immune cells claims that this protein may have an impact on cardiovascular function [10]. Sitagliptin is a drug that specifically blocks the activity of an enzyme called dipeptidyl peptidase-4 (DPP-4). This enzyme breaks down two hormones called glucagon-like peptide-1 and glucose-dependent Insulinotropic polypeptide. By inhibiting DPP-4, Sitagliptin increases the amount of these hormones in the body. This leads to an increase in insulin secretion from the pancreas in response to glucose, and a decrease in the production of glucose by the liver. Sitagliptin enhances inflammation, collagen metabolism, lipid content, myocardial apoptosis (RIP3 expression), and cardiac function in diabetic rats. This facilitates the identification of supplementary benefits of Sitagliptin that extend beyond its capacity to reduce blood glucose levels [11]. DPP-4 is also found as CD26 on the surfaces of many cells, such as leukocytes, where it

acts as an inflammatory mediator. If DPP-4 and CD26 are really proinflammatory, their inhibitors, like as Sitagliptin, have the potential to be anti-inflammatory and potentially antiatherogenic. This is because atherosclerosis is a persistent inflammation of the artery wall [12].

AIM

To clarify Sitagliptin effect on left ventricular diastolic dysfunction in T2DM, to investigate the potential effect of Sitagliptin on epigenetic modulation (Micro RNA150-5P) and inflammatory process.

MATERIALS AND METHODS

This study is an observational cross-sectional descriptive study conducted at a single center. It focuses on patients with type 2 diabetes mellitus that are of Iraqi nationality. The physician, who specializes in cardiology, diagnosed and selected all potential patients. The study was carried out at Al-Diwaniyah teaching hospital and the Department of Pharmacology and Therapeutics, Medicine College, Al-Qadisiyah University, Iraq.

SUBJECTS

Sixty adults were enrolled in this study (25 male and 36 female) aged 20-75 years old. Patients with HbA1c, renal or hepatic impairment, ejection fraction less than 50%, pregnancy, heart failure <50% ejection fraction, obesity (BMI ≥ 30) and psychiatric patient were considered as exclusion criteria. Information was taken from the patients: Name, age, gender, Weight, height, BMI, and comorbidities smoker.

DRUG USED IN THE STUDY

All patients included in the study were taking oral tablet 1000mg Metformin twice daily (30 patient) and oral tablet sitagliptin 50 mg plus 1000mg Metformin twice daily (30 patients).

ETHICAL APPROVAL

The study was confirmed by the Ethics Committee of the College of Medicine, University of Al-Qadisiyah, Iraq, (letter 30/3042) on July 27th, 2024. All patients were given a thorough explanation of the treatments and their agreement was obtained before any work was done. All patients will be informed verbally about the procedure, and the purpose of the study, before enrolling in the study, all participants will provide their written informed consent.

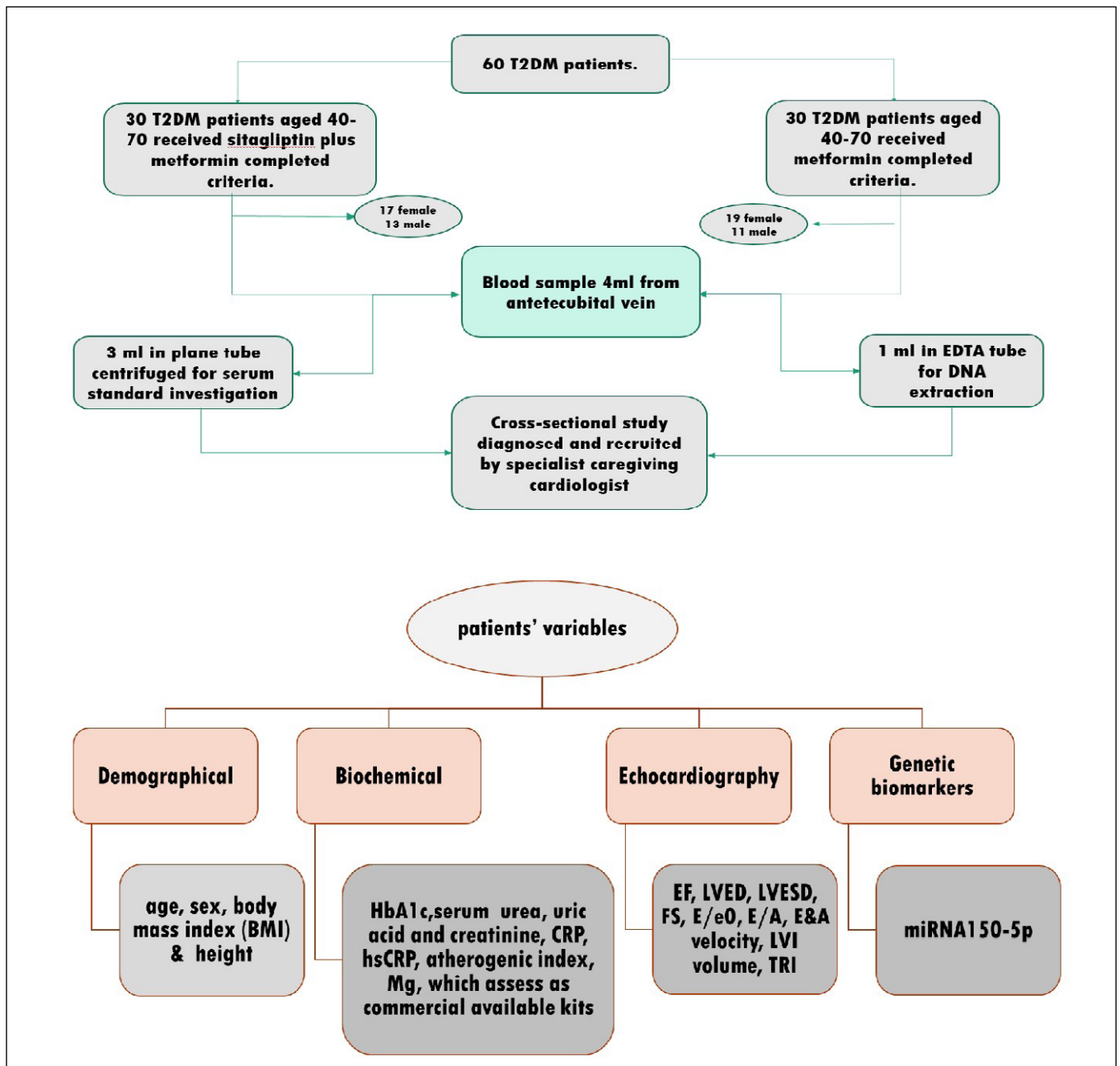


Fig. 1. All patients' variables workup at baseline were collected and assessed for echocardiography and biomarkers

BLOOD SAMPLE

The blood samples with 4 ml were collected from the patients that were aspirated from antecubital vein. Each sample was divide into two divisions, the first one was 1 ml blood was placed in 1 ml EDTA tube and refrigerated at a temperature of -20C until the time of RNA extraction. The second division was 3 ml blood in plane tube was centrifuged to extract serum for measuring (atherogenic index, blood urea, serum creatinine, uric acid, RBS, Magnesium). All patients' variables workup at baseline were collected and assessed for echocardiography, demographical and genetic biomarkers (Fig. 1).

DIASTOLIC FUNCTIONAL ELEMENTS

We measured the left atrial volume using the apical four-chamber view and the area-length approach, adjusted according to the individual's body surface area. The parameters measured for mitral inflow velocities using pulsed Doppler include the E velocity (m/s), Apex and length of A velocity, and E-wave deceleration time. The parameters measured mitral annular diastolic velocity (e0 and E/e0 ratio) using Doppler tissue imaging in pulsed waves. The E/e0 ratio split by SV was utilized as a proxy for LV diastolic stiffness and Tricuspid regurgitation velocity [13]. Fig. 2. demonstrate three parameter to measure mitral inflow and assessing left ventricular filling pressures and

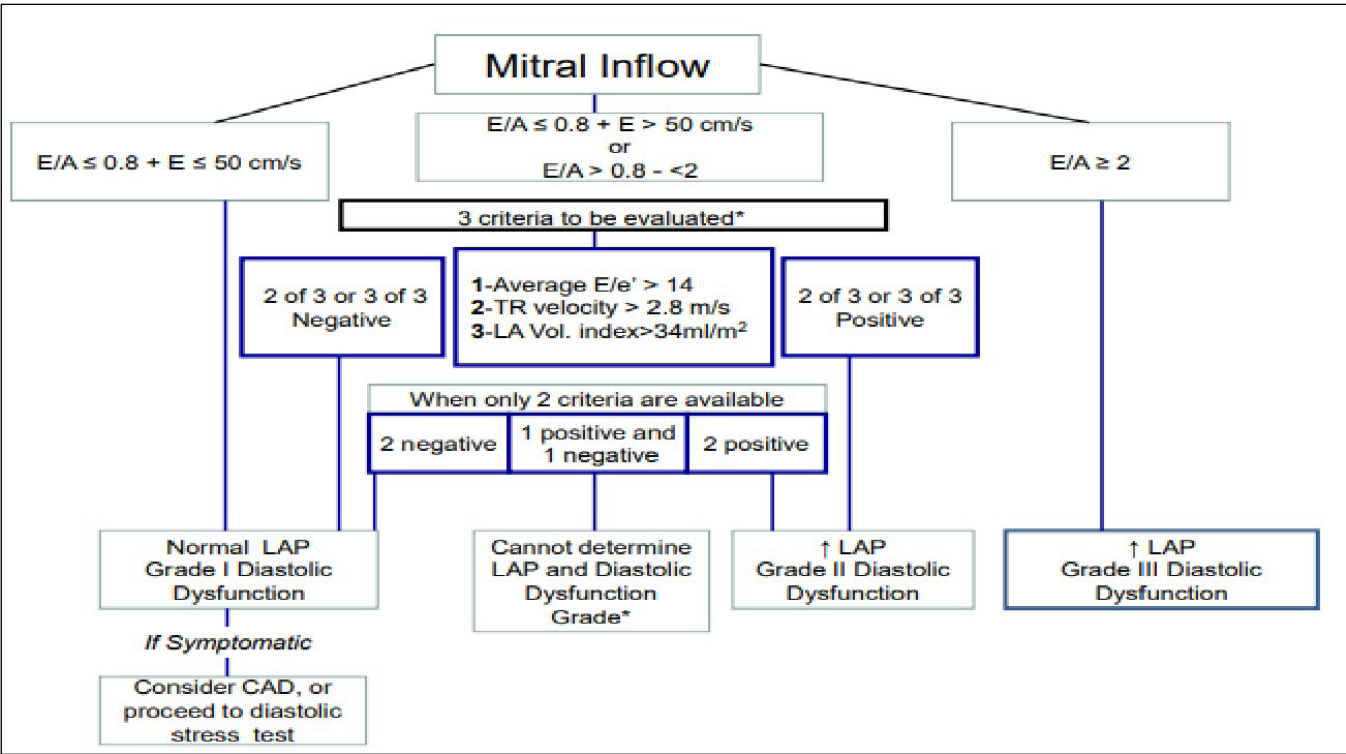


Fig. 2. Algorithm for assessing left ventricular filling pressures and grading left ventricular diastolic performance in patients with reduced left ventricular ejection fractions and patients with myocardial disease and normal left ventricular ejection fractions, taking into account clinical and other two-dimensional data

grading left ventricular diastolic performance in patients with reduced and normal left ventricular ejection fractions and patients with myocardial disease.

RNA EXTRACTION BY BLOOD SAMPLES WERE COLLECTED FROM ANTECUBITAL VEIN

QUANTITATIVE REVERSE TRANSCRIPTION REAL-TIME PCR (RT-QPCR)

Genomic RNA was extracted from blood samples using an RNA extraction kit from Genaid, Korea. The concentration of RNA was measured using a Quantus™ Fluorometer from Promega, USA. Subsequently, cDNA synthesis was performed using a cDNA synthesis kit from ADDBio, Korea.

GENE EXPRESSION OF MIR-150-5P

This study utilized the comparative Ct technique (ΔΔCt) to compare transcript levels of the target gene to the reference gene GAPDH mRNA. The normalization was done relative to the control group. This was achieved following the recommendation outlined in reference [13]. In order to accomplish this goal, the miR-150-5p gene was amplified utilizing the primers supplied by [14].

Gene of Interest (**miR-150-5p**) is: miR-150-5p-Forward: TCAATGCCCTGTCTCCCAAC
MiR-150-5p-Reverse: TTCCAAGTCCCTATCCCC
Housekeeping gene (**HKG**) or internal reference gene; human Glyceraldehyde 3-phosphate dehydrogenase is: GAPDH-F: CAGAACATCATCCCTGCCTCTA
GAPDH-R: CCAGTGAGCTTCCCGTTCA
QUANTITATIVE REVERSE TRANSCRIPTASE PCR (RT-QPCR) PREPARATION

RT-qPCR amplification: Initially, the amplification was accomplished using the AddScript RT-qPCR Syber master (AddBio, Korea). The heat conditions were conducted using BioRAD (USA).

RT-qPCR data normalization: was performed using the delta-delta Ct method, as described by [15]. This method involved normalizing transcript levels to those of GAPDH mRNA using the following formula:

$$2^{-\Delta\Delta C_t} = \frac{[(C_t \text{ gene of interest} - C_t \text{ internal control}) \text{ sample A} - (C_t \text{ gene of interest} - C_t \text{ internal control}) \text{ sample B}]}{}$$

Note: Sample A refers to a specific group. Sample B refers to a distinct and specific group.

STATISTICAL ANALYSIS

Statistical analyses were performed by SPSS version (29) for biochemical assessment were calculated. P value <0.05 was considered statistically significant. The data were shown as ± SE of mean. t-test for Equality of Means are

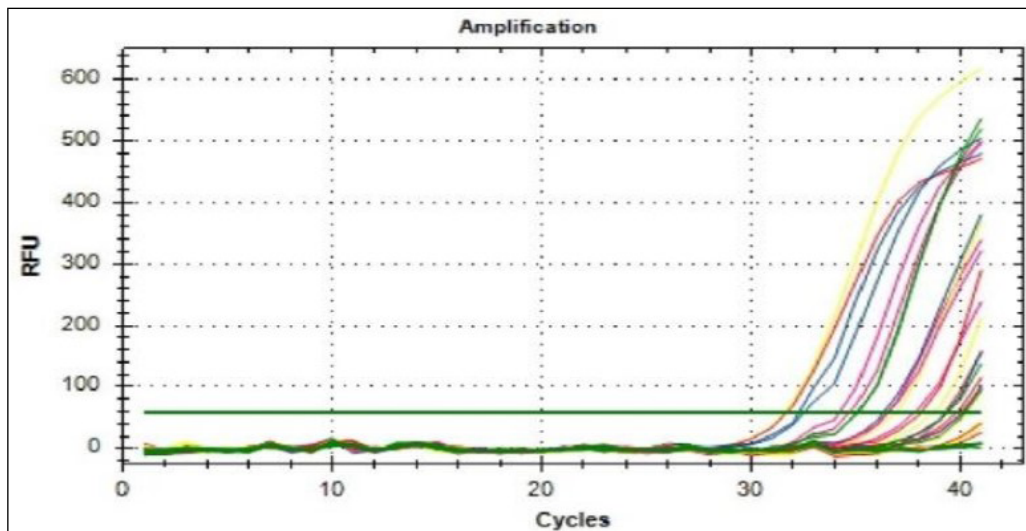


Fig. 3. The amplification curve of the tested samples was analyzed to determine the expression of the gene of interest (miR-150-5p) in the Metformin group

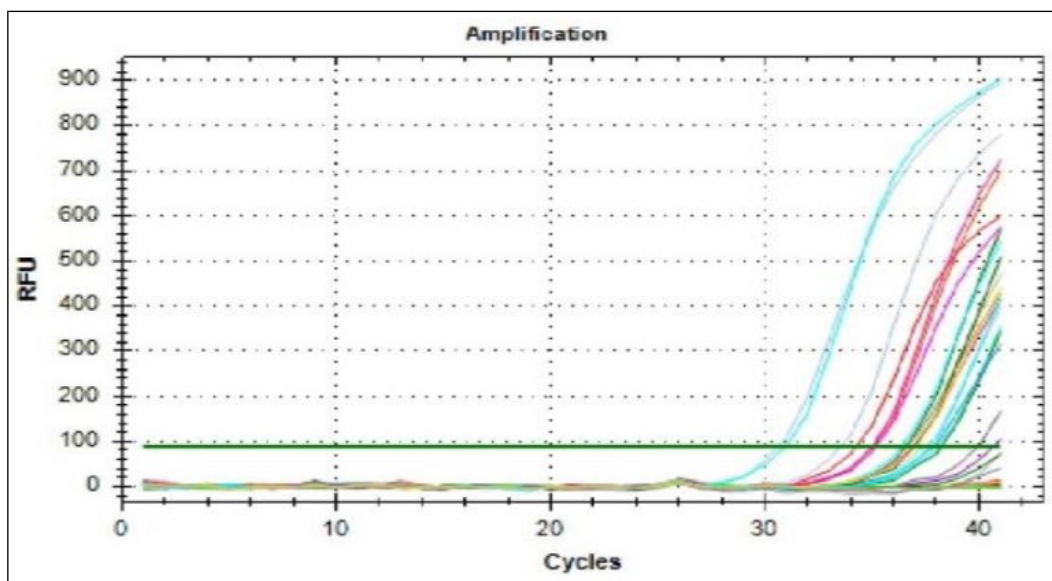


Fig. 4. The graph showing the increase in magnitude of the tested samples showing the expression of the gene of interest (miR-150-5p) in the Sitagliptin group

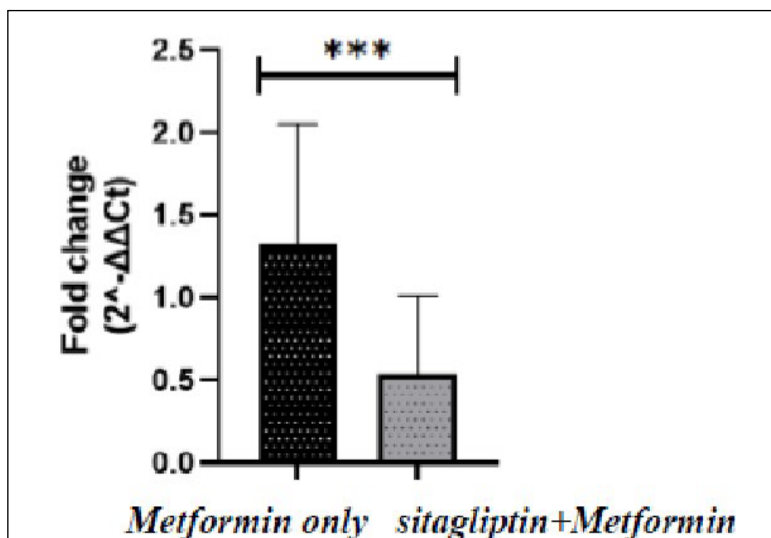


Fig. 5. Graphical represented the differences between concentration of miR-150-5p gene in the group treated with Sitagliptin plus metformin and concentration of miR-150-5p gene in the metformin group

Table 1. Values of Echocardiographic parameter of recruited diabetics patients (n = 60)

Characteristic	LVEDV(ml)	LVESV(ml)	EF (%)	FS (%)
Metformin				
Mean	124.1360	47.63	61.9550	33.5960
Std. Error Mean	6.36829	3.326	0.88655	0.62250
Sitagliptin+ Metformin				
Mean	122.9200	50.04	64.3004	35.4771
Std. Error Mean	6.47052	3.837	0.93989	0.68989
P value	0.465	0.255	0.010	0.009

Table 2. Value of LVDD grades for recruited diabetic patients (n=60)

Drug	Grade 2	Grade 1	Normal	Mean Rank	p-value
Metformin	27	3	–	21.71	0.001
Sitagliptin/metformin	9	19	2	40.60	

Table 3. Comparison of Micro RNA 150-5P mean and Std. Error of Mean in diabetic's patient

Characteristic	Mean	Std. Error of Mean	P value
Micro RNA 150-5P			
Metformin	1.320	0.1333	<0.0001
Sitagliptin + Metformin	0.5367	0.08638	

used. For genotyping frequencies, statistical analysis was performed with Graph Pad Prism software (version 8.4.3).

RESULTS

ECHOCARDIOGRAPHIC PARAMETER

The mean ± SE of LVEDV(ml) ,LVESV(ML), EF(%),%FS of patients Metformin group were 124.1360 ± 6.36829, 48.0007± 3.23524, 61.9550± 0.88655, 33.5960 ± 0.62250 respectively, and the mean ± SE of LVEDV(ml), LVESV(ML), EF(%), %FS of patients Metformin plus sitagliptin were 131.2379 ±7.65425, 50.04 ±3.837, 64.3004 ±0.93989, 35.4771±0.68989 respectively in. Table 1.

GRADES OF LEFT VENTRICULAR DIASTOLIC DYSFUNCTION

In this study which included 60 Iraqi type 2 diabetics patients about 36 patients (60%) were grade 2 and 22 patients (36.6%) were grade 1 with 2 patient (5%) have normal.

EFFICIENCY OF THE ASSAY'S AMPLIFICATION IN TESTED GROUPS FOR (MIR-150-5P)

The amplification curves demonstrate successful amplification, with matching crossing thresholds (CT), as

the number of cycles increases with the round forming unit (RFU) (Fig. 3).

The amplification curves demonstrate successful amplification, with associated crossing threshold (CT) values, as the number of cycles increases with the round forming unit (RFU) (Fig. 4).

The results indicate a substantial reduction in the expression of miR-150-5p in the group treated with Sitagliptin (P<0.0001), as compared to the group treated with metformin (Fig. 5, Table 3).

DISCUSSION

ECHOCARDIOGRAPHIC PARAMETER AND EFFECT OF SITAGLIPTIN/METFORMIN

This study performed a subgroup analysis that specifically investigated the effects of sitagliptin on echocardiographic measures of diastolic function. Participant in our study has a diagnosis of type 2 diabetes and exhibits left ventricular diastolic dysfunction, which is indicated by an ejection fraction greater than 50%. This study investigates the impact of metformin alone compared to a combination of sitagliptin and metformin. The results indicate that sitagliptin has a notable and beneficial impact on echocardiographic parameters, specifically on EF (ejection fraction) and FS (fractional shortening). According to these data, it appears that giving sitagliptin may have a protective effect on the relaxation of the heart muscles

during the filling phase (cardiac diastolic function), leading to a better outlook regardless of how well blood sugar is controlled and blood pressure levels. On the other hand, another study found that adding DPP-4 inhibitors, such as Sitagliptin, to standard antidiuretic treatments effectively reduced the advancement of carotid IMT [14,15]. The long-term administration of sitagliptin significantly prevented the advancement of heart failure in a rat model of heart failure [16] an enzyme that inactivates peptides that possess cardioprotective actions, correlates with adverse outcomes in heart failure (HF). Nevertheless, the administration of sitagliptin did not provide significant enhancement in the systolic function of individuals suffering from ischemic HF and type 2 diabetes mellitus [17]. Furthermore, Oe et al. discovered that the administration of sitagliptin to patients diagnosed with T2DM and LV (left ventricular) diastolic dysfunction did not result in any enhancement of the echocardiographic characteristics associated with this disease. The impact of DPP-4 inhibitors on cardiac function's therapeutic efficacy remains a topic of discussion due to the inconsistent outcomes observed [18] and, if so, it is attributable to the attenuation of PPH or to a direct cardiac effect of DPP-4i. We compared the effects of the DPP-4i, sitagliptin, and the alpha-glucosidase inhibitor, voglibose, on LV diastolic function in patients with type 2 diabetes.

Methods: We conducted a prospective, randomized, open-label, multicenter study of 100 diabetic patients with LV diastolic dysfunction. Patients received sitagliptin (50 mg/day). Nogueira et al. found that sitagliptin had positive benefits on LVDD in persons diagnosed with T2DM who were receiving insulin therapy. However, these effects were not as evident in T2DM patients who were just receiving insulin [19].

MICRORNAS 150-5P AND EFFECT OF SITAGLIPTIN/METFORMIN

MicroRNAs (miRNAs) have significant implications in diverse cardiovascular conditions, specifically in the advancement and progression of illnesses, and therapeutic approaches targeting miRNAs hold crucial clinical importance [20]. The current study aimed to examine the impact of MicroRNA150-5P on the left ventricular function in individuals with diabetes. Within The results of our study showed that elevated glucose levels led to a notable decrease in the levels of miR-150-5p in the group treated with Sitagliptin ($P < 0.0001$). Additionally, there was an improvement in echocardiographic parameters related to left ventricular diastolic dysfunction when compared to the group treated with metformin alone (control group). These findings suggest that Sitagliptin may have a beneficial effect as an additional therapy to metformin. Our investigation's findings are consistent with

previous research results in patients with left ventricular dysfunction (LVDD), indicating a considerable decrease in the levels of miR-150 expression in the left ventricle during the initial stages of LVDD. The greatest significant decline, totaling about two-thirds, occurred at the 2 and 4-week marks. Afterwards, the levels of expressiveness began to regain, but they still remained below the normal levels. Prior studies have demonstrated a reduction in the level of miR-150 in hypertrophic cardiac tissue [21]. Furthermore, inhibiting miR-150 facilitated the onset and progression of myocardial hypertrophy, cardiac fibrosis, and heart failure. Cardiomyocytes' size decreased when miR-150 was overexpressed. The concentration of miR-150-5p was significantly reduced in individuals with severe left heart failure or in those with chronic systolic left heart failure and atrial fibrillation. The decrease in miR-150-5p is indicative of the advancement of the disease and is linked to an unfavorable outcome in these individuals. Our research validates the results of previous studies that have shown a negative correlation between the levels of circulating miR-150-5p and the severity of the disease, as well as the prognosis of patients with left heart failure. This is in contrast to other published studies that have found positive correlations among different circulating miRNAs and outcome. Nevertheless, our research contradicts a previous study that discovered a biomarker with high sensitivity and specificity for heart failure. This study specifically examined only five miRNAs and did not incorporate miR-150-5p. Furthermore, these studies were deficient in having a control group, which sets them apart from our study design in a fundamental manner.

CONCLUSIONS

The miR-150 has reduced levels in the bloodstream of individuals suffering from Left ventricular diastolic dysfunction with T2DM. MicroRNA-150 is likely to be decreased in this context and is considered an autonomous indicator for LVDD. Measuring it may provide extra benefits in detecting patients at risk of LVDD early on, which is a strong indicator of an unfavorable prognosis. Sitagliptin improved association epigenetics deregulations MicroRNA150-5p in patients with type 2 diabetes mellitus.

RECOMMENDATIONS

In order to investigate this correlation, further research utilizing a larger sample size, longer duration of follow-up with clinical outcomes and multi centric view is required. Future research should focus on epigenetics relationships and additional biomarkers in Iraqi diabetic's patients is required.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Aswer J Abdulkadhium

University of Al-Qadisiyah

P.O.Box 88 -Al-Qadisiyah -Al-Diwaniyah, Iraq

e-mail: asawer.jawad12@gmail.com

ORCID AND CONTRIBUTIONSHIP

Aswer J Abdulkadhium: 0009-0000-4246-0097 **B** **C** **D** **E**

Bassim I Mohammad: 0000-0001-6732-5940 **A** **E** **F**

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

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The interconnections of different types of fertiliser consumption on disability-adjusted life years of digestive system diseases in European countries

Vladyslav Smiiianov¹, Maksim Husenko², Olena Vishnikina³, Olena Churikanova⁴, Tetiana Vasylieva²

¹DEPARTMENT OF PUBLIC HEALTH, SUMY STATE UNIVERSITY, SUMY, UKRAINE

²DEPARTMENT OF FINANCIAL TECHNOLOGIES AND ENTREPRENEURSHIP, SUMY STATE UNIVERSITY, SUMY, UKRAINE

³DEPARTMENT OF INTERNATIONAL TOURISM AND HOTEL AND RESTAURANT BUSINESS, UNIVERSITY OF CUSTOMS AND FINANCE, DNIPRO, UKRAINE

⁴TUBAF DIGITAL, TU BERGAKADEMIE FREIBERG, GERMANY

ABSTRACT

Aim: This study examines the impact of different fertiliser types – phosphate, nitrogen, and potash – and pesticide use on disability-adjusted life years (DALYs) associated with digestive system diseases in European countries. It focuses on pancreatitis, upper digestive system disorders, and non-alcoholic fatty liver disease (NAFLD), including cirrhosis.

Materials and Methods: Using a balanced panel dataset covering 39 European countries from 2006 to 2021, the study incorporates data from the Global Burden of Disease database (DALYs), the Food and Agriculture Organization (fertiliser and pesticide use), and the World Bank (trade indicators). A fixed-effects regression model was applied to assess the influence of agricultural chemical use and trade dynamics on DALYs.

Results: Pesticide use per hectare was significantly associated with higher DALYs for NAFLD, indicating substantial health risks. Nitrogen fertiliser use showed a protective effect against DALYs for upper digestive diseases and pancreatitis. In contrast, excessive potash application was linked to increased DALYs for pancreatitis. The effects of phosphate use varied by disease type. Trade-related interaction terms demonstrated complex and sometimes amplifying effects on health outcomes.

Conclusions: Agricultural inputs have both beneficial and adverse health implications. While essential for productivity, their misuse can contribute to chronic disease burdens. The findings highlight the importance of sustainable farming practices and regulatory oversight. Integrating health metrics such as DALYs into agricultural and environmental policy could improve public health outcomes across Europe.

KEY WORDS: environmental exposure, agricultural chemicals, gastrointestinal diseases, liver diseases, risk assessment

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INTRODUCTION

Digestive diseases, including pancreatitis, upper gastrointestinal disorders, and NAFLD, are increasing globally due to dietary, lifestyle, and environmental changes. In 2019, they accounted for 18.2% of incidence, 14.2% of deaths, and 10.9% of DALYs, ranking 13th globally, though DALY rates have declined from 1570.35 in 1990 to 1096.99 per 100,000 in 2019 [1, 2].

While lifestyle causes are widely recognized, environmental factors, especially agricultural practices, remain underexamined. DALYs, as defined by the WHO [3], show a global shift from communicable to chronic diseases, including NAFLD [4]. Overuse of fertilisers (nitrogen, phosphate, potash) contributes to water and

soil degradation, linked to liver and gastrointestinal diseases [5]. Nitrate runoff from nitrogen fertilisers causes liver toxicity and harmful algal blooms [6].

Pesticides, particularly organochlorines, bioaccumulate in fat tissue, leading to liver dysfunction and metabolic disorders [7]. Chronic exposure increases the risk of pancreatic cancer (OR = 1.4, 95% CI: 1.0–2.0) [8], with supporting evidence from affected agricultural regions such as California and South Africa [9].

The link between agricultural chemicals and human health is central to environmental public health, especially in relation to DALYs. Nitrogen fertilisers, while vital to European agriculture, are linked to nitrate-related groundwater contamination and liver damage [10–14].

Fertiliser use also correlates with increased health spending in Europe, suggesting hidden disease burdens [15].

Pesticides, often used with fertilisers, contribute to synergistic toxicity. Organophosphates trigger oxidative stress, disrupt liver enzymes [16–17], and alter gut microbiota [18], compounding digestive health risks. Their combined use amplifies effects on liver and gastrointestinal diseases [19], including NAFLD and pancreatitis via endocrine and oxidative pathways [20–21].

Digestive diseases represent a significant share of DALYs in regions with intensive agriculture, including parts of Europe [1]. Environmental degradation from overuse of fertilisers, industrialisation, and poor waste management exacerbates these risks [22–23]. Sustainable planning and eco-conscious business practices are essential for public health [24–25].

To mitigate these impacts, research supports precision and organic farming to reduce chemical inputs without compromising yields [26–28]. Data-driven tools such as machine learning and decision-support systems improve contamination monitoring and regulation [29–33], though regulatory gaps remain [34].

Behavioural change and environmental education also play key roles in promoting sustainability [35–36]. Aligning agricultural policy with the UN's Sustainable Development Goals is critical to long-term health and environmental resilience [37–39].

Despite strong evidence linking fertiliser and pesticide exposure to digestive disease burdens, their specific impact on DALYs in Europe remains underexamined, highlighting a significant research gap.

AIM

This research aims to investigate the interconnections between the consumption of different types of fertilisers (phosphate, nitrogen, and potash) and the disability-adjusted life years associated with digestive system diseases, including pancreatitis, upper digestive disorders, and NAFLD, in European countries.

The hypotheses of this research can be inferred as follows:

H1: The consumption of fertilisers (nitrogen, phosphate, and potash) has a significant impact on the DALYs associated with digestive system diseases such as pancreatitis, upper digestive system disorders, and NAFLD, including cirrhosis.

H2: The use of pesticides is significantly associated with an increase in DALYs for digestive system diseases, indicating that excessive pesticide use poses health risks, especially when combined with fertiliser exposure.

These hypotheses guide the study's investigation into the relationships between agricultural practices and public health outcomes measured through DALYs.

MATERIALS AND METHODS

The methodology employed in this study focuses on examining the relationship between the consumption of different types of fertilisers (phosphate, nitrogen, potash) and pesticides and the disability-adjusted life years associated with pancreatitis, upper digestive system diseases, and NAFLD, including cirrhosis. The analysis is based on a panel data approach, utilising a comprehensive dataset across multiple countries and years.

All variables and their sources are presented in Table 1.

The sample of the countries formed by European countries (Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, and United Kingdom) which are included in European Union, or going to join it, or have harmonised regulation and standards in area of fertilisers in agrarian productions. The timeline was chosen from 2006 to 2021 because some countries have not published the data for 2022, and Serbia and Montenegro separated their data after 2006. This allows the construction of a balanced panel dataset comprising 39 countries over 16 years, resulting in a total of 624 observations.

The study used panel data regression to capture both cross-country and time-based variation. Three models were applied: the Pooling Model (ignores individual effects), Fixed Effects (controls for time-invariant country traits), and Random Effects (assumes no correlation between effects and regressors). The Hausman test confirmed the Fixed Effects model as most appropriate.

Analyses were conducted in R Studio using the *plm* package, with diagnostics for multicollinearity, heteroskedasticity, and autocorrelation. This approach provides a solid framework to assess how agricultural inputs affect health, informing policy and future research.

RESULTS

The summarised data about variables is presented in Table 2.

The estimation results from both the FE and RE models, assessing the influence of various types of fertiliser consumption and pesticide use on DALYs related to NAFLD, including cirrhosis, are presented in Table 3.

The Hausman test rejected the null hypothesis, confirming that the random effects model is inconsistent and that the fixed effects model is more appropriate. This model accounts for unobserved, time-invariant country-specific factors and explains about 10.3% of the variation in NAFLD-related DALYs.

Table 1. Variables

Variables	Indicators	Source
y1	DALYs (Disability-Adjusted Life Years) non-alcoholic fatty liver disease (NAFLD), including cirrhosis, Percent	[39]
y2	DALYs (Disability-Adjusted Life Years) upper digestive system diseases, per cent	[39]
y3	ALYs (Disability-Adjusted Life Years) Pancreatitis, %	[39]
x1	Fertiliser nutrient nitrogen N use per area of cropland	[40]
x2	Fertiliser nutrient phosphate P2O5 use per area of cropland	[40]
x3	Fertiliser nutrient potash K2O use per area of cropland	[40]
x4	Pesticide use per area of cropland	[40]
x5	Food imports (% of merchandise imports)	[41]
x6	Imports of goods and services (% of GDP)	[41]
x7	Food exports (% of merchandise exports)	[41]
x8	Exports of goods and services (% of GDP)	[41]

Table 2. Summarised statistics of input data

Variables	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
y1	0.000340	0.001189	0.001655	0.001844	0.002413	0.006185
y2	0.003260	0.004914	0.005761	0.005932	0.006939	0.011803
y3	0.0008766	0.0015235	0.0021133	0.0026758	0.0031381	0.0108286
x1	6.03	54.95	72.00	78.91	94.92	278.26
x2	0.65	12.89	19.14	21.28	26.02	103.45
x3	0.06	10.02	19.14	23.17	30.58	125.37
x4	0.000	1.130	2.110	3.182	4.555	13.390
x5	2.498	7.840	9.970	10.457	12.815	26.638
x6	23.02	39.72	52.04	58.01	69.23	179.92
x7	1.848	6.175	10.010	13.617	15.893	74.173
x8	18.98	34.72	46.38	56.82	69.84	213.22

Source: authors' calculation in R Studio.

Pesticide use (x4) was the only significant predictor, positively associated with DALYs ($\beta = 2.5997\text{e-}05$, $p = 0.0015$), supporting previous findings on pesticide-related liver toxicity. A marginally significant effect was found for the interaction between food imports and imports of goods ($x5 \times x6$), suggesting trade-related influences on health. Other fertiliser variables were not statistically significant. These results highlight the health risks of pesticide use and the potential impact of trade on environmental health.

The estimation results from both FE and RE models assessing the relationship between fertiliser consumption and DALYs for upper digestive system diseases are presented in Table 4.

The Hausman test returned a high p-value, indicating no significant difference between the fixed and random effects models; thus, the random effects model is appropriate.

Most variables – including fertiliser types, pesticide use, and trade interactions – were not significantly associated with DALYs for upper digestive diseases ($p > 0.1$), suggesting limited direct impact. However, the

interaction between food imports and imports of goods ($x2 \times x4$) was significantly positive ($\beta = 9.8293\text{e-}07$, $p = 0.0272$), indicating a potential combined effect on disease burden. This finding highlights the importance of assessing joint chemical exposures in understanding environmental health risks.

The results of the FE and RE models examining the association between agricultural chemical inputs and DALYs for pancreatitis are summarized in Table 5.

The Hausman test ($p < 0.001$) confirmed the fixed effects model as appropriate, indicating that unobserved country-level factors affect the results, making the random effects model unsuitable. Most fertiliser and pesticide variables were not significantly linked to DALYs for pancreatitis ($p > 0.1$). However, the interaction between food and total exports ($x7 \times x8$) was highly significant ($\beta = 8.5832\text{e-}07$, $p < 0.001$), suggesting trade-related pressures may increase disease burden. Table 6 presents pooled OLS results for the impact of agricultural and trade variables on DALYs across three digestive disease categories.

Table 3. FE and RE model outputs for NAFLD-related DALYs and fertiliser/pesticide variables

Variables	FE	RE
(intercept)		2.4651e-03 (<0.0001)***
x1	1.7281e-07 (0.763924)	1.2046e-07 (0.834168)
x2	-1.9906e-07 (0.874472)	-3.0696e-07 (0.807432)
x3	7.8722e-07 (0.571519)	7.2818e-07 (0.599266)
x4	2.5997e-05 (0.001461)**	2.7234e-05 (0.000771)***
x5*x6	3.4302e-07 (0.064244) .	3.5269e-07 (0.057745) .
x7*x8	-8.7547e-08 (0.300610)	-1.0821e-07 (0.199406)
R-Squared		0.097442
Adj. R-Squared	0.10327	0.082719
F-statistic	6.62179 (<0.0001)	
Chisq		66.1811 (<0.0001)
Hausman Test	Chisq = 33.889, df = 10, p-value = 0.0001929 Alternative hypothesis: One model is inconsistent	

Signif. codes: '***' – 0.001; '**' – 0.01; '*' – 0.05; '.' – 0.1; 'No symbol' – not significant.

Source: authors' calculation in R Studio.

Table 4. FE and RE model outputs for DALYs associated with upper digestive system diseases and agricultural chemical inputs

Variables	FE	RE
(intercept)		7.0257e-03 (<0.0001)***
x1	-4.1644e-07 (0.763116)	-5.5333e-07 (0.6860962)
x2	3.8473e-06 (0.203845)	4.3081e-06 (0.1502620)
x3	1.1139e-06 (0.738800)	5.7632e-07 (0.8604760)
x4	-1.1632e-05 (0.551507)	-2.0536e-05 (0.2832155)
x5*x6	1.0892e-06 (0.014514)*	9.8293e-07 (0.0271696)*
x7*x8	1.3149e-07 (0.517220)	7.4771e-08 (0.7085534)
R-Squared	0.070924	0.058833
Adj. R-Squared	-0.0066334	0.043479
F-statistic	4.38946 (<0.0001)	
Chisq		38.3188 (3.3396e-05)
Hausman Test	Chisq = 1.3784, df = 10, p-value = 0.9993 Alternative hypothesis: one model is inconsistent	

Signif. codes: '***' – 0.001; '**' – 0.01; '*' – 0.05; '.' – 0.1; 'No symbol' – not significant.

Source: authors' calculation in R Studio.

Table 5. FE and RE model estimates for DALYs associated with pancreatitis and fertiliser/pesticide variables

Variables	FE	RE
(intercept)		3.3019e-03 (<0.0001)***
x1	2.6578e-07 (0.7163187)	3.0701e-08 (0.9670891)
x2	1.1065e-06 (0.4897261)	1.3362e-06 (0.4120193)
x3	-1.8345e-06 (0.2997306)	-2.0588e-06 (0.2507879)
x4	7.4791e-08 (0.9942277)	-3.0992e-06 (0.7673679)
x5*x6	-8.0969e-08 (0.7307358)	-3.0992e-06 (0.6731230)*
x7*x8	8.5832e-07 (<0.0001)***	8.3610e-07 (<0.0001)***
R-Squared	0.21349	0.20224
Adj. R-Squared	0.14783	0.18923
F-statistic	15.6079 (< 2.22e-16)	
Chisq		155.404 (<0.0001)
Hausman Test	chisq = 324.98, df = 10, p-value <0.0001 Alternative hypothesis: one model is inconsistent	

Signif. codes: ‘***’ – 0.001; ‘**’ – 0.01; ‘*’ – 0.05; ‘.’ – 0.1; ‘No symbol’ – not significant.
Source: authors’ calculation in R Studio.

Table 6. Pooled regression model estimates for DALYs of NAFLD, upper digestive system diseases, and pancreatitis

Variables	Disability-Adjusted Life Years		
	NAFLD, including cirrho- sis, %	upper digestive sys- tem diseases, %	Pancreatitis, %
(intercept)	2.3926e-03 (<0.0001)***	5.2820e-03 (<0.0001)***	2.6335e-03 (<0.0001)***
x1	-1.1084e-06 (0.463800)	-5.6784e-06 (0,014968)*	-1.4933e-05 (6.889e-12)***
x2	-3.1272e-05 (<0.0001)***	-8.5236e-06 (0,101113)	-2.5971e-05 (<0.0001)***
x3	1.3881e-05 (<0.0001)***	1.8051e-05 (0.0001)***	2.9149e-05 (<0.0001)***
x4	3.6731e-05 (0.006350)**	-2.0428e-04 (<0.0001)	-2.2506e-04 (<0.0001)***
x5*x6	6.6997e-07 (0.204472)	-2.0618e-06 (0,011336)*	-2.4553e-06 (0.00103)**
x7*x8	-1.1113e-06 (<0.0001)***	2,6664e-07 (0,4352197)	6.7946e-07 (0.03043)*
R-Squared	0.30863	0.22545	0.49331
Adj. R-Squared	0.29736	0.211189	0.48505
F-statistic	27.3651 (<0.0001)	17.7503 (<0.0001)	59.6822 (<0.0001)

Signif. codes: ‘***’ – 0.001; ‘**’ – 0.01; ‘*’ – 0.05; ‘.’ – 0.1; ‘No symbol’ – not significant.
Source: authors’ calculation in R Studio.

Pooled regression models for DALYs from NAFLD, upper digestive system diseases, and pancreatitis showed statistically significant results, with adjusted R-squared values between 0.21 and 0.49.

For NAFLD, phosphate fertiliser use had a significant negative association, while potash use and pesticide application were positively linked to higher DALYs. A significant negative interaction between food and total exports suggests a potential protective trade effect.

For upper digestive diseases, nitrogen and pesticide use were negatively associated with DALYs, whereas potash showed a positive association. A negative interaction between food and general imports may reflect trade-related health impacts.

In the case of pancreatitis, nitrogen and phosphate fertilisers had negative effects on DALYs, while potash was positively associated. Pesticide use again showed a negative association. Significant interactions involving both imports and exports further highlight the complex role of trade in shaping health outcomes.

These results collectively underscore the multifaceted relationship between agricultural practices, trade, and public health. They also highlight the importance of disaggregating inputs and interactions to understand the implications of chronic digestive diseases better.

DISCUSSION

This study examines the link between fertiliser and pesticide use and DALYs from digestive diseases, specifically NAFLD, pancreatitis, and upper gastrointestinal conditions, across Europe. Results highlight environmental exposures as significant contributors to non-communicable disease burdens, echoing growing global concern [1, 3, 4].

A strong positive correlation between pesticide use and NAFLD-related DALYs supports earlier evidence of liver toxicity and cancer risks from chronic exposure, particularly to organochlorines [7, 8].

Potash fertiliser consistently predicted higher DALYs, reinforcing findings on phosphate-related liver damage and environmental harm. While nitrogen fertiliser had mixed effects – protective in some cases – it remains

linked to nitrate contamination and liver dysfunction [5, 11, 12].

The study also highlights synergistic effects of fertiliser and pesticide use, with trade activity amplifying health impacts, particularly for pancreatitis [19, 20, 26].

Using fixed effects models, the research underscores the role of local agricultural practices and regulation, aligning with calls for precision farming and targeted monitoring [29, 30].

These findings affirm that unregulated agricultural inputs pose real health risks, stressing the need for balanced policies promoting both food security and environmental health [3, 15].

CONCLUSION

This study examined the relationship between agricultural inputs, specifically the use of nitrogen, phosphate, and potash fertilisers, along with pesticides, and the burden of digestive system diseases, measured by DALYs, in 39 European countries from 2006 to 2021. Focusing on NAFLD, pancreatitis, and upper digestive disorders, the research sheds light on the environmental drivers of public health outcomes and offers guidance for sustainable agricultural policy.

A fixed effects regression model was employed, using publicly available data on DALYs, fertiliser and pesticide consumption, and trade variables. The model effectively captured country-specific variations and was implemented in R Studio to ensure robust statistical validity.

Key findings revealed that pesticide use was significantly associated with increased DALYs for NAFLD, highlighting the health risks of chemical exposure. Fertiliser effects were mixed: nitrogen showed potential protective associations, while potash use correlated with higher DALYs, particularly for pancreatitis and upper digestive diseases. Trade-related interactions also influenced health outcomes, reflecting the complexity of environmental and economic factors.

The study underscores the need for a balanced approach to agricultural productivity and health, advocating for sustainable practices, precision agriculture, and stricter regulation of chemical inputs to mitigate health risks and support public well-being.

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CONFLICT OF INTEREST

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CORRESPONDING AUTHOR

Tetiana Vasyliieva
Department of Financial Technologies and Entrepreneurship
Sumy State University, Sumy, Ukraine
e-mail: tvasilyeva@ukr.net

ORCID AND CONTRIBUTIONSHIP

Vladyslav Smiiianov 0000-0002-4240-5968 [A](#) [D](#) [E](#) [F](#)
Maksim Husenko 0009-0005-4128-4534 [A](#) [B](#) [C](#) [D](#) [F](#)
Olena Vishnikina 0000-0002-3747-2904 [B](#) [D](#) [E](#) [F](#)
Olena Churikanova 0000-0001-5703-2271 [B](#) [C](#) [D](#) [F](#)
Tetiana Vasyliieva 0000-0002-6626-3650 [A](#) [B](#) [C](#) [D](#) [E](#) [F](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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Some characteristics of therapy and rehabilitation students' communicative competence (Bogomolets National Medical University)

Serhii Omelchuk¹, Lesya Lyamar¹, Kseniia Yarymbash¹, Daria Lystopad², Iryna Kylymnyk³

¹ BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

² DENTAL MEDICAL CENTER, BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

³ ZAPORIZHZHIA POLYTECHNIC NATIONAL UNIVERSITY, ZAPORIZHZHIA, UKRAINE

ABSTRACT

Aim: To determine the main characteristics of the physical therapist's communicative competence and propose teaching methods of improving it.

Materials and Methods: A survey with 193 Bogomolets NMU physical therapy students of study years 2-6 was conducted using the author's questionnaire. This form aimed to define the level of their communicative competence, as well as rank the importance of competence for respondents, self-assessment of the competence level, and the respondents' experience of communicative competence classes. Participation in the survey was voluntary, by the consent of the respondents.

Results: The results indicate that the students possess communicative strategies and ethically correct approaches to behavior, high self-esteem, high levels of self-awareness, and self-confidence. Numerous students showed good and excellent characteristics of communication, which indicates their ability to choose best communication strategies. The students' self-assessment of communication skills, mostly positive, indicates a high level of self-awareness and self-confidence in their communication abilities.

Conclusions: The physical and occupational therapy students are aware of communicative strategies and ethically correct approaches in behavior, which results from their undergraduate study. However, the communicative competence skills should be emphasized during the undergraduate studies, regarding the interactional character of therapists' job.

KEY WORDS: self-esteem, communicative competence, self-awareness, communicative strategy

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INTRODUCTION

The communicative competence of physical therapy students is a key component of their professional activity, defined as the ability of efficient interaction with patients, colleagues and others, by different communication approaches, such as verbal, nonverbal, written and etc. The competence includes not only the ability of correct information presentation, but also listening, interpreting and responding to the needs of patients with empathy. The communication competence is particularly important in physical therapy, since a physical therapist often works with individuals with physical, mental, or cognitive limitations. Such patients may have difficulty expressing their thoughts and feelings. Therefore, the physical therapist's ability to correctly interpret and respond to nonverbal cues becomes the key to successful therapy. So, an effective communication helps to establish trusting relationships with patients.

It is a fundamental one in creating a comfortable and supportive treatment environment, and also helps to take history, define the patient's needs and produce the treatment strategy. Shaping the communication skills during undergraduate medical studies is important for the physical therapy students, as it ensures high level of their professionalism and efficiency, increases the quality of therapy and contributes to the faster patients' recovery.

Shaping the communicative competence skills during undergraduate medical education of the therapy and rehabilitation students is critically important for their professional development and efficiency. It represents a component of such courses as «Ethics in Physical Therapy, Occupational Therapy», «Management and Marketing in Physical Therapy, Occupational Therapy», «Models of Rehabilitation Service», and will be integrated into all clinical courses. The students learn

the ethical aspects of the profession, empathy in active listening skills, verbal and non-verbal communication skills. This allows for productive interaction of the physical and occupational therapy students with patients. The communicative competence course is completely integrated into the entire educational process, at classes of anatomy, physiology, general psychology or physical therapy and occupational therapy. It is important for the students to learn and explain medical and rehabilitation concepts in coherent language, to adapt their communication for the patients. The communicative competence includes the skills of team work, conflict management and public speaking skills.

The classes dedicated to the communication competence include practical exercises, role plays, and clinical simulations. Reflection on practice, receiving feedback from teachers and fellow-students are important for awareness and improvement of one's communication skills. The interdisciplinary approach provides for mastering the communication skills with patients, their relatives, colleagues and teachers. This promotes inter-professional collaboration and increases the quality of the patient-centered approach.

Teaching communicative competencies should be dynamic, adapted to modern challenges. Given the constant changes in the healthcare, and the diversity of patient needs, the physical therapy and occupational therapy students' curriculum must be flexible, providing opportunity for continuous professional development.

Thus, communicative competence in undergraduate training is fundamental for highly qualified physical and occupational therapy students, who will interact efficiently in modern medical environment and provide high-quality rehabilitation assistance to patients. Considering these aspects in educational programs contributes not only to the professional development of students but also increases the quality of health care in general.

AIM

The aim of study is to determine the main characteristics of the physical therapist communicative competence and propose methods of improving it during undergraduate education.

MATERIALS AND METHODS

193 therapy and rehabilitation Bogomolets NMU students of years 2-4 filled in the questionnaires and completed the test papers in 2023-2024. The students of day-time education were surveyed in Kyiv, Ukraine. The participation was voluntary, upon the students' consent. The data remained anonymous.

Students were asked to fill out the author's test with tasks to determine communicative strategies in co-operation, adaptation, confrontation, avoidance, and choose ethically correct strategies of behavior such as support, cooperation and empathy. The test results were converted and ranked into a 5-point scale, where the predominant choice of optimal strategies (80-100%) was determined by a score of 5, a large number of choices of optimal strategies (60-79%) – a score of 4, the average number of choices of optimal strategies, with predominating non-productive choices (35%-59%) – a score of 3. Predominance of unproductive choices and a rather low choice of productive strategies (20%-34%) had a score of 2, and the absolute predominance of unproductive strategies, lack of choice of empathy corresponded to score of 1 (less than 19% of choosing optimal strategies).

The respondents were also asked to self-assess their communication strategies on a scale of «very good», «rather good than bad», «average», «rather bad than good», and «bad». On a similar scale, respondents were asked to rate the importance of communicative competence for them, on the scale «very important», «rather important than not important», «can't decide», «rather not important than important», and «not important».

Another question was whether students had studied communicative competence as a separate course, and whether they could recollect their teachers mention communicative competence in classes, with the answer options «yes», «no», «can't remember».

Approval from the University has been granted for conducting this research, confirming its ethical procedure. The research procedures adhere to the principles outlined in the Helsinki Declaration. All research participants willingly consented to become respondents, having previously completed informed consent forms. To ensure comprehensive understanding, the researchers provided a research information sheet detailing the research background, objectives, procedures, potential risks, and benefits to respondents.

The obtained results were treated using the Statistica 13.0 program.

RESULTS

The results of the survey are represented in table 1. According to the value of choosing the optimal communication strategies, 15.06% of 29 students received a score of 5; 29.53% of 57 students received "4"; 39.89% of 77 students received "3". Additionally, 9.84% of 19 students received a score of 2; 5.68% of 9 students received "1".

Regarding self-assessment of communication strategies, 19.18% (37 students) rated their abilities as «very good», and 35.23% (68 students) rated them as «rather

Table 1. Development of communicative competence of Bogomolets NMU therapy and rehabilitation students, n= 193

Name	Level										
Choosing the optimal communication strategies	«5»		«4»		«3»		«2»		«1»		
	%	q-ty	%	q-ty	%	q-ty	%	q-ty	%	q-ty	
	15.06	29	29.53	57	39.89	77	9.84	19	5.68	9	
Self-assessment of communication strategies	«Very good»		«Rather good than bad»		«Average»		«Rather bad than good»		«Bad»		
	%	q-ty	%	q-ty	%	q-ty	%	q-ty	%	q-ty	
	19.87	37	35.23	68	30.05	58	10.36	20	5.18	10	
Importance of communication competence	«Very important»		«Rather important than not important»		«Can't decide»		«Rather not important than important»		«Not important»		
	%	q-ty	%	q-ty	%	q-ty	%	q-ty	%	q-ty	
	50.25	97	30.06	58	15.03	29	3.1	6	1.56	3	
Learning communicative competence at medical classes	Positive				Negative				Could not remember		
	%		q-ty		%		q-ty		%		q-ty
	60.1		116		30.05		58		9,85		19
Level of understanding of communication strategies	High level		Above average		Average		Low level				
	%				q-ty		%		q-ty		
	75.12				145		24.88		48		

good than bad». Almost one-third, 30.05% (58 students) mentioned about «average» abilities, 10.36% (20 students) – as «rather bad than good», and only 5,18% (10 students) confirmed their abilities were «bad».

As for the importance of communication competence for physical therapists and occupational therapists, almost a half, 50.25% (97 students) consider it «very important», and another third, 30.06% (58 students) – «rather important than not important». 15% of the students (29 people) couldn't decide, and, overall, for 4% it was not important and slightly important.

Regarding the experience of developing communicative competence skills during undergraduate studies, 60.1% (116 students) answered positively, 30.05% (58 students) answered negatively, and 9.85% (19 students) couldn't recollect.

As for the knowledge of communication strategies, the vast majority – 75.12% (145 students) received grades from 3 to 5, which indicates an average, above average and high level of the communication strategies knowledge. At the same time, a small number of students – 24,88% (48 students) showed a low level of knowledge. This indicates a generally satisfactory level of education in communications, and stresses that curriculum should be more focused on the development of communication skills.

DISCUSSION

Despite the results obtained, there is a need for additional research to determine whether these as-

sessments reflect students' actual competence in the practical application of these skills.

The theme of the physical therapy competence received quite wide coverage by the teachers and psychologists, and is reflected in numerous papers. In their work, Brighton, LJ, & Bristowe, K. [1] emphasized the importance of communication in palliative care, particularly how healthcare professionals can effectively discuss end-of-life issues with patients. Furthermore, the conducted research confirms and expands the data presented by numerous studies by Włoszczak-Szubza, A., & Jarosz, M.J., on the influence of the level of development of communicative competencies and their impact on the quality and results of professional activity [2, 3, 4]. As the majority of students rated their communication skills as «good» or «rather good than bad», this indicates self-confidence in their communication abilities or overestimated self-esteem of the respondents, which emphasizes the need for an objective assessment of students' skills, both by self-assessment and assessment by teachers. It is important to find out, whether there are specific educational or psychological barriers that prevent some students from developing effective communication strategies.

According to the research, more than 80% of students consider communication competence important or very important, which underlines the general awareness of the importance of these skills in professional development, which is confirmed by the results of studies by O'Keeffe M. and others [5], and Bastemeijer

CM, and Naamanka K. [6]. Awareness of the importance of communication skills indicates its significance for interaction with patients also widely discussed. It is noteworthy that McGowan E. and others [7] identify the same core competencies required of physiotherapists working with refugees, while Wijma, AJ and others [8] outline stress on the patient-centredness in physiotherapy, identifying the approaches and attitudes that physiotherapists should adopt to ensure that patients' needs and perspectives are prioritized.

Awareness of the importance of communicative competence, as stated by McGowan E[9] and Wijma AJ [10], and confirmed by the results of this study, also indicates the desire of students to develop critical professional skills, reflecting global trends in medical education, which emphasize the importance of "soft skills" alongside with technical knowledge.

More than a half of the students (60%) indicated that they had completed a course on communicative competence, which may reflect sufficient training by the teaching staff. This reflects current trends in medical education, which is also noted in the study of other authors.

Based on the data, in order to optimize the training of first (bachelor) therapy and rehabilitation students and improve their communicative competence, we consider necessary the following steps: integration of communicative competence courses in all specializations, conducting practical classes and role-playing games to apply theoretical knowledge, systematic feedback and

self-assessment, objectivizing assessment, introducing interdisciplinary approach, mentoring and mentoring programs to transfer experience, using modern technologies, such as VR, for simulating clinical scenarios, and supporting research of communicative competence.

CONCLUSIONS

In general, the results show good knowledge of communicative strategies and ethically correct approaches in behavior by the therapy and rehabilitation students. The large number of students, who scored 4 and 5, indicates their ability to choose optimal strategies. Students' self-assessment of their communication skills, mostly positive, indicates a high level of self-awareness and self-confidence in their own communication abilities. The high assessment of the importance of communicative competence by the majority of students emphasizes the awareness of the need for these skills in professional and personal life. The overwhelming number of students, who remember taking a course on communicative competence may indicate the effectiveness of such courses within the curriculum.

Several directions for further research can be identified: analysis of the effectiveness of communicative competence courses, research on the effect of self-awareness on the development of communicative skills, assessment of changes in communicative strategies over time, study of the correlation between academic success and communicative skills.

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CORRESPONDING AUTHOR

Lesya Lymar

Bogomolets National Medical University
13 T. Shevchenko boulevard, 01601 Kyiv, Ukraine
e-mail: lesyalymar@nmu.ua

ORCID AND CONTRIBUTIONSHIP

Serhii Omelchuk: 0000-0002-2451-9689  

Lesya Lymar: 0000-0002-9407-1066A  

Kseniia Yarymbash: 0000-0003-4694-291XB 

Daria Lystopad: 0009-0002-7680-1958  

Iryna Kylymnyk: 0000-0001-5554-6498 

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Development of the healthcare system as a component of human capital in strategic regulatory acts of Ukraine

Tetiana S. Gruzieva¹, Volodymyr V. Korolenko^{2,3}

¹BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

²STATE SERVICE OF UKRAINE ON MEDICINES AND DRUGS CONTROL, KYIV, UKRAINE

³KROK UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To analyze Ukraine's current strategic documents on human potential development with a view this the healthcare component.

Materials and Methods: The methodological basis of this research work is based on a systematic approach. Methods of structural and logical analysis, bibliosemantic, abstraction and generalization were used in this article.

Conclusions: Human development indicators from UN specialized agencies – UNDP and the World Bank – indicate significant challenges faced by the health system as a result of overcoming the consequences of the COVID-19 pandemic, Russia's full-scale invasion of Ukraine as part of a change in the world order. There is a massive disruption of economic activity chains and destruction of infrastructure. The recovery of Ukraine requires a systemic approach, primarily in terms of human potential and human capital development. Current strategic documents need to be updated to take into account new challenges, new initiatives and global leadership.

KEY WORDS: human capital, human potential, public health, strategy, demographic development

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INTRODUCTION

In the current conditions of globalization processes, rapid transformations in the socio-economic environment and the influence of innovations, human capital is one of the most significant components of the development of any country. This concept includes not only the educational level, professional training, experience and intellectual potential of an individual, but also his physical and mental state, which determine the ability of a person to work effectively and actively participate in social life. Health is the basis for the implementation of this capital, since it directly affects the productivity and general well-being of society.

At the same time, the concept of human potential is broader and more multifaceted, as it encompasses not only physical and intellectual resources, but also moral, social and cultural aspects of personality development. The development of this potential largely depends on the living conditions of a person, his access to quality education and health services, as well as on the level of social support that ensures health and well-being at the individual and societal levels. In this context, the

relationship between health, social living conditions and the level of human capital becomes key to ensuring the effective development of society.

The study of these relationships is important for the formation of effective development strategies aimed at improving the quality of life, improving access to medical services and education, as well as creating favorable social conditions for all segments of the population. After all, without a healthy and educated population that has access to medical and social services, it is impossible to achieve sustainable economic growth and social stability. Thus, the study of human capital and potential with a socio-medical bias is relevant for the development of policies in the fields of health, education and social protection, which will contribute to the harmonious development of the individual and the effective functioning of society as a whole.

AIM

To analyze Ukraine's current strategic documents on human potential development with a view this the healthcare component.

MATERIALS AND METHODS

The methodological basis of research work is based on a systematic approach. Methods of structural and logical analysis, bibliosemantic, abstraction, and generalization were used in this article. An analysis of the current legislative framework of Ukraine for 1991-2025 on the development of human potential and human capital, as well as relevant acts of international law, was conducted (a total of 4687 documents from the official websites of the authorities of Ukraine, the United Nations Development Program, the World Bank, using the keywords “strategy”, “human capital”, “human potential”, “public health”).

REVIEW AND DIACUSSION

Human capital is defined as “the skills possessed by the workforce and considered as a resource or asset” [1]. It encompasses the concept of investment in people and how these investments increase human productivity. The modern concept of human capital (2022) involves four aspects: its impact on earnings, high returns from childhood investments, the well-understood technology for basic skills, and the technology for advanced skills [2].

Human potential is interpreted as the ability of people to self-improve through education, training and practice in order to reach the limit of their ability to develop abilities and skills and realize themselves in society [3]. In a broad sense, human potential is the totality of the capabilities of society, the state and individuals in the field of using human resources and productive human traits for any socially useful activity [4,5,6]. Human potential is the basis for human development in all areas of life, and the concept of “human capital” can include only that part of human potential that can be used by a person to obtain economic benefit (income). The human capital, as the part realized in profit, can be assessed using statistical data of economic indicators, while assessing the entire human potential of a person is practically impossible [7].

Structurally, human potential includes several components (socio-economic, socio-cultural, activity and socio-demographic), of which socio-demographic potential is directly socio-medical in nature. It covers quantitative and qualitative characteristics of the population (number, life expectancy, health status, age and gender balance, level and quality of education). At the same time, other components are indirectly related to the health status of the population [5].

The issues of human potential and human capital development in Ukraine are defined in a number of strategic regulatory acts, primarily in the National Security Strategy of Ukraine, approved in 2020 [8]. It defines,

in particular, that among the priorities of Ukraine’s national interests and ensuring national security are: “(...) social development, primarily the development of human capital”. The direction of implementation of this priority is also declared: “(...) development of human capital of Ukraine, in particular through the modernization of education and science, healthcare, culture, social protection”, thus defining the main vectors of human capital development [8].

The Human Development Strategy, adopted in 2021 to implement the security strategy [9], is dedicated to the formation of responses to challenges that have a significant impact on the socio-economic situation. It is stated that the current demographic situation is characterized by relatively low birth rate and high mortality, deterioration of the medical and demographic characteristics of the population due to the increase in morbidity, the spread of chronic, infectious diseases, the preservation of a high level of occupational morbidity, industrial and domestic injuries. The demographic development of Ukraine is characterized by the formation and strengthening of such negative trends as a decrease in the population: at the beginning of 2010 – 46 million, at the beginning of 2021 – 41.6 million, excluding data on the population of the temporarily occupied Crimean territories. The challenges of the demographic crisis deepened, the population of Ukraine by July 2024 decreased to 35.8 million people, including 31.1 million people in the fully-controlled territories which led to the adoption in 2024 of the Demographic Development Strategy of Ukraine [10].

Healthcare occupies a prominent place in both strategic documents. In particular, the Human Development Strategy recognizes that “the imperfection of the healthcare system, the low level of awareness of the value of health as an asset, the lack of an educational component for the population on healthy lifestyle issues, and the fact that the vast majority of the population lives in conditions of socio-economic instability lead to the creation of unfavorable conditions for maintaining a healthy lifestyle.” That is why the first strategic goal to be achieved is “Improving the medical and demographic situation in Ukraine,” which provides for the creation of a balanced healthcare system; the introduction of the latest technologies in the healthcare sector; the development of an effective state public health system in order to ensure the sanitary and epidemiological well-being of the population, biological safety and biological protection, the prevention of infectious and non-communicable diseases; and the adoption of measures to stimulate the birth rate [9].

The Demographic Development Strategy of Ukraine for the period up to 2040 also includes a number of

measures to develop the healthcare system. In particular, to implement strategic goal 2 (Creating conditions for increasing the birth rate, supporting the family), it is envisaged to improve the reproductive health of the nation, and to achieve strategic goal 3 (Reducing premature mortality) – to promote a healthy lifestyle and responsibility for one's own health; early detection and prevention of diseases that most often lead to premature mortality or loss of health; reducing risk factors for injury or mortality in everyday life; increasing the level of accessibility of medical care and its quality; preserving human dignity and a high level of quality of life during illness and treatment; developing infrastructure for healthy leisure. The target indicator for reducing premature mortality is defined as reducing the probability of death under the age of 65 to the average for EU countries: 16.3 percent among men, 8.3 percent for women (in Ukraine, the corresponding indicators, according to 2020 data, were 40 percent and 16.8 percent, respectively) [10].

In January 2025, the Ukrainian Government approved the Healthcare System Development Strategy for the period up to 2030 and approved an operational plan of measures for its implementation in 2025–2027. The preamble of this Strategy states that “the protection and promotion of motherhood, the health care of mothers and children are guaranteed by the state, necessary for the reproduction of the population and the restoration of the human potential of the entire country” [11]. The fundamental principle of the Healthcare System Development Strategy for the period up to 2030 is the implementation in Ukraine of “the principle of ‘health in all policies’, taking into account health consequences when making decisions among different sectors, seeking synergies and avoiding harmful health consequences in the process of implementing policies in other sectors in order to improve both population health and health equity”. This is provided for, in particular, by strategic objective 2 of the Strategy, which states strengthening intersectoral coordination of state policies affecting the healthcare system. Important principles include further separation of functions of health policy formation and implementation, digitalization, and sustainable and flexible financing of the healthcare system [11].

According to a joint assessment, with total losses to the health system as a result of a full-scale invasion estimated at around US\$17.8 billion, the total recovery needs are at least US\$14.2 billion, of which over US\$872 million are urgent recovery needs in 2024. In addition, the restoration of medical care, organization, and control over its provision in the deoccupied territories will require additional human and material resources [11].

Given the high human, resource, and economic losses caused by a full-scale invasion by the Russian Federa-

tion, the healthcare system must use all available and potentially available medical technologies and solutions that, through early and effective interventions, make it possible to reduce the burden of disease in the future, accelerate recovery, and preserve the country's human potential [11].

A UNDP working group led by Pakistani economist Mahbub ul-Haq developed an integral indicator – the Human Development Index (HDI). This indicator is calculated annually on the basis of three components: life expectancy (evaluates the health status of the population), the average number of years spent on education and the expected duration of education (evaluates the level of education of the population) and gross national income per capita at purchasing power parity in US dollars (evaluates the socio-economic standard of living) [12, 13].

The UNDP Human Development Report 2023–2024 states that numerous protracted geopolitical conflicts caused by the changing balance of power between states are leading to a new set of uncertainties that are worrying all of humanity and hindering its development. For the first time in the history of observations, a decrease in the global Human Development Index was noted – in 2020 and 2021. However, since then the global significance of the HDI has begun to grow, and in 2023 it is estimated to reach a record high level, but despite the projected achievement of a new maximum, the global HDI value is still below trend. At the same time, the global HDI value masks alarming differences between countries: while for all member countries of the Organization for Economic Cooperation and Development is projected to recover, a similar forecast is valid for only about half of the least developed countries [14].

Ukraine's HDI, according to the Human Development Report 2023–2024, is 0.734, making it a country with a high level of human development. Ukraine ranks 100th in the overall ranking out of 193 countries and territories [15].

At the same time, Ukraine is acutely feeling the negative impact of declining human development, as this indicator has dropped to its lowest level since 2004 [15].

Correlation analysis showed for Ukraine in 1990–2019 the interdependence of the economy and medical-social components of the HDI (life expectation at birth and GNI per capita. At the same time, the trend towards stabilization of HDI in Ukraine during the first decades of the 21st century with a simultaneous increase of life expectation at birth from 67.3 (2000) to 72.1 years (2019) and GNI per capita from \$7025 (2000) to \$13216 (2000) is insufficiently embodied in the achievements in public health area [16].

A new UNDP report says that uneven development progress around the world is leaving the poorest countries

behind, deepening inequality and increasing political polarization globally, creating a dangerous impasse that urgently needs to be broken through collective action [15].

The World Bank (2020) [17] introduced another integral indicator – the Human Capital Index (HCI). It is based on three components: Survival (percentage of children who survive beyond age 5), School (expected number of years of schooling before age 18 and harmonized test scores) and Health (percentage of 15-year-olds who survive to age 60) and healthy growth among children (the rate of stunting in children under 5 years of age) [15].

The methodologies for assessing HCI were described in the World Bank publications [18,19]. The researchers stated that human capital, which includes resources related to people's knowledge and skills, is an extremely important element for economic progress. They also noted that to assess it, it is necessary to apply relevant research not only in developed countries (this especially applies to the education component), but also in developing countries. A global comparable database was created for 164 countries representing 98% of the world's population, and two-thirds of the countries included belong to developing countries [18].

According to the 2020 Human Capital Index, Ukraine ranks 53rd out of 174 countries in the world (HCI=0.6314, down 19% from 2010). A child born in Ukraine will grow up to be 63% more productive than they could be if they had

a quality education and good health. This is lower than the average for the Europe and Central Asia region (69%), but higher than for lower-middle-income countries (48%) [19].

According to the World Bank (2019), despite the presence of a highly educated workforce in Ukraine, human capital accounts for only 34% of national wealth (while the average for Europe and Central Asia is 62%), and labor productivity accounts for only 22% of labor productivity in the European Union [20,21].

Thus, the indicated human capital indicators demonstrate the need to correct the relevant strategic documents and their effective implementation.

CONCLUSIONS

Human development indicators from various UN specialized agencies – UNDP and the World Bank – indicate significant challenges faced by the health system as a result of overcoming the consequences of the COVID-19 pandemic, Russia's full-scale invasion of Ukraine as part of a change in the world order. There is a massive disruption of economic activity chains and destruction of infrastructure. The recovery of Ukraine requires a systemic approach, primarily in terms of human potential and human capital development. Current strategic documents need to be updated to take into account new challenges, new initiatives and global leadership.

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CORRESPONDING AUTHOR

Volodymyr V. Korolenko

Krok University

120-A Beresteiska Avenue, 03115, Kyiv, Ukraine

e-mail: v_korolenko@yahoo.com

ORCID AND CONTRIBUTIONSHIP

Tetiana S. Gruziova: 0000-0001-9254-7561   

Volodymyr V. Korolenko: 0000-0002-9735-0896    

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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The use of artificial intelligence in caries detection – literature review

Jakub Fiegler-Rudol¹, Artur Los², Barbara Lipka², Monika Tysiąc-Miśta³

¹FACULTY OF MEDICAL SCIENCES IN ZABRZE, MEDICAL UNIVERSITY OF SILESIA, ZABRZE, POLAND

²DEPARTMENT OF PERIODONTAL DISEASES AND ORAL MUCOSA DISEASES, MEDICAL UNIVERSITY OF SILESIA, KATOWICE, POLAND

³DEPARTMENT OF CONSERVATIVE DENTISTRY AND ENDODONTICS, MEDICAL UNIVERSITY OF SILESIA, KATOWICE, POLAND

ABSTRACT

Artificial intelligence plays an increasingly important role in modern dentistry, offering the possibility of precise and quick diagnostic image analysis and supporting the process of pathology detection. Aim: The study aims to discuss the use of artificial intelligence in caries detection, with an emphasis on radiographs and intraoral imaging analysis, and to assess the potential of this technology in the quality and efficiency of dental diagnostics improvement. Methods: A review of the scientific literature covering the years 2015–2024 was carried out, analyzing the results of studies on the effectiveness of artificial intelligence algorithms in caries detection. Publications evaluating parameters such as sensitivity, specificity, and precision compared to traditional diagnostic methods were included. Results: AI algorithms, particularly convolutional neural networks, present high accuracy, sensitivity, and specificity in caries detection, often outperforming traditional methods in detecting early lesions. The use of artificial intelligence standardizes the diagnosis, shortens the time of analysis, and reduces errors caused by a subjective clinical assessment. Major limitations include the need for high-quality training data, implementation costs, and challenges associated with technology acceptance. Conclusions: Artificial intelligence has the potential to significantly improve caries detection, offering precision, efficiency, and algorithms standardization. However, taking full advantage of its capabilities requires further research, standardization of algorithms, and appropriate adaptation of the clinical environment.

KEY WORDS: artificial intelligence, dentistry, dental caries, X-rays, diagnostic imaging

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INTRODUCTION

Early diagnosis of dental caries plays a key role in the prevention and treatment of dental diseases, enabling not only the early detection of lesions, but also their effective therapy before severe complications occur. Detection of carious lesions at an early stage allows for the application of less invasive treatment methods, such as remineralization or minor composite restorations, which leads to a reduced risk of further tooth destruction, reduced health burden for the patient, and lower the costs of therapy. This approach supports not only patients' health but also optimizes the dentist's working time [1].

Traditionally, caries diagnosis is based on visual and tactile assessment performed during a clinical examination and on the analysis of diagnostic images, such as intraoral radiographs or images taken with intraoral cameras. These tools, although effective, have their limitations. They require a lot of experience, precision, and focus, which can be difficult to maintain during

intensive clinical work [2]. Factors such as differences in the dentist's individual diagnostic perception, professional experience, and fatigue, can lead to diagnostic errors, such as missing minor carious lesions or misinterpreting the images resulting in over-treatment of lesions, which should have been left for observation. Such imperfections can result in delayed treatment or inadequate therapy, which consequently affects the patient's health and the costs of dental care [3].

In this context, artificial intelligence (AI) is becoming one of the most promising tools supporting dental diagnostics [4]. The development of AI technologies, in particular advanced machine learning algorithms such as deep neural networks (DNNs), opens up new possibilities in the analysis of diagnostic images. AI allows for precise identification of even subtle pathological alterations, such as early carious foci, which may be difficult to spot using traditional diagnostic tools [5]. Additionally, these algorithms offer standardization of diagnostic results. The use of AI in dentistry also opens

up new perspectives in the context of working time management and increasing the efficiency of clinical work. AI can not only support doctors in making diagnostic decisions but also accelerate the process of image analysis, which is particularly important in conditions of high workload. By automating many aspects of diagnostics, it is also possible to reduce operating costs in dental clinics, which makes this technology increasingly attractive to both dentists and patients [6].

AIM

This paper aims to provide a detailed discussion of the applications of artificial intelligence in caries detection, with particular emphasis on the analysis of X-ray images and intraoral photographs. The article will analyze the key advantages, limitations, and future prospects of this technology. Particular attention is paid to the potential impact of AI on everyday dental practice and the quality of care provided to dental patients.

MATERIAL AND METHODS

In order to develop this paper, a review of the scientific literature covering the years 2000–2024 was conducted, analyzing the results of studies on the application of AI algorithms in dentistry, with particular emphasis on their effectiveness in caries diagnostics. The PubMed database was used to identify publications on the implementation of AI in the analysis of X-ray images and intraoral photographs. The selection criteria included articles describing the detailed application of AI algorithms in dental diagnostics and studies comparing the effectiveness of AI with the diagnoses made by dentists, including assessments of parameters such as sensitivity, specificity, and precision of detecting carious lesions.

REVIEW AND DISCUSSION

THE USE OF ARTIFICIAL INTELLIGENCE ALGORITHMS IN DENTAL DIAGNOSTICS

Artificial intelligence is becoming increasingly broadly used in dental diagnostics, based on advanced algorithms capable of analyzing diagnostic images. Among the most commonly used technologies, neural networks stand out, including convolutional neural networks (CNN), which are particularly effective in image analysis due to their ability to recognize patterns and structures [7].

Deep Learning models, which are an extension of neural networks, allow for a more comprehensive analysis of large data packages, making them an ideal tool for diagnosing complex cases. In addition, deci-

sion support algorithms (Decision Support Systems) provide dentists with precise diagnostic tips, which can significantly improve the quality of decision-making [8]. One of the key areas is the detection of carious lesions in X-ray images, where algorithms can identify early changes, often invisible to the human eye are interproximal spaces. Another important application is the evaluation of intraoral images for early signs of caries, which allows for rapid intervention and limiting the progression of the disease. Additionally, AI supports image segmentation, enabling precise identification of the boundaries of carious lesions, which is invaluable in treatment planning. Thanks to these capabilities, AI algorithms significantly improve the accuracy and efficiency of dental diagnostics [9].

ADVANTAGES AND LIMITATIONS OF ARTIFICIAL INTELLIGENCE IN CARIES DETECTION

The use of AI in caries diagnostics brings many benefits that can significantly improve the process of detecting pathological changes in tooth structures. One of the most important advantages is high sensitivity and specificity in detecting carious lesions, which allows for precise diagnosis, especially in the case of diagnostic images that are difficult to interpret. The speed of image analysis by AI algorithms is another important advantage, enabling shorter time needed for diagnostics purposes and improved efficiency of clinical work [10]. The use of AI also contributes to reducing errors resulting from human perception, such as fatigue, differences in clinical experience, or subjectivity of image interpretation. In addition, AI offers the potential to standardize diagnosis by eliminating the influence of individual differences in clinical judgment and ensuring consistency in the diagnostic process [11]. Despite these advantages, the application of AI in caries diagnosis is associated with some significant limitations. One of the biggest challenges is the need for large, high-quality data sets for training models, which requires significant time and technological resources [12]. The costs of implementing and adapting AI in dental practices can be a barrier, especially for smaller practices. Another limitation is the problems with the acceptance of the technology by both dentists, who may fear a reduction in their role in the diagnostic process, and patients, who may express distrust towards automatic analysis systems. Furthermore, the current lack of standardization in the development of algorithms is an obstacle to the wide application of AI, hindering the comparability of results and implementation in different clinical environments [13]. Al-Khalifa et al. found that artificial intelligence,

especially neural networks, significantly improves the precision and efficiency of caries diagnosis, surpassing traditional methods and the skills of many clinicians in early detection and risk assessment of the disease [14]. Anil et al. concluded that artificial intelligence, especially machine learning and deep learning techniques such as CNN, significantly improves the accuracy, efficiency, and objectivity of dental caries diagnosis compared to traditional methods, with the potential to move from reactive dental care to preventive and personalized care [15]. Zhang et al. demonstrated that AI-assisted caries detection using intraoral images based on MobileNet-v3 and U-net architectures provides high diagnostic accuracy (93.40%) and specificity (95.65%), with promising clinical potential despite the variability of sensitivity depending on tooth position and caries type, indicating the need for further refinement and multimodal integration [16]. Negi et al. synthesized the findings from systematic reviews, emphasizing that AI models, especially CNN-based systems, show significant potential for the detection and diagnosis of dental caries, achieving high sensitivity, specificity, and accuracy, although ethical issues and solid validation remain crucial for clinical integration [17].

A REVIEW OF CLINICAL AND EXPERIMENTAL STUDIES

Clinical and experimental studies on the use of AI in caries diagnosis provide ample evidence of the effectiveness and limitations of this technology. One seminal study compared the performance of AI algorithms with the results of diagnostics made by dentists. The results showed that AI achieved comparable and in some cases higher, sensitivity and specificity rates, especially in detecting early carious lesions on X-ray images. Another important area of research was the analysis of the results obtained by different algorithms, such as CNN, to assess their ability to identify the borders of pathological lesions. These studies highlight the differences in effectiveness between algorithms, indicating the important role of training data quality and technological parameters [18]. The practical application of AI has also been assessed in the context of real clinical cases some of which AI identified carious lesions undetected by dentists, which allowed for earlier treatment. However, studies have also revealed limitations, such as difficulties in interpreting AI results in the presence of image artifacts or in diagnostically complex situations [19]. The summary of the research results indicates that AI demonstrates high effectiveness in caries diagnosis, comparable to the results obtained by dentists, while significantly reducing the time of image analysis. Ad-

ditionally, the use of AI contributes to cost reduction by increasing the efficiency of diagnostic processes. However, despite these benefits, full integration of AI in dental practice requires further research on the standardization of algorithms and their adaptation to diverse clinical conditions [14-19].

PERSPECTIVES AND THE FUTURE OF ARTIFICIAL INTELLIGENCE IN DENTAL DIAGNOSTICS

The development of artificial intelligence opens up wide possibilities in dental diagnostics, which can significantly change the way medical services are provided in this field. One of the most promising directions is the creation of integrated diagnostic systems that will be built into dental equipment, such as dental chairs, enabling automatic analysis of diagnostic images in real-time. Another important area is the development of personalized algorithms, adapted to individual patient characteristics, such as age, oral health, or medical history, which will allow for even more precise diagnostics. Additionally, combining AI with advanced imaging technologies, including 3D imaging, may enable a more detailed assessment of tooth and bone structures, which will significantly affect the quality of diagnoses [20]. In order for the application of AI in dental diagnostics to become a standard, it is necessary to develop appropriate guidelines for its implementation. A key element of this process is training dentists in the use of AI systems and interpretation of results generated by algorithms, which will allow for their effective use in clinical practice. In addition, it is necessary to develop legal regulations that will define standards for the use of AI in dentistry, including requirements related to the security of patient data and responsibility for diagnostic decisions. An important step will also be the integration of AI with clinics' IT systems, which will enable smooth data flow between different diagnostic tools, as well as facilitate the archiving and analysis of results [21-22]. The prospects for the use of AI in dental diagnostics are extremely promising, but full application of its potential not only requires further technological innovations but also the adaptation of the clinical environment to new tools and work methods.

CONCLUSIONS

Artificial intelligence is becoming a promising tool supporting the diagnosis of caries, especially in the analysis of X-ray images and intraoral photographs. Thanks to the use of advanced algorithms, such as CNN, it is possible to precisely detect early carious changes,

often invisible to the human eye, and standardize the diagnostic process. Clinical studies have shown that AI algorithms achieve high sensitivity, specificity, and accuracy, surpassing traditional methods in some areas, which allows for faster and more objective diagnosis. Despite numerous advantages, such as reducing human errors and improving the efficiency of clinical work, this technology faces challenges, including the need to ensure high-quality training data, acceptance by dentists and patients, and standardization of algorithms. The

future of AI in dental diagnostics is associated with the development of integrated diagnostic systems, personalized algorithms, and advanced imaging technologies. However, full integration of AI in clinical practice requires the development of legal regulations, training for dentists, and further research on the adaptation of these solutions to various clinical conditions. The prospects for the development of AI in dentistry are promising, offering the potential to improve the quality of care and the efficiency of diagnostic processes.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Barbara Lipka

Department of Periodontal Diseases and Oral Mucosa Diseases
Medical University of Silesia,
40-055, Katowice, Poland;
email: barbaralipka.gte@gmail.com

ORCID AND CONTRIBUTIONSHIP

Jakub Fiegler-Rudol: 0009-0009-3173-9389   

Artur Los: 0009-0004-1743-7716   

Barbara Lipka: 0009-0009-8049-0831   

Monika Tysiąc-Miśta: 0000-0001-5750-6174  

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Integrating artificial intelligence in healthcare practice: challenges and future prospects

Natalia V. Bidenko, Nataliia V. Stuchynska, Yurii V. Palamarchuk, Mykola M. Matviienko

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To highlight the features of artificial intelligence application in healthcare, with an emphasis on specific AI solutions and the assessment of risks associated with such integration in ethical and regulatory dimensions.

Materials and Methods: To achieve the research objective, general scientific theoretical and empirical methods were used, including: bibliosemantic method – analysis of scientific, methodological, psychological, pedagogical literature, and regulatory documents on the research problem, system analysis method – to compare and generalize the experience of using artificial intelligence in healthcare, empirical methods – conversations and interviews with participants in the educational process, modeling – to implement a scheme for providing medical care using AI.

Conclusions: Generative artificial intelligence is rapidly developing and is already being used in healthcare. The resources discussed that utilizing artificial intelligence can be used by practicing doctors, patients, as well as higher education students and academic staff in the educational process for examining various clinical cases, better understanding the material, and accessing visualization databases. Therefore, the need to integrate AI technologies into the training process of healthcare professionals at higher medical educational institutions is evident. An important part of the research is addressing the key challenges that arise when applying AI in medicine: ethical and regulatory issues, as well as the difficulties in integrating with existing medical information systems. Further research should be aimed at developing clear recommendations for medical institutions and educational establishments regarding the implementation and use of AI technologies.

KEY WORDS: artificial intelligence, healthcare, medicine, diagnostics, machine learning, digital health, medical education, regulation, ethics

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INTRODUCTION

Currently, artificial intelligence (AI) is quite widespread and adapted to all areas of human activity: medicine (diagnostics, drug development, personalized medicine), finance (credit risk assessment, automated trading operations, fraud prevention), transport (autopilot for cars, logistics optimization), marketing (consumer behavior analysis, advertising), education (adaptive learning, virtual assistants, text generation, information search), manufacturing (process automation, equipment maintenance forecasting), agriculture (crop condition monitoring, yield prediction), cybersecurity (threat detection, network protection, data analysis), law (legal document analysis, automated contract drafting, court case outcome prediction), energy (optimization of energy consumption, power grid management, energy demand forecasting).

The application of AI systems in any field, including healthcare, is associated with certain limitations and challenges [1]. These include data availability and

quality, data bias, AI malfunctions, privacy issues, and the lack of clear transparency mechanisms: since the algorithms on which the system bases its decisions are usually inaccessible to end users, this may complicate trust in the technology, verification of its accuracy, and elimination of potential biases. It is important to note that these are only some of the possible issues and risks associated with artificial intelligence. The development and use of AI require a responsible approach and consideration of ethical aspects.

The integration of AI into biomedical research has been a key trend over the past decade. However, most existing AI models operate within a narrow range of tasks, such as analyzing a single data source (e.g., CT images or DNA analysis). Meanwhile, in clinical practice, doctors consider data from multiple sources simultaneously: medical imaging, electronic medical records, genetic data, wearable device data, and information on social determinants of health. The use of multi-format AI can improve the integration of these

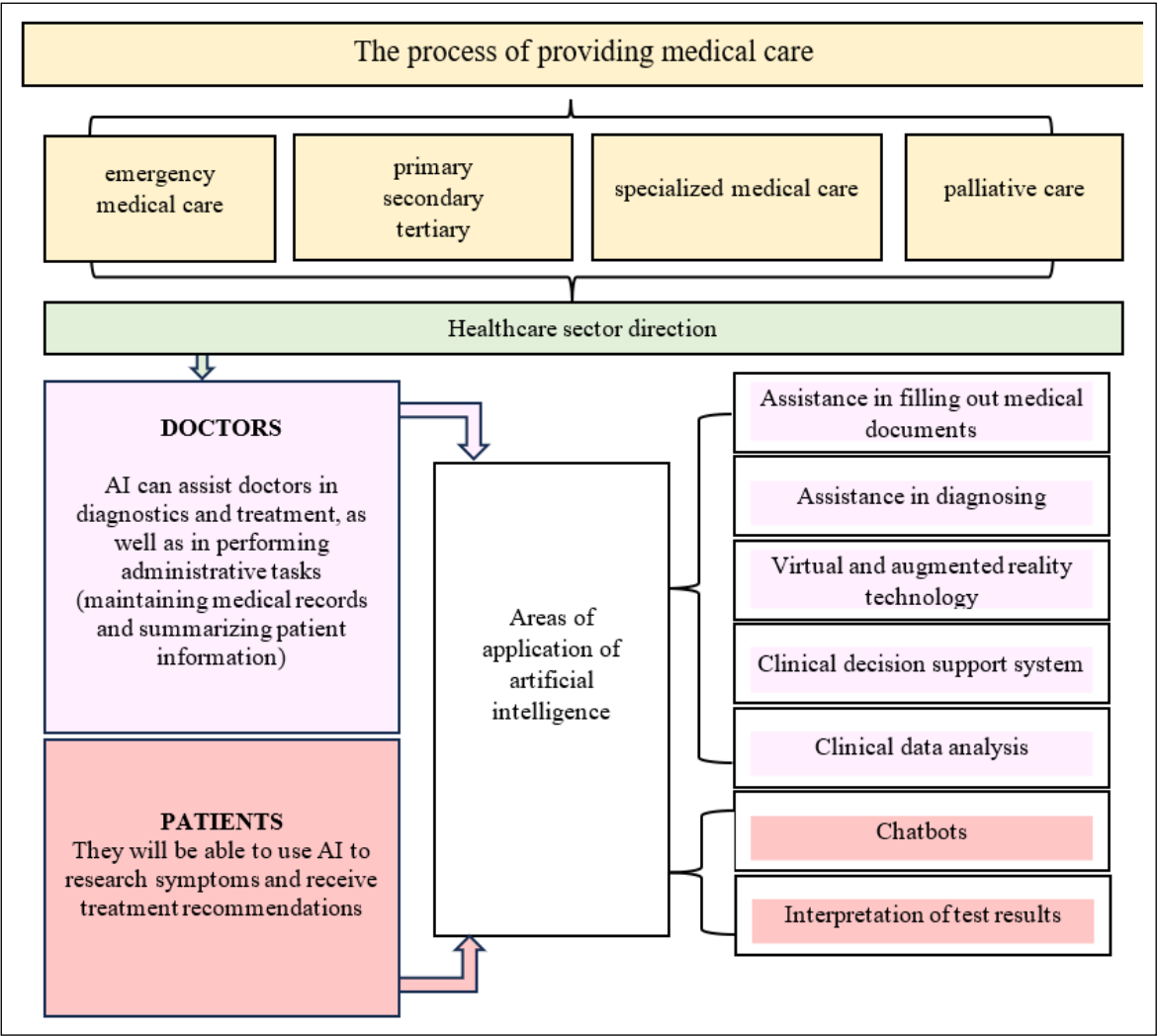


Fig. 1. AI usage diagram: doctor-patient

data, ensuring more accurate diagnostics, prognosis, and treatment.

Artificial intelligence in medicine refers to the use of machine learning models to analyze medical data and extract information that can help improve health conditions and patient experience. Thanks to recent advances in computer science and informatics, artificial intelligence is rapidly becoming an integral part of modern healthcare. AI algorithms and other AI-based applications are used to support medical professionals in clinical settings and ongoing research [2].

AIM

The aim of the article is to highlight the features of artificial intelligence application in healthcare, with an emphasis on specific AI solutions and the assessment of risks associated with such integration in ethical and regulatory dimensions.

MATERIALS AND METHODS

To achieve the research objective, general scientific theoretical and empirical methods were used, including: bibliosemantic method – analysis of scientific, methodological, psychological, pedagogical literature, and regulatory documents on the research problem, system analysis method – to compare and generalize the experience of using artificial intelligence in healthcare, empirical methods – conversations and interviews with participants in the educational process, modeling – to implement a scheme for providing medical care using AI.

REVIEW AND DISCUSSION

For the medical field, a significant number of AI-based integrated systems are currently available. They can be classified by type (text-based, assistants, clinical decision support systems, etc.) or based on the user and area of application (healthcare professionals and administrative staff, patients, etc.) (Fig. 1).

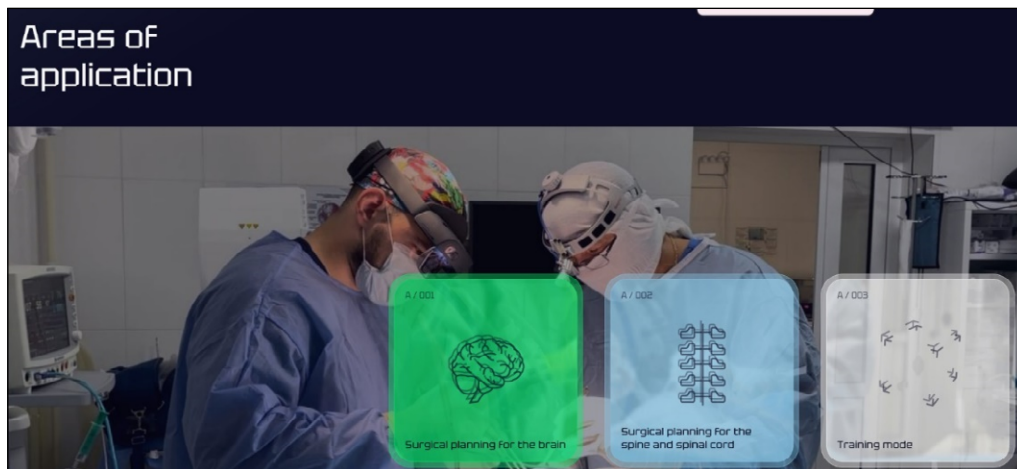


Fig. 2. The page of the Extra Vision platform



Fig. 3. CheckEye platform page

Let's consider the application of some AI-based tools for doctors in practical and scientific activities:

- **Insillico Medicine** [3] – An AI platform used to analyze large volumes of molecular data to identify potential candidates for new drugs.
- **Verily** [4] a company owned by Alphabet (the parent company of Google), uses AI to develop new vaccines and optimize their production. It relies on clinical, sensory, imaging, and omics data to scale research and implement new decision-making models for treatment.
- **Clinithink** [5] The cutting-edge AI technology from Clinithink provides fast analytics based on unstructured healthcare data, allowing pharmaceutical organizations and healthcare institutions to more effectively focus their time, money, and resources, leading to better and more accessible healthcare
- **Viz.ai** [6] A comprehensive AI-based solution aimed at improving neurovascular outcomes. It uses AI to accelerate medical care coordination, reducing system delays between patients and life-saving treatments.
- This innovative use of technology transforms clinical workflows and patient care. The platform includes real-time notification systems that alert healthcare professionals to possible stroke cases, providing critical information as early as possible. Viz.ai offers a secure collaboration platform where doctors and other medical professionals can remotely exchange diagnostic images, simplifying access to specialists' conclusions and helping reduce treatment delays. Additionally, the platform provides links to images, publications, and webinars from top doctors in the US and EU, access to a medical image database, and the possibility to request a demo version.
- **UpToDate** [7] – A clinical decision support resource developed by doctors, based on factual data, that helps healthcare professionals provide the best possible care for patients. The platform offers access to over 12,000 topics covering various medical specialties and contains over 35 million pages of content. It features interactive graphics and videos for better visualization of complex procedures or

Fig. 4. User Registration Page on the Apixmed Platform

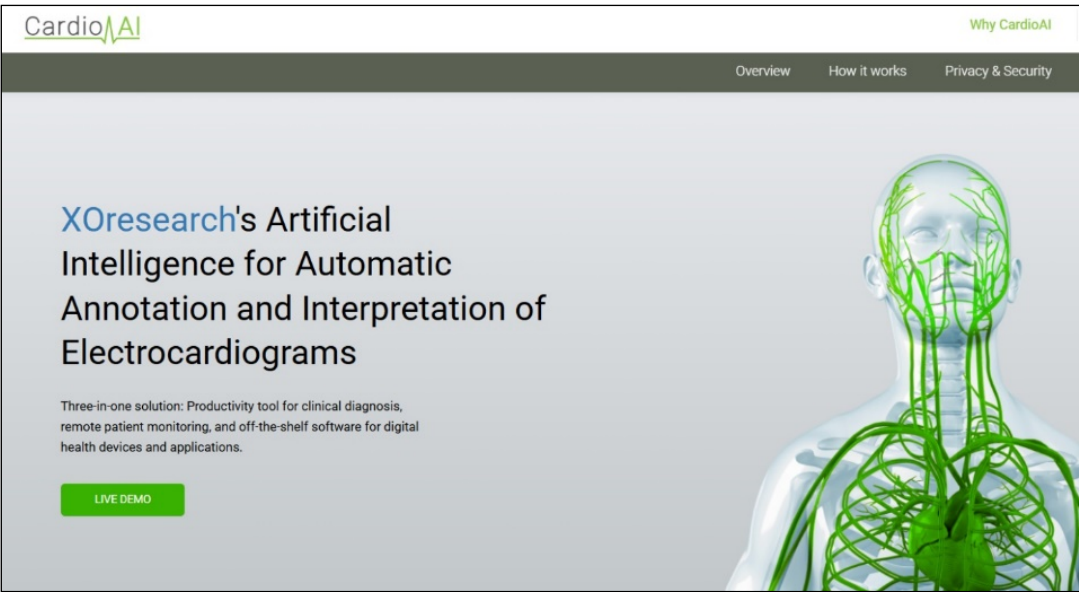


Fig. 5. The page of the CardioAI® service with a demo version option

- diseases. This feature helps users quickly grasp concepts by breaking down complex information into understandable visual guides. The UpToDate mobile app allows users to access the database anytime, anywhere, on their smartphones or tablets, even without an internet connection. The Ministry of Health of Ukraine’s Public Health Center website provides instructions for free access to the resource [8], offering the following benefits:
- remote access from any computer connected to the internet;
 - earning Continuing Medical Education (CME/CE/CPD) credits after completing clinical tasks on the UpToDate site or remotely, including on mobile devices;
 - quick access to useful information with the ability to save browsing history, most visited sections, and bookmarks;
 - automatic synchronization of your browsing histo-

- ry, most visited sections, and bookmarks across all devices with access to UpToDate, from computer to mobile phone;
- notifications about new materials on topics previously searched, whenever information is updated according to new data published in medical literature;
 - electronic “Current UpDate” news every two weeks with important clinical information updates.
- The Ukrainian platform Extra Vision [9] is an innovative resource that uses holographic 3D visualization for objects. The process of creating a 3D model involves several stages: the first stage is the analysis of CT/MRI data; the second stage involves processing the images using cloud technologies and artificial intelligence; based on the processed data, a 3D model is formed, which is then integrated with virtual reality technology through VR glasses (Fig.2).
- **CheckEye** [10] – Ukrainian AI-based platform for mass screening of chronic diseases, making preven-

tive medicine accessible to everyone. The company CheckEye (Fig. 3) developed a cloud solution for detecting diabetic retinopathy using photographic images of the fundus through an ML/AI algorithm. CheckEye enhances early detection capabilities for chronic diseases in collaboration with the Ukrainian Academy of Family Medicine (ACMY). The joint project began at four medical universities in Ukraine in Kyiv (O.O. Bogomolets National Medical University), as well as in Dnipro, Odesa, and Kharkiv. Additionally, screening technologies will be implemented as part of the professional community activities of ACMY, and soon, in one of the communities in Mykolaiv region [11].

- Ukrainian startup Apixmed [12] is a service that analyzes medical and genetic information of a patient to develop an optimal treatment plan for complex diseases (Fig. 4). The result is a personalized report that not only helps select the best therapy but also contains important warnings and recommendations for the most effective and individualized treatment.
- **CardioAI** [13] simplifies and accelerates the interpretation of electrocardiograms (ECG) (Fig. 5). This solution comprehensively integrates various equipment, including ECG machines, Holters, event monitors from different manufacturers, electronic health records (EHR), and ECG analysis software. It allows monitoring the entire process, from receiving the ECG and printing the report to routine medical examinations and outpatient heart monitoring during rehabilitation. The technology enables doctors to remotely monitor high-risk patients, regardless of their location.

Let's consider the application of some AI-based tools for patients:

- **Helsi+** uses AI to expand the capabilities of the Helsi app, offering users new features and an enhanced experience:
 - o **Analysis Decoding** (Helsi+ uses AI to analyze laboratory test results, such as blood and urine tests. The service helps patients understand their results, providing information about potential health risks and recommendations for further action.)
 - o **Personalized Recommendations** (Based on the analysis of medical data and other factors such as age, gender, and medical history, Helsi+ can provide personalized recommendations for a healthy lifestyle, nutrition, physical activity, etc.)
- **911HELP** [14] is an app designed for quick access to emergency services for people with hearing, vision, and mobility impairments. Key functions include transmitting sound, location, and medical information.

- **Medico AI Assistant** [15] – an innovative tool designed to provide medical information, support medical education, and offer advice on a healthy lifestyle. It does not replace professional medical consultations but serves as an additional resource for users who want to better understand their health status. Key functions of Medico AI Assistant:

- o **Providing Medical Information:** The Medico AI Assistant offers comprehensive information on various diseases, their symptoms, and treatment methods. For example, it can explain the pathophysiology of diabetes, its symptoms, and treatment strategies.
- o **Health and Lifestyle Tips:** The Assistant provides practical advice on healthy eating, physical activity, and other aspects of a healthy lifestyle. For example, it can offer dietary recommendations for managing hypertension.
- **Twill by Dario/twill.health** [16] is a platform created to support mental health and assist pregnant women. This paid U.S.-based service is available in 10 languages and offers a demo version. The platform provides access to a vast library of real clinical cases covering various medical specialties such as cardiology, neurology, gastroenterology, etc. The Twill.health platform uses 139 machine learning algorithms to analyze your performance in testing and case studies, then offers personalized learning paths tailored to your level and needs. It also allows medical students from all over the world to collaborate on case studies and discuss complex topics with one another. The platform features various webinars from renowned doctors sharing their knowledge on the results of advanced research.

The Ministry of Digital Transformation of Ukraine is actively working on regulating the use of artificial intelligence (AI). As part of this work, the "Roadmap" [17] and "White Paper" [18] are being developed and implemented to enhance the competitiveness of businesses and integration into global markets, according to EU standards. The main priority is ensuring the safety of citizens in the digital environment. According to current initiatives, businesses are expected to receive the necessary tools to adapt to new technologies, and subsequently, legislation will be developed to ensure effective AI regulation, considering safety requirements and ethical standards. The "White Paper" [18] states that, according to a survey conducted in April 2023 by Kantar Panel Ukraine (online survey, men and women aged 18-55, cities with a population over 50,000 excluding temporarily occupied territories and combat zones, n = 1000), 35% of respondents noticed the use of AI in healthcare.

The article "Conversational Medical AI: Ready for Practice" [19] explores the implementation of the AI assistant

(Mo) in medical consultations via chat. In a study involving 926 patients, AI improved the clarity of responses and overall user satisfaction while maintaining trust and empathy at the level of healthcare providers. Under medical supervision, 95% of the consultations were rated as safe. The research confirms the possibility of successfully integrating AI into medical practice.

In the paper “Transforming Healthcare: Navigating Digital Health with a Value-Driven Approach” [20], it is noted that digital technologies, especially artificial intelligence (AI), are actively transforming the modern healthcare system. Predictive AI, cloud computing, and the Internet of Things (IoT) are already being used in various medical systems, and telemedicine has become a routine practice. Generative AI holds the potential for further changes in the delivery of medical services. Large technology companies such as Microsoft are actively exploring the application of AI, such as integrating ChatGPT into healthcare applications. Thanks to AI and other digital innovations, healthcare is becoming more accessible, efficient, and personalized, contributing to the shift towards a hybrid model of medical service delivery.

In papers [21, 22], the authors analyze the current state of AI use in the educational process at the O.O. Bohomolets National Medical University and propose AI-based learning platforms that can be used to train future doctors. In paper [23], the existing types of artificial intelligence as a digital technology are examined for their further use in the educational process to form the digital competence of future healthcare professionals.

Despite the great prospects, the use of AI in medicine and pharmacy is associated with a number of challenges: ethical issues such as the use of patients' personal data, the potential for discrimination, and other ethical concerns need to be carefully considered; regulatory requirements: the development and implementation of new technologies must comply with current legis-

lation; integration into existing systems: integrating AI systems into existing medical information systems can be complex and costly. Despite these challenges, the future of AI in medicine and pharmacy looks promising. Over time, AI will become an integral part of medical practice, helping to save more lives and improve the quality of life for millions of people.

CONCLUSIONS

Generative artificial intelligence is rapidly developing and is already being used in healthcare. The World Health Organization has developed recommendations for governments, technology companies, and healthcare professionals to ensure the safe and effective use of large multimodal AI models to improve public health.

The resources discussed that utilizing artificial intelligence can be used by practicing doctors, patients, as well as higher education students and academic staff in the educational process for examining various clinical cases, better understanding the material, and accessing visualization databases. Therefore, the need to integrate AI technologies into the training process of healthcare professionals at higher medical educational institutions is evident.

The results obtained allow for predicting the further integration of AI technologies into medical practice as a means to improve the quality of education and establish new standards in healthcare services.

An important part of the research is addressing the key challenges that arise when applying AI in medicine: ethical and regulatory issues, as well as the difficulties in integrating with existing medical information systems.

Further research should be aimed at developing clear recommendations for medical institutions and educational establishments regarding the implementation and use of AI technologies.

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CONFLICT OF INTEREST

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CORRESPONDING AUTHOR

Nataliia V. Stuchynska

Bogomolets National Medical University,
34 Prospect Beresteyskyi, 03680, Kyiv, Ukraine
e-mail: nvstuchynska@gmail.com

ORCID AND CONTRIBUTIONSHIP

Natalia V. Bidenko: 0000-0003-1132-2446   

Natalia V. Stuchynska: 0000-0002-5583-899X     

Yurii V. Palamarchuk: 0009-0002-8517-8352  

Mykola M. Matvienko: 0009-0004-5888-2584   

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Prevention and treatment of diabetic retinopathy in cooperation a family doctor and an ophthalmologist

Taras I. Chaban¹, Tetiana O. Voloshchuk², Ivan M. Dzeman¹, Ivanna V. Shevchenko³

¹ESC «INSTITUTE OF BIOLOGY AND MEDICINE» OF TARAS SHEVCHENKO KYIV NATIONAL UNIVERSITY, KYIV, UKRAINE

²REGIONAL SPECIALIST HOSPITAL IN WROCŁAW, POLAND

³ELMED CLINIC, TORUN, POLAND

ABSTRACT

Aim: This review explores the synergistic role of general practitioners and ophthalmologists in the prevention, detection, and management of diabetic retinopathy, highlighting the importance of collaborative care between these specialties.

Materials and Methods: A systematic literature review spanning 2014 to 2024 was conducted using databases such as PubMed, MEDLINE, Scopus, and the WHO. Studies selected included original research, reviews, and guidelines focusing on the collaborative roles of family physicians and ophthalmologists in managing diabetic retinopathy.

Conclusions: Effective management of diabetic retinopathy necessitates close collaboration between general practitioners and ophthalmologists. General practitioners are vital in early detection and managing systemic risk factors like glucose and blood pressure, which are crucial for preventing retinopathy. Ophthalmologists play a critical role in diagnosing, monitoring, and treating retinal changes, ensuring timely intervention to prevent severe complications. This integrated approach significantly enhances patient outcomes, highlighting the need for coordinated care strategies in diabetic retinopathy management.

KEY WORDS: diabetic retinopathy, general practitioners, ophthalmologist

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INTRODUCTION

Diabetic retinopathy is a diabetes-related eye condition that affects the blood vessels in the retina, potentially leading to vision impairment or blindness. It occurs when high blood sugar levels damage the tiny blood vessels in the retina, causing them to swell, leak, or close off, leading to abnormal blood vessel growth. If left untreated, it can progress to severe vision loss. Early detection through regular eye exams is crucial for prevention and management [1].

According to estimates from the International Diabetes Federation (IDF), there will be 700 million people with diabetes mellitus (DM) worldwide by 2045, up from 463 million in 2019 [2]. Family doctors play a key role in the early detection and management of diabetes mellitus, which is the main cause of diabetic retinopathy. They monitor your overall health, including your blood glucose, blood pressure and cholesterol, which are important factors in the risk of developing or progressing diabetic retinopathy. The family doctor also plays an important role in educating patients on self-management of diabetes and its complications.

An ophthalmologist specialises in the examination and treatment of eye lesions caused by diabetic retinopathy. They conduct regular retinal examinations, which allows them to detect changes in the eyes in time and prevent serious complications. In addition, an ophthalmologist can perform specific procedures such as laser treatment or injections to reduce retinal swelling or prevent blood vessel formation. Thus, both specialists play an important role in the prevention of diabetic retinopathy.

AIM

The aim of the study is to analyse the role of interaction between a general practitioner – family doctor and an ophthalmologist in the detection, prevention and treatment of diabetic retinopathy based on the analysis of the literature over the past 10-15 years.

MATERIALS AND METODS

A systematic literature review was conducted from 2014 to 2024. The search was conducted in PubMed,

MEDLINE, Scopus, and the World Health Organization (WHO) databases. The inclusion criteria included original research articles, reviews, and official guidelines that discussed the role of family physicians and ophthalmologists in identifying symptoms of diabetic nephropathy, its prevention, and treatment.

REVIEW AND DISCUSSION

Diabetic retinopathy is a complication of diabetes that affects the eyes. Here are some of the main causes of its development [3]: High blood glucose levels: Long-term high blood glucose levels can damage the blood vessels in the retina, causing them to narrow, block or leak blood and fluid. Duration of diabetes: The longer a person lives with diabetes, the higher the risk of developing diabetic retinopathy. Uncontrolled blood pressure: High blood pressure can contribute to additional damage to the blood vessels in the retina. Cholesterol and fats in the blood: High levels of lipids in the blood can contribute to the accumulation of fatty deposits in the retinal vessels, which also worsens the condition. Smoking: Smoking can impair blood circulation and exacerbate vascular damage.

High blood glucose is a major risk factor for diabetic retinopathy, a serious complication of diabetes that affects the eyes. Elevated blood glucose levels contribute to this condition through vascular damage, microaneurysm formation, oxygen deficiency, macular edema, and progression to proliferative diabetic retinopathy. Over time, high blood glucose levels can cause damage to the blood vessels of the retina, the light-sensitive tissue in the back of the eye. This damage can lead to weakening, blockage or leakage of the vessels. As a result of high blood sugar levels, bulges known as microaneurysms can form on the walls of the retinal blood vessels. These can leak fluid and blood into the retina, leading to swelling and vision problems. Blocked blood vessels can restrict the flow of oxygen to the retina, leading to ischaemia. When parts of the retina lack oxygen, new fragile blood vessels can start to grow, a process called neovascularisation. These new vessels are prone to bleeding and can further impair vision. Prolonged high glucose levels can cause fluid to build up in the macula, the central part of the retina that is responsible for detailed vision. This swelling, known as macular edema, can distort vision and make tasks such as reading or driving difficult. If left untreated, non-proliferative diabetic retinopathy (where no new blood vessels have formed) can progress to proliferative diabetic retinopathy. In proliferative diabetic retinopathy, the growth of new blood vessels and scar tissue can lead to severe vision loss and even blindness [4].

Nutrition experts who specialise in the impact of diet on diabetic complications, particularly diabetic retinopathy, have shown how diets high in sucrose affect disease progression and the effectiveness of dietary modification, highlighting the role of dietary sugar in exacerbating this condition. He developed strategies for changing diets to prevent vision loss [5]. Drugs that reduce blood glucose levels have been shown to prevent the development of diabetes complications [6].

The study [7] indicates that diabetic retinopathy is the most common complication of diabetes mellitus, with risk factors including disease prolongation, poor glycaemic control. The duration of diabetes is a critical factor in the development of diabetic retinopathy. Diabetic retinopathy is one of the most common complications of diabetes and affects the blood vessels in the retina, potentially leading to vision loss. The duration of diabetes affects the development of this condition. It progresses over time, so that the risk of developing diabetic retinopathy increases with the length of time a person has diabetes. Studies have shown that almost all people with type 1 diabetes and more than 60% of those with type 2 diabetes will develop some form of diabetic retinopathy within 20 years of diagnosis. Glycaemic control shows that longer-term diabetes combined with poor glycaemic control (high blood sugar) significantly increases the risk of developing diabetic retinopathy. High blood sugar levels eventually damage the small blood vessels in the retina, impairing retinal health and function. Early onset of diabetes means that people diagnosed with diabetes at a younger age often have the disease for longer, which increases the overall risk of complications, including retinopathy. For example, those diagnosed with type 1 diabetes in childhood or adolescence are more likely to develop retinopathy at an earlier age than those diagnosed with type 2 diabetes at age 50. Biological changes occur as the duration of diabetes increases, as various biochemical mechanisms contribute to vascular damage. These include glycation end products, oxidative stress and inflammation, which affect the integrity of the retinal vessels. Screening and early detection are important. Regular eye examinations are recommended for people with diabetes because the risk of retinopathy increases with the duration of the disease. Early detection through regular eye exams can lead to timely treatment, potentially slowing the progression of the disease. Thus, the longer someone has diabetes, the more likely they are to develop diabetic retinopathy. Effective blood sugar management and regular eye examinations are key strategies to reduce this risk.

Uncontrolled blood pressure is another significant risk factor for the development and progression of diabetic

retinopathy. High blood pressure in combination with diabetes significantly increases the risk and severity of changes in the blood vessels of the eyes. Blood pressure may affect the development of diabetic retinopathy due to increased damage to blood vessels, accelerating the development of retinopathy and creating an obstacle to treatment. High blood pressure puts additional pressure on the walls of blood vessels, making them more susceptible to damage. In the retina, this can accelerate the destruction of thin blood vessels that are already compromised by high blood sugar, accelerate the development of retinopathy, and increase the risk of complications. In patients with diabetes mellitus, the simultaneous existence of high blood pressure can accelerate the progression of retinopathy from its early to more advanced stages. The combination of hypertension and diabetes increases the likelihood of developing both proliferative diabetic retinopathy and diabetic macular edema, two serious forms that can lead to vision loss. High blood pressure can cause blood vessels to narrow, reducing blood flow to the retina. This reduced blood flow can increase ischaemia (lack of oxygen) in the retina, which in turn can trigger the formation of fragile new blood vessels that bleed easily. Having both high blood pressure and diabetes increases the risk of complications such as vitreous hemorrhage, when bleeding occurs into the gel-like substance that fills the eye; tractional retinal detachment, when scar tissue pulls the retina away from its normal position; and neovascular glaucoma, a type of eye pressure problem that can cause pain and vision loss. Uncontrolled hypertension can also affect the effectiveness of diabetic retinopathy treatment. Treatments such as laser therapy or surgery may have less favourable outcomes in patients whose blood pressure is not properly controlled.

To minimise the risk of developing diabetic retinopathy, it is very important for people with diabetes and high blood pressure to effectively manage both conditions. This includes following treatment plans to control blood pressure, maintain optimal blood sugar levels and regular monitoring with comprehensive eye exams to detect and address changes in the retina early [1,8,9].

Cholesterol and fats in the blood, especially high LDL cholesterol and triglycerides, can significantly affect the development and progression of diabetic retinopathy through damage to blood vessels, increased risk of complications, oxidative stress and inflammation. Elevated LDL cholesterol and triglyceride levels can lead to the development of fatty deposits in blood vessels, a condition known as atherosclerosis. In the retina, this can cause blood vessels to narrow and block, reducing blood flow and oxygen supply to the retinal tissues. The

presence of high cholesterol and triglycerides in people with diabetes can increase inflammation and damage to the blood vessels in the retina. This contributes to a higher risk of both non-proliferative and proliferative diabetic retinopathy, where the latter involves the growth of new fragile blood vessels that are prone to leakage and bleeding. Both cholesterol and triglycerides can contribute to oxidative stress and inflammation in the vascular system. These processes can further damage the blood vessels in the retina, leading to complications such as macular edema, when fluid leaks into the retina and causes swelling. Interaction with other risk factors: The effects of cholesterol and triglycerides are often compounded by other risk factors, such as hypertension and poor glycaemic control in diabetes. Together, these conditions can lead to more serious vascular changes in the retina. Controlling cholesterol and triglyceride levels is an important part of the treatment of diabetic retinopathy. Statins and other lipid-lowering medications may be prescribed to reduce the risk of retinopathy progression and improve the overall cardiovascular health, which is closely related to eye health [10]. For patients with diabetes mellitus, it is extremely important to monitor and control blood lipid levels along with blood glucose and blood pressure to reduce the risk of diabetic retinopathy and other diabetes-related complications [11].

Smoking is a significant risk factor for the development and progression of diabetic retinopathy. The impact of smoking on diabetic retinopathy is multi-faceted, influencing various biological pathways that exacerbate the condition. Tobacco use contributes to the damage of the blood vessels throughout the body, including those in the retina. Nicotine and other harmful chemicals in cigarettes cause the blood vessels to constrict and their walls to thicken, reducing blood flow to the retina. This can exacerbate ischemia (lack of oxygen) and promote the formation of fragile new blood vessels prone to leaking and bleeding. Smoking increases oxidative stress by generating free radicals, which can damage the cells and tissues of the retina. The retina is particularly vulnerable to oxidative stress due to its high metabolic activity and exposure to light. Smoking induces inflammation, which can further damage retinal blood vessels and contribute to the progression of diabetic retinopathy. Chronic inflammation is known to exacerbate vascular diseases and is a key factor in the worsening of diabetic complications.

Tobacco use affects the rheological (flow) properties of blood, making it more viscous and harder to flow through small capillaries, such as those in the retina. This can lead to blockages and reduced oxygen supply to retinal tissues. Smoking can worsen the lipid

profile by increasing levels of bad cholesterol (LDL) and decreasing good cholesterol (HDL). This can lead to the development of atherosclerosis, which is already a risk factor for diabetic retinopathy. Tobacco use may interact synergistically with other risk factors such as high blood pressure, poor glycemic control, and high cholesterol, thereby magnifying the risk and severity of diabetic retinopathy. Smoking impairs the body's ability to heal, which can slow the recovery from retinal injuries and surgeries. This can impact the effectiveness of treatments for diabetic retinopathy, such as laser therapy or surgical interventions. Given these impacts, it is highly recommended for individuals with diabetes to quit tobacco use as part of their overall management strategy to prevent the onset and progression of diabetic retinopathy [12-14].

General practitioners (GPs) or family doctors play a crucial role in managing diabetes and thereby reducing the risk of diabetic retinopathy through several interventions and strategies. Here's how they can influence high glucose levels in patients [15]: Early Diagnosis and Regular Monitoring: GPs can identify symptoms of high blood glucose and diagnose diabetes early through regular check-ups and screening tests. Early detection allows for prompt management, which is crucial in preventing complications like diabetic retinopathy. Education is a key aspect of diabetes management. GPs can educate their patients about the importance of maintaining good blood glucose control, the risks associated with poor control, and lifestyle changes needed to manage their condition effectively [16]. GPs often manage and adjust medications to ensure effective blood glucose control. This includes prescribing or adjusting dosages of insulin and other glucose-lowering drugs. They also monitor the patient's response to these medications and make changes as needed. Advising patients on diet and exercise is a fundamental part of diabetes management. GPs can provide guidance on nutrition, including recommendations on carbohydrate intake, portion control, and avoiding high-sugar foods. They also recommend regular physical activity, which helps improve insulin sensitivity and glucose metabolism [17]. Because excess weight can affect diabetes management, GPs often work with patients to develop weight loss strategies, if necessary. This might include dietary consultations and exercise regimens tailored to individual needs [18]. GPs can refer patients to ophthalmologists for regular eye exams to monitor the health of their eyes, allowing for early detection and treatment of retinal changes before they progress to severe diabetic retinopathy. General practitioner or family doctor manage comorbid conditions such as hypertension and hyperlipidemia, which are risk factors

for the development of diabetic retinopathy. Proper control of these conditions can significantly reduce the risk of eye complications.

Smoking can exacerbate the effects of diabetes on the vascular system, including the blood vessels in the eyes. GPs can offer resources and support for smoking cessation.

GPs often coordinate care with other health professionals, such as endocrinologists, dietitians, and diabetes educators, to provide a comprehensive management plan that addresses all aspects of diabetes care. Regular follow-ups help general practitioner or family doctor monitor their patients' adherence to treatment plans, understand barriers they might face, and provide ongoing support and motivation. This continuous engagement is crucial in managing chronic conditions like diabetes. By implementing these strategies, GPs can significantly influence the management of high blood glucose in their patients and reduce the risk of complications such as diabetic retinopathy.

The study [19], aimed to assess diabetic retinopathy (DR) prevalence and its associated risk factors in adult type 1 diabetes patients. This cross-sectional analysis included 1,464 patients. It found a DR prevalence of 50.1%, with variations across different severity stages. Significant risk factors included male gender, older age, smoking, higher BMI, presence of nephropathy and neuropathy, elevated HbA1c, and longer diabetes duration. This study underscores the high prevalence of DR in type 1 diabetes and highlights critical risk factors that could guide preventive and management strategies.

The study [20] analyzed the prevalence and predictors of diabetic retinopathy (DR) in patients with long-standing type 1 diabetes who have maintained good glycemic control. Conducted on 384 patients, the study found a relatively low prevalence of DR (39.1%), with severe cases being rare (8.1%). Risk factors identified included duration of diabetes, HbA1c levels, LDL levels, and the presence of other micro- and macrovascular complications.

The incidence of diabetic retinopathy in patients with type 1 diabetes is significantly influenced by the duration of the disease and glycemic control. Studies have shown that intensive diabetes management, which maintains lower blood glucose levels, can substantially reduce the risk of developing this condition. Early and sustained intervention is crucial in preventing the onset and progression of diabetic retinopathy in individuals with type 1 diabetes [21]. The study titled "Prevalence of diabetic retinopathy in patients with newly diagnosed type 2 diabetes: A systematic review and meta-analysis" assessed the global prevalence of diabetic retinopathy among patients newly diagnosed with type 2 diabetes.

The analysis included data from 77 studies involving 99,847 patients across 26 countries. It found a pooled prevalence of diabetic retinopathy at 13.1%. The study highlights the need for routine ophthalmic assessments at diagnosis to manage this prevalent complication effectively [22].

Diabetic retinopathy often presents subtly and progresses without noticeable symptoms in the early stages [23]. Common signs and symptoms become more apparent as the condition advances. Initially, patients may experience mild vision problems and difficulty perceiving colors. As DR progresses, more severe symptoms can manifest, including: Blurred Vision: this can occur as the blood vessels in the retina start to leak, leading to swelling and distortion of vision. Spots or Dark Strings Floating in Vision (Floaters): caused by bleeding from abnormal retinal blood vessels. Vision Loss: occurs when the macula, the part of the retina that provides sharp, central vision, is damaged. Difficulty with Night Vision: as retinal damage progresses, night vision can be impaired.

Diagnosis of diabetic retinopathy primarily involves a comprehensive eye examination, which includes visual acuity testing, dilated eye exams using an ophthalmoscope to look at the retina and optic nerve, and possibly fluorescein angiography or optical coherence tomography (OCT) to capture detailed images of the eye structures. Regular screening is crucial, as early stages of diabetic retinopathy typically do not present noticeable symptoms. The American Diabetes Association recommends that individuals with type 1 diabetes begin receiving comprehensive eye examinations within five years of their diabetes diagnosis and at the time of diagnosis for those with type 2 diabetes. Following the initial exam, further screenings should be conducted annually, or more frequently depending on the individual's health status and control of their diabetes. Effective screening and early diagnosis can prevent progression and manage the risk effectively, minimizing the chances of severe vision impairment [24,25].

The treatment of diabetic retinopathy (DR) has evolved significantly over the years and includes a combination of medical interventions, lifestyle adjustments, and in some cases, surgical procedures. Currently, there are the following modern treatment strategies:

Laser Surgery: Laser photocoagulation is a common treatment for both non-proliferative and proliferative diabetic retinopathy. This procedure helps seal off leaking blood vessels and reduce the growth of new, abnormal blood vessels. **Intravitreal Injections:** Anti-vascular endothelial growth factor (VEGF) agents are injected into the eye to inhibit the proteins that stim-

ulate abnormal blood vessel growth. This treatment is particularly useful for managing diabetic macular edema (DME) and proliferative diabetic retinopathy (PDR). **Corticosteroids:** Intravitreal corticosteroids can be used to reduce inflammation and macular edema in some patients with diabetic retinopathy. **Vitrectomy:** In advanced stages of PDR, especially when there is vitreous hemorrhage or tractional retinal detachment, a vitrectomy may be performed to remove blood and scar tissue from the middle of the eye. **Control of Blood Glucose, Blood Pressure, and Lipids:** Managing diabetes effectively is crucial in slowing the progression of diabetic retinopathy. Good control of blood sugar, blood pressure, and cholesterol levels can significantly reduce the risk of vision loss. **Regular Monitoring and Screening:** Early detection through regular eye exams is vital for preventing severe diabetic retinopathy and vision loss. This includes dilated eye exams and possibly the use of imaging technologies like optical coherence tomography (OCT) and fluorescein angiography [26].

Therefore, effective management of diabetic retinopathy requires close collaboration between general practitioners (GPs) and ophthalmologists. GPs play a crucial role in early screening and management of systemic factors such as blood glucose, hypertension, and cholesterol, which can mitigate the onset and progression of diabetic retinopathy. Regular coordination with ophthalmologists ensures that patients receive timely and thorough eye examinations and appropriate interventions for retinal problems. This integrated approach to treatment improves early detection, improves treatment outcomes, and prevents serious complications associated with diabetic retinopathy, thereby preserving vision and overall quality of life.

CONCLUSIONS

General practitioners and ophthalmologists play a crucial role in the management of diabetic retinopathy. Both play a vital role in a multidisciplinary approach to prevent vision loss in patients with diabetes.

General practitioners focus on early detection and treatment of diabetes to prevent the onset of retinopathy. They monitor and control blood glucose, blood pressure and cholesterol levels, educate patients on diabetes management and refer them for regular eye examinations.

Ophthalmologists specialize in eye care, performing detailed retinal examinations for early detection and treatment of retinopathy. They perform specialized eye-related interventions such as laser treatments and injections to prevent serious complications.

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CORRESPONDING AUTHOR

Taras I. Chaban

Taras Shevchenko Kyiv National University

64/13 Volodymirska st., 01601 Kyiv, Ukraine

e-mail: chaban.taras@knu.ua

ORCID AND CONTRIBUTIONSHIP

Taras I. Chaban : 0000-0002-4310-5465   

Tetiana O. Voloshchuk: 0009-0006-7314-5050  

Ivan M. Dzeman: 0000-0002-1108-3492 

Ivanna V. Shevchenko: 0009-0003-5118-4946 

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Current issues in neuropsychonutrition in the professional training of medical students

Natalia V. Velyka, Sergiy T. Omelchuk, Tetiana I. Anistratenko, Olena V. Kuzminska

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To analyze the impact of nutrients and food components on a person's psychological state and to justify the need to study nutrition among general medical students and future medical psychologists.

Materials and Methods: Collection, critical, constructive analysis of scientific literature. Analysis of psychosomatic and somatopsychological disorders associated with nutrition.

Conclusions: Nutrition is the cornerstone of health, harmonious physical and mental development of the individual. Therefore, doctors, including medical psychologists must know the composition and the main therapeutic, dietary, and parapharmacological properties of food products and spices, and their impact on somatic health and the psychological status of patients. This knowledge is a prerequisite for a high professional level and the possibilities of alimentary prevention and parapharmacological, non-medication correction. The study of nutrition deepens knowledge of the basics of rational nutrition for a healthy person, lays the foundations of propaedeutics of dietetics and psychonutritionology, and takes into account modern scientific developments and achievements of medical science.

KEY WORDS: food components, brain, central nervous system, memory, attention, intellect

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INTRODUCTION

The rapid pace of modern life, social problems and upheavals, the expansion and complication of spheres of activity, the implementation of intensive, technologies in production and educational processes, and the increased demands on the level of general and specialized professional training require enhanced concentration, memory, mental work capacity, intellectual level, and stress resistance. At the same time, military actions, adverse political, socio-economic conditions, environmental factors, uncontrolled flow of diverse information negatively affect general and mental health, reduce the adaptive capabilities of the body, impair mental work capacity and the intellectual level of the population. Therefore, diagnosis (and, if necessary, timely correction) of the psychosomatic status of the organism is an important component of human health.

The world-famous psychologist and developer of the modern scientific and practical doctrine of intelligence, R. J. Eysenck, rightly believed that it was impossible to study and apply all the factors that can influence intelligence within the framework of psychology. He argued that attempts to influence intelligence exclu-

sively through social, educational conditions, and the environment are ineffective, and the only possible way to overcome such stagnation is to improve and purposefully correct nutrition [1-3].

Nutrition is a factor of daily influence on the organism, which can be used not only to satisfy physiological needs for nutrients, energy, and maintenance of life processes, but also for the purpose of targeted correction of metabolic processes. Scientific research scientists has proven the role of certain nutrients and non-nutritive substances in food products in the functioning of the nervous system and the course of neuropsychiatric reactions [4, 5]. This justifies the establishment of a separate direction in the science of nutrition – neuropsychonutritionology, which defines the mechanisms of influence of nutrients, non-nutritive, and parapharmacological substances of food products, spices, aromatic plants, and phytodietary compositions on the psycho-emotional sphere, memory, intellect, mental work capacity, and adaptive capabilities of the organism [4, 6].

Therefore, the subject of study in neuropsychonutritionology should be considered as the integral assessment of the directed action of food components

(macro-, micronutrients, and non-nutritive regulatory substances) on the processes of higher nervous activity, the speed of mental reactions, operational and abstract thinking, and ultimately, on the level of intellect [5, 7-10]. The importance of doctors of various specialties mastering the basic principles of nutrition science is based on the role of nutrition in the physical and psychological development and health.

Modern medical education in Ukraine, as well as in leading universities in Europe and America, pays significant attention to the study of nutrition at various stages of specialist training, which allows expanding the professional possibilities of future doctors.

Understanding the mechanisms of the impact of natural food products on the body (healthy and ill individuals), which possess nutritive, parapharmacological and therapeutic properties, allows their use in comprehensive medication-diet therapy (for the treatment of acute diseases – with the aim of enhancing treatment effectiveness; in rehabilitation, preventive, and health programs – with the aim of activating reparative processes, preventing complications, and enhancing the body's resistance to the influence of any negative factors). In these conditions, nutrition is practically the only appropriate and safe means as well as a justified alternative to allopathic methods [11-15].

AIM

To analyze the impact of nutrients and food components on a person's psychological state and to justify the need to study nutrition among general medical students and future medical psychologists.

MATERIALS AND METHODS

Collection, critical, constructive analysis of scientific literature. Analysis of psychosomatic and somatopsychological disorders associated with nutrition. The research involved more than 120 sources of literature in English and Ukrainian; various electronic databases were used, in particular <https://pubmed.ncbi.nlm.nih.gov/>, <https://www.sciencedirect.com/>, <https://www.scopus.com/home.uri>, <https://scholar.google.com.ua/>, <http://ir.library.nmu.com/>.

REVIEW AND DISCUSSION

Numerous studies have proven the role of certain nutrients in brain function processes. Proteins are sources of essential amino acids, which participate in anabolic and regulatory processes in brain tissues. For example: L-glutamic acid and glycine are inhibitory neurotrans-

mitters (they activate the processes of protective inhibition in the central nervous system (CNS), reduce psycho-emotional strain, normalize falling asleep and sleep); Glutamine is a precursor of glutamic acid (increases the level of gamma-aminobutyric acid (GABA), necessary for normal brain function and mental activity, is part of glutathione, stimulates protein metabolism and oxidative-reductive processes in the brain, participates in the transport of potassium ions and amino groups in neurons and in binding ammonia, which leads to improved mental endurance, memory, and intellect); Tyrosine is a precursor of neurotransmitters – dopamine, adrenaline, and noradrenaline (participates in the synthesis of thyroid hormones, stimulates the synthesis of melatonin, acts as a natural antidepressant and a mild psychostimulant); Threonine regulates the transmission of nerve impulses; Tryptophan is a precursor to the neurotransmitter serotonin (helps ensure emotional stability); Phenylalanine regulates the function of the thyroid gland, participates in the synthesis of adrenaline and noradrenaline, and acts as a natural antidepressant; L-tryptophan alleviates anxiety, insomnia, attention disorders, hyperactivity; Choline is a substrate for the synthesis of acetylcholine; Cysteine is part of glutathione (necessary to assimilate selenium and maintain oxidative-reductive homeostasis in the brain) [9, 16].

Traditional, complete sources of essential amino acids are only animal-derived proteins (meat of animals and poultry, fish and marine organisms, milk and dairy products, eggs). The widespread belief among vegetarians, particularly in its strictest form—veganism—that plant products (legumes, nuts, mushrooms, etc.) can fully satisfy the need for proteins and essential amino acids, is mistaken. Scientifically, it has been proven that the bioavailability of plant proteins is lower, and the amount of essential amino acids is significantly less, which is reflected in the reduced biological value of these proteins (amino acid score below 0.55, protein efficiency ratio (PER) below 1.0, net protein utilization (NPU) below 0.5 [17]. In particular, a comparative analysis of the biological value indicators of milk protein casein and soy proteins shows that the anabolic efficiency of milk protein is five times higher than soy proteins [18]. Thus, the principled stance of physicians and psychologists regarding the spread of vegetarianism and, in particular, the forced vegetarian diet in children is absolutely objective. An official decision on this matter was made at a regular meeting of the WHO Expert Committee back in 2012. In this decision, vegetarianism and raw foodism were officially classified under group F 63.8 – mental disorders of habits and impulses that require treatment [19].

Fats are an important component of nutrition, directly involved in the formation of nervous tissues, the course of a number of physiological processes, including peroxidation, and the regulation of brain functions. Specifically, phospholipids form the sphingomyelin sheaths of brain neurons. A proven correlation exists between mental health, memory, learning abilities, level of intellect, and the content of phospholipids (lecithin) in the diet. A deficiency in lecithin slows cognitive processes regardless of age. Clinical signs of phospholipid deficiency in children are quite numerous and varied. In children of early years, a deficiency of phospholipids can lead to intracranial hypertension, and delays in psychomotor and speech development are noted. Classic manifestations of phospholipid deficiency in children include behavioral disorders (psycho-emotional imbalance, irritability, tearfulness), cognitive functions (reduced ability to concentrate, memory impairment, slowed thinking processes), decreased motor activity, and increased brain fatigue [9, 17, 18].

Classic sources of phospholipids (lecithin) are sunflower seeds, legumes (beans, peas, soybeans, chickpeas, lentils), nuts, egg yolks, and unrefined sunflower and soy oils. In its refined form, lecithin is obtained from sunflower meal (the solid residue of oilseed after oil extraction) and soy, and is available in the form of dietary supplements, including lecithin itself or as a separate supplement "Lecithin", which is widely used in the therapy of atherosclerosis and brain function disorders.

Important psychonutrientological effects of polyunsaturated fatty acids (PUFAs) Omega-3 have been established. They serve as the biological substrate for the synthesis of prostacyclins, which provide help prevent atherosclerosis and thrombosis in brain vessels. Docosahexaenoic (DHA) and eicosapentaenoic (EPA) acids, through the prostacyclin system, participate in antioxidant and anti-inflammatory mechanisms, and affect the development of intellect and cognitive activity in childhood. A deficiency of Omega-3 PUFAs in brain tissues leads to neurocognitive dysfunctions – Attention Deficit Hyperactivity Disorder (ADHD). Furthermore, a decrease in the levels of DHA and EPA can lead to manifestations of aggression, anxiety, depression, and dementia [18, 20].

The role of DHA in the therapy and prevention of dementia, age-related cognitive decline, depression, stroke, vision disorders, and neurological pathology in children has been determined. The use of Omega-3 PUFAs is especially important in the treatment of Attention Deficit Hyperactivity Disorder (ADHD) in children [19-21].

The most important natural sources of Omega-3 PUFAs are the fat of marine fish and nuts, among which

walnuts ranking highest in this indicator, flaxseed, and flaxseed oil. Leading companies worldwide have begun production of dietary supplements containing Omega-3 PUFAs with standardized content of DHA and EPA, which are widely used in geriatrics, cardiology, and neurology.

An important consideration that must be taken into account when comprehensively assessing the balance of diets for ensuring higher nervous activity, including the speed of mental processes, processing and assimilation of information, and the overall level of intellect, is the adequate energy provision for brain functioning. It is known that mental processes are energy-intensive and require the energy of macroergic compounds, evidenced by an increase in glucose consumption from 12 to 59% when the activity of the cerebral cortex increases. Thus, the main nutrition of the brain is provided through the aerobic oxidation of glucose. It is known that glucose is the only carbohydrate that circulates in the bloodstream in its free form and passes freely through the blood-brain barrier. At the same time, the role of protein in these conditions is important and even somewhat limiting, as it involves the functioning of mechanisms that ensure the delivery of glucose from the blood to the brain. In stressful situations or diseases (diabetes, hyperthyroidism, and others), the support of brain energy resources in the event of glucose insufficiency may involve the oxidation of ketone bodies and free fatty acids, but not more than 20% and only for a very short period [9, 18, 21].

Vitamins play an important role in normalizing the psychosomatic status: B vitamins help the nervous system function normally, increase resistance to stress, depression, and fatigue; they participate in energy provision processes and in the metabolism of fats, proteins, and carbohydrates; they normalize the function of the cardiovascular system, liver, stomach, and intestines, thereby preventing somatopsychic disorders. Specifically, thiamine known as the "vitamin of optimism," is involved in the processes of nerve impulse transmission, affects memory and cognitive abilities; riboflavin is linked to brain energy provision, participates in the synthesis of corticosteroids, glycogen, and the restoration of glutathione; niacin regulates the synthesis of serotonin, enhances inhibitory processes, helps saturate brain cells with oxygen, and normalizes sleep; pantothenic acid and pyridoxine are involved in the synthesis of neurotransmitters and neuroleptics, protecting the brain from toxins; folic acid is necessary for the synthesis of serotonin and norepinephrine; cyanocobalamin participates in the formation of the myelin sheath of nerves and in the processes of nerve conductivity, supports cognitive functions of the brain,

and regulates its diurnal activity. Biotin provides nerve cells with energy, participates in the synthesis of glucokinase – an enzyme that “initiates” the metabolism of glucose in nerve cells, improves the functioning of the nervous system, reduces symptoms of neuropathy. Vitamin C protects against distress, mental and physical overload, is stored in the adrenal glands and its reserves are depleted during stress, thus the need increases. Tocopherol provides antioxidant protection, regulates tissue oxygen saturation, protects the adrenal glands, normalizes liver function, and participates in the synthesis of phosphatidylcholine, which plays a crucial role in the functioning of the brain and the entire nervous system. It’s important to know the natural sources of vitamins, the possibilities for their most effective use and preservation, factors that affect vitamin absorption, enhance or inhibit it, as well as conditions and diseases that require an increased intake of vitamins in the body.

In the mechanisms of neuroregulation and neuroprotection, mineral substances have a specific role. In particular, calcium balances the processes of excitation and inhibition in the cerebral cortex and participates in nerve impulse transmission; magnesium enhances inhibitory processes in the cerebral cortex, and provides calming, antispasmodic, vasodilatory, and diuretic effects; potassium regulates heart rhythm, water balance, and facilitates the penetration of nutrients through cell membranes; selenium provides powerful antioxidant protection, enhances the antioxidant efficiency of tocopherol; iodine is essential for the development and function of the brain and nervous system, supports mental work capacity and memory, the development of intellectual capabilities, and also for the synthesis of thyroid hormones. The problem of providing iodine is extremely important for Ukraine since, according to the WHO classification, Ukraine is a region endemic for iodine content [9, 21, 22].

It is important to know not only the main natural sources of minerals but also the factors that affect their absorption, the synergism and antagonism of individual mineral substances, thus, the appropriate combination of specific food products in dishes and meals that will provide maximum nutritional efficiency in meeting the body’s needs [8, 9, 18, 23].

Among the non-nutritive substances in food, aromatic substances, which are components of products and spices, deserve special attention. They have a multifaceted impact on the CNS, brain functions, and indirectly, through neurohumoral regulation, on the functions of other organs and systems of the body. Extensive experience in using essential oils shows that each essential oil is multifunctional because it contains many components; however, all essential

oils, without exception, have a beneficial effect on the nervous system; they are categorized into stimulants, adaptogens, and relaxants; all essential oils affect the emotional sphere and mental health; 65% of essential oils have analgesic properties; about 50% normalize the functions and condition of the circulatory system; nearly 40% of oils affect the digestive system, restore the functional state of the body’s excretory systems, enhance the efficiency of detoxification mechanisms; 30% of essential oils activate immune defense systems; 20% optimize the function of endocrine glands, normalize hormonal levels; importantly, about 20% of essential oils have significant antiparasitic properties [24].

The need for a differentiated approach to the selection and recommendation of products belonging to the same group, taking into account their psychonutritional characteristics, is noteworthy. For example, consider citrus fruits—lemon, orange, grapefruit, mandarin—which have different, sometimes opposite, effects on the nervous system and emotional state. Essential oils from lemon have a distinctly toning effect, stimulate mental work capacity, increase attention concentration, improve memory, emotional state, and mood, help overcome stressful situations, and prevent distress. Essential oils from grapefruit have an antidepressant and toning effect, and suppress the feeling of hunger. Essential oils from orange have bimodal effectiveness and exert a harmonizing effect on the state and functions of the nervous system: on one hand, they tone the nervous system, reduce symptoms of depression and severe fatigue, and on the other hand, they have a calming effect, effective in heightened anxiety and phobias, as well as insomnia. Essential oils from mandarin are a natural calming agent, reduce nervous tension, anxiety, irritability, and aggression [17, 18, 24].

Traditional medicine doesn’t sufficiently utilize the centuries-old experience of various peoples in using spices for therapeutic and health-improving purposes. Specifically, the use of spices and aromatic vegetables in phytoalimentary correction of disorders of the nervous system and individual psychosomatic status is important. It is known that spices such as cloves, cinnamon, ginger, and rose stimulate the nervous system: cloves help quickly restore energy after nervous tension and stressful situations, prevent distress, and improve mental performance and memory; cinnamon is an effective antidepressant, improves mental performance and mood; ginger increases work capacity, reduces fatigue, weakness, apathy, and enhances communicative abilities; rose has toning properties, reduces fatigue, improves mental performance, and concurrently aids in restoring psychological balance and reducing anxiety and restlessness. A large group of spices – cardamom,

cinnamon, marjoram, mint, lemon balm, poppy, fennel, chicory, tarragon, turmeric – are considered calming; cardamom restores balance, peace, and clarity of thought; poppy reduces fatigue and improves sleep; mint, chicory, tarragon, turmeric restore psychological balance and improve sleep; fennel decreases nervousness, irritability, and fear. Spices that enhance mental performance and memory include ginger, cumin, and black pepper. The effects are achieved not only by the direct impact of spices on the nervous system but also thanks to their spasmolytic (cloves, cinnamon, basil, marjoram, thyme, cumin), detoxifying (basil, cinnamon, ginger, black pepper, turmeric, cloves, horseradish, chicory), analgesic (cloves, chili pepper, marjoram, lemon balm, mint, parsley, rosemary) properties, and the ability to improve microcirculation in tissues, including the brain (garlic, onion, cardamom, chicory, basil, rosemary, parsley, orange) and other regulatory properties.

Separate studies have confirmed the connection between the main determinants of the development of diseases of internal organs, in particular the intestine, and human psychological functions. A number of scientists have clearly defined the role of the intestine and its microbiocenosis in the formation of secondary and tertiary nutrient flows and the synthesis of regulatory substances, their role and place in the vital activity of the organism. There is a concept that disturbances in the psychological status of patients with the development of intestinal dysbiosis may be associated with the influence of neurotransmitters of bacterial origin. It has been proven that GABA and glutamate are produced by facultative and obligate anaerobic bacteria. Anomalies in the GABA-benzodiazepine receptor complex, which is part of the main inhibitory neurotransmitter system of the brain, play an important role in the occurrence of anxiety-phobic disorders. A decrease in GABA leads to the development of irritable bowel syndrome (IBS). For instance, patients suffering from IBS with diarrhea syndrome and a reduced number of bifidobacteria have registered an increased level of personal and situational anxiety, an increase in the overall level of neuroticism, anxiety-phobic, psychosomatic disorders, emotional tension, and sleep disturbances. In patients with IBS and an increased content of conditional-pathogenic flora and *Staphylococcus aureus*, the psychological status was characterized by an increase in the severity of anxiety-phobic disorders, personal and situational anxiety. The level of depressive disorders had a direct correlation with the increase in the number of conditional-pathogenic microflora, *Staphylococcus aureus*, and an inverse correlation with the content of enterococci in the colon. A negative correlation was established between the number of lactose-positive *Escherichia coli* and the de-

gree of severity of anxiety-phobic, depressive disorders, overall level of neuroticism, and situational anxiety, while an increase in lactose-negative *Escherichia coli* was associated with the presence of depression and psychosomatic disorders. The severity of psychoemotional and psychosomatic disorders correlated with a decrease in the number of obligate flora (bifidobacteria, lactobacilli etc.). All this opens fundamentally new possibilities for the therapy of disturbances in the psychological status of patients and the correction of behavioral disorders with products and mixtures having probiotic efficacy [25, 26]. Within this problem the influence of optimizing dietary regimes, particularly functional foods containing pro-, pre-, sym-, and synbiotics on intellect, is substantiated. In turn, it is important that psychoemotional stress causes changes in the gut microbiocenosis, affecting both the obligate and facultative microflora. Thus, the complex of nutritive and non-nutritive substances contained in traditional food products, spices, and dietary supplements to food regimes represents a poly-pathogenetic complex influencing the functional state of the brain, processes of higher nervous activity, intellectual capabilities, and the psychological status of the individual and is an effective means of enhancing the professional level and expanding the professional capabilities of doctors, including psychologists. This justifies the necessity of in-depth study of these factors in the medical training of doctors.

In the disciplines taught at the Department of the Food Hygiene and Nutrition Science of the National Medical University named after O.O. Bogomolets, "Fundamentals of Healthy Eating", "Nutritionology", and in separate sections of the discipline "Hygiene and Ecology", there is a study and deepening of knowledge students on the basics of rational nutrition of a healthy person, laying the foundation for the propaedeutics of dietology and psychonutritionology. Specific topics and sections include studying human nutritional status and its connection with psychological state, determining individual needs for specific nutrients; a detailed study of nutrient sources and justification for including certain food products in appropriate combinations in diets, taking into account individual nutritional and psychological status. Nutritionology classes involve discussions of approaches to various theories and approaches to nutrition for the purpose of their critical analysis; analyzes the diet of specific population groups, deepens and complements the nutritional and dietetic characteristics of traditional and non-traditional food products, their parapharmacological properties, the appropriateness of their use in rational, therapeutic, and prophylactic nutrition, including the possibility of

alimentary correction of somatic and psychosomatic disorders, which is subsequently used in the diet therapy of various diseases, thus anticipating the integration of teaching with clinical disciplines.

CONCLUSIONS

Studying the discipline of “Nutritionology” with elements of psychonutrition opens up wide opportunities for the formation of preventive thinking in future doctors, including psychologists, acquiring specialized professional skills for identifying the causes of development and signs of multinutrient deficiencies, preventing alimentary and alimentary-induced diseases, nutrient-induced disorders of physical and psychological status, and the possibility of prescribing adequate nutrition, which is an effective factor in the comprehensive system of primary and secondary prevention of diseases and their complications.

Knowledge of psycho-nutrition is a powerful base for doctors in the analysis of psychosomatic and somato-psychological disorders related to nutrition.

The “Nutritionology” course takes into account modern scientific prospective developments and achievements of medical science, priority directions, on the basis of which the international “Health of the Nation” program is formed, in which the main problems of alimentary diseases and ways to overcome them in the world and in Ukraine are formulated.

The course also considers the recommendations of European and international dietetics and nutrition societies (Deutsche Gesellschaft für Ernährung – DGE, Scientific Committee on Food – SCF), which is of particular importance in connection with Ukraine’s integration into the European Union, teaching this course to students from other countries who are obtaining higher medical education in Ukraine, as well as for professionals planning further study and professional development abroad.

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CONFLICT OF INTEREST

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CORRESPONDING AUTHOR

Olena V. Kuzminska

Bogomolets National Medical University
34 Prospect Beresteiskyi, 03680 Kyiv, Ukraine
e-mail: el-kuz@ukr.net

ORCID AND CONTRIBUTIONSHIP

Natalia V. Velyka: 0000-0003-3497-7584 [A](#) [B](#) [E](#) [F](#)

Sergei T. Omelchuk: 0000-0003-3678-4241 [E](#) [F](#)

Tetyana I. Anistratenko: 0000-0003-1112-6242 [B](#) [D](#)

Olena V. Kuzminska: 0000-0002-8259-1611 [B](#) [D](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

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Peculiarities of prevention of chronic pain associated with combat trauma

Nadiia Ya. Zhylka, Andrii M. Strokan

SHUPYK NATIONAL HEALTHCARE UNIVERSITY OF UKRAINE, KYIV, UKRAINE

ABSTRACT

Aim: To analyze international experience in solving the problems of preventing chronic pain associated with combat trauma.

Materials and Methods: bibliosemantic and analytical methods were used in the study. The materials were international scientific sources that covered the experience of providing medical care in military conflicts for the period 2014–2024.

Conclusions: The best practices for preventing chronic pain associated with combat trauma are the effectiveness of pain relief immediately after injury, the timeliness of pain relief at all stages of evacuation, including the hospital and post-hospital period or the so-called stepped care model. In order to overcome the problem of opioid addiction in patients with combat trauma, the use of local and regional pain relief, as well as the use of a complex of non-drug methods, is recommended. The biopsychosocial model of chronic pain prevention (synonymously multidisciplinary, interdisciplinary, multicomponent) has the primary goal of restoring physical, psychological, and social functioning, involving a core team of multidisciplinary health care professionals (physicians, physiotherapists, occupational therapists, psychologists, and nurses) working as an integrated team as a response to the complex suffering of patients with chronic pain worldwide.

KEY WORDS: chronic pain, prevention, combat trauma, strategy, multidisciplinary approach

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INTRODUCTION

A feature of combat trauma is that it often leads to extensive tissue damage and limb loss, which in turn causes chronic neuropathy and phantom limb pain (PLP) and residual limb pain (RLP) [1, 2]. The military population differs in both demographic and social characteristics of the injury compared to other amputation and trauma cohorts. According to the results of a systematic review of the Embase and MEDLINE databases, the frequency of chronic and neuropathic pain associated with combat trauma was 57%, which indicates a high prevalence of post-amputation and chronic neuropathic pain after combat trauma [3–5].

Chronic pain is considered a disease model worldwide [6]. Acute pain initially occurs as an unpleasant, dynamic psychophysiological process, usually in response to tissue injury and associated with inflammatory processes. Acute pain is often life-threatening issue and plays a major role in the outcome of treatment. Once the acute phase has passed, pain becomes a disease in its own right. Acute pain becomes chronic when it persists beyond the expected healing period of 3 months according to the International Classification of Diseases, 11th revision criteria [7].

Acute and chronic pain are very common among veterans who participated in Operation Enduring Freedom/

Operation Iraqi Freedom/Operation New Dawn (OEF/OIF/OND). Chronic pain is often accompanied by psychiatric disorders such as posttraumatic stress disorder (PTSD) or depression, as well as traumatic brain injury, which complicates pain management and recovery in this population. In the military health care system, the incidence of chronic pain diagnoses among service members quadrupled from 2007 to 2014, reaching 68.7 per 10,000 person-years [8]. Numerous factors have contributed to the dramatic increase in chronic pain, including improved survival rates from combat injuries, increased re-entry into combat, and rigorous physical training requirements [8].

AIM

To analyze international experience in solving the problems of preventing chronic pain associated with combat trauma.

MATERIALS AND METHODS

Bibliosemantic and analytical methods were used. The materials were international scientific sources that covered the experience of providing medical care in military conflicts for the period 2014–2024.

REVIEW AND DISCUSSION

The best practices for the prevention of chronic pain in the world are considered to be pain management throughout the treatment cycle. From the effectiveness of primary analgesic therapy, namely its components: the choice and dosage of the drug, the timeliness of pain relief and the subsequent effective staging of the analgesic effect. One of the effective methods for the prevention of chronic pain is its timely treatment using updated approaches.

In 2019, the issue of timely and effective pain relief following combat injuries has been of increasing significance in military medicine. Historically, the medical triage has been the priority, followed by pain relief. However, as highlighted by D. J. Aldington et al., this is not so anymore, with modern military pain relief being centered on early intervention to prevent both short-term complications and the long-term risk of chronic pain [9]. Evidence presented by S. P. Cohen et al. show that effective analgesia is not merely significant in preventing medical complications in the form of cardiovascular instability and respiratory distress, but is also critical in preventing PTSD, which is common in combat casualties where pain is not well managed [5-6, 10]. R.D. Treede et al. also underline that chronic pain should not be regarded simply as a symptom, but as a distinct disease entity, requiring specific preventive measures to provide improved long-term outcomes [7].

The British Defense Medical Service has adopted a tiered pain care system from the point of wounding to ultimate release from military service. The system is organized in a four-echelon structure, with ongoing care at each level of care. The first echelon is immediate on-scene care by the wounded soldier, comrades, or field medic staff. The second echelon is early stabilization at a forward medical station where pain is treated in addition to hemodynamic stabilization. The third echelon is field hospitals where limb- and lifesaving surgery is performed, and complex pain care strategies are implemented. The fourth echelon is specialist rehabilitation centers, e.g., the Royal Centre for Defence Medicine in Birmingham, where long-term pain care is implemented [8, 9]. Evidences by K. Bannister et al. and R. S. Adams et al. confirm the effectiveness of the tiered system, stating that organized, multimodal pain care reduces the number of persistent pain disorders in combat veterans [2, 8-10].

Proper pain assessment is a critical component of effective pain management. A.C.C. Williams and K.D. Craig (2016) state that pain is very subjective and that poor assessment is a contributing factor in the development of chronic pain [10]. Up until 2009, the British military employed the Numerical Rating Scale (NRS),

0-10 (no pain-severe pain), as the primary assessment. However, in acknowledgment of the necessity of a simpler, actionable tool for frontline medical personnel, a three-point scale (0-3) has been adopted. The new system is based on the World Health Organization's three-step analgesic ladder so that each one-point change is clinically significant. U. Kaiser et al., findings suggest that maintaining pain scores below 2 is very effective in the prevention of the development of chronic pain, further emphasizing the importance of standardized pain assessment procedures in military settings [11].

Prehospital pain relief is a critical component of combat casualty care. According to M.J. Buys et al., inadequate pain relief in the acute phase of injury is a strong predictor of chronic pain syndromes, particularly in military personnel who undergo severe trauma [12]. British military medic personnel now carry intramuscular auto-injectors of 10 mg of morphine. However, as M.D. Eckhoff et al., point out, this is comparable in analgesic potency to 1 g of paracetamol or 400 mg of ibuprofen, so in the event of major injuries, it may not be effective in reducing pain sufficiently [3, 13]. To address this limitation, the British Defense Medical Service introduced oral transmucosal fentanyl citrate (OTFC) as an adjunct to morphine. OTFC is said by A. Huang et al. and B.M. Ilfeld et al. to have a rapid onset of action and is very effective in combat scenarios where intravenous access is difficult [13, 14]. Moreover, S.P. Cohen et al., point out the necessity to include opioid alternatives and multimodal analgesic techniques to avoid the risks of long-term opioid administration [6, 14].

Multimodal pain relief is used in field hospitals, incorporating opioids, NSAIDs, regional anesthesia, and PCA. One of the innovations is the Baxter Infusor PCA device, which is mechanical and does not interfere with Royal Air Force navigation systems, thus appropriate for aeromedical evacuation purposes [9, 14-15]. One of the significant improvements in combat pain relief has been the expanded use of regional anesthesia techniques, including epidural, spinal, and peripheral nerve blocks. K. Bannister et al. (2020) note that regional anesthesia is critical in preventing chronic pain by blocking nociceptive transmission at the site of injury [2]. However, as D.J. Aldington et al. (2011) and L. Wang et al. (2020) noted that epidural anesthesia is risky in terms of infection, and peripheral nerve blocks have the risk of delaying acute compartment syndrome diagnosis, which may necessitate prophylactic fasciotomy in high-risk scenarios [9].

Recent technological improvements in portable ultrasound machines have significantly made better the accuracy and safety of regional anesthesia. J. Vollert et al. noted that ultrasound-guided nerve blocks allow

the direct visualization of anatomical structures, enabling improved accuracy in positioning the catheter and reducing complications of blind injections [15]. This technological advancement has been very helpful in military medicine, where efficient pain relief is paramount in austere environments. E. Dragioti et al. (2018) also recommend the use of multidisciplinary pain management programs, combining regional anesthesia with psychological and rehabilitation interventions to achieve the improved long-term outcomes [16]. Prevention of chronic pain in combat veterans requires an integrated approach through the combination of pharmacological, interventional, and psychological interventions. R.S. Adams et al., suggest expanding pain care programs after deployment to incorporate long-term monitoring and treatment of chronic pain disorders in military veterans [8]. A.C. Williams et al. (2012) also emphasize the importance of psychological interventions, i.e., cognitive-behavioral therapy (CBT) and mindfulness-based stress reduction (MBSR), in preventing the establishment of chronic pain [10, 17]. U. Kaiser et al. (2017) and J.S. Gewandter et al. (2015) suggest that prevention of pain should not be addressed merely at acute pain relief but also at the detection of patients at risk of developing chronic pain at an early phase so that intervention is done on time [11, 18-19].

The improvements in multimodal analgesia, regional anesthesia, and methods of early intervention have significantly improved pain outcomes in military medicine. However, additional researches are still needed to further advance pain prevention strategies, particularly in the area of reducing opioid dependence and integrating rehabilitation-focused methods. Implementation of evidence-based pain care practices, as proposed by S.P. Cohen et al. (2021), will be critical in decreasing the long-term burden of chronic pain in combat casualties [6, 7, 20]. With further advancement of existing methods and the integration of new pain care strategies, military medicine will be better positioned to further enhance the quality of life of wounded soldiers, ultimately reducing the burden of chronic pain on the military and veterans.

The next stage of care for the casualty is repatriation. The main principle of this stage is to provide analgesia before the evacuation begins, as attempting to do so during the evacuation is always very difficult. RAF air medical teams can now manage epidurals and continuous peripheral nerve blocks in flight. The next stage is the hospital phase of care, which involves ensuring the safe use of techniques such as epidurals and local anaesthetic infusions. These approaches have provided a combined moderate to severe pain score of 10%, and 90% of patients had pain scores of 0 or 1 or less. Spe-

cial attention is paid to local anesthetic techniques for two reasons. Firstly, continuous peripheral nerve block results in lower pain scores. Secondly, for patients undergoing multiple surgeries in a short period of time, as in the military persons, an analgesic that does not have systemic side effects is intuitively more beneficial than alternative (opiate-based) analgesia. Catheter cultures for analgesia and identification of any microorganisms are performed to prevent infectious complications. It is also not uncommon for oral opiates and continuous peripheral nerve block to be used concurrently in the same patient. Continuous epidural infusions significantly increase patient safety and drug efficacy while reducing side effects [20]. Treatment of neuropathic pain begins at a relatively early stage, which has a positive effect on the prevention of chronic pain. Antineuropathic analgesics reduce the perioperative need for opiates [9, 21], since opioid use is an important problem for the socialization of war wounded in the future.

For example, in the USA, according to the Department of Veterans Affairs, about 26.2% (5.2 million) of veterans of the Vietnam War, Iraq, and some other conflicts had mental illnesses or substance abuse (SA) [21, 22]. At the same time, the central place in the policy on drug addicts in the army is occupied by mandatory screening for the use of SA. It took the USA about 35 years to introduce such a procedure. It was a set of successive steps: the introduction of testing of a person before enlistment in the service, random testing during its passage and participation in combat operations, etc. At the same time, the US Army practiced the controlled use of SA (only in certain doses under the supervision of a doctor). Another, no less important component of the policy on drug addicts in the US Army was the introduction of social adaptation and rehabilitation programs for military personnel at the state level. For example, according to the information presented on the official website of the US Department of Veterans Affairs, assistance to drug-addicted military personnel is provided both in local medical centers, including under the patronage of public organizations, and in specialized clinics subordinate to the department. At the same time, the provision of such assistance is based on evidence-based methods (cognitive-behavioral therapy, motivational interviewing with a veteran, during which specialists try to help him to discover his personal motivation for change, etc.). In the USA, it is possible to use substitution therapy and undergo rehabilitation in a hospital [21].

Contracting or mobilization in the USA occurs only after the screening for signs of drug or psychotropic substance use according to a certain procedure, volume and responsible units. Accordingly, at the time of

service, cases of substance use are rare, when a person either starts using for the first time or returns to use that was not diagnosed by screening during contracting/mobilization [21-23]. The above mentioned confirms that rehabilitation is a significant component of the prevention of chronic pain which is associated with combat trauma. Morphine remains one of the most widely used analgesics in military medicine, but it has a high potential for addiction. Historical evidence, as evidenced in the American Civil War, mentions "soldier's disease," a term used to describe opioid addiction in wounded soldiers. While the historical accuracy of this name is doubtful, opioid addiction is still a significant issue in military medicine [9]. S.P. Cohen et al. and M.J. Buys et al. indicated that, while opioids are a critical component of acute pain relief, opioid dependence over the long term needs to be closely monitored and treated through formal rehabilitation processes [6, 12, 22]. During rehabilitation, military personnel undergo tapering of the drug over time, so opioid administration is stopped in a controlled manner. Military pain specialists also carry out regular assessment and maintain open communication channels to enable long-term recovery and prevent dependency [14].

The final level of pain care is at the level of the primary care, where specialists in military rehabilitation may not have the experience. U. Kaiser et al. (2021) state that transitioning to civilian healthcare facilities is normally challenging for veterans with chronic pain disorders [11, 19, 23]. To address this, some military garrisons have established special pain relief units, where senior pain medicine consultants collaborate with rehabilitation specialists, sports medicine specialists, and general practitioners. The units not just provide direct care to patients but also serve as training centers for primary care professionals, offering a standardized approach to treating chronic pain [8, 23].

Management of pain within the military is a multidisciplinary process in which the anesthetists, surgeons, physicians, psychiatrists, primary care doctors, nurses, physiotherapists, occupational therapists, and psychologists are involved [23]. The British military healthcare system is a mixed system with both military and civilian professionals, increasing the scope of interventions that can be accessed [7, 22]. Training is also a part of this system, with specialist medical courses having pain management as a core competency. The Battlefield Advanced Trauma Life Support (BATLS) course, which is attended by medical personnel of the UK and coalition forces, has an updated section on pain management. Additionally, pre-deployment training of field hospital staff consists of special lectures on pain management techniques [2, 22]. The Postgraduate Medical Officer

(PGMO) course also provides military doctors with appropriate training in pain management before posting [22-23].

One of the persistent challenges in pain management is the relative paucity of knowledge on pain mechanisms. L. Wang et al. (2020) note that even when mechanism-based pain treatment models have been described, it remains difficult to make a clear distinction between the treatment of nociceptive and neuropathic pain in the clinic [5]. Much of current pain management remains empirical despite advances, underlining the necessity of ongoing research on pain perception and treatment outcomes [18]. Multidisciplinary care, comprising pharmacological, interventional, and psychological interventions, has been shown to reduce some of the uncertainty and deliver improved outcomes in patients [16, 21].

The US military has made significant improvements in pain management through evidence-based care and multimodal, interdisciplinary interventions [22, 23]. Evidences by C.M. Brummett et al. suggest that the implementation of military pain management guidelines has led to increased pain monitoring, better patient education, and better overall outcomes of care [6, 24-25]. The US military has also taken steps to prevent opioid abuse so that opioids remain an essential part of acute and chronic pain relief without perpetuating long-term dependence [26]. Inefficient pain management is still a widespread issue in both military and civilian populations, particularly in chronic pain. Evidence by U. Kaiser et al. (2017) suggests that the integration of military pain management practices into civilian healthcare systems could significantly improve pain relief outcomes and reduce the societal burden of chronic pain [19, 27-29].

Prevention of chronic pain is aligned with the recommendations of the International Association for the Study of Pain (IASP, 2020), which focus on secondary and tertiary prevention [30]. Prevention of pain chronicity not just relieves the pain of the sufferer but also the long-term burden on the healthcare system. Secondary prevention aims at detecting pain conditions at an earlier stage to avoid progression, and tertiary prevention aims at preventing complications, disability, and functional impairment in patients with already established chronic pain [19, 27]. Literature data indicate that effective secondary prevention requires a well-identified set of risk factors of pain chronicity, as well as the development of validated assessment tools to identify high-risk patients [28].

Classification of risk factors into biological (red flags), psychosocial (yellow flags), occupational (blue flags), compensatory (black flags), and sociocultural (white

flags) provides a structure to create targeted interventions [27]. Based on the study by A. Sarmanova et al. (2018), some risk factors – i.e., age, sex, heredity, pre-existing pain disorders, and psychological factors – are accountable for the development of chronic pain, particularly following surgical procedures [28, 30]. Subdivision of patients on the grounds of risk of pain chronicity and the respective adjustment of the treatment approach has been proved to be an effective way of optimizing outcomes both in the short and medium terms [29, 30–32]. In addition to risk stratification, theoretical models such as the avoidance and coping model have provided insight into pain prevention strategies specific to individuals [23]. For tertiary prevention, interventions seek to alleviate secondary consequences of chronic pain, i.e., impairment of function, loss of work, psychological distress, and social isolation [29]. The fear-avoidance model and the avoidance and coping model both highlight the manner in which psychosocial impairments impact the quality of life in patients with chronic pain [30–33].

The biopsychosocial perspective of pain, initially conceptualized in the 1980s and later defined by the IASP task force in 2017, has played a central role in the modern pain care approach [9]. It has led to the common practice of a multidisciplinary, interdisciplinary, and multicomponent pain treatment method involving physical, psychological, and social rehabilitation. It is primarily intended to restore maximum functional potential through a core team of healthcare professionals, including physicians, physiotherapists, occupational therapists, psychologists, and nurses, working within an integrated system [16, 34].

Interdisciplinary pain care has been recognized internationally as a central method of chronic pain treatment. However, ongoing research shows that chronic

pain remains a significant and unsolved issue in both military and civilian healthcare settings [20, 35–37]. Recent research suggests that combining psychological therapies, physical rehabilitation, and opioid-sparing strategies into multimodal pain care regimens is very effective in promoting long-term outcomes in patients [25, 38, 39]. As chronic pain is increasingly being recognized as a major public health issue, future research should be targeted at optimizing prevention strategies, expanding access to multidisciplinary pain care programs, and advancing knowledge on pain mechanisms. With the integration of personalized, evidence-based interventions, healthcare systems have the potential to reduce the burden of chronic pain and enhance the well-being of individuals affected by it [20, 40–41].

CONCLUSIONS

Thus, the best practices for the prevention of chronic pain associated with combat trauma are the effectiveness of pain relief immediately after injury, the timeliness of pain relief at all stages of evacuation, including the hospital and post-hospital period, or the so-called stepped care model. In order to overcome the problem of opioid dependence in patients with combat trauma, there is the use of local and regional analgesia, as well as the use of a complex of non-drug methods. The biopsychosocial model of chronic pain prevention (synonymously multidisciplinary, interdisciplinary, multicomponent) has the main goal of restoring physical, psychological and social functioning, involving a core team of multidisciplinary health professionals (physicians, physiotherapists, occupational therapists, psychologists and nurses) working in an integrated team as a response to the complex suffering of patients with chronic pain worldwide.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Andrii M. Strokan

Shupyk National Healthcare University of Ukraine
9 Dorohozhytska St., 04112 Kyiv, Ukraine
e-mail: dr.strokan@gmail.com

ORCID AND CONTRIBUTIONSHIP

Nadiia Ya. Zhyllka: 0000-0003-0732-1141     
Andrii M. Strokan: 0000-0002-4544-7143   

 – Work concept and design,  – Data collection and analysis,  – Responsibility for statistical analysis,  – Writing the article,  – Critical review,  – Final approval of the article

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Hygienic assessment of the safety of cereal grain grown from seed material treated with combined fungicides containing tebuconazole and metalaxyl-M

Anna V. Blagaia, Mykola V. Kondratiuk, Oksana I. Poliukhovich

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Introduction: A comprehensive approach to solving many issues ensures the country's food security. The main criteria for such security are the qualitative and quantitative provision of food products to the population, among which grain products occupy the first place in Ukraine. In the technological cycle of growing grain crops, storing the harvest for its subsequent use as seed material makes up a significant part of the total duration of this process. Unfavourable storage conditions can lead to substantial losses of seed material. In modern intensive technologies for growing cereals, fungicides are used to prevent the effects of fungal pathogens.

Aim: To assess the safety of cereal grain grown from seed material treated with the combined fungicide formulation containing tebuconazole and metalaxyl-M (30 and 20 g per litre of preparation, respectively) from a hygienic standpoint.

Materials and Methods: Material – wheat seeds treated with fungicide preparation at a rate of 1.0 litre per ton; active ingredients (a.i.) of the preparation are tebuconazole ((RS)-1-p-chlorophenyl-4,4-dimethyl-3-(1H-1,2,4-triazol-1-yl-methyl) pentane-3-ol, FRAC Group G) and metalaxyl-M ((R)-2[(2,6-dimethyl phenyl)-methoxy-acetylamino]-propionic acid methyl ester, FRAC Group A). Methods – natural in-field hygienic experiment, organoleptic method, gas-liquid chromatography (GLC), statistical methods.

Results: It was found that the organoleptic properties (odour, colour, appearance) of wheat grown from treated material did not differ from the control samples taken from plots where untreated seeds were sown. The content of active ingredients at different time points after sowing were as follows: for tebuconazole on day 27 in the green mass of spring wheat plants <0.07 mg/kg, on day 60 in the spikes – <0.07 mg/kg, on day 111 (yield) in grain – <0.07 mg/kg (with the limit of quantification of the GLC method being 0.07 mg/kg) and for metalaxyl-M <0.2 mg/kg, <0.2 mg/kg, <0.07 mg/kg (with the limit of quantification of the GLC method being 0.2 mg/kg), respectively. It should be noted that these values did not exceed the approved medical and sanitary standards (maximum residue levels (MRLs), which are 0.2 mg/kg for tebuconazole in cereal grains and 0.2 mg/kg for metalaxyl -M in cereal grains.

Conclusions: Residual amounts of tebuconazole and metalaxyl-M were not found in wheat plants during the vegetative season and during harvesting, which indicates that when treating seed material with a preparation containing tebuconazole and metalaxyl-M, its content in the grown grain crop does not exceed the MRLs established for cereal grain. Considering the technology of preparation application (pre-sowing seed treatment) and the absence of residual quantities of active substances in the harvest, we concluded and subsequently suggested that setting a pre-harvest interval before harvesting spring wheat is inappropriate. When applying the preparations containing tebuconazole and metalaxyl-M, we recommend monitoring the content of active ingredients in cereal grains by determining both a.i. Regarding the above-stated, application of fungicide formulation containing tebuconazole and metalaxyl-M (30 and 20 g per litre of preparation, respectively) for pre-sowing treatment of spring wheat seeds (following the application rates and techniques approved by State authorities) will not pose a risk and danger to the population consuming food products made from grain harvested from treated seed material.

KEY WORDS: Agricultural crops, environment, food safety, public health

Current problems in breast cancer early detection in Ukraine: opportunities for artificial intelligence integration

Tetiana S. Gruzieva, Inna I. Kucherenko, Anton H. Chebotarenko

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Introduction: Breast cancer remains one of the most prevalent oncological diseases among women in Ukraine. According to the National Cancer Registry, over 12,500 new cases were reported in 2023 alone. Early detection significantly increases the chances of successful treatment, with screening mammography playing a key role. However, unlike many European countries that utilize double reading, Ukraine relies on a single radiologist to interpret each mammogram, increasing the likelihood of diagnostic errors. This creates a strong case for the integration of artificial intelligence (AI) as a supportive tool to improve screening outcomes and reduce human error.

Aim: To justify the need for improving the breast cancer early detection system in Ukraine through the implementation of artificial intelligence and an interdisciplinary approach.

Materials and Methods: The current stage of the study includes:

- A literature review of international scientific publications on the application of AI in mammography screening;
- A comparative analysis of legal and regulatory frameworks in Ukraine versus countries that have adopted double reading and AI-based support systems;
- A conceptual review of clinical trial outcomes evaluating AI as a second reader in breast cancer diagnostics.

Results: International studies demonstrate that AI can enhance the sensitivity and specificity of breast cancer screening and reduce radiologists' workload. Evidence from trials such as MASAI indicates that AI-assisted reading can be non-inferior to double reading performed by two radiologists. In contrast, Ukraine currently lacks both the double reading protocol and practical experience in AI implementation, which may limit screening effectiveness and diagnostic quality.

Conclusions: Given the absence of double reading practices in Ukraine and the growing international evidence supporting AI in breast cancer screening, it is advisable to investigate how artificial intelligence can improve diagnostic accuracy and reduce missed or misinterpreted cases. Further research is warranted to explore AI integration into national screening programs, especially under current resource constraints.

KEY WORDS: Artificial intelligence, mammography, breast cancer screening, diagnostic support, public health systems

Prevention of excessive intake of estrogen-like substances in the child's body by optimization of treatment protocols in dentistry

Alina O. Grygorova¹, Viktoriia V. Kuzina¹, Yuliia Y. Yaroslavskaya¹, Tetyana G. Khmiz¹, Tetyana E. Peshko²

¹KHARKIV NATIONAL MEDICAL UNIVERSITY, PEDIATRIC DENTISTRY AND IMPLANTOLOGY DEPARTMENT KHARKIV, UKRAINE

² DENTAL CLINIC «NEW SMILE» KYIV, UKRAINE

ABSTRACT

Introduction: Despite a range of existing preventive measures, the prevalence of caries, its intensity, and malocclusion remain quite high. To address this issue, dental practice has introduced fissure sealing, tooth restoration with fillings or artificial crowns, removable or fixed orthodontic devices, and adhesives. Derivatives of bisphenol-A are currently the most commonly used in the production of dental materials. When present in the oral cavity for a long time, they undergo partial dissolution, corrosion, and wear. Particles of this substance, which are chemically xenoestrogens, enter the child's body. They behave like natural estrogens, and in excessive amounts, they can cause various undesirable effects. It is not difficult to calculate the average amount of sealant needed to seal the fissures of permanent teeth in a child with a history of high-intensity caries in temporary teeth, considering that between 0.5 to 2.0gr. of material is used for one filling. The potential amount of estrogen-like substance that will act as an additional source of exposure to the child's body is also of concern.

Aim: To prevent the excessive intake of estrogen-like substances into the child's body by optimization of treatment protocols in dentistry.

Materials and Methods: The retention rate of Bis-GMA-free fissure sealant, using the criteria proposed by Tonn and Ryge, was assessed after 6 months of application.

Results: After 6 months, 118 occlusal surfaces of permanent molars and premolars were examined. A score of 0 was found on 73% of the teeth. Partial loss of sealant, corresponding to score 1, was detected on 19% of the teeth. Sealants were absent (score 2) on eight percent of the teeth.

Conclusions: The entire world is concerned about environmental pollution caused by plastic waste. When it enters the human body, due to its chemical nature, it behaves like natural estrogens, increasing the risk of premature sexual maturation, behavioral disorders, and more. The use of paper packaging for consumer goods, biodegradable tableware, and waste sorting, proposed in many countries, partially helps reduce the negative consequences of this situation. Dentistry is a branch of medicine that widely uses polymers. At present, it is impossible to eliminate them. Optimization of treatment protocols can help prevent the introduction of potentially harmful substances into the patient's body.

KEY WORDS: Bis-GMA-free fissure sealant, xenoestrogen, treatment protocols

Analysis of the dynamics of morbidity of children of the first year of life in Ukraine during 2009-2023

Liubov L. Lytvynova

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Introduction: This year, World Health Day is dedicated to the health of mothers and newborns for a reason. In 2023, the World Health Organization, in its report "Nurturing Care Framework Progress Report 2018-2023: Reflections and Looking Forward," emphasized the importance of the first years of a child's life. It is during these years that a promising outlook for strong health, optimal nutritional status, and well-being throughout life is formed, which can also impact future generations. Despite progress in achieving the Global Early Childhood Development and Care System, the poorest and most unstable countries require increased investment in medical care for children in the early years of life.

Aim: To investigate the changes in the health of children under one year of age in Ukraine during the period 2009-2023 against the backdrop of the war events.

Materials and Methods: The study analyzed official statistical data from the Ukrainian Center for Medical Statistics.

Results: Maternal and child health protection is one of Ukraine's national priorities. According to the "New Life - New Quality of Maternal and Child Health Care" project, 19 perinatal centers were established and 114 newborn intensive care units have been operating since 2010. Achievements made during 2009-2020 regarding certain diseases among children under one year of age were nearly undone in the first two years of the war. Thus, the overall morbidity rate of children under one year of age decreased by 24% from 2009-2020, reaching 1219.7 ‰, but in just two years of full-scale invasion, it increased by 20%. A detailed analysis of infant morbidity for specific diseases revealed that the greatest increase in the last two years was observed in relation to the prevalence of infectious diseases (by 40%), nervous system diseases (by 32%), cerebral palsy (by 2.3 times), ear and mastoid process diseases (by 44%), respiratory organs (by 35%, with mortality from these rising by 88.8%), digestive organs (by 38%), skin conditions (by 30%), and musculoskeletal system disorders (by 2 times). Even diseases unrelated to infants, such as those of the circulatory system, became more common (by 86.6%). However, particular concern regarding infants is always caused by conditions arising in the perinatal period, which increased by 17.6%, and congenital malformations — which increased by 40% (with a 64% rise in the frequency of congenital malformations of the circulatory system). It is logical to assume that such negative changes are related, in particular, to the deterioration of medical care for children, including those in the first year of life. Indeed, the availability of specialized pediatric beds has decreased by 36.36%. The efficiency of using beds for premature and sick newborns has decreased — bed occupancy has almost halved, yet mortality on these beds has increased by 60%. The availability of pediatricians for the child population has decreased by 65% since 2009 (with a 50% decrease in the last two years), and the number of neonatologists has decreased by 36%. At the same time, staffing levels in certain positions have dropped to 70%, and widespread dual employment negatively affects the quality of care provided by exhausted doctors.

Conclusions: The deterioration in the health of children under one year of age is undoubtedly caused by the war. Despite the decrease in birth rates, and thus the reduction in the number of pregnant women and children, the burden on pediatric services has increased due to a lack of material, technical, and human resources in healthcare overall. However, preventive work with pregnant women and mothers remains relevant, emphasizing their responsible attitude towards preserving their own health and the health of their newborn children.

KEY WORDS: health, infant morbidity, medical care for children, neonatologists, pediatricians, perinatal centers

Trends in maternal and infant mortality as integral indicators of maternal and child health

Nataliia M. Mykytenko, Hanna V. Inshakova, Tetiana S. Gruzieva

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Introduction: Maternal and child health is a fundamental factor in ensuring sustainable social and economic development of society. Its preservation and strengthening have been identified as a priority of social policy. Integral indicators of maternal and child health are included in the Sustainable Development Goals at both global and national levels.

Aim: To assess progress in reducing maternal and infant mortality rates in the WHO European Region (WHO ER).

Materials and Methods: The study materials included scientific publications, national regulatory and legal acts, WHO and WHO ER program documents, and data from the European "Health for All" database. The study employed bibliosemantic, medical-statistical, and content analysis methods.

Results: Analysis of scientific literature and WHO documents revealed a significant global reduction over 20 years in maternal mortality by 38% and early childhood mortality by half. However, these rates remain substantial, and global targets have not yet been achieved.

Analysis of infant mortality rates in the WHO ER, based on estimated data, also showed a positive trend, decreasing by 62.5% between 2000 and 2022. In European Union (EU) countries, the reduction was 47.5%, and in Ukraine, it was 55.7%. However, significant disparities in infant mortality rates were identified. The average rate in the WHO ER was twice as high as in the EU. In Ukraine, the infant mortality rate was 11.1% higher than in the WHO ER and 2.3 times higher than in the EU. Several countries achieved notably low infant mortality rates, including Norway (1.8‰), Finland (1.9‰), and Sweden (2.1‰). At the same time, in some Central Asian countries, mortality rates reached 26.7‰ and 35.8‰, indicating a 20-fold difference in these indicators.

The trend in maternal mortality rates in the WHO ER between 2000 and 2020 was positive, with a reduction rate of 50.0%. In EU countries, this indicator decreased by 45.5%, and in Ukraine, by 52.8%. Disparities in maternal mortality rates within the region reached a 25-fold difference. Specifically, in 2020, the maternal mortality rate in Norway was 2 cases per 100,000 live births and in Germany, 4 cases per 100,000 live births, while in Kyrgyzstan and Uzbekistan, it was 50 and 30 cases per 100,000 live births, respectively.

According to the 2024 Report on the State of Health in Europe, it was emphasized that many infants and children continue to die from preventable causes. Statistical data indicate that many countries are lagging behind the schedule for achieving the Sustainable Development Goals related to maternal and newborn mortality. This necessitates a comprehensive set of measures, including preventing unwanted pregnancies, ensuring access to high-quality care during pregnancy, childbirth, and the postpartum period, strengthening reproductive health, providing skilled birth attendance, promoting breastfeeding and adequate nutrition, vaccination, and treatment of common childhood illnesses, among others. An approach focusing on both immediate biomedical causes of mortality and broader social, economic, and environmental determinants is essential.

Conclusions: Despite positive trends in reducing maternal and infant mortality, significant disparities in progress toward achieving target indicators persist, requiring comprehensive measures to improve healthcare services and address key determinants.

KEY WORDS: maternal mortality, infant mortality, trends, Sustainable Development Goals, strategies

Experience of using the theoretical model in the study of market efficiency of services

Anastasiia A. Rudenko

NATIONAL PIROGOV MEMORIAL MEDICAL UNIVERSITY, VINNYTSYA, UKRAINE

ABSTRACT

Introduction: The active development of modern medicine is inevitably accompanied by numerous clinical trials that form the basis of evidence-based medicine and provide answers to questions of varying complexity. In a situation where a person's life may depend on the treatment tactics recognised as effective in a particular clinical trial, it is extremely important that this clinical trial is conducted correctly and contains not only data analysis but also theoretical concepts. There are many requirements for conducting clinical trials, one of which is the use of a theoretical model. The choice of a theoretical model depends on many characteristics: study design, data, etc. Unfortunately, there are many clinical trials in the world in which various mistakes have been made, including the failure to use a theoretical model. Fortunately, such models are available in healthcare organisations, although they are borrowed from econometrics.

Aim: To present the experience of using the theoretical model in studies that evaluate the organisation of services for patients with rhythm disturbances.

Materials and Methods: The organisation is evaluated on the example of the theoretical model of D. Dranov and M. Satterwhite.

Results: There are many opportunities to use this theoretical model, as it describes the process of any service in a competitive environment. The model allows to link the basic characteristics of the service, such as quality and comfort, with market characteristics: demand, price (through the corresponding elasticities), which allows using these variables to reach the balance values of price, quality, and comfort. The idea of applying the model is that if the regularities predicted by it are confirmed by the characteristics of the service provision organisation, then the current values of the three main variables (price, quality, and comfort) are close to optimal.

Dranov and Satterwhite's theoretical model is based on the market behaviour of a service provider that seeks to maximise profits under the constraints set by demand by optimising three main variables, namely price (p), quality of service (ql) and comfort (cm). Demand q is a function of the last three, i.e. $q(p, ql, cm)$. Demand limits the price and increases ql and cm .

Of course, this model cannot be presented in this format for practical evaluation, as it contains a number of unmeasured and unknown values, which requires first of all the definition of unmeasured variables and approaches to working with unknown values.

We first developed a transition to an empirical model on the example of a healthcare organisation in the context of working with patients with heart rhythm disorders.

Conclusions: the empirical model was used to understand the extent to which the organisation of services for patients with arrhythmias is adapted to the existing market.

KEY WORDS: theoretical model, rhythm disturbance

Job satisfaction of healthcare professionals: a necessity or a modern trend?

Nataliia N. Terenda, Tetiana P. Vashchuk, Nataliia Ya. Panchyshyn

IVAN HORBACHEVSKY TERNOPIL NATIONAL MEDICAL UNIVERSITY OF THE MINISTRY OF HEALTH OF UKRAINE, TERNOPIL, UKRAINE

ABSTRACT

Introduction: In the context of a full-scale war on the territory of Ukraine and a decrease in the number of healthcare professionals, managers of healthcare institutions face the problem of retaining their human resources. One of the components of retaining human resources is the use of tangible and intangible incentives to enhance job satisfaction of healthcare professionals.

Aim: To assess the necessity of studying job satisfaction among healthcare professionals.

Materials and Methods: A review of 35 scientific sources on job satisfaction of healthcare professionals based on PubMed and the V.I. Vernadskyi National Library of Ukraine was conducted.

Results: In recent years and even decades, the issue of job satisfaction among personnel has become particularly acute. This is due to the fact that society has undergone major transformations and all aspects of economic life have strengthened, leading to the need for highly efficient employees in various fields of activity. The contradiction between the demand for product quality improvement and the decrease in the number of professionals responsible for this has become more intense. Employers are setting increasingly higher requirements for educational standards, professional competence, and labor productivity. The relationship between job satisfaction and productivity has been studied for a decade (J. Kaap-Deeder, 2018; O.M. Shovgelya, 2012; S.R. Covey & Colosimo J., 2011, etc.), but numerous studies conducted in this area in different countries have shown conflicting results. Personal characteristics of employees, such as cognitive abilities and emotional stability, as well as their work experience and prospects for applying the acquired skills, are also related to job satisfaction. According to several studies (Vezhnovets T.A., 2017; Udod M.O., 2020), job satisfaction in the healthcare system is associated with emotional burnout syndrome, which together can affect the quality of healthcare and, consequently, the health of the population as a whole. The risk of this combined impact increases due to a combination of professional factors such as high and irregular workload, work-life balance, high emotional stress from communicating with patients and their families, the need for quick decision-making, and great responsibility for the lives and health of patients.

Conclusions: The study of job satisfaction of healthcare professionals is currently both relevant and essential, considering its impact on the quality of healthcare, the risk of professional burnout among healthcare workers, and the significant psycho-emotional burden they experience due to ongoing military actions.

KEY WORDS: job satisfaction, healthcare professionals, professional burnout, human resources

The role of vitamin D imbalance in the etiopathogenesis of complications of acute pancreatitis

Viktoriia V. Teterina, Nataliia V. Velyka

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Introduction: Vitamin D (25(OH)D) plays a crucial role in numerous anti-inflammatory, immunomodulatory, and metabolic processes and potentially significantly impacts the clinical course of acute pancreatitis. The prevalence of this condition is increasing every year in Europe and, in some countries, reaches up to 100 cases per 100,000 population. The involvement of a multidisciplinary team of medical professionals is essential for improving the management of acute pancreatitis, as it is one of the most complex surgical diseases with a high risk of complications and a mortality rate of up to 42%. A common consequence of acute pancreatitis is vitamin D imbalance. However, the role of the latter as a risk factor for the disease and its complication, acute secondary sarcopenia associated with the disease (SSARC), has not been sufficiently studied and requires increased attention from the scientific community.

Aim: To determine the role of vitamin D imbalance as a risk factor for developing acute pancreatitis and secondary sarcopenia associated with acute pancreatitis.

Materials and Methods: We conducted a descriptive review of current research data regarding the role of vitamin D imbalance as a risk factor for acute pancreatitis and its complication, secondary sarcopenia associated with the disease, which significantly affects patients' prognosis and quality of life of patients.

Results: Research has proven that vitamin D insufficiency or deficiency in blood serum is quite common in patients with acute pancreatitis: according to current studies, the decrease in serum 25(OH)D levels (<50 ng/ml) of varying severity among hospitalized patients was 72.2-84.7%, while normal levels (>50 nmol/l) were found in only 15.3-27.8% of patients with acute pancreatitis. A negative correlation was also reported between the severity of acute pancreatitis according to the revised classification (Atlanta, 2012) and serum 25(OH)D levels. Moreover, severe vitamin D deficiency (≤ 13.28 ng/ml) can be considered a significant predictor of severe acute pancreatitis (sensitivity 83.3%, specificity 94.4%).

Monitoring and correcting vitamin D imbalance has excellent potential in preventing recurrent attacks of acute pancreatitis and chronicity of the disease

due to its anti-inflammatory and antifibrotic properties. However, the issue of vitamin D therapy as part of a complex of measures to prevent secondary sarcopenia associated with the disease remains controversial among scientists and clinicians. On the one hand, some studies have reported no significant association between 25(OH)D levels and muscle strength, quality, and function. On the other hand, the inflammatory process is pronounced in acute pancreatitis and plays a key role in the etiopathogenesis of SSARC. Vitamin D has been shown to regulate inflammation in several ways. For example, it inhibits the important inflammatory regulator NF- κ B (nuclear factor kappa-light-chain-enhancer of activated B cells) and synthesis of proinflammatory cytokines (TNF- α , IL-1 β , IL-6). It increases the production of the anti-inflammatory cytokine IL-10 by binding to immune cells' vitamin D receptor (VDR). In addition, vitamin D directly affects immune cells: it inhibits the activation of T lymphocytes and the release of proinflammatory cytokines by macrophages by suppressing phagocytosis, suggesting an excellent potential for vitamin D therapy to prevent and treat SSARC.

Conclusions: These data indicate the prospects of monitoring and correcting of serum 25(OH)D levels as part of a set of measures to reduce the risk of acute pancreatitis, as well as the need for an in-depth study of the role of vitamin D in the prevention and treatment of secondary sarcopenia associated with acute pancreatitis.

KEY WORDS: vitamin D imbalance, acute pancreatitis, secondary sarcopenia, inflammatory processes

The impact of social support and information hygiene on mental health during wartime: Survey results

Olena T. Yelizarova¹, Svitlana V. Hozak¹, Tetiana V. Stankevych¹, Alla M. Parats¹, Natalia V. Lebedynets²

¹ STATE INSTITUTION «O.M. MARZIEIEV INSTITUTE FOR PUBLIC HEALTH OF THE NATIONAL ACADEMY OF MEDICAL SCIENCES OF UKRAINE», KYIV, UKRAINE

² DRAGOMANOV UKRAINIAN STATE UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Introduction: In the face of contemporary challenges caused by the full-scale military invasion of Ukraine, the mental health of the population is significantly affected by multiple stress factors. Isolation during the pandemic has shown that in times of social anxiety or instability, people often increase their information seeking. In this case, a sense of emotional security is promoted by social support, which can reduce anxiety associated with receiving potentially disturbing new.

Aim: To assess the impact of social support and frequency of news consumption on the mental health of adults during wartime.

Materials and Methods: Between April and June 2023, an online survey was conducted among 1,797 adults from all regions of Ukraine. Depressive and anxiety symptoms were assessed using the Patient Health Questionnaire-2 (PHQ-2) and the Generalized Anxiety Disorder 2-item (GAD-2) scale. Additional variables included age, gender, education level, place of residence, migration status, frequency of news consumption, and the presence and types of social support. Data analysis was performed using RStudio, employing contingency tables, analysis of variance, and regression models.

Results: One year after the onset of the full-scale invasion, a high level of social support from friends, relatives, and colleagues was reported by 21.8% of respondents. At the same time, only 1.6% acknowledged receiving significant support from local authorities and social services, regardless of migration status. Independent of gender and age, 21.2% of respondents view news up to once a day, while 49.6% reported continuous news consumption. Increased frequency of news consumption was associated with a 10% increase in the likelihood of experiencing depressive symptoms (OR=1.10; CI: 1.07-1.13) and an 11% increase in anxiety symptoms (OR=1.11; CI: 1.08-1.14). Conversely, a high level of social support reduced the likelihood of depressive symptoms by 27.2% (OR=0.79; CI: 0.77-0.81) and anxiety symptoms by 25.8% (OR=0.80; CI: 0.78-0.82).

Conclusions: Social support is a key determinant in improving psychological well-being during crises. Excessive news consumption increases the risk of depressive and anxiety symptoms, underscoring the necessity of maintaining information hygiene. The findings have practical implications for developing psychological assistance strategies, public information campaigns, and support programs for the population during emergency situations.

KEY WORDS: mental health, news consumption, assessment of social support, war

Sociological study of alcohol abuse: assessing prevalence and identifying risk groups

Iryna V. Yevtushenko¹, Nataliia V. Shestak², Tetiana S. Gruzieva^{1,2}, Hanna V. Inshakova^{1,2}

¹BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

²STATE INSTITUTION OF SCIENCE «CENTER OF INNOVATIVE HEALTHCARE TECHNOLOGIES» STATE ADMINISTRATIVE DEPARTMENT, KYIV, UKRAINE

ABSTRACT

Introduction: Alcohol dependence and risky patterns of alcohol consumption pose a serious threat to both individual health and the social and economic aspects of societal development. This phenomenon becomes particularly relevant in the context of modern society, where transformations in sociocultural conditions, stress, and lifestyle changes contribute to an increase in instances of risky alcohol consumption. Given these challenges, analyzing the prevalence of this phenomenon and identifying risk groups are crucial for developing effective prevention and intervention strategies.

Aim: Based on the materials of the sociological study, to determine the prevalence of alcohol abuse among the population and identify risk groups prone to developing alcohol dependence.

Materials and Methods: The sociological study was conducted using the WHO AUDIT standardized questionnaire through an anonymous online survey on the Google Form platform. The study was carried out in January–February 2025 and covered 129 individuals aged 19 to 69, of whom 36,4% were male and 63,6% were female. The majority of the respondents lived in urban areas (93,0%), had higher education (59,7%), and incomplete higher education (32,6%). Regarding the social status of the respondents, 55,0% were employed, 31% were students, 9,3% were retirees, and 4,7% were unemployed. Data analysis was performed by calculating the frequency of characteristics per 100 respondents and its standard error ($\pm m$).

Results: Regarding the frequency of alcohol consumption, $38,8 \pm 4,3$ per 100 respondents reported drinking alcohol once a month or less frequently, $30,2 \pm 4,0$ per 100 consumed alcohol 2 to 4 times a month, and $9,3 \pm 2,6$ per 100 did not consume alcohol at all. Meanwhile, $10,1 \pm 2,7$ per 100 respondents reported drinking alcohol 4 times a week or more. A concerning fact is that among these individuals, 23,0% were young people under 25 years of age, and 30,8% were over 55 years old, with 69,2% of them holding a higher education degree. As for the number of alcoholic drinks consumed on a typical day when alcohol is consumed, the majority ($56,6 \pm 4,4$ per 100) reported having one or two drinks, while $6,2 \pm 2,1$ per 100 respondents consume 5 or more drinks.

Among those who are unable to stop once they start drinking, $16,3 \pm 3,3$ per 100 respondents were identified, with 33,3% of them being young people under 25 years old. Alcohol consumption was a cause of not fulfilling responsibilities for $14,7 \pm 3,1$ per 100 respondents; notably, 47,4% of these individuals were of working age. The need to drink alcohol in the morning to be able to do anything after excessive drinking the previous day was reported by $5,4 \pm 2,0$ per 100 respondents, 28,6% of whom were under 25 years old. According to the survey results, $74,4 \pm 3,1$ per 100 respondents do not feel guilty about drinking alcoholic beverages. Among the quarter of respondents who experience guilt due to alcohol consumption, the majority are urban residents – almost 9 out of 10 – hold a higher education degree, and are employed (60,6% each). A concerning finding is that $10,9 \pm 2,7$ per 100 respondents reported amnesia of events from the previous day due to alcohol intoxication. The vast majority (85,7%) of this group hold a higher or incomplete higher education.

Alcohol abuse poses a serious threat to society, as it increases the risk of injuries both to individuals under the influence and to those around them. The study results revealed that $9,3 \pm 2,6$ per 100 respondents reported incidents where their state of intoxication led to injuries to themselves or others. Data analysis showed that $14,7 \pm 3,1$ per 100 respondents had received warnings from close individuals or healthcare professionals regarding excessive alcohol consumption.

Conclusions: The study revealed the prevalence of risky alcohol consumption patterns, posing a threat to public health. Young people under 25, individuals over 55, and respondents with higher education demonstrated an increased tendency toward regular and excessive alcohol consumption. Instances of regular drinking, amnesia, injuries, failure to fulfill responsibilities, and an inability to stop drinking indicate significant behavioral issues. The low level of self-criticism and insufficient awareness of the negative consequences of alcohol consumption among the respondents highlight the need to develop and implement comprehensive preventive measures aimed at promoting responsible attitudes toward alcohol and reducing alcohol-related harm.

KEY WORDS: alcohol abuse, alcohol dependence, risk groups, sociological survey, AUDIT

