ORIGINAL ARTICLE

CONTENTS

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

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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.

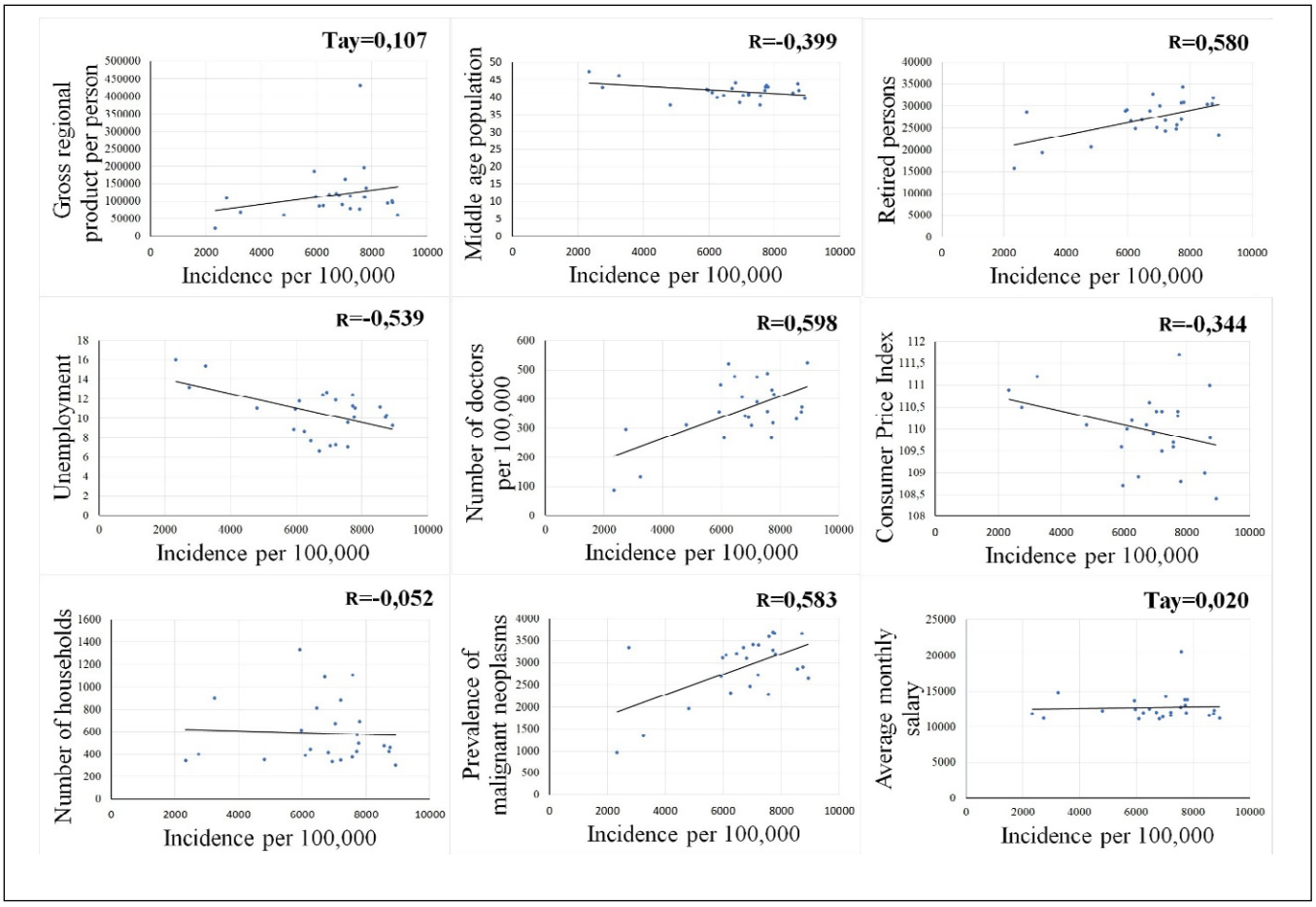

Fig. 1. Correlation fields for COVID-19 incidence and some medical, social, and economic indicators, 2021

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-

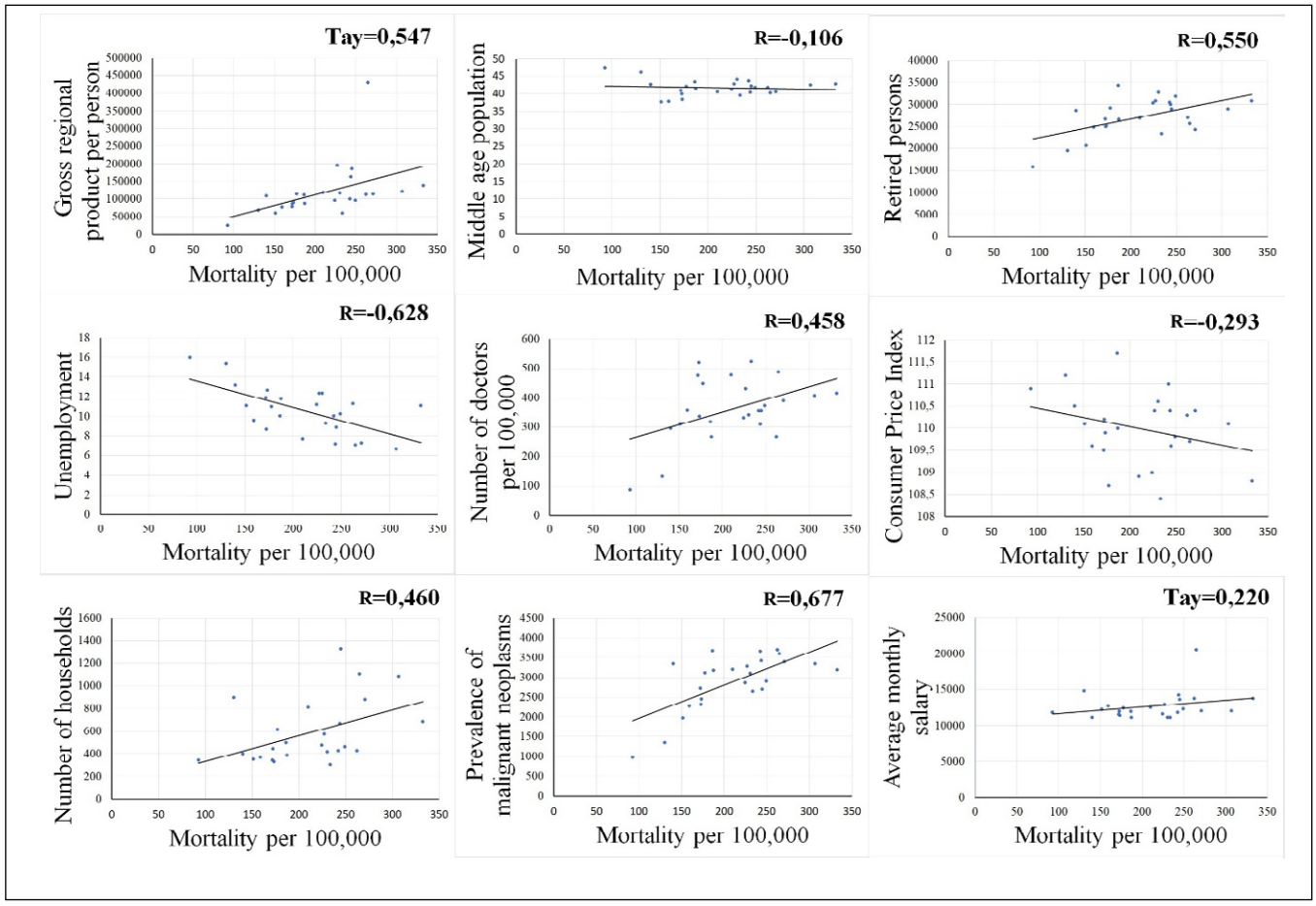

Fig. 2. Correlation fields for COVID-19 mortality and some medical, social, and economic indicators, 2021

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).

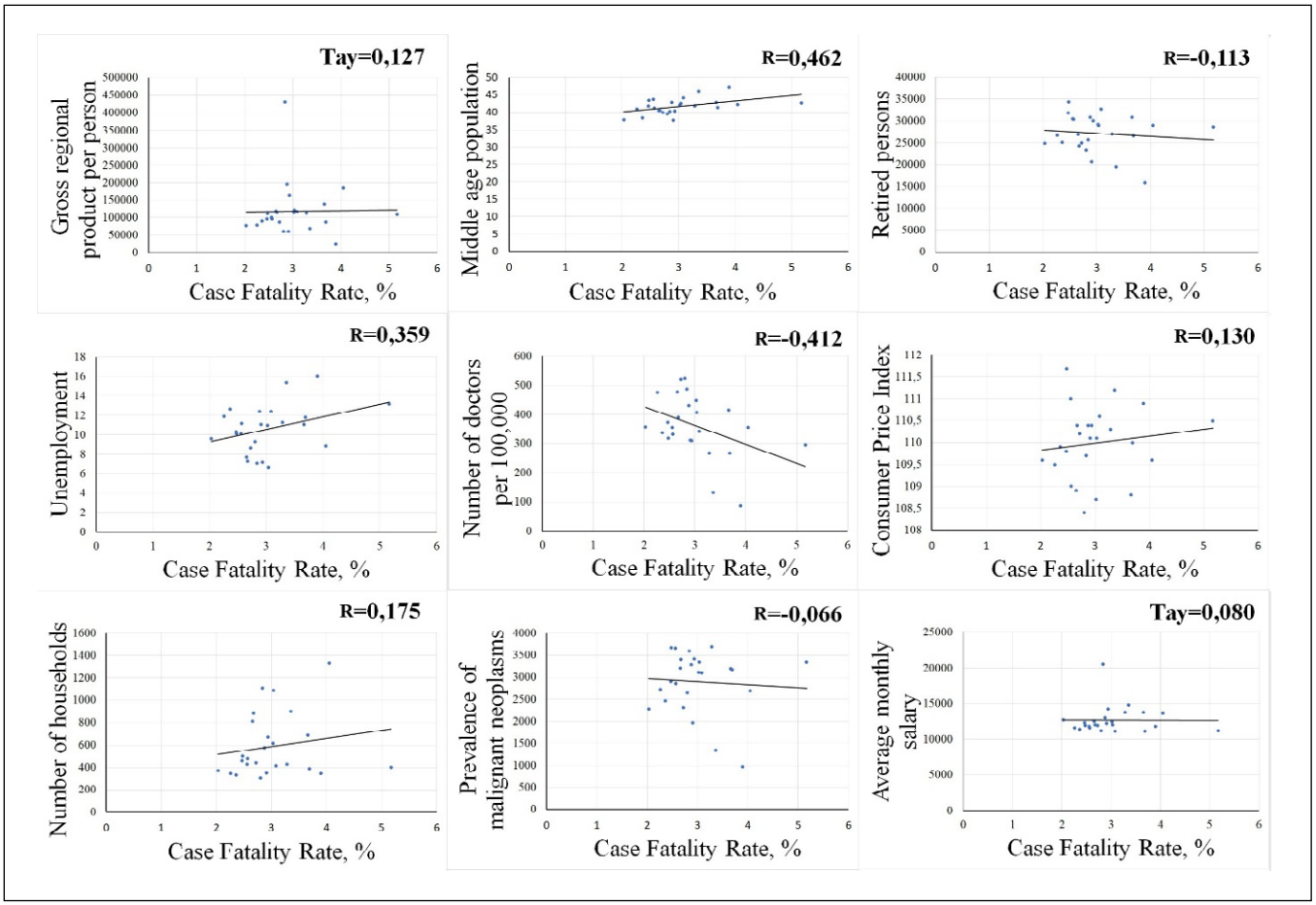

Fig. 3. Correlation fields for CFR of COVID-19 and some medical, social, and economic indicators, 2021

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

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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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