

# Dynamics of the prevalence of thyroid gland diseases among the adult population

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## ABSTRACT

**Aim:** To content analysis the problem of thyroid disorders and thyroid gland pathology among adults in Ukraine and Ternopil region.

**Materials and Methods:** The research was conducted during 2021–2025 in several stages on the base of scientific literature about endocrine system disorders. At the theoretical stage, the state of problem development in the scientific literature of iodine deficiency was studied. 75 scientific papers were used for the analysis, which were searched for using the following keywords: goitre, hypothyroidism, thyrotoxicosis, thyroiditis, iodine deficiency. Statistical data was also collected and analyzed on the incidence of iodine deficiency disorders among the adult population of Ukraine, particularly in the Ternopil region. International manuscripts and articles on the problem of iodine deficiency diseases were studied also, such as: Diffuse goitre, Nodular goitre, Hypothyroidism, Postoperative hypothyroidism, Thyrotoxicosis, Thyroiditis; Ukraininan experience was analyzed and generalized.

**Conductions:** The reason for iodine deficiency is the consequences of the Chernobyl accident and negative state of the environment due to a natural deficiency of iodine and other elements. The scientific report shows the need to inform about preventive and health-improving measures among the adult population, depending on regional characteristics.

**KEY WORDS:** thyroid gland, goitre, hypothyroidism, thyrotoxicosis, thyroiditis, iodine deficiency, metabolic disorders, postnatal ontogenesis

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## INTRODUCTION

Endocrine system disorders occupy a leading place in the structure of the overall morbidity of the population. In recent years, the incidence of endocrine diseases has been on the rise both worldwide and in our country [1-3]. There has been an increasing of the number of patients with various endocrinopathies, the most common of which are thyroid disease and diabetes mellitus.

According to WHO data, over the past half-century there has been an increase in thyroid pathology, which ranks first among endocrinopathies after diabetes [4, 5]. Almost a third of the world's population is at risk of developing thyroid disorders [6]. This problem is becoming increasingly relevant due to the deterioration of the environmental situation in Ukraine. According to the Ministry of Health of Ukraine, the overall incidence of thyroid disorders has increased fivefold over the past five years, and statistical indicators vary among different regions of Ukraine depending on various factors (iodine-deficient regions, chronic stress, unbalanced nutrition, the presence of comorbidities, etc.) [7, 8].

The thyroid gland is an important part of the neuroendocrine system. Its main function is to maintain normal metabolism in the cells, organs and whole organism by supplying the body with such thyroid hormones as: triiodothyronine (T3) and thyroxine (T4), which contain iodine as an essential structural component [9]. Iodine deficiency conditions lead to decreasing of the production of the hormones of the thyroid gland and the development of iodine deficiency disorders, which can cause miscarriage, reproductive disorders in women, and numerous negative consequences for the fetus [10-12]. Iodine deficiency disorders are all pathological conditions caused by iodine deficiency, the development of which can be completely prevented through the implementation of individual, group, and mass prevention methods [13, 14].

Ukrainian and foreign studies have shown that the most common cause of thyroid disease is a deficiency of iodine intake from the environment into the body. Prolonged iodine deficiency disrupts adaptive processes, leading to iodine deficiency disorders, which

manifest themselves in various pathologies at different ages [15].

The problem of iodine deficiency remains unresolved for Ukraine, with almost the entire territory of Ukraine experiencing iodine deficiency of varying severity [16-18] as there are no regions where the risk of iodine deficiency disorders for the population has not been recorded [19]. In regions with insufficient iodine supply, the most common cause of thyroid dysfunction is endemic goiter, which leads to gland hypofunction. Its annual incidence reaches 3.5 per 1,000 women and 0.6 per 1,000 men [17, 18].

## AIM

To content analysis of scientific literature in the problem of thyroid disorders and thyroid gland pathology among adults in Ukraine and Ternopil region.

## MATERIALS AND METHODS

The research was conducted during 2021–2025 in several stages on the base of scientific literature about endocrine system disorders. At the theoretical stage, the state of problem development in the scientific literature of iodine deficiency was studied. 75 scientific papers were used for the analysis, which were searched for using the following keywords: goitre, hypothyroidism, thyrotoxicosis, thyroiditis, iodine deficiency. Statistical data was also collected and analyzed on the incidence of iodine deficiency disorders among the adult population of Ukraine, particularly in the Ternopil region. International manuscripts and articles on the problem of iodine deficiency diseases were studied also, such as: Diffuse goitre, Nodular goitre, Hypothyroidism, Postoperative hypothyroidism, Thyrotoxicosis, Thyroiditis; Ukrainian experience was analyzed and generalized.

## ETHICS

All sources used in this literature review are publicly available.

## FRAMEWORK

The work is carried out within the framework of the initiative research work of the I. Horbachevsky Ternopil National Medical University (Ternopil, Ukraine) "0116 U003390 Systemic and organ disorders due to the action of extraordinary factors on the body, the mechanisms of their development and pathogenetic correction".

## REVIEW AND DISCUSSION

Diffuse and nodular goiter remain the most common thyroid disorders in Ukraine today. The number of registered goiter patients in Ukraine is measured in hundreds of thousands. The main cause of goiter is iodine deficiency in the population's diet, as well as the direct or indirect influence of various negative factors, including environmental ones [8, 19]. It is precisely the imbalance between micronutrients and vitamins in patients' diets, combined with the deteriorating environmental situation in the region and insufficiently effective preventive measures, that contributes to the development of thyroid diseases.

When assessing the total number of registered patients with goiter in Ukraine, there is a downward trend in the incidence of grade I diffuse goiter. The number of new cases in 2020 was 48,649, and in 2023 – 34,861. Over the course of five years, diffuse goiter of grades II-III also showed a slight downward trend, with a prevalence of 156,613 cases in 2020 and in 2023, 153,556 cases, which translates to 31.5 and 28.6 new cases per 100,000 population. These data truly reflect the positive dynamics of preventive work and educational and informational awareness of the population in Ukraine regarding the reduction of thyroid diseases.

It should be noted that the level of goitre in western region is higher when to compare with the national average and the indicators for the north-eastern regions of Ukraine. In the Ternopil region, there has been a trend towards an increase in the prevalence of grade I goitre in recent years – 2,218 (2019) and 2,225 (2023), which translates into 256.5 and 259.0 newly diagnosed cases per 100,000 population. This is due to an increase in the incidence of thyroid disease among the population of the western regions as a result of iodine deficiency endemic in these regions. An analysis of the prevalence of nodular goitre among the adult population of Ukraine shows an increase in this pathology every year. According to statistical data, since 2019, there has been a trend towards an increase in nodular goitre among the population of Ukraine and the Ternopil region in particular. The number of patients increases by almost 10% annually. The reason for this increase in the incidence of nodular goitre in Ukraine is the consequences of the Chernobyl accident, as well as the negative state of the environment due to a natural deficiency of iodine, selenium and other trace elements. Given the high incidence of benign thyroid neoplasms in Ukraine, in 2019, 28,850 patients with nodular goitre were diagnosed for the first time (the incidence rate was 81.7 per 100,000 people), in 2021 – 29,982 patients (83.6 per 100,000 people), in 2022 – 30,012 patients (87.5 per

100,000 people), and in 2023 – 33,721 patients (90.2 per 100,000 people). The diagnosis of nodular goitre has improved significantly in recent years thanks to modern ultrasound examinations, indicating an overall increase in the disease.

The prevalence of nodular goitre among the adult population in the Ternopil region during 2019–2023 showed a tendency towards progression of the disease. Thus, in 2019, 4,540 patients with nodular goitre were detected for the first time (the incidence rate was 49.6 per 100,000 population), in 2021 – 5,001 patients (56.7 per 100,000 population), in 2022 – 5,544 patients (57.2 per 100,000 population), and in 2023 – 5,712 patients (58.6 per 100,000 population).

Ukrainian and foreign studies have shown that the most common cause of thyroid disease is a deficiency of iodine intake from the environment into the body [6,9, 20]. Today, the problem of iodine deficiency remains unresolved for Ukraine, as there are no regions where the risk of iodine deficiency diseases for the population has not been recorded. Numerous studies conducted by employees of the V.P. Komissarenko Institute of Endocrinology and Metabolism of the National Academy of Medical Sciences of Ukraine have confirmed that almost the entire territory of Ukraine suffers from iodine deficiency of varying severity [17, 21]. In particular, the Ternopil region is classified as a region with a moderate degree of iodine deficiency. In addition, the situation is complicated by the fact that Ukraine has not yet adopted a document at the legislative level that would regulate the prevention of iodine deficiency.

Compared to other thyroid disorders, thyrotoxicosis is much less common, but there are still tens of thousands of cases in Ukraine. The prevalence of thyrotoxicosis in 2019 was 144.9 per 100,000 population, and the incidence of thyrotoxicosis was 13.8 cases per 100,000 population. In 2021, the prevalence was 150.5 per 100,000 population, and the incidence was diagnosed in 16.4 cases per 100,000 population. In 2023, the prevalence of thyrotoxicosis was 154.4, and in 2019, it was 158.1 per 100,000 population. The incidence of this nosology in Ukraine is also gradually increasing, with the number of new cases of thyrotoxicosis in 2019 amounting to 4,999 and in 2023 – 6,027 per 100,000 population. An increase in the prevalence and incidence of hyperthyroidism was also observed in the Ternopil region.

In recent years, the prevalence of thyroiditis has been growing rapidly in Ukraine. This diagnosis includes acute, subacute, chronic thyroiditis and autoimmune thyroiditis. It should be noted that in 2019, the prevalence was 16,330 cases of thyroiditis, and in 2023, it was 18,403 cases, which translates to 37.0 and 49.2

new cases per 100,000 population. An analysis of the prevalence and incidence of thyroiditis in the Ternopil region also showed an upward trend. Thus, in 2019, the prevalence was 26.1, and in 2023, it was 40.6 new cases.

In the population, the prevalence of clinically significant hypothyroidism ranges from 0.5% to 2%, and subclinical hypothyroidism from 5% to 10%. In iodine-deficient regions, hypothyroidism is found in 80% of women during menopause.

Hypothyroidism is a thyroid gland disorder characterised by a hormone deficiency and affecting up to 5% of the general population. It is one of the most common disorders of the endocrine system, caused by a deficiency of thyroid hormones or a reduction in their biological effect at the tissue level. Iodine deficiency is the most common cause of all thyroid disorders worldwide, including hypothyroidism. Subclinical hypothyroidism is a pathological condition in which serum thyroid hormone levels are within the reference range, but serum thyrotropin levels are persistently elevated (at least twice) beyond the control range of more than 4.5 mIU/L. The diagnosis of subclinical hypothyroidism is based solely on the analysis of thyroid function using laboratory diagnostics. In populations with adequate iodine intake, subclinical hypothyroidism affects up to 10% of the population, with the highest prevalence among women and the elderly [22].

In Ukraine, the prevalence of subclinical hypothyroidism among the adult population ranges from 4 to 20%, depending on gender (higher percentage among women), age (over 60 years), body mass index, race, smoking, iodine intake, etc. [23]. The most common cause of subclinical hypothyroidism is autoimmune thyroiditis. Other causes of subclinical hypothyroidism may include postpartum thyroiditis (hypothyroid phase), thyroid surgery, iodine deficiency, and laboratory abnormalities (e.g., heterophilic antibodies in serum) [23, 24].

The prevalence of subclinical hypothyroidism is five to six times higher than that of overt hypothyroidism [25]. Subclinical hypothyroidism is the mildest form of thyroid gland insufficiency with minimal clinical symptoms, which may be masked by the initial manifestations of climacteric disorders. Some studies have found that subclinical hypothyroidism, like overt hypothyroidism, is associated with hypoestrogenemia in perimenopausal women [26]. Therefore, in women of this age group, hypothyroidism may go unnoticed or its symptoms may be misinterpreted as menopausal manifestations.

In the elderly population, hypothyroidism is more common in women during menopause. The annual incidence of primary hypothyroidism is 3.5 per 1,000 women and 0.6 per 1,000 men [2, 6].

The prevalence of hypothyroidism among the population of the Ternopil region is constantly increasing: the prevalence of acquired hypothyroidism in 2019 was 209.7 per 100,000 population. In 2021, it was 254.3 per 100,000 population. In 2023, it will be 292.8.

Hypothyroidism is divided into primary, which develops as a result of damage to the thyroid gland itself, and secondary, which occurs as a result of a deficiency in the synthesis of TSH by the pituitary gland or TRH by the hypothalamus. In the works of some researchers, women without thyroid pathology with a complicated course of menopause showed an increase in TSH, unlike women with a physiological course. A test with 200 mg of thyrotropin showed that the increase in TSH levels is compensatory and characteristic of a euthyroid state [27]. The compensatory increase in TSH levels may be associated with a decrease in the stimulating effect of oestrogens on the thyroid gland. As a result, its reserves are reduced and the risk of developing hypothyroidism increases.

Hypothyroidism progresses slowly and often develops unnoticed by patients and those around them. Diagnosis of this pathology is complicated and is due to its multi-symptomatic nature and similarity of symptoms to the manifestations of ageing [28]. As is known, the course of hypothyroidism is often accompanied by manifestations of goitre in iodine-deficient regions and, according to the literature [27, 28], it is more often detected in women aged 40-60 years. In 2022, the prevalence of hypothyroidism was 292.8 per 100,000 population, and in 2023, it was 348.6 per 100,000 population, while the incidence was diagnosed in 30.9 cases and increased to 32.6 cases per 100,000 population.

Another frequently diagnosed thyroid disease is autoimmune thyroiditis, a genetically determined autoimmune disease that develops under the influence of environmental factors [12]. The genetic nature of autoimmune thyroiditis is confirmed by certain HLA antigens (HLA DR3, HLA DR5). Autoimmune thyroiditis is often associated with other systemic and organ diseases (type 1 diabetes mellitus, rheumatoid arthritis, systemic lupus erythematosus, scleroderma, etc.). In addition to age and gender, environmental factors such as sun exposure, infectious diseases, and excessive iodine intake can contribute to the development of autoimmune thyroiditis. Thus, according to some authors, iodine consumption is accompanied by an increase in the prevalence of autoimmune thyroiditis, while other authors report varying prevalence rates of both thyrotoxicosis and hypothyroidism depending on iodine supply [29, 30]. There are studies indicating

that excessive iodine absorption in the presence of genetic predisposition contributes to the formation of active radicals that destroy proteins and lipids in the epithelial cells of the thyroid gland, leading to its lymphoid infiltration.

The course of autoimmune thyroiditis is often accompanied by an hypotrophy of the thyroid gland (Hashimoto's goitre). The atrophic form of thyroiditis is characterised by a reduction in its size (atrophic thyroiditis). The histological picture of autoimmune thyroiditis in thyroid tissue is represented by lymphoid and plasmacytic infiltration, destruction of the follicular apparatus, and fibrosis [14].

Autoimmune thyroiditis is caused by a defect in the immunological response associated with a deficiency of T-suppressors. In the course of various immunological processes under the influence of T-helpers, lymphocytes are transformed into plasma cells and form antibodies to thyroglobulin and peroxidase. Interaction with T-killers has a cytotoxic effect on the follicular cells of the thyroid gland. This eventually leads to destruction, reduction in mass and decreased function of the thyroid gland. Autoantibodies to peroxidase bind to the C1/3 fraction of complement, forming immune complexes that have a cytotoxic effect on thyroid epithelial cells [30, 31]. T-lymphocytes sensitised to specific antigens are capable of secreting lymphokines that are cytotoxic to target cells. Lymphokines include chemotactic factor, macrophage migration inhibitory factor, tumour necrosis factor, and lymphotoxin. Damage to the thyroid epithelium leads to thyroid hypertrophy, a reaction to maintain euthyroid status, and in rare cases, to destructive thyrotoxicosis with thyroid hyperfunction [31]. Subsequently, there is a decrease in the functional activity of the thyroid gland and overt hypothyroidism develops.

One of the main goals of the healthcare system in most countries around the world is to take preventive measures against pathological conditions that can develop as a result of iodine deficiency and contribute to the development of iodine deficiency disorders and diseases. Thyroid pathology is one of the most common reasons for patients seeking medical help, and this is particularly noticeable in iodine-deficient and polluted areas of certain regions.

According to the WHO, about 2 billion people live in conditions of chronic iodine deficiency, with nodular goitre, diffuse goitre, hypothyroidism, thyrotoxicosis and thyroiditis being the most common thyroid disorders. Analysis of official statistics has made it possible to determine the significant prevalence of iodine deficiency and endocrine diseases in many regions. Traditionally, the regions of Ukraine with a pronounced

**Table 1.** Prevalence of thyroid gland pathology among adults (per 100,000 population) in Ukraine and Ternopil region

Diseases	Country/Region	2020	2021	2022	2023
Diffuse goitre, grade I	Ukraine	1268,8	1285,3	1348,7	1381,5
	Ternopil	1175,4	1326,1	1307,1	1291,3
Diffuse goitre, grade II	Ukraine	434,2	457,3	445,3	441,3
	Ternopil	608,4	645,9	649,0	627,5
Nodular goitre	Ukraine	766,4	817,6	855,3	891,5
	Ternopil	523,4	579,1	612,0	647,3
Hypothyroidism	Ukraine	251,6	268,2	282,3	302,8
	Ternopil	254,3	292,8	318,4	348,6
Postoperative hypothyroidism	Ukraine	213,1	234,5	234,3	246,9
	Ternopil	130,6	120,0	137,9	147,5
Thyrotoxicosis	Ukraine	144,9	150,5	154,4	158,1
	Ternopil	165,6	174,1	177,2	177,9
Thyroiditis	Ukraine	465,3	493,2	543,7	520,7
	Ternopil	140,8	193,4	269,2	226,7

Source: compiled by the authors of this study

iodine deficiency include Ternopil, Ivano-Frankivsk, Chernivtsi, Rivne, Zakarpattia, Volyn, and Lviv regions. An analysis of the prevalence of thyroid diseases in the Ternopil region and in Ukraine as a whole shows that from 2020 to 2023, not only did the overall incidence increase, but the overall structure of thyroid pathology also changed (Table 1).

Iodine, as a trace element, is essential for the synthesis of the necessary amount of thyroid hormones for its functioning. The daily requirement for iodine depends on a person's age and physiological state; it ranges from 90 to 250 mcg/day [3, 32]. Thyroid hormones are necessary for regulating energy metabolism, growth and reproduction. Insufficient iodine intake leads to the development of processes aimed at adapting and maintaining hormone secretion by the gland. Increasing of the interest to the problems of thyroid pathology in Ukraine in recent years is caused by its growing prevalence among the adult population, the high frequency of temporary and permanent disability [7, 33].

Iodine deficiency is a significant risk factor in the development of iodine deficiency disorders and thyroid diseases, but smoking, genetic predisposition, ethnicity, and various endocrine disorders also contribute to their development.

Diffuse and nodular goitre remains the most common thyroid disorder in Ukraine today. The number of registered goitre patients in Ukraine is measured in hundreds of thousands. The main cause of goitre is iodine deficiency in the population's diet, as well as the direct or indirect influence of various negative factors,

including environmental ones [34]. It is the imbalance of microelements and vitamins in the population's diet, against the backdrop of a deteriorating environmental situation and insufficiently effective preventive measures at the state level, that causes the development of thyroid diseases.

The endemic nature of thyroid damage contributes to earlier menstrual dysfunction and the onset of menopause [27]. There is a close relationship between menopause and thyroid pathology. In a number of studies, in 30% of cases, the manifestation of thyroid diseases occurs during menopause [9]. Prolonged residence in an iodine-deficient area also gradually leads to nodule formation and the development of thyroid autonomy. Gradually, the number of thyrocytes that have become autonomous and lost sensitivity to the regulatory influence of TSH increases [19]. The production of excessive amounts of thyroid hormones by autonomous tissue leads to the development of thyrotoxicosis even in the absence of additional iodine intake. Taking iodised salt or iodine-containing pharmaceuticals only accelerates this process [10, 11].

Over the past 10 years, the absolute number of thyroid gland diseases in Ukraine has increased from 689,000 to 1,846,000, which translates into a prevalence of 941.6 and 4,210.4 cases per 100,000 population, respectively.

According to WHO data, iodine deficiency is one of the most common causes of mental retardation in children, which is quite dangerous for them in childhood, because the endocrine hormones of the gland are necessary for regulating the development,

differentiation and formation of tissues of all organs and systems of the child's body, primarily the brain.

In Ukraine, no document regulating the prevention of iodine deficiency has yet been approved at the legislative level [18]. Scientists from the National Academy of Medical Sciences of Ukraine, together with experts from the United States, have calculated the economic consequences of prolonged iodine deficiency for our country. Due to reduced working capacity caused by iodine deficiency in Ukraine, losses exceed UAH 1.2 billion. Meanwhile, investing in an IDD prevention programme would reduce expenditures from the State Budget of Ukraine by up to 80% of

the funds potentially lost due to reduced labour productivity [21, 34].

## CONCLUSIONS

The presented results of the incidence and prevalence of thyroid diseases indicate a tendency towards an increase in thyroid pathology among the adult population of Ukraine and the Ternopil region. The statistical report dictates the need to make informed decisions at the state level regarding the development of preventive and health-improving measures among the adult population, depending on regional characteristics.

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## CONFLICT OF INTEREST

The Authors declare no conflict of interest

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