HYGIENIC ASSESSMENT OF THE UKRAINIAN ADULT POPULATION THYROID DISEASES MORBIDITY FROM 2000 TO 2013

[1]Antonenko Anna Mykolaivna, [2]Korshun Maria Mykhailivna, [1]Vavrinevych Olena Petrivna, [3]Omelchuk Sergiy Tykhonovych, [1]Bardov Vasyl Gavrylovych

[1]Hygiene and Ecology Department № 1, [2] Hygiene and Ecology Department № 3, [3]Hygiene and Ecology Institute

O.O. Bogomolets National Medical University

Kyiv, Ukraine

Corresponding author: Antonenko Anna Mykolaivna, Hygiene and Ecology Department № 1 of O.O. Bogomolets National Medical University, I. Franko, 6, 257, Kyiv region, s. Sofiivska Borshchshivka, 08131, +380991466331, antonenko1985@ukr.net

Abstract.

Background. Diseases of the thyroid gland have attracted considerable attention in recent decades. This is partly due to the fact that the thyroid gland reacts actively to the geochemical state and pollution of the environment with industrial and agricultural pollutants with the subsequent occurrence of certain pathological processes.

Objective of the work was to analyze the morbidity of the adult population of Ukraine for the thyroid gland diseases in the period from 2000 to 2013.

Methods. The methods of empirical and theoretical research of scientific information, namely analysis, synthesis, induction, deduction and systematization, epidemiological and statistical methods were used. Using the Microsoft Office Excel (2007) and IBM SPSS StatisticsBase v.22 program correlation and regression analyzes were conducted.

Results. It was established that in the period from 2000 to 2013, higher levels of adult population endocrinopathies, thyroid in general and diffuse goiter of varying degrees general and primary morbidity were recorded in the Western and Northern regions of Ukraine, lower – in the Central, Eastern and Southern regions. Reliable ($p < 0,001$) positive correlation between the level of prevalence and the level of incidence of endocrine pathology, diseases of the thyroid gland as a whole, as well as on individual nosologies was detected. It was established that the endocrine diseases incidence rates of the adult population are well correlated ($p < 0,01$) with the prevalence and morbidity rates of the diffuse goiter of various degrees, which is explained by the high specific gravity of the latter in the structure of endocrine diseases in general and thyroid pathology, in particular.

Conclusion. The regional peculiarities of the levels and dynamics of changes in the incidence rates of the thyroid morbidity among adult population of Ukraine can be attributed to the action of priority environmental factors for each region. It is known that the Western and Northern regions of Ukraine are characterized by low natural iodine content in the soil. The Northern regions significantly contaminated by radioactive substances. In the Eastern region, powerful industrial centers are concentrated. The Central and Southern regions have developed agricultural production, which today widely uses chemical plants

protection products. The study of the environmental factors influence on the Ukrainian adult population thyroid morbidity will be devoted to our further research.

Key words: morbidity, thyroid gland, adult population.

Introduction. Diseases of the thyroid gland have attracted considerable attention in recent decades: in the structure of endocrine pathology prevalence in Ukraine they occupy the first place - on average 44 %, and in endemic with iodine deficiency western regions – up to 70 % [1]. This is partly due to the fact that the thyroid gland reacts actively to the geochemical state and pollution of the environment with industrial and agricultural pollutants with the subsequent occurrence of certain pathological processes [2]. In the structure of endocrinological pathology, the largest proportion belongs to different types of goiter [3, 4]. Minimizing thyroid dysfunction rates is an important task for most countries of the world, since, according to WHO publications, nearly 2 billion planet's inhabitants are at risk for thyroid diseases, including iodine-dependent diseases [4, 5].

The objective of the work was to analyze the morbidity of the adult population of Ukraine for the thyroid gland diseases in the period from 2000 to 2013.

Methods. The object of our research was the level and the dynamics of the endocrine system (Class IV, E00-E90 according to the International Diseases Classification of the Tenth Revision) and thyroid gland (E00-E07) general morbidity (prevalence[1]) and the primary morbidity (incidence[2]) of 24 regions of Ukraine, the Crimea and the Kyiv and Sevastopol cities of adult population in the period from 2000 to 2013.

The sources of information were the reports of the Endocrinology Service of Ukraine "The main indices of the activity of the endocrinology service of Ukraine ..." for the period of 8 years: 2000, 2004, 2005, 2006, 2009, 2010, 2011 and 2013 [7-14], according to which the the general endocrinological morbidity, incidence of diffuse nontoxic goiter I degree, diffuse non-toxic goiter II-III degree, nodule goiter, hypothyroidism, thyrotoxicosis, thyroiditis and thyroid cancer (II class of neoplasm, C73) accounting was carried out. The spreadsheet was created in Microsoft Office Excel (2007).

The methods of empirical and theoretical research of scientific information, namely analysis, synthesis, induction, deduction and systematization, epidemiological and statistical methods were used.

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[1] The term recommended by WHO.

[2] The term recommended by WHO.

For the analysis of changes in the level of general and primary thyroid disease, the average absolute increase (ΔI), which characterizes the average annual growth rate, growth rate (GRR,%) and gain rate (GR,%), were calculated. Calculations of the basic (relative to the level of the initial year) and the chain (relative to the level of the previous year) indices were carried out.

Using the Microsoft Office Excel (2007) and IBM SPSS StatisticsBase v.22 program correlation (with Pearson correlation coefficient – r) and regression analyzes to estimate the dynamics of population morbidity over a fourteen-year period; ranking of investigated administrative territories (AT) of Ukraine according to the levels of prevalence and incidence for 2000-2013 years and the rate of their growth; the identification of the relationship between the levels of the incidence rate of the individual thyroid diseases and the relationship between the levels and the rate of growth of the morbidity index based on the calculation of the Spearman rank correlation coefficient (r_s) were conducted

Results. The current WHO statistics show that the pathology of the endocrine system ranks third place after cardiovascular and cancerous diseases in the structure of the overall morbidity and causes of mortality in most countries of the world and it continues to grow [1]. A similar situation is observed in Ukraine also, where the increase in the number of patients with various endocrinopathies in the period from 2005 to 2010 amounted to 9,85% [14].

It has been established that in the period from 2000 to 2013, the overall endocrinological incidence (prevalence of endocrinopathies) of adult population in 16 regions of Ukraine, the Crimea, Kyiv and Sevastopol increased, as evidenced by the statistically significant coefficients of the Pearson correlation pair ($r > r_{tabl}$; $r_{tabl} = 0,707$ at $n = 8$, $p = 0,05$). Regarding the primary incidence of the endocrine system diseases, in the period under investigation, a positive correlation was established only in 6 regions, another one (Cherkassy) showed a tendency to increase ($r > r_{tabl}$; $r_{tabl} = 0,629$ at $n = 8$, $p = 0,1$). At the same time, the largest GRR and GR of both general and primary morbidity were observed in Zaporizhzhia region (GR 137,1 and 118,6 % respectively), Kyiv (113,3 and 33,8 %), Mykolaiv (102,7 and 55,8 %), Kharkiv (100,7 and 64,8 %), and Poltava (100,1 and 57,4 %) regions (respectively, 1, 2, 3, 4 and 5 rank positions for GR of general morbidity and 1, 5 , 4, 2 and 3 – GR of primary morbidity).

Significant ($p < 0,05$) reduction of the total endocrinological morbidity that correlated with the year was observed only in three regions: Volyn, Sumy and Chernihiv. In the remaining (five) regions the reliable correlation between the prevalence of endocrine pathology and the year was not detected. Regarding the primary morbidity, a reliable inverse correlation relationship was found in 8 regions (including Volyn, Sumy and Chernihiv); in another one (Kirovograd) and Crimea regions there was a tendency to decrease index ($0,05 < p < 0,1$). In the remaining (10) investigated AT, the level of primary morbidity did not significantly change for 14 study years ($p > 0,1$).

In general, between the GR of the general and GR of the primary incidence of endocrine system diseases the in the period from 2000 to 2013 was a significant positive correlation ($r_s = 0,916$; $r_{s\ tabl} = 0,597$ at $n = 27$, $p = 0,001$). The same correlation was found between the levels of prevalence and incidence of endocrine pathology ($r_s = 0,841$).

In general, the period from 2000 to 2013 the highest levels of both indices of endocrine disease were reported in Vinnytsia region and regions of Western Ukraine – Zakarpattia, Rivne, Volyn (Table. 1). Primary morbidity was high also in Ivano-Frankivsk, Ternopil and Khmelnytsky regions, and prevelence – In the northern region (Kyiv, Chernihiv and Sumy regions). It should be noted that these areas have the highest incidence of diffuse goiter of varying degrees, and in the northern region nodular goiter and thyroid cancer also.

The seven last ranked places according to both indices of incidence of endocrine system diseases were occupied by eastern (Luhansk), southern (Zaporizhzhya, Kherson), central (Poltava) regions and Sevastopol. Primary morbidity was also low in Donetsk and Odessa regions, and prevalence – in Kirovograd and Mykolayiv. The lowest rates of diffuse goiter of different degrees were foun here (Table 1).

However, it should be noted that in the regions that occupy the last ranked positions according to the levels of both morbidity indices, GRR and GR were high. On the contrary, in regions with high morbidity, GRR and GR were low or even negative. This was confirmed by the Spirman rank correlation coefficients, which showed a reliable backward correlation between the level and the GR of the total ($r_s = -0,576$; $r_{s\ tabl} =$

0,478 at n = 27, p = 0,01) and the primary (r_s = -0,509, p <0,01) incidence of endocrinopathies among the population of 27 investigated AT of Ukraine.

In general, the incidence rates of the adult population for endocrine diseases are well correlated with the prevalence and morbidity rates of diffuse goiter of various degrees (Table 2), which is explained by the high specific gravity of the latter in the structure of endocrine diseases. Thus, in Ukraine in 2010, in the structure of endocrinopathy, diffuse goiter of I-III degrees ranked second position (29,99 %) after diabetes mellitus (31,88 %), and the proportion of all thyroid gland diseases was 46,67 % [14].

In the analysis of both indices of thyroid morbidity, it was found that during the period under investigation, their higher levels were recorded in the western and northern regions of Ukraine, and the lowest ones were in the central, eastern and southern (except in the Autonomous Republic of Crimea) regions (Fig. 1). At the same time, in most of the western and northern regions in 14 years there was a decrease in both (Volyn, Lviv, Zakarpattia, Ivano-Frankivsk, Sumy oblasts), or one (Ternopil, Zhytomyr, Kiev, Chernihiv) of the morbidity indices, while changes in other were insignificant (Fig. 2).

The exception was Kyiv, where both indices, especially the level of general morbidity, increased; Rivne and Chernivtsi regions, where the general morbidity significantly increased without significant changes in the primary one, and Khmelnytsky region, where significant changes in both indices did not occur. The opposite was the situation in the central, eastern and southern regions, where in the majority of regions there was a significant increase in both (Cherkassy, Poltava, Kharkiv, Donetsk, Zaporizhzhia, Mykolaiv, Odesa) or one (Vinnytsia, Dnipropetrovsk, Kherson, Luhansk regions and Sevastopol) of indices with minor changes of another. Exceptions were Kirovograd region and Crimea, in which the general morbidity did not change significantly, and the primary one – decreased (Fig. 2).

Thus, in relation to thyroid pathology, as well as in the case of endocrine diseases in general, there was revealed a reliable inverse relationship between the level and GR of the general (r_s = -0,687, p <0,001) and primary (r_s = -0,735, p <0,001) morbidity of the adult population of 27 investigated AT of Ukraine.

Table 1 – Ranking places of administrative territories according to the levels of thyroid general (GM) and primary (PM) morbidity of the adult population during the period of 2000-2013.

Regions	Administrative territory	Rank places															
		Endocrine systems diseases (ESD)		Diffuse goiter of I degree (DG-I)		Diffuse goiter of II-III degrees (DG-II+III)		Nodular goiter (NG)		Thyroid cancer (TC)		Hypothyroidism (HT)		Thyrotoxicosis (TT)		Thyroiditis (TD)	
		ЗЗ	ПЗ	ЗЗ	ПЗ	ЗЗ	ПЗ	ЗЗ	ПЗ	ЗЗ	ПЗ	ЗЗ	ПЗ	ЗЗ	ПЗ	ЗЗ	ПЗ
Western	Volyn	2**	5**	1**	2**	4**	4**	12	16	27’’	25’’	10	24’’	17	18	25’’	26’’
	Zakarpattia	3**	1**	2**	3**	1**	1**	20	27’’	25’’	27’’	14	13	2**	3**	24’’	24’’
	Ivano-Frankivsk	8	4**	7**	4**	17	17	18	23’’	26’’	26’’	1**	8	4**	4**	22’’	20
	Lviv	11	12	6**	6**	14	16	24’’	22’’	17	15	16	18	8	21’’	14	14
	Rivne	5**	2**	4**	1**	2**	2**	14	14	23’’	21’’	22’’	19	16	10	23’’	22’’
	Ternopil	12	6**	13	5**	10	13	19	25’’	22’’	22’’	19	21’’	15	19	27’’	27’’
	Khmelnytslij	9	7**	14	10	11	8	8	12	18	20	6**	4*	1**	1**	17	12
	Chernivetska	10	8	12	12	5**	6**	22’’	19	11	24’’	25’’	23’’	10	26’’	12	18
Northern	Zhytomyr	15	16	11	13	9	9	7**	13	15	12	24’’	26’’	13	16	19	23’’
	Kyiv	4**	15	3**	11	3**	3**	2**	3**	2**	2**	8	10	21’’	17	6**	4**
	Sumy	7**	9	10	9	7**	5**	4**	5**	8	4**	17	15	6**	12	7**	9
	Chernihiv	6**	19	5**	14	6**	15	3**	4**	6**	6**	21’’	20	7**	13	9	10
	Kyiv	16	17	21’’	20	15	12	1**	1**	1**	1**	2**	1**	24’’	7**	1**	1**
Central	Vinnytsia	1**	3**	8	7**	8	11	5**	2**	4**	7**	5**	5**	5**	15	8	7,5**
	Dnipropetrovsk	17	18	16	16	12	10	13	8	7**	9	4**	2**	9	6**	5**	6**
	Kirovograd	21’’	13	15	15	24’’	19	21’’	20	19	16	26’’	27’’	20	27’’	13	15
	Poltava	22’’	24’’	18	21’’	19	24’’	9	6**	13	11	18	14	14	8	15	13
	Cherkasy	13	10	20	18	13	7**	10	10	12	10	11	12	12	2**	21’’	19
Eastern	Donetsk	19	21’’	22’’	23’’	21’’	22’’	11	9	9	13	3**	3**	3**	5**	2**	3**
	Luhansk	27’’	26’’	23’’	22’’	20	18	27’’	21’’	24’’	23’’	27’’	25’’	25’’	14	26’’	25’’
	Kharkiv	18	14	17	17	16	14	25’’	15	16	19	13	6**	27’’	24’’	3**	2**
Southern	Zaporizhzhia	26’’	25’’	24’’	24’’	26’’	25’’	16	11	10	8	23’’	17	19	11	11	5**
	Mykolaiv	24’’	20	19	19	22’’	21’’	26’’	18	21’’	18	7**	9	26’’	23’’	10	11
	Odessa	20	23’’	26’’	27’’	25’’	26’’	23’’	26’’	14	14	15	16	11	25’’	20	17
	Kherson	23’’	22’’	25’’	26’’	18	23’’	6**	7**	3**	3**	9	11	22’’	20	4**	7,5**
	Crimea	14	11	9	8	23’’	20	15	17	20	17	12	7**	18	9	18	16
	Sevastopol	25’’	27’’	27’’	25’’	27’’	27’’	14	24’’	5**	5**	20	22’’	23’’	21’’	16	21’’

Note.** – the highest levels of morbidity, ’’ - the lowest levels of morbidity.

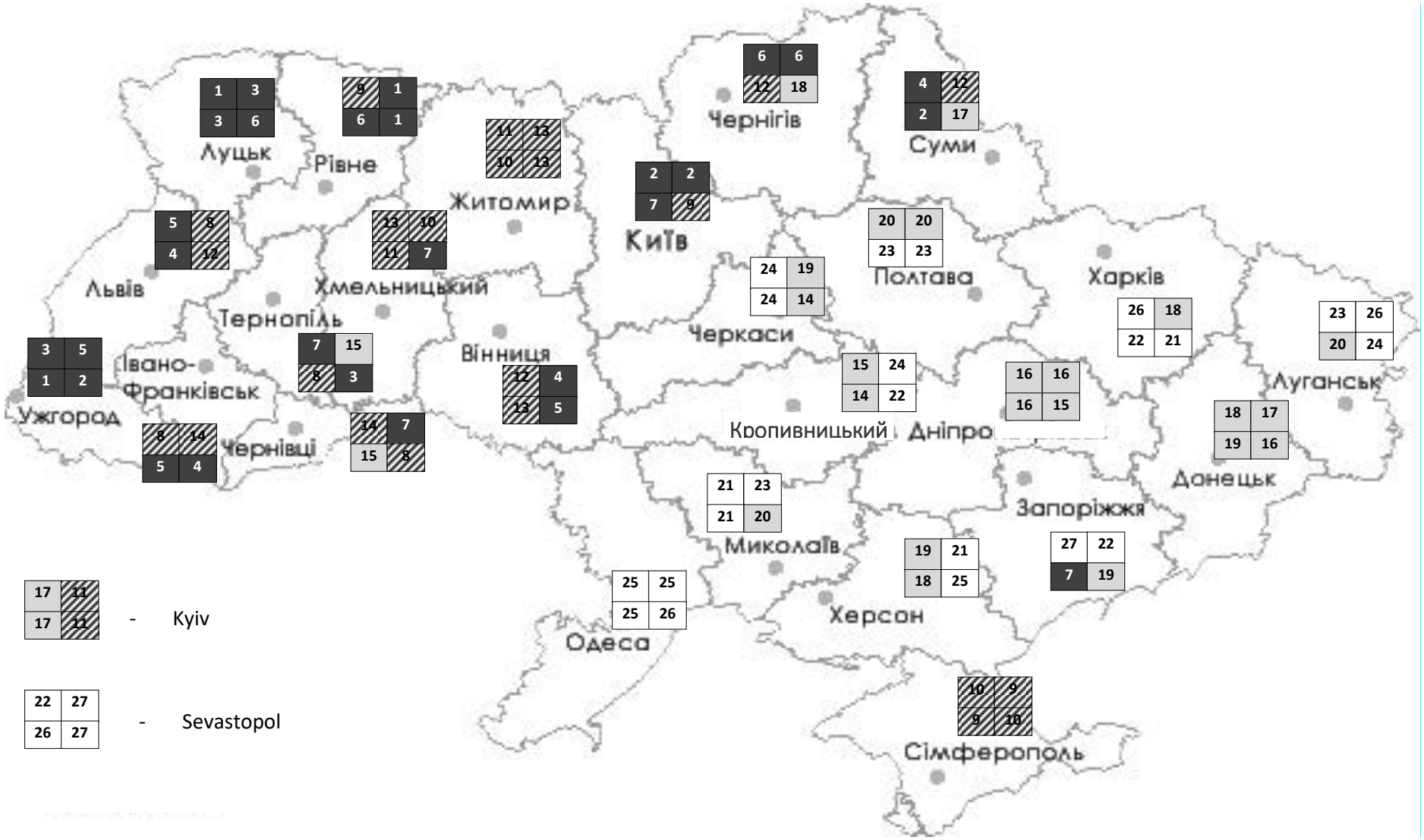
Table 2 – Correlation between the levels of thyroid general (GM) and primary (PM) morbidity of the adult population of Ukraine during the period of 2000-2013.

	Spirman's rank correlation coefficients														
	ESD-GM	ESD-PM	DG-I-GM	DG-I- PM	DG-II+III-GM	DG-II+III- PM	NG-GM	NG- PM	TC- GM	TC- PM	HT-GM	HT- PM	TT-GM	TT-PM	TD-GM
ESD-GM	1														
ESD-PM	0,841*	1													
DG-I-GM	0,882*	0,764*	1												
DG-I-PM	0,844*	0,906*	0,916*	1											
DG-II+III-GM	0,858*	0,692*	0,783*	0,714*	1										
DG-II+III-PM	0,797*	0,750*	0,717*	0,716*	0,920*	1									
NG-GM	0,360^	0,037	0,160	0,023	0,350^	0,265	1								
NG- PM	0,160	-0,124	0,023	-0,151	0,235	0,176	0,822*	1							
TC- GM	-0,114	-0,422''	-0,335^	-0,499*	-0,056	-0,144	0,640*	0,702*	1						
TC- PM	-0,184	-0,488*	-0,328^	-0,493*	-0,159	-0,219	0,691*	0,717*	0,911*	1					
HT- GM	0,234	0,184	0,041	0,063	0,034	0,073	0,323^	0,332^	0,194	0,156	1				
HT- PM	0,079	0,063	-0,104	-0,083	-0,060	-0,001	0,291	0,442''	0,325^	0,253	0,868*	1			
TT- GM	0,559*	0,469''	0,396''	0,409''	0,392''	0,308	0,211	0,021	-0,053	-0,169	0,223	0,183	1		
TT- PM	0,245	0,217	0,132	0,181	0,19	0,259	0,418''	0,313	-0,033	0,009	0,430''	0,507*	0,494*	1	
TD- GM	-0,163	-0,338^	-0,246	-0,408''	-0,122	-0,158	0,388''	0,672*	0,772*	0,673*	0,376^	0,545*	-0,118	-0,092	1
TD- PM	-0,153	-0,322	-0,248	-0,397''	-0,175	-0,184	0,379^	0,698*	0,701*	0,642*	0,456''	0,672*	-0,083	0,065	0,940*

Note. Spirman's rank correlation coefficients (п=27): * – $r_{s\ tabl}$ = 0,487 at p=0,01;

'' – $r_{s\ tabl\ л}$ = 0,381 at p=0,05;

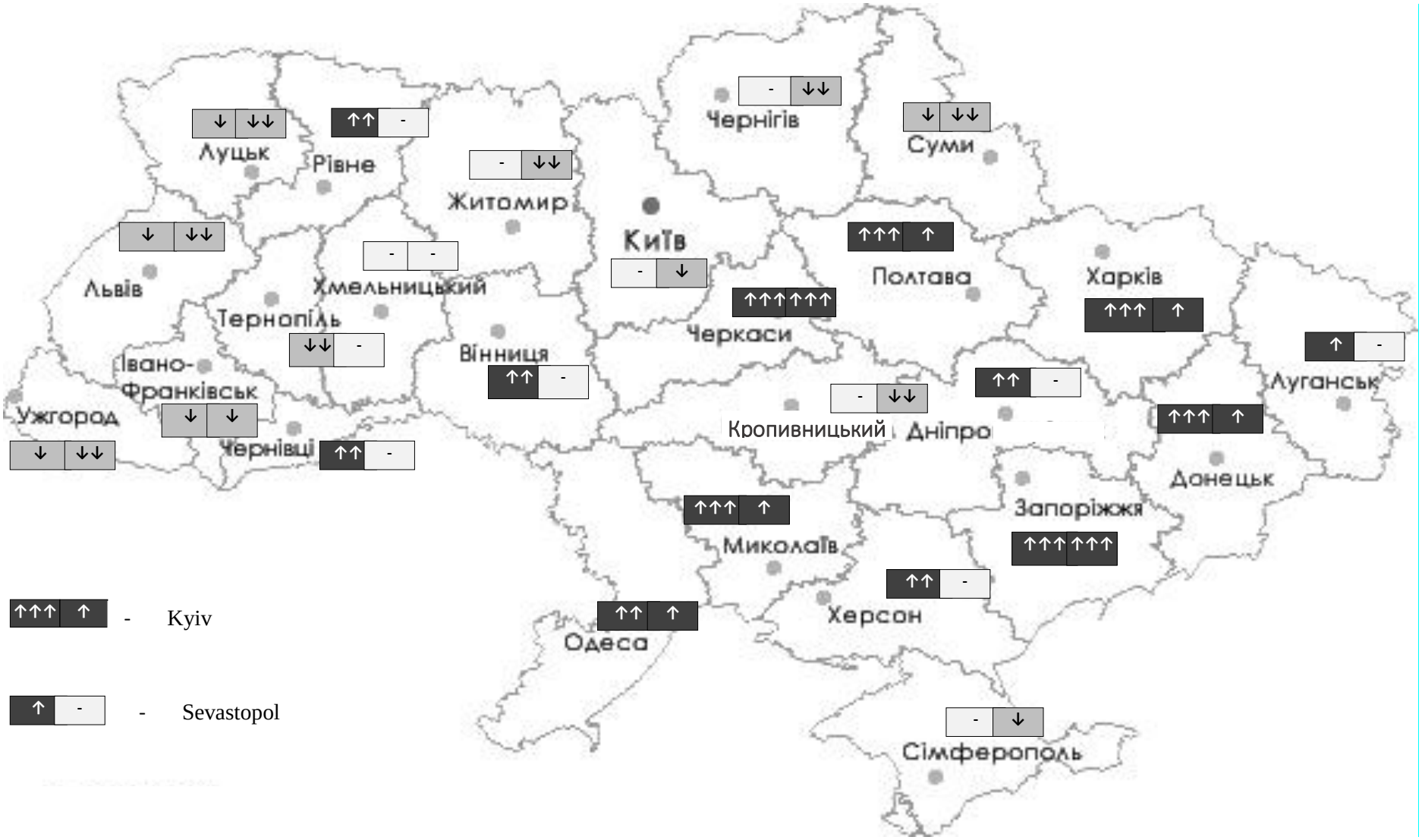
^ – $r_{s\ tabl}$ = 0,323 at p=0,1.



Notes: 1. | GM 2000 y. | GM 2013 y. |
| PM 2000 y. | PM 2013 y. |
, where GM – general morbidity, PM – primary morbidity;

2. ranks: ■ – from 1 to 7; ▨ – from 8 to 14; □ – from 15 to 20; □ – from 21 to 27.

Fig. 1 – Thyroid morbidity



Notes: 1. Changes in ranges: «-» - less than ±25 %; ↑/↓ - 25-50 %; ↑↑/↓↓ - 50-100 %; ↑↑↑/↓↓↓ - more than 100%; GM PM - general/primary morbidity.

2. ↑ – index increasing; ↓ - index decreasing; - - significant ghanges are absent.

Fig. 2 – Dynamics of changes in the thyroid general and primary morbidity

Concerning certain nosological forms of thyroid pathology, during the investigated period, significant regional features were revealed both for the levels of both morbidity indices and the direction of their changes in the investigated period.

Thus, the levels of primary and general morbidity of diffuse goiter (DG) were the highest in the western (Zakarpattia, Rivne and Volyn regions – DG of I and II-III degrees, Chernivtsi – DG of II-III degrees, Lviv and Ivano-Frankivsk - DG of I degree) and northern (Kiev, Sumy, Chernihiv) regions, and the lowest ones – In the eastern (Donetsk) and southern (Odesa, Zaporizhzhia, Kherson regions and Sevastopol) regions (Table 1).

For the 14 studied years, the general morbidity rate for diffuse goiter of I (DG-I) and II-III (DG-II-III) degrees in 11 and 6 regions respectively decreased, at 8 and 13 AT – increased, which was confirmed by reliable correlation coefficients. In 3 and 2 AT respectively, there was a tendency to increase (0,707> r > 0,622, 0,05 <p <0.,1); in the rest of the AT there were no significant changes. Regarding the primary morbidity of the diffuse goiter of different degrees, its level decreased in 16 AT ($p < 0,05$), in one another – a tendency to decrease was observed; in other 10 AT there were no significant changes. It should be noted that between the level and GR of both the general and the primary morbidity with diffuse goiter of I and II-III degrees there is a reliable inverse relationship (from $r_s = -0,390$ to $r_s = -0,582$; $r_{s\ tabl} = 0,381$ at $n = 27$ and $p = 0,05$): as lower the level of incidence in the region, the greater the pace of its growth.

The highest levels of nodular goiter primary and general morbidity are recorded in the northern region (Kyiv city, Kyiv, Chernihiv and Sumy regions), Vinnytsia and Kherson regions (Table 1). At the same time, here, as well as in Sevastopol, the highest levels of thyroid cancer morbidity incidence and prevalence have been recorded. The lowest levels of morbidity rates for both nodular goiter and thyroid cancers were recorded in western (Zakarpattia, Ivano-Frankivsk, Ternopil) and Luhansk regions; only nodular goiter – in Lviv and Odessa, only cancer – in the Volyn and Rivne regions. In general, between the levels of nodular goiter primary and general morbidity f, on the one hand, and cancer, on the other hand, there is a significant positive correlation (Table 2).

Regarding the dynamics, in the study period, the nodular goiter general morbidity in 25 of 27 AT increased, which was confirmed by a reliable positive correlation coefficient; in Zhytomyr region there was a tendency to increase ($0,707 > r > 0,622$, $0,05 < p < 0,1$) and only in the Volyn region the index decreased ($r = -0,902$; $p < 0,01$). Nodular goiter primary morbidity increased in 22 AT ($r > 0,707$, $p < 0,05$); in three – it did not change significantly, remaining steadily high in the Kyiv and Sumy regions; and in Volyn and Zhytomyr – declined ($r = -0,908$, $p < 0,01$ and $-0,748$, $p < 0,05$, respectively).

Regarding the overall incidence of thyroid cancer, in general between 2000 and 2013 there was no reliable relationship with the observation period in 25 out of 27 AT ($p > 0,05$), only in the Kyiv region there was an increase ($r = 0,784$, $p < 0,05$), while in Chernivtsi – decrease ($r = -0,716$, $p < 0,05$) of the index.

The primary incidence of thyroid cancer in the investigated period increased in 15 regions and the Crimea Autonomous Republic ($r > 0,707$, $p < 0,05$), while in 4 regions (Rivne, Zhytomyr, Kirovograd, and Odesa), there was a tendency to increase ($0,707 > r > 0,622$, $0,05 < p < 0,1$), in the rest of the AT the relationship between the level of the indices and the year of observation was not detected ($p > 0,05$).

The highest levels of both indices of the incidence of adult thyroiditis in Ukraine are registered in Kyiv city, Kharkiv, Donetsk, Kyiv, Dnipropetrovsk and Kherson regions, and the lowest – in Ternopil, Volyn, Luhansk, Zakarpattia and Rivne regions (Table 1). In general, the levels of both thyroiditis morbidity indices are well correlated with the incidence of thyroid cancer, nodular goiter and hypothyroidism (Table 2).

During the study period, the overall incidence of thyroiditis, hypothyroidism and thyrotoxicosis increased in most (24, 20 and 26, respectively) of the studied AT, which was confirmed by a reliable positive coefficient of correlation. Regarding the primary morbidity of thyroiditis, hypothyroidism and thyrotoxicosis, the level of the indeces increased in 13, 17 and 11 respectively.

Discussion. The regional peculiarities of the levels and dynamics of changes in the incidence rates of the thyroid morbidity among adult population of Ukraine can be attributed to the action of priority environmental factors for each region. It is known that the Western and Northern regions of Ukraine are different from the rest of the low natural content in the soil of iodine. The Northern (Kyiv, Chernihiv,

Zhytomyr, Rivne) and Cherkasy regions significantly contaminated by radioactive substances, including radioactive iodine isotopes (predominantly I-131), as a result of the Chernobyl accident. In the Eastern region, Dnipropetrovsk and Zaporizhzhia regions, powerful industrial centers are concentrated, in which relatively high levels of environmental pollution by industrial toxicants, including heavy metals, are recorded. The Central and Southern regions have developed agricultural production, which today widely uses chemical protection products for plants. The study of the environmental factors influence on the Ukrainian adult population thyroid morbidity will be devoted to our further research.

Conclusions: 1. It was established that in the period from 2000 to 2013, higher levels of adult population endocrinopathies, thyroid glands in general and diffuse goiter of varying degrees general and primary morbidity were recorded in the Western and Northern regions of Ukraine, lower – in the Central, Eastern and Southern regions.

2. Reliable ($p < 0,001$) positive correlation between the level of prevalence and the level of incidence of endocrine pathology, diseases of the thyroid gland as a whole, as well as on individual nosologies was detected.

3. It was established that the endocrine diseases incidence rates of the adult population are well correlated ($p < 0,01$) with the prevalence and morbidity rates of the diffuse goiter of various degrees, which is explained by the high specific gravity of the latter in the structure of endocrine diseases in general and thyroid pathology, in particular.

4. Factors that cause the development of various diseases of the thyroid gland, and the regional peculiarities of their development, require further study to develop effective methods of protection and prevention.

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