

Journal of Geology, Geography and Geoecology

Journal home page: geology-dnu.dp.ua

ISSN 2617-2909 (print)
ISSN 2617-2119 (online)

Journ. Geol. Geograph.
Geology,
31(1), 89–98.

doi: [10.15421/112209](https://doi.org/10.15421/112209)

Kornus O. H., Kornus A. O., Skyba O. M., Shyshchuk V. D., Pshenychna L. V., Danylchenko O. S. Journ. Geol. Geograph. Geoecology, 31(1), 89–98

Nosogeographic assessment of the adult population morbidity of the Sumy region (Ukraine)

Olesia H. Kornus¹, Anatolii O. Kornus^{1,2}, Olha M. Skyba¹, Volodymyr D. Shyshchuk²,
Liubov V. Pshenychna¹, Olena S. Danylchenko¹

¹ Sumy State Pedagogical University named after A.S. Makarenko, Sumy, Ukraine, a_kornus@ukr.net

² Sumy State University, Sumy, Ukraine, vdshyshchuk@gmail.com

Received: 04.06.2021

Received in revised form: 13.10.2021

Accepted: 26.10.2021

Abstract. The aim of the article is the nosogeographic assessment of the adult population morbidity of the Sumy region during 2009–2019. The assessment was made by primary morbidity and prevalence of cardiovascular, respiratory diseases as well as oncological pathologies. There is a tendency towards a decrease of diseases prevalence as well as primary

morbidity of above mentioned diseases among the adult population of the Sumy region in 2019 as compared to the “top” indicators in 2016 and 2017. The prevalence of diseases among the region’s population in 2019 decreased by 9.72% and 9.40% compared to 2016 and 2017, respectively, while the primary morbidity rate decreased by 13.9% and 10.29%, respectively. The indicators of diseases prevalence and population primary morbidity by cardiovascular diseases and neoplasm which are basic causes of mortality in Ukraine, as well as the European Union were analyzed. During the last 10 years highest indicators of prevalence of the cardiovascular diseases were registered in 2018 (57, 459.63 cases per 100 000 people) and primary cardiovascular morbidity – in 2016 (4394.71 cases per 100 000 people). Prevalence of neoplasm among the Sumy region’s inhabitants for the last 10 years increased by 29.59% and in 2019 was 6 126.43 cases per 100 000 people. At the same time the primary morbidity increased by 6.18%. Respiratory diseases occupy the 1st place in the structure of primary population morbidity, the 2nd place – in structure of prevalence of the diseases); its highest indicators were observed in 2016. The index of accumulation of the diseases (the ratio between prevalence of diseases and primary morbidity) among the Sumy region population and by administrative-territorial districts was identified. To realize the nosogeographic assessment of the adult population of the Sumy region and to highlight the groups of the administrative-territorial districts of the Sumy region by the characteristics of population morbidity the cluster analysis procedure was used. The first cluster includes the Sumy and Serechna-Buda districts. The second cluster was formed by 6 administrative-territorial districts of the region: Yampil’, Hlukhiv, Trostianets, Krasnopillia, Shostka and Velyka Pysarivka districts. The third cluster united both Romny and Buryn’ districts. The fourth cluster includes most of administrative-territorial districts of the region: Lypova Dolyna, Nedryhailiv, Lebedyn, Krolevets, Konotop, Putyvl’, Okhtyrka and Bilopillia districts. The fifth cluster is represented by the regional center – the city of Sumy.

Keywords: cardiovascular diseases, respiratory diseases and neoplasm, cluster, nosogeographic assessment, Sumy region.

Нозогеографічна оцінка захворюваності дорослого населення Сумської області (Україна)

О.Г. Корнус¹, А.О. Корнус^{1,2}, О.М. Скиба¹, В.Д. Шищук², Л.В. Пшенична¹, О.С. Данильченко¹

¹ Сумський державний педагогічний університет імені А.С.Макаренка, Суми, Україна, a_kornus@ukr.net

² Сумський державний університет, Суми, Україна, vdshyshchuk@gmail.com

Анотація. Проведено нозогеографічну оцінку захворюваності дорослого населення Сумської області на серцево-судинні захворювання, хвороби органів дихання та онкопатології протягом 2009–2019 років. Встановлено тенденцію до зниження показників поширеності хвороб розглянутих хвороб і первинної захворюваності на них дорослого населення Сумської області у 2019 році відносно «пікових» показників 2016 і 2017 років. Рівень поширеності хвороб серед населення у 2019 році знизився на 9,72% та 9,40% відносно показників 2016 і 2017 років відповідно, тоді як показник первинної захворюваності – на 13,9% та 10,29% відповідно. Проаналізовано показники поширеності та первинної захворюваності населення регіону на хвороби системи кровообігу та новоутворення, що є основними причинами смертності населення як в Україні, так і в країнах Європейського Союзу. Впродовж останніх 10 років найвищі значення поширеності хвороб системи кровообігу були зареєстровані у 2018 році (57459,63 випадків на 100 тис. населення), первинної захворюваності – у 2016 році (4394,71 випадків на 100 тис. населення). Поширеність новоутворень серед населення за останні 10 років зросла на 29,59% і у 2019 році становила 6 126,43 випадків на 100 тис. осіб; у той же час первинна захворюваність зросла на 6,18%. Хвороби органів дихання, які у структурі первинної захворюваності посідають перше місце (у структурі поширеності хвороб – друге), найвищі значення поширеності і первинної захворюваності мали у 2016 році. Визначено індекс накопичення хвороб (відношення між усіма зареєстрованими захворюваннями та уперше в житті встановленими) серед населення Сумської області в цілому та по

її адміністративно-територіальним одиницям. Для проведення нозогеографічної оцінки захворюваності населення Сумської області та виділення груп адміністративно-територіальних одиниць регіону за особливостями захворюваності було використано процедуру кластерного аналізу. До першого кластеру увійшли Сумський та Середино-Будський райони. Другий кластер сформували 6 територіально-адміністративних одиниць регіону: Ямпільський, Глухівський, Троянецький, Краснопільський, Шосткинський та Великописарівський райони. Третій кластер об'єднав два райони Роменський і Буринський. До четвертого кластеру увійшла найбільша кількість територіально-адміністративних одиниць області, серед яких: Липоводолинський, Недригайлівський, Лебединський, Кролевецький, Конотопський, Путивльський, Охтирський та Білопільський райони. П'ятий кластер представлений обласним центром – м. Суми.

Ключові слова: серцево-судинні захворювання, хвороби органів дихання, новоутворення, кластер, нозогеографічна оцінка, Сумська область.

Introduction

Health system development strategy in Ukraine is determined by the state and dynamics of public health, the activities of health care institutions and the socio-economic and political situation in the country (Klanza, 2018; TsiBOROVSKY & CHEPELEVSKAYA, 2017). The current state of Ukrainian population health is characterized by many crisis phenomena, which appear in negative values of medical and demographic indicators and depopulation (Mezentseva et al., 2018; Serdyuk & Kartashova, 2019).

The difficult medical and geographical conditions of Ukraine is exacerbated by low birth rates, significant labor migration, a high level of general morbidity and prevalence of diseases, significant regional disparities in morbidity levels.

Moreover, the situation in the country is exacerbated by the rapid spread of the coronavirus disease (COVID-19), which has made and continues to make the significant changes in the public health, have a negative impact on the formation and development of the public health system as a basis for preventive medicine (Ustinov, 2020). Today, the draft of the Law of Ukraine “About On the Public Health System” remains unapproved, which would regulate the mechanisms of creating an effective public health system aimed at strengthening the health of the population, disease prevention, control of epidemics and increasing the life expectancy of the population, etc.

As of December 01, 2020, the resident population of Ukraine (without temporarily occupied territories of the Autonomous Republic of Crimea, Sevastopol and parts of Donbass) was 41 629.9 numbers of people (State Statistics of Ukraine, 2020). That is, over the past 30 years Ukraine has lost more than 10 million people, which is the result of the negative dynamics of natural and mechanical movement of the population. During 2020, the largest absolute population decline was typical for the eastern and northeastern regions: Dnipro (–30.5 thousand), Kharkiv (–21.4 thousand), Zaporizhia (–18.2 thousand), Poltava (–13.5 thousand), Sumy (–13.2 thousand), Chernihiv (–11, 9 thousand) regions (Ministry of Finance, 2021). As it can be seen, the demographic situation in the Sumy region is one of the worst, which creates great risks for the further

socio-economic well-being of the region (Kornus et al., 2015; 2017).

The Sumy region has ranks 19th rank among the regions of Ukraine by the total number of population. During 2020, the total population here decreased by 13.171 people, is predominantly the result of natural population decline (the number of deaths was 2.5 times higher than the number of live births) (State Statistics Service of Ukraine, 2020), which can be considered as a crisis demographical situation. During 2020 18.971 people died in the Sumy region, which is 1500 people more than during 2019 (State Statistics Service of Ukraine, 2020). The main causes of the population death in the region are coinciding with the national ones: diseases of the circulatory system, neoplasms and external causes of death (The top 10 causes of death, 2020). In 2020 new cause – the coronavirus disease (COVID-19) was included in the death causes, which killed 552 people (State Statistics Service of Ukraine, 2020). However, the main cause of death in the region's population is diseases of the circulatory system (in particular coronary heart disease and cerebrovascular diseases), caused the deaths of 12.597 people. That's 1 100 more deaths compared to 2019 (State Statistics Service of Ukraine, 2020).

Considering the above mentioned, one of the most important priorities of the state and regional health care policy should be overcoming the consequences of medical and demographic crisis, or at least a slowdown in its pace. These priorities should be to maintain and improve the health of the population, decrease the level of primary morbidity and prevalence of diseases, decrease the population disability, reduction of mortality, development of intersectoral cooperation on the principle of “health care is in all state policies” (Kotvitska & Lobova, 2012; Mezentseva et al., 2018). The search of the ways to implement the certain priorities determines the relevance of conducting complex medical and geographical research.

Review of previous researches indicates a significant interest of scientists to the study of health status of the population in Ukraine as well as its particular regions. D. Lawlor (Lawlor et al, 2003) conducted research of geographical variation of the cardiovascular diseases, risk factors, and their control among British Women's. Cardiovascular disease prevalence (age ad-

justed) varied by geographical region were the highest is in Scotland (from 21.5% to 28.8%) and the lowest is in South England (from 13.5% to 17.6%) (95% confidence interval). Geographical variations of cardiovascular disease prevalence are explained by variations in major risk factors, socioeconomic situation, and health service. Studies of geographic distribution of the pancreas malignant neoplasms in Japan in relation to climatic factors, such as the amount of global solar radiation and the daily maximal temperature conducted by K. Setsuko (Setsuko et al., 2007). Mortality by malignant neoplasm of the pancreas tends to be higher in northern Japan and in northern European countries. The study reported that standardized mortality ratios by pancreas malignant neoplasms were negatively correlated to solar radiation level. People residing in the regions with lower solar radiation and lower temperatures may be at higher risk of development of pancreas of the malignant neoplasms. However, the impact of climatic factors on the human body varies according to individual lifestyles and occupations. Geographic patterns of prostate cancer mortality and variations of an access to medical care in the United States were described by A. Jemal (Jemal et al., 2005). The authors investigated the association between geographic variations of prostate cancer mortality and regional variations of an access to medical care, as reflected by the incidence of late-stage disease, prostate-specific antigen utilization, and residence in rural counties. It has been proven that from 10% to 30% of geographic variation of the mortality rates may relate to variations in access to medical care. In Ukraine, L. Nemets (Nemets et al., 2021) came to a similar opinion. Global cancer statistics for 2020, which includes estimates of Incidence and mortality Worldwide for 36 cancers in 185 countries, are presented in the work of H. Sung (Sung, 2021). Worldwide, an estimated 19.3 million new cancer cases (18.1 million excluding nonmelanoma skin cancer) and almost 10.0 million cancer deaths (9.9 million excluding nonmelanoma skin cancers) occurred in 2020. Female breast cancer surpassed lung cancer as the most commonly diagnosed cancer, with an estimated 2.3 million new cases (11.7%), followed by lung (11.4%), colorectal (10.0%), prostate (7.3%), and stomach (5.6%) cancers. However, the lung cancer is remaining the leading cause of cancer death. The global cancer burden is expected to be 28.4 million cases in 2040, a 47% higher than in 2020. The scientific work of V. Chorna (Chorna et al., 2020) examined and analyzed the total incidence and prevalence of diseases in the population of Ukraine in comparison to the EU countries and ana-

lyzed the determinants of health. The authors found that in Ukraine, diseases of circulatory system, malignant neoplasms, injuries and poisonings are leading in the structure of death causes, and in the structure of morbidity – respiratory diseases and circulatory diseases. The work of I. Blanco (Blanco et al., 2019) visualized spatial data on chronic obstructive pulmonary disease prevalence in Africa, Asia and Australasia using inverse distance weighted interpolation technique prepared by Geographic Informational System. The authors found that areas of high/very high prevalence were found in: Southern Africa and in most of the Central and Eastern Africa regions; in practically all of Central Asia; in the western regions of Southern Asia; in the southern regions of East European Plain and West Siberian Plain, as well as in the Malay Archipelago. As it can be seen, there are significant geographical differences in morbidity, which indicates the need for research at the regional level.

We studied the health status of the Sumy region population (Kornus O. et al., 2015), including the study of geographical differences of the primary morbidity and prevalence of the circulatory system diseases among the population of Sumy region (Kornus O., 2018). Also, we were carried out the nosogeographical analysis respiratory morbidity as well as search of factors affecting pulmonary diseases of population (Kornus A.O. et al., 2020). Air pollution influence on cancer morbidity of the population of the Sumy region also was studied (Kornus O. et al., 2012). It should be noted that these above mentioned three nosological forms are playing an indicator role for evaluative studies of the health status of population. Therefore, their aggregate study is relevant, which determined the purpose of our study.

The aim of the article is the nosogeographic assessment of the primary morbidity and prevalence of cardiovascular, respiratory diseases and oncological pathologies among the adult population of the Sumy region¹, which includes the study of regional characteristics of morbidity for these pathologies, trends of their dynamics among the population of the region based on the analysis of official statistics, calculating the index of diseases accumulation among region's inhabitants and allocation of groups of the districts by the morbidity level for these diseases.

Material and research methods

To carry out a nosogeographic assessment of prevalence of diseases and morbidity of the adult population of Sumy region the data from annual statistical reports

¹ Information about the districts of the Sumy region is given according to the administrative-territorial structure, which was before the entry into a force of the Resolution of the Parliament of Ukraine dated July 17, 2020 No. 807-IX "About On the formation and liquidation of districts"

of medical institutions of the Sumy region were taken, which are subordinate to the Ministry of Public Health of Ukraine, prepared for the period of 2009–2019. The following ICD-11 class diseases were analyzed: cardiovascular diseases, respiratory diseases and neoplasm.

According to the medical statistics obtained since 2014, the study has been conducted without taking into account the temporarily occupied territories of the Autonomous Republic of Crimea, the city of Sevastopol and the temporarily occupied territories of Donetsk and Luhansk regions.

An important moment of nosogeographic assessment of the territory is establishment the level of accumulation of the diseases. One of these indicators is accumulation diseases index – the ratio between prevalence of diseases (Pr) and primary morbidity (In): $I_{st} = \frac{P_r}{I_n}$.

The accumulation diseases index makes possible the analysis of level of the preventive work and assesses the quality of primary diagnosis of the diseases as well as the availability of medical services. Higher values of accumulation diseases index in a particular region or district indicates the prevalence of chronic forms of the diseases over acute one, and about the better level of medical care of the population and the beneficial effect of other social factors on the course of diseases (Dudina et al., 2015).

The work uses a systematic approach, comparative geographical, statistical, cartographic, analytical, and other research methods. All calculations, figures and graphic images were obtained using SPSS Statistic 17.0 computer software by SPSS Inc. and Microsoft Excel 2010.

Statistical processing was carried out according to the generally accepted methods of variation statistics.

Results and discussion

Prevalence of diseases reflects the accumulation of chronic pathologies among the population, at the same time characterizing the load on medical institutions and advances in disease treatment, which allows prolonging the life of patients (Kotvitska & Lobova, 2012).

According to the medical statistics the prevalence of above mentioned three groups of diseases among the population of Sumy region, during 2009–2019 increased by 0.91%. Analysis of dynamics of the diseases prevalence showed that during 2009–2017 the prevalence of diseases increased by 10.4%, but in 2019 compared to 2018 she decreased by 8.6% (Fig. 1).

In the period of 2009–2019 the prevalence of diseases most increased among the inhabitants of Lypova Dolyna (+27.76%), Romny (+ 25.82%), Putyvl’ (+16.41%), Buryn’ (+15.34%), Konotop (+ 13.19%), Lebedyn (+12.73%), Bilopillia (+12.47%), Okhtyrka (+11.57%) and Nedryhailiv (+11.49%) districts. On the other hand, the prevalence of diseases among the inhabitants of the city of Sumy during the indicated period decreased by 19.26%. As of January 1, 2020 the highest prevalence of diseases was registered in Romny (19 1581.26), Buryn’ (17 7650.50) and Krolevets (17 0789.28) districts, and the smallest values are typical for Sumy (13 0273.08) and Seredyna-Buda districts (12 6277.33 cases per 100 000 people).

During the studied period the primary morbidity among region’s inhabitants decreased by 5.31%. Analyzed The analysis of the dynamics of primary morbidity indicates that is has wave-like character (fig. 1) – the highest rate was in 2016 (54 369.78 cases per 100 000 people), which exceeds the indicator of 2019 (47 755.52 per 100 000 people).

The rapidest increase of the primary morbidity was observed among the population of Nedryhailiv

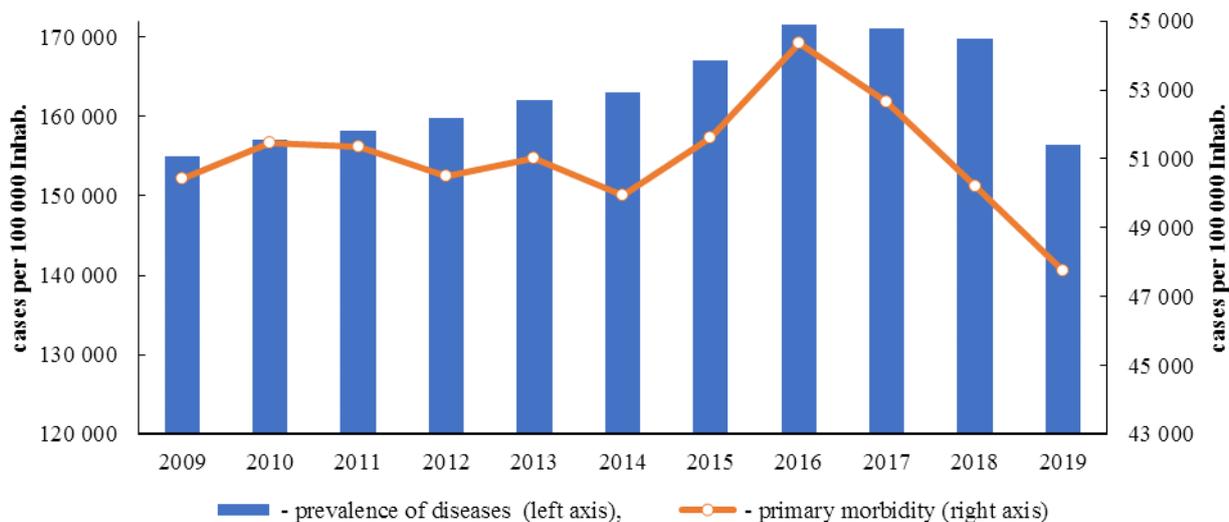


Fig. 1. Prevalence of diseases and primary morbidity of the population of the Sumy region in 2019 compared to 2009 (Source: Dovidnyk, 2010, 2013, 2016, 2020).

(+11.18%), Romny (+14.95%), Putyvl' (+15.33%), Konotop (+18.67%) and Lypova Dolyna (+19.56%) districts. At the same time the population of others districts of the region showed significant decrease in primary morbidity rates – Hlukhiv (–33.03%), Sumy (–27.42%), Trostianets (–26.41%) and Seredyna-Buda (–21.77%).

In 2019, the leaders by the level of primary morbidity of the population were the city of Sumy (64 669.53), Krolevets (57 180.33), Romny (52 994.05) and Konotop (51 038.29 cases per 100 000 people) districts. Fewer new cases of diseases are recorded among inhabitants of Velyka Pysarivka (32 822.71), Sumy (30 421.16) and Seredyna-Buda (29 562.77 cases per 100 000 people).

Accumulation diseases index in Sumy region in 2019 was 3.28. The lowest values are recorded in Konotop (3.23) and Krolevets (2.99) districts, and the city of Sumy (2.41). The highest rates of the accumulation diseases index were observed in Lebedyn (4.66), Velyka Pysarivka (4.39), Lypova Dolyna (4.37), Sumy (4.28), Seredyna-Buda (4.27), Trostianets (4.11), Hlukhiv (4.08) and Nedryhailiv (4.03) districts.

Cardiovascular diseases (CVDs) occupy the 1st place for prevalence of diseases among the population and 2nd place for primary morbidity of inhabitants. These diseases are among the main causes of mortality of the population both in Ukraine and in Sumy region. Ukraine has the first rank in Europe in term of mortality from CVDs due to “epidemic” of strokes, heart attacks and other CVDs. Almost 70% of death of the population of Ukraine is caused by CVDs. Mostly these are the people of working age. Among CVDs, the main cause of death are coronary heart disease (68.5% of the total number of deaths from CVDs). This indicates that the culture of prevention, diagnosis and treatment of cardiovascular diseases is too low (Yurochko, 2018).

During 2009–2019 the prevalence of pathologies of this group among population of the region increased by 5.42%. The highest rates were recorded in 2018–57 459.63 cases per 100 000 people. Although, in 2019 the prevalence of these pathologies among the population decreased by 9.36% (Fig. 2). Among administrative-territorial districts the prevalence of CVDs decreased only among inhabitants of city of Sumy (–28.43%). At the same time, most of all increases of this indicator was observed in Okhtyrka (+22.46%), Buryn' (+27.19%), Romny (+28.34%), Bilopillia (+31.77%) and Lypova Dolyna (+32.11%) districts.

In general, the primary morbidity of population by CVDs in 2009–2019 decreased by 3.58%. Most of all morbidity by CVDs are among the residents of Bilopillia (–42.83%) and Trostyanets (–24.33%) districts. Top five districts, where primary morbidity by CVDs increased, included Buryn' (+11.12%), Krolevets (+15.22%), Romny (+15.93%) and Nedryhailiv (+17.24%) districts (Fig. 2).

In terms of administrative-territorial districts of the region the highest level of primary morbidity by CVDs are among the inhabitants of Nedryhailiv (4 994.26), Krolevets (4 872.51), Romny (4 838.62), Hlukhiv (4 701.98), Putyvl' (4 653.17), Velyka Pysarivka (4 430.90), Lypova Dolyna (4 354.74) and Okhtyrka (4 129.01) districts. The lowest primary morbidity in 2019 was observed in Bilopillia (2 485.34) and Trostianets (2 379.07 cases per 100 000 people) districts.

The disease accumulation index of the CVDs among the population of Sumy region is 13.57. At the same time Trostianets (22.32) and Bilopillia districts (24.98) have highest indicators accumulation diseases index of the CVDs, while the lowest rate recorded in the city of Sumy (9.75).

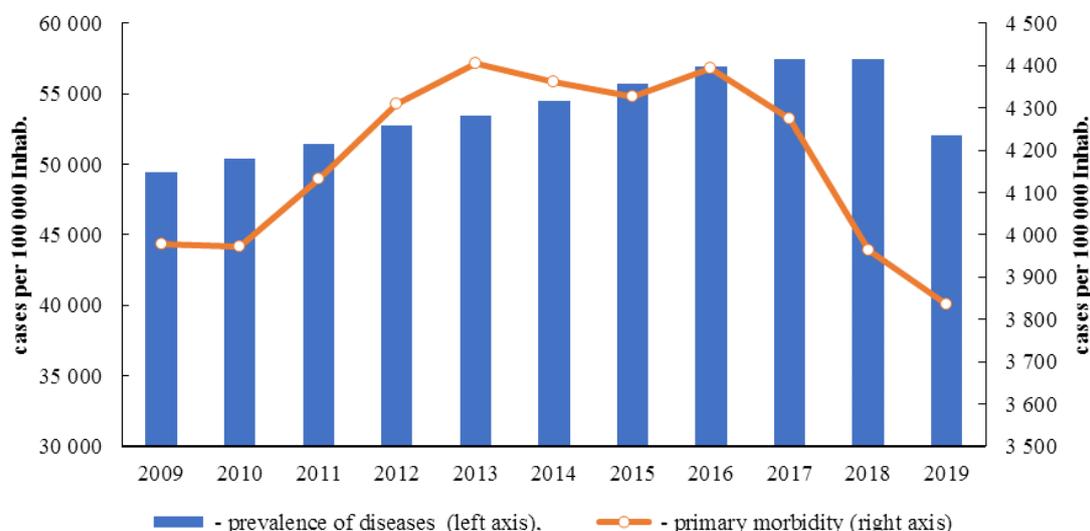


Fig. 2. Primary morbidity and prevalence of CVDs among the population of the Sumy region during 2009–2019 (Source: Dovidnyk, 2010, 2013, 2016, 2020).

Respiratory diseases for primary morbidity of the population occupy the 1st place in the general structure of diseases, and the 2nd place – by prevalence of diseases.

For the last 10 years the prevalence of respiratory diseases among the population increased by 0.14% and in 2019 it counted 26 805.04 cases per 100 000 inhabitants. The highest rate was recorded in 2016–29476.16 cases per 100 000 people (Fig. 3).

Among administrative-territorial districts the prevalence of respiratory diseases increased in Lypova Dolyna (by 55.43%), Putyvl' (by 50.37%), Romny (by 33.71%), Konotop (by 24.74%) and Nedryhailiv (by 24.45%) districts. While a significant reduction of the prevalence of the pathologies of this group was observed in Trostianets (by 23.81%), Sumy (by 24.08%) and Hlukhiv (by 35.39%) districts.

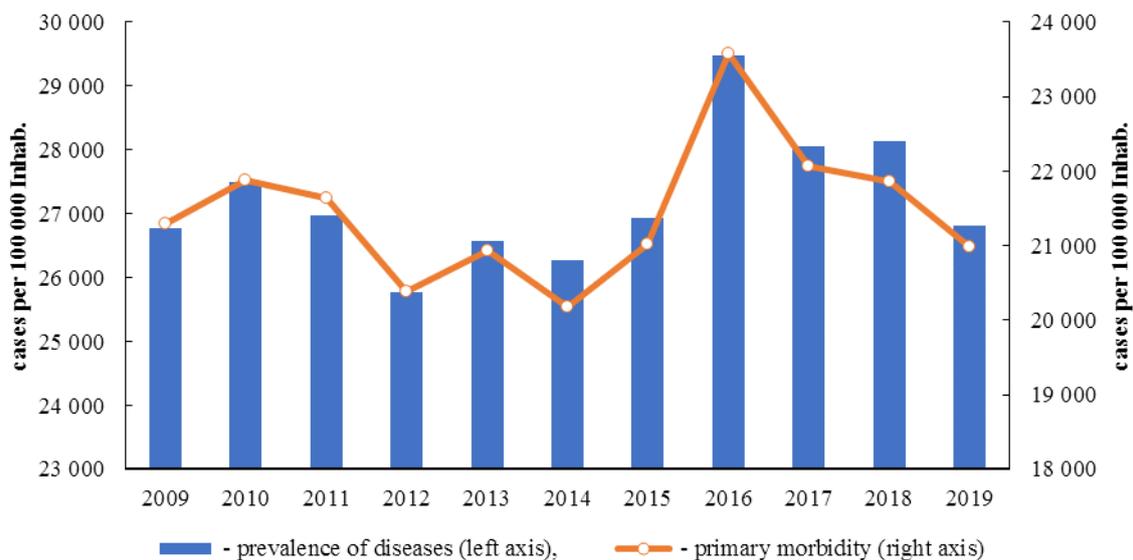


Fig. 3. Primary morbidity and prevalence of respiratory diseases among the population of the Sumy region during 2009–2019 (Source: Dovidnyk, 2010, 2013, 2016, 2020).

At the end of 2019, leaders in the prevalence of respiratory diseases among administrative-territorial districts were the city of Sumy (36 872.39), Konotop (30 505.61), Romny (29 664.50) and Buryn' (29 608.42 cases per 100 000 people) districts. Lowest prevalence rates of the respiratory diseases was fixed in Sumy (16 568.99) and Hlukhiv (15 938.65 cases per 100 000 people) districts. In 2016 the total primary morbidity was maximum 23 581.0 cases per 100 thousand people, after which was it reduced by 11%. It should be noted, that for the last 10 years of the primary morbidity of increased respiratory diseases there is a positive trend towards a decrease of newly registered cases of the respiratory diseases. Especially, it can be observed among the inhabitants of Lypova Dolyna (by 75.14%), Nedryhailiv (by 48.79%), Konotop (by 40.34%), Putyvl' (by 36.25%), Romny (by 34.91%) and Yampil' (by 33.63%) districts, in Sumy city (by 33.93%) and Hlukhiv (by 41.51%) districts.

Of the region the primary morbidity of respiratory diseases in 6 administrative-territorial districts in 2019 was higher than the middle regional indicator – in city of Sumy (29 407.22 cases per 100 000 people), Konotop (25 389.73), Romny (23 335.22), Buryn' (22 383.44), Krolevets (22 323.77) and Bilopil'ia (22 277.82 cases

per 100 000 people) districts. Fewer new cases of respiratory diseases for this year was registered among inhabitants of Seredyna-Buda (12 698.31), Hlukhiv (11 807.22) and Sumy (11 442.42 per 100 000 people) districts.

In 2019 the highest rates of accumulation index of the respiratory diseases were in Seredyna-Buda (1.54), Sumy (1.45) and Putyvl' (1.44) districts. The lowest accumulation disease indexes belongs to inhabitants of Okhtyrka (1.24), Krolevets (1.24) and Konotop (1.2) districts.

Neoplasms is one of the main causes of death of the population in Ukraine, which has the second rank after deaths from CVDs (Yurochko, 2018). The neoplasms by its prevalence among the population of Sumy region occupies 8st place in the general structure of diseases, and the 10th place – by the primary morbidity. According to the ICD-11 classification these pathologies included a wide range of malignant and benign neoplasms. WHO estimates (Noncommunicable diseases, 2018), that cancer is now one of the leading causes of death in the world: 9.6 million people in 2018 died from this disease. Cancer causes almost every 6 death in the world. There are many reasons for the progress of this pathology. In particular the chemical carcino-

gens (asbestos and arsenic) are included into them. Oil spills can occur in places of oil mining in the Sumy region. Oil contains arenes or aromatic hydrocarbons (benzene, toluene, xylenes, ethylbenzene). Benzene, which is a very harmful for public health carcinogen, can penetrate even intact skin and integrate into human DNA and cause acute leukemia, anemia, bone marrow disease and lead to other cancers (Koroleva et al., 2019).

The trends to increases of the prevalence of the neoplasms among the population were observed in the last 10 years in Sumy region: in 2019 this indicator was

6 126.43 cases per 100 000 people that is 29.59 % higher compared to 2009 (Fig. 4).

Among all administrative-territorial districts only three fixed reduction of the prevalence of this pathology among the population – Sumy (by 3.57%), Velyka Pysarivka (by 5.42%) and Krasnopillia (by 10.24%) districts. Most of all the prevalence of neoplasms increased among the population of Lypova Dolyna (by 51.15%), Yampil’ (by 46.13%), Okhtyrka (by 38.23%), Buryn’ (by 35.73%) and Romny (by 34.04%) districts, as well as the city of Sumy inhabitants (by 43.22%).

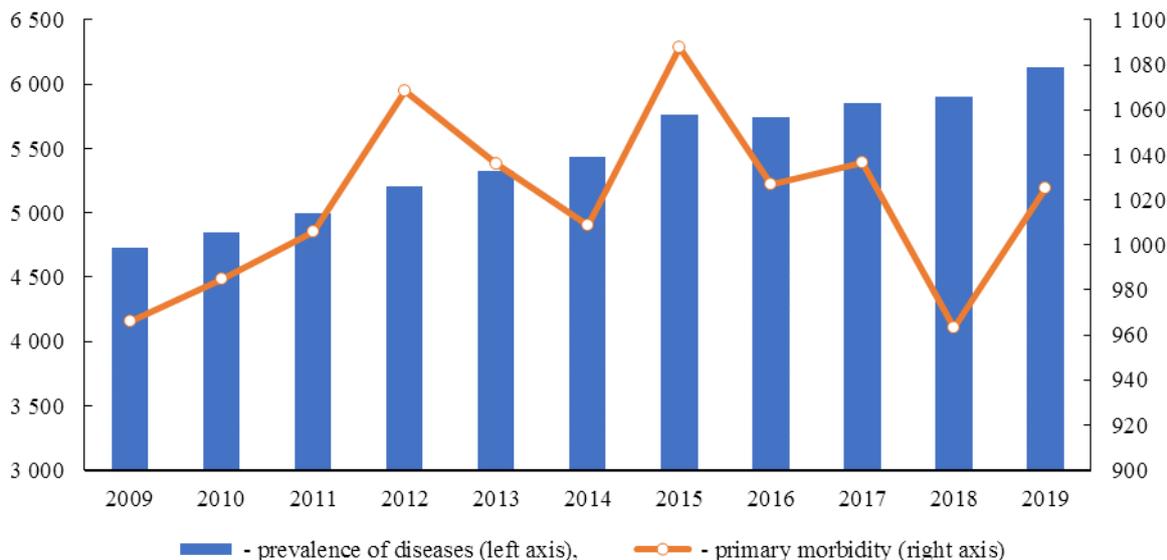


Fig. 4. Primary morbidity and prevalence of neoplasms among the population of the Sumy region during 2009–2019 (Source: Dovidnyk, 2010, 2013, 2016, 2020).

According to the medical statistics, in 2019 the neoplasms have most prevalence among the population of the city of Sumy (9 364.89 cases per 100 000 people), Buryn’ (6 541.94), Konotop (6 419.40), Romny (5 876.27) and Lypova Dolyna (5 533.92 cases per 100 000 people). The smallest prevalence of this pathology are in Seredyna-Buda (3 766.40), Velyka Pysarivka (3 585.35), Sumy (3 563.19), Krasnopillia (3 372.39) and Yampil’ (3 138.55 cases per 100 000 people) districts.

The primary morbidity by neoplasms increased by 6.18% over the studied period. High values of the primary diagnosis of neoplasms were observed in 2012 and 2015, the lowest – in 2018. However, already in 2019, the number of primary diagnosed cases of the neoplasms increased again – by 6.47% (Fig. 5).

The primary morbidity by neoplasms decreased mostly among all districts: in Buryn’ (by 31.34%), Lypova Dolyna (by 31.74%), Konotop (by 34.83%) and Yampil’ (by 35.54%) districts, while leaders in increase of the primary morbidity by neoplasms were

Putyv’ (by 43.91%), Velyka Pysarivka (by 34.51%), Hlukhiv (by 26.49%) and the city of Sumy (by 32.46%).

In 2019, the highest primary morbidity by neoplasms was registered in the city of Sumy (1 815.35), Hlukhiv (1 080.56), Buryn’ (975.78), Putyv’ (927.63) and Krolevets (924.75 cases per 100 000 people) districts. The districts with low primary morbidity by neoplasms are Bilopillia (594.68), Lebedyn (594.11), Lypova Dolyna (521.03), Sumy (515.93), Yampil’ (476.85) and Krasnopillia (429.28 cases per 100 000 people).

The highest indicators of accumulation diseases index of neoplasms belongs to the inhabitants of Lypova Dolyna (10.62), Bilopillia (9.03), Lebedyn (8.69), Krasnopillia (7.86), Konotop (7.61) and Trostianets (7.43) districts. The best situation for the accumulation of oncology diseases is recorded in the city of Sumy (5.16) and Velyka Pysarivka (5.32), Shostka (5.68), Krolevets (5.78), Putyv’ (5), Seredyna-Buda (4.71), Hlukhiv (4.31) districts.

The procedure of cluster analysis was used to 3 groups of the administrative-territorial units of Sumy region according to the population morbidity

and prevalence. The following indicators were taken to implement the clustering: the primary morbidity, prevalence of diseases, as well as an index of diseases accumulation. The constructed dendrogram clearly

shows 5 clusters, which include administrative units that have similar indicators of morbidity, prevalence of diseases and the disease accumulation index (Fig. 5).

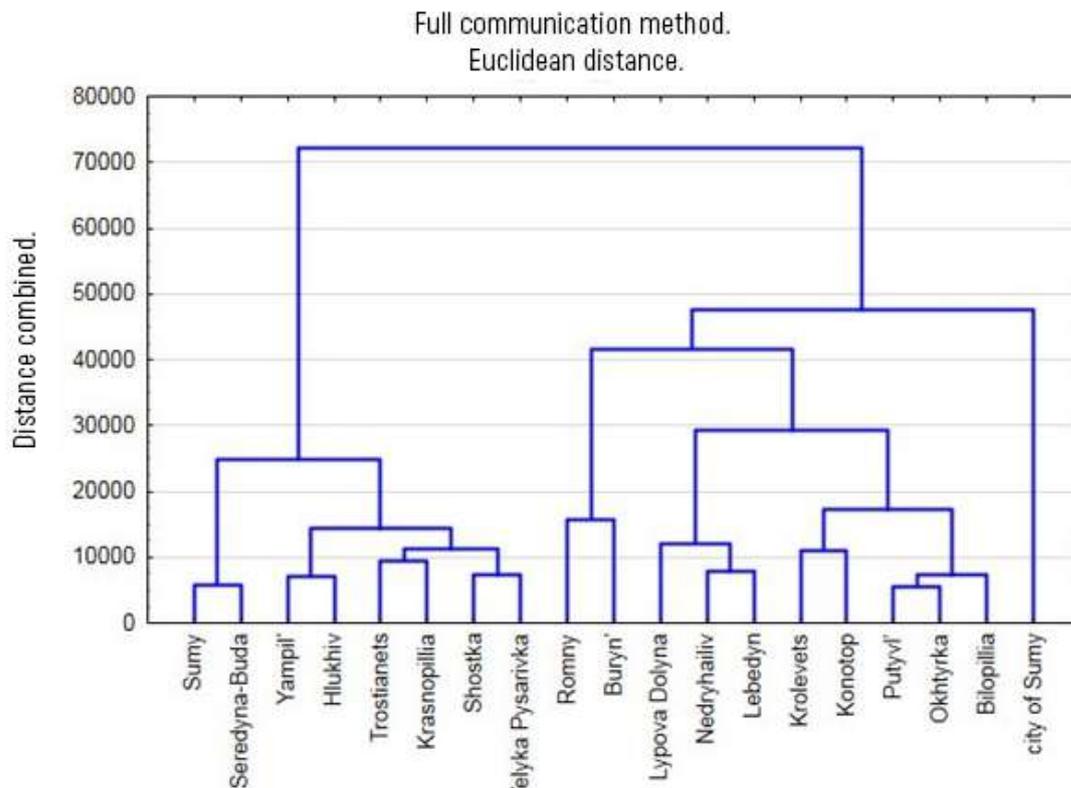


Fig. 5. Clustering tree of the administrative-territorial districts of the Sumy region by the level of incidence of the population by the diseases of cardiovascular system, respiratory diseases and neoplasms.

The *first cluster* included Sumy and Seredyna-Buda districts. The districts of this cluster are characterized by low rates of disease prevalence and primary morbidity of the population.

The second cluster is formed by Yampil', Hlukhiv, Trostianets, Krasnopillia, Shostka and Velyka Pysarivka districts. It should be noted that the districts of this cluster have many features in common. For example, populations in these districts have nearly the same low disease prevalence rates, which range from 135 945.9 to 145,45 .4 cases per 100 thousand people. Trostianets, Krasnopillia and Yampil' districts have a similar prevalence of diseases and primary morbidity of population by CVDs. The regions of this cluster are also characterized by similar indicators of primary morbidity of the population and the prevalence of respiratory diseases, etc.

The *third cluster* united Romny and Buryl' districts. These districts have the highest rates of prevalence of diseases, including cardiovascular and respiratory diseases. They also have a similar situation with the prevalence of neoplasms among the population.

The *fourth cluster* includes the big number of administrative-territorial districts of the Sumy region, among which: Lypova Dolyna, Nedryhailiv, Lebedyn, Krolevets, Konotop, Putyvl', Okhtyrka and Bilopillia districts. The indicators of these districts are also similar to each other in terms of the primary morbidity of neoplasms, the prevalence of cardiovascular diseases, etc.

The *fifth cluster* is represented by the regional center – the city of Sumy. It has the highest general primary morbidity of the population, as well as the primary morbidity and the prevalence of respiratory diseases, neoplasms. At the same time, this cluster has the lowest prevalence of diseases of the circulatory system, low indices of accumulation disease index, including cardiovascular diseases.

Conclusions

The “top” values of the prevalence of diseases and primary morbidity of the adult population of the Sumy region, which observed in 2016 and 2017 were established. The prevalence of disease rate in 2019 decreased by 9.72 % and 9.40 % as compared to 2016

and 2017, while the primary morbidity rate – by 13.9% and 10.29%, respectively. The accumulation disease index among the adult population of the Sumy region were 3.28, with high values in Lebedyn (4.66), Velyka Pysarivka (4.39), Lypova Dolyna (4.37), Sumy (4.28), Seredyna-Buda (4.27), Trostianets (4.11), Hlukhiv (4.08) and Nedryhailiv (4.03) districts. Prevalence of CVDs among the population of the region during last 10 years increased by 5.42%, with “top” indicators in 2018 (57 459.63 cases per 100 000 people). The primary morbidity by CVDs decreased by 3.58%, and its high value was observed in 2016 (4 394.71 cases per 100 000 people). The prevalence of respiratory diseases and primary morbidity of population were highest in 2016 making 29 476.16 and 23 581.0 cases per 100 000 people of region respectively. Prevalence of neoplasms among the population during 2009–2019 increased by 29.59% and in 2019 it made 6 126.43 cases per 100 000 people, while the primary morbidity increased by 6.18%. High values of newly diagnoses of neoplasms were observed

in 2012 and 2015 (1 068.22 and 1 087.98 cases per 100 000 people respectively).

Cluster analysis made it possible to group up the administrative units of the Sumy region into 5 groups (clusters) according to the similarity of the nosological situation in them. The results of research can be used for planning and implementation of treatment and prophylactic measures by administrative-territorial districts of Sumy region.

Promising research directions are the search of factors causing a high level of morbidity and mortality, further monitoring of health status of the population, as well as substantiation of conceptual approaches for improving of diseases prevention. First of all, it is actual for the morbidity by malignant neoplasms of the Sumy region population. Especially, taking into account that the analysis of dynamics of the malignant neoplasms predicting that the incidence rate by neoplasms among the inhabitants of the region will grow.

References

- Blanco, I., Diego, I., Bueno, P., Fernández, E., Casas-Maldonado, F., Esquinas, C., Soriano, J. B., Miravittles, M., 2019. Geographic distribution of chronic obstructive pulmonary disease prevalence in Africa, Asia and Australasia. *The International Journal of Tuberculosis and Lung Disease*, 23, 10, 1100–1106. doi: <https://doi.org/10.5588/ijtld.19.0015>
- Chorna, V.V., Khliestova, S.S., Gumeniuk, N.I., Makhniuk, V.M., Sydorochuk, T.M., 2020. Pokazyky zakhvoriuvanosti i poshyrenosti ta suchasni pohliady na profilaktyku khvorob [Morbidity indicators and dissemination and modern attitudes on disease prevention]. *Reports of Vinnytsia National Medical University*, Vol. 24, No. 1. 158–164. doi: [https://doi.org/10.31393/reports-vnmedical-2020-24\(1\)-31](https://doi.org/10.31393/reports-vnmedical-2020-24(1)-31) (In Ukrainian).
- Dovidnyk pokaznykiv diialnosti ustanov okhorony zdorovia Sumskoi oblasti za 2009 rik, 2010. [Directory of indicators of the health care institutions activities of the Sumy region 2010]. Regional Information and Analytical Center for Medical Statistics. Sumy. 240 (In Ukrainian).
- Dovidnyk pokaznykiv diialnosti ustanov okhorony zdorovia Sumskoi oblasti za 2012 rik, 2013. [Directory of indicators of the health care institutions activities of the Sumy region 2013]. Regional Information and Analytical Center for Medical Statistics. Sumy. 252 (In Ukrainian).
- Dovidnyk pokaznykiv diialnosti ustanov okhorony zdorovia Sumskoi oblasti za 2015 rik, 2016. [Directory of indicators of the health care institutions activities of the Sumy region 2016]. Regional Information and Analytical Center for Medical Statistics. Sumy. 248 (In Ukrainian).
- Dovidnyk pokaznykiv diialnosti ustanov okhorony zdorovia Sumskoi oblasti za 2019 rik, 2020. [Directory of indicators of the health care institutions activities of the Sumy region 2020]. Regional Information and Analytical Center for Medical Statistics. Sumy. 260 (In Ukrainian).
- Dudina, O., Haborets, Yu., Voloshyna, U., 2015. Do stanu zdorovia dytiachoho naseleння [To the health of the child population]. *Ukraine. The health of the nation*. 3(5), 10–11 (In Ukrainian).
- Jemal, A., Ward, E., Wu, X., Martin, H. J., McLaughlin, C. C., Patterns M.J., 2005. Geographic of Prostate Cancer Mortality and Variations in Access to Medical Care in the United States. *Cancer Epidemiol Biomarkers Prev.*, 14(3), 590–595. doi: <https://doi.org/10.1158/1055-9965.EPI-04-0522>
- Klanza, I.A., 2018. Hromadske zdorovia yak umova natsionalnoi bezpeky [Public health as a condition of national security]. *Bulletin of the National Academy under the President of Ukraine (Public Administration Series)*, 1, 107–113 (In Ukrainian).
- Kornus, A.O., Kornus, O.H., Shyshchuk, V.D., Potseluev, V.I., 2020. The regional nosogeographical analysis and factors affecting population respiratory morbidity (on example of the Sumy region, Ukraine). *Journal of Geology, Geography and Geoecology*, Vol. 29, No 1, 82–93 doi: <https://doi.org/10.15421/112008>
- Kornus, O., Kornus, A., Shyshchuk V., 2018. Geographical differences of morbidity and prevalence of the circulatory system diseases among the population of the Sumy region. *Ukraine. Dnipropetrovsk Univ. Bulletin. Geology, Geography*, 26(1), 100–112. doi: <https://doi.org/10.15421/111811>
- Kornus, O., Kornus, A., Shyshchuk, V., Kononikhin, V., 2012. Doslidzhennia vplyvu zabrudnennia atmosferynoho povitria na onkologichnu zakhvoriuvanist naseleння Sumskoi oblasti [The investigation of air pollution influence on cancer morbidity of Sumy region populations]. *Human geography journal*, 13(2). 151–157 (In Ukrainian).
- Kornus, O.H. at al., 2015. Terytorialno-nozologichna struktura zakhvoriuvanosti naseleння Sumskoi

- oblasti [Territorial-nosological structure of population morbidity of the Sumy region]: mohograph. Sumy, 172 (In Ukrainian).
- Koroleva, E.G., Rakhimbek, S.K. & Tupov, S.S., 2019. Medical and geographical aspects of monitoring the incidence of the population. *Hygiene and sanitation*, 11(98), 1285–1295. doi: <http://dx.doi.org/10.18821/0016-9900-2019-98-11-1285-1295>
- Kotvitska, A.A., & Lobova, I.O., 2012. Doslidzhennia sotsialno-epidemiolohichnykh pokaznykiv naseleennia Ukrainy vnaslidok khvorob systemy krovoobihu na derzhavnomu ta rehionalnomu rivniakh [Research of social and epidemiological indicators of the population of Ukraine due to diseases of the circulatory system at the state and regional levels]. *Bulletin of Pharmacy*, 4(72), 62–65 (In Ukrainian).
- Lawlor, D.A., Bedford, C., Taylor, M., Ebrahim, S., 2003. Geographical variation in cardiovascular disease, risk factors, and their control in older women: British Women's Heart and Health Study. *Journal of Epidemiology and Community Health*, 57, 134–140. doi: <http://dx.doi.org/10.1136/jech.57.2.134>
- Mezentseva, N.I., Batichenko, S.P., & Mezentsev, K.V., 2018. Zakhvoriuvanist ta zdorovia naseleennia v Ukraini: sotsialno-heohrafichniy vymir [Morbidity and health of the population in Ukraine: socio-geographical dimension]: Monograph. Kyiv: State Enterprise Print Service. 136 (In Ukrainian).
- Ministerstvo finansiv. Naseleennia Ukrainy z 1990 po 2021, 2021 roky [Ministry of Finance. Population of Ukraine from 1990 to 2021, 2021]. Retrieved from: <https://index.minfin.com.ua/ua/reference/people/sumskaya> (In Ukrainian).
- Niemets, L., Bartosh, O., Sehida, K., Niemets, K., Kliuchko, L., Kravchenko, K., Telebienieva, I., 2021. Human-geographical peculiarities of the healthcare system of Ukraine in the conditions of modern challenges. *Visnyk of V.N. Karazin Kharkiv National University, series «Geology. Geography. Ecology»*, 54, 206–223. doi: <https://doi.org/10.26565/2410-7360-2021-54-16>
- Noncommunicable diseases, 2018. World Health Organization, Retrieved from: <https://www.who.int/ru/news-room/fact-sheets/detail/noncommunicable-diseases>
- Serdyuk, A.M., & Kartashova, S.S., 2019. Vtracheni roky potentsiinoho zhyttia sered naseleennia Ukrainy yak pokaznyk vyznachennia priorytetiv okhorony zdorovia. Navkolyshnie seredovyshe ta zdorovia [Lost years of potential life in the population of Ukraine as an indicator for the determination of health care priority tasks]. *Environment and health*, 3, 4–10. doi: <https://doi.org/10.32402/dovkil2019.03.004>
- Setsuko, K., Yukiko, W., Masafumi, O., 2007. Geographical distribution for malignant neoplasm of the pancreas in relation to selected climatic factors in Japan. *Int J Health Geogr.*, 6, 34. doi: <https://doi.org/10.1186/1476-072X-6-34>
- State Statistics Service of Ukraine. Demographic and social statistics / Population and migration, 2020. Retrieved from: <http://www.ukrstat.gov.ua/>
- Sung, H., Ferlay, J., Siegel, R.L., Laversanne, M., Soerjomataram, I., Jemal, A., Bray, Fr., 2021. Global cancer statistics 2020: Globocan estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*, 71, 209–249. doi: <https://doi.org/10.3322/caac.21660>
- The top 10 causes of death, 2020. World Health Organization, Retrieved from: <https://www.who.int/ru/news-room/fact-sheets/detail/the-top-10-causes-of-death>
- Tsiborovsky, O.M., & Chepelevskaya, L.A., 2017. Determinanty demohrafichnoi sytuatsii v Ukraini [Determinants of the demographic situation in Ukraine]. *Ukraine. The health of the nation*, 4(45), 42–48 (In Ukrainian).
- Ustinov, O.V., 2020. Rol likaria pervynky u protydii COVID-19 [The role of the primary care physician in counteracting COVID-19]. *Ukrainian medical journal. Current issues of clinical practice*. Online. Retrieved from: <https://www.umj.com.ua/article/191697/rol-likarya-pervynki-u-protidyyi-covid-19> (In Ukrainian).
- Yurochko T., 2018. Zdorovia naseleennia yak stratehichna skladova staloho rozvytku Ukrainy [Population health as a strategic component of sustainable development of Ukraine]: [section of the analytical document] Retrieved from: <http://ekmair.ukma.edu.ua/handle/123456789/15801> (In Ukrainian).