# Comparison of Population Mortality Rates in Ukraine and Poland: A Spatial Aspect

Roman S. Molikevych[1]*

[1] Department of Geography and Ecology, Kherson State University, Ukraine
* Roman S. Molikevych, corresponding author. Email: molikevych@gmail.com
Submitted: 4 June 2021. Accepted: 19 May 2022. Published: 21 October 2022
Volume 31, 2023. pp. 235–248. http://doi.org/10.25133/JPSSv312023.014

## Abstract

The main task of the article is to analyze the dynamics of mortality in Poland and Ukraine and to establish similar regional types of mortality structure by the leading causes. The novelty of this research is to analyze the objects of study from the standpoint of typical regional medical and demographic systems, along with the subsequent typification of administrative units. This approach is due to several factors: the growing rate of migration of Ukrainians to Poland and the similarity of the problems of industrial regions and coastal and mountainous regions. The article presents the results of a comparative geographical study on mortality rates in Poland and Ukraine. The study establishes that the level of mortality is radically different in the two countries. For example, the mortality rate in Poland is 1.4 times lower than in Ukraine. However, Poland is affected by typical problems of European countries, such as an increase in mortality rate from neoplasm and diseases of the digestive and endocrine systems. The leading cause of mortality in Ukraine is cardiovascular diseases, the share of which continues to grow. The highest mortality rates in spatial aspects are recorded in the central and coastal territories of both states, which, together with the analysis of the structure of the leading causes of death according to regions, allow us to remark on similar types of mortality in both states. In accordance, cluster analysis made it possible to identify the high, medium, and low types of mortality structure in both states.

## Keywords

Infant mortality; mortality; public health

# Introduction

Mortality rates are a specific demographic fact and a sound indicator of the quality of life and the effectiveness of medical services. As a result, mortality rates are often used in different assessment and comparison techniques in various social sciences. Geographical sciences are no exception, the specificity of which lies in the spatial analysis of differences in the formation of phenomena and processes and the search for causes and dependencies at the local, regional, national, and international levels. Therefore, in this paper, we compare the indicators of the two states of Poland and Ukraine at the level of administrative units of higher rank. This approach will identify standard features and problems in the development of regions, as well as reveal the most optimal vectors for solving the question of mortality rates for Ukrainian realities.

Regarding choosing the research targets, Ukraine and Poland are comparable, as both countries had approximately the same demographic conditions in the early 1990s. Then, thanks to the effectiveness of economic reforms, Poland reached a higher level of development and provision of society, which also affected the quality of demographic indicators (Meslé, 2015). Ukraine, on the other hand, continued to remain demographically stagnant. Accordingly, a comparative analysis of the dynamics and spatial distribution of mortality rates in Poland and Ukraine will reveal differences and dependencies in their formation and conclude the effectiveness of public policy in the health sector and the possibility of solving Ukrainian problems by implementing similar regulatory mechanisms. Thus, the expediency of comparing the mortality structure of the two countries is as follows.

According to various estimates, a large number of labor migrants have migrated from Ukraine to Poland. There are approximately 1.3 million Ukrainians in Poland, comprising roughly 3.4% of the total population of Poland, of which only 300,000 (0.8%) have valid residence permits (Suszko & Europe Without Barriers Project Group, 2021). Consequently, Ukrainians have caused specific changes to the public health of Poles. Therefore, similar gender and age structures of the populations of both countries make them suitable for demographic comparisons. Similar spatial features of the territories of states (mountain, coastal, industrial, and urban centers) allow for the identification of common problems based on geographical determinism. While maintaining preconditions, the corresponding comparison will allow for adjusting the regional medical, demographic, and social policies to achieve optimal results. These countries have strong ties both in economic relations, as Poland is Ukraine's largest trading partner, and in public, which allows us to allude to a certain level of integration and interaction of relevant systems.

Thanks to the above approach, international comparisons of demographic processes have been a relevant area of research for some time. In general, it is possible to discover solutions to regional problems by tracking the dynamics of indicators and their variation depending on changes in the medical systems and social and economic indicators. Thus, it is possible to prevent undesirable processes in the shift within population structures and to predict future problems that will arise with a similar course of development of the appropriate processes. The most successful international comparisons of mortality rates were, for example, from the work of Nakaya and Dorling (2005). They identified the typical age, economic and environmental factors of mortality rates in Japan and Britain. Although this topic has been quite relevant for the past 50 years in European countries, it was only since the 1970s–1980s

that there has been a focus on the dependence of mortality rates on the activities of medical services (Kunst et al., 1988; Lassarre & Thomas, 2005; Meslé, 2015).

The topic of high mortality rates in post-Soviet countries has likewise interested many European scientists, but the specifics of such studies are often comparative (Pizzato et al., 2021). Research often compares medical and demographic indicators of Poland and Ukraine (Dubrovina et al., 2020; Grshybowskyj et al., 2019; Gutor et al., 2021; Lyubinets et al., 2021; Zapadniuk, 2017), with much of the research being devoted to the impact of Ukraine's demographic problems on its economic development associated with both significant natural population and migratory decline (Ivanova, 2018; Kravets, 2021; Slabkiy et al., 2019). Although geographers significantly contribute to the study of population mortality and demographic issues in spatial terms (Niemets, 2018; Santalova, 2018), it was a team of Polish scientists that described the impact of concentrations of pollutants in the air on mortality in Podlaskie voivodeship compared with western Ukraine (Kuźma, Dąbrowski, et al., 2020).

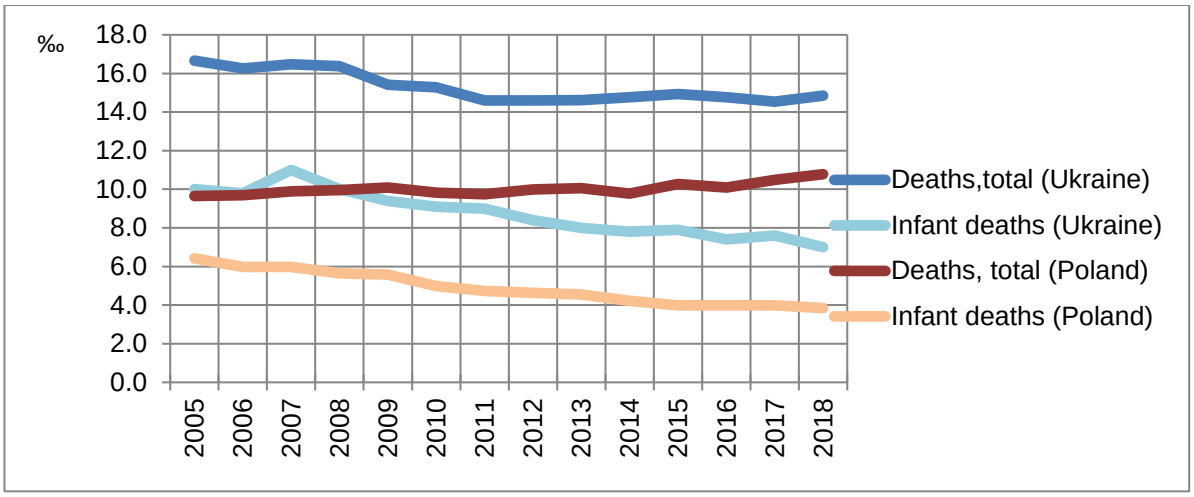
# Data and methods

The data from the Department for Population and Regional Statistics of the State Statistics Service of Ukraine (2018) and the Central Statistical Office of Poland (2021) were used in this research. The basis of the work is a comparative geographical approach. The study suggests a comparison of the dynamics of total mortality and infant mortality, the leading cause of mortality. The investigation presents maps of differentiation of mortality rates from the main groups of diseases according to the most recent International Classification of Diseases (ICD–10), which shows the variation of mortality rates for the average country indicator using bar charts. To identify similar types in the mortality structure of administrative units of compared countries, a cluster analysis of mortality rates (absolute and average) reveals both similarities in the size of indicators and their variation for the nationwide average indicator. Consequently, these methods have identified regions in both countries with the same mortality structure and, therefore, common public health problems.

# Results and discussion

To compare mortality rates in Ukraine and Poland, it was necessary to analyze the main parameters of the total mortality and infant mortality rates of these countries. By comparing the total and infant mortality rates of the last 15 years, we found that the earlier overall mortality rate in Ukraine was 1.7 times higher than that of Poland. However, although Poland's mortality rate did not significantly change during this period, mortality rate has slightly increased in recent years. In contrast, the mortality rate in Ukraine decreased by 1.4 times that of Poland. While infant mortality rates in both countries fell throughout the period, in Ukraine, infant mortality rates were consistently 1.5–1.8 times higher than that of Poland (Figure 1).

**Figure 1:** Dynamics of Total and Infant Mortality in Ukraine and Poland (2005–2018)




*Note: Department for Population and Regional Statistics of the State Statistics Service of Ukraine (2018); Central Statistical Office of Poland (2021)*

The sex and age structure of the population is also no less critical in the analysis of mortality rates. In terms of overall percentages (Table 1), the countries had an almost identical structure in the primary age groups, which made the two countries suitable for demographic comparisons. The life expectancy for both men and women in Poland was five years higher than in Ukraine. The life expectancy for men was 75 years in Poland versus 68.75 in Ukraine and 82.75 versus 78.39 years for women. This aspect was the main factor in reducing mortality in Poland.

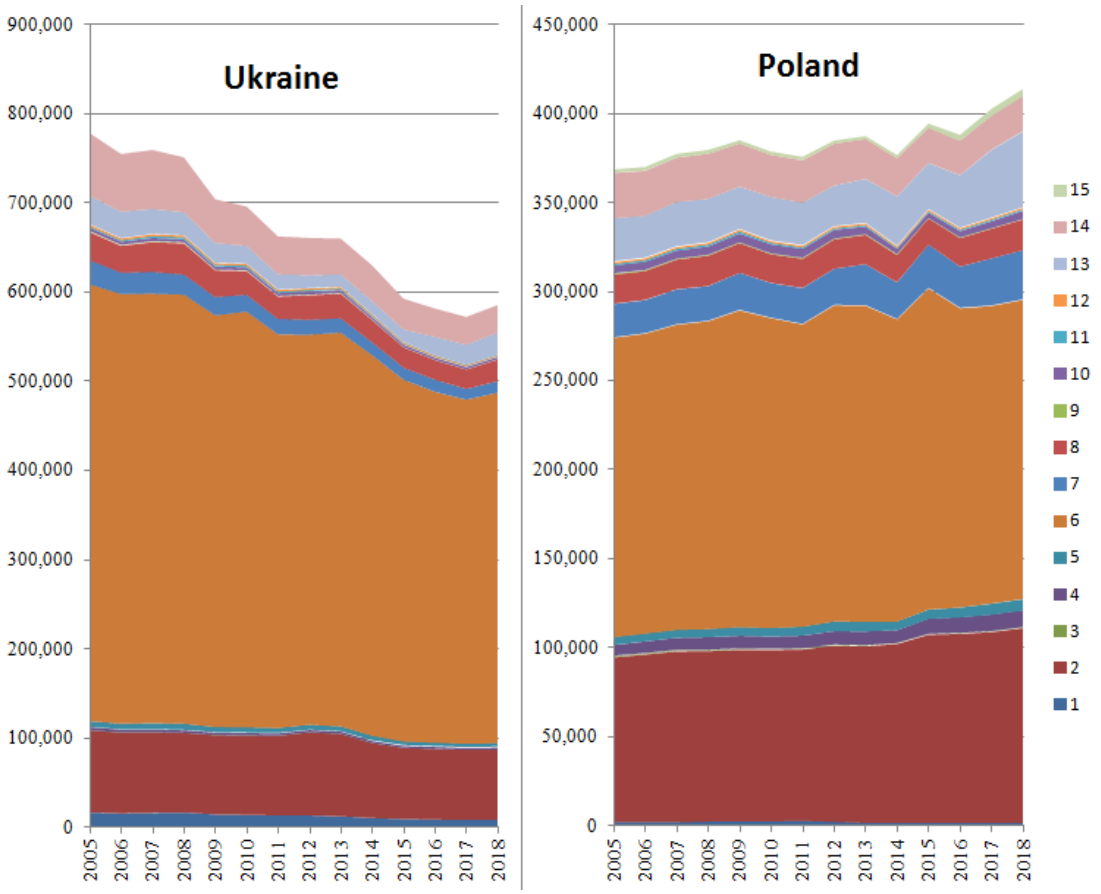
**Table 1:** Age Structure in Ukraine and Poland

| | Ukraine | Poland |
|---|---|---|
| **0–14 years** | 16.16% | 14.83% |
| **15–24 years** | 9.28% | 9.80% |
| **25–54 years** | 43.66% | 43.33% |
| **55–64 years** | 13.87% | 13.32% |
| **65 years and over** | 17.03% | 18.72% |

*Note: Central Intelligence Agency (2018)*

Figure 2 presents the cumulative mortality from the main groups of diseases performed in absolute terms. It contains the following causes of death: 1– specific infectious and parasitic disease; 2–neoplasm; 3–diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism; 4–endocrine, nutritional and metabolic diseases; 5–diseases of the nervous system and sense organs; 6–diseases of the circulatory system; 7–diseases of the respiratory system; 8–diseases of the digestive system; 9–diseases of the musculoskeletal system and connective tissue; 10–diseases of the genitourinary system; 11–certain conditions originating in the perinatal period; 12–congenital malformations, deformations, and chromosomal abnormalities; 13–symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified; 14–external causes of morbidity and mortality; and 15–other causes.

**Figure 2:** Comparison of Mortality Dynamics by Main Groups of Causes in Ukraine and Poland (Number of Cases, 2005–2018)




*Note: Department for Population and Regional Statistics of the State Statistics Service of Ukraine (2018); Central Statistical Office of Poland (2021)*

The structure of the leading causes of mortality in both countries was also interesting. In Ukraine, there was a significant reduction in the gross indicators of mortality, owing to population loss from the annexation of Crimea and Donbas by the Russian Federation. From the beginning of 2014, the loss was 6.5 million people, or 12.5% of the population (Laver et al., 2019). Thus, it was impossible to draw any conclusions about the declining trend in mortality rates. Moreover, more than 20 years have passed since the last population census in Ukraine, and in modern realities, even various public services often provide radically different data on the total population. In Poland, there was an increase in mortality due to a slight reduction in population.

According to the dynamics of specific causes of death in Ukraine from 2005 to 2018, the gross mortality rate decreased. However, the percentage of mortality increased in such groups as cardiovascular disease (from 63% to 67%) and neoplasm (from 12% to 14%). This reality may signify a general deterioration in the medical field and a lack of periodic diagnostic measures and medical examinations. In this regard, it should be emphasized that a large proportion of deaths from cardiovascular diseases are sudden, so the patients may not have been registered with chronic diseases within the system; similarly, high mortality from tumors may have already been detected in the later stages of the disease. Mortality significantly decreased in absolute and relative terms by groups of infectious and parasitic diseases (from 4 to 2%) and

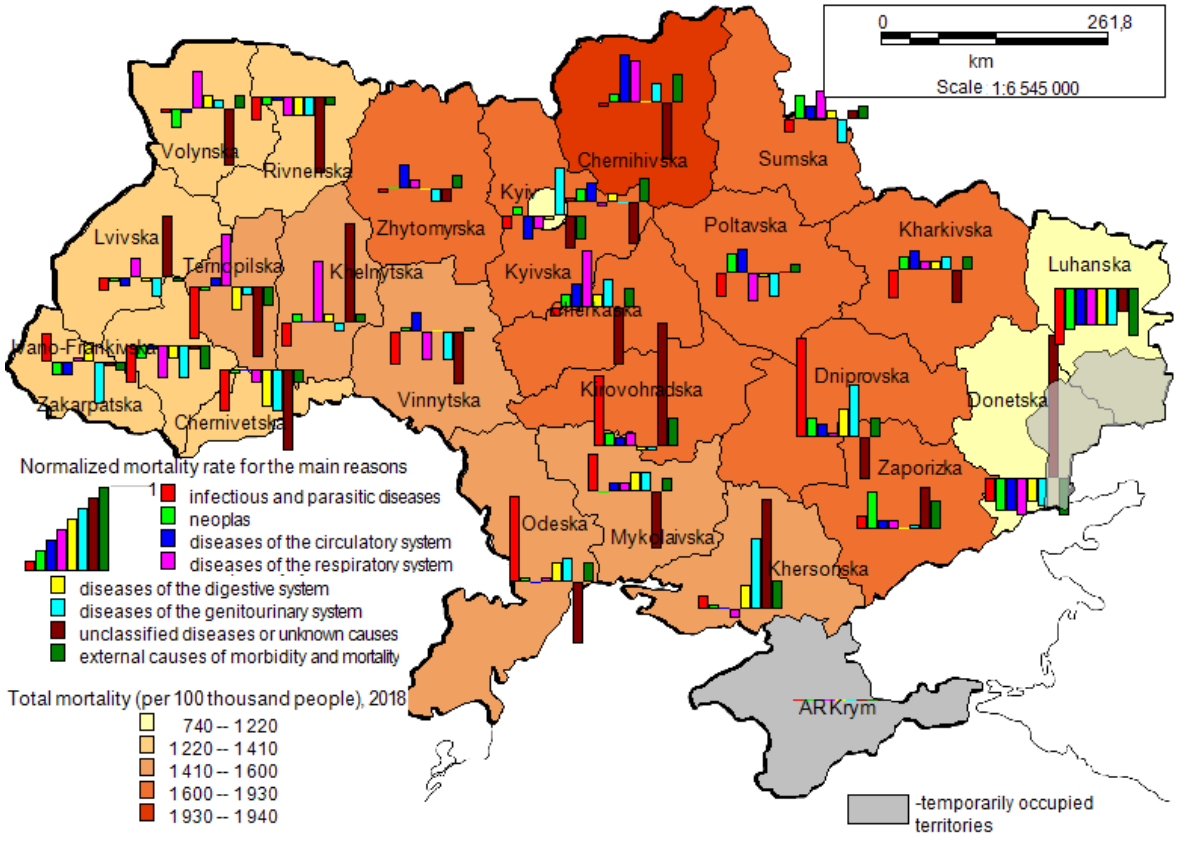
by external causes of mortality (from 9% to 5%), which explains the decrease in population. The share of deaths from unclassified or unidentified causes also remains high (constantly around 4%), with an exceptionally high number in rural areas, where there is not much possibility of appropriately establishing a post-mortem diagnosis.

The following conclusions can be drawn for Poland. A significant increase in mortality from neoplasm. In absolute terms, it would be more than 20,000 deaths compared to the results of 2005; however, the total increase in mortality growth was only about 2%. The change in morbidity and mortality from neoplasm is generally a European trend (Majcherek et al., 2020). Mortality rates from circulatory system diseases have decreased. If, in absolute terms, the number was mostly unchanged, then in relative terms, there would be a reduction in mortality by 6%. This percentage is a planned result of most public health policies and increased public awareness and responsibility for personal health (Department of Health of the Republic of Poland, 2019). Interestingly, not only was there an increase in mortality from respiratory diseases by almost 3% or 10,000–12,000 cases compared to the same period in 2005, the number of deaths from symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified, doubled during this period.

In Ukraine and Poland, there were both familiar and different trends in the structure of causes of death, such as mortality rates from infectious and parasitic diseases were twice as high in Ukraine. Still, the similarity in mortality structure in both countries was stable. The mortality rate from neoplasm in Poland was almost twice as high as in Ukraine; nonetheless, this number continued to grow in both countries. Mortality from endocrine, nutritional, and metabolic diseases was five times higher in Poland than in Ukraine, and this number continued to increase. The mortality rate from circulatory system disease was 1.5 times lower in Poland, while this number was tremendous in Ukraine. The mortality rate from respiratory diseases declined in Ukraine, which increased in Poland. Moreover, there was a gradual decrease in deaths from external causes and injuries in both countries.

It is more interesting to analyze regional differences in the mortality structure of the population of both states. Figures 3 and 4 show significant spatial differences in the formation of indicators in Ukraine and Poland, but there are also common patterns. Thus, the highest mortality rates from infectious diseases were in the central voivodeship of Łódź in Poland and the Pomerania and Warmia-Masuria coastal areas. Similarly, in Ukraine, high rates were observed in the Kirovohrad and Dnipropetrovsk central regions and the Odesa and Mykolaiv coastal regions. The distribution of mortality rates from neoplasm was also natural, with the highest rates being in the Silesia, Lower Silesia, and Łódź industrial areas of Poland (although the variation was insignificant in all Polish voivodeships) (Majcherek et al., 2020) and Zaporizhzhia, Kyiv, Dnipropetrovsk (a significant variation was observed throughout Ukraine) (Gutor & Litvinyak, 2021).

**Figure 3:** Territorial Differences in Total Mortality and Mortality by Main Causes in the Administrative Regions of Ukraine in 2018




*Note: Department for Population and Regional Statistics of the State Statistics Service of Ukraine (2018)*

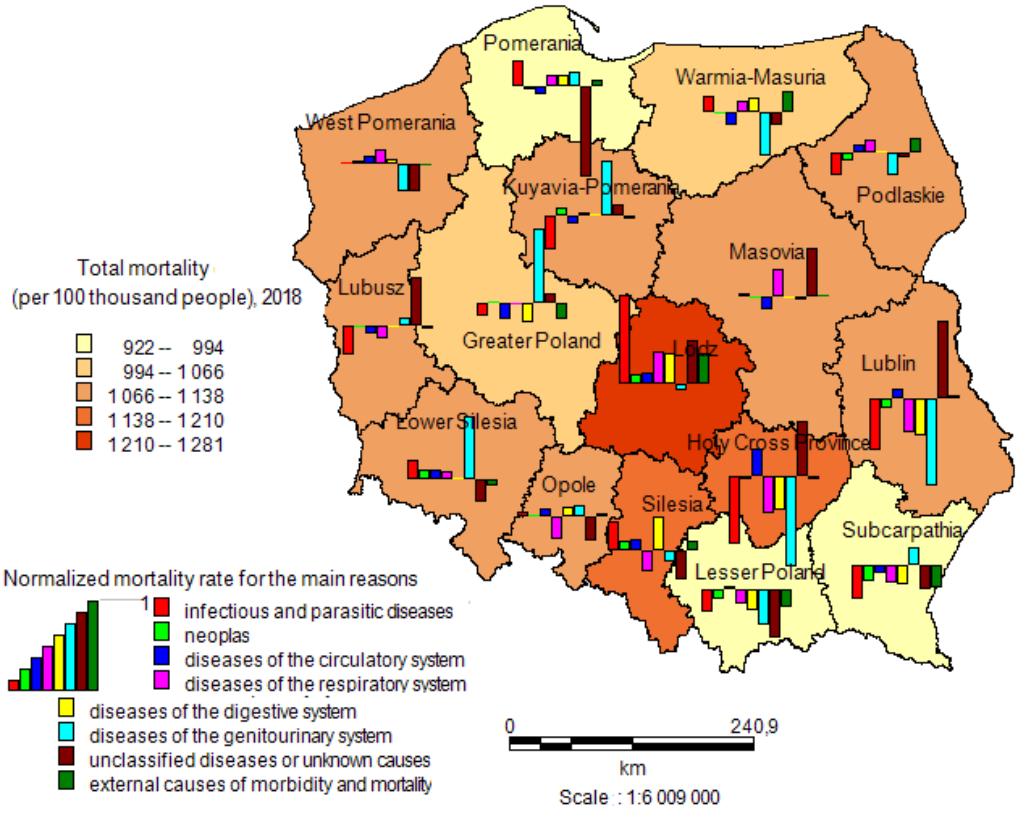
Mortality from circulatory system diseases in Poland had similar features in distribution to the previous indicators. Mortality was high in southwestern industrial voivodeships, with the highest rate being in Holy Cross province. The Łódź voivodeship had the highest mortality of total and infant mortality rates, which were unusual compared to neighboring voivodeships (Dutkowski et al., 2020). However, this group had many problems classifying the causes of death from diseases (Fihel, 2020). This indicator was high in half of the regions in Ukraine, with the highest being in the Chernihiv region. This result could be due to the highest proportion of older people in this region.

In Poland, high mortality from respiratory diseases was observed in the more humid climate of the coastal voivodeships of Pomerania, Warmia-Masuria, and West Pomerania, as well as in the highly urbanized Masovia region (Kuźma, Struniawski, et al., 2020). This indicator was related to climatic delimitation in Ukraine, with the highest mortality observed in the north-western regions, where it is wetter and colder Ternopils, Khmelnytsk, Chernihiv, and Volyn regions, while the indicators were the lowest in the south.

As for mortality from diseases of the digestive system, the specificity of this indicator had a clear correlation with the general mortality rate in the Polish voivodeships (Paciej-Gołębiowska et al., 2020). The highest mortality rate, for this reason, was observed in Silesia, Łódź. The highest rates were associated with the southern region of Ukraine—a region of

concentrated vegetable growing, partly due to the unregulated use of agrochemicals (Skirda et al., 2017). However, the highest mortality rate was in the Dnipropetrovsk region.

**Figure 4:** Territorial Differences in Total Mortality and Mortality by Main Causes in the Voivodeships of Poland in 2018




*Note: Central Statistical Office of Poland (2021)*

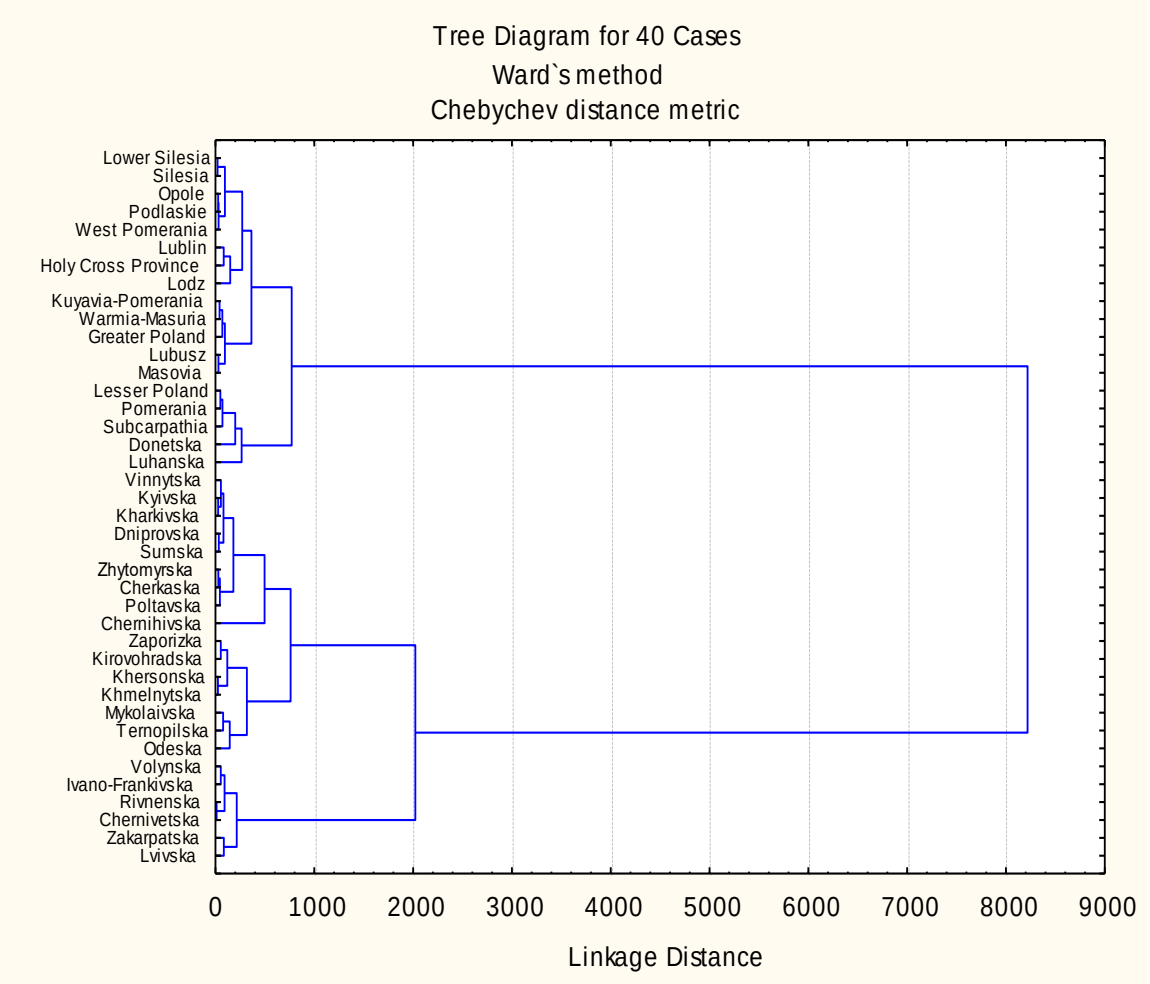
The mortality rates from diseases of the genitourinary system were high in the west (Lower Silesia, Kuyavia-Pomerania, Greater Poland) and low in the east (Holy Cross Province, Warmia-Masuria, Lublin). Due to poor drinking water quality, high mortality rates were confined to the Dnieper River basin in Ukraine. Still, the highest mortality rates were observed in the Dnipropetrovsk, Kherson, Cherkasy, and Kyiv regions.

Mortality from symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified, was a rather complicated category to analyze, as it was difficult to determine the territorial connection with specific patterns. Although, in contrast to Poland, this issue was more expressed and was related to the problems of the system of pathological services in Ukraine. So, each region's mortality from external causes had its specifics and may even differ yearly.

The study used cluster analysis to analyze regional differences using the indicators of total mortality, mortality by leading causes, and infant mortality. In the first case, relative indicators were used, with the number of cases per 100,000 population. The dendrogram formed the types of Polish voivodeships and Ukrainian regions (Figure 5). The only exceptions were Luhansk and Donetsk regions, which included Type I, and the Polish voivodeships Subcarpathia, Pomerania, and Lesser Poland. We can quite naturally explain

this situation. As for Donetsk and Luhansk regions, the calculation was made only in the unoccupied territories, where the population was insignificant, as most of the population had departed.

**Figure 5:** Dendrogram of Administrative Units' Grouping of Poland and Ukraine by Indicators of Mortality by Main Groups of Causes (Performed by Relative Indicators of Cases per 100,000 People)



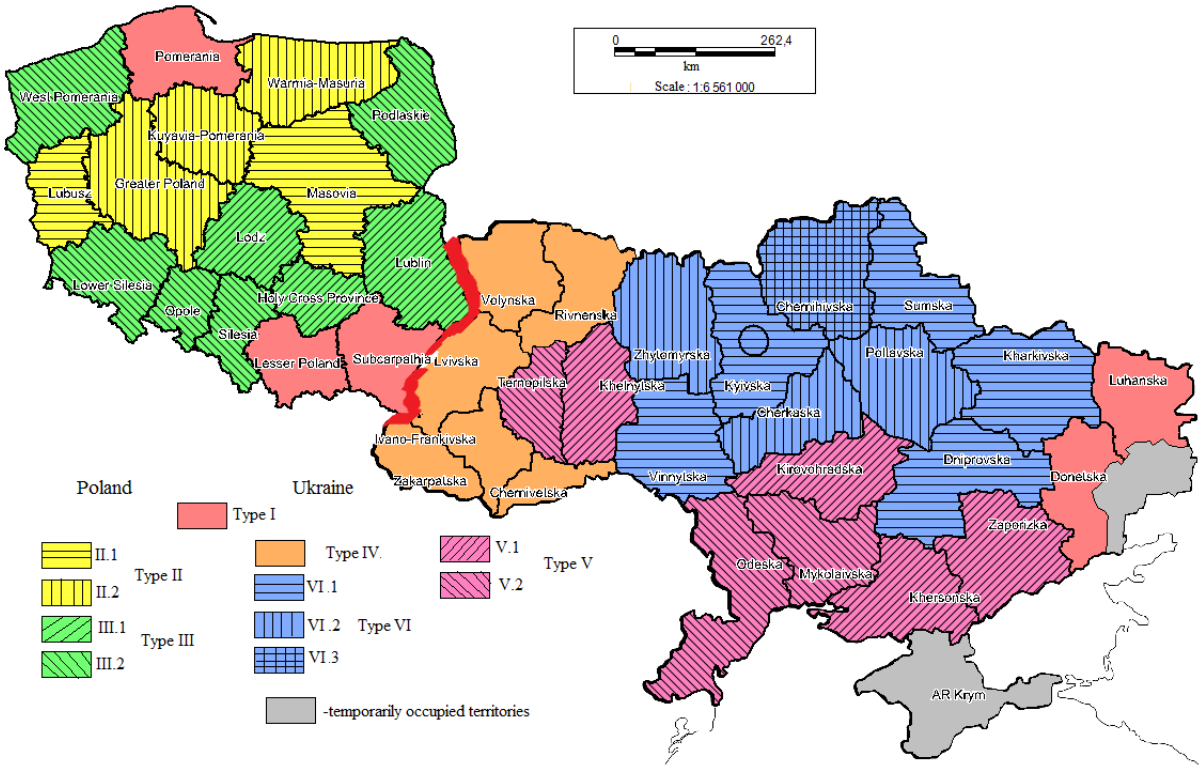

Furthermore, considering the general statistical accounting problem in this region, the indicators did not give an accurate picture. Moreover, let us consider the Polish voivodeships included in this type. The main characteristics for their unification were lower, according to the average in Poland, such as total mortality and mortality from tumors, unclassified and external causes. Thus, Type I could be called the type with the most optimal situation in terms of mortality. In this case, these voivodeships could not be combined with the Donetsk and Lugansk regions; however, to reflect this specificity on the map, the distribution was classified according to the cluster distribution (Figure 6).

Type II included voivodeships with lower-than-average cardiovascular mortality rates but not high infant mortality rates. There are also two subtypes in the type. Subtype II.1 (Masovia, Lubusz) was characterized by higher-than-average total mortality and low mortality from neoplasms and diseases of the digestive system. The differences for the isolation of Subtype

II.2 were lower or close to average total mortality. Generally, the situation with the structure of mortality in Type II was described as average within the country.

Voivodeships that included Type III were characterized by high rates of total mortality, mortality from cardiovascular diseases, and high or medium infant mortality rates. Subtype III.1 (Łódź, Holy Cross Province, Lublin) was characterized by low mortality rates from diseases of the genitourinary system and high mortality rates from unidentified and unclassified causes. Subtype III.2 (Lower Silesia, Silesia, Opole, Podlaskie, West Pomerania) was high mortality from infectious diseases, digestive diseases, and external causes. So, the voivodeships included in Type III had the worst situation in terms of mortality. Thus, a gradual deterioration of indicators from Types I to III was observed among the selected types.

**Figure 6:** Mapping Scheme of Comparative Typification of Administrative Units in Ukraine and Poland by Population Mortality Rates (2018)




The following selected types were included in the Ukrainian regions. In the mapping scheme, there was zoning according to the specification of the causes of mortality.

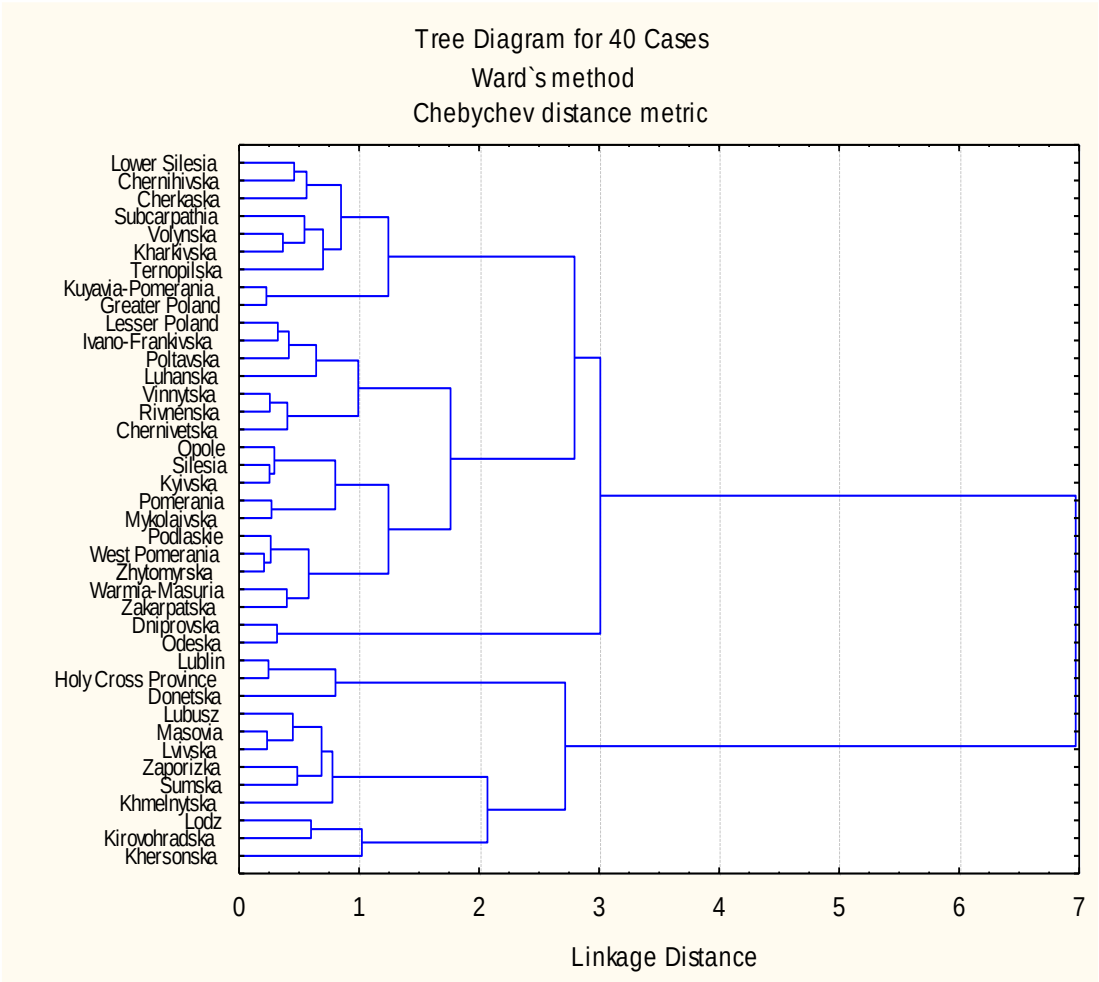
Type IV constituted the most optimal situation in terms of mortality. It included the western regions of Ukraine, with low mortality rates in general and by individual groups.

Type V represented a far worse situation than the previous one, but still, it had high total mortality, mortality from cardiovascular diseases, and infant mortality. Subtype V.1. (Zaporizhzhia, Kirovohrad, Kherson, Khmelnytsk) had high mortality rates from tumors, external causes and symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified. Subtype V.2. (Mykolaiv, Ternopil, Odesa) was characterized by high mortality rates from respiratory diseases (these areas are in the lead in terms of tuberculosis morbidity) and low deaths from unknown causes.

Thus, the areas included in Type VI had, in general, the worst mortality structure–high rates of total mortality, mortality from tumors, diseases of the cardiovascular system, and external causes. The situation was consistent, as Type VI included highly urbanized areas with high socioeconomic development. Subtype VI.1 (Vinnytsia, Kyiv, Dnipropetrovsk, Sumy) had high mortality rates from digestive diseases and low mortality from symptoms, signs, and abnormal clinical and laboratory findings were not elsewhere classified. Subtype VI.2 (Zhytomyr, Cherkasy, Poltava) had low mortality from infectious diseases. Subtype VI.3 included only the Chernihiv region, which had high mortality rates for almost all groups of diseases.

In this typification, the separation of Ukrainian and Polish selected types could be explained by the fact that there was a significant gap between the indicators of the two countries. In this case, no collaborative groups were formed by similarity. Quite often, the lowest figure in Ukraine was much higher than the highest figures in Polish voivodeships. Therefore, to identify the similarity between Ukraine and Poland's regional types, balanced coefficients were calculated by dividing the indicators by administrative units by the average indicator within the country. The qualitative structural comparison was performed without considering the quantitative side of the situation in this approach. It was almost the only approach in which the operating units of two different systems were equated.

**Figure 7:** Dendrogram of a Grouping of Administrative Units of Poland and Ukraine by Mortality Rates by Main Groups of Causes (Performed by Balanced Coefficients According to the Average Indicator for Each Country)



Using the above approach, new types were obtained in regions and voivodeships that already had standard structural features (Figure 7). For example, the Chernihiv region and Lower Silesia had high similarities in the structure of mortality, where the mortality rates were higher than the average indicator in the country. The reasons for this similarity were that Lower Silesia was a mining region that significantly impacted the population's health, and the Chornobyl accident affected the Chernihiv region. Similar were the Lesser Poland and the Ivano-Frankivsk mountainous regions, with the lowest mortality rates. Also similar in terms of mortality were the Pomerania and Mykolaiv coastal regions. The Łódź and Kirovohrad central regions of the two countries also had typically high mortality rates for almost all groups of reasons. Thus, with this method, the dependence of the mortality structure of the population due to both natural and geographical features of the coastal and mountainous regions and socioeconomic relations of the central-peripheral position, capital position, and industrial regions could be established. To conclude, there were similar models of forming the structure of mortality in Poland and Ukraine.

# Conclusions

According to the analysis of the mortality dynamics of Ukraine and Poland, a common vector of increase in indicators was established, but structurally they differed significantly. In Ukraine, the growth of indicators was primarily due to diseases of the cardiovascular system, which is typical for middle-income countries in reforming the medical system. In Poland, the role of mortality from tumors and diseases of the digestive system increased, a familiar trend for developed European countries. Along with improving the quality of life, the role of diseases was associated with reduced physical activity and household chemicals. According to its performance indicators, the Polish and Ukraine health care systems have united to correct the situation with the medical infrastructure in Ukraine.

Typifying coastal, mountain, and central administrative units of the two countries according to the specifics of mortality allowed us to identify similar types of structural mortality. Thus, although states differ in socioeconomic development, the same mortality factors could be seen in areas with similar natural conditions and economic activity. Therefore, further research must focus on an integrated analysis of mortality and morbidity to establish more accurate patterns and consider the process at lower-level district and administrative units.

# Acknowledgments

The study is a part of the Visegrad Scholarship (52010310) from the University of Szczecin, Poland. The author is grateful to the Visegrad Fund, its scientific supervisor Prof. Paweł Czapliński, and the leadership of the Institute of Spatial Management and Socio-Economic Geography, the University of Szczecin for their help and assistance with the research.

# References

Central Intelligence Agency. (2018). *Countries - The World Factbook*. https://www.cia.gov/the-world-factbook/countries/

Central Statistical Office of Poland. (2021). *Bank Danych Lokalnych [Local Data Bank].*

https://bdl.stat.gov.pl/bdl/start

Department for Population and Regional Statistics of the State Statistics Service of Ukraine. (2018). *Population*. All-Ukrainian Population Census. http://database.ukrcensus.gov.ua/

Department of Health of the Republic of Poland. (2019). *Raport: system ochrony zdrowia w Polsce – stan obecny i pożądane kierunki zmian [Report: Health care system in Poland - Current situation and future changes]*. Supreme Audit Office. https://www.nik.gov.pl/plik/id,20223,vp,22913.pdf

Dubrovina, N., Gulášová, I., & Babečka, J. (2020). Tendencies of the mortality rates from esophageal cancer in the EU countries and Ukraine. *Kharkiv Surgical School*, *2*, 102–107. https://doi.org/10.37699/2308-7005.2.2020.21

Dutkowski, M., Rudewicz, J., Łonyszyn, P., Michalski, T., Rydzewski, T.P., Sypion-Dutkowska, N., (2020). *Ośrodki wojewódzkie w Polsce: ujęcie alternatywne [Voivodship centers in Poland: An alternative approach]*. Scientific Publishing House of the University of Szczecin.

Fihel, A. (2020). Investigating multi-cause mortality in Poland. *Demographic Studies*, *2(178)*, 53–73. https://doi.org/10.33119/sd.2020.2.2

Grshybowskyj, J. L., Smiianov, V. A., Myronyuk, I. M., & Lyubinets, O. V. (2019). Ten indicators that characterize medical-demographic processes in adjacent regions of Ukraine and Poland. *Medical News*, *72*(5), 868–876. https://doi.org/10.36740/wlek201905126

Gutor, T. G., Zaremba, N. I., Kovalska, O. R., Moskviak-Lesniak, D. Je., Gerasymovych, I. M., Kobyletskyy, O. Ja., & Nahurna, Y. V. (2021). Comparative analysis of the main social health determinants of life expectancy and infant mortality in Ukraine and Poland. *Medical News*, *74*(3), 750–755. https://doi.org/10.36740/wlek202103235

Gutor, T., & Litvinyak, R. (2021). Analysis of morbidity and mortality from malignant neoplasms of the larynx in Ukraine and Lviv region in 2010–2019 years. *Acta Medica Leopoliensia*, *27*(3–4), 98–107. https://doi.org/10.25040/aml2021.3-4.098

Ivanova, L. (2018). Людський потенціал: демографічні чинники його формування в сучасних умовах [Human potential: Demographic factors of its formation in modern conditions]. *Socio-Economic Research Bulletin*, *0*(3(67)), 131–139. https://doi.org/10.33987/vsed.3(67).2018.131-139

Kravets, I. (2021). Demographic crisis in Ukraine: state, consequences and prospects of overcoming it. *Herald of Khmelnytskyi National University*, 296(4), 114–120. https://doi.org/10.31891/2307-5740-2021-296-4-19

Kunst, A. E., Looman, C. W. N., & Mackenbach, J. P. (1988). Medical care and regional mortality differences within the countries of the European community. *European Journal of Population*, *4*(3), 223–245. https://doi.org/10.1007/bf01796895

Kuźma, Ł., Dąbrowski, E. J., Kurasz, A., Bachórzewska-Gajewska, H., & Dobrzycki, S. (2020). The 10-year study of the impact of particulate matters on mortality in two transit cities in North-Eastern Poland (PL-PARTICLES). *Journal of Clinical Medicine*, *9*(11), Article 3445. https://doi.org/10.3390/jcm9113445

Kuźma, Ł., Struniawski, K., Pogorzelski, S., Bachórzewska-Gajewska, H., & Dobrzycki, S. (2020). Gender differences in association between air pollution and daily mortality in the capital of the green lungs of Poland–population-based study with 2,953,000 person-years of follow-up. *Journal of Clinical Medicine*, *9*(8), Article 2351. https://doi.org/10.3390/jcm9082351

Lassarre, S., & Thomas, I. (2005). Exploring road mortality ratios in Europe: National versus regional realities. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, *168*(1), 127–144. https://doi.org/10.1111/j.1467-985x.2004.00340.x

Laver, O., Matyashovska, B., & Shumilo, N. (2019). Матеріальні втрати та втрати народонаселення Української Держави внаслідок агресії Російської Федерації [Material loss and loss of population of the Ukrainian state the aggression of the Russian Federation]. *Scientific Herald of Uzhhorod University. Series: History*, *0*(1(40)), 48–54. https://doi.org/10.24144/2523-4498.1(40).2019.170229

Lyubinets, O., Kachmarska, M., Sygit, K. M., Cipora, E., & Grshybowskyj, J. (2021). Mortality and alcohol as its cause–comparative characteristics of the two neighboring countries: Ukraine and Poland. *International Journal of Environmental Research and Public Health*, *18*(20), Article 10810. https://doi.org/10.3390/ijerph182010810

Majcherek, D., Weresa, M. A., & Ciecierski, C. (2020). Understanding regional risk factors for cancer: A cluster analysis of lifestyle, environment and socio-economic status in Poland. *Sustainability*, *12*(21), Article 9080. https://doi.org/10.3390/su12219080

Meslé, F. (2015). Adult Mortality in Eastern Europe and the Former Soviet Republics. *International Encyclopedia of the Social & Behavioral Sciences*, 161–169. https://doi.org/10.1016/b978-0-08-097086-8.31048-0

Nakaya, T., & Dorling, D. (2005). Geographical inequalities of mortality by income in two developed island countries: A cross-national comparison of Britain and Japan. *Social Science & Medicine*, *60*(12), 2865–2875. https://doi.org/10.1016/j.socscimed.2004.11.007

Niemets, L. (2018). From the geography of morbidity to the geography of health: Current focuses of scientific research. *Economic and Social Geography*, *80*, 42–56. https://doi.org/10.17721/2413-7154/2018.80.42

Paciej-Gołębiowska, P., Pikala, M., & Maniecka-Bryła, I. (2020). Years of life lost due to malignant neoplasms of the digestive system in Poland during 10 years of socioeconomic transformation. *European Journal of Cancer Prevention*, *29*(5), 388–399. https://doi.org/10.1097/cej.0000000000000574

Pizzato, M., Carioli, G., Bertuccio, P., Malvezzi, M., Levi, F., Boffetta, P., Negri, E., & La Vecchia, C. (2021). Cancer mortality and predictions for 2020 in selected Australasian countries, Russia and Ukraine. *European Journal of Cancer Prevention*, *30*(1), 1–14. https://doi.org/10.1097/cej.0000000000000639

Santalova, S. O. (2018). Preconditions of the especially dangerous population diseases' emergence, development, and spreading in Ukraine. *Ukrainian Geographical Journal*, *2018*(4), 41–48. https://doi.org/10.15407/ugz2018.04.041

Skirda, I. Yu., Petishko, O. P., & Zavgorodnyaya, N. Yu. (2017). Epidemiological features of diseases of the digestive system in children and adolescents in Ukraine. *Gastroenterology*, *51*(4), 229–236. https://doi.org/10.22141/2308-2097.51.4.2017.119287

Slabkiy, G. O., Mironyuk, I. S., Koshelia, I. I., & Dudnyk, S. V. (2019). Медико-демографічна ситуація як глобальна проблема громадського здоров'я України [The medical-demographic situation as a global problem of public health in Ukraine]. *Bulletin of Social Hygiene and Health Organization of Ukraine*, *3*, 62–72. https://doi.org/10.11603/1681-2786.2019.3.10594

Suszko, I., & Europe Without Barriers Project Group. (2021). *Fakty I mity o Ukraińskiej Migracji Zarobkowej do Krajów Grupy Wyszehradzkiej [Facts and myths about Ukrainian gainful migration to the Visegrad Group countries]*. https://naszwybor.org.pl/wp-content/uploads/2021/03/PL_mity_i_fakty.pdf

Zapadniuk, S. O. (2017). Trends of spreading of especially dangerous diseases in the population in Ukraine and some countries of Europe. *Ukrainian Geographical Journal*, *2017*(4), 53–61. https://doi.org/10.15407/ugz2017.04.053