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Environmental determinants of health of the population of Ukrainian regions in the context of sustainable development

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The World Health Organisation's 2030 Agenda notes that health and well-being, in combination with environmental factors and human work, are the outcomes, determinants and systemic factors that contribute to sustainable societal development. Sustainable Development Goal 3 – "Promote healthy lives and well-being for all at all ages" – is the main one and covers several environmental determinants of health, and in fact, environmental determinants of health are directly or indirectly related to all the Sustainable Development Goals. Health is a prerequisite for the full realisation of human biosocial potential and sustainable development of Ukraine. Accelerating technological progress, growing environmental pollution and a significant increase in the number of stressors in the modern lifestyle increase the risk of developing various diseases. To determine the health of the population, an integrated approach is used, characterised by medical, statistical and demographic indicators: pre-existing conditions, morbidity, disability, and physical development. The article presented here identifies and studies the patterns of changes and trends in demographic processes and morbidity of different categories of population in Vinnitsia, Chernihiv and Lviv regions of Ukraine. We have noted that there is a deep demographic crisis, which is manifested in a sharp decline in the population of different regions of the country. It has been established that the processes of depopulation, increased mortality of younger people from diseases and an increase in the level of demographic old age have several prerequisites for further deepening of these processes. Despite the similar dynamics of demographic processes in the surveyed regions, in terms of sustainable development, the least threatening situation is observed in the Lviv region, and the most alarming in the Chernihiv region, which is primarily due to socio-economic factors.

Keywords: sustainable development; sustainable development goals; mortality; demography; morbidity; ageing; fertility.

Introduction

One of the World Health Organization's (WHO) priorities is the 2030 Agenda for Sustainable Development. Its main objectives are to achieve the global Sustainable Development Goals (SDGs) in the European region. These issues were also raised at the High-Level Meeting on the Mid-Term Review of the European Environment and Health Process, held in Haifa, Israel, in April 2015, and at the Sixth Ministerial Conference on Environment and Health, held in June 2017 in Ostrava, Czech Republic (Libanova, 2014; Healthy Environments for Healthier People, 2018). On 30 September 2019, the President of Ukraine issued a Decree "On the Sustainable Development Goals of Ukraine for the period up to 2030", in which he supported the achievement of the global sustainable development goals and the results of their adaptation, taking into account the specifics of Ukraine's development, as set out in the National Report "Sustainable Development Goals: Ukraine".

In the 2030 Agenda for Sustainable Development, health and well-being, in combination with environmental factors and human work, are seen as outcomes, determinants and systemic factors contributing to sustainable development. The Sustainable Development Goals in the field of public health in different regions of Ukraine are integrated and indivisible, they include health determinants that cover economic, environmental and social indicators that determine the state and level of health of individuals

and population groups, where the importance of ensuring equity is particularly emphasised (Afanasieva, 2014; Health care facilities and morbidity of the population of Ukraine in 2017: a statistical collection, 2018).

SDG Goal 3 – "Ensure healthy lives and promote well-being for all at all ages" – is the overarching goal and covers several environmental determinants of health. However, improving health and closing the health gap caused by social inequity is itself a development goal and a priority under many of the other SDGs. The environmental determinants of health are directly or indirectly related to all the SDGs (Libanova, 2014; Protection of Children in need of Special Attention of society: Statistical Collection, 2018; Healthy Environments for Healthier People, 2018).

Health determinants are a complex of individual, social, economic and environmental factors that determine the state and level of health of individuals, population groups and the nation as a whole. Environmental determinants are one of the most important aspects of the health status of the population in different regions of Ukraine. There is no doubt that industrial production, primarily in large cities, agriculture and other sectors of the economy inevitably leads to a deterioration in the ecological state of environmental components, reducing the quality and duration of human life and the level of environmental safety of the population as a whole. We should not forget about the long-term negative effects of the Chernobyl accident on the state of Ukraine's environment and public health. All of this directly affects not only human health, but also causes enor-

mous damage to the economy, sharply reduces labour resources, and potentially creates carcinogenic, mutagenic, teratogenic, embryotoxic and gonadotoxic hazards to the health of not only current but also future generations. Increasing rates of industrialisation and urbanisation lead to a violation of ecological balance and cause degradation of not only the environment but also human health. But among all the environmental factors that have an impact on individual and population health and disease patterns, nutrition and physical activity are perhaps the most important. At least two obvious aspects of human nutrition have a significant impact on sustainable development. On the one hand, the health of future generations directly depends on what their predecessors eat. On the other hand, food production has a global impact on the environment.

Malnutrition causes the largest number of deaths worldwide. Even more than smoking, high blood pressure and any other risk factor. This is confirmed by the results of a large study on the impact of nutrition on human health, which was obtained by analysing data from 195 countries from 1990 to 2017. According to this study, every fifth death in the world occurs precisely because people do not consume healthy food. The reason is too much salt, and not enough whole grains, fresh fruit and vegetables. People also consume too few nuts, seeds, omega-3 fatty acids and fibre. The study shows that the impact of individual dietary factors varies from country to country. However it is the excessive consumption of salt and insufficient amounts of whole grains, fresh vegetables and fruits in the diet that cause more than 50% of diet-related deaths. The rest is due to the high consumption of red meat and technologically processed meat products, sweetened beverages and trans fats. In addition to mortality, unhealthy diets affect the DALY (Disability-Adjusted Life Year). This is the number of years of healthy life lost as a result of illness or death. Poor nutrition has resulted in 255 million years of healthy life lost – 16% of DALYs among adults worldwide (GBD 2017 Diet Collaborators (2019). Health effects of dietary risks in 195 countries, 1990-2017, 2017).

All of this gives grounds to consider health and disease to be derivatives of the environment. The concept of "health" as a mandatory criterion should include not only physical health but also the possibility of full labour and social activity. Illness not only hinders but often significantly limits or deprives a person of this opportunity. The movement from health to illness can be seen as a process of gradual weakening of the body's ability to adapt to changes in the social and production environment, and environmental conditions, which ultimately leads to a decrease in public, social and labour functions. Health is a prerequisite for the full realisation of human biosocial capabilities and the sustainable development of the country.

The realities of our time, such as accelerating technological progress, progressive environmental pollution, inadequate (unbalanced) nutrition, a significant increase in the number of stresses in the modern lifestyle under martial law in Ukraine and in the post-war period, increase the risk of developing various diseases (Afanasyeva, 2014; Latysheva & Rovenska, 2019), especially cancer, which is associated with low-stress resistance of Ukrainians.

Today, public health is an important indicator of a country's sustainable development. Its monitoring is extremely necessary and should be carried out on an ongoing basis for various purposes. The ability to assess changes in public health over time, its dynamics in different regions of Ukraine, and comparison with other countries will provide a scientific basis for the development of effective state policy in this area. The Concept for the Development of the Public Health System of Ukraine defines public health as a set of tools, procedures and measures implemented by state and non-state institutions to promote public health, prevent diseases, increase the duration of active and working age and encourage a healthy lifestyle by combining the efforts of the whole society (<https://zakon.rada.gov.ua/laws/show/560-2017-80>). There is no single criterion for assessing public health, but there are many approaches to defining the concept of "health". A comprehensive approach is used to define the health of the population in the world, which is characterised by demographic indicators: pre-disease conditions, morbidity, disability, and physical development. In the proposed article, we reveal demographic indicators and morbidity, which leads to the highest mortality rates.

Some indicators of human development in Ukraine include consolidated budget expenditures on healthcare as a percentage of gross domestic product (GDP). These expenditures have not exceeded 4.8% throughout

the years of independence and amounted to 3.6% in 2020. The total amount of healthcare expenditures is increasing at the expense of local budgets to 10–13%, in 2020 – to 13% (Healthcare facilities and morbidity of the population of Ukraine in 2017: a statistical collection, 2018).

The population of Ukraine had a stable upward trend until the early 1990s but with a decline in growth intensity since the 1970s. In 1991, for the first time, mortality rates exceeded fertility rates, with the total mortality rate at 12.9 per thousand population and increasing to 14.1 in 2019, while the total fertility rate decreased from 12.1‰ to 10.2‰ (Paliienko, 2017; Chepelevska, 2018).

The implementation of the comprehensive programme "Health of the Nation" and a set of regional and departmental programmes in the field of health protection and improvement contributed to a significant reduction in the consequences of the medical and demographic crisis but did not ensure its overcoming (Pozniak & Shevchuk, 2014).

Over 30 years (1990–2020), the population of Ukraine decreased by 21.2%, from more than 52 million people to 41 million 785 thousand people (World demographic trends, 2011; Pozniak & Shevchuk, 2014). The UN Secretariat has published another report on world demographic trends with a forecast of an increase in the world's population to 9 billion people in 2050, despite the downward trend in fertility in developed countries. By 2050, 2 billion people will be over 60 years old (Paliienko, 2017). For Ukraine, the forecast is unfavourable: by 2050, its population is expected to decline by another 7.8 million people (World Demographic Trends, 2011; Paliienko, 2017).

The state of reproductive health is characterised by fertility rates, and the health of children and women is reflected in maternal and infant mortality. Currently, the maternal mortality rate in Ukraine remains one of the highest in Europe, although there is a downward trend in these indicators. Abortion is one of the determining factors and remains a common method of birth control for Ukrainian women, with the number of abortions being 1.2 times higher than the number of births. For comparison, this figure in France and Germany is 0.25, and in Japan – 0.06. In addition, abortions have a negative impact on women's reproductive health, leading to infertility and miscarriage, and in 5 cases (out of 10,000 abortions) this procedure leads to death (Afanasyeva, 2014; Lekhan et al, 2017).

Ukraine's demographics are characterised by a high rate of infant and working-age mortality, especially among young men, from cardiovascular disease, which is not typical for developed countries (Markovych, 2013; Chepelevska, 2018).

Another problem in Ukraine is the reduction of the average age of death from most diseases: the differentiation between the causes of death and the average age of death is very high (unlike in the EU). The lowest average age of death among Ukrainians is recorded in the class of infectious diseases (AIDS, tuberculosis).

In Ukraine, life expectancy is gradually decreasing, with an average life expectancy of 71 years (women – 75, men – 66), and our country ranks 52nd among the world's countries in this regard.

In its global strategic document for national health services, *Health for All in the 21st Century*, the WHO has defined the criteria that all countries should strive for. These criteria include positive natural population growth and life expectancy, which should be at least 75 years. The demographic situation in Ukraine currently does not meet these criteria, so it is important to study the problems related to socio-demographic processes.

The purpose of the study is to identify patterns of changes and trends in the socio-demographic processes of morbidity in the population of Vinnytsia, Lviv and Chernihiv regions of Ukraine. Based on the research, the study aims to identify the causes of the deterioration of public health in these regions and to propose ways to improve the current situation.

The social and demographic situation

The social and demographic situation in Vinnytsia, Lviv and Chernihiv regions is unfavourable. Each of the regions has a distinctive history, production, economic and human resources potential, and rich natural and labour resources. All of this contributes to the industrial, social and economic development of the regions. At the same time, intensive industrial development leads to a tense environmental and demographic situation, which poses, among other challenges, the need to improve healthcare and

social services. The Chornobyl accident has changed the perception of the degree of danger of anthropo-environmental impacts on humans and its medical consequences continue to be closely studied by experts, as this impact on public health is unparalleled both in nature and in scale. It is well known that all types of adaptations are based on the formation of a systemic structural footprint (SSF) – a set of structural changes in the cells and tissues of organs and systems specifically responsible for this adaptation, which increases their functional capacity. The reason and trigger for the formation of CVS is the discrepancy between the increased load on the organs and their original functional capacity. These changes consist of an increase in the activity of the genetic apparatus of cells, which leads to an increase in the number and mass of cellular structures (ribosomes, mitochondria, etc.) responsible for the most important functions of synthesis of essential proteins, ion transport, an increase in copies of genes encoding essential proteins, and others. New structures are formed, which increases the functional capacity of the system and brings the organism to a new level of functioning required for the duration of the environmental factor (Chu et al., 2022; Tanemoto et al., 2022). The number of newly created structures is called the "structural cost of adaptation". With prolonged, strong, or repeated exposure to environmental factors, tissues and organs undergo a stage of wear and tear (maladaptation), in which the capabilities of hypertrophied cells are exhausted. They reduce the rate of synthesis, disrupt the renewal of structures, and stimulate the death of functional cells and their replacement by connective tissue elements, i.e. develop organ or systemic sclerosis with the formation of functional organ failure. Functional insufficiency has been established for compensatory hypertrophy of the heart, kidneys, liver, nerve centres, pituitary-adrenal system, secretory cells of the stomach, pancreas and other organs. Wear and tear due to hyperfunction is the cause of many diseases, including hypertension and diabetes. Thus, at the last stage of adaptation formation, the adaptive response turns into a maladaptive, pathological one, i.e., the transformation of adaptation into a disease (Lieberman, 2016; Lea et al., 2023). This pathogenetic mechanism is called local wear and tear of the systems dominant in adaptation. All of these mechanisms are characteristic of long-term exposure to radiation (Chu et al., 2022; Tanemoto et al., 2022).

In the development of environmentally-dependent extreme states, the main nonspecific mechanisms of maladaptation are the lack of functional reserves of the autonomic nervous system (ANS), which causes an energy imbalance with an increase in anaerobic catabolism and the involvement of the body's plastic resources in the reaction, labelling of cell membranes with activation of lipid peroxidation (LPO) processes and depletion of the

antioxidant system potential, disruption of antigenic-structural and functional-vegetative homeostasis (Khammash, 2021).

To calculate the vegetative coefficient (adaptation coefficient), we used the functional vegetative diagnosis of the population according to V. F. Makats (Furdychko et al., 2020; Yermishev, 2020). The vegetative coefficient k_V (adaptation coefficient) is the numerical result of the relative ratio of the sum of the total sympathetic activity to parasympathetic activity and reflects the direction of the vegetative balance. We examined 1516 people of different ages and genders who underwent sanatorium rehabilitation in Ukrainian sanatoriums from 1993 to 2006. The surveyed people were divided into three groups according to their place of residence, those who lived in radiation-contaminated (RC) regions (Vinnytsia and Chernihiv regions) and those in "conditionally radiation-free" regions (Lviv region, Table 1). The average doses of total (external and internal) exposure in mSv accumulated in the period 1986–2005 after the Chornobyl accident in the regions of Ukraine are as follows: Vinnytsia oblast – 2.2, Lviv oblast – 0.87 and Chernihiv oblast – 2.3.

Table 1

Regional peculiarities of the adaptive capacity of the population of Ukraine (vegetative coefficient, k_V ; basic norm = 1.00)

Area	Women's group	Men's group	Average
Vinnytsia	0.94	0.90	0.92
Lviv	1.20	1.18	1.19
Chernihiv	0.94	0.94	0.94

An increase in k_V above the norm in female and male groups indicates a "sympathetic orientation" of the vegetative orientation (critical functional stress of adaptation), which in this situation indicates the absence of a "radiation component" of the integrated environmental pressure. We noted the opposite situation during long-term observations of the dynamics of the vegetative orientation of the population in the 4th zone of radiation contamination for Vinnytsia and Chernihiv regions. Long-term residence of the population in the zone of increased radiation exposure causes negative dynamics of functional individual and population (group, collective) health and its environmental dependence. The latter is accompanied by a steady increase in parasympathetic activity and is the main mechanism of maladaptation of the human body to environmental components, as evidenced by a decrease below the normal k_V .

As of 1 January 2020, the total population of the regions showed a decrease: the largest percentage of decline was observed in Chernihiv region, which amounted to 26.4%, and the smallest percentage in Lviv region, which was 9.3% (Table 2).

Table 2

Key demographic indicators of Vinnytsia, Lviv and Chernihiv regions (as of 1 January 2020)

Area	Changes in population, %			Annual population decline, thousands of people	Urban population, %		Rural population, %	
	total population of the region	urban population	rural population		1995 year	2020 year	1995 year	2020 year
Vinnytsia	–18.22	–10.16	–25.39	14.5	47.09	51.73	52.91	48.20
Lviv	–9.32	–9.25	–9.43	17.0	61.02	61.06	38.98	38.94
Chernihiv	–26.44	+8.20	–8.20	15.5	57.00	65.20	43.00	34.80

A steady trend towards urbanisation was found in Vinnytsia and Chernihiv oblasts, in contrast to Lviv oblast, where the situation has not changed, but in all oblasts, there is a decrease in the total number of the urban and rural population (Nykyforenko, 2018; Main Department of Statistics in Vinnytsia region, 2019; Yermishev et al, 2020).

There was a disproportion in gender and demographic characteristics in all surveyed regions with a reduced number of men compared to women. At the same time, there is a decrease in the female population in the Vinnytsia region by 19.7% and Chernihiv region by 27.3%, with the highest number of men per 1000 women in Lviv region – 901 (Table 3).

The population in 2020 in the regional centres was as follows: Vinnytsia – 370.7 thousand people; Lviv – 756 thousand people; city of Chernihiv – 286.2 thousand people.

The gender structure of the population is characterised by changes in the number of men and women over the course of life. A fairly stable ratio of the number of births was found: in Vinnytsia region – 52.1% of boys, girls – 47.9%, in Lviv region – 51.4% and 48.6%, in Chernihiv region – 52.1% and 47.9%, respectively. In these regions, as well as in Ukraine as a

whole, there is an increase in the number of boy births. In the future, this ratio will change as a result of the influence of biological and social factors. Thus, at a young age, there is approximately the same number of men and women, and in old age, due to higher mortality rates among men, the proportion of women in the population structure changes and becomes higher than among men (Pozniak & Shevchuk, 2014).

The age structure of the population

The age structure of the population in the regions is characterised by an ageing trend (Table 4). Table 4 shows that the largest proportion of the total population by age is the group of people aged 70 and older, and the smallest proportion of adults is the group of people aged 65–69 (Annual report on the state of health of the population, the sanitary and epidemiological situation and the results of the health care system of Ukraine, 2017). As of the beginning of 2020, proportions of persons of a young non-working age (up to 15 years inclusive) in the regions were as follows: Vinnytsia – 15.2%, Lviv – 17.4%, Chernihiv – 14.4%; working age (16–

59 years): Vinnytsia – 65.4%, Lviv – 62.0%, Chernihiv – 58.2%; older people (60 and older): Vinnytsia – 19.4%, Lviv – 20.6%, Chernihiv – 27.4% (Annual report on the state of health of the population, the sanitary and epidemiological situation and the results of the health care system of Ukraine, 2017).

Table 3

Gender and demographic characteristics of the population of Vinnytsia, Lviv and Chernihiv regions

Area	Male population, %		Female population, %		Number of men per 1000 women
	1995	2020	1995	2020	
Vinnytsia	45.19	46.33	54.81	53.67	863
Lviv	47.50	47.40	52.50	52.60	901
Chernihiv	44.96	45.49	55.04	54.51	835

Table 4

The main age groups of the population of the studied regions

Regions	up to 1 year, %	20–24 years old, %	25–29 years old, %	30–34 years old, %	45–49 years old, %	50–54 years old, %	65–69 years old, %	70 years and older, %
Vinnytsia	1.30	5.69	7.29	8.14	7.01	6.85	5.59	12.50
Lviv	0.99	6.35	7.50	8.60	6.77	6.71	4.63	10.00
Chernihiv	0.61	4.46	6.23	8.30	6.94	6.68	6.45	19.90

In 1995, this ratio was as follows: Vinnytsia oblast – 19.7%, 58.8%, 22.2%; Lviv oblast – 23.7%, 58.6%, 17.7%; Chernihiv oblast – 19.5%, 55.6%, 24.9%, respectively. This was typical for a progressive type of age structure, as the proportion of younger people exceeded older age groups. In recent years, a regressive type of age structure has been characteristic. The number of pensioners per 1000 people is 400 in Vinnytsia Oblast, 290 in Chernihiv Oblast, and 274 in Lviv Oblast (Paliienko, 2017).

We also studied the state of natural population movement – changes in its size and qualitative composition as a result of the main demographic phenomena, i.e. birth and death rates. Since 1995, the overall fertility rate has decreased: in Vinnytsia region by 33.6%, in Lviv region by 30.7%, and in Chernihiv region by 25.0%. The lowest fertility rates were in 2019 and 2001: Vinnytsia region – 1.21‰ and 1.22‰, Lviv region – 1.26‰ and 1.26‰, Chernihiv region – 1.03‰ and 1.08‰. Then, gradually, this indicator increased and reached its maximum values in 2012–2014, and then began to decline again.

The overall mortality rate in the study areas in 2019 was as follows: Vinnytsia – 15.61‰, which is 9.3% higher than in 1990 (17.22‰); Lviv – 3.02‰, which is 6.6% higher than in 1995 (12.16‰), Chernihiv – 18.60‰, which is 0.3% higher than in 1995 (18.90‰).

The total fertility rate has also changed since 1995: in Vinnytsia Oblast, it has fallen to 1.205 (by 26.25%), in Chernihiv Oblast to 1.028 (by 25.0%), and in Lviv Oblast to 1.258 (by 22.7%). In all three oblasts, the highest fertility rate per 1,000 women of the respective age group has shifted from 20–24 to 25–29 years old, along with the decline.

The number of children has also decreased since independence. In Vinnytsia region, it has decreased by more than 100,000, in Lviv region – by 196,000, and in Chernihiv region – by 63,000. Around the world, and in Ukraine in particular, there is a growing number of informal relationships among young people, which in turn has an impact on the development of demographic processes. As a result, the number of children born out of wedlock and in single-parent families is constantly increasing. The number of registered marriages decreased by 26.8% in Vinnytsia region, 50.9% in Lviv region, and 37.0% in Chernihiv region compared to 1995 (Main Department of Statistics in Vinnytsia region, 2019; Yermishev et al., 2020).

Characteristics of households

A survey of households in the study areas and their living conditions was conducted (Table 5). Almost two-thirds of households are located in urban areas and consist mainly of two people, with the lowest number of households with four or more people. Only in Lviv region do over one third of households have four or more people in the family (35.1%). The overwhelming majority of families have only one child (Yeroshkina & Derevianko, 2019; Population of Ukraine 2019. Demographic Yearbook,

2019). The number of divorces has increased since 1995, resulting in 5,000 children being left to live in single-parent families every year. Most divorces in Ukraine generally occur in the period of 1–4 years of marriage (30.3–38.3%) and 5–9 years (24.2–27.2%). But in recent years, there has been a tendency to improve this figure.

Table 5

Characteristics of households in the surveyed regions

Region	Total households, thousands	The average number of people in a family, persons	Average number of people in the family, %				Number of children in the family, %		
			1	2	3	>4	1	2	>2
Vinnytsa	629.7	2.47	24.5	33.0	25.4	17.1	71.5	25.6	2.9
Lviv	821.5	3.02	19.4	24.4	21.1	35.1	73.9	21.7	4.4
Chernihiv	435.2	2.30	25.3	39.0	20.7	15.0	91.5	7.4	1.1

The number of abortions

Analysing the number of abortions among the female population of the surveyed oblasts, a significant decrease was found over 19 years, from 2000 to 2019 (Yeroshkina & Derevianko, 2019). For example, in Vinnytsia Oblast, the number of abortions per 100 pregnancies decreased by 2.8 times, in Lviv Oblast by 4.4 times, and in Chernihiv Oblast by 5.1 times, respectively (Table 6). In addition, the number of abortions among women of childbearing age decreased, and the abortion-to-childbirth ratio decreased.

Table 6

Number of abortions per 100 pregnancies in the studied regions

Region	Number of abortions per 100 pregnancies	
	2000 year	2019 year
Vinnitsia	96	34
Lviv	62	14
Chernihiv	135	26

An equally important demographic indicator of public health is mortality. The mortality rates of the population of the regions by age decreased in 5 age groups under 24, and since 2007 there has been a decrease in this indicator in the age group of 70 years and older, which can be attributed to modern methods of work of geriatric services. At the same time, there has been a significant increase in the mortality rate in the 9 age groups from 25 to 69. In terms of gender, 16 men in 1000 die in Vinnytsia and Chernihiv regions, and 17 in 1000 in Lviv region; 14 women in 1000 die in Vinnytsia region, 15.9 in 1000 in Lviv region and 8 in 1000 in Chernihiv region, respectively (Annual report on the state of health of the population, the sanitary and epidemiological situation and the results of the health care system of Ukraine, 2017).

The main causes of death

The main causes of death are 6 groups of diseases, with circulatory diseases leading the way (Table 7).

Table 7

The main causes of death in the surveyed regions (%)

Region	Major diseases leading to death, %					
	diseases of the circulatory system	neoplasms	external causes	diseases of the respiratory system	diseases of the digestive system	some infectious and parasitic diseases
Vinnytsia	66.02	14.71	7.02	5.01	5.01	1.16
Lviv	61.42	13.50	5.05	4.34	4.34	4.34
Chernihiv	73.65	10.96	5.16	3.17	2.38	1.09

In 2019, the first rank among the diseases that are the main causes of death was occupied by circulatory diseases, which tended to decrease slightly, followed by malignant neoplasms, the third rank by external causes, the fourth by respiratory diseases, the fifth by digestive diseases, and the sixth by some infectious and parasitic diseases, which tended to increase. Since 2008, there has been an increase in the number of infectious diseases in the regions, with AIDS and tuberculosis taking an important place among them. For example, in Vinnytsia region, there was an in-

crease in the number of deaths caused by AIDS by 29.1%, in Chernihiv region by 47.8%, and in Lviv region by 40.0%, and deaths caused by tuberculosis by 58.1%, 38.9% and 42.0%, respectively, of all deaths in this class (Protection of children in need of special attention of society: Statistical collection, 2018; Population of Ukraine 2019. Demographic Yearbook, 2019).

Since independence, there has been a downward trend in the mortality rate of children under the age of 1: in the Vinnytsia region – by almost 8 times, in Chernihiv region – by 3 times, in Lviv region – by almost 2 times. According to the data obtained, we can confidently say that this indicator has improved. This is due to improved medical monitoring of pregnant women, more efficient check-ups of newborns and an increase in the number and quality of perinatal centres. The main causes of infant mortality are diseases and pathological conditions. The first place is occupied by pathological conditions arising in the perinatal period, the second by congenital developmental defects, deformities and chromosomal abnormalities, the third by diseases of the nervous system, the fourth by respiratory diseases, and the fifth by accidents and other external causes of death (Protection of children in need of special attention of society: Statistical collection, 2016; Annual report on the state of health of the population, the sanitary and epidemiological situation and the results of the health care system of Ukraine, 2017).

Another important demographic indicator is life expectancy. This figure is increasing compared to 1995. This is due to the optimisation of the geriatric service and the improvement of preventive measures. However, this indicator still lags behind Western European countries (by 10 years or more). The difference between the life expectancy of men and women is almost 10.3 years (Population of Ukraine 2019. Demographic Yearbook, 2019). For example, in Vinnytsia and Lviv regions, life expectancy increased by 5 years from 71 to 76 years, and in Chernihiv region by 3.6 years from 67.1 to 70.7 years. Life expectancy in Europe is over 75.0 years (79.0 years for women and 70.5 for men).

The nutrition of the population has a direct bearing on the formation of demographic processes and determines the structure of morbidity and its changes. The burden of disease is assessed by the disability-adjusted life years (DALYs) indicator. DALYs include an estimate of the number of years of life lost due to various diseases before the age of 82.5 years for women and 80 years for men (Earth Summit Agenda 21, 1992) and the number of years lived in a state of disability (Nutrition policy in WHO European Member States, 1995).

Health conditions that do not result in death are assigned values (disability weights) based on the results of the examinations to estimate the number of years lost due to disability. The number of years lost as a result of disability (adjusted for severity) is then summed with the number of years lost as a result of premature mortality to produce a comprehensive health unit, the DALY. One DALY represents the loss of one year of healthy life.

In 2017 globally, 11 million deaths (22% of all adult deaths) and 255 million DALYs (15% of all adult DALYs) were attributable to dietary risk factors. Cardiovascular disease was the leading cause of diet-related deaths (10 million deaths and DALYs), followed by cancer (913,090 deaths and 20 million DALYs) and type 2 diabetes (338,714 deaths and 24 million DALYs). High sodium intake (3 million deaths and 70 million DALYs), low whole grain intake (3 million deaths and 82 million DALYs), and low fruit intake (2 million deaths and 65 million DALYs) were the leading dietary risk factors for death and DALYs in many countries. More than 5 million (95%) of diet-related deaths (45% of total diet-related deaths) and 177 million diet-related DALYs (70% of total diet-related DALYs) occurred among adults under 70 years of age (GBD 2017 Diet Collaborators, 2019). According to the same data, Ukraine is in a small group of countries with the highest rates of age-standardised mortality per 100,000 population – 397 and DALYs per 100,000 population – 8740, related to nutrition.

Table 8 shows the contribution of nutrition to the burden of disease in Europe (Health 21, 1999), which is directly related to nutrition. In 2000, 136 million years of healthy life were lost in Europe. The most important nutritional risk factors were responsible for the loss of more than 56 million, and other diet-related factors contributed to another 52 million years. The leading cause of death is cardiovascular disease (CVD), which causes

more than 4 million deaths a year in Europe. Nutrition factors explain many of the differences in these diseases across Europe. The World Health Report (Shaw et al., 1999) includes an assessment of the quantitative contribution of nutritional risk factors such as high blood pressure, cholesterol, overweight, obesity, and low consumption of vegetables and fruits. It should also be noted that in Ukraine, CVDs claim the lives of more than 400,000 people a year.

Table 8

Contribution of nutrition to the burden of disease in Europe

Disease group	%	Type of Disease	%
Diseases of the population that are directly related to nutrition	41	Malnutrition	2
		Diabetes mellitus	5
		Malignant neoplasms	32
		Cardiovascular diseases (CVD)	61
		Total	100
Diseases of the population that are partly related to nutrition	38	Maternal diseases	1.0
		Diseases of the oral cavity	1.1
		Disorders of the hormonal system are related to nutrition	2.6
		Congenital malformations	4.2
		Respiratory infections	6.8
		Diseases of the digestive system	9.5
		Infectious and parasitic diseases	10.5
		Respiratory diseases	13.2
		Neuropsychiatric disorders	51.1
		Total	100.0
Other disorders	21	Diseases of the sensory organs	0.1
		Eye diseases	0.1
		Diseases of the genitourinary system	5.0
		Perinatal diseases	8.0
		Diseases of the musculoskeletal system	19.0
		Intentional injuries	21.9
		Unintentional injuries	45.9
Total	100	–	100.0

Nutrition of the population

There are many common components to the contribution of nutrition to the development of CVD, cancer, type 2 diabetes and obesity. The development of these four diseases is also linked to a sedentary lifestyle.

By analysing the structure of the diet of the population of Ukraine from 1992 to 2019, we can identify a significant improvement (Table 9). Among the food groups whose increase in the population's diet contributes to better health are meat and meat products, eggs, fruits and berries, vegetables and gourds, and fish and fish products, but their quantity does not meet the minimum recommended WHO standards. The National Report "Sustainable Development Goals: Ukraine" provides a vision of the benchmarks for Ukraine's achievement of the SDGs, which were approved at the UN Sustainable Development Summit in September 2015 as part of the 70th session of the UN General Assembly in New York. According to this document, meat consumption per capita, kg/year, should be increased to 71 kg in 2025 and 80 kg in 2030; milk consumption – to 320 and 380, and fruit consumption – to 78 and 90 kg, respectively (www.kmu.gov.ua/storage/app/sites/1/natsionalna-dopovid-csr-Ukrainy.pdf). Against the backdrop of these changes, the World Food Organisation (FAO) has reported an increase in malnutrition in Ukraine from 2.8% of the population in 2017 to 4.8% in 2023, based on the results of a national study of the current dietary patterns of Ukrainians (www.fao.org/faostat/ru/#data).

In 2019, a national study of the current dietary patterns of Ukrainians was conducted. The study involved 1232 people aged 1 to 60 years. The sample is representative of the urban population of Ukraine by the following criteria: age, gender, type of settlement, and region. The research methodology was developed and agreed upon with the participation of local and global experts (nutritionists) in the field of nutrition. Expertise in the study was provided by the leading professional association in the field of nutrition – the Association of Nutritionists of Ukraine. The study was conducted by the international research company IPSOS at the initiative of Danone in Ukraine. According to the study, for the first time, an objective level of salt consumption was determined that significantly exceeds the recommended level starting from early childhood, which leads to a lifelong preference for salty foods. Adult men consume more

than double and women almost double the recommended 5 grams, leading to an increase in blood pressure and the risk of related heart attacks and strokes. There is also a low level of consumption of natural foods that have proven health benefits, such as vegetables, fruits and berries, legumes, nuts, fish and dairy products. As a result, this leads to deficiencies in

important vitamins and minerals. For example, preschool children receive 11% less than the recommended amount of calcium, and adolescents receive 21% less than the daily value of this mineral. Adults have low intakes of magnesium and vitamins A, C, and E. The lack of these important nutrients is damaging the health and quality of life of Ukrainians.

Table 9
Nutrition dynamics of the population of Ukraine

Years	Regions	Food groups, consumption per 1 person per year, kg (pcs, l)								
		meat and meat products	milk and dairy products	eggs	potatoes	fruits and berries	vegetables and melons cultures	oil	bread and bread products	fish and fish products
Rational norm (calculated by the Ministry of Health of Ukraine)		80	380	290	124	90	161	13	101	20
1992–1996	Ukraine	37.9	242.8	171.2	122.9	33.4	95.7	8.1	128.7	3.6
	Vinnitsia region	42.9	215.6	204.0	169.7	34.6	88.7	7.9	139.6	5.8
	Lviv region	27.6	274.6	156.8	139.5	43.2	54.1	6.9	120.7	8.0
	Chernihiv region	46.6	338.2	208.0	207.1	42.3	120.1	5.3	133.3	4.7
1997–2001	Ukraine	33.8	210.2	170.2	132.4	29.8	101	9.2	126.5	9.7
	Vinnitsia region	40.5	208.3	195.4	169.3	25.4	86.5	8.9	129.6	16.6
	Lviv region	40.5	270.2	171.8	143.4	35.5	79.9	8.5	126.2	17.8
	Chernihiv region	40.5	296.1	219.2	201.8	31.8	136.5	7.3	140.9	10.6
2002–2006	Ukraine	37.4	227.6	226.4	136.3	33.5	116.8	12.4	124.9	15.3
	Vinnitsia region	37.8	321.8	231	173.4	38.7	110.1	13.6	140.8	15.3
	Lviv region	37.3	266.8	203.6	157.3	34.1	110.8	11.6	121.9	15.3
	Chernihiv region	35.8	282.4	250.6	185.5	25.6	144.8	10.9	127.1	15.3
2007–2011	Ukraine	49.8	212.4	276.4	132.7	46.4	138.2	14.5	113.2	15.2
	Vinnitsia region	48.5	218.7	288.4	167.5	51.5	144.8	15.8	128.6	26.3
	Lviv region	44.3	224.1	254.2	162.9	43.1	130.3	14.9	111.4	31.3
	Chernihiv region	44.9	251.3	270.2	171.7	37.4	160.1	14.1	121.2	15.8
2012–2016	Ukraine	53.2	214.7	294.6	138.8	52.5	162.9	12.7	106.1	10.7
	Vinnitsia region	53.4	215.6	305.4	176.0	61.4	172.9	13.5	117.9	21.8
	Lviv region	48.1	236.1	279.2	173.9	48.0	150.8	13.5	104.3	23.2
	Chernihiv region	47.6	237.9	281.2	176.0	41.9	172.1	12.0	116.5	11.6
2017–2019	Ukraine	52.7	198.3	273.7	140.9	56.3	163.5	11.9	100.1	10.7
	Vinnitsia region	55.4	199.9	291.7	181.5	61.4	167.8	13.2	114.8	22.4
	Lviv region	50.6	208.1	271.2	181.5	54.3	161.9	12.5	94.0	22.3
	Chernihiv region	50.3	215.6	277.7	174.5	43.8	163.8	11.9	115.3	11.3

The consumption of the most unhealthy source of calories, free sugar, also increases with age. Children of all age groups consume too much sugar: on average, young children (1–3 years old) consume 47 grams of sugar per day; preschool children – 56 grams, schoolchildren and adolescents – 67 grams of free sugar per day. This is significantly higher than the maximum permissible amount of free sugar consumption for an adult of 50 grams per day according to the recommendations for a healthy diet for adults.

In addition to sugar, children of all ages and adults consume too many flour products, potatoes, and saturated fats, which contributes to weight gain and increases the risk of dangerous chronic diseases such as diabetes, atherosclerotic cardiovascular disease, and cancer. At the same time, Ukrainian children consume a small amount of dairy products – an average of 185 mL per day. The level of consumption of such products among adolescents was particularly low – only 155 mL daily. This is less than 1 portion per day compared to the generally recommended 2–3.

Analysing the regional peculiarities of consumption of various food groups (per person per year, kg (pcs, l)), it can be concluded that the nutritional status of the population of Vinnitsia Oblast is significantly better compared to other regions studied and Ukraine as a whole, except for milk and dairy products, bread and bread products, of which more are consumed in Chernihiv Oblast. Although the consumption of milk and dairy products is higher in Chernihiv region, in the dynamics of 27 years, its consumption has fallen from 338.2 litres per capita per year to 215.6, i.e. by 63.4%. According to Babych (2019), the regional food security assessment ranking at the regional level is 1 for Vinnitsia region, 21 and 10 for Lviv region and Chernihiv region, respectively.

Among the 9 food groups, only vegetables and gourds are provided in the required quantity to the population of all the regions under study, and fish and fish products to the population of Vinnitsia and Lviv regions. A significant shortage of meat and meat products, milk and dairy products, eggs, fruits and berries in the diets of the population with a simultaneous excessive intake of potatoes, bread and bread products is an impor-

tant limiting factor in the formation of the health of the population of the studied regions. It has been proven that the daily physiological requirement for proteins is 0.8–1.0 g per 1 kg of body weight (approximately 90–95 g), of which 55–60% should be animal proteins (meat, milk, eggs, fish), and 40–45% should be vegetable proteins (beans, nuts, soybeans, cereals). In the case of exhausting hard physical labour, and, importantly, in the face of adverse environmental factors (ionising radiation, soil endemism, etc.), the amount of protein in food should be increased to 2.5 g per 1.0 kg of body weight to prevent nitrogen losses. It should also be taken into account that in some respects, the rational consumption rate calculated by the Ministry of Health of Ukraine does not meet the WHO criteria, which require 60% higher consumption of fruit, 45% higher consumption of meat and 15% higher consumption of vegetables.

An important point of the research results was the identification of an increase in the dynamics of fish and fish product consumption in Ukraine as a whole and all the regions studied. However, the leaders are Vinnitsia and Lviv regions, where the consumption of this food group per person is almost two times higher than in Ukraine and Chernihiv region. According to a study by McBurney et al. (2021), the life expectancy of people who do not regularly eat oily seafood (salmon and mackerel) decreases by an average of 5 years (for comparison, the life expectancy of people who smoke decreases by an average of 4 years). Fish should be a regular part of a balanced diet, as it is a rich source of easily digestible proteins, B vitamins and valuable minerals such as iron, magnesium, potassium, calcium and iodine. Oily marine fish are especially useful, as they are a treasure trove of omega-3 polyunsaturated fatty acids. These acids stabilise cholesterol levels, strengthen the immune system, speed up metabolism, improve cardiovascular function, increase concentration, etc. A diet rich in omega-3 fatty acids is also a key to a longer life. Low levels of fatty acids in the diet should be recognised as one of the key risk factors for heart disease and premature death (McBurney et al., 2021).

To analyse the impact of population nutrition on the development of certain types of diseases, we conducted a correlation analysis of these in-

teractions. Since the data samples do not follow a normal distribution, we used the non-parametric Spearman correlation method. The obtained Spearman's rank correlation coefficient can be used to determine a non-parametric measure of statistical dependence between two variables (Table 10). The strength of the correlation ranges from 0 – no relationship; ± 0.10 to ± 0.49 – weak dependence; ± 0.50 to ± 0.69 – medium dependence; ± 0.70 to ± 0.99 – strong dependence; ± 1 – complete dependence. The table includes only indicators above 0.50.

Analysing the data obtained, it can be concluded that most food groups in the diets of the population have a direct impact on the development of many major types of diseases. Thus, the development of tumours is influenced by most food groups, with eggs, vegetables and gourds, meat and meat products, and oil being the leaders. At the same time, milk and bread have an average inverse correlation. Hypertension, diabetes mellitus, hyperthyroidism, and circulatory and pancreatic diseases are also highly dependent on the population's diets. At the same time, milk and dairy products, and bread and bread products have a medium to high inverse correlation to certain diseases. Some of the results of the analysis contradict modern scientific data on the impact of certain foods on health, but this can be

attributed to the specificity of the formation of national food groups. For example, the impact of red meat and industrially processed meat on the development of certain types of cancer, hypertension, and atherosclerosis has been proven, while eating white meat is a preventive measure. The same applies to milk, which stimulates the development of certain diseases, dairy products, which are preventive, and fish and fish products (industrially processed, unprocessed, river or sea). However, the purpose of the correlation analysis was to prove the close links between nutrition and public health.

To improve fertility rates and positively address family policy issues, it is necessary to form a set of personal and social values that focus on creating and maintaining families of more than two children, increasing and strengthening the educational potential as the main unit of population reproduction. The state should pay the greatest attention to young families and families with children. To reduce mortality, improve health, and increase life expectancy, it is necessary to develop measures to improve the quality of life, prevent diseases, reduce the impact of harmful and dangerous occupational factors on the body, improve the sanitary, epidemiological, and environmental situation, and stimulate positive changes in people's behaviour and lifestyle (Paliienko, 2017).

Table 10
Correlations between types of major diseases and food groups in the population's diet

Types of diseases of the population (Vinnytsia, Lviv and Chernihiv regions)	Food consumption groups per 1 person per year, kg (pcs, l)								
	meat and meat products	milk and dairy products	eggs	potatoes	fruits and berries	vegetables and melons cultures	oil	bread and bread products	fish and fish products
Neoplasms	0.75	–	0.88	–	0.63	0.88	0.66	–0.54	0.51
Diseases of the endocrine system, eating disorders, metabolic disorders	–	–	0.64	–	–	0.61	0.60	–	–
Diabetes mellitus	0.83	–0.72	0.88	–	0.66	0.80	0.69	–	–
Incidence of hyperthyroidism in the population	0.60	–	0.79	–	–	0.84	0.62	–0.67	–
Diseases of the circulatory system	0.62	–	0.83	–	–	0.79	0.73	–	0.54
Anaemia	–	–	–	–	–	–	–	–	–
Hypertensive disease	0.66	–0.59	0.83	–	0.56	0.74	0.79	–	0.65
Acute myocardial infarction	–	–	–	–	–	–	–	–0.51	–
Cerebrovascular diseases	–	–	0.58	–	–	0.63	–	–	–
Strokes	–	–	–	–	–	–	–	–	–
Diseases of the respiratory system	–	–	–	–	–	–	0.59	–	0.74
Bronchial asthma	–	–0.74	0.56	–	–	–	0.67	–	0.58
Diseases of the digestive system	–	–	0.67	–	–	0.70	0.59	–	–
Diseases of the pancreas	0.62	–0.61	0.74	–	–	0.67	0.63	–	–

Diseases of the circulatory system have taken the leading position among the causes of death from diseases for many years. This is why it is necessary to create cardiology and cardiac surgery facilities in regional and city centres and to provide highly qualified specialists to perform cardiac surgery such as stenting and bypass surgery in the required number to meet international standards. All of this will help reduce the number and mortality rate from strokes, myocardial infarctions and other vascular pathologies. In Vinnytsia, a new building of the regional cardiac centre is currently planned to be commissioned (Shushkovska et al., 2022). The regional hospital in Chernihiv is preparing for open-heart surgery by opening a department of interventional cardiology and reperfusion therapy. It will treat patients with myocardial infarction and acute coronary syndrome. The Lviv Regional State Clinical Diagnostic and Treatment Cardiology Centre, established in 1995, has been operating as a reperfusion centre for the past two years and has been providing round-the-clock interventions (coronary angiography, stenting) to patients with acute myocardial infarction. In recent years, the number of coronary angiographies and stenting procedures has been increasing.

There is an urgent need to expand the system to prevent the occurrence of circulatory diseases. Measures to combat mortality from these diseases should be different for people of different ages. In younger men, cardiovascular disease, which has a high mortality rate, is associated with alcohol abuse, smoking, inactivity and poor nutrition and is closely linked to lifestyle. In older people, these diseases are associated with natural age-related changes (World demographic trends, 2011; Markovych, 2013). It has already been proven that targeted preventive screening for specific diseases, taking into account age, gender, and risk factors, yields effective results in reducing these diseases. In 2016, European recommendations on

preventive measures for circulatory system diseases were issued to narrow the age range for screening (World Demographic Trends, 2011; Piepoli et al., 2016).

On 1 January 2016, the UN strategy that sets out the SDGs came into force. It contains 17 global goals and 169 targets that UN member states have agreed to achieve by 2030. All of the SDGs are directly related to health or have an impact on health policy: SDG 3 calls for "ensuring healthy lives and promoting the well-being of all at all ages"; SDG 3.4 calls for reducing premature deaths from non-communicable diseases (NCDs) by one third by 2030 (Poston & Bouvier, 2017).

Conclusion

The problems of demographic policy now require the development of a modern ideology of demographic development of the country, improvement of the quality of scientific developments in the field of demographic research and financial support. Today, this should be the main content of the demographic state strategy.

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