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The organization and structure of nutrition of the Ukrainian population as a health factor

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Abstract. The paper examines the relationship between the organization of nutrition according to the locations (at home and out-of-home) and formats (restaurants, canteens, buffets/cafeterias, etc.), nutrition structure (consumption of basic staples) and health and mortality of the population of Ukraine. The organization and structure of nutrition of the population of Ukraine is analyzed. It was determined that the organization of food outside the home has long-term consequences for morbidity and mortality of the population. The authors investigated morbidity and mortality from the most common diseases and found that the morbidity rate in Ukraine is high, and deaths from ischaemic heart disease, also called coronary heart disease (CHD), infectious and parasitic diseases, also mortality from cerebrovascular and circulatory system. The paper found and interpreted dependences between household expenses for food according to different organization, development and health of the population. The scholars established that household expenditures on eating at home and out-of-home do not have a significant impact on the morbidity of the population in Ukraine. The results of the activities of food establishments (their revenue) cause a slight increase in the obesity of the population. Food consumption and the spread of morbidity in Ukraine are also poorly linked. However, the study revealed that there are groups of food products whose consumption is associated with the loss of health of the population, and therefore an increase in mortality. It was determined that such products are sugar, bread and bakery products. The authors found that the development of food organization formats by increasing household expenditures contribute to a slight decrease in population mortality in Ukraine, and increasing household expenditures on food products prevent an increase in mortality from malignant neoplasms.

1. Introduction

The UN General Assembly adopted the 2030 Agenda for Sustainable Development (2015) that includes 17 Sustainable Development Goals (SDGs) and 169 targets. The sustainable development paradigm calls for improving living standards of the population by balancing the three dimensions of sustainable development: economic, social and environmental ones. The researchers clearly give a leading role to the social component, as the ultimate goal of sustainable development is to ensure safe human development, and the mechanisms of its achievement foresee the transformation of the human environment. At the social level, it is the nation that forms the potential for the social and economic development of the state. Nevertheless, David E. Bloom proves that this relationship is reciprocal, as “Countries with higher incomes tend to have healthier populations, traditionally seen as the result of the superior nutrition and the better access to safe water, sanitation, and health care that higher income brings” [Bloom, 2014, pp. 6].

Among others, the Global Sustainable Development Goals recognise ensuring healthy lives and promote well-being for all at all ages (Goal 3), as well as food security and nutrition (Goal 2). Objectives and statistics on the achievement of sustainable development goals are formed in the plane of each particular goal and all of them are declared in Resolution No. 71/313 (2017). Nonetheless, there is a need to take specific steps, while taking into account the complexity and links between them and regional features and to relate not only to the development of the global



goals with regard to agriculture and medicine, but also to the food business, which is complementary to them. This is what the national programmes do, in particular the Presidential Decree “On the Sustainable Development Goals of Ukraine until 2030” (2019) and the reference document of the Polish Ministry of Economic Development, Labour and Technology (2018).

2. Material and methods

We conducted a correlation and regression analysis to establish the relationship between the organization of nutrition and the health (morbidity) of the population. The input indicators include publicly available statistical data regarding consumer expenditure on food and non-alcoholic beverages (eating at home) and out-of-home consumption of food and drinks (expenditure on catering or eating out), consumption of basic staples by the population, the amount of revenue received by catering services, i.e. restaurants, cafes, canteens, and the like. The results include the indicators of the health-incidence of various diseases (prevalence of obesity, diseases and disorders of the musculoskeletal system and connective tissue, diseases of the respiratory system, digestive organs, mental and behavioural disorders, trauma and poisoning, cerebrovascular disease, ischaemic (coronary) heart disease, infectious and parasitic diseases).

The information base of the study was the statistical data of the Statistics Poland (formerly known in English as the Central Statistical Office, popularly called GUS) and the State Statistics Service of Ukraine on the number and structure of organization of nutrition and its revenues, household income and expenditure, consumption of basic staples and data of the WHO Regional Office for Europe on morbidity and mortality. Given that publicly available statistical information on different indicators in Ukraine is presented for different time periods, the study takes into account the data that is available since 2000. There are also peculiarities in the collection and presentation of statistical data regarding the incidence of diseases among population. In view of the above, we have further investigated the relationship between the aforementioned indicators and mortality from various diseases.

3. Theory

The experts of the World Health Organization estimated that 50% of a person's physical health status is determined by his/her lifestyle (primarily by the nature of diet, bad habits, and working conditions), 20% by environmental factors, another 20% by genetic predisposition and only 10% by the medical care. Given this observation, the Food and Agriculture Organization of the United Nations (2017) identifies the problem of poor-quality diets, which causes two major issues: either hunger due to lack of food (like in African countries), or overweight and obesity due to micronutrient deficiencies. Ashkan Afshin, Christopher J. L. Murray, Patrick Sur et al. [Afshin, Sur et al., 2019] found that every fifth death in the world occurs precisely because people do not eat healthy food. In addition to mortality, poor diet affects the DALYs (Disability-Adjusted Life Years), years of life lost due to premature mortality, disability or time lived in states of less than full health. 255 million years of healthy life are lost due to poor diet: this is 16% of DALYs among adults worldwide.

Furthermore, direct economic losses from diseases are also significant. According to the report of the World Economic Forum and Harvard University [Bloom, Cafiero, Jane-Llopis et al., 2011], mortality from major non-communicable diseases leads to a total loss in output, which is equivalent to about 5% of annual global GDP. In addition, due to the high morbidity of the employed population, especially due to non-adherence to a healthy lifestyle, the total loss of productivity in 2010-2015 amounted to 5.4% in China and 8% of GDP in the United States.

M. Marmot & R. Wilkinson [Marmot, Wilkinson, 2006], Morrison G. [Morrison, 2009], Raphael D [Raphael, 2009], and Shushpanov D [Shushpanov, 2016] position diet as a social and economic determinant of health, while emphasising the link between food (i.e. nutrition) and household income. However, we cannot consider this relationship a causal one. Gheribi E. [Gheribi, 2016] identifies a number of factors, including lifestyle changes, income growth, employment diversification, and reduced leisure time, that contribute to the breakaway from the traditional model of eating at home and give impetus to the development of new formats of food organization. E. Figeo & M. Oortwijn [Figeo, Oortwijn, 2004], as well as B.Kowrygo &

D.Stangierska [Kowrygo, Stangierska, 2012], identify five main channels of consumer coverage in the food sector: catering entities, restaurants, retail, vending and entertainment companies.

The overall objective of our research is to find the relationships between food organization or, in other words, diet (at home and out-of-home (business models)), food quality (consumption of basic staples) and health of the population using the case study of Ukraine.

4. Result and discussion

Household Eating Behaviours. Ukraine is a country with different levels of social and economic development, however with common historical and cultural traditions of particular territories. In recent years, there has been a shift in emphasis with regard to nutrition/diet in Ukraine. Increase in the quality of life and the growth of household incomes are driving the changes in eating habits: traditional home cooking and family consumption have increasingly been replaced by cooking and eating out, in food establishments. However, meals at home, and therefore the costs of its organization, remain quite significant in Ukraine.

In absolute terms, expenditures on food and non-alcoholic beverages increased 13 times, however, the percentage of the indicator decreased from 64% in total expenditures (82% in total household income) in 2000 to 46.6% in 2019 (37.2% in total income). Expenditures on eating out (indicator: expenditures on restaurants and hotels) increased from 5 Ukrainian hryvnias (UAH) to UAH 251 (from 1% of total household expenditures in 2000 to 2.6% in 2019) and relative to income it amounted to 1.2 % and 2.1% respectively (Fig. 1).

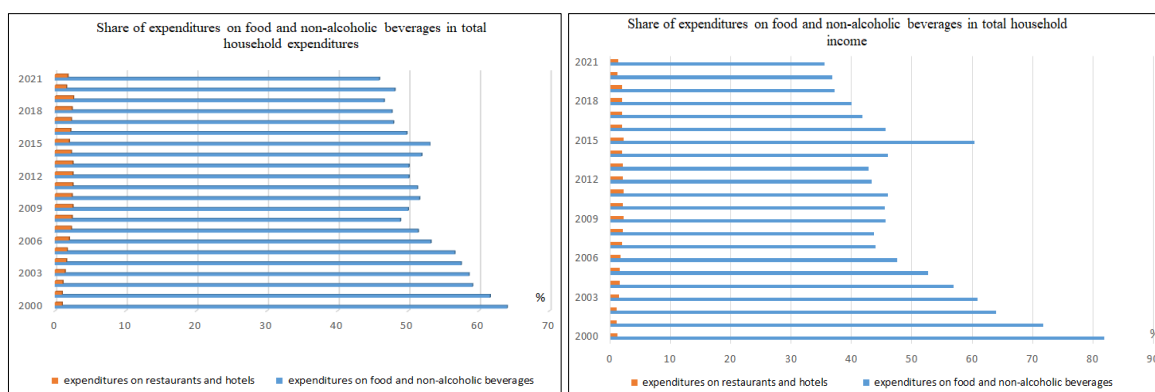


Fig. 1. Dynamics of Household Food Expenditure at Home and Away From Home in total Household Expenditures and Incomes (Ukraine).

Source: own elaboration based on the data of State Statistics Service of Ukraine

We should also underline that household consumption of food in Ukraine is high. In 2019, compared to 2000, the consumption of meat and meat products (+1.8 kg/month per person), milk and dairy products (+1.9 kg), fruit (+1.5 kg) increased significantly slightly, while for eggs (+2 pcs) and fish (+0.2 kg) the consumption slightly increased. Consumption of potatoes (-4.2 kg), bread and bakery products (-2.6 kg), sugar (-0.9 kg) and vegetables (-0.7 kg) decreased.

The main reasons for the identified disparities are of ethnic and economic nature. Ukrainians like to eat well, and with increasing incomes, the range of gastronomic preferences is also expanding. Besides, although no one has raised the issue of food waste in Ukraine at the state level yet, however it is surely present. On the other hand, for a significant part of the population of Ukraine the income level remains quite low, and therefore eating at home is the prevalent choice. Hence, the lack of effective demand does not stimulate the development of the catering industry.

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the lack of effective demand does not stimulate the development of the organization of nutrition outside the home.

Organization and structure of population nutrition. In Ukraine the organization of nutrition outside the home is underdeveloped, compared to other European countries. For instance, according to studies conducted by G. Anisimov, Y. Zhukov & D. Lipovoy [Anisimov, Zhukov, Lipovoy, 2018] in the countries of Western Europe the indicator of the availability of catering establishments is 32 objects, in the low-income countries the number is 16, and in Ukraine the number is 11. In Europe, there is one food establishment per 477 inhabitants and in Ukraine one per 845 people.

The major business models in the catering industry, for which one can find available statistical information, include restaurants, cafes and bars, canteens, snack bars and buffets in Ukraine. In the area of establishments, there has been an increase over the last period from 9 to 15 bars and restaurants per 100,000 people, correspondingly an increase from 6 to 17 gastronomic outlets and a decrease from 7 to 5 canteens. In Ukraine, cafes, snack bars, buffets, and canteens dominate in the structure of catering establishments, while restaurants are the least numerous ones. The share of restaurants increased from 6% to 8.9%, for canteens it increased from 43% to 50.4%, and the share of cafes, snack bars and buffets it decreased from 40% to 30%, the share of bars remained unchanged, namely 10%. In Ukraine the regional distribution of caterers generally corresponds to the level of their development in terms of GDP per capita. Most catering establishments are located in the capital (Kyiv), Dnipropetrovsk and Kyiv Oblasts (regions), Ternopil and Rivne Oblasts have the smallest number of caterers. In Ukraine, there is a trend of increasing household spending on meals outside the home and income from the activities of establishments.

Population health level (morbidity and mortality). The statistics of the WHO European Regional Office for show that the health of the population of Ukraine is deteriorating. In terms of the prevalence of diseases (per 100,000 population), respiratory diseases and cerebrovascular diseases prevail.

The most common causes of death (from disease) in Ukraine are diseases of the circulatory system, coronary heart disease, cerebrovascular diseases and malignant neoplasms. Mortality from diseases of the respiratory system, diabetes, endocrine, nutritional and metabolic diseases, malignant neoplasms, mental disorders and diseases of the nervous system and sensory organs is higher in European countries, unlike Ukraine.

Nevertheless, in Ukraine mortality from ischaemic (coronary) heart disease, infectious and parasitic diseases is 6 times higher, and death rate from cerebrovascular and circulatory diseases is 2 times higher than in European countries. There is an approximately the same mortality rate from blood diseases.

In order to identify the relationship between the organization, quality of food and the health of the population, we performed a correlation-regression analysis of the influence of models of food organization and consumption of food products by households on the morbidity and mortality of the population.

Input indicators characterizing food organization models are the sums of household expenses for meals at home (x_1), the sums of household expenses for meals outside the home (x_2) and the amount of revenue received by food establishments (x_3). The resulting indicators are the population incidence rates (per 100,000 people) of obesity (y_1), musculoskeletal and connective tissue diseases (y_2), respiratory diseases (y_3), digestive diseases (y_4), mental and behavioral disorders (y_5), injuries and poisoning (y_6), cerebrovascular diseases (y_7), coronary heart disease (y_8), infectious and parasitic diseases (y_9). The results of the analysis proved the presence of strong correlations between all input indicators and the prevalence of obesity (correlation coefficient $r > 0.86$) and mental and behavioral disorders ($r > 0.86$). There are also strong correlations between food expenditure at home and outside the home and the prevalence of infectious and parasitic diseases ($r > 0.86$). However, adequate regression relationships that explain 99% of the variation of the independent variable and are adequate according to Fisher's test and with statistically significant variables according to Student's test were found only between household expenditures on food outside the home and the amount of revenue of food establishments and the prevalence of obesity. Established causal relationships indicate that a 1%

increase in household spending on eating out can increase obesity by 0.07% and food establishments by 0.02%.

The correlation and regression analysis, which we conducted for Ukraine on the basis of data for seven years, showed insignificant causal links only between household expenditures on eating out and the revenues of catering establishments and the prevalence of obesity.

Correlation-regression analysis based on eleven years of data showed strong correlations between all inputs and the prevalence of obesity and household expenditure on food and non-alcoholic beverages and mental and behavioral disorders, injuries and poisonings, infectious and parasitic diseases. However, insignificant cause-and-effect relationships were found only between household spending on food outside the home and the amount of revenue of food organization establishments and the prevalence of obesity.

Thus, a 1% increase in household spending on food outside the home can lead to a 0.07% increase in the prevalence of obesity, and a 0.02% increase in the revenue of food establishments (Table 1).

Table 1. Results of correlation and regression analysis of the impact of **nutrition/diet organization** (at home (x_1), out-of-home (x_2)) and the performance results of catering establishments (x_3) upon the **morbidity** of the population (y_i) in Ukraine.

Morbidity of the population (per 100 thousand people) (y_i)	Ukraine			
	Correlation relationship Relationship strength	Factors (x_i)	Regression dependencies Statistically significant factors (x_i)	Elasticity coefficient
Prevalence of obesity (y_1)	>0.86	X_1, X_2, X_3	X_1 X_2	+0.07 +0.02
Regression model*	$y_1=19,78+0,023x_2+3,65E-08x_3$			
Muscle and connective tissue diseases	Statistically insignificant relationship and effect			
Diseases of respiratory system	Statistically insignificant relationship and effect			
Diseases of digestive system	>0.75<0.85	X_1	Statistically insignificant effect	
Mental and behavioural disorders	>0.75<0.85 ≥ 0.85	X_2, X_3 X_1	Statistically insignificant effect	
Injury and poisoning diseases	>0.75<0.85 ≥ 0.85	X_2 X_1	Statistically insignificant effect	
Cerebrovascular diseases	Statistically insignificant relationship and effect			
Ischaemic (coronary) heart disease	Statistically insignificant relationship and effect			
Infectious and parasitic diseases	>0.75<0.85 ≥ 0.85	X_2 X_1	Statistically insignificant effect	

Source: own elaboration based on the data of State Statistics Service of Ukraine

Legend:

X_1 - Household Expenditures on Eating at Home

X_2 - Household Expenditures on Eating Out

X_3 - Performance Results of Catering Establishments

* Regression dependencies are given in the final version after checking the adequacy of the model (Fisher's test) and regression coefficients (Student's test)

Food consumption by the population and the estimated morbidity cases in Ukraine are also poorly linked. The reasons may include the objective lack of a statistically significant relationship and unaccounted facts of disease when people do not consult a physician.

In this study, the resulting indicators of population morbidity are unchanged, and the input indicators are the average monthly consumption per person of meat and meat products (x_1), milk and dairy products (x_2), eggs (x_3), fish and fish products (x_4), sugar (x_5), oil and vegetable fats (x_6), vegetables and melons (x_7), fruits, berries, nuts and grapes (x_8), bread and bakery products (x_9), potatoes (x_{10}).

The analysis revealed significant ($r \geq 0.75$) and strong correlations ($r \geq 0.85$) between the consumption of fish and fish products by the population and the prevalence of obesity, digestive diseases, mental and behavioural disorders, injuries and poisonings; consumption of meat, fruit, berries, nuts, grapes and cerebrovascular diseases and ischaemic (coronary) heart disease; consumption of potatoes, bread and bakery products and the prevalence of obesity, digestive diseases, injuries and poisonings, mental and behavioural disorders. Adequate regression dependencies that explain 99% of the variation of the independent variable and are adequate according to Fisher's test and with statistically significant variables according to Student's test were found. We established a causal relationship between the prevalence of obesity and the consumption of fish and fish products, sugar and potatoes, as well as the consumption of fish and potatoes and the growth of mental and behavioural disorders. Hence, an increase in fish and potato consumption by 1% can lead to a decrease in the prevalence of obesity by 0.1 and 0.56%, respectively, while an increase in sugar consumption may lead to an increase in the prevalence of obesity by 0.38%. If the consumption of other foods remains the same, an increase in the consumption of fish and fish products by 1% can lead to an increase in mental and behavioural disorders by 0.76%, and an increase in the consumption of potatoes can lead to a corresponding increase by 1.8%. The presence of contradictory, from the point of view of nutrition, relationships (including causal ones) between the consumption of fish and fish products in Ukraine and the increase in morbidity may indicate the inadequate quality of these products, associated not only with the quality of raw materials, but also with the subsequent process of its processing, transportation and storage.

The impact of the same input indicators on population mortality rates is more noticeable. The resulting mortality rates include data from the WHO European Office on mortality from diseases of the respiratory system (y1), cervical cancer (y2), cerebrovascular diseases (y3), diabetes (y4), diseases of the circulatory system (y5), diseases of the digestive system (y6), diseases of the blood, hematopoietic organs and certain disorders of immunity (y7), endocrine, food and metabolic diseases (y8), external causes of injuries and poisoning (y9), infectious and parasitic diseases (y10), coronary heart disease (y11), malignant neoplasms (y12), mental disorders, diseases of the nervous system and sense organs (y13).

The form of food organization and the revenue of catering establishments are not only related to mortality from cervical cancer and diseases of the digestive organs.

Further development of food organization and increase in household expenditures on eating out (by 1%) can help reduce mortality from other diseases considered in the study, aside from the mortality from diseases of the circulatory system and infectious and parasitic diseases, within the range of mortality from 0.15% of malignant neoplasms up to 0.77% in case of mental disorders, diseases of the nervous system and sense organs.

Our research also revealed strong correlations (correlation coefficient $r \geq 0.85$) between the consumption of sugar, potatoes, bread and bakery products and mortality from the vast majority of the studied diseases, except for cervical cancer, digestive diseases and malignant neoplasms. Nevertheless, the strength of the impact of consumption of these products on mortality shows that other factors that are not taken into account in this study are more significant. In particular, we found that an increase in population consumption of potatoes by 1% can lead to an increase in mortality from blood diseases by 2.9%, from endocrine diseases by 1.41%, from infectious and parasitic diseases by 1.7%. The analysis also established the causal relationships between milk consumption and mortality from external injuries and poisonings, as well as from mental and behavioural disorders. Hence, according to the findings an increase in milk consumption by 1% can lead to an increase in mortality from external injuries and poisonings by 1.77% and to an increase in mortality from mental and behavioural disorders by 2.94% (Table 2).

Table 2. Results of correlation and regression analysis of the impact of consumption of **food staples** by households of Ukraine (x_i) upon the **mortality** of the population (y_i).

Mortality of the population (per 100 thousand people) (y_i)	Ukraine			
	Correlation relationship Relationship strength	Factors (x_i)	Regression dependencies Statistically significant factors (x_i)	Elasticity coefficient
Diseases of respiratory system (y_1)	≥ 0.85	X_5, X_9, X_{10}	Statistically insignificant effect	
Cancer of the cervix uteri (y_2)			Statistically insignificant relationship and effect	
Cerebrovascular diseases (y_3)	≥ 0.85	X_5, X_9, X_{10}	Statistically insignificant effect	
Diseases of diabetes (y_4)	≥ 0.85	X_5, X_9, X_{10}	Statistically insignificant effect	
Diseases of circulatory system (y_5)	≥ 0.85	X_5, X_9, X_{10}	Statistically insignificant effect	
Diseases of digestive system (y_6)			Statistically insignificant relationship and effect	
Diseases of the blood, blood forming organs and certain immunity disorders (y_7)	≥ 0.85	X_5, X_9, X_{10}	X_{10}	+2.9
Endocrine, nutritional and metabolic diseases (y_8)	≥ 0.85	X_5, X_9, X_{10}	X_{10}	+1.41
External causes of injury and poisoning diseases (y_9)	≥ 0.85	X_2, X_5, X_9, X_{10}	X_2	+1.77
Infectious and parasitic diseases (y_{10})	≥ 0.85	X_4, X_5, X_9, X_{10}	X_4 X_{10}	+0.67 +1.70
Ischaemic (coronary) heart disease (y_{11})	≥ 0.85	X_5, X_9, X_{10}	Statistically insignificant effect	
Diseases of malignant neoplasms (y_{12})			Statistically insignificant relationship and effect	
Diseases of mental disorders, diseases of nervous system and sense organs (y_{13})	≥ 0.85	X_2, X_5, X_9, X_{10}	X_2	+2.94

Source: own elaboration based on the data of State Statistics Service of Ukraine

Legend:

X_1 - household consumption of meat and meat products	X_6 - household consumption of vegetable oil and other vegetable fats
X_2 - household consumption of milk and dairy products	X_7 - household consumption of vegetables and melon crops
X_3 - household consumption of eggs	X_8 - household consumption of fruit, berries, nuts and grapes
X_4 - household consumption of fish and fish products	X_9 - household consumption of bread and bakery products
X_5 - household consumption of sugar	X_{10} - household consumption of potatoes

5. Conclusions

The satisfaction of a person's primary physiological need for food occurs through the use of both different organization and structure of nutrition in Ukraine and is reflected in his health.

Based on the analysis of the organization and structure of nutrition of Ukrainian households, a characteristic trend has been established: reduction of food costs and modifications of its organization, growth of eating outside the home.

The paper analysed analyzes the organization and structure of catering establishments in Ukraine over a long period. The research found that in Ukraine there are structural changes in the formats of the organization of food, as well as the lagging of Ukraine from European countries in terms of the level of provision of food establishments for the population.

The study assessed correlation and causal relationships between morbidity, mortality and the structure of the population in Ukraine.

A 1% increase in fish and potato consumption can lead to a 0.1% and 0.56% decrease in obesity prevalence, respectively, and a 0.38% increase in sugar intake can lead to a 0.38% increase in obesity prevalence. If the consumption of other food products remains unchanged, a 1% increase in the consumption of fish and fish products can lead to an increase in mental and behavioral disorders by 0.76%, and potatoes - by 1.8%. The existence of contradictory, from the point of view of dietetics, connections between the consumption of fish and fish products in Ukraine and the increase in morbidity may indicate the inadequate quality of these products, related not only to the quality of raw materials, but also to the subsequent process of its processing, transportation and storage.

It has been proven that an increase in potato consumption by the population by 1% can lead to an increase in mortality from blood diseases by 2.9%, endocrine diseases by 1.41%, and infectious and parasitic diseases by 1.7%. There are also causal relationships between milk consumption and mortality from external injuries and poisonings and mental and behavioral disorders, according to which a 1% increase in milk consumption can lead to a 1.77% increase in mortality, respectively (from external injuries and poisonings) and by 2.94% - from mental and behavioral disorders.

Therefore, the results of the study confirm the influence of the organization and structure of the nutrition of the population of Ukraine on their health.

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