

# Non-communicable diseases and their risk factors in Ukraine: analysis of the global burden of disease 2019 study

Nataliia M. Orlova<sup>1</sup>, Gavrilo I. Kovtun<sup>2</sup>, Svitlana E. Holovchanska-Pushkar<sup>1</sup>, Valentyna L. Pylypchuk<sup>1</sup>, Inna V. Palamar<sup>1</sup>, Olena V. Tkachenko<sup>1</sup>, Oksana V. Zadorozhniuk<sup>1</sup>

<sup>1</sup>NATIONAL PIROGOV MEMORIAL MEDICAL UNIVERSITY, VINNYTSIA, UKRAINE

<sup>2</sup>BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

## ABSTRACT

**Aim:** To analyse the burden and risk factors of Non-Communicable diseases (NCDs) in Ukraine to determine the ways to prevent them.

**Materials and Methods:** Using a statistical method, NCDs DALYs (Disability-Adjusted Life Years) in Ukraine were analyzed in dynamics for 1990-2019 and in comparison, with European and EU countries based on the data from "Global Burden of Disease, 2019" research.

**Results:** The burden of NCDs in Ukraine is 1.5 time higher than in European and EU countries. The most negative dynamic trends and significant differences between indicators in Ukraine and EU countries (with an excess of 2 or more times) were identified for DALYs due to cardiovascular diseases, digestive diseases and substance use disorders. In Ukraine the burden of NCDs can be reduced on 25.9% by normalization of systolic blood pressure, on 21.2% by optimizing diet, on 18.5% by quitting smoking, on 17.6% by lowering LDL cholesterol, on 16.5% by normalizing body weight and on 9.2% by quitting alcohol abuse.

**Conclusions:** Ukraine should develop and implement a modern system for monitoring and assessing the NCDs burden and their risk factors; strengthen the capacity of public health institutions and their ability to attract communities to implement interventions to control NCDs modified risk factors, increase awareness and the population's responsible attitude towards their health; strengthen the ability and motivate primary health care to provide quality primary prevention, screening and timely diagnosis and treatment of chronic NCDs.

**KEY WORDS:** Non-Communicable diseases, DALYs, risk factors, prevention, health care management

Wiad Lek. 2024;77(4):682-689. doi: 10.36740/WLek202404111 

## INTRODUCTION

Non-Communicable diseases (NCDs) are one of the most urgent global public health problems. According to the World Health Organization data, NCDs kills 41 million people in the world every year, including 17 million (41.5%) people under the age of 70. NCDs is the cause of 74% of all deaths in the world [1,2].

NCDs is not only a medical, but also a socio-economic problem. The program of global actions until 2030 in the field of sustainable development, adopted by the UN, sets one of the goals of reducing premature mortality from non-communicable diseases by a third [3].

This goal can be achieved through the effective implementation of population strategies for leading risk factors modifying and timely detection and effective treatment of NCDs. And if in the countries of the European Union (EU), thanks to the successful provision of programs for primary, secondary and tertiary prevention, have achieved a significant reduction in age-standardized mortality due to NCDs, then Ukraine, like other countries of Eastern Europe, remains one of

the European and world leaders in NCDs premature mortality [2,4,5].

To develop an effective policy in the field of public health, including the strategy for the prevention of NCDs in Ukraine, it is necessary to rely on scientifically based comprehensive data on the impact of NCDs and their risk factors on the health of the population [6,7,8]. A modern approach that allows for such an assessment is a comprehensive analysis of the burden of disease, which is measured by the indicator of years of healthy life lost due to premature mortality and disability. In the context of the transformation of the public health system in Ukraine, which was initiated in Ukraine, using the DALYs indicator due to NCDs instead of simply measuring the number of deaths and diseases, as well as quantifying the factors that lead to the loss of years of healthy life, will allow to obtain a more accurate epidemiological picture of NCDs, and due to a reasonable assessment, form an evidence base for strategy of NCDs prevention [6, 9,10].

The use of data from the international study Global Burden of Disease (GBD) to analyze the burden of NCDs

in Ukraine is especially relevant in the absence of a national information base for a comprehensive analysis of the epidemiology of NCDs and their risk factors [6].

## AIM

To analyse the burden and risk factors of Non-Communicable diseases (NCDs) according to the DALYs indicator in Ukraine in dynamics for 1990-2019 and in comparison with Europe and the European Union in order to determine the ways of prevention.

## MATERIALS AND METHODS

The assessment of the burden of NCDs in Ukraine was based on the analysis of statistical information obtained from the database of the international epidemiological study Global Burden of Diseases (GBD), coordinated by the Institute for Health Metrics and Evaluation, University of Washington, USA [10].

The burden of NCDs was estimated in DALYs (Disability-Adjusted Life Years). One DALY is one year of healthy life lost. DALYs are calculated by adding Years of Life Lost (YLLs) and Years Lived with Disability (YLDs).

The statistical analysis used data on the absolute number of DALYs, YLLs and YLDs due to NCDs; crude rates of NCDs DALYs per 100,000 population, age-standardized rates of NCDs DALYs (the direct method of standardization according to the world standard of age composition of the population was used). The analysis was carried out over the period 1990-2019; the growth rate indicator (% change) was used to assess the intensity of dynamic changes. The comparative analysis was carried out using a comparison index, for the calculation of which the age-standardized rates of NCDs DALYs in Europe and EU countries were taken as 1.0. The analysis was performed for all NCDs, as well as according to the level 2 and level 3 causes of DALYs presented in the GBD database.

The analysis of environmental, behavioral and metabolic risk factors for the NCDs burden in Ukraine was carried out based on an assessment of their contribution (in %) to the formation of NCDs DALYs, as well as by comparing the NCDs DALYs rates caused by the influence of a specific factor in 1990 and 2019.

## RESULTS

In 2019, the population of Ukraine lost 17,610,060.4 years of healthy life, or 39,984.3 per 100,000 population, due to disability and premature mortality caused by NCDs. Throughout the observation period, NCDs were consistent leaders in the structure of DALYs: their

specific weight among all causes of DALYs was 78.2% in 1990 and 81.6% in 2019.

Among all years of life lost due to NCDs disability and mortality, 47.2% were caused by cardiovascular diseases, 15.3% - neoplasms, 6.7% - digestive diseases, 5.6% - musculoskeletal diseases, 4.6% - mental disorders, 4.4% - neurological diseases (Fig. 1).

73.2% of years of healthy life of the population were lost due to NCDs premature mortality, and 26.8% - due to NCDs disability. Predominance of years lost due to premature mortality over years lived in a state of disability is characteristic of such groups of NCDs as: cardiovascular diseases (95.9%), neoplasms (97.2%), digestive diseases (87.2%), chronic respiratory diseases, substances use disorders (63.5%). The predominance of years lived in a state of disability over years lost due to premature mortality occurred for: neurological diseases (60.6%), diabetes and kidney diseases (63.5%). Almost 100% of DALYs are caused by years lost due to disability in the case of mental disorders, sense organs diseases, skin and subcutaneous diseases, and musculoskeletal diseases.

The analysis of the dynamics of the age-standardized NCDs DALYs, carried out for 1990-2019, revealed its wave-like fluctuation at a sufficiently high level in Ukraine with the maximum values of the indicator in 1995 and 2007. The dynamics of NCDs DALYs in Ukraine is fundamentally different from Europe and the European Union, where throughout the entire period there was a stable and pronounced trend towards a decrease in the burden of NCDs. (Fig. 2). As a result, over 30 years it decreased by 20.9% in European countries, and by 23.6% in EU countries, while in Ukraine in 2019 the NCDs DALYs was 3.4% higher than in 1990. Dynamic changes led to a growing gap in the levels of DALYs in Ukraine and Europe, if in 1990, the indicators in Ukraine were close to the European ones, then in 2019, the Ukrainian NCDs DALYs exceeded the similar indicator in Europe by 1.4 times, and in EU countries – 1.6 times.

The problem of high loss of years of healthy life due to premature mortality and disability caused by NCDs in Ukraine primarily concerns the male population. Over 30 years of observation, the gap in NCDs DALYs in men and women increased from 1.4 to 1.6 times.

A comparative analysis of the causes of DALYs in Ukraine and Europe revealed that the first 2 ranking positions in all territories are consistently occupied by cardiovascular (CVD) and neoplasms, while the ranking of other NCDs groups in Ukraine differs from the European one. (Table 1).

The levels of age-standardized DALYs rates per 100,000 population for groups of NCDs and their dynamic trends in Ukraine also differed from European ones.

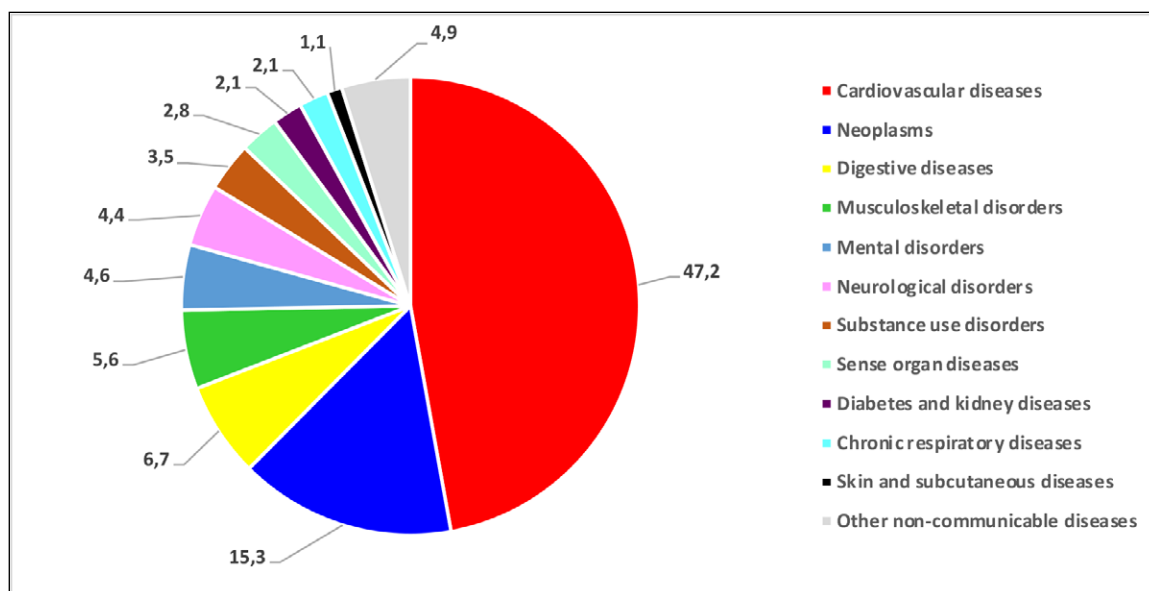


Fig. 1. Composition of DALYs due to NCDs in Ukraine, 2019 (%).

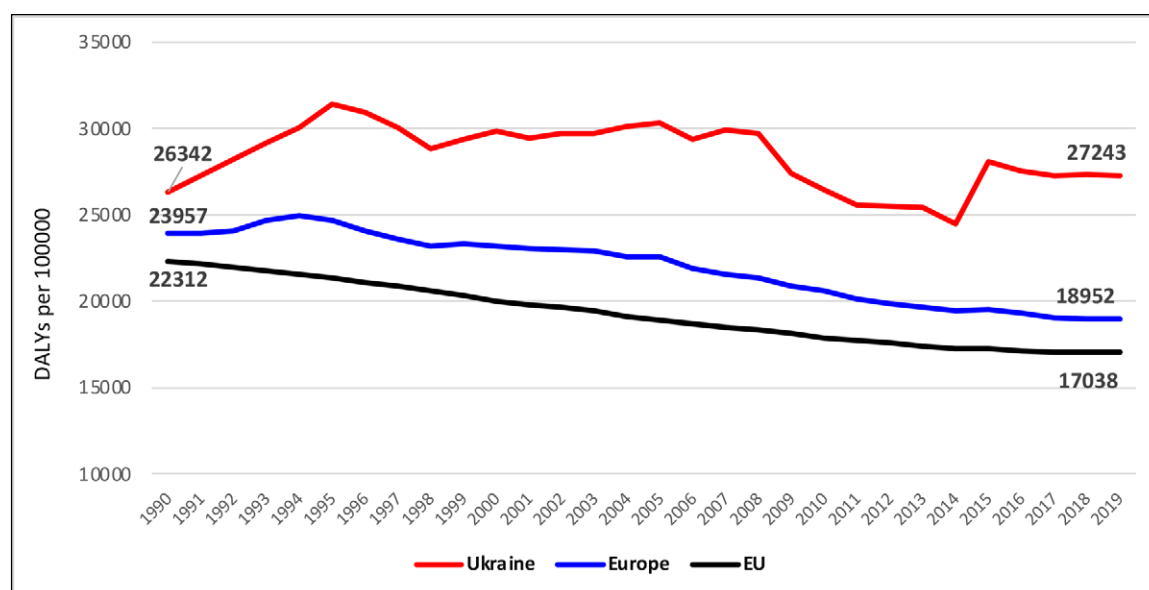


Fig. 2. Dynamics of age-standardized NCDs DALYs rates in Ukraine, Europe and the EU in 1990-2019 (per 100,000 population).

The most significant differences, which almost fully explain the gap in the burden of NCDs in Ukraine and Europe, are determined for CVD. In 2019 the population of Ukraine lost 2.6 times more years of healthy life due to CVD than residents of Europe and 4.1 times more than in EU countries (Table 1). Compared to 1990, the gap increased due to multidirectional trends in the levels of CVD DALYs: in Ukraine, the indicator increased by 16.0%, while in European countries it decreased by 39.5%, and in the EU - by 53.9%. Ukrainians, like Europeans in general, lose the greatest number of years of healthy life due to ischemic heart disease (IHD), strokes and cardiomyopathies. In Ukraine, IHD accounts for 25.9% of DALYs from all causes, strokes - 8.6%, cardiomyopathia and myocarditis - 2.3%, respectively. IHD takes Ukrainians 3.3 times

more years of healthy life than the average in Europe and 5.8 times more than in the EU. Losses due to strokes are 2.1 and 3.3 times higher, due to cardiomyopathies and myocarditis 2.7 and 6.6 times, respectively.

Compared to CVD, the situation with neoplasms DALYs in Ukraine was closer to the European one: the level of DALYs from this cause decreased by 17.0% over 30 years (in Europe by 21.9%, in the EU by 22.4%) and exceeded similar European indicators only in 1.2 times. The main losses of years of healthy life are due such Neoplasms as cancer of the trachea, bronchi, and lungs (2.1% of DALYs from all causes), colorectal cancer (1.6%), stomach cancer (1.2%), and breast cancer (1.1%).

The burden of chronic respiratory diseases in Ukraine at the beginning of the observation period

**Table 1.** Comparative characteristics of the NCDs DALYs\* in Ukraine, Europe, and EU in 1990, 2019

Years	Ukraine		Europe		EU		Comparison index Ukraine/ Europe	Comparison index Ukraine/ EU
	DALYs per 100 000	Rank	DALYs per 100 000	Rank	DALYs per 100 000	Rank		
All non-communicable diseases (DALYs per 100 000)								
1990	26341.5		23957.1		22312.4		1.1	1.2
2019	27243.2		18951.6		17038.3		1.4	1.6
% change	+3.4		-20.9		-23.6			
Cardiovascular diseases (DALYs per 100 000)								
1990	9753.9	1	7275.7	1	5983.2	1	1.3	1.6
2019	11316.7	1	4401.1	1	2758.8	1	2.6	4.1
% change	+16.0		-39.5		-53.9			
Neoplasms								
1990	4881.2	2	4368.0	2	4304.7	2	1.1	1.1
2019	4049.7	2	3411.9	2	3342.4	2	1.2	1.2
% change	-17.0		-21.9		-22.4			
Chronic respiratory diseases								
1990	1347.4	8	1086.6	6	1047.1	7	1.2	1.3
2019	575.4	9	729.6	8	754.5	8	0.8	0.8
% change	-57.3		-32.9		-27.9			
Digestive diseases								
1990	1005.7	8	1054.1	7	1077.9	6	1.0	0.9
2019	2007.2	3	977.3	6	764.8	7	2.1	2.6
% change	+99.6		-7.3		-29.0			
Neurological disorders								
1990	1272.4	6	1383.0	5	1397.4	5	0.9	0.9
2019	1324.3	6	1372.6	5	1407.5	5	1.0	0.9
% change	+4.1		-0.7		+0.7			
Mental disorders								
1990	1643.7	3	1746.7	4	1865.9	4	0.9	0.9
2019	1575.6	5	1750.2	4	1873.5	4	0.9	0.8
% change	-4.1		+0.2		+0.4			
Substance use disorders								
1990	1013.2	7	715.9	9	537.8	10	1.4	1.9
2019	1171.3	7	718.9	9	602.8	10	1.6	1.9
% change	15.6		0.4		12.1			
Diabetes and kidney diseases								
1990	435.0	11	770.8	8	751.4	8	0.6	0.6
2019	572.6	10	829.1	7	796.8	6	0.7	0.7
% change	+31.6		+7.6		+6.0			
Skin and subcutaneous diseases								
1990	435.1	10	602.4	10	673.9	9	0.7	0.6
2019	444.8	11	614.8	10	683.9	9	0.7	0.7
% change	+2.2		+2.1		+1.5			
Sense organ diseases								
1990	747.0	9	595.8	11	515.3	11	1.3	1.4
2019	720.1	8	554.7	11	483.5	11	1.3	1.5
% change	-3.6		-6.9		-6.2			
Musculoskeletal disorders								
1990	1543.1	4	1876.8	3	2012.5	3	0.8	0.8
2019	1593.4	4	1895.9	3	2019.8	3	0.8	0.8
% change	+3.3		+1.0		+0.4			
Other non-communicable diseases								
1990	2263.9		2481.2		2145.4		0.9	1.1
2019	1892.1		1695.4		1550.1		1.1	1.2
% change	-16.4		-31.7		-27.7			

\*2-nd level cause of DALYs in GBD study.

exceeded the similar indicator in Europe by 1.2 times, and in EU countries by 1.3 times. Due to the higher rates of reduction of DALYs in Ukraine (by 57.3%, against 32.9% in Europe and 27.9% in the EU), the burden of these diseases in 2019 was 80.0% of European. The main losses of years of healthy life are due to such respiratory diseases as chronic obstructive pulmonary diseases.

The most unfavorable dynamic trend is established for the burden of digestive diseases, which increased in Ukraine by 2 times over 30 years and in 2019 exceeded similar indicators in Europe by 2.1 times, in the EU by 2.6 times. This trend in Ukraine is caused by liver cirrhosis and other liver diseases.

Substance use disorders are another group of NCDs, the burden of which in Ukraine significantly exceeds the European one and has a negative trend over time. For this cause DALYs in Ukraine increased by 16.3% over 30 years and in 2019 exceeded the average in Europe by 1.6 times and in the EU countries by 1.9 times. Alcohol use disorders caused the most DALYs in this group.

The comparative analysis revealed that due to sense organs diseases Ukrainians lose 1.3 times more years of healthy life than Europeans and 1.5 times more than residents of EU countries. Age-related hearing loss and blindness are the main cause of DALYs among all sense organs diseases in Ukraine.

According to the materials presented in Table 1, the loss of years of healthy life due to the remaining groups of NCDs does not exceed the average indicators in Europe and EU countries and has dynamic trends close to European ones.

During further analysis of the NCDs burden in Ukraine, we identified the leading diseases and pathological conditions from level 3 causes in the GBD database, which together account for half (52.5%) of DALYs from all causes (Table 2). These include (in ranking order): IHD, strokes, liver cirrhosis, lower back pain, cardiomyopathy, cancer of the trachea, bronchi, and lungs, alcohol use disorders, depressive disorders, colorectal cancer, headaches.

Over 30 years, age-standardized DALYs due liver cirrhosis increased (2.4 times), IHD (by 32.0%), cardiomyopathies (by 53.3%), alcohol use disorders (by 4.3%). Age-standardized DALYs decreased due to bronchial cancer, lung trachea (by 42.6%), strokes (by 20.0%), and colorectal cancer (by 11.7%). All (apart from lung cancer) crude indicators of DALYs had an upward trend, most pronounced for those diseases whose increase was revealed by the analysis of standardized indicators.

At the next stage of the research the role of behavioral, metabolic, and environmental risk factors on the formation of the burden of NCDs in Ukraine was estimated and it was determined how many years of

healthy life can be saved if the effects of these factors are eliminated.

It was found that normalization of systolic blood pressure can reduce NCDs DALYs by a quarter (25.9%), optimizing diet - by 21.2%, smoking cessation - by 18.5%, lowering LDL cholesterol - by 17.6%, normalizing body weight - by 16.5%, refusal to drink alcohol - by 9.2%, normalization of glucose level in plasma - by 8.4%, elimination of air pollution - by 5.6%, kidney dysfunction - by 4.9%, optimization of the temperature regime - by 3.7% (Table 3).

The dynamic analysis of the risk factors contribution to the formation of NCDs DALYs revealed that alcohol abuse caused an increase in DALYs by 1143.5 years (per 100,000 population) in 2019 compare to 1990, high body-mass index - by 910.7 years, high systolic blood pressure - by 649.6, high LDL cholesterol - by 646.7, irrational diet - by 558.6, respectively. Negative dynamic changes in NCDs DALYs were also caused by such risk factors as high glucose level, substance use, and kidney function. Reduced exposure to air pollution, occupational hazards and smoking led to lower NCDs DALYs in 2019 compared to 1990 (Table 3).

## DISCUSSION

The study found that the NCDs burden in Ukraine is 1.5 times higher than in European and EU countries. Its dynamics is characterized by a wave-like fluctuation at a sufficiently high level, in contrast to a stable and pronounced decline in Europe. The most significant differences between indicators in Ukraine and EU countries (with an excess of 2 or more times) are discovered for DALYs due to CVD, digestive diseases, substance use disorders. High body-mass index and alcohol abuse were the risk factors that most determined the increase in NCDs DALYs over 30 years in Ukraine.

The revealed trends are consistent with the results of other studies, which showed an increase in the burden of NCDs in the countries of Eastern Europe since 1991 (with a peak in 2005) against the background of its decrease in the countries of Western Europe [4, 12]. The reason for such dynamics in the east of Europe is socio-economic transformations in the countries of the former socialist camp and the Soviet Union. Socio-psychological stress experienced by the population as a result of the protracted socio-economic crisis and the extremely high prevalence of behavioral risk factors, a significant part of which (tobacco smoking, abuse of alcohol and other psychoactive substances, poor nutrition), correlating with socio-economic situation of the population, as well as the lack of access to quality health care for patients with NCDs, have been identified

**Table 2.** 10 main causes of DALYs due to Non-Communicable diseases in Ukraine, 1990, 2019

Cause of DALYs (3-rd level in GBD)	% of total DALYs	Age-standardize DALYs rate per 100 000			Crude DALYs rate per 100 000		
		1990	2019	% change	1990	2,019.00	% change
Ischemic heart disease	25.9	5604.9	7400.2	32.0	7305.7	12674.5	73.5
Stroke	8.62	3165.4	2533.5	-20.0	4183.2	4217.9	0.8
Cirrhosis liver	3.52	382.1	1305.3	241.6	479.4	1724.8	259.8
Low back pain	2.99	1096.9	1086.1	-1.0	1291.0	1463.3	13.3
Cardiomyopathy	2.32	563.8	864.5	53.3	665.2	1137.7	71.0
Lung cancer	2.09	1099.2	631.2	-42.6	1494.1	1025.8	-31.3
Alcohol use disorders	2.04	764.8	797.7	4.3	851.7	999.4	17.3
Depressive disorders	1.79	756.6	683.4	-9.7	871.5	876.4	0.6
Colon and rectum cancer	1.69	549.4	485.3	-11.7	735.7	795.8	8.2
Headache disorders	1.5	641.1	641.0	0.0	695.4	737.0	6.0

**Table 3.** The contribution of individual risk factors in the formation of NCDs DALYs in Ukraine, 1990, 2019

Risk factors	1990			2019			DALYs <sub>2019</sub> - DALYs <sub>1990</sub> (per 100 000)
	DALYs per 100 000	%*	Rank	DALYs per 100 000	%	Rank	
High systolic blood pressure	5533.0	22.8	1.0	6182.6	25.9	1.0	649.6
Dietary risks	4522.3	18.5	3.0	5080.9	21.2	2.0	558.6
Tobacco use	4748.0	20.0	2.0	4575.7	18.5	3.0	-172.3
High LDL cholesterol	3575.8	14.6	4.0	4222.5	17.6	4.0	646.7
High body-mass index	3136.4	13.1	5.0	4047.0	16.5	5.0	910.7
Alcohol use	1679.4	6.1	8.0	2822.9	9.2	6.0	1143.5
High fasting plasma glucose	1520.1	6.2	7.0	1983.1	8.4	7.0	463.1
Air pollution	2061.2	8.6	6.0	1365.7	5.6	8.0	-695.5
Kidney dysfunction	875.8	3.6	10.0	1173.7	4.9	9.0	297.9
Non-optimal temperature	972.8	4.0	9.0	866.7	3.7	10.0	-106.1
Drug use	315.7	1.1	12.0	632.4	1.8	11.0	316.7
Occupational risks	481.2	1.9	11.0	343.1	1.2	12.0	-138.1

\*The DALYs due to Non-communicable in Ukraine, which is caused by the influence of each individual risk factor, includes the individual contribution of each risk factor, as well as its interaction with other risk factors.

as the main reasons for the significant gap that currently exists in the NCDs burden in Western and Eastern Europe [4, 12, 13].

The greatest territorial variability in the burden of disease in the European region was found, as in our study, for CVD, digestive, respiratory diseases, substance use disorders and diabetes [4].

The analysis of the experience of the countries of Western Europe proves that the success of these countries in reducing the NCDs burden is due, first of all, to a reduction in premature mortality caused by CVD, which by 50% is the result of improving control over modified risk factors through a successful combination of population and individual (for high-risk groups) approaches and by 40% - improvement of timely diagnosis and treatment of CVD [14].

It has been proven that the most effective preventive strategies are those that lead to lifestyle changes regarding diet, physical activity, quitting smoking, alcohol and controlling metabolic disorders [7, 15].

Particularly encouraging is the success of the North Karelia Project in Finland, which aimed to control the main modifiable risk factors for cardiovascular disease (hypertension, smoking and hypercholesterolemia) through a population-based lifestyle intervention strategy and which achieved a reduction in mortality from cardiovascular diseases by 82% in Finland [16].

To date, the economic effectiveness of interventions in the field of prevention of NCDs has been proven. It has been shown that for every US\$1 spent on scaling up control of NCDs in low- and lower-middle-income countries, society will receive a benefit of at least US\$7



due to growth in employment, productivity, and life expectancy. Implementation of effective measures to prevent NCDs in low-income and lower-middle-income countries requires an additional cost of only US \$1.27. USA per person per year [17].

The Ukrainian strategy aimed to reduce the NCDs burden should be based on a modern system for monitoring and assessing the NCDs burden and their risk factors; be comprehensive, interdisciplinary, rationally combine population and individual approaches to primary prevention with modern methods of secondary and tertiary prevention of NCDs and consider the experience of European countries, which have achieved significant success in this field over the past 30 years [5,6].

## CONCLUSIONS

In 2019, NCDs took 17,610,060.4 years of healthy life from the population of Ukraine (39,984.3 per 100,000 population), which accounted for 81.6% of all years lost due to disability and premature mortality. The main classes of diseases that formed the structure of the NCDs burden in Ukraine are cardiovascular diseases (47.2%), neoplasms (15.3%), digestive diseases (6.7%), musculoskeletal diseases (5.6%), mental disorders (4.6%), neurological diseases (4.4%).

During the entire observation period (1990–2019), the Ukrainian age-standardized NCDs DALYs exceeded the similar indicators in Europe and EU countries. Due to the

significant decrease over 30 years of the NCDs burden in Europe, against the background of its high value in Ukraine, in 2019 this excess reached 1.4 and 1.6 times. The most negative dynamic changes and a significant excess of Ukraine's indicators compared to European ones were founded for DALYs caused by CVD, digestive diseases and substance use disorders.

The study shows that it is possible to reduce NCDs DALYs in Ukraine by normalizing systolic blood pressure (by 25.9%), optimizing diet (by 21.2%), quitting smoking (by 18.5%), lowering LDL cholesterol (by 17.6%), normalizing body weight (by 16.5%), quitting alcohol use (by 9.2%), normalization of the level of glucose in the plasma (by 8.4%).

Taking into account global experience and the experience of European countries, which have already achieved significant success in controlling NCDs, Ukraine should develop and implement a modern system for monitoring and assessing the NCDs burden and their risk factors as a component of the electronic health care system; strengthen the capacity of public health institutions and their ability to attract communities to implement interventions to control NCDs modified risk factors, increase awareness and the population's responsible attitude towards their health; strengthen the ability and motivate primary health care to provide quality primary prevention, screening and timely diagnosis and treatment of chronic NCDs.

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*The work is a fragment of scientific research work of Bogomolets National medical university: «Medico-social substantiation of optimization of the organization of medical care in the conditions of development of the public health system» (2020-2022, № state registration 0122U202017). The authors did not receive additional financial support.*

### CONFLICT OF INTEREST

The Authors declare no conflict of interest

### CORRESPONDING AUTHOR

**Nataliia M. Orlova**

National Pirogov Memorial Medical University  
56 Pirogova st, 21018 Vinnitsia, Ukraine  
e-mail: nataliaorlova08@gmail.com

### ORCID AND CONTRIBUTIONSHIP

Nataliia M. Orlova: 0000-0002-8413-5310 [A](#) [C](#) [D](#) [E](#) [F](#)  
 Gavriilo I. Kovtun: 0000-0001-9689-2055 [A](#) [B](#) [D](#) [E](#)  
 Svetlana E. Holovchanska-Pushkar: 0000-0002-3861-0133 [D](#) [E](#) [F](#)  
 Valentyna L. Pylypchuk: 0009-0007-6261-2378 [A](#) [D](#) [E](#)  
 Inna V. Palamar: 0009-0000-2889-2459 [B](#) [C](#) [D](#)  
 Olena V. Tkachenko: 0000-0002-7374-4970 [B](#) [C](#) [D](#)  
 Oksana V. Zadorozhniuk: 0009-0002-6182-5797 [B](#) [D](#) [E](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

**RECEIVED:** 21.12.2023

**ACCEPTED:** 20.03.2024

