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ORIGINAL ARTICLE

ANALYSIS OF THE BURDEN OF CARDIOVASCULAR DISEASES IN UKRAINE IN 1990-2019

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ABSTRACT

The aim: To analyze the burden of cardiovascular diseases (CVD) and their modified risk factors in Ukraine to substantiate ways of prevention.

Materials and methods: The burden of CVD was estimated by DALYs (Disability-Adjusted Life Years). The statistical method was used to analyze the data obtained from the statistical database of the international epidemiological study «Global Burden of Disease», updated for 2019. The analysis was carried out in the dynamics for 1990-2019 in Ukraine in comparison with European and EU countries.

Results: Age-standardized DALYs per 100,000 population in Ukraine are 2.6 times higher than the average in European countries and 4 times higher than in the EU. Over the 1991-2019 the gap in DALYs increased due to a significant decrease in the burden of CVD in Europe, against the consistently high level in Ukraine. The burden of CVD in Ukraine can be reduced on 54.2% by normalizing blood pressure, on 42.1% by improving diet, on 37.3% by lowering low-density lipoprotein cholesterol, on 28.1% by lowering body mass index, and on 22.9% by quitting smoking.

Conclusions: The Ukrainian strategy of reducing the burden of CVD should be intersectoral, comprehensive, combine population and individual (for high-risk groups) approaches to the control of modified CVD risk factors with modern methods of secondary and tertiary prevention of CVD, which have proven their efficiency in European countries.

KEY WORDS: cardiovascular diseases, DALYs, risk factors, prevention, Ukraine

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INTRODUCTION

In the 21st century, cardiovascular disease (CVD) remains the dominant global public health problem [1,2]. In Europe, they are the leading cause of death and disability of the population [3,4]. In addition to human suffering, CVD has serious economic consequences [5].

Reducing premature mortality from non-epidemic diseases (including CVD) by 30% to 2030 is one of the tasks (3.4) of the Sustainable Development Goals adopted at the UN Summit in 2015 [6]. And for the countries of Western Europe, the achievement of this task, in accordance to the stable trend of decreasing mortality from CVD over the last decades in this region, looks quite real, then for the countries of Eastern Europe, which have the highest mortality rate from CVD in the world and less encouraging dynamic trends, in order to achieve this task, significant efforts in the field of control of CVD should be done with support of well-planned epidemiological studies [2-5].

Ukraine is one of the European and world leaders of mortality from CVD [2-4]. Premature mortality from CVD is one of the reasons for significantly lower life

expectancy in Ukraine compared to Western European countries.

Improving control over CVD and preventing premature death from CVD is impossible without monitoring and evaluating the epidemiology of CVD in Ukraine and in comparison, with European countries.

An important component of monitoring of the population health, implemented at the international level for 30 years, is the evaluation of the burden of diseases according to such an indicator as DALYs, which include the Years of Life Lost (YLLs) and Years Lived with Disability (YLDs) [1, 7, 8]. Analysis of the DALYs from CVD and their risk factors allows us to consider the problem of the social significance of CVD and determine priority areas for their prevention from a new point of view, which defines the relevance of this study.

THE AIM

The purpose of the current study was to analyze the burden of cardiovascular diseases (CVD) and their modified risk factors in Ukraine to substantiate ways of prevention.

MATERIALS AND METHODS

A statistical method was used to analyze DALYs (Disability-Adjusted Life Years), YLLs (Years of Life Lost), YLDs (Years Lived with Disability) due to CVD in Ukraine, as well as the main risk factors of CVD. The information sources for the study were the materials of the statistical database of the international epidemiological study, which coordinated by the Institute of Health Metrics and Evaluation at the University of Washington, "Global Burden of Disease (GBD)" [8]. In this article the analysis of DALYs from CVD in Ukraine was carried out in the dynamics for 1990-2019 and in comparison with European and Europe Union (EU) countries. DALYs and its components (YLLs and YLDs) were analyzed both for the entire class of CVD and for individual diseases, such as: ischemic heart disease (IHD), strokes, cardiomyopathies and myocarditis, atrial fibrillation and flutter, rheumatic heart disease, hypertensive disease, endocarditis, non-rheumatic valvular heart disease.

The comparative characteristics of human resources and some diagnostic and interventional methods of treatment of CVD in Ukraine and European countries are based on the materials published by the European Society of Cardiology [4].

RESULTS

According to the results of the analysis of the materials of the database of the Global Burden of Diseases it is estimated that in Ukraine in 2019, CVD accounts for one third (38.3%) of all years of life lost due to disability and premature death and ranks first in the DALY structure among all diseases. In 2019, 8,305,261 years of healthy life were lost in Ukraine as a result of CVD, or 18,857.4 per 100,000 of the total population.

In the structure of burden of CVD, 67.2% years of healthy life are lost due to IHD, 22.4% - due to strokes, and 6% - due to cardiomyopathy (Table I).

The age-standardized DALYs for men is 2.1 times higher than the similar indicator for women. At the same time, the structure of DALYs is similar for men and women.

In the structure of DALYs for CVD, 95.9% of healthy life years of the population are lost due to premature mortality (YLLs), and 4.1% - due to disability (YLDs). In absolute terms, these losses in 2019 amounted to 7,964,599 and 340,663 years, respectively. A significant predominance of years lost due to premature death over years lived in disability is typical for almost all nosological forms of CVD, with the exception of atrial fibrillation and flutter and non-rheumatic heart disease, the proportion of years

living with disability in the structure of the disease burden by these nosological forms were 54.2% and 39.1%, respectively.

The structure of years lost due to premature mortality (YLLs) is similar to the structure of DALYs: the first place with proportion 69.2% belongs to IHD, the second - to strokes (21.1%) and the third - to cardiomyopathies (6.2%). But in the structure of YLDs, half of healthy life years lost due to disability is caused by strokes (52.9%), and the fifth part (21.2%) is caused by IHD.

The ranking positions of the three main components in the structure of DALYs due to CVD in Ukraine correspond to those in the countries of Europe and EU, but the age-standardized DALYs per 100,000 population in Ukraine are significantly different from those in Europe. Per 100,000 people, the population of Ukraine loses 2.6 more healthy life years than European residents and 4.1 times more than in the residents in EU (Table II).

The situation with IHD is particularly unfavorable in Ukraine, which takes 3.3 times more years of healthy life from Ukrainians 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 by 2.7 and 6.6 times, rheumatic heart disease by 1.6 and 2.0 times, respectively.

Ukrainian indicators of DALYs for atrial fibrillation and flutter, as well as endocarditis, are close to the average European levels. But the DALYs due to hypertension and non-rheumatic valvular heart disease in Ukraine is significantly lower and is only 1/5 of the European rates.

A dynamic analysis of the Age-standardized DALYs per 100,000 population conducted over 1990–2019 revealed undulating high levels in Ukraine against the steady downward trend in DALYs for CVD in Europe and the European Union (Fig. 1). These dynamic trends of DALYs were determined by the dynamics of YLLs, as both in Ukraine and Europe, the years of life lost due to premature mortality make up the major share of the burden of CVD and led to a growing gap in DALYs indicators in Ukraine and Europe over 30 years of observation. The age-standardized rate of YLDs due to CVD in Ukraine less significantly exceeded the European rates and tends to decrease, but at a slower pace than in Europe and the EU.

The problem of premature mortality from CVD in Ukraine primarily concerns the male population. During 1990-2019, the gap in DALYs between men and women grew from 1.6 to 2.1 times due to multi-directional dynamic trends: over 30 years, a trend towards a decrease in the indicator in women and an increase in men was outlined (Fig. 2).

The main risk factors for the formation of DALYs due to CVD in men and women in Ukraine are a high level

Table I. CVD Disability-Adjusted Life Years (DALYs) lost by cause, males, females, both, Ukraine, 2019

Course (diseases)	Male		Female		Both	
	DALYs lost	% of total CVD DALYs lost	DALYs lost	% of total CVD DALYs lost	DALYs lost	% of total CVD DALYs lost
Cardiovascular diseases	4515370	100	3789891	100	8305261	100
Ischemic heart disease	3023564	67.0	2558574	67.5	5582137	67.2
Stroke	915741	20.3	941940	24.9	1857680	22.4
Cardiomyopathy and myocarditis	384858	8.5	116226	3.1	501085	6.0
Atrial fibrillation and flutter	46355	1.0	75236	2.0	121591	1.5
Aortic aneurysm	38265	0.8	12427	0.3	50692	0.6
Rheumatic heart disease	16063	0.4	18838	0.5	34901	0.4
Hypertensive heart disease	11916	0.3	10173	0.3	22089	0.3
Endocarditis	10438	0.2	3725	0.1	14164	0.2
Non-rheumatic valvular heart disease	5635	0.1	4661	0.1	10296	0.1
Other heart diseases	62535	1.4	48091	1.3	110626	1.3

Table II. Comparison of Age-standardized CVD DALYs rate in Ukraine, Europe, EU, 2019

Diseases	Age-standardized DALYs rate per 100,000			Comparison index (%)	
	Ukraine	Europe	EU	Ukraine / Europe(%)	Ukraine / EU(%)
Cardiovascular diseases	11316.7	4401.1	2758.8	257.1	410.2
Ischemic heart disease	7400.2	2237.9	1277.3	330.7	579.4
Stroke	2533.5	1230.5	754.3	205.9	335.9
Cardiomyopathy and myocarditis	864.5	314.2	130.8	275.2	661.1
Atrial fibrillation and flutter	155.9	132.0	134.5	118.1	115.9
Rheumatic heart disease	54.5	33.2	27.4	164.2	199.2
Hypertensive heart disease	31.9	160.3	152.1	19.9	21.0
Endocarditis	26.5	24.0	20.8	110.2	127.3
Non-rheumatic valvular heart disease	15.0	57.3	66.7	26.1	22.4

Table III. Percentage of CVD DALYs attributable to selected risk factors, by sex, 2019, Ukraine, (%)*

Risk factors	Male	Female	Both
Dietary risk factors	68.7	63.0	54.2
High systolic blood pressure	67.1	63.4	42.1
High low-density lipoprotein cholesterol	39.1	38.0	37.3
High body mass index	24.1	26.1	28.1
Smoking	32.7	5.7	22.9
High fasting plasma glucose	16.2	16.0	13.2
Alcohol use	9.5	11.2	4.2
Low physical activity	5.4	4.5	5.2

*The CVD burden attributable to each individual risk factor includes the individual contribution of each risk factor as well as its interaction with other risk factors. Hence, the sum of the CVD burden attributable to each risk factor exceeds 100%

of systolic pressure (causes 54.2% of DALYs due to CVD), an irrational diet (42.1%), a high level of low-density lipoprotein cholesterol (37.3%), a high body mass index (28.1%), smoking (22.9%) (Table III). Dietary risk factors include consumption of foods with a high sodium, trans

fats, processed meat, insufficient consumption of whole grains, legumes, fruits, vegetables, nuts and seeds, seafood omega-3 fatty acids, polyunsaturated fatty acids.

The higher level of DALYs due to CVD in Ukraine, compared to European countries, can be associated not

Table IV. Comparison of human resources and some diagnostic and interventional methods for the treatment of CVD in Ukraine and in European Society of Cardiology member countries*

Indicator	Ukraine	Median (IQR)**	minimum	maximum
Interventional cardiologists per million people (2020)	4.5	12.1 (9.2–17.4)	1.9 (Uzbekistan)	25.2 (Bulgaria)
Diagnostic coronary angiograms per million people (2019)	1105	4084 (2563–5007)	394 (Kyrgyzstan)	6898 (Belgium)
Percutaneous coronary intervention per million people (2020)	533	1879 (1313–2550)	191 (Kyrgyzstan)	3767 (Latvia)
Ablation procedures per million people (2020)	64.3	372.3 (145.2–518.8)	9.0 (Egypt)	1112.3 (Germany)
Pacemaker implants per million people (2020)	142.4	652.2 (267.5–874.7)	17.8 (Uzbekistan)	1038.2 (Sweden)

*The table is based on the materials of the European Society of Cardiology, presented in [4].

**Median and IQR (interquartile range) in European Society of Cardiology member countries.

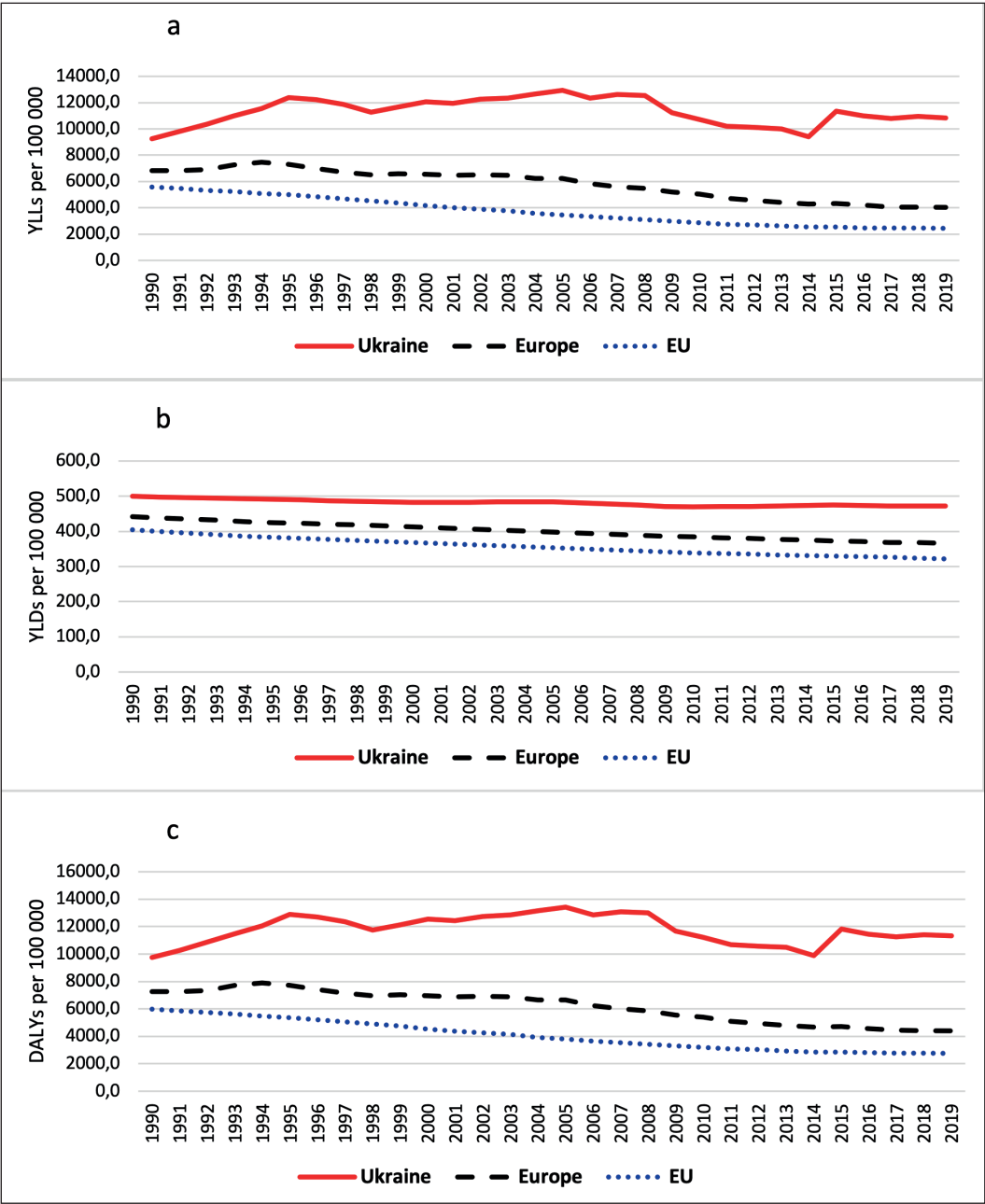


Fig. 1. Dynamics of the age-standardized YLLs (a), YLDs (b), DALYs (c) rates due CVD in Ukraine, Europe, EU, 1990-2019 (per 100,000)
YLLs = years of life lost, YLDs = years lived with disability, DALYs = disability-adjusted life years

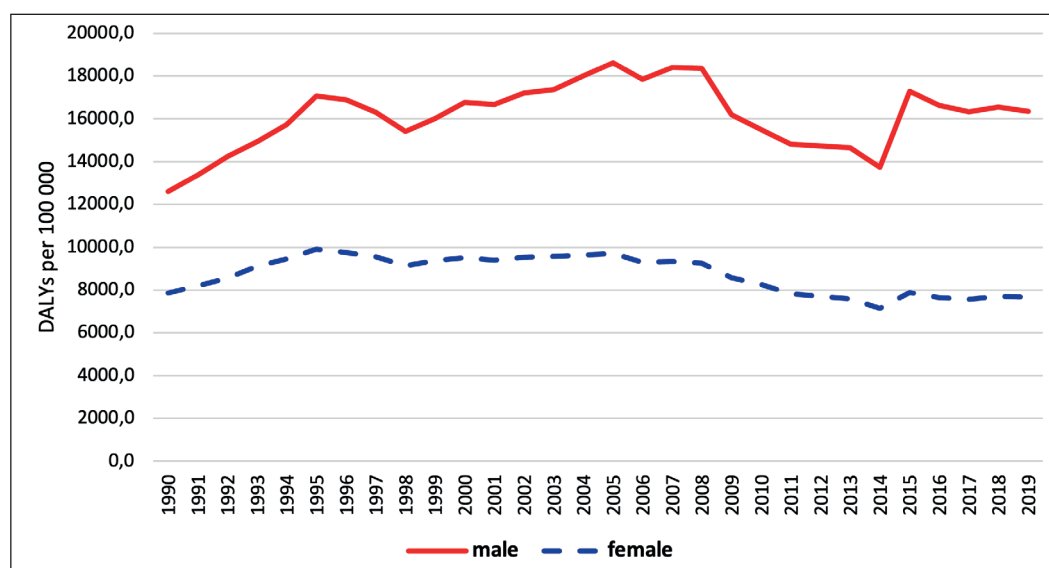


Fig. 2. Age-standardized CVD DALYs rates, male, female, Ukraine, 1990-2019 (per 100,000)

only with the significant prevalence of risk factors and insufficiency of primary prevention of CVD, but also less accessibility for the population of Ukraine to the modern (including invasive) methods of diagnosis and treatment of these diseases. For example, per 1 million population, on an average, European Society of Cardiology member countries have, 2.7 times more interventional cardiologists, 3.7 times more diagnostic coronary angiography, 3.5 times more percutaneous coronary interventions, 5.8 times more ablation procedures, 4.6 times more pacemaker implantations than in Ukraine (Table IV).

DISCUSSION

An appropriate evidence base should be used to set health priorities and shape disease prevention policies [9, 10]. The analysis of years of healthy life lost due to premature mortality and disability due to CVD is a methodological approach that allows monitoring and a comprehensive estimation of the burden of CVD at a modern scientific level. In the context of the development of the public health system in Ukraine, the use of the DALYs indicator and the quantitative assessment of its risk factors, instead of traditional indicators of mortality and disability, provides substantiated evidence for the development of an appropriate CVD prevention policy [9, 11].

According to the study results CVD is a leading cause of DALYs for the population of Ukraine. The most significant socio-medical losses due to CVD in Ukraine are caused by the loss of years of healthy life due to premature mortality from IHD and strokes. And these losses primarily concern the male population.

Ukraine has one of the highest rates of DALYs for CVD in Europe and lags far behind European countries in decline of it. The success of economically developed countries in Europe in reducing DALYs from CVD is

primarily associated with a decrease in premature mortality from IHD, which is on 50% attributed to the control of modified risk factors and 40% - to improved diagnosis and treatment of IHD [12-15].

High DALYs due to CVD in Ukraine can be explained by the socio-psychological stress experienced by the population as a result of a protracted socio-economic crisis [11, 15], the extreme prevalence and insufficient control over the modified risk factors of CVD [10], among which, according to the results of our research, the most important are: high blood pressure, unhealthy diet, hypercholesterolemia, high body mass index and smoking.

Insufficient government spending on the health care system is a factor that causes problems with the accessibility of specialized and highly specialized medical care to the population and Ukraine's significant lag behind Western European countries in the introduction of high-tech interventional techniques for the effective treatment of CVD [11, 15].

The positive experience of Western Europe countries indicates the possibility of a significant reduction in the burden of CVD, both through the successful implementation of the population strategies for modifying the leading risk factors for CVD, and due to the timely detection and effective treatment of patients with CVD, including the use of invasive cardiac surgical technologies [12-14].

CONCLUSIONS

In Ukraine, the share of CVD is one third (38.3%) of all years of healthy life lost due to premature death and disability. They rank first place in the DALYs structure among all diseases. In 2019, 8,305,261 years of healthy life were lost due to CVD, or 18,857.4 years per 100,000 population.

Age-standardized DALYs per 100,000 population in Ukraine are 2.6 times higher than the average in European countries and 4 times higher than in the EU. During 1990–2019 the gap in DALYs rates increased due to a significant reduction in the burden of CVD in Europe, against the backdrop of a high level of rates in Ukraine.

The burden of CVD in Ukraine can be reduced on 54.2% by normalizing blood pressure, on 42.1% by improving diet, on 37.3% by lowering low-density lipo-

protein cholesterol, on 28.1% by lowering body mass index, and on 22.9% by quitting smoking.

The Ukrainian strategy to reduce the burden of CVD should be intersectoral, comprehensive, combine population and individual (for high-risk groups) approaches to the control of modified CVD risk factors with modern methods of secondary and tertiary prevention of CVD, which have proven their efficiency in European countries.

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The Authors declare no conflict of interest.

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