

Global dynamics of mortality from cardiovascular diseases in different regions of the world

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In most regions of the world, complications of cardiovascular diseases (CVD) are the leading cause of death in adults. There is currently a significant variability in the incidence of CVD mortality across countries.

The aim of this review is to analyze trends in CVD mortality across 12 world regions from 1990 to 2022, as well as to assess differences in CVD mortality depending on countries' economic development and the role of various risk factors (RF).

Methods. Data from the Global Burden of Disease, Injuries, and Risk Factors research group were used. CVD mortality was analyzed across eighteen specific CVD conditions. Each relevant epidemiological metric was assessed for 23 age groups, ranging from birth to 95 years and older; for males, females, and both sexes combined, from 1990 to 2022. The material for this article was gathered from peer-reviewed publications indexed in PubMed, eLIBRARY.RU, CyberLeninka, and other research platforms from 2016 to 2024.

Results. An analysis of age-standardized CVD mortality rates across different global regions revealed a range

from 73.6 per 100,000 in the high-income Asia-Pacific region to 432.3 per 100,000 in Eastern Europe in 2022. Overall, between 1990 and 2022, there has been an average 38.5% reduction in CVD mortality across 12 global regions. The analysis also examined differences in CVD mortality by the level of a country's economic development and the role of various RF.

Conclusion. Over recent decades, there has been a global decline in CVD mortality, with more significant progress observed in regions with high levels of economic development compared to low-income countries. Public health policy should focus on the most impactful risk factors in specific country groups.

Keywords: mortality, cardiovascular diseases, regions, dynamics, risk factors, economic level.

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Cardiovascular diseases (CVD) remain the leading cause of mortality among the adult population of both sexes worldwide. This trend was first recorded in the 1960s [1–3]. At the same time, the early 21st century has seen a rapid increase in mortality from cancer [4]. Despite a 34.9% global decrease in CVD mortality over the past 32 years, complications from cardiovascular diseases still represent the main cause of adult mortality in most countries, due to their high prevalence across different regions of the world. According to the literature, the current age-standardized prevalence of CVD ranges from 5,881.0 per 100,000 population in South Asia to 11,342.6 per 100,000 in Central Asia. As of 2023, coronary heart disease (CHD) has the highest age-standardized DALY (Disability-Adjusted Life Years) rate globally among all diseases — 2,275.9 per 100,000 people. Intracerebral hemorrhage and ischemic stroke follow as leading contributors to CVD-related DALYs [5].

The aim of this review is to analyze trends in CVD mortality across 12 world regions from 1990 to 2022, as well as to assess differences in CVD mortality depending on countries' economic development and the role of various risk factors (RF).

Methods

Overall, international analysts classify the world's countries into 21 regions. These regions consist of countries and territories that are geographically close and epidemiologically similar. For the preparation of this article, materials from the Global Burden of Disease, Injuries, and RF (GBD) study group were used. The GBD project generates time series of comprehensive health metrics, including prevalence, cause-specific mortality rate (CSMR), years of life lost (YLLs), years lived with disability (YLDs), and disability-adjusted life years (DALYs). Cardiovascular disease mortality was analyzed with reference to eighteen specific CVDs. Each epidemiological metric of inter-

est was assessed for 23 age groups, ranging from birth to age 95 and older, for males, females, and both sexes combined, from 1990 to 2022. Age standardization was performed using the direct method with the standard age structure of the global population defined by GBD. This standard population size is based on the population structure of all settlements in countries with populations >5 million. The share of the population in each age group is calculated based on the specific settlement, and then these age proportions are averaged across all settlements [6, 7].

The material for this article was collected from peer-reviewed publications indexed in PubMed, eLIBRARY.RU, CyberLeninka, and other research platforms from 2016 to 2024. Keywords used for the search included: cancer, mortality, cardiovascular diseases, regions, trends, risk factors, economic level.

Results and Discussion

Cardiovascular diseases in Eastern and Central Europe

Over the observation period from 1990 to 2022, CVD mortality in Eastern Europe decreased by 24.3%. It is important to emphasize that age-standardized CVD mortality within the region varied by a factor of 2.6 — ranging from 215.0 to 553.0 per 100,000 population. Among all analyzed regions, Eastern Europe ranked first in CVD mortality, a position it has maintained consistently over the past 32 years [5].

In 2022, following CHD and stroke, alcoholic cardiomyopathy had the highest age-standardized DALY rate — 521.2 per 100,000 population. Among all risk factors (RF), the most significant was arterial hypertension (AH), particularly elevated systolic blood pressure (SBP)^{1,2}.

In 2022, the age-standardized mortality rate from cardiovascular disease (CVD) among Central

¹ Murray CJL Protocol for the Global Burden Of Diseases, Injuries, And Risk Factors Study (GBD). Accessed November 10, 2023. https://www.healthdata.org/sites/default/files/files/Projects/GBD/March2020_GBD%20Protocol_v4.pdf

² Gibson G, Blumer V, Mentz RJ, Lala A. Universal Definition and Classification of Heart Failure: A Step in the Right Direction from Failure to Function. Accessed November 8, 2023. <https://www.acc.org/Latest-in-Cardiology/Articles/2021/07/12/12/31/Universal-Definition-and-Classification-of-Heart-Failure>

European countries ranged from 132.6 to 581.4 per 100,000 population, indicating a 4.4-fold difference. Over time, CVD mortality decreased by 47.0%, which is twice the reduction observed in Eastern Europe. Among all analyzed regions, Central Europe ranked 2nd in age-standardized CVD mortality in 1990 and 7th in 2022.

Cardiovascular Diseases in Central Asia

Mortality from CVD in the countries of Central Asia and the South Caucasus is among the highest globally. In 2022, age-standardized mortality rates in this region ranged from 331.8 to 542.3 per 100,000 population. Over the period of observation, mortality decreased by 16.5%. It is worth noting that out of the 21 global regions, Central Asia ranked 4th in 1990 and 2nd in 2022 in terms of age-standardized CVD mortality, and 1st in age-standardized CVD prevalence. After CHD and all subtypes of stroke, hypertensive heart disease had the highest age-standardized DALY rate in 2022—337.4 per 100,000 people [5].

Cardiovascular Diseases in Western Europe

In Western European countries, age-standardized CVD mortality rates ranged from 80.2 to 199.9 per 100,000 in 2022 — a 2.5-fold difference. Over the observation period, CVD mortality declined by 60.2%. Western Europe has some of the best outcomes among the 21 global regions, ranking 15th in 1990 and 19th in 2022 for age-standardized CVD mortality. High SBP accounted for the largest number of age-standardized CVD parameters — 977.2 per 100,000 [5].

Cardiovascular Diseases in North America

In 2022, age-standardized CVD mortality rates in high-income North American countries ranged from 99.4 to 191.6 per 100,000 — a 1.9-fold difference. Over the 32-year observation period, CVD mortality declined by 45.9%. This region ranked 17th both in 1990 and 2022 in terms of age-standardized CVD mortality. As in Western Europe, high SBP contributed the most to age-standardized CVD burden.

Cardiovascular Diseases in Australia

In 2022, age-standardized CVD mortality rates in Australia ranged from 92.0 to 122.5 per 100,000, with a relatively small variation (1.3-fold difference). Between 1990 and 2022, CVD mortality decreased by 65.5%. In 2022, the region had one of the best out-

comes, ranking 20th out of 21 global regions, compared to 16th in 1990. High SBP accounted for the highest number of age-standardized CVD parameters — 777.3 per 100,000 [5].

Cardiovascular Diseases in Asia-Pacific Countries

In 2022, age-standardized CVD mortality rates in high-income Asia-Pacific countries ranged from 72.7 to 252.6 per 100,000 population — a 3.55-fold difference. From 1990 to 2022, CVD mortality declined by 64.2%. Among the 21 high-income global regions, Asia-Pacific countries ranked 20th in 1990 and 21st in 2022 for age-standardized CVD mortality — the best ranking. In this region, after CHD and stroke, aortic aneurysm had the highest age-standardized DALY rate in 2022 at 79.6 per 100,000. Among all RF, high SBP contributed the most to the age-standardized burden [5].

Cardiovascular Diseases in Southeast Asia

In Southeast Asia, age-standardized CVD mortality rates in 2022 ranged from 123.2 to 406.2 per 100,000 — a 3.3-fold variation. Over the 32-year period, CVD mortality declined slightly by 16.9%. The region ranked 8th in 1990 and 6th in 2022 for age-standardized CVD mortality. Following CHD and all stroke subtypes, hypertensive heart disease had the highest age-standardized DALY rate in 2022 — 458.5 per 100,000 [5].

Cardiovascular Diseases in North Africa and the Middle East

In 2022, age-standardized CVD mortality rates in North Africa and the Middle East ranged from 132.5 to 578.7 per 100,000 population — a 4.4-fold difference. Between 1990 and 2022, CVD mortality declined by 31.6%. This region ranked 3rd in 1990 and 5th in 2022 for age-standardized CVD mortality. After CHD and stroke, hypertensive heart disease showed the highest age-standardized DALY rate in 2022 — 654.8 per 100,000 [5].

Cardiovascular Diseases in Central Sub-Saharan Africa

In Central Sub-Saharan Africa, CVD mortality rates across countries were relatively close, ranging from 323.5 to 464.6 per 100,000 in 2022 — a 1.4-fold difference. From 1990 to 2022, only a modest 12.3% re-

duction in CVD mortality was observed. Out of the 21 global regions, Central Sub-Saharan Africa ranked 6th in 1990 and 4th in 2022 for age-standardized CVD mortality. After CHD and all stroke subtypes, hypertensive heart disease had the highest DALY rate in 2022 — 1,110.7 per 100,000 population [5].

Cardiovascular Diseases in Central Latin America

In 2022, age-standardized cardiovascular disease CVD mortality rates in Central Latin American countries ranged from 109.5 to 329.4 per 100,000 population — a threefold difference. Over the 32-year observation period, CVD mortality declined by 25.1%. Among the 21 global regions, Central Latin America ranked 19th in 1990 and 14th in 2022 in terms of age-standardized CVD mortality. After CHD and all stroke subtypes, hypertensive heart disease had the highest age-standardized DALY rate in 2022 — 185.0 per 100,000 population [5].

Cardiovascular Diseases in Tropical Latin America

In the countries of Tropical Latin America, age-standardized CVD mortality rates ranged from 157.7 to 201.8 per 100,000 population in 2022, showing only a 1.3-fold difference between countries. Over the past 32 years, CVD mortality significantly decreased by 52.6%. Of the 21 global regions, Tropical Latin America ranked 12th in 1990 and 15th in 2022 in age-standardized CVD mortality. Following CHD and all stroke subtypes, hypertensive heart disease had the highest age-standardized DALY rate in 2022 — 245.4 per 100,000 population [5].

Analysis of CVD Mortality Trends Across Global Regions

In 2022, age-standardized CVD mortality rates varied widely — from 73.6 per 100,000 in the high-income Asia-Pacific region to 432.3 per 100,000 in Eastern Europe.

Overall, between 1990 and 2022, 12 global regions saw an average 38.5% decline in CVD mortality. Table 1 presents the dynamics of CVD mortality across these years, along with variations among countries within the 12 regions [5].

The greatest reductions in CVD mortality were seen in Australia, Asia-Pacific region, and Western Europe — with an average decline of around 63% over

32 years. As of 2022, CVD mortality in these regions ranged from 81.6 to 191.7 per 100,000 population. A similar trend is noted in North America and Tropical Latin America. It is worth noting that while Central Europe also showed a marked decrease in CVD mortality, some countries in this region still had high mortality rates in 2022. In contrast, Central Asia showed a 3-4 times smaller decline compared to the aforementioned regions. A similar situation is observed in Central Africa and Southeast Asia. Particularly in Central Asia, average CVD mortality remains among the highest across all analyzed regions globally.

Table 1. Dynamics of mortality from CVD in different regions of the world (1990-2022)

World regions	Dynamics of mortality from CVD, 1990-2022	Variation of mortality from CVD in countries of the regions, per 100 thousand population, in 2022
Eastern Europe	24.3 %	215.0-553.0
Central Europe	47.0 %	132.6-581.4
Central Asia	16.5 %	331.8-542.3
Western Europe	60.2 %	80.2-199.9
North America	45.9 %	99.4-191.6
Australia	65.5 %	92.0 — 122.5
Asia-Pacific Countries	64.2 %	72.7-252.6
Southeast Asia	16.9 %	123.2-406.2
North Africa and the Middle East	31.6 %	132.5-578.7
Central Africa	12.3 %	323.5-464.6
Central Latin American	25.1 %	109.5-329.4
Cardiovascular Diseases in Tropical Latin America	52.6 %	157.7-201.8

Impact of economic level and risk factors on CVD mortality

It is well established that numerous factors influence CVD mortality, including the efficiency of healthcare organization, chronic disease prevention, public health literacy, and access to medical services [8, 9]. All these issues are closely tied to the level of economic development. It is evident that countries with a high economic status have demonstrated more pronounced declines in mortality and currently exhibit lower CVD mortality rates compared to regions and countries with lower economic development [10]. A number of studies in the literature have explored the relationship between RF, economic development, and CVD mortality across various countries [11, 12].

One such project is the international, multi-center PURE study (Prospective Urban and Rural Epidemiological study). This study included 155,722 participants from 21 countries (aged 35–70 years), enrolled between 2005 and 2016 across five continents (excluding Australia).

The average follow-up period was 9.5 years [12]. The causes of death were analyzed based on economic development level (low, middle, and high), as well as the impact of modifiable RFs on the development of cardiovascular complications (CVC) — including cardiovascular diseases, myocardial infarction, stroke, and chronic heart failure — and related mortality in these categories of countries.

According to the obtained data, CVD was the cause of death in 43%, 42%, and 23% of cases, while cancer accounted for 15%, 30%, and 55% of deaths in countries with low, middle, and high economic levels, respectively. Age- and sex-standardized all-cause mortality rates decreased with increasing income levels — 13.3, 6.9, and 3.4 per 1,000 person-years in low-, middle-, and high-income countries, respectively.

An analysis by individual disease categories showed that low income was associated with higher mortality from cardiovascular and respiratory diseases, injuries, and infections, and lower mortality from cancer. The ratio of CVD mortality to cancer mortality was 3.0, 1.3, and 0.4 in low-, middle-, and high-income countries, respectively. The most significant cardiovascular risk factor was arterial hypertension, followed by elevated low-density lipoprotein (LDL) cholesterol, with air pollution ranking third. Smoking, poor diet, low educational attainment, and abdominal obesity had a comparable impact on cardiovas-

cular risk. In high-income countries, behavioral and metabolic risk factors accounted for nearly the entire burden of CVD, whereas in middle- and low-income countries, lower educational levels and air pollution played a greater role [13].

The findings from the PURE study reaffirm that a country's economic status influences the incidence and mortality of CVD and other non-communicable diseases. Moreover, depending on the economic level, various additional RF alongside the major ones play a role in the development of CVD.

Conclusion

In most regions of the world, complications of CVD remain the leading cause of adult mortality, with CHD and stroke occupying central positions. Over the past decades, there has been a significant global decline in CVD mortality; however, this trend is more pronounced in regions with high economic development compared to low-income countries. At present, there is also substantial variability in CVD mortality rates across different regions worldwide.

Health policy efforts should focus on the specific RF that have the greatest impact in each group of countries. In high-income regions, a large proportion of cardiovascular complications can be prevented through optimal control of metabolic and behavioral risk factors. In low- and middle-income countries, the greatest benefit can be expected from tobacco control, blood pressure management, and increased investment in healthcare, including improved access to preventive medications and the use of advanced technologies for CVD treatment.

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