Preplanned Studies

A Global Decomposition Analysis of the Effect of Population Aging on Disability-Adjusted Life Years Associated with Cardiovascular Disease — 204 Countries and Territories, 1990–2021

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Summary

What is already known about this topic?

The influence of population aging on the disability-adjusted life years (DALYs) associated with cardiovascular disease (CVD) is acknowledged, yet the magnitude of this impact remains unclear.

What is added by this report?

This research quantified the influence of population aging on CVD DALYs from 1990 to 2021 through decomposition analysis. The findings revealed that the proportion of DALYs attributable to aging varied widely, ranging from −77.0% to 148.9% across 204 countries. There was significant variation in the attributed DALY proportions among different countries or territories and types of CVD. Ischemic heart disease and stroke emerged as the leading contributors to DALYs influenced by aging.

What are the implications for public health practice?

Globally, the association of population aging with increased CVD DALYs underscores the critical need for enhancing health systems to cater to the needs of older adults. Mitigating the burden of CVD DALYs linked to demographic aging can be achieved by investing in resources and adjusting fertility policies.

Cardiovascular disease (CVD) is a major cause of premature mortality and a significant factor in escalating healthcare costs. With the lower birth rates and increased life expectancy, population aging and it's associated CVD burden have emerged as a critical social challenge. This study sought to systematically assess the effect of population aging on the disability-adjusted life years (DALYs) associated with CVD, utilizing data from the Global Burden of Disease Study (GBD) 2021. The findings reveal that global DALYs for CVD reached 428.3 million in 2021, marking a 44.0% increase since 1990, largely driven by aging populations. Notably, the impact of population aging on DALYs varied significantly across different countries, territories, and types of CVD. Public health professionals are urged to focus on tailored preventive and treatment strategies to address the impending challenges of population aging and its influence on CVD burden.

Data were obtained from the GBD 2021 online database (http://ghdx.healthdata.org/gbd-results-tool), encompassing DALYs, age-standardized DALY rate (ASDR), and population sizes spanning 1990 to 2021. Age-standardized rates facilitated the comparison of DALY rates across nations or regions with diverse age structures and demographic profiles. The analysis included a total of 204 countries and territories, categorized into five socio-demographic index (SDI) regions (high, high-middle, middle, low-middle, and low) (*1*).

The average annual percent change (AAPC) was determined using Joinpoint regression analysis to evaluate trends in ASDR (*2*). A decomposition method was utilized to assess the variations in DALYs due to population growth, aging, and changes in age-specific DALY rates (*3*). Both the absolute and relative contributions of these three factors to the alterations in DALYs were computed, using 1990 as a baseline. In countries where DALYs increases were linked to population aging, ratios of DALYs ascribed to changes in DALY rates (R_1) and to population growth (R_2) were separately calculated in comparison to those due to population aging. Comprehensive methodologies for data correction are provided in the Supplementary Material (available at https://weekly.chinacdc.cn/). All processes of data handling, analytical procedures, and the production of graphical content were conducted using R (version 4.1.3, Development Core Team, Vienna, Austria).

In 2021, the global burden of CVD amounted to

approximately 428.3 million DALYs, with a 95% uncertainty interval (*UI*) of 403.7 to 453.7 million. The ASDR was 5,055.9 per 100,000 individuals (95% *UI*: 4,759.5, 5,359.2). From 1990 to 2021, there was a 1.3% decrease in the global ASDR for CVD [95% confidence interval (*CI*): −1.4%, −1.2%], despite a 44.0% increase in the global DALYs attributed to CVD. Among various SDI quintiles, DALYs consistently increased in all but the high SDI quintile. Notably, ASDR declined across all SDI categories, with the most pronounced decrease occurring in the high SDI quintile.(Figure 1 and Table 1). Rheumatic heart disease experienced the sharpest decrease in ASDR, with an AAPC of −2.5% (95% *CI*: −2.5%, −2.4%) (Table 1).

Since 1990, global DALYs attributable to population aging have gradually increased, reaching 138.2 million by 2021. Over the same timeframe, population growth accounted for an additional 144.2 million DALYs, while changes in DALY rates led to a reduction of 151.7 million DALYs (Figure 2A and Table 2). The impact of these three determinants varied significantly across different regions and countries (Table 2 and Supplementary Table S1, available at https://weekly.chinacdc.cn/). From 1991 to 2021, the percentage of DALYs linked to population aging rose globally and across most SDI quintiles, with figures ranging from 2.9% in the lowest SDI countries to 79.0% in middle SDI countries (Figure 2B). The extent of total DALYs changes due to population aging varied widely from −77.0% in Afghanistan to 148.9% in the United Arab Emirates, with 174 countries or territories recording an increase in DALYs attributed to aging (Supplementary Table S1). IHD and stroke were the conditions most affected by aging, with 42 countries noting more than a 25% increase in IHD

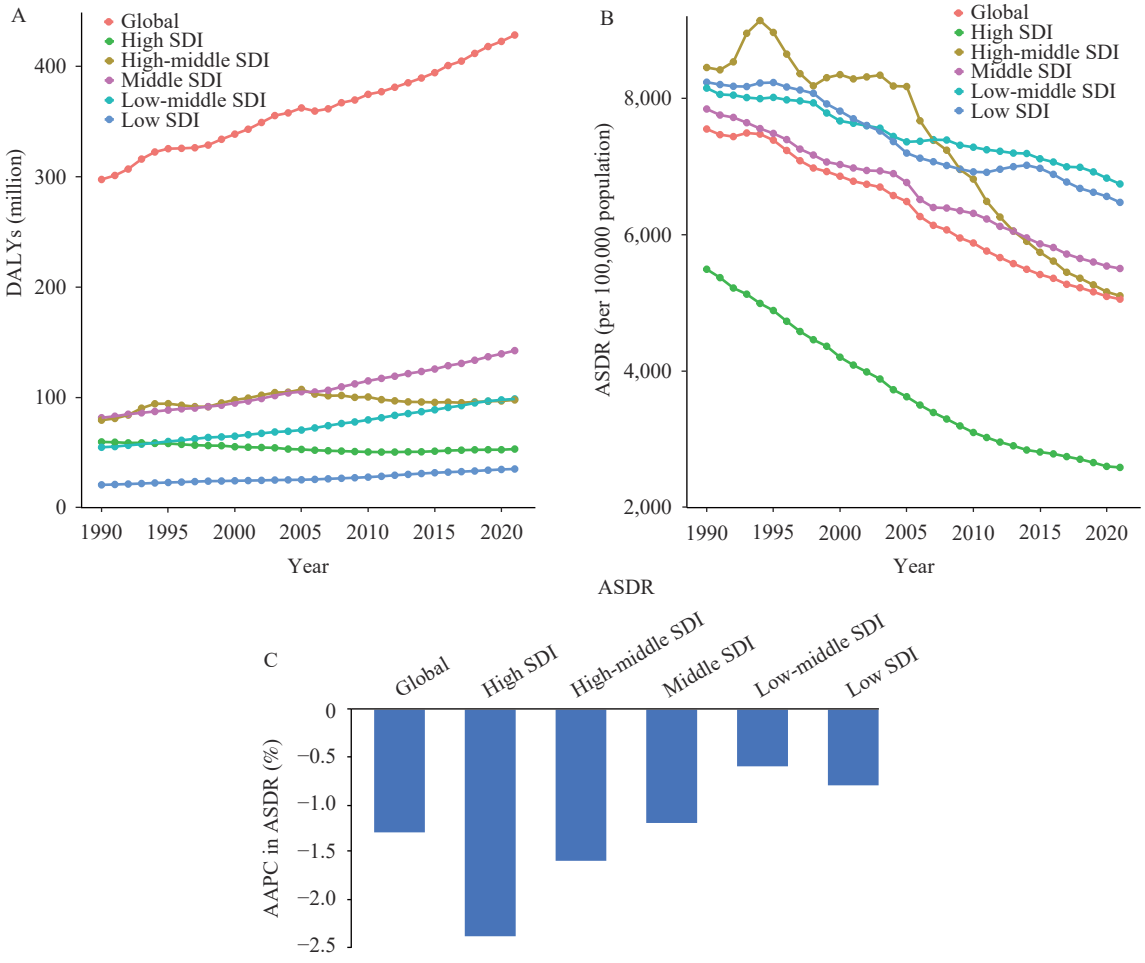

FIGURE 1. Global DALYs and ASDR of CVD from 1990 to 2021. (A) DALYs across various SDI regions. (B) ASDR across different SDI regions. (C) AAPC in ASDR.
Abbreviation: DALYs=disability-adjusted life years; ASDR=age-standardized DALY rate; CVD=cardiovascular disease; SDI=socio-demographic index; AAPC=average annual percent change.

TABLE 1. DALYs cases and the ASDR for CVD from 1990 to 2021.

Characteristics	1990		2021		1990–2021
	DALYs cases No. ×10^4 (95% *UI*)	ASDR per 100,000 No. (95% *UI*)	DALYs cases No. ×10^4 (95% *UI*)	ASDR per 100,000 No. (95% *UI*)	AAPC No. (95% *CI*)
Global	29,750.7 (28,460.1, 30,934.6)	7,550.2 (7,181.5, 7,862.0)	42,832.7 (40,368.4, 45,371.2)	5,055.9 (4,759.5, 5,359.2)	−1.3 (−1.4, −1.2)
SDI					
High	5,984.0 (5,651.8, 6,203.0)	5,494.2 (5,185.5, 5,700.0)	5,338.5 (4,835.2, 5,708.6)	2,588.8 (2,388.0, 2,762.8)	−2.4 (−2.5, −2.4)
High-middle	7,955.2 (7,549.6, 8,296.2)	8,451.9 (8,001.6, 8,819.2)	9,787.9 (8,980.2, 10,573.9)	5,105.1 (4,685.7, 5,507.5)	−1.6 (−1.8, −1.3)
Middle	8,173.6 (7,673.6, 8,708.0)	7,843.6 (7,348.3, 8,338.5)	14,251.9 (13,208.1, 15,296.2)	5,505.1 (5,088.9, 5,901.3)	−1.2 (−1.3, −1.0)
Low-middle	5,500.8 (5,143.9, 5,804.8)	8,149.9 (7,607.7, 8,594.9)	9,878.8 (9,203.1, 10,563.6)	6,744.4 (6,289.1, 7,198.7)	−0.6 (−0.7, −0.5)
Low	2,096.8 (1,907.1, 2,295.2)	8,236.3 (7,566.5, 8,920.5)	3,533.5 (3,184.7, 3,911.8)	6,474.7 (5,883.2, 7,124.5)	−0.8 (−0.9, −0.7)
Type of CVD					
Aortic aneurysm	188.4 (178.4, 200.7)	48.8 (6.0, 51.8)	310.8 (285.7, 335.4)	36.5 (33.5, 39.5)	−0.9 (−1.0, −0.8)
Atrial fibrillation and flutter	335.9 (271.5, 414.2)	100.8 (82.8, 122.6)	835.9 (697.1, 1,013.3)	101.4 (84.9, 122.4)	0.0 (0.0, 0.1)
Cardiomyopathy and myocarditis	857.4 (765.6, 942.4)	195.0 (175.9, 211.1)	1,165.4 (1,070.8, 1,262.6)	142.2 (130.6, 154.1)	−1.0 (−1.4, −0.6)
Endocarditis	133.4 (105.6, 150.9)	28.3 (23.3, 31.6)	207.6 (182.7, 230.9)	25.6 (22.3, 28.4)	−0.3 (−0.4, −0.2)
Hypertensive heart disease	1,547.4 (1,231.1, 1,731.2)	406.5 (328.9, 452.2)	2,546.2 (2,149.3, 2,804.8)	301.6 (255.1, 332.1)	−1.0 (−1.0, −0.9)
Ischemic heart disease	11,916.3 (11,454.8, 12,345.5)	3,107.6 (2,966.5, 3,222.7)	18,836.1 (17,703.7, 19,815.4)	2,212.2 (2,075.5, 2,327.6)	−1.1 (−1.2, −0.9)
Non-rheumatic valvular heart disease	179.2 (164.6, 196.7)	49.3 (45.3, 54.2)	323.8 (293.4, 359.4)	39.7 (35.8, 44.1)	−0.7 (−0.8, −0.6)
Other cardiovascular and circulatory diseases	664.2 (564.7, 766.9)	147.5 (128.0, 169.5)	998.6 (838.6, 1,210.7)	121.5 (102.6, 145.8)	−0.6 (−0.7, −0.5)
Lower extremity peripheral arterial disease	91.3 (75.5, 118.0)	26.6 (22.3, 33.8)	155.8 (126.7, 204.6)	18.6 (15.2, 24.2)	−1.2 (−1.5, −0.9)
Rheumatic heart disease	1,628.0 (1,370.7, 1,917.7)	347.5 (292.5, 409.6)	1,342.6 (1,151.7, 1,578.0)	162.1 (139.1, 190.5)	−2.5 (−2.5, −2.4)
Stroke	12,140.5 (11,472.2, 12,762.5)	3,079.0 (2,893.6, 3,237.3)	16,045.7 (14,778.1, 17,164.3)	1,886.2 (1,739.0, 2,017.9)	−1.6 (−1.7, −1.5)

Abbreviation: CVD=cardiovascular disease; SDI=socio-demographic index; DALYs=disability-adjusted life years; ASDR=age standardized DALY rate; *UI*=uncertainty interval; *CI*=confidence interval; AAPC=average annual percent change.

DALYs and 36 countries observing a similar increase for stroke DALYs. Notably, the rise in DALYs related to aging between 1990 and 2021 was less than 5.0% for most diseases (Table 3).

Globally, the reduction in total CVD DALYs due to decreased DALY rates (−151.7 million) surpassed the increase caused by population aging (138.2 million) from 1990 to 2021, with an R_1 value of −1.1. R_1 values varied, with −1.7 in high SDI regions and −14.7 in low SDI regions (Figure 2 and Table 2). Out of 174 countries that saw an increase in DALYs due to population aging, 103 recorded R_1 values of ≤−1, 64 reported values between −1 and 0, and 7 had values greater than 0 (Supplementary Table S1). On a global scale, the increase in DALYs due to population growth was greater than that due to aging (Figure 2). Among the countries studied, 1 had R_2 values of ≤−1, 33 ranged between −1 and 0, and 140 had R_2 values greater than 0. R_2 values ranged from −1.0 in Georgia to 353.6 in Democratic Republic of the Congo (Supplementary Table S1).

DISCUSSION

This study examined the burden of CVD and its trends from 1990 to 2021, concentrating on the changes in DALYs that resulted from population aging, using a decomposition method. During this period, the global ASDR decreased by 1.3%, whereas the global DALYs attributable to total CVD increased by 44.0%. Significant variations in DALY changes associated with population aging were observed across SDI categories, regions, countries, and types of CVD. Given the influence of population aging on the escalating burden of CVD, there was an urgent need for increased investments in healthcare infrastructure, enhancements

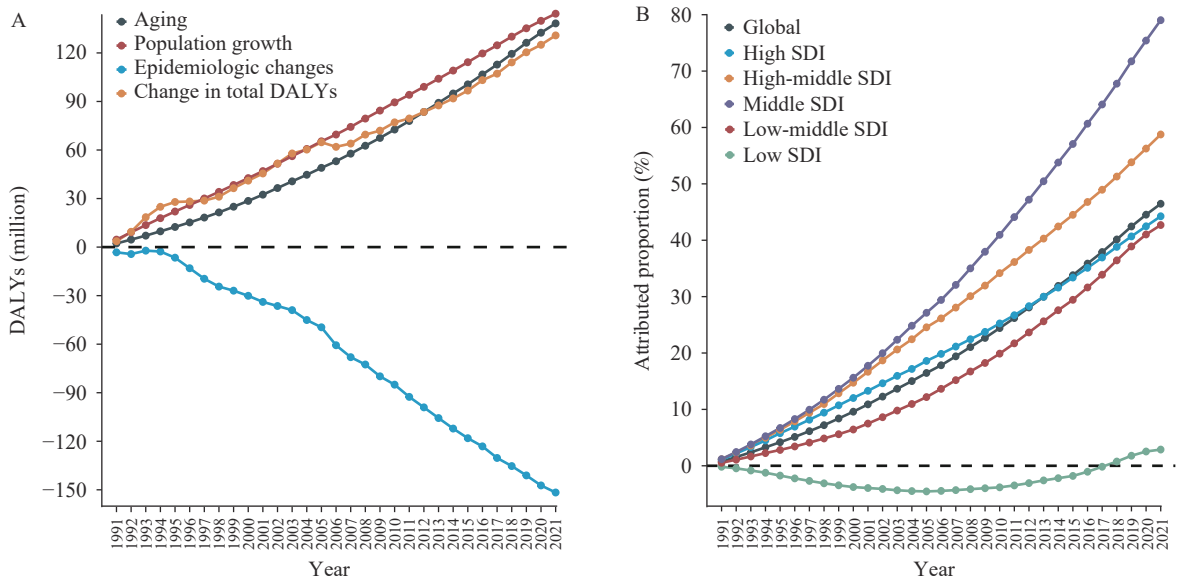

FIGURE 2. Changes in DALYs attributed to population aging, population growth, and DALY rate changes. (A) Global DALYs changes associated with population aging, population growth, and DALY rate changes from 1990 to 2021. (B) Proportion of DALYs associated with population aging globally and by SDI, 1990–2021.
Note: A decomposition analysis was conducted using the number of DALYs in 1990 as the reference year. The attributable proportion of DALYs was calculated as the number of DALYs due to population aging divided by the total DALYs in 1990, then multiplied by 100%.
Abbreviation: DALYs=disability-adjusted life years; SDI=socio-demographic index.

in screening and early intervention programs for high-risk elderly populations, and the implementation of public health education campaigns to foster awareness and encourage healthy lifestyles.

The analysis highlighted global disparities in the burden and trends of CVD. ASDRs had declined in most countries, whereas DALYs saw an increase from 1990 to 2021. For example, China witnessed a 58.5% surge in CVD-related DALYs, escalating from 63.2 million in 1990 to 100.2 million in 2021. This rise was linked to rapid economic transformation, industrialization, urbanization, and globalization in developing nations over the past 32 years. These developments markedly altered lifestyles and diets, consequently contributing to the increase in CVD. Simultaneously, China had advanced the standardization of clinical pathways for major CVDs, which shortened hospital stays, improved the quality of care, enhanced treatment effectiveness, and significantly boosted patient survival rates (*4*). These advancements provide valuable experience for the development of CVD prevention and control strategies in China, underscoring the importance of comprehensive reforms in healthcare systems, social security, and risk factor management.

Population aging correlates with a consistent increase in DALYs, which is mainly due to higher DALY rates among the elderly and an expanding older population segment. Aging results in a gradual decline in physiological integrity, diminished function, and an elevated vulnerability to diseases and mortality in older age groups. Although social advancements and enhancements in healthcare services have extended life expectancy, the effects of population aging differ significantly by region and country. Regions with higher SDI benefit from superior education, healthcare systems, and policy priorities, facilitating more efficient management of disease burdens. Conversely, regions with lower SDI, which are hampered by inadequate healthcare infrastructure, find it challenging to effectively mitigate disease burdens. As low-income countries progress, they encounter challenges linked to population aging and should draw lessons from the experiences of high-income nations (e.g., equitable healthcare, drug availability, and fertility policies) to allocate resources towards proven health interventions that promote healthy aging (*5*).

Despite the challenges posed by an aging population, the increase in DALYs for total CVD and specific categories has been mitigated by decreasing DALY rates over time. This favorable outcome likely results from reduced risk-attribution rates that

TABLE 2. Comparative contributions of change in DALY rates and population growth versus population aging to the change in the number of CVD DALYs between 1990 and 2021.

Characteristics	Population aging No. ×10^4	Population growth No. ×10^4	DALY rate change No. ×10^4	R_1	R_2
Total	13,824.4	14,424.3	−15,166.7	−1.1	1.0
Types of CVD					
Aortic aneurysm	74.3	122.2	−74.2	−1.0	1.6
Atrial fibrillation and flutter	148.1	349.4	2.6	0.0	2.4
Cardiomyopathy and myocarditis	221.9	399.8	−313.8	−1.4	1.8
Endocarditis	28.9	65.3	−19.9	−0.7	2.3
Hypertensive heart disease	659.7	1,001.0	−661.9	−1.0	1.5
Ischemic heart disease	4,645.6	7,587.6	−5,313.5	−1.1	1.6
Non-rheumatic valvular heart disease	86.4	120.9	−62.4	−0.7	1.4
Other cardiovascular and circulatory diseases	177.3	321.0	−163.9	−0.9	1.8
Lower extremity peripheral arterial disease	20.0	90.1	−45.6	−2.3	4.5
Rheumatic heart disease	283.8	623.0	−1,192.1	−4.2	2.2
Stroke	5,523.8	5,676.4	−7,295.0	−1.3	1.0
SDI					
High	2,648.1	1,324.1	−4,617.8	−1.7	0.5
High-middle	4,674.5	1,877.7	−4,719.5	−1.0	0.4
Middle	6,459.7	3,959.1	−4,340.6	−0.7	0.6
Low-middle	2,348.9	3,776.3	−1,747.2	−0.7	1.6
Low	60.3	2,260.6	−884.2	−14.7	37.5
Region					
East Asia	6,540.8	1,671.1	−4,384.5	−0.7	0.3
Southeast Asia	1,562.5	1,294.5	−682.1	−0.4	0.8
Oceania	9.4	41.6	−10.3	−1.1	4.4
Central Asia	126.3	189.0	−140.8	−1.1	1.5
Central Europe	732.9	−115.0	−925.2	−1.3	−0.2
Eastern Europe	1,020.3	−269.1	−730.7	−0.7	−0.3
High-income Asia Pacific	742.2	58.5	−788.5	−1.1	0.1
Australasia	55.4	53.1	−128.2	−2.3	1.0
Western Europe	1,093.5	350.5	−2,408.9	−2.2	0.3
Southern Latin America	98.1	91.7	−231.3	−2.4	0.9
High-income North America	657.7	539.0	−1,124.7	−1.7	0.8
Caribbean	95.3	71.6	−81.8	−0.9	0.8
Andean Latin America	55.9	73.7	−76.4	−1.4	1.3
Central Latin America	384.1	270.0	−213.4	−0.6	0.7
Tropical Latin America	508.3	349.3	−627.9	−1.2	0.7
North Africa and Middle East	913.9	1,675.2	−1,425.4	−1.6	1.8
South Asia	2,552.3	3,599.6	−1,353.4	−0.5	1.4
Central Sub−Saharan Africa	−2.0	293.5	−93.9	−	−
Eastern Sub−Saharan Africa	27.6	685.0	−313.4	−11.4	24.8
Southern Sub−Saharan Africa	70.6	102.1	−2.6	0.0	1.4
Western Sub−Saharan Africa	−104.4	982.1	−322.7	−	−

Note: In countries where population aging corresponded with a rise in DALYs from 1990 to 2021, we calculated R_1 and R_2. R_1 was determined by the equation "DALYs attributed to changes in DALY rate / DALYs attributed to population aging," while R_2 was computed as "DALYs attributed to population growth / DALYs attributed to population aging."
Abbreviation: CVD=cardiovascular disease; SDI=socio-demographic index; DALYs=disability-adjusted life years.

TABLE 3. Number of countries and territories with different increases in cause-specific proportions of DALYs associated with population aging between 1990 and 2021.

Cause of cardiovascular diseases DALYs	Increase in attributed proportion of DALYs (number of countries/territories)					
	1.0%–5.0%	5.1%–10.0%	10.1–15.0%	15.1–20.0%	20.1–25.0%	≥25.1%
Ischemic heart disease	16	25	23	35	22	42
Stroke	14	29	33	34	30	36
Hypertensive heart disease	97	20	2	0	0	0
Atrial fibrillation and flutter	43	0	0	0	0	0
Cardiomyopathy and myocarditis	62	1	0	0	0	0
Other cardiovascular and circulatory diseases	60	2	0	0	0	0
Rheumatic heart disease	30	1	0	0	0	0
Aortic aneurysm	14	0	0	0	0	0
Non-rheumatic valvular heart disease	18	0	0	0	0	0
Lower extremity peripheral arterial disease	0	0	0	0	0	0
Endocarditis	1	0	0	0	0	0

Note: The attributed proportion was calculated as the number of DALYs attributed to population aging for each cause of DALYs between 1990 and 2021 divided by total DALYs in 1990 ×100%. Countries and territories with an attribution rate of <1.0% were ignored.
Abbreviation: DALYs=disability-adjusted life years.

effectively counterbalance the DALYs increase due to aging. This reflects advancements in the prevention and control of diseases such as stroke and peripheral artery disease (*6*). However, progress has been uneven across different disease categories. To sustain these gains, significant investments are necessary to improve disease monitoring, early warning systems, and healthcare infrastructure, especially in regions where the effects of population aging surpass the reductions in DALY rates. It is crucial to implement continuous, cost-effective interventions and policies to meet the 2030 goal of a ≥30% reduction in premature noncommunicable disease mortality (*7*). Enhancing primary prevention through better control of risk factors, improving access to early screening and diagnosis for timely treatment, and strengthening healthcare capacity, particularly in primary healthcare services, are essential steps.

This study is subject to some limitations. First, the findings were contingent on the quality of DALYs and population estimates from the GBD 2021, which might be subject to bias stemming from variations in population-based studies and access to CVD diagnostics across different countries. Second, factors such as increasing life expectancy and declining fertility rates were not examined due to data constraints, although these are known to be associated with the rising burden of DALYs due to population aging. Lastly, our methodology only incorporated three variables and did not account for additional factors like lifestyle and healthcare accessibility.

In conclusion, the global burden of CVD has been profoundly influenced by demographic shifts. From 1990 to 2021, the global burden of CVD DALYs increased due to population aging, with variations observed across SDI levels, regions, countries, and types of CVD. Notably, significant reductions in DALY rates in certain regions largely mitigated the increases. Addressing the impact of aging populations requires collaborative efforts from stakeholders, policymakers, and researchers. Strategies may include promoting healthy lifestyles, adjusting fertility policies, enhancing healthcare access, and implementing interventions aimed at reducing CVD risk factors among the elderly.

Conflicts of interest: No conflicts of interest

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SUPPLEMENTAL MATERIAL

A positive contribution indicated an increase in overall DALYs, while a negative contribution signified a decrease. In nations where population aging correlated with higher DALYs from 1990 to 2021, we determined the ratio (R_1) of DALYs resulting from changes in DALY rates to those due to population aging to evaluate their relative impacts on the total DALYs. An R_1 value less than -1 implies that decreases in DALY rates had a greater impact on reducing total DALYs compared to the increase caused by population aging; an R_1 value of −1 means the impacts of DALY rate reductions and population aging are balanced; an R_1 value between −1 and 0 indicates that the effect of DALY rate reductions is lesser than that of population aging; an R_1 value greater than 0 indicates that both changes in DALY rates and population aging contributed to increases in DALYs during that period. Furthermore, to assess the relative contributions of population growth versus population aging on changes in total DALYs, the ratio (R_2) of DALYs attributed to population growth vs. those attributed to population aging was calculated.

SUPPLEMENTARY TABLE S1. Proportion of DALYs associated with population aging and comparative contributions from 1990 to 2021 across 204 countries and territories.

Characteristics	DALYs in 1990 No.×10^4	Population aging No. ×10^4	Population growth No. ×10^4	DALY rate change No. ×10^4	Proportion of DALYs attributed to population aging (%)	R_1	R_2
Afghanistan	123.8	−95.3	176.0	−59.2	−77.0	–	–
Albania	15.6	20.7	−4.6	−7.9	132.4	−0.4	−0.2
Algeria	120.2	88.0	93.2	−92.4	73.2	−1.1	1.1
American Samoa	0.2	0.2	0.0	0.0	82.2	0.0	0.0
Andorra	0.2	0.1	0.1	−0.2	84.2	−2.0	1.0
Angola	44.0	−1.7	79.6	−29.1	−3.9	–	–
Antigua and Barbuda	0.4	0.1	0.2	−0.2	27.1	−2.0	2.0
Argentina	221.4	53.0	67.8	−162.5	23.9	−3.1	1.3
Armenia	23.6	16.3	−3.4	−10.8	69.0	−0.7	−0.2
Australia	98.7	47.0	43.6	−106.6	47.7	−2.3	0.9
Austria	70.3	21.3	9.0	−54.0	30.3	−2.5	0.4
Azerbaijan	55.3	23.3	24.7	−22.7	42.2	−1.0	1.1
Bahamas	1.2	0.8	0.7	−0.6	69.0	−0.8	0.9
Bahrain	2.1	1.7	3.7	−3.6	83.4	−2.1	2.2
Bangladesh	515.9	400.6	292.0	−310.3	77.7	−0.8	0.7
Barbados	1.6	0.6	0.3	−0.8	39.6	−1.3	0.5
Belarus	123.9	44.9	−15.4	−9.0	36.3	−0.2	−0.3
Belgium	71.6	20.6	8.6	−57.2	28.8	−2.8	0.4
Belize	0.5	0.2	0.7	−0.3	45.9	−1.5	3.5
Benin	16.0	−1.7	24.6	−6.6	−10.6	–	–
Bermuda	0.5	0.3	0.0	−0.4	76.9	−1.3	0.0
Bhutan	1.9	1.6	0.5	−0.9	82.2	−0.6	0.3
Bolivia	25.1	11.1	19.2	−20.7	44.2	−1.9	1.7
Bosnia and Herzegovina	31.8	27.4	−10.8	−14.8	86.2	−0.5	−0.4
Botswana	4.7	2.3	3.7	−3.0	49.3	−1.3	1.6
Brazil	688.7	502.8	337.8	−622.4	73.0	−1.2	0.7
Brunei Darussalam	0.9	0.6	0.7	−0.8	73.4	−1.3	1.2
Bulgaria	149.1	73.1	−36.2	−52.0	49.0	−0.7	−0.5
Burkina Faso	31.4	−3.6	39.6	−5.9	−11.4	–	–

Continued

Characteristics	DALYs in 1990 No.×10^4	Population aging No. ×10^4	Population growth No. ×10^4	DALY rate change No. ×10^4	Proportion of DALYs attributed to population aging (%)	R_1	R_2
Burundi	28.1	−2.9	29.1	−20.3	−10.2	–	–
Cabo Verde	1.3	0.3	0.8	0.0	25.3	0.0	2.7
Cambodia	45.3	30.1	32.2	−24.6	66.6	−0.8	1.1
Cameroon	35.8	−3.2	68.6	−5.8	−8.9	–	–
Canada	147.4	77.9	50.6	−132.2	52.8	−1.7	0.6
Central African Republic	14.9	−0.3	13.4	−4.2	−2.2	–	–
Chad	23.0	−11.1	39.1	−0.5	−48.3	–	–
Chile	48.7	34.4	19.9	−47.3	70.6	−1.4	0.6
China	6,325.4	6,367.8	1,615.9	−4,288.3	100.7	−0.7	0.3
Colombia	105.0	97.2	57.6	−104.4	92.5	−1.1	0.6
Comoros	1.7	0.9	1.1	−1.0	48.8	−1.1	1.2
Congo	13.2	2.7	14.8	−7.3	20.1	−2.7	5.5
Cook Islands	0.1	0.1	0.0	−0.1	81.9	−1.0	0.0
Costa Rica	7.6	7.1	4.9	−6.0	92.9	−0.8	0.7
Cote d'Ivoire	38.3	10.7	49.3	−10.7	27.8	−1.0	4.6
Croatia	53.2	32.2	−7.1	−41.3	60.6	−1.3	−0.2
Cuba	64.3	45.0	2.9	−33.2	70.1	−0.7	0.1
Cyprus	5.1	3.8	3.4	−7.2	74.5	−1.9	0.9
Czechia	139.7	52.2	3.8	−114.4	37.3	−2.2	0.1
North Korea	126.5	83.9	45.5	−5.8	66.3	−0.1	0.5
Democratic Republic of the Congo	145.6	0.5	176.8	−50.7	0.4	−101.4	353.6
Denmark	48.1	9.9	4.9	−41.0	20.5	−4.1	0.5
Djibouti	1.1	0.9	2.5	−0.6	81.9	−0.7	2.8
Dominica	0.4	0.2	0.0	−0.1	40.3	−0.5	0.0
Dominican Republic	24.7	19.3	16.9	−2.9	78.0	−0.2	0.9
Ecuador	26.6	17.1	22.1	−18.3	64.2	−1.1	1.3
Egypt	530.0	90.4	417.3	−295.9	17.1	−3.3	4.6
El Salvador	14.9	8.4	3.5	−6.9	56.7	−0.8	0.4
Equatorial Guinea	2.3	−0.8	4.2	−2.2	−33.7	–	–
Eritrea	13.7	4.1	11.8	−7.8	30.0	−1.9	2.9
Estonia	22.0	9.1	−3.2	−16.5	41.6	−1.8	−0.4
Eswatini	2.4	0.9	1.2	0.0	38.5	0.0	1.3
Ethiopia	183.9	10.8	159.2	−156.4	5.9	−14.5	14.7
Fiji	5.4	3.0	1.3	−1.7	56.6	−0.6	0.4
Finland	48.0	22.2	4.5	−39.1	46.3	−1.8	0.2
France	321.5	142.9	43.7	−240.9	44.5	−1.7	0.3
Gabon	5.1	−0.1	3.8	−1.8	−1.1	–	–
Gambia	3.2	0.7	4.8	−0.1	22.1	−0.1	6.9
Georgia	71.1	24.2	−24.5	−28.4	34.1	−1.2	−1.0
Germany	785.9	279.1	45.5	−593.7	35.5	−2.1	0.2
Ghana	69.5	16.2	83.3	−33.6	23.4	−2.1	5.1

Continued

Characteristics	DALYs in 1990 No.×10^4	Population aging No. ×10^4	Population growth No. ×10^4	DALY rate change No. ×10^4	Proportion of DALYs attributed to population aging (%)	R_1	R_2
Greece	83.4	51.1	−1.8	−59.4	61.3	−1.2	0.0
Greenland	0.3	0.2	0.0	−0.3	63.8	−1.5	0.0
Grenada	0.6	0.2	0.1	−0.3	27.4	−1.5	0.5
Guam	0.6	0.7	0.1	−0.3	111.0	−0.4	0.1
Guatemala	18.9	12.8	17.0	−14.1	68.0	−1.1	1.3
Guinea	28.6	−8.8	30.4	−4.3	−30.6	–	–
Guinea−Bissau	5.7	−0.5	5.2	−1.9	−8.2	–	–
Guyana	5.6	2.9	−0.1	−2.9	51.9	−1.0	0.0
Haiti	51.3	6.3	46.3	−24.3	12.3	−3.9	7.3
Honduras	12.6	8.1	17.7	1.7	64.7	0.2	2.2
Hungary	154.1	51.9	−10.6	−92.9	33.7	−1.8	−0.2
Iceland	1.4	0.5	0.4	−1.2	38.8	−2.4	0.8
India	3,689.0	2,092.5	2,707.6	−1,041.9	56.7	−0.5	1.3
Indonesia	904.0	618.5	571.2	−62.7	68.4	−0.1	0.9
Iran	242.5	212.6	129.4	−211.7	87.6	−1.0	0.6
Iraq	104.6	39.5	126.6	−54.4	37.8	−1.4	3.2
Ireland	26.9	8.8	7.5	−28.7	32.8	−3.3	0.9
Israel	23.9	8.4	16.7	−29.7	35.0	−3.5	2.0
Italy	395.7	214.2	19.8	−312.6	54.1	−1.5	0.1
Jamaica	9.7	4.2	1.9	−3.0	42.9	−0.7	0.5
Japan	562.6	573.0	9.8	−545.7	101.8	−1.0	0.0
Jordan	13.2	11.0	27.3	−21.1	83.2	−1.9	2.5
Kazakhstan	129.6	26.1	20.1	−29.9	20.1	−1.1	0.8
Kenya	38.1	14.5	50.2	2.1	38.1	0.1	3.5
Kiribati	0.5	0.1	0.3	−0.1	23.4	−1.0	3.0
Kuwait	4.9	4.5	8.3	−5.8	92.3	−1.3	1.8
Kyrgyzstan	30.7	1.7	14.8	−10.3	5.7	−6.1	8.7
Laos	33.5	9.3	22.6	−22.7	27.8	−2.4	2.4
Latvia	39.4	16.1	−11.7	−18.1	40.8	−1.1	−0.7
Lebanon	20.1	10.2	14.2	−23.8	50.9	−2.3	1.4
Lesotho	5.0	0.2	1.4	3.0	3.9	15.0	7.0
Liberia	11.0	−2.2	11.3	−3.2	−19.5	–	–
Libya	16.5	8.5	12.4	0.7	51.2	0.1	1.5
Lithuania	41.9	22.5	−11.7	−19.5	53.6	−0.9	−0.5
Luxembourg	3.1	0.4	1.3	−2.7	14.2	−6.4	2.7
Madagascar	63.7	−3.4	80.0	−18.9	−5.3	–	–
Malawi	30.0	−0.5	27.9	−3.7	−1.6	–	–
Malaysia	78.5	59.2	70.7	−40.7	75.5	−0.7	1.2
Maldives	1.0	0.7	1.2	−1.6	72.1	−2.3	1.7
Mali	31.0	−7.1	44.7	−14.2	−22.9	–	–
Malta	2.5	1.9	0.5	−2.8	74.7	−1.5	0.3
Marshall Islands	0.3	0.2	0.1	0.0	71.4	0.0	0.5

Continued

Characteristics	DALYs in 1990 No.×10^4	Population aging No. ×10^4	Population growth No. ×10^4	DALY rate change No. ×10^4	Proportion of DALYs attributed to population aging (%)	R_1	R_2
Mauritania	9.9	0.3	9.4	−5.4	2.7	−18.0	31.3
Mauritius	7.8	6.5	1.3	−7.3	82.7	−1.1	0.2
Mexico	177.0	175.9	118.9	−52.2	99.3	−0.3	0.7
Micronesia	0.8	0.4	0.0	−0.2	45.6	−0.5	0.0
Monaco	0.3	0.0	0.1	−0.2	10.9	–	–
Mongolia	12.9	5.6	6.9	−7.3	43.0	−1.3	1.2
Montenegro	4.9	2.7	−0.1	0.2	54.4	0.1	0.0
Morocco	174.7	102.5	89.6	−65.5	58.7	−0.6	0.9
Mozambique	47.0	−13.7	59.5	6.0	−29.0	–	–
Myanmar	329.6	137.9	122.6	−211.2	41.8	−1.5	0.9
Namibia	5.4	1.6	4.0	−1.4	29.4	−0.9	2.5
Nauru	0.1	0.0	0.0	0.0	14.0	–	–
Nepal	81.6	42.4	51.1	−36.1	52.0	−0.9	1.2
Netherlands	96.9	38.6	12.6	−82.0	39.8	−2.1	0.3
New Zealand	22.5	8.4	9.4	−21.6	37.2	−2.6	1.1
Nicaragua	6.8	5.2	5.4	−3.8	76.0	−0.7	1.0
Niger	24.7	−1.1	43.9	−14.9	−4.3	–	–
Nigeria	369.6	−85.5	447.3	−199.8	−23.1	–	–
Niue	0.0	0.0	0.0	0.0	–	–	–
North Macedonia	19.6	10.9	2.0	−7.6	55.3	−0.7	0.2
Northern Mariana Islands	0.2	0.2	0.0	0.0	113.1	0.0	0.0
Norway	37.8	4.3	7.3	−31.4	11.3	−7.3	1.7
Oman	9.2	2.6	10.4	−9.0	28.3	−3.5	4.0
Pakistan	448.9	29.6	527.5	42.5	6.6	1.4	17.8
Palau	0.1	0.1	0.0	0.0	78.2	0.0	0.0
Palestine	10.0	1.4	12.3	−8.2	13.7	−5.9	8.8
Panama	6.4	4.4	5.4	−4.3	68.7	−1.0	1.2
Papua New Guinea	21.7	3.9	32.8	−6.4	18.1	−1.6	8.4
Paraguay	12.7	6.7	10.3	−5.5	52.9	−0.8	1.5
Peru	51.0	27.3	33.4	−37.9	53.5	−1.4	1.2
Philippines	242.1	152.6	233.8	−9.8	63.0	−0.1	1.5
Poland	424.2	196.0	0.7	−325.4	46.2	−1.7	0.0
Portugal	85.3	52.1	3.6	−89.2	61.1	−1.7	0.1
Puerto Rico	17.0	14.8	−1.7	−15.0	87.2	−1.0	−0.1
Qatar	1.3	0.9	5.5	−3.8	67.5	−4.2	6.1
Republic of Korea	177.2	217.3	31.9	−275.4	122.6	−1.3	0.1
Moldova	44.3	27.3	−9.9	−18.3	61.5	−0.7	−0.4
Romania	284.5	167.5	−59.7	−139.8	58.9	−0.8	−0.4
Russian Federation	1,901.1	673.9	−80.5	−600.6	35.4	−0.9	−0.1
Rwanda	37.9	7.5	24.5	−35.6	19.8	−4.7	3.3
Saint Kitts and Nevis	0.4	0.1	0.1	−0.3	22.6	−3.0	1.0

Continued

Characteristics	DALYs in 1990 No.×10^4	Population aging No. ×10^4	Population growth No. ×10^4	DALY rate change No. ×10^4	Proportion of DALYs attributed to population aging (%)	R_1	R_2
Saint Lucia	0.7	0.7	0.2	−0.7	96.2	−1.0	0.3
Saint Vincent and the Grenadines	0.6	0.4	0.0	−0.3	71.4	−0.8	0.0
Samoa	0.9	0.3	0.3	−0.1	34.3	−0.3	1.0
San Marino	0.1	0.1	0.0	−0.1	57.4	−1.0	0.0
Sao Tome and Principe	0.4	0.0	0.3	0.0	−2.8	–	–
Saudi Arabia	67.1	42.9	98.5	−27.2	64.0	−0.6	2.3
Senegal	31.6	5.6	31.8	−12.0	17.6	−2.1	5.7
Serbia	115.4	78.1	−9.4	−70.0	67.7	−0.9	−0.1
Seychelles	0.5	0.2	0.2	−0.3	38.0	−1.5	1.0
Sierra Leone	21.0	−3.5	20.4	−5.4	−16.6	–	–
Singapore	13.8	12.1	10.9	−22.4	87.9	−1.9	0.9
Slovakia	60.4	25.5	1.6	−38.1	42.2	−1.5	0.1
Slovenia	15.5	8.6	0.7	−13.7	55.6	−1.6	0.1
Solomon Islands	2.1	0.8	2.3	−0.3	38.9	−0.4	2.9
Somalia	26.5	−1.4	38.3	−14.1	−5.1	–	–
South Africa	124.6	58.6	76.0	−15.1	47.0	−0.3	1.3
South Sudan	21.7	−1.6	12.3	−5.2	−7.6	–	–
Spain	227.4	119.3	36.5	−192.9	52.5	−1.6	0.3
Sri Lanka	78.1	63.6	26.6	−50.7	81.4	−0.8	0.4
Sudan	164.0	−3.2	150.1	−106.7	−1.9	–	–
Suriname	2.1	1.2	1.1	−1.2	59.6	−1.0	0.9
Sweden	81.0	13.5	12.9	−59.1	16.7	−4.4	1.0
Switzerland	44.9	13.7	10.6	−39.4	30.6	−2.9	0.8
Syrian Arab Republic	85.8	67.5	10.5	−38.9	78.7	−0.6	0.2
Taiwan (Province of China)	77.3	81.6	13.9	−87.0	105.5	−1.1	0.2
Tajikistan	29.4	3.2	23.3	−13.9	10.7	−4.3	−7.3
Thailand	180.6	223.3	42.8	−128.0	123.6	−0.6	0.2
Timor−Leste	2.7	2.0	2.6	−0.4	71.8	−0.2	1.3
Togo	12.0	5.1	16.4	−2.9	42.8	−0.6	3.2
Tokelau	0.0	0.0	0.0	0.0	–	–	–
Tonga	0.4	0.1	0.0	0.0	32.9	0.0	0.0
Trinidad and Tobago	7.4	5.8	1.3	−5.5	79.0	−0.9	0.2
Tunisia	38.8	33.5	19.2	−19.7	86.5	−0.6	0.6
Turkey	315.7	219.4	143.6	−267.8	69.5	−1.2	0.7
Turkmenistan	24.3	13.6	11.4	−2.9	55.8	−0.2	0.8
Tuvalu	0.1	0.0	0.0	0.0	18.1	–	–
Uganda	48.6	−4.6	60.7	−23.4	−9.4	–	–
Ukraine	714.6	237.2	−150.3	−46.0	33.2	−0.2	−0.6
United Arab Emirates	5.5	8.2	21.7	−16.3	148.9	−2.0	2.6
United Kingdom	552.3	91.3	74.7	−440.4	16.5	−4.8	0.8

Continued

Characteristics	DALYs in 1990 No.×10^4	Population aging No. ×10^4	Population growth No. ×10^4	DALY rate change No. ×10^4	Proportion of DALYs attributed to population aging (%)	R_1	R_2
Tanzania	76.8	5.8	91.8	−18.7	7.5	−3.2	15.8
USA	1,700.1	576.0	486.8	−986.9	33.9	−1.7	0.8
United States Virgin Islands	0.6	0.6	−0.1	−0.5	105.3	−0.8	−0.2
Uruguay	24.4	6.4	1.8	−14.9	26.3	−2.3	0.3
Uzbekistan	117.4	49.5	82.9	−19.0	42.2	−0.4	1.7
Vanuatu	1.1	0.5	1.2	−0.2	43.7	−0.4	2.4
Venezuela	64.8	73.5	36.1	−28.2	113.5	−0.4	0.5
Viet Nam	285.5	209.8	162.8	−71.9	73.5	−0.3	0.8
Yemen	83.1	17.3	108.4	−50.2	20.8	−2.9	6.3
Zambia	24.6	0.6	34.4	−4.0	2.5	−6.7	57.3
Zimbabwe	23.2	3.8	15.8	16.9	16.3	4.4	4.2

Note: For countries where population aging was associated with increases in DALYs between 1990 and 2021, we calculated the R_1 and R_2. R_1 was calculated as "DALYs attributed to DALY rate change / DALYs attributed to population aging"; R_2 was calculated as "DALYs attributed to population growth / DALYs attributed to population aging".
Abbreviation: DALYs=disability-adjusted life years.