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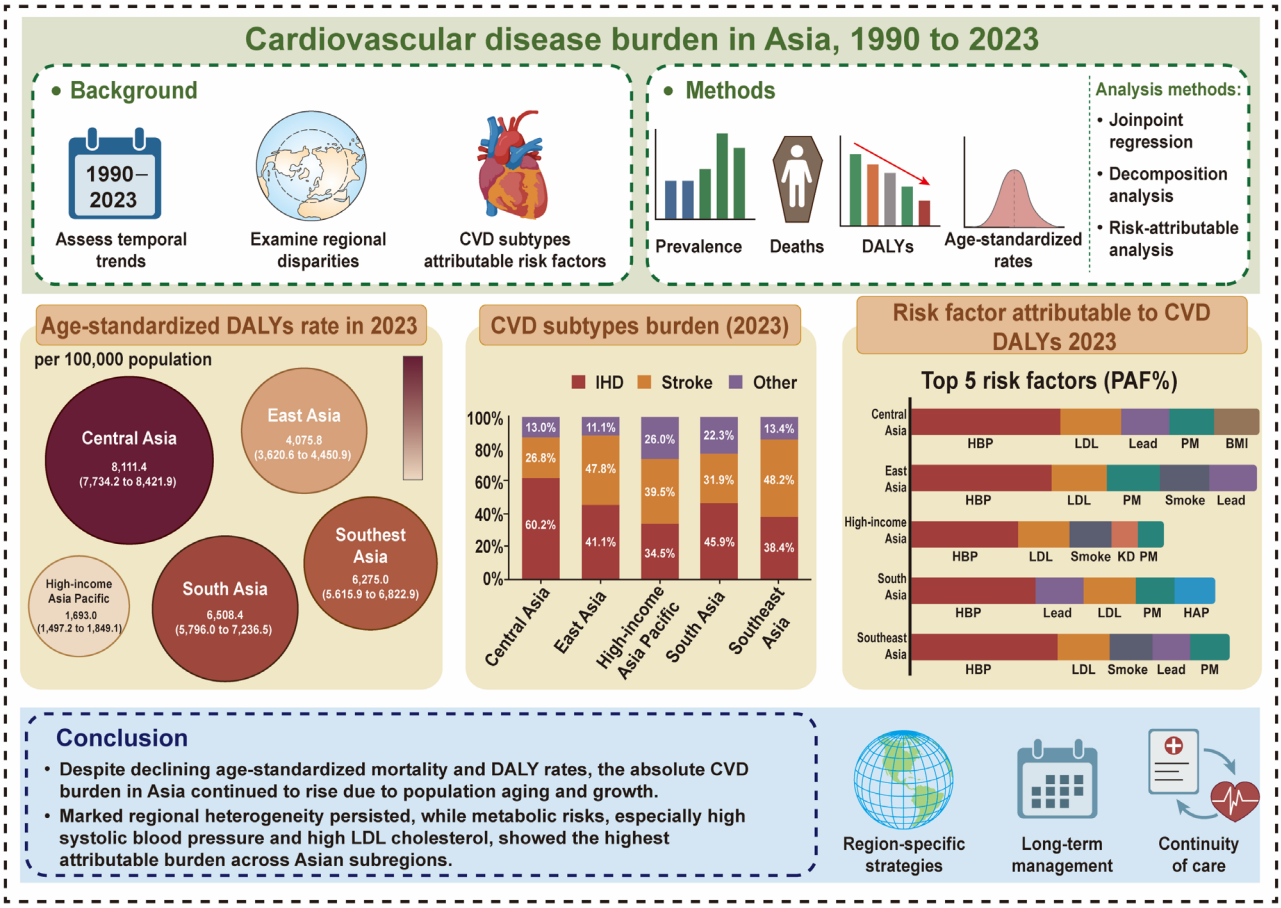
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The burden of cardiovascular diseases in Asia from 1990 to 2023

An analysis for the Global Burden of Disease Study 2023

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Graphical abstract



Supplemental Digital Content is available for this article.

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Abstract

Background: Cardiovascular diseases (CVDs) remain the leading cause of mortality and disability worldwide. Asia bears a disproportionate share of this burden, with substantial heterogeneity across subregions.

Methods: Using data from the Global Burden of Disease (GBD) 2023 Study, we assessed the burden of CVDs in Asia and its subregions from 1990 to 2023, including prevalence, deaths, and disability-adjusted life years (DALYs), stratified by age and sex. Temporal trends were evaluated using Joinpoint regression, and decomposition analysis was performed to quantify the contributions of population growth, aging, and epidemiological changes. Population attributable fractions of level 2 risk factors and rankings of the most detailed risk exposures were assessed across subregions. Estimates for prevalence, deaths, DALYs, and population attributable fractions with corresponding 95% uncertainty intervals (UI) were derived.

Results: From 1990 to 2023, age-standardized mortality rates (ASMR) and age-standardized DALY rates (ASDR) declined across all Asian subregions, whereas age-standardized prevalence rates remained stable or increased in several regions. Joinpoint regression analysis revealed transient increases in ASMR and ASDR during specific periods in certain subregions. In 2023, East Asia had the largest absolute burden (140.5 million cases [95% UI: 130.7–152.8]; 4.7 million deaths [95% UI: 4.1–5.2]), while South Asia recorded the highest DALYs (102.3 million [95% UI: 90.6–113.5]). Central Asia exhibited the highest age-standardized rates (ASMR: 400.7 [95% UI: 374.0–418.6]; ASDR: 8,111.4 [95% UI: 7,734.2–8,421.9] per 100,000), whereas high-income Asia Pacific had the lowest. Despite the declines in age-standardized rates, absolute CVD deaths increased in all subregions, with decomposition analysis showing this rise was primarily driven by population aging and population growth. Ischemic heart disease and stroke accounted for over 86% of deaths and DALYs in most subregions, with ischemic heart disease predominating in Central Asia and stroke contributing disproportionately in Southeast Asia. South Asia showed a notable burden of rheumatic heart disease, along with elevated early-life DALYs primarily driven by stroke and cardiomyopathy/myocarditis. Metabolic risk factors dominated across regions, with high systolic blood pressure and high low-density lipoprotein (LDL) cholesterol as the leading contributors.

Conclusions: Although age-standardized CVD mortality and DALYs have declined across Asia, the overall burden remains substantial and heterogeneous. Region-specific strategies targeting dominant risk factors are essential to effectively reduce CVD burden across diverse Asian populations.

Keywords: Asia, cardiovascular diseases, Global Burden of Disease Study, mortality, risk factors, temporal trends, disability-adjusted life years

Nonstandard Abbreviations and Acronyms

CVD	cardiovascular disease
DALY	disability-adjusted life year
ASMR	age-standardized mortality rate
ASDR	age-standardized DALY rate
GBD	Global Burden of Disease
ICD	International Classification of Diseases
CODEm	Cause of Death Ensemble modeling
GHDx	Global Health Data Exchange
LDL	low-density lipoprotein
PAF	population attributable fraction
APC	annual percent change
CI	confidence interval
UI	uncertainty interval
FAST	Face, Arms, Speech, Time

Highlights

- Despite declines in age-standardized CVD mortality and DALY rates across all Asian subregions from 1990 to 2023, absolute CVD deaths increased, primarily driven by population aging and population growth.
- East Asia bore the largest absolute burden, South Asia had the highest total DALYs, and Central Asia had the highest age-standardized rates.
- Ischemic heart disease and stroke dominated the CVD burden, with high systolic blood pressure and high LDL cholesterol as the leading risk factors.

1. Introduction

Cardiovascular diseases (CVDs) remain the leading cause of mortality and disability worldwide and have long been recognized as a major public health challenge, accounting for an estimated 19.2 million deaths globally and nearly one in three deaths in 2023.[1–3] Despite advances in prevention, diagnosis, and treatment, the burden of CVDs continues to grow, largely driven by population growth, population aging, and persistent exposure to modifiable risk factors such as obesity, tobacco use, and environmental factors.[1,4,5]

Asia is home to more than half of the global population and consequently bears a disproportionate share of the global CVD burden.[6] Previous analyses from the Global Burden of Disease (GBD) Study 2021 showed that Asia already accounted for over 60% of global CVD deaths and disability-adjusted life years (DALYs), with marked heterogeneity across subregions driven by disparities in socioeconomic development, population structure, health-system capacity, and exposure to cardiovascular risk factors.[6–10] Projections further indicated that this

burden will continue to rise through 2050 across major Asian subregions, highlighting the growing public health challenge in the region.[11]

Compared with GBD 2021, the GBD 2023 framework incorporates substantial advancements in data sources and estimation methods. These include the integration of thousands of additional data inputs, particularly vital registration, verbal autopsy, and survey data; improved correction for COVID-19 misclassification in cause-of-death modeling; more refined age-sex-specific modeling using enhanced OneMod approaches in demographics; and enhanced comparative risk assessment for risk-factor attribution with better subtype disaggregation.[12,13] Building upon the latest GBD 2023 estimates, this study aimed to comprehensively assess the temporal trends and regional patterns of CVD burden across Central Asia, East Asia, high-income Asia Pacific, South Asia, and Southeast Asia, stratified by age and sex from 1990 to 2023. By incorporating measures of prevalence, mortality, DALYs, and associated risk factors, we aimed to offer nuanced insights that are particularly relevant in the rapidly transitioning Asian landscape, where diverse epidemiological profiles, socioeconomic development stages, and shifting risk-factor patterns necessitate tailored prevention and control strategies.

2. Methods

2.1. Overview

The GBD Study provides standardized estimates of the burden of 375 diseases and injuries and 88 risk factors across 204 countries and territories from 1990 to 2023.[12–14] In this study, we obtained data on CVDs for Asia from GBD 2023 stratified by age, sex, year, subregion (Central Asia, East Asia, high-income Asia Pacific, South Asia, and Southeast Asia), and country. CVDs were further categorized into 12 specific subtypes according to the GBD cause hierarchy.[12] Data are publicly accessible via the Global Health Data Exchange (GHDx). Detailed descriptions of the GBD 2023 framework are available in the Methods, Supplemental Digital Content, https://links.lww.com/CARES/A22.

2.2. Data sources and measurements

Estimates of mortality for CVDs were derived from multiple data sources, including vital registration systems and verbal autopsy studies, with causes of death coded according to the International Classification of Diseases (ICD).[15] Deaths assigned to intermediate, implausible, or nonspecific causes were redistributed to underlying causes using standardized GBD algorithms to improve comparability across locations.[1,16] In the GBD 2023 study, CVDs were defined according to the GBD cause hierarchy (see **Supplementary** Table 1, Supplemental Digital Content, https://links.lww.com/CARES/A22) and included 12 specific causes: aortic aneurysm, atrial fibrillation and flutter, cardiomyopathy and myocarditis, endocarditis, hypertensive heart disease, ischemic heart disease, lower extremity peripheral arterial disease, non-rheumatic valvular heart disease, other cardiovascular and circulatory diseases, pulmonary arterial hypertension, rheumatic heart disease, and stroke.[1] Estimation of cause-specific mortality, a central component of the GBD Study, was conducted using the Cause of Death Ensemble modeling (CODEm) framework. This tool tests combinations of covariates using out-of-sample performance metrics and integrates them into an ensemble model to estimate mortality by cause, region, age, sex, and year.[13] Detailed information on all data sources is provided in **Supplementary** Table 2, Supplemental Digital Content, https://links.lww.com/CARES/A22.

Estimates of non-fatal CVD outcomes were derived from published scientific literature and population-based survey data. Detailed information is available through the Global Health Data Exchange.[17] These estimates were generated using DisMod-MR 2.1, a Bayesian meta-regression tool developed within the GBD framework, integrating heterogeneous epidemiological data through a modeling approach.[18] Detailed information on estimation for fatal and non-fatal outcomes is provided in Methods, Supplemental Digital Content, https://links.lww.com/CARES/A22.

2.3. Risk factor-attributable estimates

The GBD 2023 comparative risk assessment framework was applied to estimate the burden of CVDs attributable to risk factors. Within this framework, risk factors are organized into a four-level hierarchical structure, ranging from broad categories at level 1 (behavioral, environmental/occupational, and metabolic risks) to the most detailed specific exposures at level 4, based on robust epidemiological evidence, as also shown in **Supplementary** Table 1, Supplemental Digital Content, https://links.lww.com/CARES/A22.[17] In this study, the burden of CVDs and their subtypes was assessed using both level 2 risk factors, namely high systolic blood pressure, high fasting plasma glucose, high low-density lipoprotein (LDL) cholesterol, high body mass index, kidney dysfunction, tobacco use, high alcohol use, low physical activity, dietary risks, air pollution, other environmental risks, and non-optimal temperature, and the most detailed level 4 risk factors. Population attributable fractions (PAFs) for CVDs were estimated through a standardized analytical approach. Briefly, this approach integrates relative risks across exposure levels with corresponding exposure distributions by age, sex, location, and year, and compares them against theoretical minimum risk exposure levels to quantify the proportion of disease burden attributable to each risk factor, which are then used to estimate attributable deaths and DALYs.[19]

2.4. Statistical analysis

We conducted descriptive analyses to characterize the burden of CVDs in Asia from 1990 to 2023, stratified

by 12 specific CVD causes, subregion (Central Asia, East Asia, high-income Asia Pacific, South Asia, and Southeast Asia), country, age group, and sex. Age was categorized into 5-year intervals from 0–4 years to 80 + years. The burden of CVDs was assessed using three key measures, including prevalence, deaths, and DALYs. DALYs represent the sum of years of life lost due to premature mortality and years lived with disability, reflecting the overall health loss associated with a disease.[20] Moreover, we further evaluated temporal trends in the rankings and PAFs of risk factors to assess their evolving relative contributions and impact on the CVD burden in Asia.

Temporal trends were assessed using Joinpoint regression analysis to estimate annual percent change (APC). The Joinpoint Regression Program (Version 6.0.1, National Cancer Institute, Bethesda, Maryland) was applied to identify significant changes in temporal trends and to quantify segment-specific APCs.[21] Joinpoint regression fits a series of log-linear regression models to the time series data, in which the natural logarithm of the outcome is modeled as a function of calendar year. The optimal number of joinpoints was selected using a Monte Carlo permutation test, ensuring the best model fit while avoiding overfitting. For each identified segment, APC and its corresponding 95% confidence interval (CI) were calculated under the assumption of a constant rate of change within that segment. In this study, Joinpoint regression was conducted for CVDs from 1990 to 2023, stratified by measure and subregion.

In addition, decomposition analysis based on the Das Gupta method was performed to quantify the contributions of population growth, population aging, and epidemiological changes to the change in CVD deaths between 1990 and 2023, thereby identifying the primary determinants of the evolving CVD burden.[22] Briefly, the decomposition was based on the principle of counterfactual scenarios, where each factor is varied sequentially while holding others constant at the average of their values across the two time points to ensure that the sum of the components equals the total change. Specifically, changes in total deaths were decomposed into three components: (1) population growth, reflecting changes in total population size while holding age structure and age-specific mortality rates constant; (2) population aging, reflecting changes in the age distribution of the population while holding total population size and age-specific mortality rates constant; and (3) epidemiological change, reflecting changes in age-specific mortality rates over time while holding population size and age structure constant. The sum of the three components was compared with the observed change in total deaths to ensure internal consistency.

GBD estimates were based on multiple simulation draws, and the uncertainty interval (UI) was calculated as the 2.5th and 97.5th percentiles of the draws. All analyses were conducted using R (version 4.5.1). Detailed information on the estimation of uncertainty and APC analysis is provided in the Supplemental Digital Content, https://links.lww.com/CARES/A22.

3. Results

3.1. Overview of CVD burden in Asia from 1990 to 2023

From 1990 to 2023, age-standardized mortality rates (ASMR) and disability-adjusted life year rates (DALY) of CVDs declined across all five Asian subregions. In contrast, age-standardized prevalence rates (ASPR) did not show a consistent decrease, with slight increases or plateaus observed in East Asia, South Asia, and Southeast Asia (**Supplementary** Fig. 1, Supplemental Digital Content, https://links.lww.com/CARES/A22).

3.2. Regional distribution of CVD burden in 2023

Across Asia in 2023, the burden of CVDs varied substantially across subregions. East Asia had the largest absolute burden, with an estimated 140,535,710 (95% UI: 130,680,486–152,781,775) prevalence cases and 4,652,279 (95% UI: 4,000,015–5,163,851) deaths (Table 1). Meanwhile, South Asia exhibited a particularly heavy burden in terms of DALYs, recording 102,275,354 (90,617,094–113,484,540), exceeding the corresponding figure for East Asia. Furthermore, Central Asia consistently had the highest age-standardized rates across all three measures—prevalence at 11,642.4 (95% UI: 11,047.8–12,417.0), deaths at 400.7 (95% UI: 374.0–418.6), and DALYs at 8,111.4 (95% UI: 7,734.2–8,421.9) per 100,000 population—compared with the lowest rates in high-income Asia Pacific of 5,694.6 (95% UI: 5,380.9–6,073.3), 74.6 (95% UI: 61.7–82.4), and 1,693.0 (95% UI: 1,497.2–1,849.1), respectively. ASPRs were consistently higher in males than in females across all subregions, whereas for ASMR and ASDR, males generally had higher rates, except in some countries in South Asia and Southeast Asia (**Supplementary** Fig. 1, Supplemental Digital Content, https://links.lww.com/CARES/A22).

3.3. Changes in CVD burden across Asia, 1990 to 2023

From 1990 to 2023, trends in age-standardized rates displayed considerable heterogeneity across Asian countries, with marked improvements in many settings contrasted by stagnation or worsening in others (Supplementary Table 3, Supplemental Digital Content, https://links.lww.com/CARES/A22). As for prevalence, the majority of Asian countries experienced substantial declines from 1990 to 2023. In contrast, notable increases were observed in Bangladesh (6.4% [95% UI: 3.5–9.3]), the Democratic People's Republic of Korea (3.9% [95% UI: 0.3–7.7]), and China (2.2% [95% UI: 0.1–4.4]). Detailed APC analyses further demonstrated transient increases in ASPR in several subregions, with clear peaks observed in Central Asia during 1995 to 2000 (APC = 1.66%, 95% CI: 1.56%–1.75%), East Asia during 1995 to 2000 (APC = 2.12%, 95% CI: 1.97%–2.28%), and South Asia during 2005 to 2010 (APC = 1.20%, 95% CI:

Table 1

Numbers and age-standardized rates of cardiovascular diseases and their subtypes across Asian regions in 2023.

	Central Asia		East Asia		High-income Asia Pacific		South Asia		Southeast Asia	
	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate
Cardiovascular diseases										
Prevalence	10,834,195 (10,247,575–11,656,083)	11,642.4 (11,047.8–12,417.0)	140,535,710 (130,680,486–152,781,775)	6,188.7 (5,782.8–6,693.5)	24,312,356 (22,865,735–25,925,678)	5,694.6 (5,380.9–6,073.3)	96,421,644 (90,240,730–105,746,631)	5,973.7 (5,579.8–6,509.1)	38,591,055 (36,521,112–41,533,811)	5,395.9 (5,100.3–5,776.5)
Deaths	292,670 (276,256–303,203)	400.7 (374.0–418.6)	4,652,279 (4,000,015–5,163,851)	207.8 (178.7–232.0)	480,650 (378,049–543,084)	74.6 (61.7–82.4)	3,919,788 (3,423,034–4,398,496)	284.2 (244.9–317.7)	1,656,106 (1,486,627–1,802,514)	248.8 (223.0–271.9)
DALYs	6,862,456 (6,542,100–7,116,531)	8,111.4 (7,734.2–8,421.9)	92,696,322 (81,984,361–101,019,649)	4,075.8 (3,620.6–4,450.9)	8,167,041 (6,937,408–8,982,707)	1,693.0 (1,497.2–1,849.1)	102,275,354 (90,617,094–113,484,540)	6,508.4 (5,796.0–7,236.5)	45,769,889 (40,930,188–49,747,035)	6,275.0 (5,615.9–6,822.9)
Ischemic heart disease										
Prevalence	8,021,972 (7,341,037–8,918,598)	8,570.4 (7,872.1–9,472.4)	69,212,637 (57,747,931–82,049,689)	3,032.4 (2,566.7–3,600.9)	9,982,327 (8,472,332–11,531,323)	2,268.7 (1,972.1–2,630.7)	26,474,543 (22,753,176–31,334,161)	1,614.0 (1,386.6–1,922.0)	11,820,092 (10,246,949–13,606,370)	1,615.2 (1,403.1–1,850.5)
Deaths	184,978 (174,554–193,526)	256.7 (239.7–269.1)	2,037,695 (1,733,388–2,286,656)	92.1 (78.2–104.0)	167,901 (135,810–190,555)	27.1 (22.9–30.0)	1,835,689 (1,605,323–2,148,914)	129.9 (112.7–151.1)	650,837 (546,035–745,017)	96.8 (81.8–110.7)
DALYs	4,128,504 (3,910,376–4,317,830)	4,951.3 (4,666.8–5,168.7)	38,117,657 (33,932,217–41,913,288)	1,686.5 (1,493.9–1,847.3)	2,815,006 (2,399,066–3,112,564)	589.7 (521.6–645.3)	46,968,719 (40,795,944–55,773,516)	2,956.8 (2,566.9–3,480.3)	17,558,366 (14,794,890–20,114,493)	2,378.9 (2,006.0–2,724.6)
Stroke										
Prevalence	916,841 (879,606–952,673)	969.6 (930.4–1,011.6)	27,514,962 (24,930,361–30,540,582)	1,229.5 (1,119.0–1,358.4)	4,258,375 (3,960,112–4,577,816)	1,026.6 (962.0–1,097.6)	17,254,590 (15,774,548–18,915,080)	1,027.4 (937.8–1,130.0)	10,775,530 (10,117,586–11,467,074)	1,476.9 (1,388.6–1,571.9)
Deaths	78,143 (73,430–82,337)	105.8 (98.3–111.6)	2,116,810 (1,805,364–2,414,151)	92.8 (79.1–106.2)	180,137 (141,838–203,034)	28.2 (23.4–31.2)	1,284,043 (1,040,168–1,543,308)	93.7 (75.7–112.1)	795,936 (688,331–911,945)	119.5 (103.0–136.9)
DALYs	1,841,929 (1,726,421–1,937,812)	2,163.2 (2,020.1–2,281.6)	44,305,342 (39,078,141–49,454,601)	1,920.6 (1,699.3–2,134.1)	3,229,364 (2,704,999–3,548,374)	673.7 (588.3–734.1)	32,632,319 (25,922,580–38,671,099)	2,108.0 (1,675.1–2,508.3)	22,058,523 (19,077,246–25,031,380)	3,027.8 (2,633.2–3,445.5)
Hypertensive heart disease										
Prevalence	75,295 (53,959–105,219)	93.9 (65.9–131.6)	4,457,522 (3,423,852–5,706,649)	189.5 (147.2–240.9)	300,574 (220,976–397,401)	56.3 (42.7–71.4)	1,479,254 (1,145,695–1,898,787)	108.6 (84.4–139.6)	1,056,938 (842,460–1,336,094)	162.3 (129.8–205.2)
Deaths	13,042 (11,267–14,950)	18.4 (15.9–21.1)	317,129 (207,158–396,806)	14.4 (9.3–18.0)	25,303 (18,086–31,120)	3.4 (2.6–4.2)	309,748 (202,533–449,209)	25.5 (16.7–36.7)	127,170 (84,726–175,455)	19.5 (13.0–26.9)
DALYs	265,873 (234,486–305,729)	326.3 (285.5–372.8)	5,253,738 (3,682,446–6,359,564)	230.2 (159.4–279.6)	315,642 (247,375–378,743)	52.8 (42.8–63.9)	6,298,813 (4,150,856–9,041,246)	445.0 (294.8–641.2)	3,070,728 (2,042,936–4,240,923)	428.4 (287.2–586.7)

(Continued)

Table 1

Continued

	Central Asia		East Asia		High-income Asia Pacific		South Asia		Southeast Asia	
	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate
Rheumatic heart disease										
Prevalence	703,458 (566,128–854,805)	700.5 (566.3–849.6)	4,810,862 (4,074,311–5,604,140)	275.7 (232.5–322.6)	83,446 (71,055–97,881)	22.5 (19.5–25.9)	14,437,680 (11,405,186–17,716,055)	724.6 (575.5–889.5)	3,335,258 (2,642,325–4,050,433)	434.1 (345.6–528.5)
Deaths	2,427 (2,125–2,727)	2.6 (2.3–3.0)	59,236 (42,000–73,691)	2.6 (1.8–3.3)	5,430 (3,852–6,591)	0.7 (0.5–0.9)	238,737 (128,571–387,418)	15.5 (8.4–25.0)	13,410 (8,350–21,068)	1.8 (1.1–2.8)
DALYs	117,954 (99,268–137,299)	118.6 (99.9–138.1)	1,376,611 (1,088,266–1,642,908)	64.3 (50.8–77.9)	67,778 (50,945–79,562)	12.2 (9.8–14.0)	8,586,988 (5,041,153–13,365,002)	486.5 (280.1–764.3)	811,977 (536,342–1,185,330)	107.9 (71.4–157.8)
Atrial fibrillation and flutter										
Prevalence	532,303 (404,706–673,415)	661.5 (502.8–836.2)	12,802,796 (9,744,063–16,116,256)	541.5 (410.5–679.5)	2,226,186 (1,730,000–2,770,954)	464.1 (366.3–570.0)	8,377,712 (6,284,283–10,723,408)	600.0 (452.0–770.5)	3,994,202 (3,057,219–5,082,920)	610.3 (464.2–781.5)
Deaths	1,648 (1,500–1,793)	2.6 (2.4–2.9)	68,174 (54,675–78,901)	3.3 (2.6–3.8)	19,161 (14,613–22,100)	2.6 (2.1–3.0)	48,765 (36,217–67,852)	4.8 (3.5–6.7)	22,069 (17,009–27,473)	4.1 (3.1–5.1)
DALYs	66,285 (51,347–89,205)	86.5 (67.2–112.9)	1,816,458 (1,460,703–2,385,012)	79.8 (64.4–103.6)	389,224 (312,570–487,178)	70.7 (56.5–88.9)	1,351,948 (1,034,264–1,764,124)	106.6 (81.7–139.5)	621,244 (487,259–832,547)	99.8 (78.0–131.4)
Cardiomyopathy and myocarditis										
Prevalence	65,342 (54,986–76,346)	69.4 (57.8–81.4)	411,314 (340,493–484,660)	27.0 (22.3–31.7)	218,223 (180,785–262,947)	93.4 (80.4–109.3)	834,232 (671,212–989,807)	49.7 (40.7–58.7)	205,173 (169,312–239,664)	31.1 (25.4–36.9)
Deaths	7,418 (6,597–8,210)	8.2 (7.3–9.2)	17,280 (12,651–23,484)	0.9 (0.6–1.2)	10,783 (8,497–12,716)	1.9 (1.6–2.2)	90,430 (56,123–131,352)	6.5 (4.0–9.3)	18,557 (12,552–24,891)	2.9 (1.9–3.9)
DALYs	265,344 (237,451–290,044)	268.3 (240.7–293.7)	465,976 (348,982–609,321)	28.9 (21.8–37.4)	187,281 (157,400–216,663)	54.7 (48.2–61.7)	2,786,636 (1,713,547–4,103,467)	171.9 (106.2–251.4)	574,298 (385,053–772,109)	81.0 (54.5–108.8)
Non-rheumatic valvular heart disease										
Prevalence	524,930 (453,271–614,390)	642.5 (559.6–747.7)	3,855,832 (3,636,902–4,114,060)	159.5 (150.6–170.0)	3,409,723 (3,144,599–3,691,631)	664.3 (614.0–722.7)	889,692 (795,555–982,436)	60.8 (54.5–67.0)	719,802 (637,124–825,897)	109.9 (97.3–125.0)
Deaths	602 (525–683)	0.8 (0.7–0.9)	3,007 (2,301–4,145)	0.1 (0.1–0.2)	26,448 (18,810–31,819)	3.3 (2.4–3.9)	18,070 (11,003–26,420)	1.4 (0.9–2.1)	2,407 (1,653–3,761)	0.4 (0.3–0.6)
DALYs	20,511 (17,021–26,025)	25.7 (20.9–32.9)	111,020 (84,177–151,982)	5.0 (3.8–6.8)	322,126 (237,297–382,305)	47.2 (36.7–55.1)	412,751 (255,174–608,764)	27.7 (17.1–40.7)	69,397 (48,641–105,754)	10.1 (7.1–15.1)
Aortic aneurysm										
Prevalence	—	—	—	—	—	—	—	—	—	—
Deaths	1,330 (1,164–1,502)	1.7 (1.5–1.9)	10,293 (8,027–12,481)	0.5 (0.4–0.6)	29,242 (23,057–32,900)	4.8 (4.0–5.3)	18,936 (12,424–29,093)	1.4 (0.9–2.1)	6,846 (5,453–8,486)	1.1 (0.9–1.3)
DALYs	31,474 (27,829–35,752)	35.7 (31.5–40.4)	265,582 (203,891–326,492)	12.3 (9.3–15.2)	426,042 (355,014–469,263)	87.6 (76.2–94.7)	434,141 (284,989–669,266)	28.3 (18.5–43.3)	154,401 (122,440–194,743)	22.3 (17.7–27.8)

(Continued)

Table 1

Continued

	Central Asia		East Asia		High-income Asia Pacific		South Asia		Southeast Asia	
	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate	Number	Age-standardized rate
Lower extremity peripheral arterial disease										
Prevalence	866,590 (654,566–1,146,899)	1,106.0 (828.2–1,443.0)	29,847,053 (22,544,423–39,029,156)	1,245.3 (944.3–1,611.3)	4,766,792 (3,585,526–6,100,992)	878.1 (662.5–1,128.2)	23,908,843 (18,401,635–31,284,292)	1,706.8 (1,308.1–2,219.8)	7,081,254 (5,368,375–9,344,084)	1,068.9 (807.2–1,368.2)
Deaths	226 (195–256)	0.3 (0.3–0.4)	1,544 (1,170–2,007)	0.1 (0.1–0.1)	2,828 (2,076–3,400)	0.4 (0.3–0.4)	4,950 (3,173–7,422)	0.4 (0.3–0.6)	843 (582–1,164)	0.1 (0.1–0.2)
DALYs	8,977 (6,339–13,018)	11.8 (8.2–17.3)	189,012 (98,905–337,650)	8.0 (4.2–14.2)	57,062 (41,509–79,988)	9.1 (6.6–12.8)	230,598 (141,551–359,572)	17.3 (10.6–26.2)	61,811 (38,028–99,696)	9.5 (5.8–15.3)
Endocarditis										
Prevalence	1,272 (1,107–1,469)	1.3 (1.2–1.5)	47,831 (40,334–57,120)	2.6 (2.2–3.0)	25,136 (18,752–31,624)	6.7 (5.5–7.8)	34,356 (29,077–40,229)	2.0 (1.7–2.3)	35,301 (30,210–40,809)	5.3 (4.5–6.1)
Deaths	205 (178–233)	0.2 (0.2–0.2)	3,285 (2,547–4,164)	0.2 (0.1–0.2)	6,185 (4,614–7,462)	0.9 (0.7–1.1)	12,023 (8,063–17,318)	0.8 (0.5–1.2)	8,076 (6,217–11,666)	1.2 (0.9–1.7)
DALYs	9,695 (8,340–11,205)	9.8 (8.4–11.3)	77,252 (60,982–96,008)	4.4 (3.4–5.6)	79,602 (63,565–93,979)	15.9 (13.4–18.4)	396,018 (260,729–577,406)	23.4 (15.4–34.0)	289,433 (215,746–420,887)	39.1 (29.3–56.3)
Pulmonary arterial hypertension										
Prevalence	2,280 (1,863–2,796)	2.3 (1.9–2.8)	42,954 (34,699–53,779)	2.2 (1.8–2.7)	9,250 (7,461–11,498)	3.0 (2.5–3.7)	30,486 (24,682–38,004)	1.7 (1.4–2.1)	13,971 (11,258–17,598)	1.9 (1.5–2.3)
Deaths	340 (255–431)	0.4 (0.3–0.5)	5,515 (3,730–7,480)	0.3 (0.2–0.4)	1,207 (894–1,510)	0.3 (0.2–0.3)	5,314 (2,904–9,059)	0.4 (0.2–0.7)	913 (351–2,427)	0.1 (0.0–0.4)
DALYs	13,032 (9,513–16,757)	13.9 (10.3–17.7)	111,523 (76,201–155,265)	5.7 (4.0–8.3)	22,188 (17,606–26,999)	9.4 (7.8–11.2)	181,112 (106,215–302,715)	11.2 (6.3–18.9)	37,734 (15,692–86,620)	5.4 (2.2–13.0)
Other cardiovascular and circulatory diseases										
Prevalence	455,083 (345,598–599,255)	502.4 (382.9–664.0)	6,578,435 (4,823,747–8,854,365)	302.4 (231.1–395.5)	3,283,160 (2,482,363–4,159,504)	930.8 (727.0–1,186.9)	10,714,899 (8,149,509–14,108,009)	691.4 (526.6–913.9)	2,744,831 (2,204,169–3,453,018)	391.7 (312.2–492.2)
Deaths	2,312 (2,042–2,592)	2.8 (2.5–3.2)	12,311 (9,550–16,311)	0.6 (0.4–0.8)	6,024 (4,591–7,192)	1.0 (0.8–1.2)	53,082 (36,444–74,201)	3.9 (2.6–5.4)	9,042 (6,082–13,654)	1.3 (0.9–2.0)
DALYs	92,879 (80,682–105,008)	100.4 (87.5–114.4)	606,151 (468,488–784,248)	30.1 (23.4–38.4)	255,725 (192,612–334,618)	70.1 (52.8–93.3)	1,995,311 (1,480,690–2,642,736)	125.7 (93.6–165.4)	461,977 (325,112–636,412)	64.7 (45.3–89.0)

Age-standardized rates are expressed per 100,000 population. All estimates are presented with 95% uncertainty intervals (UI). Prevalence data for aortic aneurysm were not available.
DALYs = disability-adjusted life years.

1.15%–1.25%) (**Supplementary** Fig. 2, Supplemental Digital Content, https://links.lww.com/CARES/A22).

ASMR and ASDR showed even more pronounced and widespread reductions, with particularly large improvements in high-income Asia Pacific countries. However, progress remained limited or absent in several countries. For instance, Tajikistan showed a slight increase in ASMR (+4.5% [95% UI: −9.7 to 20.5]) and near-stagnation in ASDR, while Bangladesh experienced substantial rises in both ASMR (+37.2% [95% UI: −3.5 to 70.9]) and ASDR (+22.0% [95% UI: −8.3 to 47.8]). Joinpoint analyses indicated that ASMR and ASDR generally declined across Asian subregions by 2023, although small upward trends were still observed in specific regions (**Supplementary** Figs. 4 and 5, Supplemental Digital Content, https://links.lww.com/CARES/A22). For example, East Asia showed a modest increase in ASMR during 2020 to 2023 (APC = 2.17%, 95% CI: 0.98%–3.37%), while South Asia demonstrated fluctuating mortality trends over time.

Notably, despite the widespread declines in ASMR across Asia, the absolute number of CVD deaths increased in all Asian subregions from 1990 to 2023. Decomposition analysis revealed that this upward trend in absolute mortality was primarily driven by population aging and population growth, which collectively outweighed the reductions contributed by epidemiological changes (**Supplementary** Fig. 6, Supplemental Digital Content, https://links.lww.com/CARES/A22). The relative contributions of these drivers varied by subregion, with population aging being the predominant driver in East Asia and high-income Asia Pacific.

3.4. CVD subtypes burden across Asia in 2023

The distribution of CVD subtypes varied markedly across Asian subregions. For prevalence, ischemic heart disease was the predominant subtype in Central Asia, accounting for 65.9% of cases—a figure substantially higher than those recorded in South Asia (25.3%) and Southeast Asia (28.3%) (Fig. 1). In Central Asia, the proportion was even higher among males, reaching 67.5% (**Supplementary** Fig. 7, Supplemental Digital Content, https://links.lww.com/CARES/A22). This dominance was also reflected in its exceptionally high ASPR in Central Asia, which exceeded the overall CVD ASPR of all other subregions (Table 1 and **Supplementary** Fig. 8, Supplemental Digital Content, https://links.lww.com/CARES/A22). Additionally, distinct regional clusters emerged: non-rheumatic valvular heart disease was markedly more prevalent in high-income Asia Pacific, while lower extremity peripheral arterial disease and stroke showed disproportionately high contributions in South Asia and Southeast Asia, respectively, with each exceeding the lowest proportions observed across subregions by more than 3-fold.

The distribution of CVD subtypes for deaths and DALYs showed broadly similar patterns across Asian subregions in 2023. Ischemic heart disease and stroke jointly constituted the vast majority of the regional CVD burden, with their combined proportion peaking at over 86% in Central, East, and Southeast Asia. Within these two leading subtypes, a distinct imbalance was observed in Central Asia, where the proportion of ischemic heart disease was more than twice that of stroke, whereas in other subregions, their contributions were approximately comparable. In addition, South Asia exhibited a unique burden of rheumatic heart disease, accounting for a higher proportion of deaths and DALYs compared with other subregions, with the DALY burden being substantially higher among females than males (11.2%, compared with 6.2% in males). Patterns in age-standardized rates further highlighted regional disparities. High-income Asia Pacific consistently showed the lowest rates across all subtypes,



Figure 1. Proportional distribution of cardiovascular disease subtypes for prevalence, deaths, and DALYs across regions of Asia. DALYs = disability-adjusted life years. Proportions less than 1.0% are not explicitly labeled within the rings for clarity.

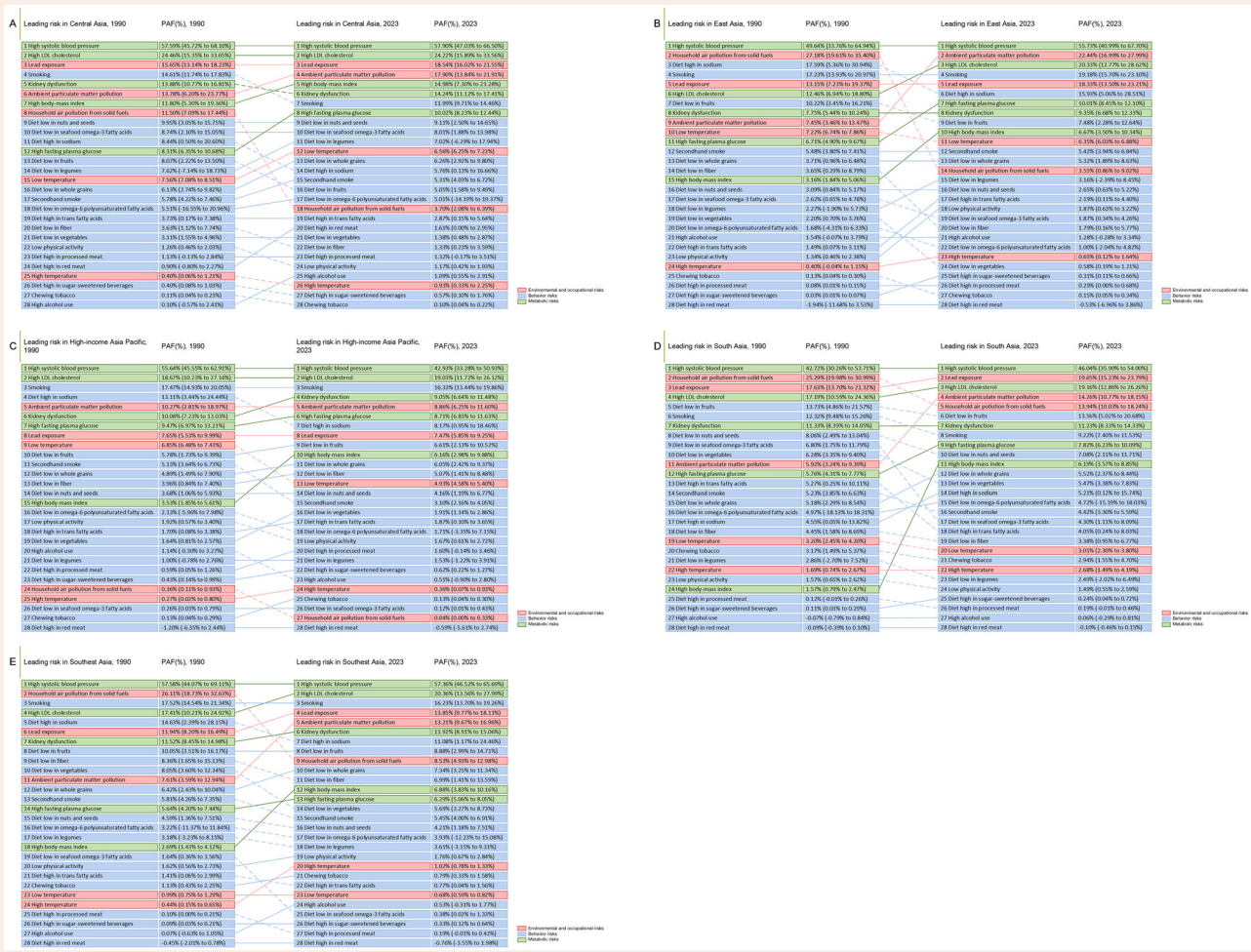


Figure 2. Temporal changes in the ranking of risk factors attributable to CVD DALYs from 1990 to 2023 across regions of Asia. CVD = cardiovascular disease, DALY = disability-adjusted life year, PAF = population attributable fraction. Risk factors are connected by lines between time periods: *solid lines* represent an increase or no change in rank, and *dashed lines* represent a decrease in rank.

while Central Asia and Southeast Asia had the highest mortality and DALY rates for ischemic heart disease and stroke, respectively.

Age-specific patterns of DALY rates for CVD subtypes were broadly consistent across Asian subregions, with rates generally increasing with advancing age (**Supplementary** Table 4, Supplemental Digital Content, https://links.lww.com/CARES/A22). However, notable exceptions were observed in the youngest age group, where South Asia exhibited a substantially higher overall CVD DALY rate among males (1,279.1 [95% UI: 695.6–2,033.5] per 100,000) compared with Central Asia (456.7 [395% UI: 64.7–561.3]), Southeast Asia (305.4 [95% UI: 183.6–448.5]), high-income Asia Pacific (141.2 [95% UI: 117.9–169.9]), and East Asia (111.7 [95% UI: 81.2–148.2]). This elevated burden in South Asia was primarily driven by stroke (800.4 [95% UI: 399.2–1,330.4]) and cardiomyopathy/myocarditis (276.6 [95% UI: 104.8–564.4]).

Sex-specific patterns showed that males generally had higher DALY rates than females across most age groups and subregions. However, among individuals aged 80 years and older, hypertensive heart disease DALY rates were consistently higher in females than in males across all subregions, with the largest sex disparities observed in South Asia and high-income Asia Pacific.

3.5. CVD risk factors across regions of Asia

Overall, metabolic risks became increasingly dominant, with most showing rising or stable trends over time (Fig. 2). By 2023, metabolic risk factors were all ranked among the top contributors, with PAFs generally exceeding 6%. In particular, high systolic blood pressure and high LDL cholesterol remained the leading risk factors across regions. In Central Asia, for instance, they collectively accounted for 57.90% (95% UI: 47.03%–66.50%) and 24.22% (95% UI: 15.89%–33.56%) of the CVD burden in 2023,

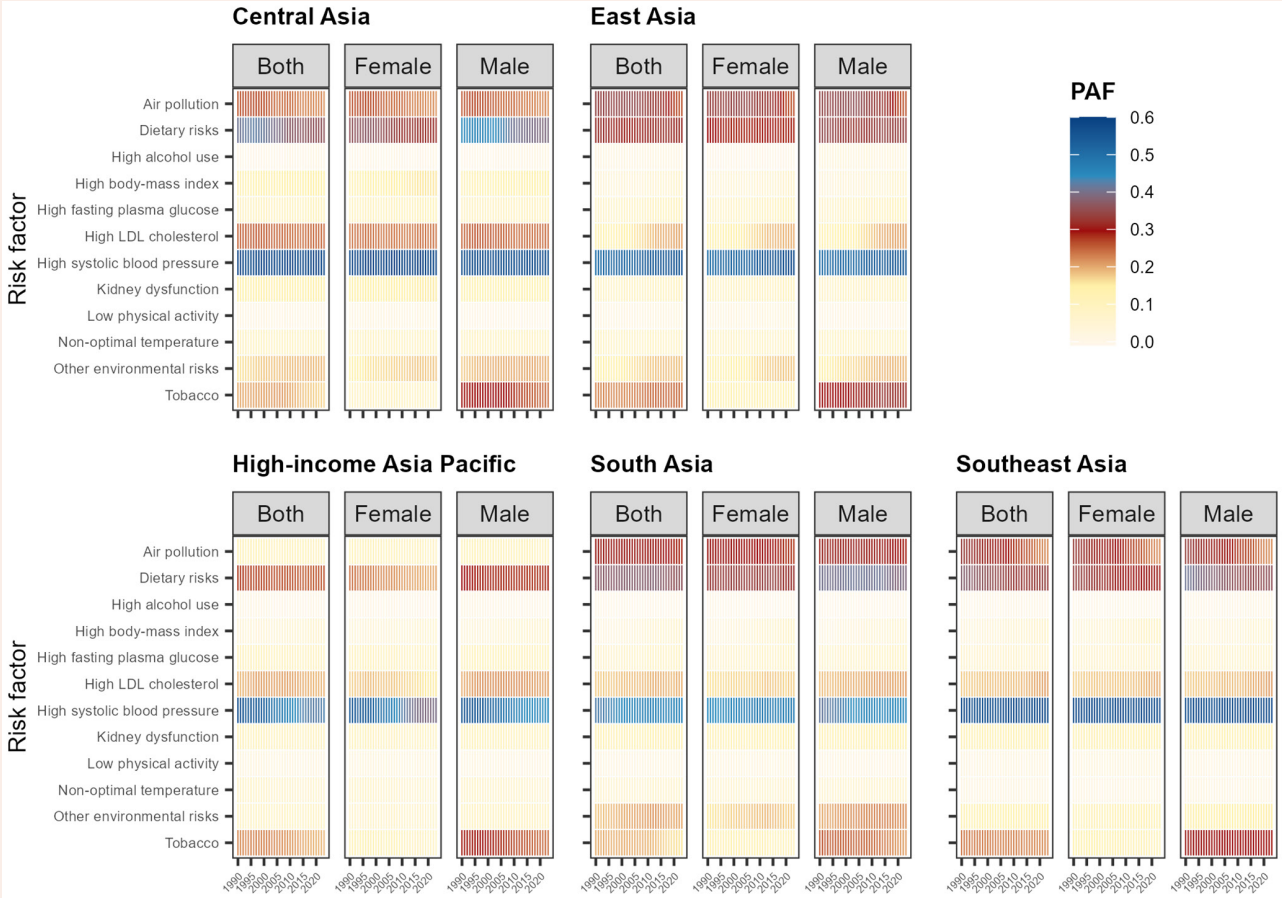


Figure 3. PAF (%) for ASDR attributable to all CVD level 2 risk factors from 1990 to 2023 across regions of Asia, stratified by sex and age. CVD = cardiovascular disease, ASDR = age-standardized DALYs rate, DALY = disability-adjusted life year, PAF = population attributable fraction.

respectively. At level 2, high systolic blood pressure remained the highest attributable burden of CVD across Asia, with the highest PAFs and remarkably stable contributions over the past three decades among nearly all subregions, except in high-income Asia Pacific, where a clear and sustained decline was observed, particularly among females (Fig. 3). In addition, high LDL cholesterol remained persistently high in Central Asia and exhibited increasing trends in East Asia, South Asia, and Southeast Asia. Collectively, these findings highlight the increasingly dominant role of metabolic risk factors in shaping the contemporary CVD burden across Asia.

Regarding environmental and occupational risks, household air pollution from solid fuels declined substantially across regions: for instance, in East Asia, it decreased from 27.18% (95% UI: 19.61%–35.40%), ranking second in 1990, to 3.55% (95% UI: 0.86%–9.02%), ranking 14th in 2023. However, ambient particulate matter pollution increased markedly, rising to become the second leading risk factor in East Asia by 2023. Ambient air pollution maintained high attributable fractions in all subregions except high-income Asia Pacific. Encouragingly, a downward trajectory was observed in the past decade in most areas, with the notable exception of South Asia, where levels remained largely unchanged. Together, these patterns indicate a shift in the attributable burden of air pollution to CVD across Asia, with the impact of household air pollution declining over time while ambient particulate matter pollution has emerged as an increasingly important risk factor.

Furthermore, tobacco use demonstrated pronounced sex disparities, with markedly higher PAFs among males than females across Asia. Notably, no clear decline was observed among men in East Asia and Southeast Asia over the entire study period.

4. Discussion

Our study provides a comprehensive and updated assessment of the CVD burden across Asia from 1990 to 2023. Despite declines in ASMR and ASDR, CVD prevalence remained stable, suggesting a growing population living with CVDs, with uneven progress across countries. This resulted in a growing absolute number of people living with CVDs, largely driven by population aging and growth. Marked heterogeneity persists across subregions,

with Central Asia bearing the highest age-standardized burden and high-income Asia Pacific showing the lowest rates. These disparities were also evident across countries. Distinct subtype patterns were observed, including a predominance of stroke in Southeast Asia, elevated rheumatic heart disease in South Asia, and unusually high early-life CVD DALYs among young males in South Asia. Risk factor attribution shifted toward metabolic drivers by 2023, with high systolic blood pressure and high LDL cholesterol accounting for the largest attributable proportions across subregions, while ambient particulate matter pollution rose to a prominent position despite substantial declines in household air pollution. Joinpoint analyses further highlighted substantial temporal heterogeneity across Asian subregions, with ASPR showing fluctuating patterns and transient increases in several periods. Compared with GBD 2021 estimates, the overall patterns of cardiovascular disease burden in Asia remained broadly consistent in GBD 2023, with CVDs continuing to decline in age-standardized mortality and DALY rates across most regions, while prevalence trends showed greater stability or modest increases in several settings.[6]

Central Asia stood out as the only subregion in Asia where all three age-standardized metrics remained markedly high in 2023, which is highly consistent with previous evidence.[1,6,23] Central Asia's persistently high burden was characterized by a predominance of ischemic heart disease, which accounted for 65.9% of prevalent cases, far higher than in other subregions, and resulted in an ASMR more than twice that of stroke. Central Asia also showed persistently high PAF estimates for high systolic blood pressure. Together, high systolic blood pressure and high LDL cholesterol were the two leading metabolic risk factors for CVD burden in 2023, each contributing substantially to the overall burden (57.9% and 24.2%, respectively), and both showed virtually no decline from 1990 to 2023. This pattern contrasted with the clear reductions observed in high-income Asia Pacific. High systolic blood pressure is a well-established major risk factor for ischemic heart disease, which causes endothelial dysfunction, increases shear stress leading to accelerated atherosclerosis, induces left ventricular hypertrophy, and ultimately results in myocardial ischemia and infarction.[24,25] Several interconnected factors likely contribute to this suboptimal hypertension management. A series of studies from Central Asian countries indicated that awareness of hypertension remains alarmingly low in many settings, meaning a substantial proportion of individuals already have elevated blood pressure but are unaware of their condition and thus remain undiagnosed.[26–31] For instance, in Kyrgyzstan, community screening found only 32% awareness among those with elevated blood pressure, and over half of participants had never had their blood pressure measured in the past year.[27] Moreover, even among those already diagnosed, adherence to treatment is relatively low, leading to treatment gaps and a low control rate of hypertension.[32–34] Accordingly, the primary drivers of poor adherence in Central Asian countries raised by previous studies included high out-of-pocket expenditure on antihypertensive medications, habits of self-medication, low health literacy, poor access to adequate screening coverage in rural areas, and shortages of devices and providers.[32,33,35] Despite the substantial declines in mortality and DALY rates observed in Central Asia over the past three decades, and the growing body of evidence documenting regional efforts and experiences in hypertension management and CVD prevention, progress remains incomplete and uneven, with persistent gaps compared with other subregions.[36–38] Central Asia should prioritize systematic hypertension and dyslipidemia control through universal primary care screening, subsidized essential medicines, and improved health literacy programs to accelerate further declines.

The predominance of stroke over ischemic heart disease in Southeast Asia may reflect distinct regional cardiovascular patterns associated with differences in risk factor profiles and health-system characteristics, and aligns with previous findings yet requires further discussion.[8,39] While elevated blood pressure remains a dominant underlying risk across Asian regions, its downstream manifestation may differ depending on coexisting exposures. In Southeast Asia, several factors, including high dietary sodium intake, underlying tropical infections, air pollution, and arsenic exposure, as well as hookah smoking, have been associated with the elevated regional stroke burden.[40,41] However, the precise underlying mechanisms remain to be fully validated. In addition, the relatively greater proportion of hemorrhagic stroke (19%–46%) compared with high-income countries, which carries substantially higher case fatality, further contributes to the elevated proportion of stroke-related deaths.[40] Unlike ischemic heart disease, which can often be mitigated through long-term management, stroke outcomes depend heavily on timely acute care. In Southeast Asia, limited access to such care, reflected in lower thrombolysis rates and prolonged prehospital delays, likely exacerbates case fatality and may partly account for the disproportionately high stroke mortality burden.[42,43] Therefore, actions should be taken to strengthen stroke systems of care by improving prehospital recognition through the FAST (Face, Arms, Speech, Time) campaign, expanding thrombolysis capacity, and implementing population-level sodium reduction measures.

An interesting regional contrast was observed in valvular heart disease across Asia. In South Asia, rheumatic heart disease accounts for a higher proportion of CVD burden compared with other Asian subregions, driven by ongoing exposure to group A streptococcal infections, compounded by socioeconomic constraints, contributing to progressive valve damage and increased mortality.[44–47] By comparison, in high-income Asia Pacific regions such as Japan, Singapore, and South Korea, non-rheumatic valvular heart disease predominates and is likely influenced by population aging and degenerative processes affecting

the cardiac valves.[45,48] Improved survival from other CVDs and longer life expectancy may further increase the relative contribution of these conditions.

The present study period fully encompasses the COVID-19 pandemic, a period that has exerted profound indirect effects on CVD burden, healthcare delivery, and the management of related risk factors worldwide.[49] In East Asia, both ASMR and ASDR showed a significant reversal during 2020 to 2023 (APC = 2.17% and 1.78%, respectively). This unfavorable trend likely reflects the indirect consequences of the pandemic, including widespread disruptions to healthcare systems, reduced access to routine cardiovascular services, postponement of elective procedures, and delayed presentation for acute cardiovascular events.[49,50] In addition, prolonged lockdown measures in several countries, particularly China, may have contributed to decreased physical activity, increased sedentary behavior, heightened psychosocial stress, and worsening control of major risk factors such as hypertension and diabetes.[51]

We also observed that the ASDR for stroke and cardiomyopathy/myocarditis in boys aged 0 to 4 years in South Asia is markedly higher than in other subregions. This pattern may be associated with the relatively high prevalence of infectious diseases reported in some South Asian settings. Hospital-based studies indicate that pediatric stroke often stems from tuberculosis, dengue, or meningitis-induced cerebral venous thrombosis, while previous studies have reported that myocarditis in children is frequently associated with viral or bacterial infections.[52–54] As for the male predominance among the 0 to 4 years age group, this may be partly explained by sex-related biological differences, as boys have been shown to exhibit greater vulnerability to infection-related and ischemic injury, potentially due to differences in immune responses and cellular injury pathways.[55,56] Additionally, thiamine (vitamin B_1) deficiency remains a persistent problem in parts of South Asia and Southeast Asia, which has been linked to infantile beriberi in exclusively breastfed infants, a condition that manifests as acute heart failure mimicking cardiomyopathy.[57,58] Targeted pediatric protocols addressing infectious triggers and nutritional deficiencies are thereby warranted in South Asia.

China and India, as Asia's two most populous nations, exemplify the region's heterogeneous CVD burden and underscore the need for country-specific strategies. In 2023, despite notable declines in age-standardized mortality and DALY rates since 1990, both countries continue to exhibit substantial gaps compared with high-income Asia Pacific. As populations in both nations are rapidly aging, they face the common challenge of a growing number of individuals living with CVDs amid stable or slowly rising ASPR, coupled with the increasing dominance of metabolic risk factors and the potential effects of air pollution.[11] Tailored, multilevel interventions, including strengthening primary care for hypertension and dyslipidemia management, improving acute cardiovascular care, and addressing emerging metabolic risks in the context of rapid population aging, are urgently needed. In addition, more granular country-level and subnational analyses will be essential to refine these strategies and bridge the remaining gaps with high-income Asia Pacific benchmarks.

Compared with the previous GBD 2021 analysis of CVD burden in Asia, our study provides several important novel epidemiological insights. First, beyond conventional comparisons between two time points, we incorporated Joinpoint regression and decomposition analyses to comprehensively characterize temporal trends in CVD burden across Asia from 1990 to 2023. This approach revealed divergent trajectories between prevalence and fatal burden, whereby ASMR and ASDR declined across most Asian subregions while ASPR remained stable or increased in several regions, indicating a growing population living with chronic CVDs despite improvements in mortality outcomes. Furthermore, by extending the study period through 2023, our analysis captured the postpandemic transition period and identified a reversal of previously declining ASMR and ASDR trends in East Asia during 2020 to 2023, highlighting the potential indirect cardiovascular consequences of COVID-19 healthcare disruption and behavioral changes. Second, our study moved beyond overall burden estimation and identified distinct regional CVD situations across Asia, including ischemic heart disease predominance in Central Asia, disproportionately high stroke burden in Southeast Asia, and persistent rheumatic heart disease and elevated early-life CVD burden in South Asia. These findings emphasize that the epidemiological characteristics and underlying drivers of CVD burden may differ across Asian subregions. Third, unlike previous studies that primarily compared risk-factor rankings between 1990 and 2021, we further incorporated temporal analyses of risk-attributable burden and risk-factor rankings over time, enabling characterization of dynamic shifts in cardiovascular risk profiles across Asia. Collectively, these findings provide a more nuanced understanding of the evolving epidemiological transition of CVDs across Asia.

Overall, our findings underscore the need to adopt regionally tailored approaches to CVD prevention and control across Asia. In settings with a persistently high and treatment-sensitive burden, the priority should be strengthening health systems to improve long-term risk factor management and continuity of care. Specific measures include universal hypertension screening, subsidized essential medicines, and task-shifting to community health workers. In regions where acute and fatal presentations contribute more substantially to the burden, greater emphasis is warranted on timely access to effective clinical services and emergency care, including organized stroke systems with FAST-based prehospital recognition and expanded thrombolysis capacity. Meanwhile, as most regions are increasingly facing the dual challenges of aging-related chronic conditions and emerging risk

exposures, there is a need for more integrated, preventive, and forward-looking health strategies, including population-level interventions targeting dietary sodium, air pollution, and tobacco use that can address both long-term disease management and evolving risk profiles.

5. Limitations of the study

Our study has several limitations. First, the estimates were derived from the GBD framework and are therefore subject to uncertainties related to data availability and model assumptions, which may affect the accuracy of country-level comparisons.[59] Although the GBD framework integrates extensive literature, registry, survey, and vital registration data through standardized modeling approaches, concerns regarding the representativeness and reliability of estimates in some regions may still remain, particularly for non-fatal CVD estimates in low-data settings. These issues may affect the accuracy of country-level comparisons and warrant cautious interpretation. Second, the associations between risk factors and disease burden are based on comparative risk assessment and should not be interpreted as causal relationships. Moreover, as this is an ecological analysis, inferences at the individual level are limited. Third, although the GBD 2023 study incorporated updated data and methodological adjustments to account for the impact of the COVID-19 pandemic on mortality and health systems, including improved cause attribution and updated input sources for recent years, residual effects may still persist.[12] Possible disruptions from the COVID-19 pandemic, including mortality shifts and health-system interruptions, could therefore have influenced the 2020 to 2023 estimates. Finally, our analysis had limited granularity regarding stroke subtypes, cardiomyopathy etiologies, and subnational heterogeneity, especially in large countries such as China and India. Future studies with finer subtype classifications and higher-resolution subnational data would provide deeper insights into this heterogeneity.

6. Conclusions

In summary, although ASMR and ASDR have declined across Asia over the past three decades, the overall burden remains substantial and is increasingly characterized by a growing number of individuals living with CVDs and marked heterogeneity across regions. Distinct regional patterns in disease subtypes and risk factor profiles indicate that the patterns of attributable CVD burden differ considerably across subregions. These findings highlight the need for region-specific strategies that reflect local epidemiology and health-system capacities, as well as strengthened prevention and long-term management to address the evolving and multifactorial issue of CVD burden in Asia.

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Ethical statements

This study used publicly available data from the GBD 2023 study, accessed through the Global Health Data Exchange . The data are de-identified and publicly available. Therefore, ethical approval and informed consent were not required.

Conflicts of interests

The authors declare no competing interests.

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Data availability statement

The data from GBD 2023 used in this study are publicly available from the Global Health Data Exchange GBD 2023 website .

Author contributions

Designed the overall study: Yiding Zhuang, Qingfeng Ma, Peng Yin.

Had unrestricted access to all data in the study: Peng Yin.

Performed the analyses: Yiding Zhuang, Xuehua Hu, Lin Yang, Yanlong Li, Lingling Yu, Hui Gao.

Conducted the statistical analyses and reviewed the article: Xuehua Hu, Lin Yang, Yanlong Li, Lingling Yu, Hui Gao, Jinen Xi.

Prepared the first draft of the manuscript and edited the manuscript: Yiding Zhuang.

All authors reviewed and approved the final manuscript.

Affiliated with the GBD Collaborator Network as a GBD Principal Collaborator: Peng Yin.

AI statement

During the preparation of this work, the authors used ChatGPT (OpenAI, GPT-5.3) to assist with language refinement and code optimization. The authors reviewed and edited all generated content as needed and take full responsibility for the content of the published article.

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