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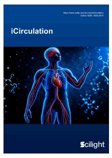

Review Article

Burden and Trends of Cardiovascular Disease in China over the Past 30 Years

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Abstract: Objective: To describe the current situation and trends of cardiovascular disease burden in China, and the progress and challenges of prevention and control. Methods: The electronic online databases of PubMed, Web of Science, ScienceDirect, China National Knowledge Infrastructure, and Wanfang Data were utilized to systematically search published articles in China, the long-term trends of cardiovascular disease prevalence, incidence rate, mortality and disability adjusted life years were systematically reviewed, and the risk factors, population differences and regional distribution characteristics were discussed. Results: From 1990 to 2019, the prevalence and incidence rate of cardiovascular diseases in China increased by 99.75% and 93.75%, respectively. The age-standardized incidence rate showed an upward trend, in contrast to the global downward trend. The burden of subtypes such as ischemic heart disease and stroke continues to increase, particularly in rural areas, the elderly, and the central and western regions; High systolic blood pressure, unhealthy diet, smoking, and air pollution are the main attributable risk factors, contributing over 70% of the disease burden. Conclusion: Although the age-standardized mortality rate and disability adjusted life year rate have decreased, the aging population has offset the intervention effect, and the inflection point of disease burden has not yet appeared. Precise prevention and control strategies need to be implemented for key populations, subtypes, and regions.

Keywords: cardiovascular disease; disease burden; prevalence; incidence rate; mortality rate

1. Introduction

Cardiovascular disease (CVD) is the leading cause of death and disease burden worldwide. In China, CVD has become a major public health challenge, with incidence and mortality rates continuing to rise, and the turning point for a decline in disease burden has yet to appear [1]. It is reported that the impact of CVD and its risk factors on public health is still intensifying [2]. At present, deaths from CVD in China account for more than 40% of all disease-related deaths among residents, and the annual growth rate of hospitalization costs for cardio-cerebrovascular diseases is relatively fast, imposing a heavy economic burden on individuals, families, and the healthcare system.

Although numerous studies have described the burden of CVD in China from different perspectives, the available evidence remains fragmented, highlighting the need for an updated and more comprehensive synthesis of different burden indicators, CVD subtypes, and population and geographic variations. Therefore, this review based on the literature in China searched from electronic online databases aims to provide a comprehensive description of the current burden of cardiovascular diseases, facilitate the implementation of targeted prevention and control strategies, optimize healthcare resource allocation, and inform relevant public health policies.

2. Materials and Methods

This review searched the electronic online databases of PubMed, Web of Science, ScienceDirect, the China National Knowledge Infrastructure, and Wanfang Data for relevant literature published in China over the past 10 years. Search terms included "cardiovascular disease," "disease burden," "incidence," "prevalence," "mortality," "disability-adjusted life years," "risk factors," "urban–rural disparities," "regional disparities," "coronary heart disease," "ischemic heart disease," and "stroke." Following the initial search, the retrieved literature was further screened. Priority was given to studies and authoritative reports published within the past 5 years that reflected the disease burden of CVD in China and differences across population groups and regions. Studies with unclear indicator definitions, duplicate content, or limited relevance to the topic were excluded. A total of 67 references were ultimately included. The included literature was synthesized according to the overall disease burden, different burden indicators, and major CVD subtypes, with further analysis of related risk factors, population-level heterogeneity, and geographic distribution patterns.

3. Disease Burden of Cardiovascular Disease in China

CVD is the leading cause of death among Chinese residents. Changes in its disease burden are jointly influenced by multiple factors, including population aging, urbanization, lifestyle changes, and adjustments in public health policies, showing the characteristics of rising total burden, diverging age-standardized indicators, and significant regional and population differences.

3.1. Current Status and Trends of Prevalence and Incidence

The total number of people with CVD in China is already at a high level and continues to rise. From a long-term trend perspective, between 1990 and 2019 the prevalence and incidence of CVD increased by 99.75% and 93.75%, respectively; the ASIR rose from 646.20 per 100,000 in 1990 to 652.21 per 100,000 in 2019, standing in stark contrast to the year-by-year decline in the global ASIR (Figure 1) [2,3]. In 2019, China had 12.3411 million newly diagnosed cases of CVD [2]. Although this was lower than the United States and the global average, the increase over the past 30 years far exceeded that of developed countries, and the pressure for disease prevention and control has continued to grow. Data from the National CVD Surveillance System in 2023 show that the crude incidence rate of CVD among people aged 18 and above in China reached 620.33 per 100,000, with a clear seasonal fluctuation in incidence, peaking in winter and spring [4]. Extremely high temperatures can increase the risk of acute CVD by 17%, and extremely low temperatures can increase the risk of hospitalization for CVD by 13%. Non-optimal temperatures can explain a total of 10.55% of CVD hospitalizations, corresponding to annual medical costs of RMB 11.7 billion, with greater vulnerability among rural populations, older adults, and regions in central and western China [5,6]. Based on data from the Global Burden of Disease (GBD) 2023, from 1990 to 2023, the age-standardized prevalence rate of CVD in China continued to increase, rising from 6046.6 to 6180.6 per 100,000, an increase of 2.2%. However, in contrast to the findings described above, the age-standardized incidence rate decreased from 569.9 to 512.1 per 100,000, representing a decline of 10.2% [7]. As GBD estimates are derived from statistical modelling of data from multiple sources, they may be affected by the quality of the original data, model assumptions, and data-integration methods, and may therefore differ from the actual situation. Further epidemiological studies are needed to clarify the specific trends.

The incidence and prevalence characteristics vary significantly across age groups, generally showing an increasing trend with age. After age 45, the rates of incidence and prevalence rise more rapidly, with the incidence rate reaching its peak in the 95 years and older age group [3]. Notably, in addition to the elderly population, CVD has shown a trend toward younger onset. The ASIR of ischemic heart disease (IHD) among the working-age population aged 15–59 years increased at an average annual rate of 0.78%, with a particularly marked rise in incidence risk among middle-aged and young men [8]. Among women of childbearing age, the age-standardized prevalence and incidence rates of IHD increased by 17.44% and 25.83%, respectively, from 1990 to 2021, and are projected to continue rising over the next 15 years, highlighting the need for cardiovascular prevention and control across the entire life course [9].

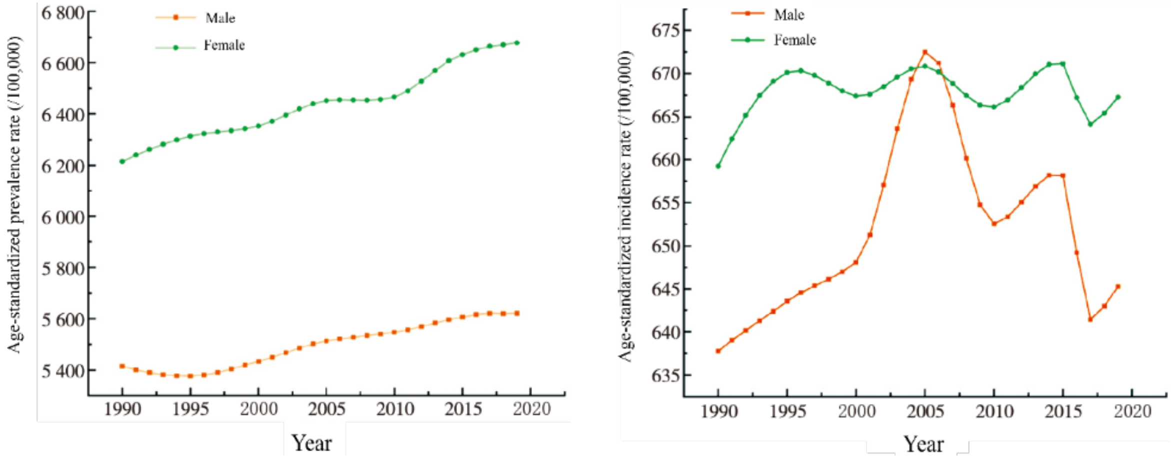


Figure 1. Trends in standardized prevalence and incidence of cardiovascular diseases by gender in China, 1990–2019 [3].

From the perspective of disease subtypes, the incidence trends differ significantly across types. The ASIR of rheumatic heart disease declined from 29.62 per 100,000 in 1990 to 23.95 per 100,000 in 2019, with an average annual decrease of 0.73%, indicating remarkable prevention and control efforts, although the incidence rate in women remains higher than in men [10]. The incidence of non-rheumatic valvular disease has grown rapidly; the number of new cases nationwide increased by 220% from 1990 to 2021, far exceeding the global average growth rate of 129%, with population aging as the main driving factor [11]. The ASIR of degenerative mitral valve disease increased by 42.8% from 1990 to 2019, reaching 12.7 per 100,000 in 2019, with the peak incidence occurring among those aged 60–64 years [12]. The number of prevalent cases of hypertensive heart disease reached 3.912 million in 2021, and its prevalence has continued to rise since 1990; the age-standardized prevalence rate is expected to keep increasing over the next 30 years [13].

The prediction results show that the incidence and prevalence of CVD in China will continue to increase in the future. The ARIMA model predicts that the ASIR of CVD from 2020 to 2050 will rise to 663.618 per 100,000, and the inflection point of declining disease burden has yet to appear [3]. The incidence and prevalence among middle-aged and older adults over 45 are expected to continue increasing, and the number of cases of IHD among the elderly will further rise. Meanwhile, the risk of disease among groups such as women of childbearing age and young and middle-aged men will also continue to increase, so prevention and control efforts need to be planned in advance [14].

3.2. Current Status and Trends of Mortality Rate

CVD is the leading cause of death among Chinese residents, accounting for more than 40% of disease-related deaths [2]. In 2021, China's CVD mortality rate was 357.44 per 100,000, and the age-standardized mortality rate (ASMR) was 280.11 per 100,000, ranking among the highest in G20 member countries, with a relatively severe disease mortality burden (Figure 2) [15]. From a long-term trend perspective, the crude mortality rate increased by an annual average of 1.58% from 2010 to 2021; however, the ASMR showed a downward trend, declining by an annual average of 2.13% during this period [15]. This indicates that population aging is the main driver of the rise in crude mortality, while public health interventions and improvements in medical care have effectively reduced mortality risk after age adjustment. Based on data from the GBD 2023, the crude and age-standardized mortality rates in 2023 were 314.7 and 208.0 per 100,000 population, respectively. From 1990 to 2023, the crude mortality rate increased by 12.80%; however, its 95% uncertainty interval ranged from −6.38% to 36.14% and included zero, indicating that the change was not statistically significant. Over the same period, the age-standardized mortality rate decreased by 58.1% [7]. Although GBD 2023 likewise showed a declining age-standardized mortality rate, its estimate of the long-term trend in crude mortality differed from previous findings. Because GBD estimates are generated by synthesizing data from multiple sources using statistical models, they may not fully reflect observed real-world patterns. The long-term trend in crude mortality should therefore be interpreted with caution.

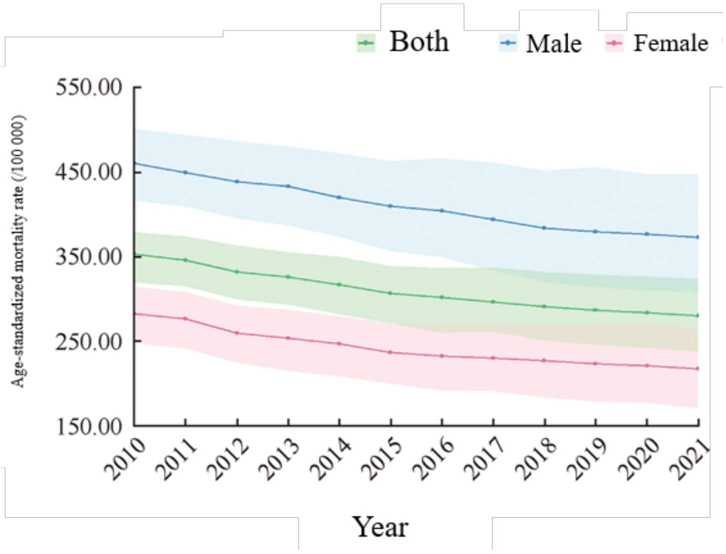


Figure 2. Trends in standardized mortality rates of cardiovascular diseases in China from 2010 to 2021 [15].

Urban-rural disparities are prominent. In recent years, the mortality rate from CVD in rural areas has remained consistently higher than in urban areas. In 2019, CVD deaths accounted for 48.98% and 47.35% of all deaths in rural and urban areas, respectively. This is closely related to the insufficient medical resources in rural areas, low control rates of risk factors, and poor treatment adherence [2].

Age and gender differences were particularly evident in mortality rates. The mortality rate from CVD was significantly higher in men (392.80 per 100,000) than in women (320.38 per 100,000) [15]. Mortality increased rapidly with age, with a markedly greater rise after age 45; among those aged 75 and older, the mortality rate exceeded 4000 per 100,000, making them a high-risk group for CVD death [14]. A comparative study based on the GBD found that China's age-standardized CVD mortality rate in 2019 was 276.9 per 100,000, higher than the levels in the United States and Japan during the same period. In terms of trends, China's annual decline rate in CVD mortality from 1990 to 2019 was lower than that of the United States and Japan [16].

Risk factors make a significant contribution to CVD mortality. High systolic blood pressure (SBP) is the foremost risk factor, followed by unhealthy diet, smoking, air pollution, and high low-density lipoprotein (LDL) cholesterol [17–20]. High SBP is the primary risk factor for CVD deaths in China; in 2018, 2.67 million CVD deaths in China were attributable to high SBP, accounting for more than 40% of total CVD deaths [18]. High fasting blood glucose is also an important metabolic risk factor; CVD deaths attributable to high fasting blood glucose increased from 353,000 in 2010 to 499,000 in 2018. The ASMR in men shows an upward trend, while that in women is relatively stable, and the disease burden is more pronounced in regions with medium to high Socio-Demographic Index (SDI) [21]. In 2021, the ASMR of diet-related CVD was 77.76 per 100,000. High sodium intake was the most important dietary risk factor, while mortality related to sugar-sweetened beverage intake increased the fastest [19]. Low physical activity contributed to 127,000 CVD deaths in 2019, and the rise in low physical activity-related mortality was most pronounced among women aged over 75 and men aged 25–44 [22].

3.3. Current Status and Trends of Disability-Adjusted Life Years (DALYs)

Disability-adjusted life years (DALYs) comprehensively reflect the health loss caused by premature death and disability. From 2010 to 2021, the crude DALY rate for CVD increased by an average of 0.83% per year, while the age-standardized DALY rate decreased by an average of 2.02% per year, consistent with the trend in mortality rates (Figure 3) [15]. This indicates that prevention and control measures have been effective in reducing the relative burden on the population, but population aging has offset some of the intervention effects. In 2019, China's age-standardized DALY rate for CVD was 6463.47 per 100,000, significantly higher than that of the United States and Japan [16]. Based on data from the GBD 2023, the age-standardized DALY rate for CVD in China was 4059.3 per 100,000 population in 2023. The trends in DALYs showed a discrepancy similar to that observed for mortality: the age-standardized DALY rate decreased by 59.7%, whereas the change in the crude DALY rate was not statistically significant [−9.34% (95% UI: −24.11% to 10.48%)] [23].

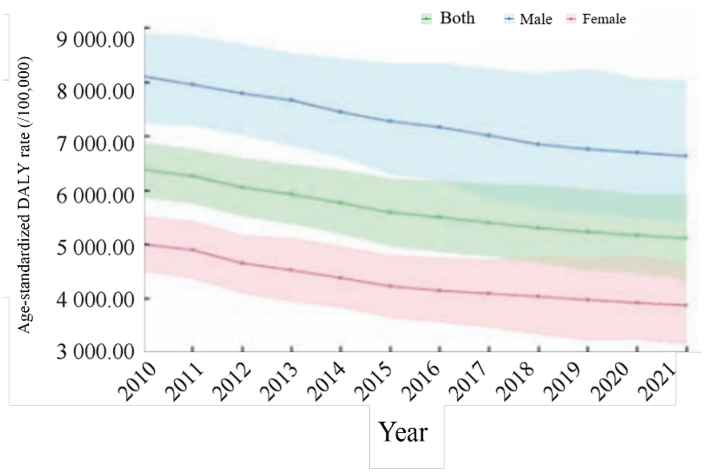
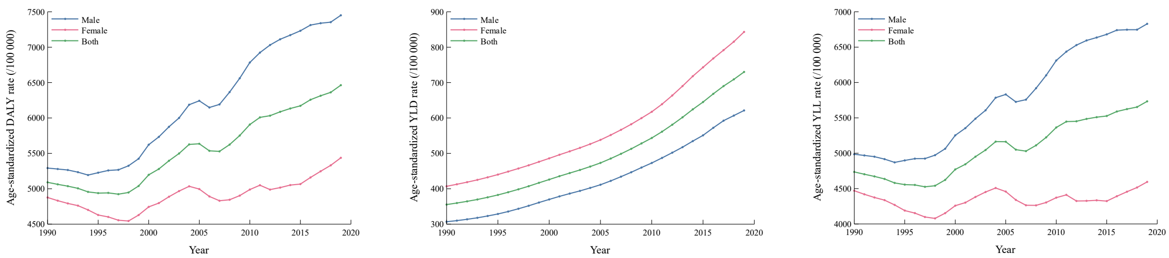


Figure 3. Trends in standardized Disability-adjusted life year rates of cardiovascular diseases in China from 2010 to 2021 [15].

Regional differences are also reflected in the DALY distribution. Qinghai, Tibet, Heilongjiang, and other provinces had the highest age-standardized DALY rates, while Hong Kong, Macau, Shanghai, and other regions had the lowest. The burden gap across regions is highly correlated with levels of economic development and accessibility of medical resources [24,25]. There are significant interprovincial differences in DALYs for CVD related to low physical activity: in 2019, Jilin, Inner Mongolia, and Hebei had the highest age-standardized DALY rates; Qinghai, Gansu, and Chongqing saw the largest increases; while Beijing, Macau, and Guangdong showed a downward trend, reflecting differences in lifestyle and intervention measures across regions [22].

Age and sex differences were prominent in the DALY burden. From 1990 to 2019, the age-standardized DALY rate increased by 40.78% in men, compared with only 11.50% in women (Figure 4) [3]. The DALY rate continued to rise with age, exceeding 60,000 per 100,000 among people aged 75 and older. Years of life lost (YLL) due to premature death were the main component of DALYs, but years lived with disability (YLD) grew more rapidly. From 1990 to 2019, the YLD rate increased by 102.42% in men and 107.13% in women, reflecting the rising disability burden caused by an increasing number of people living with the disease and longer survival [3].



YLL, Years of life lost YLD, years lived with disability DALY, Disability-adjusted life year

Figure 4. Burden of cardiovascular diseases in China, 1990–2019 (1/100,000) [3].

In terms of the contribution of risk factors to DALYs, high SBP, unhealthy diet, smoking, and air pollution continued to be the major contributors to CVD deaths and DALYs, accounting for over 70% of the CVD burden [17]. In 2021, the age-standardized DALY rate for diet-related CVD was 1499.58 per 100,000, with high sodium intake, low whole grain intake, high processed meat intake, and high sugar-sweetened beverage intake being the main sources of risk [19]. In 2019, low physical activity-related CVD DALYs reached 1.863 million person-years, with the most significant increases in related DALYs seen among people aged ≥75 years and men aged 25–44 years [22]. Diabetes-related CVD DALYs increased from 6.657 million person-years in 1990 to 13.586 million person-years in 2019, and the decline in age-standardized DALY rates was faster in women than in men [26].

The future trend of the DALY burden of CVD in China remains unpromising. Projections show that the age-standardized DALY rate will continue to rise from 2020 to 2030, and the DALY burden among middle-aged and older adults over 45 years will further increase. The continued rise in the proportion of YLD suggests that future CVD prevention and control should not only reduce mortality, but also pay greater attention to maintaining functioning and improving the quality of life of affected populations, thereby reducing the long-term health losses caused by disability [3,14].

4. Disease Burden of Coronary Heart Disease

4.1. Current Status and Trends of Prevalence and Incidence

As one of the main types of atherosclerotic CVD, coronary heart disease shows diverse trends in prevalence and incidence among the Chinese population. Based on data from the GBD 2021 study, the age-standardized prevalence of IHD in China in 2021 was 3042.3 per 100,000 (95% UI: 2601.7–3629.9), which clearly reflects the widespread prevalence of IHD in the Chinese population [27]. Another study suggested that between 1990 and 2021, the age-standardized prevalence of IHD in China increased by 20.42%, with an annual percentage change rate of 0.60%, which was higher than the global average [28]. In 2021, the ASIR of IHD in China was 365.7 per 100,000 (95% CI: 293.3–440.1) [27]. In terms of incidence ranking, China's ASIR of IHD ranked 14th globally in 1990 and rose to 7th by 2021, while its prevalence ranking jumped from 8th to 5th [29], highlighting the severity of the epidemiological trend of IHD in China.

From the long-term trend perspective, the absolute number of IHD cases in China continued to rise between 1990 and 2021. In 2021, the number of new IHD cases and prevalent cases in China increased by about 2-fold and 3-fold, respectively, compared with 1990 (Figure 5) [27]. However, incidence showed a different pattern after age standardization. Between 1990 and 2023, the ASIR of IHD in China peaked around 2006 and subsequently declined steadily [30]. This to some extent reflects the initial effectiveness of disease prevention and control efforts.

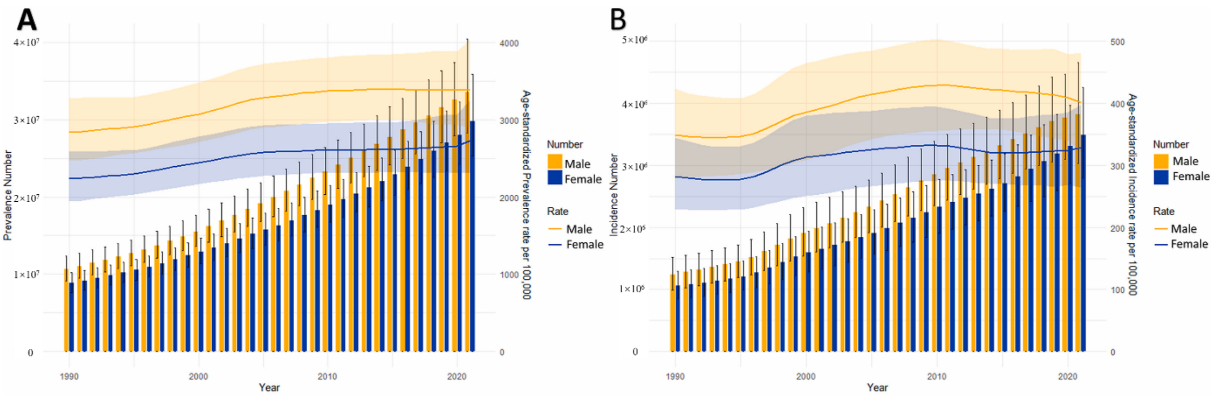


Figure 5. Trends in all-age case numbers and age-standardized prevalence, incidence rates of IHD by sex from 1990 to 2021. (**A**) Number of prevalent cases and prevalence rate. (**B**) Number of incident cases and incidence rate [27].

The risk of developing IHD increases significantly with age. Studies have shown that the incidence rises markedly after age 60 and peaks in the 70–74 age group [27]. Among young and middle-aged populations, the incidence of IHD also shows an increasing trend; studies have shown that both the age-standardized prevalence and incidence of IHD among young people aged 15 to 39 worldwide increased from 1990 to 2021 [31].

The disease burden of IHD in China shows a clear gender difference. Data from 2021 indicate that men bear a higher incidence and prevalence in almost all age groups [32]. Specifically, the sex ratio of IHD incidence peaks in the 35–39 age group, while the sex ratio of prevalence and incidence peaks in the 55–59 age group [33]. Notably, women's prevalence exceeds that of men after age 75, which may be related to the loss of estrogen's cardiovascular protective effect after menopause [34,35]. Looking at long-term trends from 1990 to 2021, the annual average increases in age-standardized prevalence and incidence were both higher in women than in men [8], a trend that deserves close attention from public health policymakers.

4.2. Current Mortality Status and Trends

The mortality rate of coronary heart disease is one of the key indicators for measuring its disease burden and an important reference for evaluating the effectiveness of disease prevention and control. Based on data from the GBD 2021 study, the ASMR of IHD in China in 2021 was 110.9 per 100,000 population (95% CI: 92.4–128.6), with 110.91 deaths per 100,000 population (95% CI: 92.42–128.56) [27]. In the same year, deaths caused by IHD were approximately 9 million worldwide (95% UI: 8.3–9.5 million), while in China there were about 1.96 million deaths [36], highlighting the important role of IHD as a cause of CVD mortality in China.

From the perspective of long-term trends, the mortality rate of IHD in China has shown a complex pattern of first rising and then falling. A study based on GBD 2021 data suggests that between 1990 and 2021, the absolute values of both the mortality rate and the DALY rate showed an upward trend, while Joinpoint analysis showed that both the ASMR and the age-standardized DALY rate were declining (Figures 6 and 7) [27]. Another analysis based on GBD 2019 found that between 1990 and 2019, China's ASMR and age-standardized DALY rate for IHD were both lower than global levels, but showed an overall upward trend, whereas the global trend was downward [37]. This seemingly contradictory phenomenon actually reflects the impact of China's population aging process on disease burden: the rise in absolute numbers is mainly driven by population growth and population aging, while the decline in age-standardized rates indicates that the risk of death at the population level has actually decreased. Based on data from the GBD 2023, the age-standardized mortality rate of IHD in China was 93.19 per 100,000 population (95% UI: 78.67–105.49 per 100,000) in 2023. From 1990 to 2023, a similar pattern was observed: the crude mortality and DALY rates increased, whereas the corresponding age-standardized rates declined [34].

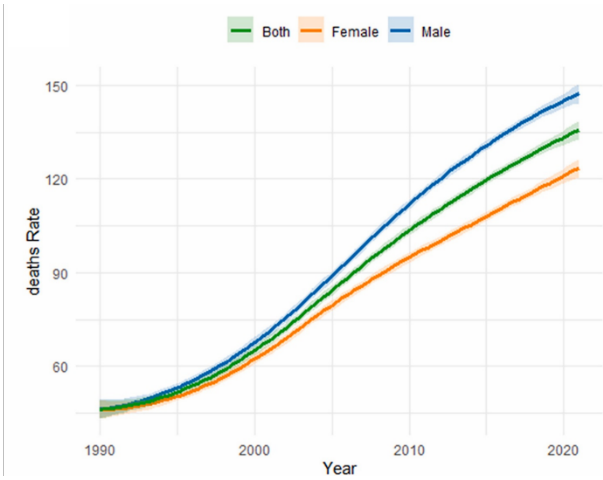


Figure 6. Trends in all-age mortality rates of ischemic heart disease by sex from 1990 to 2021 [27].

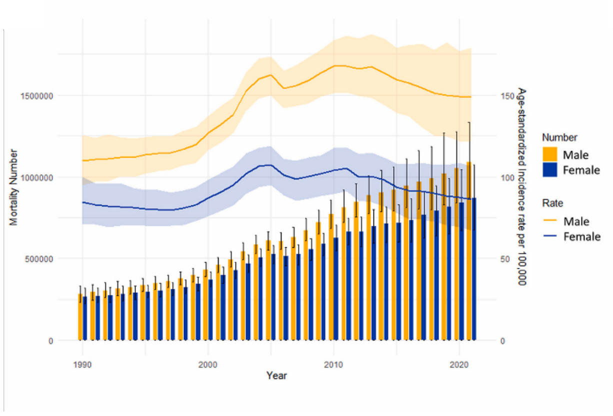


Figure 7. Trends in all-age case numbers and age-standardized mortality rates of IHD by sex from 1990 to 2021 [27].

From an international comparative perspective, China's IHD mortality rate is relatively high on a global scale. In 2021, China ranked seventh globally in the ASMR of IHD; compared with other G20 member countries, China's IHD burden is also far from optimistic [29]. This suggests that there is still a gap between China and developed countries in CVD prevention and control, and that China needs to draw on international successful experience and improve in light of its own national conditions.

The annual change characteristics of the ASMR are also worth attention. From 1990 to 2021, China's ASMR for IHD had an average annual change of 0.49% (95% CI: 0.23–0.75) [27]. Among young and middle-aged working populations, the ASMR for IHD among those aged 15 to 59 years decreased by an average of 0.76% per year (95% CI: −0.94 to −0.57), with a greater decline in women than in men [8]. However, in low and lower-middle SDI regions, the ASMR and DALY rates showed less favorable trends [38], reflecting the imbalance in CVD prevention and control efforts across regions with different development levels.

There are significant sex differences in the mortality rate of IHD in China, with a higher mortality burden among men. In 2021, the global mortality rate of IHD was higher in men than in women across almost all age groups [39], and data from China show the same pattern [34,35]. Joinpoint regression analysis identified key turning points: the ASMR in men continued to rise before 2010 and then declined slightly, whereas in women it began to decline after 2004 [27]. The predictive model shows that by 2036, the male ASMR will still remain at a high level (39.01; 95% UI: 22.69–55.33); this indicates that the mortality burden of IHD in men will continue for a considerable period in the future [40].

The risk of death from IHD rises sharply with age. Mortality increases steeply after age 75 [27]. Global data show that both the mortality rate and the DALY rate peak in the oldest age groups for both sexes [33,39]. Age-period-cohort model analysis shows that the risk of death peaked between 2002 and 2006 and has since declined, which may be related to the advancement of CVD prevention and treatment efforts in China in recent years and improvements in medical service quality [8].

In terms of regional differences, the burden of coronary heart disease is significantly unevenly distributed across China's provinces. Based on data from the GBD 2015 study, among China's provinces, Heilongjiang Province had the highest ASMR for IHD, reaching 187.4 per 100,000 (95% UI: 161.6–217.5), while Shanghai had the lowest, at only 44.2 per 100,000 (95% UI: 37.0–53.1). From a geographic distribution perspective, the ASMRs in southern provinces are lower than those in northern provinces, especially in the southeastern coastal provinces, where the disease burden is relatively lighter [41]. This north-south difference may be related to the high-latitude climatic characteristics of northern China, differences in dietary habits, and the prevalence of risk factors such as hypertension.

4.3. Current Status and Trends of Disability-Adjusted Life Years (DALY)

Based on data from the 2021 GBD Study, the age-standardized DALY rate for IHD in China in 2021 was 1856.51 (95% UI: 1548.73–2159.82) [27]. In 2019, the total number of DALYs for CVD in China's entire population reached 91.93 million, with IHD accounting for a substantial proportion [16]. Globally, IHD caused 188.4 million DALYs in 2021 (95% UI: 177–198.1 million) [39].

From the perspective of long-term trends, the absolute number of DALYs for IHD in China has continued to increase, but the age-standardized rate has shown a declining trend. Between 1990 and 2021, DALYs for IHD in China increased significantly, with the absolute number nearly doubling; however, the age-standardized DALY rate showed a downward trend. This suggests that the growth in the disability burden has also been relatively effectively contained (Figure 8) [27]. Based on data from the GBD 2023, the age-standardized DALY rate for IHD in China was 1694.23 per 100,000 population (95% UI: 1496.51–1865.45) in 2023. From 1990 to 2023, the absolute number of DALYs increased, whereas the age-standardized DALY rate declined [34].

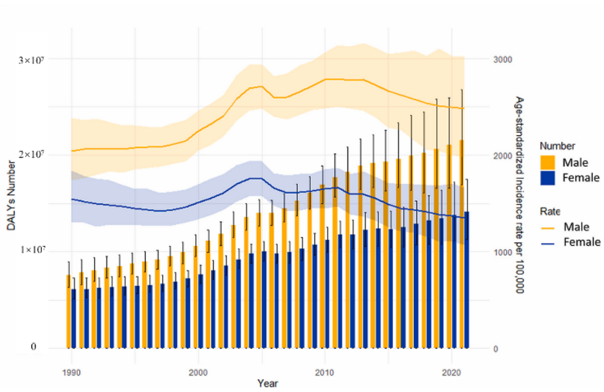


Figure 8. Trends in all-age case numbers and age-standardized DALY rates of IHD by sex from 1990 to 2021 [27].

From the composition of DALYs, YLLs due to premature death and YLDs show different gender characteristics among Chinese patients with IHD. Studies have shown that in 2021, Chinese men with IHD had higher levels of years of life lost, DALYs, and other indicators than women [27]. This means that the disease burden in male patients is mainly manifested as premature death, while female patients suffer more from long-term disability. This gender difference has important reference value for formulating targeted prevention and intervention strategies—attention should be focused on the prevention and treatment of acute events for men, while greater attention should be given to chronic disease management and rehabilitation services for women.

From the perspective of age distribution, DALYs increased markedly with age, particularly among people aged 70 years and above, and reached the highest level among those aged 80 years and older [42]. Between 1990 and 2021, DALYs from IHD in China peaked in the 55–59 age group [35]. Age-period-cohort model analysis showed that the risk of DALYs peaked between 2002 and 2006 and then gradually declined, which may be related to advances in CVD diagnosis and treatment technologies as well as the promotion of secondary prevention efforts [8]. Birth cohort effect analysis further showed that the risk of DALYs declined with successive birth cohorts, which may reflect increased cardiovascular health awareness and improved lifestyles among younger generations [8].

Regarding regional differences, there are also significant disparities in the burden of DALYs from IHD among China's provinces. Based on data from the GBD 2015 study, in 2015 the age-standardized DALY rate in Xinjiang Uygur Autonomous Region was the highest, reaching 3040.8 per 100,000 (95% UI: 2488.8–3735.4), while Shanghai had the lowest at only 524.4 per 100,000 (95% UI: 434.7–638.4). In terms of geographic distribution, the age-standardized DALY rates in southern provinces were all lower than those in northern provinces, with the disease burden in southeastern coastal provinces being relatively lighter in particular [41]. This huge disparity, nearly sixfold, highlights the major imbalance among China's provinces in CVD prevention and control.

From an international comparison perspective, China's burden of DALYs from IHD is at a relatively high level worldwide. In 2021, China ranked seventh globally in the age-standardized DALY rate for IHD; compared with other G20 member countries, China's disease burden in terms of DALYs also ranked among the highest [29]. However, in terms of trends, the global age-standardized DALY rate showed a downward trend from 1990 to 2021 (EAPC: −1.2), with the most pronounced decline in high SDI regions [38]. It is expected that by 2030, the global age-standardized DALY rate will continue to decline [38]. Nevertheless, China was among the G20 members with the highest absolute number of IHD DALYs in 2023, with age identified as a major determinant of IHD DALY rates [30].

From the attribution analysis of risk factors, most of the DALYs burden of IHD can be attributed to modifiable risk factors. Based on an integrated analysis of the LDL 2021 study, high SBP and high LDL cholesterol are the main risk factors leading to IHD deaths and DALYs [39]. In 2019, the proportions of global IHD DALYs attributable to high SBP, high LDL cholesterol, and smoking reached 54.6%, 46.6%, and 23.9%, respectively [43]. In China, the main attributable risk factors for IHD in 2019 were high SBP, high LDL cholesterol, smoking, ambient particulate matter pollution, and a high-sodium diet [42]. In addition, the age-standardized DALYs rate related to alcohol consumption increased most significantly from 1990 to 2019, reaching 486.01%, with an average annual growth of 10.93% [44]. The impact of metabolic risk factors on the burden of IHD in China is particularly prominent, and the increasing trend in disease burden caused by high fasting plasma glucose and high body mass index (BMI) is also concerning [21,45].

From the decomposition analysis results, population aging and population growth are the main drivers of the increase in DALYs due to IHD in China. Based on the decomposition analysis from the GBD 2019 study, between 1990 and 2019, DALYs due to IHD increased by 133.66%, of which 29.57% was attributable to population growth, 108.74% to population aging, 8.87% to the rise in age-specific prevalence, and changes in disease severity contributed a decrease of −13.53% [44]. The analysis for 1990 to 2023 also confirmed this pattern; the main driver of the 100.02% increase in DALYs during this period was population aging, with a contribution rate of 124.46% [44]. These data fully demonstrate that population aging is the core driving force behind the continued rise in the burden of IHD in China, and that the progress achieved in disease prevention and control has been partly offset by the effects of population aging.

From the perspective of future trend forecasting, predictions based on the Bayesian age-period-cohort model show that the overall numbers of prevalent IHD cases, deaths, and DALYs in China may decrease by 2035 [34]. By sex, the ASIR and prevalence rate among men are expected to decrease, whereas those among women may continue to increase [8,34]. Predictions for adults aged 60 and above likewise show that the number of cases and the total number of DALYs will continue to increase, which is closely related to the ongoing aging of the population [34].

In terms of attributable DALYs for modifiable risk factors, research on environmental risk factors has also made important progress. In 2021, the global age-standardized DALY rate of IHD attributable to environmental factors was 827.52 per 100,000 (95% UI: 648.13–987.15); among these, ambient particulate matter pollution and household air pollution were the main attributable risk factors [46]. The burden of IHD related to environmental factors was negatively correlated with SDI, suggesting that in regions with lower development levels, the contribution of environmental factors to IHD may be more prominent [46]. Based on the current status of air pollution in China, the burden of IHD caused by ambient particulate matter pollution also deserves close attention [40,42].

5. Disease Burden of Stroke

5.1. Current Status and Trends of Prevalence and Incidence Rates

From 1990 to 2021, the incidence of stroke in China increased cumulatively by 100.6%, with ischemic stroke showing the most pronounced increase at 201.1%, and the incidence in men remained consistently higher than in women; over the same period, the prevalence of stroke increased cumulatively by 102.9%, and the number of prevalent cases nationwide reached 26.3 million in 2021 [47]. Notably, although the crude incidence and crude prevalence continued to rise, after age standardization the overall age-standardized incidence of stroke showed a downward trend; from 1990 to 2021, it declined cumulatively by 9.8%, with only the age-standardized incidence of ischemic stroke still showing an upward trend (Figure 9) [47]. This pattern stands in stark contrast to the global trend. From 1990 to 2021, the global age-standardized incidence of stroke increased by only 15.0%, significantly lower than the increase in China during the same period [47]. This reflects that, while China's stroke prevention and control efforts have offset pressures from population aging and exposure to risk factors, it still faces the challenge of rapid growth in ischemic stroke subtypes. Based on data from the GBD 2023, China had 26.68 million prevalent stroke cases in 2023. In line with the trends described above, the crude incidence and prevalence rates continued to increase, whereas the age-standardized incidence rate declined [48]. However, unlike the previously reported increasing global trend, the global age-standardized incidence rate decreased by 25.0% from 1990 to 2023 [49], with a greater reduction than that observed in China.

The risk of stroke incidence and prevalence shows significant heterogeneity by age, sex, and region. By age, the risk of incidence increases rapidly with age, and the age-specific incidence rate begins to rise at an accelerated pace after the 55–59 age group, reaching its peak in the 85+ age group [50]. By sex, except for the 0–14 age group, the incidence and prevalence of all stroke subtypes are higher in men than in women [51]. In 2021, the ASIR of stroke was 17.2% higher in men than in women, and this difference was more pronounced in the hemorrhagic stroke subtype [47].

Differing levels of exposure to risk factors have further driven the divergence in incidence and prevalence trends. Among metabolic risk factors, high SBP, high fasting plasma glucose, and high LDL cholesterol are the primary drivers. The risk of stroke among patients with diabetes is significantly elevated; in China, the number of diabetes-attributable stroke deaths among people aged 25 years and older showed an upward trend from 1990 to 2019, with only the age-specific mortality rate declining [26]. The risk of stroke in patients with atrial fibrillation/flutter is 5 to 7 times that of the general population; in China, the number of people living with atrial fibrillation/flutter increased from 3.2 million in 1990 to 10.78 million in 2021, directly pushing up the incidence base of ischemic stroke [52].

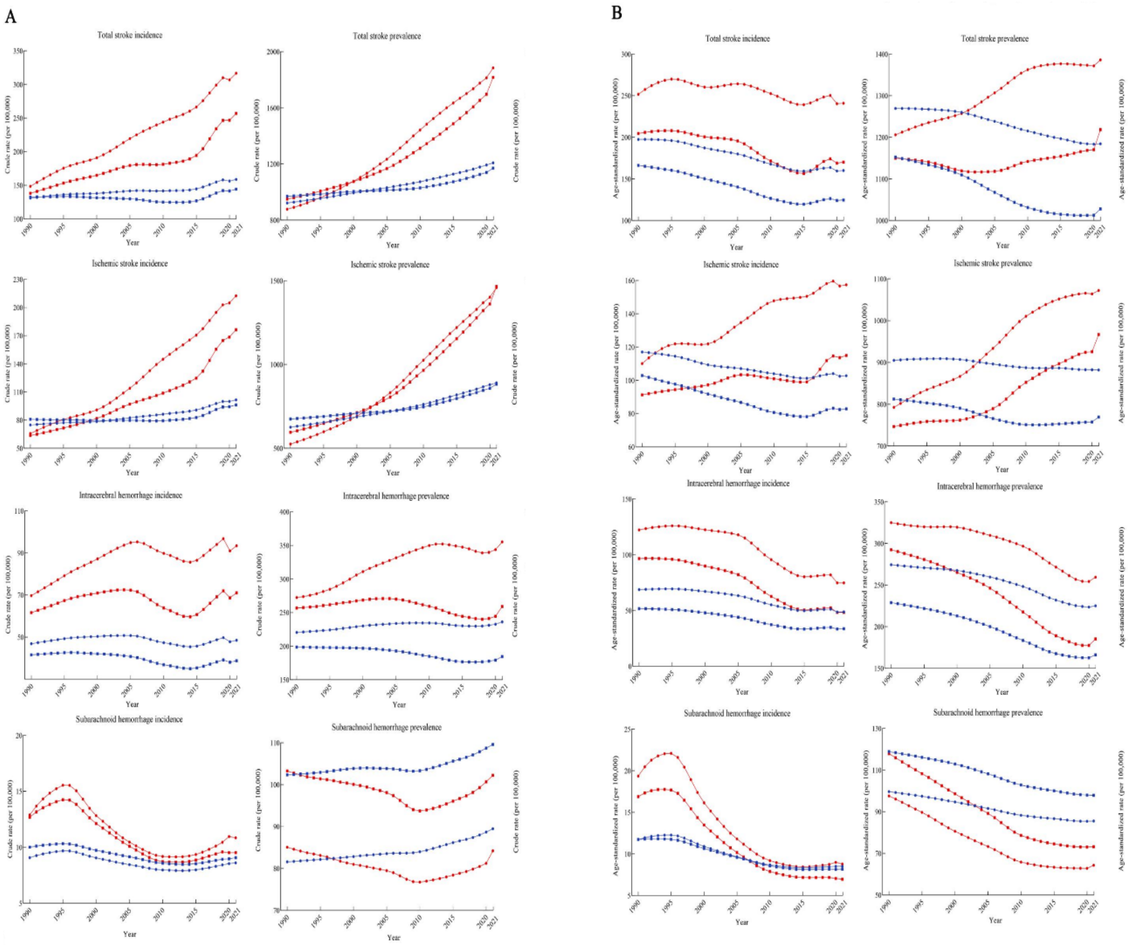
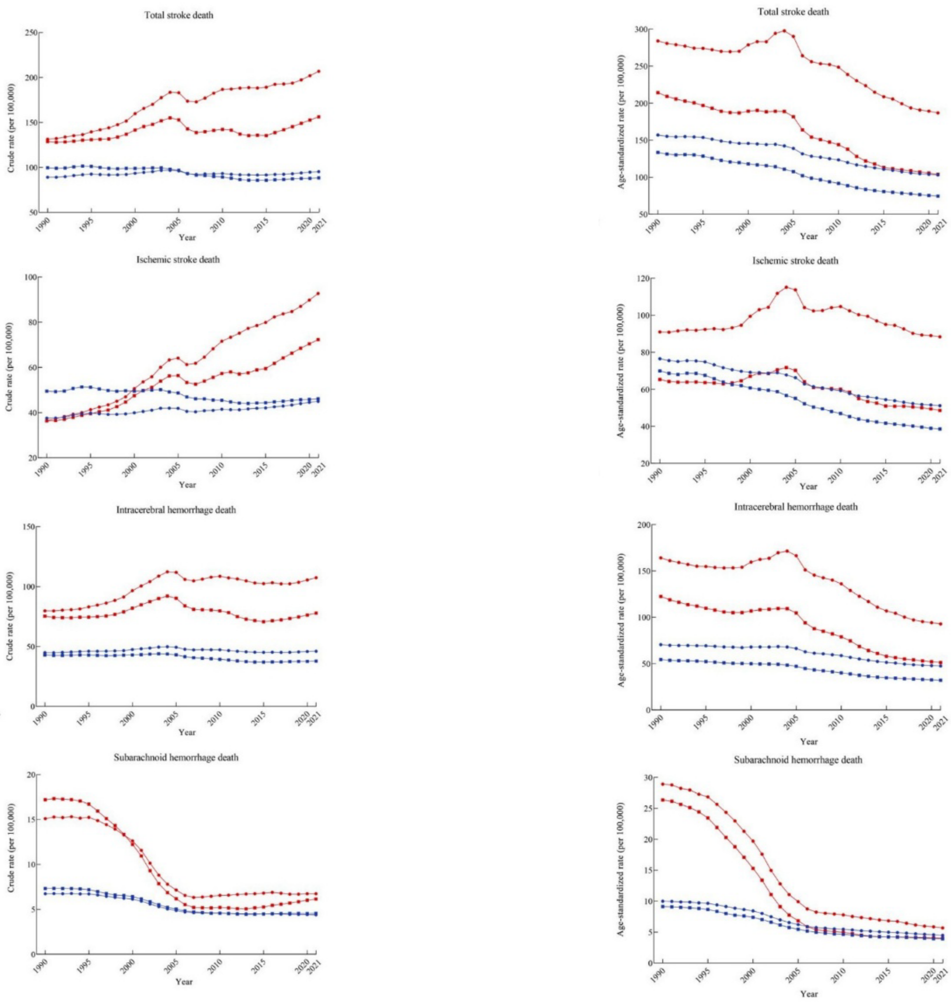


Figure 9. Crude (**A**) and age-standardized (**B**) incidence, prevalence rates (per 100,000 people) from 1990 to 2021, by sex. Blue lines represent global estimates and red lines represent estimates for China; circles indicate males and squares indicate females [47].

From the perspective of prevention and control effectiveness, measures such as hypertension management, smoking control, and air quality improvement have driven a decline in the overall ASIR of stroke, but the continued prevalence of some risk factors is offsetting the benefits of these efforts. From 1990 to 2019, the ASIR of stroke declined by 9.3%, but during the same period, the prevalence of risk factors such as high BMI, high blood glucose, and air pollution increased, causing the ASIR of ischemic stroke to continue to rise [53]. Predictive data show that from 2022 to 2040, the ASIR of stroke in men will decline slightly, while the ASIR in women will increase somewhat, and the ASIR of ischemic stroke will continue to climb, suggesting that in the future, differentiated prevention and control strategies should be developed for different populations and different subtypes [54].

5.2. Current Status and Trends of Mortality Rate

Since 1990, China's crude stroke mortality rate has continued to rise, but the ASMR has shown a significant downward trend, indicating both progress in prevention and control and the pressure of population aging. From 1990 to 2021, China's stroke mortality rate increased cumulatively by 40.0%, and the number of deaths reached 2.6 million in 2021, accounting for 35.6% of global stroke deaths, making China the country with the highest number of stroke deaths in the world (Figure 10) [47]. From 1990 to 2019, the ASMR fell cumulatively by 43.0%, with an average annual decline of 2.43%, faster than the global average during the same period (a 2.6% decline in global stroke ASMR). This reflects improvements in stroke treatment and positive progress in risk factor control [53]. Affected by the public health event in 2020, the crude stroke mortality rate rebounded somewhat compared with 2019. The total number of stroke deaths is expected to reach 2.3 million in 2025 and further rise to 2.4 million in 2030, with population aging being the core driver of the future increase in deaths [50].



(**A**) (**B**)

Figure 10. Crude (**A**) and age-standardized (**B**) mortality rates (per 100,000 people) from 1990 to 2021, by sex. Blue lines represent global estimates and red lines represent estimates for China; circles indicate males and squares indicate females [47].

The differences in stroke mortality are pronounced across populations, regions, and subtypes. By age, the age-specific mortality rate rises rapidly after the 55–59 age group, peaks in those aged 85 and above, and from 2013 to 2019 the stroke mortality rate in the 85+ age group showed an upward trend against the overall decline in age-standardized rates, standing in stark contrast to the general downward trend [50]. The elderly population aged 65 and above is a high-incidence group for stroke deaths; high SBP, high fasting plasma glucose, and high LDL cholesterol together accounted for more than 70% of the stroke mortality burden in this group, with high SBP alone attributing 1.2411 million deaths [55]. By sex, the stroke ASMR in men was significantly higher than in women; in 2019, the ASMR was 137.7 per 100,000 for men and 90.4 per 100,000 for women, with men at 1.52 times the rate of women [50]. From 1990 to 2021, the average annual decline in stroke mortality was slower in men (−1.37%) than in women (−2.31%), and the gender gap has been widening [54]. Regionally, the central region had the highest stroke ASMR (126.5 per 100,000), followed by the western region (123.5 per 100,000), while the eastern region had the lowest (97.3 per 100,000); rural areas had a significantly higher ASMR (123.0 per 100,000) than urban areas, reflecting regional disparities in access to healthcare resources and risk factor prevention and control [50]. At the provincial level, Qinghai, Tibet, Heilongjiang, and other provinces rank among the highest in the country for ASMR from noncommunicable diseases; as the leading fatal noncommunicable disease, stroke is the core source of disease burden in these provinces [24].

At the subtype level, the decline in the ASMR of hemorrhagic stroke (intracerebral hemorrhage, subarachnoid hemorrhage) was significantly greater than that of ischemic stroke. From 1990 to 2019, the ASMRs of intracerebral hemorrhage and subarachnoid hemorrhage both showed a downward trend, whereas the ASMR of ischemic stroke remained basically stable [53]. In 2019, hemorrhagic stroke accounted for 48.8% of all stroke deaths and remained the leading stroke subtype causing death, but the proportion of ischemic stroke deaths had risen to 47.0%, increasing by 171.1% from 1990 to 2019 [56].

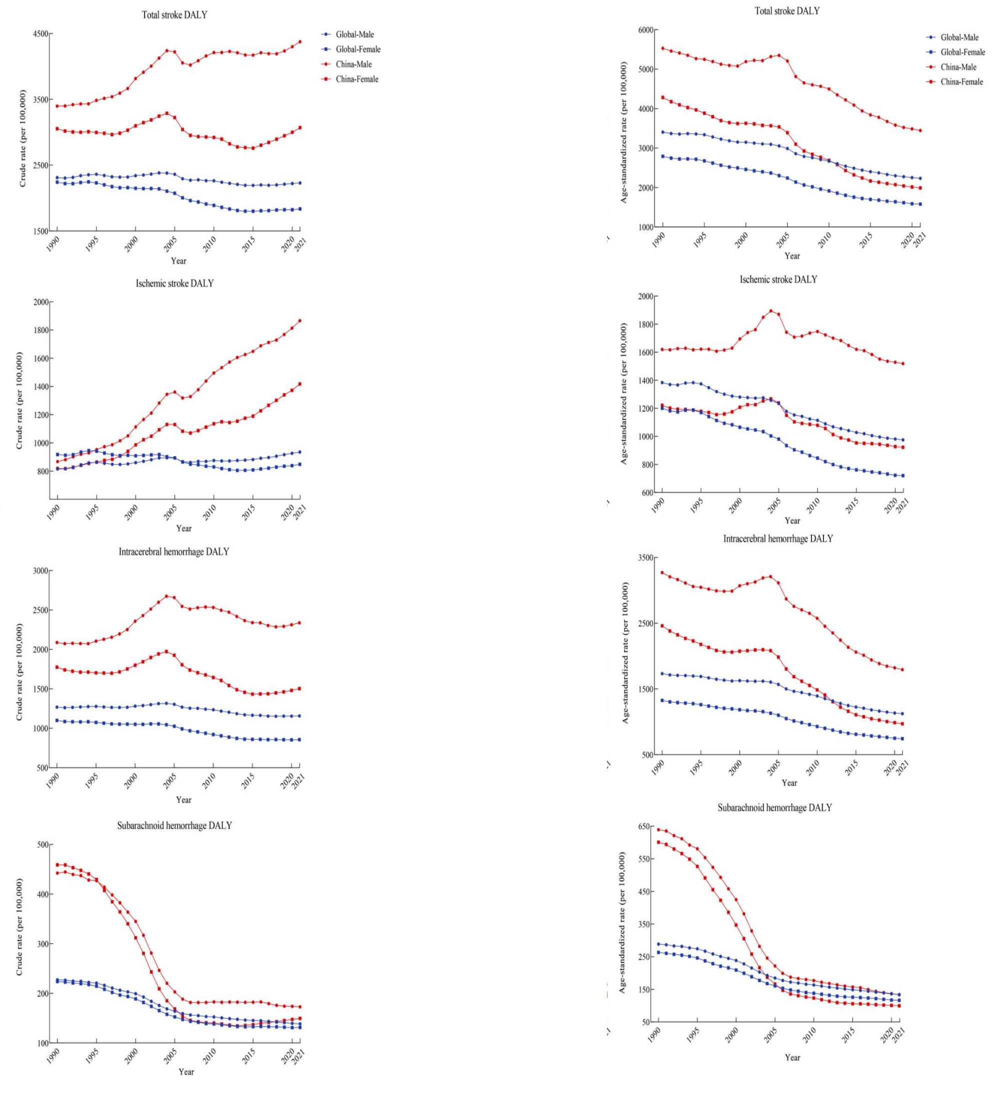
The contribution of different risk factors to mortality varies significantly: high SBP has consistently been the leading attributable factor for stroke deaths, with its attributable mortality share remaining above 45% from 1990 to 2021 [47]. Among environmental factors, ambient PM2.5 exposure contributed to 24.7% of stroke deaths in people aged 15 and above in 2019, with 541,800 attributable deaths, and the ASMR increased by an average of 1.11% per year, making it one of the few risk factors still on the rise [57]. The proportions of ischemic stroke and hemorrhagic stroke deaths related to household solid fuel use were 12.0% and 14.2%, respectively; the ASMR attributable to this factor declined by 59.3% from 1990 to 2013, but western provinces such as Guizhou and Xinjiang remain heavily affected [58]. The crude mortality rate of ischemic stroke related to a high-sodium diet continued to rise from 1990 to 2021, with only the ASMR declining slightly; men and older populations face higher risk [59]. The number of ischemic stroke deaths related to secondhand smoke exposure rose from 23,400 in 1990 to 53,700 in 2021; although the ASMR declined, the burden in China remains significantly higher than the global average [60]. The ASMR of ischemic stroke related to high BMI increased from 0.98 per 100,000 in 1990 to 2.21 per 100,000 in 2021, with a much larger increase in men than in women, and no turning point in the decline [61]. The number of stroke deaths related to high fasting blood glucose continued to rise, and China has the highest burden in the world, with 956,300 deaths in 2021 [62].

From future trends, although the ASMR will continue to decline, population aging and the rising prevalence of risk factors will drive a continued increase in the absolute number of deaths. Projections show that from 2022 to 2040, the ASMR for stroke will continue to decline [54], but the total number of deaths in 2030 will still exceed 2.4 million [50]; the ASMR for high BMI-related ischemic stroke is expected to reach 4.05 per 100,000 in men and 3.23 per 100,000 in women by 2044 [61]. Factors such as air pollution and high-sodium diets will also continue to contribute to the burden of deaths.

5.3. Current Status and Trends of Disability-Adjusted Life Years (DALY)

Stroke is the subtype with the highest DALY burden among non-communicable diseases in China. Since 1990, the absolute number of DALYs has continued to rise, but the age-standardized DALY rate has declined significantly, and the burden structure has shifted from being dominated by premature death to a balance between premature death and disability. From 1990 to 2021, China's stroke DALYs increased by a cumulative 15.7%, reaching 53.2 million person-years in 2021, accounting for 33.1% of the global total stroke DALYs and 15.2% of China's all-cause DALYs, making it the second-largest source of CVD DALYs after IHD; during the same period, age-standardized DALY rate declined by a cumulative 45.2% (Figure 11) [47]. Stroke prevention and control have achieved dual effects in reducing both premature death and disability burdens. In terms of burden structure, the ratio of YLL to YLD for stroke decreased from 20.13 in 1990 to 9.48 in 2021, and the proportion of YLD increased from 4.7% to 9.5%, reflecting the dual effectiveness of stroke prevention and control in reducing both premature death and disability burdens [54].

The population, regional, and subtype differences in stroke DALY burden are pronounced. By age, DALY rates increase rapidly with age, reaching 19,406.6 per 100,000 in those aged 70 years and older [63]. In 2019, stroke DALYs among the elderly population aged 60 years and older reached 19.202 million person-years, making stroke the leading source of DALYs in this age group [64]. By sex, the DALY rate for stroke in men is significantly higher than in women; in 2017, the crude DALY rate was 3657.1 per 100,000 for men and 2591.8 per 100,000 for women, with men at 1.41 times that of women. However, the YLD rate in women (530.9 per 100,000) was slightly higher than in men (475.5 per 100,000), suggesting that women with stroke survive longer and bear a relatively heavier disability burden [63]. From 1990 to 2019, the DALY rate of high BMI-related stroke in men continued to rise, while in women it showed an inverted U-shaped trend, and the gender gap gradually widened [65]. Regionally, the age-standardized DALY rate of stroke in central and western China was significantly higher than in eastern China, and higher in rural areas than in urban areas, with even more pronounced differences at the provincial level. In Yunnan, a southwestern province, the stroke YLD rate increased by 32.5% and the age-standardized DALY rate decreased by 24.3% from 1990 to 2017, slower than the national average [66].



(A) **(B)**

Figure 11. Crude (**A**) and age-standardized (**B**) DALY rates (per 100,000 people) from 1990 to 2021, by sex [47].

The contributions of different risk factors to DALYs vary significantly. High SBP is the primary attributable factor, contributing more than 57% of stroke DALYs in 2021 [47]. Exposure to ambient PM2.5 contributed 24.7% of stroke DALYs in 2019, with the age-standardized death rate increasing by an average of 1.11% per year, significantly higher than the global level [57]. Household solid fuel use contributed 12.0% of ischemic stroke DALYs and 14.2% of hemorrhagic stroke DALYs, and the age-standardized death rate attributable to this factor showed a downward trend in all provinces from 1990 to 2013, but remained high in western provinces such as Guizhou [58]. The burden of stroke DALYs related to high sodium intake ranked among the highest globally, with the DALY rate for ischemic stroke attributable to high sodium intake reaching 485.83 per 100,000 in 2021, down 55.05% from 1990 but still above the average level in high SDI regions [67]. The DALY rate for ischemic stroke related to high BMI rose from 24.61 per 100,000 in 1990 to 56.21 per 100,000 in 2021, and is projected to exceed 100 per 100,000 by 2044 [61]. Low physical activity contributed 1.863 million person-years of CVD DALYs in 2019, with ischemic stroke accounting for a higher share than hemorrhagic stroke, and the burden was highest in provinces such as Jilin, Inner Mongolia, and Hebei, while the largest increases were seen in Qinghai, Gansu, and Chongqing [22]. The number of ischemic stroke DALYs related to secondhand smoke exposure has continued to rise, and this burden in China is significantly higher than the global average, with older women being a high-risk group [60].

From future trends, although the age-standardized death rate will continue to decline, population aging and the rising prevalence of risk factors will drive the absolute number of DALYs to keep increasing. In response to these challenges, precise prevention and control strategies should be developed for different populations, regions, and subtypes, with a focus on strengthening measures such as hypertension management, air pollution control, high sodium diet reduction, and weight management to offset the rising burden caused by population aging.

6. Discussion

The prevalence and incidence of cardiovascular disease in China have continued to increase, accompanied by a persistent rise in the age-standardized incidence rate. By contrast, the age-standardized mortality rate and DALY rate have declined, suggesting that China's CVD prevention and control efforts have achieved some progress in reducing severe health losses, including death and disability, but remain insufficient in preventing disease onset. Moreover, the risks of CVD-related death and DALYs in China remain substantially higher than those in the United States and Japan, while the burdens of major CVD subtypes, including ischemic heart disease and stroke, continue to increase. Therefore, the overall situation of CVD prevention and control in China remains challenging. Meanwhile, the crude mortality and DALY rates of CVD continue to rise. The divergence between crude and age-standardized rates suggests that, although recent prevention and control measures have produced certain health gains, population aging may have offset part of these benefits, resulting in continued increases in the overall mortality and DALY burdens.

The disease burden of CVD also shows marked urban–rural, regional, and population-level heterogeneity. Tailored interventions should therefore be developed for different regions and population groups, accompanied by more equitable allocation of high-quality healthcare resources to promote health equity. High systolic blood pressure remains the leading risk factor, followed by unhealthy diet, smoking, and air pollution. Future CVD prevention and control strategies should therefore shift the focus further upstream, strengthen multisectoral collaboration, and place greater emphasis on primary prevention by reducing exposure to risk factors and the accumulation of risk from early stages of life.

However, based on data from the GBD 2023 study, different trends in the disease burden of CVD. From 1990 to 2023, the age-standardized incidence rate of CVD in China declined. Over the same period, the crude mortality and DALY rates showed upward point estimates; however, the 95% uncertainty intervals for their percentage changes included zero, indicating uncertainty regarding the direction of change in these two crude rates. Differences across studies may be related to variations in data sources, study populations, and other methodological characteristics. The GBD study applies standardized disease classifications and statistical models over an extended time span, thereby providing strong temporal and cross-national comparability. It can systematically characterize long-term changes in the burden of CVD in China and place the national burden within a global context. Nevertheless, GBD estimates are generated by synthesizing data from multiple sources and published studies through statistical modeling and may therefore be influenced by the quality of the underlying data and model assumptions, potentially resulting in discrepancies from the actual disease burden. By contrast, authoritative reports and epidemiological studies are generally based on empirical survey or surveillance data and may more directly reflect the disease burden in specific regions and periods in China. However, they may also differ in geographic coverage, disease definitions, data years, and the presentation of burden indicators. Given that exposure to major CVD risk factors and their attributable burden remain high in China, trends in CVD burden indicators should therefore be interpreted in light of evidence from different studies and further examined through continued surveillance and future research.

Drawing on recent evidence from different literature, this review provides a multidimensional and relatively comprehensive overview of the current burden and major characteristics of CVD in China.

7. Conclusions

China has a large overall number of people with CVD. Although the age-standardized stroke incidence rate, mortality rate, and DALY rate have declined, the ASIR, mortality rate, and DALY rate of IHD continue to rise, in contrast to the declining trends of similar global indicators. High SBP, unhealthy diet, tobacco exposure, and air pollution are currently the main contributing factors to CVD deaths and DALYs in China, and the prevalence of multiple risk factors further increases the difficulty of prevention and control.

The progress made in CVD prevention and control in China is also worthy of attention. Over the past decade, China's healthcare access and quality index has improved at one of the fastest rates in the world, and many cardiovascular diagnostic and treatment technologies have approached or reached world-leading levels. Since 2022, a number of original clinical studies, independently developed drugs, and technological achievements have gained international recognition, laying a foundation for improving prevention and treatment capabilities. However, it must not be overlooked that the current upward trend in CVD incidence has not yet been fundamentally reversed, and the turning point for a decline in disease burden has still not appeared. The task of prevention and control remains long and arduous.

Author Contributions

Z.W.: Conceptualization; Z.W.: Writing—original draft preparation; Z.W., F.L., X.W., C.Z.: Writing—review and editing; Z.W.: Supervision. All authors have read and agreed to the published version of the manuscript.

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