

Analysis of Epidemiology, Disease Burden, and Incidence Prediction of Cardiovascular Diseases in China, 1990–2019: Postprint

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Abstract

Background: Cardiovascular disease is a major chronic disease that seriously endangers human health and remains a pressing public health challenge in China and globally. Objective: To investigate the epidemiological characteristics and disease burden of cardiovascular disease in China from 1990 to 2019, predict the incidence of cardiovascular disease in China from 2020 to 2050, and provide evidence for developing cardiovascular disease prevention and treatment strategies. Methods: The Global Burden of Disease Study 2019 (GBD 2019) database was retrieved to extract and analyze relevant data on cardiovascular disease burden and risk factors in China and globally from 1990 to 2019. Publicly available incidence, prevalence, mortality, and corresponding age-standardized (abbreviated as standardized) rates based on the GBD 2019 database were used to quantify the epidemiological status of cardiovascular disease. Years lived with disability (YLD), years of life lost (YLL), and disability-adjusted life years (DALY) were used to quantify disease burden. An ARIMA model was constructed to predict the incidence of cardiovascular disease in China from 2020 to 2050. Results: From 1990 to 2019, the incidence, prevalence, and mortality of cardiovascular disease in China showed a consistently increasing trend, with incidence, prevalence, and mortality increasing by 93.75%, 99.75%, and 57.39%, respectively. The standardized incidence and standardized prevalence rates in females were higher than those in males, while the standardized mortality rate was lower than that in males. Based on 2019 data, the overall incidence of cardiovascular disease in China increased with age, peaking in the age group of 95 years and above. The incidence trends for males and females were similar to the overall trend, but with slight differences. The overall prevalence increased with age, and was higher in females than in males. After age 45, cardiovascular disease mortality showed an upward trend, with male mortality higher than female mortality across all age groups. From 1990 to 2019, the YLL rate, YLD rate, and

DALY rate in males increased by 36.99%, 102.42%, and 40.78%, respectively, while in females they increased by 2.79%, 107.13%, and 11.50%, respectively. Based on 2019 data, the YLL rate, YLD rate, and DALY rate for cardiovascular disease in the total Chinese population generally increased with age, with no inflection point observed. The YLL rate and DALY rate in males gradually increased with population aging and were substantially higher than those in females, while the YLD rate in females gradually increased after the 55-59 age group and was substantially higher than that in males. From 1990 to 2019, the standardized incidence, standardized prevalence, and standardized mortality of cardiovascular disease globally showed a decreasing trend, while China's standardized incidence and standardized prevalence continued to increase; although standardized mortality decreased, it remained higher than the global level. From a global perspective, China's standardized YLL rate and standardized DALY rate for cardiovascular disease showed a downward trend along with the global trend, but after 2000, the disease burden of cardiovascular disease in China was higher than the global level, and the standardized YLD rate increased year by year. The risk factors associated with cardiovascular disease mortality mainly included smoking, second-hand smoke exposure, alcohol consumption, low physical activity, high fasting blood glucose, high systolic blood pressure, high BMI, high low-density lipoprotein cholesterol, and renal insufficiency. Based on data from China and globally, high systolic blood pressure (hypertension) remained the primary risk factor for cardiovascular disease mortality, with the number of deaths increasing year by year. High low-density lipoprotein cholesterol (hyperlipidemia) was the second leading factor for cardiovascular disease mortality globally and in China in recent years. From 2020 to 2050, the standardized incidence of cardiovascular disease in China will continue to show an upward trend, and it is projected that the standardized incidence of cardiovascular disease will reach 663.618 per 100,000 by 2050. Conclusion: From 1990 to 2019, the incidence, prevalence, and mortality of cardiovascular disease in China showed a consistently increasing trend, the disease burden caused by cardiovascular disease was severe, with no turning point anticipated in the next 50 years, and both disease prevalence and burden were higher than the global level. It is projected that the standardized incidence of cardiovascular disease will reach 663.618 per 100,000 by 2050.

Full Text

Preamble

Epidemic Status, Disease Burden and Prediction of Cardiovascular Diseases in China, 1990–2019

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Abstract

Background: Cardiovascular disease is a major chronic disease that seriously endangers human health and remains a critical public health challenge in China and globally. **Objective:** To examine the epidemic characteristics and disease burden of cardiovascular diseases in China from 1990 to 2019, forecast the incidence of cardiovascular diseases in China from 2020 to 2050, and provide evidence for formulating prevention and treatment strategies. **Methods:** We retrieved and analyzed data on cardiovascular disease burden and risk factors in China and worldwide from 1990 to 2019 using the Global Burden of Disease Study 2019 (GBD 2019) database. Disease prevalence was quantified using publicly available incidence, prevalence, mortality, and corresponding age-standardized rates (referred to as standardized rates) from GBD 2019. Disease burden was quantified using years lived with disability (YLD), years of life lost (YLL), and disability-adjusted life years (DALY). An ARIMA model was constructed to predict cardiovascular disease incidence in China from 2020 to 2050. **Results:** From 1990 to 2019, the incidence, prevalence, and mortality of cardiovascular diseases in China showed 逐年上升趋势, increasing by 93.75%, 99.75%, and 57.39%, respectively. Age-standardized incidence and prevalence were higher in females than males, while age-standardized mortality was lower in females. In 2019, overall cardiovascular disease incidence in China increased with age, peaking in the 95+ age group. Incidence trends were similar for men and women, with slight variations. Overall prevalence also increased with age and was higher in women than men. Cardiovascular disease mortality began rising after age 45, with males having higher mortality than females at all ages. From 1990 to 2019, YLL rates, YLD rates, and DALY rates increased by 36.99%, 102.42%, and 40.78% in men, respectively, and by 2.79%, 107.13%, and 11.50% in women. In 2019, YLL, YLD, and DALY rates increased with age without any inflection point. Male YLL and DALY rates rose progressively with population aging and far exceeded female rates, while female YLD rates increased after age 55–59 and far exceeded male rates. Globally, age-standardized incidence, prevalence, and mortality decreased from 1990 to 2019, whereas China's age-standardized incidence and prevalence increased, and mortality remained higher than global levels. China's age-standardized YLL and DALY rates declined alongside global trends, but after 2000, China's cardiovascular disease burden exceeded global levels, with age-standardized YLD rates increasing annually. Major risk factors for cardiovascular disease mortality included smoking, sec-

onhand smoke, alcohol consumption, low physical activity, high fasting blood glucose, high systolic blood pressure, high BMI, high low-density lipoprotein cholesterol, and renal insufficiency. High systolic blood pressure (hypertension) remained the leading risk factor for cardiovascular disease mortality, with deaths increasing annually. High low-density lipoprotein cholesterol (hyperlipidemia) was the second leading factor globally and in China in recent years. The ARIMA model predicted that China's age-standardized cardiovascular disease incidence will continue rising from 2020 to 2050, reaching 663.618 per 100,000 by 2050. **Conclusion:** From 1990 to 2019, cardiovascular disease incidence, prevalence, and mortality in China increased annually, creating a severe disease burden with no inflection point expected in the next 50 years. China's disease prevalence and burden exceed global levels, with age-standardized incidence projected to reach 663.618 per 100,000 by 2050.

Keywords: Cardiovascular diseases; Burden of illness; Disability-adjusted life years; Risk factors; Prediction

Introduction

Cardiovascular diseases are characterized by high incidence, prevalence, recurrence, mortality, and economic burden, posing a serious threat to human health and creating substantial societal costs. They represent a major chronic disease and a critical public health challenge in China and worldwide. Over the past 30 years, China's clinical technical capabilities have improved rapidly, achieving notable progress in in-hospital cardiovascular disease treatment. However, these advances have not altered the epidemiological landscape or disease burden. According to the *China Cardiovascular Disease Report 2019*, cardiovascular disease prevalence continues to rise, affecting 290 million people, including 13 million stroke cases and 11 million coronary heart disease cases. Cardiovascular disease remains the leading cause of death, with one-year recurrence rates of 10% for angina, 10.6% for myocardial infarction, and 16.9% for heart failure. Cerebral infarction and intracerebral hemorrhage have one-year recurrence rates of 17.7% and 32.5%, respectively. Mortality rates in rural and urban areas are 309.33/100,000 and 265.11/100,000, respectively, accounting for 45.5% and 43.16% of all-cause mortality. Annual costs reach 19.085 billion yuan for myocardial infarction, 25.419 billion yuan for intracerebral hemorrhage, and 60.105 billion yuan for cerebral infarction. With China's growing population base, accelerating aging and urbanization, and rising prevalence of risk factors such as hypertension, diabetes, dyslipidemia, and overweight/obesity, cardiovascular disease prevention and control will become increasingly challenging.

Understanding gender- and age-specific trends in cardiovascular disease burden is essential for policymakers to develop effective prevention strategies, yet such data are currently lacking. This study uses GBD 2019 data to analyze trends in incidence, mortality, YLD, YLL, and DALY by gender and age in China from

1990 to 2019, and to forecast incidence from 2020 to 2050, providing evidence for understanding epidemiological trends and controlling cardiovascular disease development.

Methods

Data Sources

We searched the GBD 2019 database (<http://ghdx.healthdata.org/gbd-results-tool>) to extract and analyze data on cardiovascular disease burden and risk factors in China and globally from 1990 to 2019. Cardiovascular diseases in the GBD database include ICD-10 codes I05–I09, I11, I20–I25, I34–I38, I41–I42, I48, I50–I51, I60–I69, and I71–I73.

Indicators

Disease prevalence was quantified using incidence, prevalence, mortality, and corresponding age-standardized rates (standardized rates) from GBD 2019. Disease burden was quantified using YLD, YLL, and DALY. Incidence refers to the frequency of new cases in a specific population during a defined period, calculated as new cases divided by person-time at risk multiplied by a constant K. Prevalence refers to the proportion of new and existing cases in a population at a specific time, calculated as total cases divided by population at risk multiplied by K. Mortality refers to deaths from a disease divided by average population multiplied by K. YLD measures healthy life years lost due to disability, calculated as incident cases multiplied by disability weight and average duration. YLL measures years lost due to premature death, calculated as standard life expectancy minus age at death. DALY represents total healthy life years lost from onset to death, summing YLL and YLD.

Statistical Methods

We used Excel 2019 for data processing and statistical analysis. Trends from 1990–2019 were analyzed using change rates calculated as $(2019 \text{ value} - 1990 \text{ value}) / 1990 \text{ value} \times 100\%$. Joinpoint 4.9.0.1 software calculated average annual percentage change (AAPC) and annual percent change (APC) for standardized rates and burden indicators, with two-sided significance at $\alpha = 0.05$. ARIMA time series models were constructed using SPSS 26.0 to forecast incidence.

Results

Overall Epidemiology of Cardiovascular Diseases

From 1990 to 2019, cardiovascular disease incidence in China increased from 447.81 to 867.65 per 100,000 (93.75% increase), with standardized incidence ris-

ing from 646.20 to 652.21 per 100,000 (0.93% increase). Prevalence increased from 4,235.43 to 8,460.08 per 100,000 (99.75% increase), with standardized prevalence rising from 5,847.92 to 6,176.75 per 100,000 (5.62% increase). Mortality increased from 204.78 to 322.30 per 100,000 (57.39% increase), while standardized mortality decreased from 381.21 to 276.94 per 100,000 (27.35% reduction) .

Further analysis revealed that in 2019, standardized incidence, prevalence, and mortality rates for Chinese men were 645.30, 5,621.04, and 361.93 per 100,000, respectively, representing changes of +1.18%, +3.80%, and -17.49% from 1990. For women, the corresponding rates were 667.28, 6,678.37, and 219.73 per 100,000, with changes of +1.22%, +7.47%, and -36.18% from 1990 .

From 1990 to 2019, standardized incidence rates showed fluctuating upward trends for both men and women, with greater variability in men. Female standardized incidence exceeded male rates in all years except 2005–2006. Standardized prevalence increased annually for both genders, with female rates consistently higher than male rates. Standardized mortality declined overall for both genders, but male rates remained higher than female rates [Figure 1: see original paper]–[Figure 3: see original paper].

Joinpoint regression analysis revealed phased fluctuations in standardized incidence. From 1990 to 2019, overall AAPC was 0.017% (0.035% for men, 0.037% for women). Both genders showed six distinct phases, with statistically significant trends in most periods ($P < 0.05$). The largest male increase occurred during 2000–2005 (APC = 0.801%), while the largest decrease was during 2014–2017 (APC = -0.862%). For women, the largest increase was during 1990–1994 (APC = 0.351%) and largest decrease during 2014–2017 (APC = -0.354%) .

Standardized prevalence showed phased upward fluctuations ($P < 0.05$), with overall AAPC of 0.191% (0.131% for men, 0.249% for women). Men showed six phases and women five phases, with most trends statistically significant. The largest male increase occurred during 1997–2005 (APC = 0.294%), while overall and female rates increased most during 2010–2015 (APC = 0.417% and 0.540%, respectively) .

Standardized mortality showed phased downward fluctuations ($P < 0.05$), with overall AAPC of -1.130% (-0.656% for men, -1.554% for women). Men and women each showed six phases, with most trends statistically significant. The largest male increase occurred during 2007–2010 (APC = 1.872%), while the largest decrease was during 2013–2019 (APC = -2.493%). For women, the largest increase was during 1998–2004 (APC = 0.686%) and largest decrease during 2004–2007 (APC = -3.544%) .

Age distribution analysis showed that in 2019, overall cardiovascular disease incidence increased with age, peaking in the 95+ age group. Male and female trends were similar, though female incidence exceeded male rates between ages 45–79. Prevalence also increased with age, with female rates higher than male

rates. Mortality began rising after age 45, with male rates exceeding female rates at all ages [Figure 4: see original paper]–[Figure 6: see original paper].

Disease Burden of Cardiovascular Diseases

From 1990 to 2019, YLL rates due to cardiovascular disease in China increased from 4,735.61 to 5,733.41 per 100,000, YLD rates from 355.42 to 730.05 per 100,000, and DALY rates from 5,091.03 to 6,463.47 per 100,000.

Further analysis showed that in 2019, compared with 1990, male YLL, YLD, and DALY rates increased by 36.99%, 102.42%, and 40.78%, respectively, while female rates increased by 2.79%, 107.13%, and 11.50% .

Joinpoint analysis of standardized YLL rates revealed phased downward fluctuations ($P < 0.05$), with overall AAPC of -1.571% (-1.020% for men, -2.204% for women). Men and overall rates showed five phases, women six phases. Most trends were statistically significant. The largest male increase occurred during 2007–2011 ($APC = 0.921\%$), while the largest decrease was during 2004–2007 ($APC = -2.618\%$). Female rates decreased in all phases, most steeply during 2004–2007 ($APC = -4.488\%$) .

Standardized YLD rates showed phased upward fluctuations ($P < 0.05$), with overall AAPC of 0.320% (0.299% for men, 0.344% for women). Overall rates showed six phases, men six phases, and women five phases. Most trends were statistically significant. The largest male increase occurred during 2014–2017 ($APC = 1.169\%$), while the largest decrease was during 2000–2006 ($APC = -0.121\%$). Female rates increased most during 2010–2015 ($APC = 1.097\%$) .

Standardized DALY rates showed phased downward fluctuations ($P < 0.05$), with overall AAPC of -1.406% (-0.932% for men, -1.918% for women). Men and overall rates showed five phases, women six phases. Most trends were statistically significant. The largest male increase occurred during 2007–2011 ($APC = 0.886\%$), while the largest decrease was during 2004–2007 ($APC = -2.448\%$). Female rates decreased most during 2004–2007 ($APC = -4.006\%$) .

Age distribution analysis in 2019 showed that YLL, YLD, and DALY rates generally increased with age without clear inflection points. Male YLL rates began rising from ages 25–29 and far exceeded female rates. Female YLD rates increased after ages 55–59 and far exceeded male rates. Male DALY rates also rose after ages 25–29 and far exceeded female rates [Figure 7: see original paper]–[Figure 9: see original paper].

Comparison Between China and Global Trends

Epidemiology Compared with 1990, China's standardized incidence increased 0.93% (from 646.20 to 652.21 per 100,000) while global rates decreased 13.46% (from 790.78 to 684.33 per 100,000). China's standardized prevalence increased 5.62% (from 5,847.92 to 6,176.75 per 100,000), while global rates decreased 4.41% (from 6,728.04 to 6,431.57 per 100,000). China's standardized

mortality decreased 27.35%, compared with a 32.34% global decrease, though China's rates remained higher than global levels in all years [Figure 10: see original paper]–[Figure 12: see original paper].

Disease Burden From 1990 to 2019, China's standardized YLL rate decreased 36.47% and global rates decreased 33.20%. China's decline was greater, though rates were higher than global levels during 2001–2017. China's standardized YLD rate increased 9.65% while global rates decreased 3.34%, with Chinese rates substantially exceeding global levels. China's standardized DALY rate decreased 33.38% compared with 31.35% globally, with Chinese rates remaining above global levels [Figure 13: see original paper]–[Figure 15: see original paper].

Risk Factors In 2019, cardiovascular disease deaths in China attributable to smoking, secondhand smoke, alcohol, low physical activity, high fasting glucose, high systolic blood pressure, high BMI, high LDL cholesterol, and renal insufficiency were 822,500, 189,300, 185,200, 127,000, 700,300, 247,200, 549,500, 916,000, and 376,800, respectively, accounting for 17.94%, 4.13%, 4.04%, 2.77%, 15.28%, 53.92%, 11.99%, 19.98%, and 8.22% of total deaths. From 1990 to 2019, deaths attributable to these risk factors increased continuously, with high systolic blood pressure as the leading factor. Before 2011, smoking was the second leading factor, after which high LDL cholesterol became second. Compared with 1990, the proportions of deaths attributable to smoking, alcohol, low physical activity, high fasting glucose, high systolic blood pressure, high BMI, high LDL cholesterol, and renal insufficiency increased by 3.96%, 5.98%, 73.79%, 24.24%, 11.44%, 63.17%, 52.76%, and 33.06%, respectively, while secondhand smoke decreased 10.04% [Figure 16: see original paper].

Global data showed similar patterns, with high systolic blood pressure as the leading risk factor and high LDL cholesterol as the second leading factor in recent years. Compared with 1990, global proportions attributable to smoking, secondhand smoke, and high LDL cholesterol decreased 20.55%, 10.05%, and 4.79%, respectively, while proportions attributable to alcohol, low physical activity, high fasting glucose, high systolic blood pressure, high BMI, and renal insufficiency increased 16.50%, 12.00%, 39.49%, 0.40%, 30.34%, and 16.19%, respectively. In 2019, China had higher proportions of deaths attributable to smoking, secondhand smoke, alcohol, and high systolic blood pressure than global levels [Figure 17: see original paper].

Prediction of Cardiovascular Disease Incidence in China, 2020–2050

The ARIMA model predicted that China's age-standardized cardiovascular disease incidence will continue rising from 2020 to 2050, reaching 663.618 per 100,000 by 2050 .

Discussion

Although China has prioritized cardiovascular disease prevention and control, current efforts remain in early stages. Research shows that mortality from hemorrhagic stroke decreased from 1990–2015, while mortality from ischemic heart disease and ischemic stroke continued rising. Compared with developed countries, China's age-adjusted mortality from ischemic heart disease has surpassed developed nations, while stroke mortality remains far higher.

Based on GBD 2019 data, this study analyzed trends in cardiovascular disease epidemiology and burden in China from 1990–2019. Over 30 years, incidence, prevalence, and mortality increased annually, rising 93.75%, 99.75%, and 57.39% by 2019. Female standardized incidence and prevalence exceeded male rates, while standardized mortality was lower. Age-specific analysis showed incidence and prevalence increased with age, with female rates higher than male rates between ages 45–79. Mortality rose after age 45, with male rates exceeding female rates at all ages. These findings align with the *China Health Statistics Yearbook 2019*, which reported higher coronary heart disease mortality in rural areas (128.24/100,000) than urban areas (120.18/100,000) in 2018, and higher male mortality in both settings. From a prevalence perspective, women require greater attention; from a demographic perspective, middle-aged populations should be prioritized.

Cardiovascular disease burden is closely linked to high incidence, prevalence, and mortality. Despite China's clinical advances reaching world-class levels, burden data show no relief. Compared with 1990, male YLL, YLD, and DALY rates increased 36.99%, 102.42%, and 40.78%, respectively, while female rates increased 2.79%, 107.13%, and 11.50%. In 2019, YLL, YLD, and DALY rates increased with age without inflection points. Male YLL and DALY rates rose with population aging and far exceeded female rates, while female YLD rates increased after ages 55–59 and far exceeded male rates. The inflection point for reduced burden has not yet appeared, indicating that hospital-based technological progress alone cannot reduce China's cardiovascular disease burden.

Developed countries have achieved declining cardiovascular mortality through risk factor interventions. GBD 2019 data show that while global standardized incidence, prevalence, and mortality decreased over 30 years, China's standardized incidence and prevalence increased, and mortality remained above global levels. China's YLL and DALY rates declined alongside global trends, but after 2000, China's burden exceeded global levels, with YLD rates increasing annually. This primarily reflects inadequate control of cardiovascular risk factors (hypertension, diabetes, dyslipidemia, overweight/obesity) in China. Additionally, China's large population, rapid aging and urbanization, and lifestyle factors such as smoking, unhealthy diets, and physical inactivity contribute to the epidemic.

Cardiovascular risk factors often develop insidiously and cause vascular lesions and severe events like myocardial infarction and stroke. GBD 2019 data identify

smoking, secondhand smoke, alcohol, low physical activity, high fasting glucose, high systolic blood pressure, high BMI, high LDL cholesterol, and renal insufficiency as major risk factors. High systolic blood pressure (hypertension) remains the leading cause of cardiovascular disease mortality, with deaths increasing annually. High LDL cholesterol (hyperlipidemia) is the second leading factor globally and in China. The China Hypertension Survey (2012–2015) found a crude hypertension prevalence of 27.9% (weighted rate 23.2%) among adults ≥ 18 years, with prevalence 11.5 times higher in those ≥ 75 years (59.8%) than in those 18–34 years (5.2%). National data show dyslipidemia prevalence of 34.7% in residents ≥ 35 years and 43% in those ≥ 40 years after age and sex standardization. Therefore, blood pressure and lipid control remain top priorities.

The ARIMA model forecast indicates that China's cardiovascular disease incidence will continue rising through mid-century, with age-standardized incidence reaching 663.618 per 100,000 by 2050. Cardiovascular disease prevention and control will remain critically important.

In summary, from 1990–2019, China's cardiovascular disease incidence, prevalence, and mortality increased annually, creating a severe disease burden with no inflection point expected in the next 50 years. China's disease prevalence and burden exceed global levels.

References

- [1] LU Jianan, ZHANG Jianmin. Cerebrovascular disease prevention and treatment: Starting from joint prevention of cardiovascular and cerebrovascular diseases[J]. *Chinese Journal of Cardiovascular and Cerebrovascular Disease Prevention*, 2020, 20(1): 25–37, 42. DOI: 10.3969/j.issn.1009-816x.2020.01.007.
- [2] China Cardiovascular Health and Disease Report Writing Group. Summary of the China Cardiovascular Health and Disease Report 2019[J]. *Chinese Circulation Journal*, 2020, 35(9): 833–854. DOI: 10.3969/j.issn.1000-3614.2020.09.001.
- [3] NAGHAVI M, MAKELA S, FOREMAN K, et al. Algorithms for enhancing public health utility of national causes-of-death data[J]. *Population Health Metrics*, 2010, 8: 9. DOI: 10.1186/1478-7954-8-9.
- [4] ZHAO D, LIU J, WANG M, et al. Epidemiology of cardiovascular disease in China: Current features and implications[J]. *Nature Reviews Cardiology*, 2019, 16(4): 203–212. DOI: 10.1038/s41569-018-0119-4.
- [5] DU X, PATEL A, ANDERSON C S, et al. Epidemiology of cardiovascular disease in China and opportunities for improvement: JACC International[J]. *Journal of the American College of Cardiology*, 2019, 73(24): 3135–3147. DOI: 10.1016/j.jacc.2019.04.036.

- [6] MA Liyuan, WANG Zengwu, FAN Jing, et al. Interpretation of key points of the China Cardiovascular Health and Disease Report 2021[J]. *Chinese General Practice*, 2022, 25(27): 3331–3346.
- [7] FORD E S, AJANI U A, CROFT J B, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980–2000[J]. *New England Journal of Medicine*, 2007, 356(23): 2388–2398. DOI: 10.1056/NEJMsa053935.
- [8] WANG Z W, CHEN Z, ZHANG L F, et al. Status of hypertension in China: Results from the China hypertension survey, 2012–2015[J]. *Circulation*, 2018, 137(22): 2344–2356. DOI: 10.1161/CIRCULATIONAHA.117.032380.
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Author Contributions

YANG Ji conceptualized the study, designed the research protocol, retrieved GBD 2019 data, performed statistical analysis, and drafted the manuscript. ZHANG Yao retrieved GBD 2019 data, processed data, and created figures and tables. MA Teng and TIAN Xintong retrieved GBD 2019 data, extracted and compiled data, and performed secondary verification. ZHAO Yingqiang provided quality control and critical revision of the manuscript. All authors approved the final version.

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