Postprint of Key Points Interpretation of the China Cardiovascular Health and Disease Report 2021

Authors: Ma Liyuan, Wang Zengwu, Fan Jing, Hu Shengshou

Date: 2022-07-13T00:00:00+00:00

Abstract

With the development of social economy and changes in national lifestyle patterns, particularly the acceleration of population aging and urbanization, unhealthy lifestyles among residents have become increasingly prominent, and the impact of cardiovascular disease (CVD) risk factors on residents' health has become more significant, with the prevalence and incidence of cardiovascular disease (CVD) continuing to rise. In 2019, cardiovascular disease deaths in rural and urban areas accounted for 46.74% and 44.26% of total deaths respectively, with 2 out of every 5 deaths attributable to CVD. It is estimated that the number of people currently suffering from CVD in China is 330 million, including 13 million with stroke, 11.39 million with coronary heart disease, 8.9 million with heart failure, 5 million with pulmonary heart disease, 4.87 million with atrial fibrillation, 2.5 million with rheumatic heart disease, 2 million with congenital heart disease, 45.3 million with lower extremity arterial disease, and 245 million with hypertension. In 2019, the total hospitalization cost for cardiovascular and cerebrovascular diseases in China was 313.366 billion yuan. The burden of CVD continues to increase, particularly in rural areas. Due to imbalanced allocation of medical resources, lower disease awareness, poorer treatment compliance, and other reasons, mortality rates from coronary heart disease and cerebrovascular disease in rural areas have consistently exceeded those in urban areas in recent years. At the same time, it should be noted that China has also been making continuous progress in CVD prevention and control, with declining smoking rates, rising hypertension control rates, significant improvements in clinical diagnosis and treatment levels and basic research, certain achievements in community prevention and treatment efforts, increasing emphasis on post-disease rehabilitation, and medical device research and development in a stage of rapid development.

Full Text

An Essential Introduction to the Annual Report on Cardiovascular Health and Diseases in China (2021)

MA Liyuan, WANG Zengwu, *FAN Jing, HU Shengshou*

National Center for Cardiovascular Diseases/Fuwai Hospital, Chinese Academy of Medical Sciences, Beijing 100037, China

*Corresponding authors: WANG Zengwu, Chief physician, Professor; E-mail: wangzengwu@foxmail.com
HU Shengshou, Academician of Chinese Academy of Engineering, Chief physician, Professor; E-mail: huss@fuwaihospital.org

Abstract

The prevalence and incidence of cardiovascular diseases (CVD) are increasing among Chinese residents due to the ever-deepening influence of associated risks caused by socioeconomic factors (such as the acceleration of population aging and urbanization) and lifestyle changes (such as recently emerged unhealthy lifestyle factors). In 2019, CVD-related deaths accounted for 46.74% and 44.26% of all deaths in China' s rural and urban areas, respectively—two out of every five deaths were attributable to CVD. It is estimated that approximately 330 million individuals suffer from CVD in China, including 13 million with stroke, 11.39 million with coronary heart disease, 8.9 million with heart failure, 5 million with pulmonary heart disease, 4.87 million with atrial fibrillation, 2.5 million with rheumatic heart disease, 2 million with congenital heart disease, 45.3 million with lower extremity artery disease, and 245 million with hypertension. In 2019, the total hospitalization costs for cardiovascular and cerebrovascular diseases reached 313.366 billion yuan. The burden of CVD continues to increase, particularly in rural areas. In recent years, mortality from coronary heart disease and cerebrovascular disease in rural areas has consistently exceeded urban levels due to unequal allocation of healthcare resources, low disease awareness, and poor treatment compliance. Nevertheless, China has made substantial progress in CVD prevention and control, including declining smoking rates, improving hypertension control, significant advances in clinical diagnosis and treatment and basic research, achievements in community-based prevention, growing emphasis on post-disease rehabilitation, and rapid development of medical device research and development.

Keywords: Cardiovascular disease; Epidemiology; Health influencing factors; Risk factors; Prevalence; Mortality; Community-based prevention and control; Rehabilitation; Basic research; Medical device development; Medical fees

---

To advance the implementation of the "Healthy China" strategy in the cardiovascular field and promote the shift from a disease-centered to a health-centered ap-

proach, the National Center for Cardiovascular Diseases reorganized the *China Cardiovascular Disease Report* into the *Annual Report on Cardiovascular Health and Diseases in China* in 2018, adding content on cardiovascular health behaviors, rehabilitation, basic research, and device development. China faces dual pressures from population aging and prevalent metabolic risk factors, with CVD incidence and prevalence continuing to rise, making it the leading cause of death among residents. CVD imposes an increasingly heavy economic burden on both society and individuals. This article interprets key points from the newly published *Annual Report on Cardiovascular Health and Diseases in China (2021)* to provide scientific evidence for CVD prevention and policy formulation.

1 Cardiovascular Health Influencing Factors

Smoking

In 2017, smoking caused 2.6 million deaths in China, accounting for nearly one-third of global tobacco-related deaths and demonstrating that tobacco use harms Chinese populations far more than the global average [1]. Chinese men have consistently had one of the world' s highest smoking rates. Although current smoking rates among Chinese residents aged $ $15 years declined from 28.1% to 26.6%, the rate of decline is slower than the global average. In 2018, the smoking rate among men aged $ $15 years was 50.5%, while women' s was 2.1%. The current e-cigarette usage rate was 0.9%, with 5.8% of middle school students having tried smoking and 48.6% exposed to secondhand smoke. Among students, 69.8% had at least one smoking parent. The China Kadoorie Biobank (CKB) study followed 500,000 people for 9 years, finding that compared with never smokers, urban male smokers had a hazard ratio (HR) of 1.63 for CVD death, while female smokers had an HR of 1.58 [2].

Diet

Data from the 1982–2012 China National Nutrition Surveys (CNNS) and China Health and Nutrition Surveys (CHNS) show significant changes in Chinese residents' food intake patterns, characterized by decreased grain and vegetable consumption and increased animal food intake—primarily pork—while egg, fish, and dairy intake remain low. Cooking oil intake increased significantly, while household cooking salt decreased; both remain far above recommended levels. The risk of inadequate vitamin and mineral intake persists. For the first time, rural fat energy supply ratio exceeded the recommended upper limit. Total energy intake shows a declining trend, protein intake remains relatively stable, carbohydrate energy supply ratio has decreased significantly, and fat energy supply ratio has increased and now exceeds dietary guideline recommendations (Figure 1 [Figure 1: see original paper]).

Physical Activity

The 2016 Physical Activity and Fitness in China-The Youth Study, using multistage cluster sampling of over 120,000 primary and secondary students across provinces, found that physical activity 达标率 (meeting guidelines) was higher among primary school students than middle school students in 2016, with no significant change among high school students. The 2014 National Physical Fitness Monitoring showed that Chinese residents' regular exercise participation rate was lowest among those aged 20–29 and highest among those aged 60–69. CHNS data revealed a declining trend in total physical activity among Chinese adults (MET · h/week). Male occupational activity decreased from 382.9 MET · h/week in 1991 to 266.4 MET · h/week in 2011, with similar trends for females [3-5]. WHO data analysis showed that meeting physical activity recommendations could prevent 8.3% of premature deaths in CKB, equivalent to avoiding 381,000 premature deaths annually among people aged 40–74 [6]. A CKB study of over 460,000 CVD-free individuals followed for 7.2 years found an inverse association between total physical activity and CVD mortality. Compared with the lowest activity group (\$ $9.1 MET \cdot h/day$), $the highest group$(\$33.8 MET · h/day) had a 41% lower CVD death risk. Each 4 MET · h/day increase in activity reduced CVD death risk by 12% [7]. Both occupational and non-occupational activity increases reduced CVD risk.

The Global Burden of Disease (GBD) study estimated that physical inactivity-related medical costs in China reached \$6.8 billion in 2013, accounting for 15% of global medical costs from inactivity, with indirect costs of \$1.2 billion [8]. The 2013 CCDRFS and National Health Service Survey data showed that 12.3% of coronary heart disease, 15.7% of stroke, 12.5% of hypertension, and 16.9% of type 2 diabetes in Chinese residents were directly attributable to physical inactivity (not meeting WHO standards), with overweight/obesity from inactivity further exacerbating these risks [9]. In 2013, physical inactivity' s economic burden was \$8.86 billion, representing 15.2% of total chronic disease economic expenditure, exceeding 15% of China' s total direct economic burden from major non-communicable diseases [9].

Healthy Body Weight

The *Report on Chinese Nutrition and Chronic Diseases (2020)* shows rising overweight and obesity rates. Compared with 2002, overweight and obesity rates among adults aged 18 increased by 40.7% and 88.5%, respectively, with higher increases in rural than urban areas [10]. In 2015, the China PEACE project surveyed 35–75 year-olds, finding age-standardized abdominal obesity rates (waist circumference 90 cm for men, 85 cm for women) of 32.7% in women and 29.0% in men, estimating 270 million people with abdominal obesity nationwide [11]. By 2030, adult overweight/obesity rates (Chinese standards) may reach 70.5% and 31.8%, respectively, affecting 108.9 million children aged 7–17 and 48.5 million children 6 years (WHO standards) [12]. GBD data show that in 2019, high BMI caused 540,000 CVD deaths in China, with an age-

standardized CVD mortality rate of 38.2 per 100,000. Direct medical costs from overweight/obesity reached $8.4 billion, with indirect costs of $2.1 billion [12]. Based on CHNS trends, overweight/obesity-related medical costs are projected to reach $61.7 billion by 2030 [12].

Mental Health

A meta-analysis of 23 hospital-based studies found that 51% of Chinese hospitalized coronary heart disease patients had depression, with 14.7% having major depression [13]. Community-based studies found depression in 34.6% of coronary heart disease patients, with 11.8% having major depression [14]. Shanghai Mental Health Center analysis of 1,826 depression patients found that 17.6% initially presented with circulatory system symptoms, alongside insomnia, gastrointestinal disorders, trunk pain, paresthesia, neurological disorders, decreased libido, and body pain [15].

2 CVD Risk Factors

Hypertension

Eight nationwide hypertension surveys from 1958–2018 show rising prevalence among Chinese residents aged $ $15 years (Figure 2 [Figure 2: see original paper]). The 2012–2015 China Hypertension Survey (CHS) of 451,755 urban and rural residents aged $ $18 years found a hypertension prevalence of 23.2%, higher in men than women (24.5% vs 22.0%), increasing with age [16]. The 2018 CCDRFS survey of 179,873 residents aged $ $18 years showed a hypertension prevalence of 27.5% [17]. A meta-analysis of 2,748,369 Chinese individuals found hypertension prevalence increased at 0.4% annually before 1980 and 2.9% annually after 1980—7.3 times the pre-1980 rate [18].

CHS found that age-standardized detection rates of high-normal blood pressure (systolic 130–139 mmHg or diastolic 85–89 mmHg) increased from 23.8% in 1991 to 39.1% in 2015, estimating 435 million people with high-normal blood pressure. A prospective cohort study of 14,392 adults aged >60 years showed hypertension age-standardized incidence increased from 56.9 to 116.9 per 1,000 person-years. CHNS cross-sectional surveys of adults aged $ $18 years showed high-normal blood pressure age-standardized detection rates increased from 26.3% in 2002 to 42.7% in 2010 [19-22].

Large epidemiological studies show dyslipidemia prevalence (defined as TC $ $6.22 mmol/L, LDL-C $ $4.14 mmol/L, TG $ $2.26 mmol/L, or HDL-C<1.04 mmol/L) among Chinese residents aged $ $18 years rose dramatically from 18.6% in 2002 to 33.8% in 2015 [23]. The 2015 CHS showed awareness, treatment, and control rates for dyslipidemia were 16.1%, 6.8%, and 2.5%, respectively [25]. The fourth CCDRFS survey of 163,641 residents found that among 3,351 high-risk individuals, LDL-C non-achievement rates were 74.5% (LDL-C<2.6 mmol/L target); among 1,441 very-high-risk individuals, LDL-C non-achievement rates were 93.2% (LDL-C<1.8 mmol/L target) [26].

A study of 41,728 adults without ASCVD from the Chinese Multi-Provincial Cohort Study, classified by 10-year ASCVD risk, found low-dose statin intervention could reduce 10-year ASCVD incidence by 4.3%, 9.2%, and 15.8% in low-, moderate-, and high-risk groups, respectively. Reducing statin prices to government centralized procurement levels significantly improved cost-effectiveness for ASCVD primary prevention [27].

Diabetes

Diabetes prevalence in China shows a significant upward trend. A 2018 cross-sectional survey of 31 provinces found adult diabetes prevalence of 12.4%, affecting 140 million adults, with prediabetes prevalence of 38.1% [28]. Analysis of Zhejiang's diabetes surveillance system showed type 2 diabetes age-standardized incidence increased from 281.7 per 100,000 person-years in 2007 to 351.5 per 100,000 person-years in 2017, with faster increases among men, younger people, and rural populations [29].

The Da Qing Diabetes Prevention Study randomized 577 adults with impaired glucose tolerance to control or lifestyle intervention groups (diet, exercise, diet plus exercise). Over 30 years of follow-up, intervention reduced diabetes incidence by 39%, cardiovascular events by 26%, stroke by 40%, severe retinopathy by 47%, composite microvascular events by 33%, all-cause mortality by 10%, and cardiovascular death by 33% [30]. Lifestyle intervention was highly cost-effective, reducing 30-year diabetes cumulative incidence, increasing life expectancy by 1.44 years, and decreasing total costs by $4,390 per quality-adjusted life year (QALY) gained [31].

Chronic Kidney Disease (CKD)

A national CKD prevalence survey of 47,204 adults aged 18 years in 13 provinces found total CKD prevalence of 10.8%, estimating 129.8 million CKD patients nationwide. Abnormal kidney function (eGFR<60 ml $\cdot$ min^{-1} $\cdot$ (1.73 m^{2})^{-1}) prevalence was 1.7%, and albuminuria (urine albumin-to-creatinine ratio 30 mg/g) prevalence was 9.4% [32]. In 2016, average per capita hospitalization costs were $1,230 for CKD patients, $2,450 for hemodialysis patients, and $1,790 for peritoneal dialysis patients—significantly higher than for non-CKD patients [32].

Metabolic Syndrome

The 2010–2012 China National Nutrition and Health Survey of 97,098 adults aged $ $18 years found metabolic syndrome prevalence of 15.4% using revised NCEP ATP III criteria [33]. Among 10,640 children and adolescents aged 10–17 years, metabolic syndrome prevalence was 2.4% using Chinese Pediatric Society criteria and 4.3% using Cook criteria [34].

Air Pollution

Ambient and indoor air pollution are China' s third-leading risk factor for disability-adjusted life years (DALYs). From 1990–2017, deaths related to indoor air pollution decreased by 47.8% and DALY losses by 57.2% [35]. In 2017, long-term $PM_{2·5}$ exposure caused over 1.2 million excess deaths in China, with 610,000 annual excess deaths. Since 2013, daily mortality data show that increased $PM_{2·5}$, PM_{10}, and O_3 exposure concentrations raise mortality risks for CVD, coronary heart disease, and hypertension patients [36].

3 CVD Community Prevention and Control

The National Chronic Disease Comprehensive Prevention and Control Demonstration Areas (Demonstration Areas) are pilot projects implementing "Healthy China" concepts. By 2020, 488 national Demonstration Areas were established across 31 provinces, covering 17.1% of counties (cities/districts), exceeding the 2020 target of 15% in the *China Chronic Disease Prevention and Control Mid- to Long-Term Plan (2017–2025)* [37].

Tianjin' s Demonstration Areas, while promoting "Three Reductions and Three Health" lifestyle actions, explored innovative community hypertension management and medical alliance models. Analysis of 2008–2018 all-cause mortality monitoring showed Demonstration Areas' life expectancy increased from 80.9 to 81.8 years, while non-Demonstration Areas showed no increase in male life expectancy. Demonstration Areas' acute myocardial infarction (AMI) crude and standardized mortality rates declined, with greater annual percentage changes than non-Demonstration Areas (crude: -4.9% vs -1.4%; standardized: -5.9% vs -2.2%) [37].

Chongqing and Guiyang, through continuous improvement of chronic disease surveillance systems, analyzed major chronic disease premature death probabilities in Demonstration Areas. Chongqing' s Demonstration Areas showed major chronic disease premature death probability declining from 16.2% in 2012 to 13.2% in 2018, with CVD premature death probability at 5.0% in 2018 [38]. Guiyang' s Demonstration Areas showed major chronic disease premature death probability declining from 15.9% in 2014 to 13.8% in 2019, with CVD premature death probability at 4.8% in 2019 [39].

4 CVD Prevalence Trends

CVD prevalence in China continues rising. It is estimated that 330 million people have CVD, including 13 million with stroke, 11.39 million with coronary heart disease, 8.9 million with heart failure, 5 million with pulmonary heart disease, 4.87 million with atrial fibrillation, 2.5 million with rheumatic heart disease, 2 million with congenital heart disease, and 45.3 million with lower extremity artery disease. In 2019, rural and urban CVD deaths accounted for 46.74% and 44.26% of total deaths, respectively—two of every five deaths were

CVD-related [40].

Coronary Heart Disease

According to the *China Health Statistics Yearbook 2020*, 2019 urban coronary heart disease mortality was 148.51 per 100,000 (AMI: 77.89; other ischemic heart disease: 70.62), while rural mortality was 164.66 per 100,000 (AMI: 79.14; other: 85.52). Rural coronary heart disease mortality has exceeded urban levels since 2016 (Figure 8 [Figure 8: see original paper]). AMI mortality showed rapid increases from 2005, with rural areas surpassing urban areas in 2012 and remaining higher (Figure 9 [Figure 9: see original paper]) [40].

The 2013 Fifth National Health Service Survey found coronary heart disease prevalence of 10.2‰ among adults aged $ $15 years. The 2018 Fourth Survey estimated 11.4 million coronary heart disease patients nationwide. China PEACE analyzed 29,581 hospitalizations from 1,631 hospitals, finding continuously increasing STEMI hospitalizations from 2001–2015, with significant geographic variations in care processes and outcomes persisting across four time points [41].

The China Acute Coronary Syndrome Clinical Pathways Study (CPACS) enrolled 7,199 ACS patients from 51 hospitals across 15 provinces, showing declining rates of guideline-recommended secondary prevention medications after discharge, from 86.7% at discharge to 68.9% at 1 year. Tertiary hospitals had 88.8% application rates at discharge versus 79.2% in secondary hospitals. Lower-income patients had lower utilization of antihypertensive and statin medications [42].

The Chinese Cardiac Surgery Registry (CCSR) data from 77 cardiac centers showed 19,506 patients underwent coronary artery bypass grafting (CABG) in 2020, with mean age 62.8 years and 22.4% female. Overall in-hospital mortality was 2.1% [43].

Stroke

Stroke was China' s leading cause of death in 2019, with 2.19 million deaths. There were 28.8 million stroke patients, and stroke was the leading cause of DALYs (45.9 million). Age-standardized DALY rate was 2,636 per 100,000 [44]. In 2019, cerebrovascular disease crude mortality was 149.56 per 100,000 (urban: 132.31; rural: 161.48), higher in men than women and in rural than urban areas [40].

From 2003–2019, rural cerebrovascular disease crude mortality exceeded urban levels. Mortality showed a gradual decline from 2003–2009 but increased slightly from 2009–2019, more pronounced in rural areas (Figure 10 [Figure 10: see original paper]) [40]. CHNS analysis of 14,920 residents showed age-standardized stroke incidence was 501 per 100,000 person-years in northern versus 334 in

southern China, with differences explained by hypertension prevalence variations [45].

The China National Stroke Screening Survey (CNSSS) of adults aged $ $40 years found atrial fibrillation in 2.4% of ischemic stroke patients, estimating over 1.5 million ischemic stroke patients with atrial fibrillation nationwide, yet only 21.7% received anticoagulation therapy [48].

Arrhythmia

Despite COVID-19 impacts, 2020 national pacemaker implantations reached 86,445 (dual-chamber: 73.3%). Indications included sick sinus syndrome (45.1%), atrioventricular block (39.3%), and others [53]. The 2012–2015 CHS found atrial fibrillation prevalence of 0.7% among adults aged $ 18*years*(0.8*{2}DS*{2}$-VASc $ $2 was only 28.7% overall (36.5% in tertiary, 15.7% in non-tertiary hospitals) [49].

Atrial fibrillation radiofrequency catheter ablation (RFCA) is widely used in >500 Chinese hospitals, with procedures growing at 13.2% annually since 2010, though 2020 saw a decrease due to COVID-19 [53].

A prospective study following 678,718 people identified 2,553 sudden cardiac deaths (SCD), estimating 544,000 annual SCD cases nationwide (41.8 per 100,000), higher in men than women [50].

Valvular Heart Disease

Echocardiography of 35,017 adults aged $ $18 years found valvular heart disease prevalence of 3.8%, estimating 25 million patients nationwide. Rheumatic valvular disease remains the leading cause, though degenerative valvular disease has increased significantly. Among valvular heart disease patients, 55.1% have rheumatic and 21.3% degenerative lesions [51]. Analysis of 35,660 patients undergoing transthoracic echocardiography found 1.3% with bicuspid aortic valve, 15.0% with aortic dilation, 6.1% with aortic insufficiency, and 3.3% with aortic root dilation [52].

Congenital Heart Disease

Congenital heart disease (CHD) ranks first among newborn birth defects in many regions, with detection rates varying from 2.4–15.0‰. A meta-analysis of 74 studies including 65,458,911 newborns found national CHD detection rates rising from 2.7‰ in 1980–1984 to 4.0‰ in 2015–2019, increasing from west to east and south to north [53]. In 2019, urban CHD mortality was 0.91 per 100,000 (rural: 1.11) [40]. In 2020, 77,228 CHD surgeries were performed in 741 hospitals, accounting for 28.1% of all cardiac and aortic surgeries—declining to second place. Adult CHD surgeries accounted for 28.5% of total CHD procedures, showing a yearly increase [53]. In 2020, 35,799 interventional CHD procedures

were performed in 468 local hospitals with 98.5% success rate, 0.12% mortality, and 0.43% severe complication rate [53].

Cardiomyopathy

Analysis of 8,080 adults found hypertrophic cardiomyopathy (HCM) prevalence of 0.16% (0.2% men, 0.1% women), estimating 230,000 HCM patients nationwide [54]. Dilated cardiomyopathy prevalence was 0.04% [55]. Genetic testing in 1,015 HCM patients found pathogenic mutations in 31.7%, most commonly MYH7 and MYBPC3 genes. Fuwai Hospital studies found common genetic variants are also important HCM causes, suggesting non-Mendelian inheritance patterns with ethnic specificity [54].

Heart Failure

The CHS found heart failure prevalence of 1.3% among adults aged $ $35 years, with left ventricular systolic dysfunction (LVEF<50%) in 1.4% and moderate/severe diastolic dysfunction in 2.7% [55]. The China-HF registry analysis of 31,356 hospitalized heart failure patients showed in-hospital mortality of 4.1% [56]. The 2020 China Heart Failure Medical Quality Control Report found hospitalized heart failure patients averaged 67 years old, 60.8% male. Valve disease proportion decreased yearly, while hypertension (56.3%) and coronary heart disease (48.3%) became leading causes [57]. Infection was the primary precipitating factor, followed by myocardial ischemia and exertion. Heart failure with reduced, mid-range, and preserved ejection fraction accounted for 40.2%, 21.8%, and 38.0%, respectively [57].

Diuretic use remained stable, digoxin use declined due to international clinical trials, and aldosterone antagonist and β-blocker use increased. Renin-angiotensin system (RAS) blocker use increased overall, but ACEI/ARB use decreased due to ARNI introduction [57]. Nearly 200 left ventricular assist device implantations have been performed in 20 hospitals, with 4 approved clinical trials [57].

Pulmonary Vascular Disease and Venous Thromboembolism

A multicenter study of 3,007 pulmonary hypertension (PH) patients found 58.7% had pulmonary arterial hypertension (PAH) and 12.0% chronic thromboembolic PH (CTEPH). Among PAH patients, congenital heart disease-associated PAH accounted for 43.4%, idiopathic PAH for 35.9%, and connective tissue disease-associated PAH for 11.2% [58]. Before 2006, China had no PAH-targeted drugs; survival has improved significantly in the targeted therapy era, with 1-, 3-, and 5-year survival rates of 92.1%, 75.1%, and 64.3%, respectively [58].

Analysis of 10,763 hospitalized pulmonary embolism (PE) patients from 90 tertiary hospitals found PE accounted for 0.13% of inpatients, with mortality decreasing significantly from 8.5% in 2007 to 3.9% in 2016 [59]. A study of 10,563 VTE patients found age- and sex-adjusted hospitalization rates increased from

3.2 per 100,000 in 2007 to 17.5 per 100,000 in 2016, while in-hospital mortality decreased from 4.7% to 2.1% [59].

Aortic and Peripheral Arterial Disease

Aortic Disease: Health insurance data estimated 137,000 annual acute aortic dissection cases in mainland China (98,000 men, 39,000 women) [60]. The Sino-RAD registry showed Chinese aortic dissection patients are younger (~51 years) than Western counterparts [61]. For type A dissection, open surgery accounted for 64.6%, hybrid treatment 10.3%, and medical treatment 25.1%, with mortality rates of 5.5%, 14.9%, and 21.4%, respectively [62]. For type B dissection, medical treatment accounted for 61.4%, endovascular treatment 33.9%, and surgical treatment 4.7%, with mortality rates of 9.4%, 3.5%, and 14.1%, respectively [62].

Hospital Quality Monitoring System (HQMS) data showed thoracic endovascular aortic repair (TEVAR) averaged 14 days hospitalization and $13,600 cost in 2019, while Bentall procedure averaged 21 days and $21,500, and total aortic arch replacement averaged 23 days and $31,200 [63].

Peripheral Arterial Disease: A stratified random survey of 31,638 adults aged 35 years found lower extremity artery disease (LEAD) prevalence of 6.6%, estimating 45.3 million LEAD patients nationwide, with 5.4% receiving revascularization (estimated 24,000 cases) [66]. Screening of 109,551 high-risk individuals found carotid artery moderate-or-greater stenosis in 6.5% [67]. A single-center study of 1,012 renal artery stenosis (RAS) patients found atherosclerosis caused 78.9%, fibromuscular dysplasia 11.0%, and Takayasu arteritis 8.5%, with non-atherosclerotic causes more common in patients 40 years [68]. Inter-arm systolic blood pressure difference 15 mmHg is a strong indicator for subclavian artery stenosis screening [69].

5 CVD Rehabilitation

A 2017 survey of 124 tertiary hospitals across China' s seven geographic regions found only 30 hospitals (24.2%) offered cardiac rehabilitation services, averaging 1.2 hospitals per 100 million population [70]. Among 101 hospitals with cardiac surgery capabilities, 30 (29.7%) offered in-hospital Phase I rehabilitation, 17 (16.8%) offered Phase II, and 13 (12.9%) offered both [70].

Stroke Rehabilitation: China has 977 rehabilitation hospitals with 244,501 beds. A survey of 2,922 hospitals found 2,716 (92.9%) had rehabilitation wards (average 42 beds) and 1,816 (62.1%) offered early stroke rehabilitation [71]. In 2018, there were 45,980 rehabilitation physicians and 126,000 therapists (60% rehabilitation-trained, 40% traditional Chinese medicine-trained) [71]. Average rehabilitation hospitalization costs were $1,740 in 2018, with drug costs declining and therapy costs increasing [72].

6 Cardiovascular Basic Research and Device Development

Basic Research: High-quality cardiovascular basic research in mainland China began around 2010 and has rapidly developed. From 2016–2020, 2,018 papers with Chinese corresponding and first authors explored cardiac/vascular anatomy, development, and disease mechanisms, focusing on cardiac protection/regeneration, single-cell sequencing, gene therapy, and machine learning [73].

Medical Device Development: From 2016–2020, the National Medical Products Administration approved 330 innovative medical devices, including 113 cardiovascular products (34.2% of total), demonstrating cardiovascular innovation' s dominance. Among 113 approved cardiovascular products, 88 (77.9%) were domestically developed, including 46 interventional, 13 imaging, 8 flow measurement, 18 open surgery, 12 active surgical, and 16 AI software devices [73].

7 CVD Medical Costs

From 1980–2019, discharged CVD and diabetes patients increased continuously. In 2019, CVD discharges reached 15.86 million (16.6% of total discharges), including 11.86 million CVD and 4.0 million diabetes patients. Ischemic heart disease (4.75 million) and cerebral infarction (3.98 million) accounted for the largest proportions (Figure 12 [Figure 12: see original paper]). CVD discharge growth rate (8.5% annually) exceeded the all-disease average (6.8%) [40].

In 2019, total hospitalization costs for cardiovascular and cerebrovascular diseases were 313.366 billion yuan, including 190.868 billion for CVD. Ischemic heart disease (110.699 billion), cerebral infarction (66.837 billion), and cerebral hemorrhage (40.892 billion) accounted for major expenses. From 2004–2019, AMI, cerebral infarction, and cerebral hemorrhage total costs grew at annual rates of 25.0%, 18.2%, and 14.0%, respectively (Figure 13 [Figure 13: see original paper]). Average per-hospitalization costs in 2019 were $2,070 for ischemic heart disease, $4,020 for AMI, $1,690 for cerebral infarction, and $4,090 for cerebral hemorrhage (Figure 14 [Figure 14: see original paper]) [40].

Acknowledgments: We thank all experts who participated in writing the *Annual Report on Cardiovascular Health and Diseases in China (2021)*. The author list is available in reference [73].

Conflict of Interest: None declared.

References [1] FONG G T, YUAN J, CRAIG L V, et al. Achieving the goals of healthy China 2030 depends on increasing smoking cessation in China: comparative findings from the ITC project in China, Japan, and the republic of Korea [J]. China CDC Wkly, 2021, 3(22): 463-467. [2] PANG Y J, YU C Q, GUO Y, et al. Associations of lifestyles with major chronic diseases in Chinese adults: evidence from the China Kadoorie Biobank [J]. Chinese Journal of Epidemiol-

ogy, 2021, 42(3): 369-375. ···(remaining references follow the same format as in the original text)

Note: Figure translations are in progress. See original paper for figures.