Postprint on the Current Status of Hypertension Epidemiology and Prevention in China from the China Cardiovascular Health and Disease Report 2021

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Abstract

Along with socioeconomic development and the accelerating processes of population aging and urbanization, the prevalence of hypertension in China has exhibited a continuous upward trend, especially in rural areas. While the awareness, treatment, and control rates of hypertension have improved, they remain at relatively low levels. Currently, China has 245 million hypertensive patients, and the high-normal blood pressure population is also increasing continuously, imposing an increasingly heavy economic burden on residents and society and constituting a major public health problem. Strengthening government-led hypertension prevention and control efforts is imperative.

Full Text

Preamble

Epidemiology and Management of Hypertension in China: An Analysis Using Data from the Annual Report on Cardiovascular Health and Diseases in China (2021)

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Abstract

With socioeconomic development and accelerated population aging and urbanization, the prevalence of hypertension in China is gradually increasing, particularly in rural areas. Although the rates of awareness, treatment, and control of hypertension have improved, they remain at relatively low levels. Currently, China has 245 million hypertensive patients, and the population with high-normal blood pressure continues to grow, imposing an increasingly heavy economic burden on residents and society. Hypertension has become a major public health problem, making it imperative to strengthen government-led prevention and control efforts.

Keywords: Hypertension; Epidemiology; Prevalence; Incidence; Awareness rate; Treatment rate; Control rate

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In response to the "Healthy China Action" and to implement the national policy of "focusing on primary-level care and prioritizing prevention," the National Center for Cardiovascular Diseases has transformed the annual "China Cardiovascular Disease Report" (published since 2005) into the "China Cardiovascular Health and Diseases Report." This new initiative advocates for lifecycle cardiovascular health management, enhances public awareness of cardiovascular disease (CVD) risk, emphasizes that individuals are the primary guardians of their own health, and focuses on controlling upstream risk factors such as unhealthy diet and physical inactivity to prevent CVD at its source. This article provides an interpretation of the hypertension section from the "China Cardiovascular Health and Diseases Report 2021."

China currently faces dual pressures from population aging and the prevalence of metabolic risk factors, leading to continuously increasing CVD morbidity and mortality, which has become the leading cause of death in China. As a major risk factor for CVD, hypertension prevalence continues to rise. In 2015, there were already 245 million hypertensive patients among Chinese adults aged 18 and above [1], and in 2017, elevated systolic blood pressure caused 2.54 million deaths in China, accounting for over 5% of disability-adjusted life years [2]. Hypertension has become a critical public health challenge in China. Therefore, it is essential to timely, accurately, and comprehensively understand the current epidemiological status and trends of hypertension in China to provide scientific evidence for CVD prevention and policy formulation.

1.1 National Hypertension Prevalence Surveys

Since the first national hypertension survey in 1959, China has conducted seven large-scale hypertension prevalence surveys through 2018. Although these studies differed in age range, sample size, sampling methods, survey regions, blood pressure measurement tools, and diagnostic criteria—making direct comparisons

difficult—they collectively demonstrate an upward trend in hypertension prevalence in China (Table 1).

A meta-analysis examining the longitudinal trend of hypertension prevalence in Chinese adults from 1959 to 2018 included 18 studies with a total of 9,191,121 participants. The results showed that the annual growth rate of hypertension prevalence was 0.29% before 2004, but increased to 2.45% after 2004—approximately eight times higher than the pre-2004 rate [3].

Hypertension prevalence increases with age, with particular attention needed for hypertension among young adults. The China Health and Nutrition Survey (CHNS) conducted nine cross-sectional surveys between 1991 and 2015 among 72,452 adults aged 20–79 [4], revealing that the prevalence of hypertension among young people aged 20–39 increased most significantly during this period, from 4.5% in 1991 to 11.0% in 2015, representing a relative change of 144.4%. The 2012–2015 China Hypertension Survey (CHS), which included 451,755 adults across 31 provinces, autonomous regions, and municipalities, found hypertension prevalence rates of 4.0%, 6.1%, and 15.0% among young adults aged 18–24, 25–34, and 35–44, respectively [1].

The 2018 China Chronic Disease and Risk Factor Surveillance (CCDRFS) survey of 179,873 permanent residents aged $ $18 in 298 counties (districts) across 31 provinces showed youth hypertension prevalence of 8.9% among those aged 18–29 and 13.4% among those aged 30–39 [5]. Among adults over 60, the prevalence was 54.92%, and among those aged $ $80, it was 56.5% [6–8].

Additionally, hypertension prevalence remains higher in men than in women and higher in northern than in southern China. North China [33.3% (95%CI: 31.5%–35.2%)] and Northeast China [32.7% (95%CI: 28.1%–37.4%)] have higher rates than other regions, with statistically significant differences ($P<0.0001$) [5]. Notably, the increasing trend in rural hypertension prevalence is concerning. CHNS research shows that rural age-standardized hypertension prevalence increased from 13.3% in 1991 to a significantly higher level, with a relative change rate of 106.0%. During the same period, urban age-standardized hypertension prevalence was 22.9% and 18.9%, with a relative change rate of only 21.8%; by 2015, rural hypertension prevalence had surpassed that of urban areas [4]. The 2012–2015 CHS study found no difference between rural and urban hypertension prevalence (23.1% vs. 23.4%) [1]. However, the 2018 CCDRFS study revealed that rural residents' hypertension prevalence was 3.7% higher than that of urban residents (29.4% vs. 25.7%), a statistically significant difference [5]. Although these research findings are not entirely consistent, they uniformly demonstrate the rapid rise in rural hypertension prevalence, likely related to China' s rapid economic development, accelerated urbanization, and the resulting proliferation of unhealthy lifestyles, coupled with relatively poorer education and lower disease risk awareness in rural areas.

1.2 Hypertension Prevalence in Children

Notably, approximately 4% of Chinese children have persistently elevated blood pressure levels, making hypertension a common cardiovascular metabolic abnormality among Chinese children.

The 2010 National Student Physical Fitness Survey of 190,000 Han students aged 7–17 showed a hypertension prevalence of 14.5% among Chinese school-age children and adolescents, with higher rates in boys than girls (16.1% vs. 12.9%) and a gradual increase with age [9]. CHNS data from nine cross-sectional surveys between 1991 and 2015 revealed that the prevalence of hypertension among school-age children in surveillance areas increased from 8.9% in 1991 to 20.5% in 2015 [10] (Figure 1 [Figure 1: see original paper]).

Obesity is the most common risk factor for childhood hypertension. An analysis of 943,128 Han children nationwide from 1995 to 2014 found that the independent contribution of overweight and obesity to hypertension risk (population attributable risk percentage, PAR%) increased from 6.3% in 1995 to 19.2% in 2014. For systolic hypertension, PAR% increased from 7.4% in 1995 to 26.2% in 2014, an increase twice that of the concurrent increase in diastolic hypertension PAR%, indicating that overweight and obese children are a priority population for hypertension prevention and treatment [11].

2 Hypertension Incidence in the Chinese Population

Compared with prevalence, incidence more accurately reflects epidemiological changes in disease. However, research on hypertension incidence in China is relatively limited. A prospective cohort study from CHNS (1991–2015) that included 12,952 Chinese adults aged >18 found that hypertension incidence showed an increasing trend from 1993 to 2015, with regional variations [12].

The age-standardized hypertension incidence rate increased from 40.8 per 1,000 person-years [95%CI (38.3, 43.4)] in 1993–1997 to 41.5 per 1,000 person-years [95%CI (39.9, 43.2)] in 2000–2009, and further increased to 48.6 per 1,000 person-years [95%CI (46.1, 51.0)] in 2011–2015. Compared with western China, residents in the relatively more developed eastern, central, and northeastern regions showed significantly higher hypertension incidence. No significant difference was observed between urban and rural hypertension incidence. Female incidence was significantly lower than male incidence, and hypertension incidence increased with age, body mass index (BMI), and alcohol consumption.

3 Prehypertension Detection Rate

Prehypertension is defined as systolic blood pressure of 120–139 mmHg (1 mmHg = 0.133 kPa) and/or diastolic blood pressure of 80–89 mmHg without antihypertensive medication. Many cases of hypertension develop gradually from prehypertension. Without active intervention, most people with prehypertension will

develop hypertension. Studies have shown that the detection rate of prehypertension in Chinese people is continuously increasing. For example, CHNS data from 1991–2011 in eight provinces (nine provinces from 1997, and 12 provinces from 2011) showed that the age-standardized detection rate of prehypertension increased from 23.9% in 1991 to 33.6% in 2011, with a clear upward trend before 2006 and no statistically significant change between 2006–2011 [13].

CHS study results showed that the prehypertension detection rate among Chinese residents aged $ $18 was 41.3%. The detection rate first increased and then decreased with age, with statistically significant differences among age groups (Figure 2 [Figure 2: see original paper]). The prehypertension detection rate was higher in men than in women (47.8% vs. 34.6%, P<0.001), while no statistically significant differences were found between rural and urban areas (41.4% vs. 41.1%) or between Han and ethnic minorities (41.3% vs. 40.8%).

The CCDRFS study found that in 2018, the prehypertension detection rate among Chinese adults aged $ $18 was 50.9%, meaning that more than half of Chinese adult residents had blood pressure in the prehypertension range [5].

4 Awareness, Treatment, and Control Rates of Hypertension

The awareness, treatment, and control rates of hypertension (collectively referred to as the "three rates") are important indicators for evaluating hypertension prevention and control levels. Although China's "three rates" have continuously increased (Figure 3 [Figure 3: see original paper]), they remain relatively low compared with developed countries. In 2015, the awareness, treatment, and control rates among Chinese adults were 46.9%, 40.7%, and 15.3%, respectively [1]; in 2018, these rates were 41.0%, 34.9%, and 11.0%, respectively [5], representing significant improvements from 1991 levels of 27.0%, 12.0%, and 3.0%. Comparisons across demographic characteristics show that the "three rates" are higher in women than in men, higher in urban than in rural areas, and increase with age. Compared with northern China, southern China has higher awareness, treatment, and control rates among hypertensive patients.

CHNS data indicate that from 1991–2015, the "three rates" among Chinese adults aged 20–79 increased, but the magnitude was limited and remained at low levels: awareness increased from 24.2% to 27.2%, treatment from 15.1% to 23.6%, and control from 3.6% to 8.4%. Notably, while hypertension prevalence increased most significantly among young adults aged 20–39, their awareness, treatment, and control rates did not improve and even decreased somewhat [4].

5 Hypertension Prevention

Hypertension prevention should focus on controlling risk factors, such as promoting healthy lifestyles, maintaining positive mental states, weight reduction, increasing physical activity, and smoking cessation and alcohol limitation. The

"Chinese Guideline for Healthy Lifestyle to Prevent Cardiometabolic Diseases" [14] provides recommendations for Chinese adults aged $ $20 regarding diet and beverages, physical activity, smoking, and alcohol consumption to promote healthy lifestyles and prevent cardiometabolic diseases, thereby advancing the implementation of Healthy China Action.

In recent years, the government has implemented multiple programs, including the "China Medium- and Long-term Plan for Chronic Disease Prevention and Treatment," "National Essential Public Health Services," "National Demonstration Areas for Comprehensive Chronic Disease Prevention and Control," and "Healthy Lifestyle Action for All." These initiatives support the creation of health-promoting environments such as healthy communities, healthy workplaces, healthy schools, healthy restaurants, healthy walking paths, and healthy theme parks. They also promote the development of appropriate health technologies and tools, such as oil control pots, salt-limiting spoons, BMI scales, and measuring wine cups. During implementation, localities have explored new models tailored to local conditions, including specialized activities for healthy kitchens, balanced diet and physical activity, and maintaining healthy weight [15]. From 2010–2016, the number of hypertensive patients under standardized management in China increased exponentially, from 42.159 million in 2010 to 90.23 million in 2016, with a standardized management rate reaching 70.31% [16].

6 Hypertension Treatment

The fundamental goal of hypertension treatment is to reduce the total risk of cardiovascular, cerebrovascular, and renal complications and mortality in hypertensive patients. Lifestyle modification is the foundation of hypertension treatment and should be maintained throughout the entire treatment process. The "2018 Revised Edition of the Chinese Hypertension Guideline" [17] advocates a more aggressive treatment principle: general hypertensive patients should achieve blood pressure <140/90 mmHg; those who can tolerate medication and some high-risk or very high-risk patients can further reduce to <130/80 mmHg; the blood pressure threshold for initiating combination therapy has been lowered, with patients having blood pressure $ $140/90 mmHg eligible to start low-dose combination therapy; early target achievement is emphasized, with blood pressure reduced to target levels within 4 weeks or 12 weeks. The CHIEF study demonstrated that initial low-dose combination therapy has good blood pressure-lowering effects and significantly improves hypertension control rates in Chinese middle-aged and elderly hypertensive patients with cardiovascular risk factors [18].

One study found that compared with standard hypertension control (target blood pressure 140/90 mmHg), intensive hypertension control (target blood pressure 133/76 mmHg) could prevent 2.209 million coronary heart disease events, 4.409 million stroke events, and 75,100 CVD deaths among Chinese hypertensive patients over 10 years. Intensive control could prevent 13% of

stroke events and 17% of coronary events in men and 11% of coronary events in women compared with standard control [19].

However, the actual treatment rate of hypertensive patients in China is not high, and the standardized treatment rate is low. In the 2012–2015 CHS study, only 40.7% of hypertensive patients received treatment, with an effective blood pressure control rate of 15.3% [1]; the 2018 CCDRFS study showed that only one-third of Chinese hypertensive patients received antihypertensive treatment, and only 11% achieved effective blood pressure control [5]. This represents a significant gap compared with the United States, where treatment and control rates exceed 50% and 40%, respectively [20].

Low awareness is a key factor limiting hypertension control in China. Patients who are unaware of their condition cannot actively seek treatment. Additionally, non-standardized treatment is an important constraint on control rates. Most hypertensive patients require combination therapy with two or more medications to effectively control blood pressure [18], but monotherapy remains common in China, particularly in primary care institutions. Regular blood pressure measurement and timely detection of hypertension are the first steps in prevention and treatment. The CCDRFS study showed that the 3-month blood pressure measurement rate among Chinese residents aged $ $18 was 47.5%, with 41.9% among those without a hypertension diagnosis. The measurement rate was higher in women than in men, higher in urban than in rural areas, increased with age, and was higher in East China than in other regions. Among patients with diagnosed hypertension, the measurement rate was 89.0% [95%CI (88.2%, 89.8%)] [5].

The "2018 Revised Edition of the Chinese Hypertension Guideline" suggests establishing a "blood pressure measurement at first visit"mechanism and providing other opportunistic blood pressure measurement conditions when population screening is not feasible. It recommends integrating hypertension management into the daily practice of general practitioners, using multiple approaches to improve patients' disease knowledge and self-care awareness, and correctly promoting home blood pressure monitoring technology where conditions permit [17].

Receiving national essential public health services can produce significant effects on hypertension prevention and control. A 2017 study analyzing 4,958 hypertensive patients identified in the 2011–2013 CHARLS study found that by 2013, 404 patients (8.1%) had received national essential public health services, with hypertension control rates increasing by 7.9%, antihypertensive medication use increasing by 10.3% ($P<0.001$), and blood pressure detection increasing by 10.5% ($P<0.001$) [21].

7 Cost-Effectiveness Analysis of Hypertension Control Strategies

In 2013, China' s total health expenditure was 3,186.9 billion yuan, with direct economic burden from hypertension accounting for 6.6%. Research estimates that community-based standardized hypertension management can reduce annual medication costs by approximately 26 yuan and annual per capita hospitalization costs by 245 yuan per patient, saving about 210 yuan in annual per capita direct medical expenses for hypertensive patients [22]. An annual per capita investment of 800 yuan in community-based hypertension health management in China can generate positive net benefits, meaning output exceeds input.

According to predictions from the China Cardiovascular Disease Policy Model for 2015–2025, compared with maintaining the status quo, treating patients with existing CVD and those with stage I and II hypertension without CVD would reduce 803,000 CVD events annually (690,000 strokes and 113,000 myocardial infarctions) and gain 1.2 million quality-adjusted life years (QALYs) [23].

Another study indicated that if China adopted the 2017 American College of Cardiology/American Heart Association (ACC/AHA) Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults and achieved current treatment rates, lifetime antihypertensive medication costs would increase by $42.7 billion, but CVD treatment costs would decrease by $3.77 billion, while preventing 1.41 million disability-adjusted life years [24].

8 Hypertension Health Education and Management

According to the "Healthy China Action (2019–2030)" [25], the mortality rate of cardiovascular and cerebrovascular diseases in China needs to be reduced to 209.7/100,000 and below by 2022, and to 190.7/100,000 and below by 2030. The awareness rate of hypertension among residents aged $ $30 should reach no less than 55% and 65%, respectively, and the standardized management rate of hypertensive patients should reach no less than 60% and 70%, respectively.

The "Chinese Hypertension Health Management Standard (2019)" [26] emphasizes the concepts of primordial and primary prevention, providing full-lifecycle, comprehensive blood pressure health management services and guidance for the entire population. Achieving these prevention and control goals requires joint efforts from government and society, with further improvements needed in health knowledge dissemination, risk factor intervention, disease risk awareness enhancement, implementation of blood pressure measurement at first visit, standardized patient management, and improvement of medication adherence.

Hypertension is a global chronic non-communicable disease, a major threat to human health, the leading cause of global disease burden, and an important public health problem facing China. The prevalence of hypertension in China shows an annual increasing trend, growing from 5.1% in 1959 to 23.2% in 2015 and

27.5% in 2018. Numerous studies show even higher prevalence among Chinese elderly populations, posing enormous challenges for hypertension prevention and control as society ages. Although extensive work in hypertension prevention knowledge dissemination and community-based standardized management has substantially increased China' s hypertension awareness, treatment, and control rates, these improvements remain insufficient. Particularly concerning is the rapid upward trend in rural hypertension prevalence coupled with relatively low awareness, treatment, and control rates, making rural areas the main battlefield for hypertension prevention and treatment. Additionally, more than 50% of adults have prehypertension, and the rising prevalence of hypertension among children and adolescents presents severe challenges for future hypertension prevention and control. Government departments and medical professionals should fully understand the epidemiological characteristics and trends of hypertension to develop scientific and practical policies and actions for hypertension prevention and control in China.

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