Short report

Prevalence of Hypertension in Older and Middle-aged Adults in China:

--Estimates from Two National Longitudinal Surveys

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ABSTRACT

Hypertension is a leading chronic risk for population health in China, especially for older and middle-aged adults. However, a representative estimate of hypertension prevalence lacks for general older populations. With datasets from the Chinese Longitudinal Healthy Longevity Study (CLHLS) and China Health and Retirement Longitudinal Study (CHARLS), two nationally representative longitudinal surveys, this report aims to provide some estimates of hypertension prevalence in older and middle-aged adults overall and by social and demographic variables. There had been a marked increase in hypertension prevalence from 41% to 52% among older adults over the past two decades. Older adults, who were females, with urban residence, high income, from eastern China, and engaged in non-agricultural work, were more likely to be hypertensive. About 30% of middle-aged people in China were suffering from hypertension. These findings are significant in identifying potentially vulnerable populations with hypertension, which may have implications for clinical intervention.

KEYWORDS:

Hypertension prevalence; older adults; CLHLS; CHARLS

INTRODUCTION

Hypertension is an emerging public health issue and attributed to the population aging, urbanization, industrialization, and unhealthy lifestyles. According to the World Health Organization (WHO), hyper-tension affects 1 billion people worldwide, and about 9 million people have died from this condition-related each year (1). Hypertension is a silent killer because it contributes a substantial risk for cardiovascular disease, stroke, kidney failure, and premature mortality. According to the WHO's projection, the causes of deaths will mainly be cardiovascular disease (24%), cancer (12%), and chronic respiratory disease (8%) by 2030(1). In the low- and middle-income countries where the health care system is weak, hypertension may disproportionately affect the populations. Hypertension was estimated at 35% in the high-income countries, while about 40% in other countries, according to the WHO in 2008 (2).

Hypertension is also a leading risk for population health in China. It is estimated that about 270 million people in general populations are suffering from hypertension, according to the 2012 Chinese Nutrition and Health Surveillance by the Chinese Centers for Disease Control and Prevention, and the prevalence might be even higher

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among those middle-aged and older adults (3). Also, the distribution of hypertension prevalence in middle-aged and older adults in China is notably different in association with socioeconomic status compared with other countries. In the more developed countries, low socioeconomic status is associated with a higher risk of hypertension (4, 5). In China, a higher prevalence of hypertension might be associated with inactivity and unhealthy diet in rich people, according to a study based on the 2013 data of CHARLS (6). However, a limited number of studies focused on the dynamics of hypertension prevalence and the difference in hypertension by socioeconomic characteristics in older and middle-aged adults based on a nationally representative sample (7) over the past two decades when there was a rapid socioeconomic development in China. This report aims to fill that gap.

METHODS

Data

The dataset used was from two nationwide longitudinal surveys in China. The first survey was the Chinese longitudinal healthy longevity survey (CLHLS) conducted from 2002 to 2018 (8), a nationally representative sample of the elderly (age at 65 years old or above) from 23 of 31 provinces in China. The detailed survey designs have been described else-where(8-10), and initially a baseline survey was conducted in oldest-old people aged 85 or older in 1998, with a follow-up survey conducted in 2000 (9). Because of sample attrition due to natural death or dropped out, the survey was re-designed in 2002 by adding new samples aged 65 to 79 to the oldest-old people who participated in the 1998 and 2000. For this study, we only used the samples that participated in the re-designed survey of CLHLS conducted in 2002, 2005, 2011, 2014, and 2018 to estimate hypertension prevalence.

Table 1 listed the detailed sample size by each wave of the survey. The 2002 survey included 16,064 respondents. The 2005 follow-up survey included 15,638 respondents, 8143 had participated in the past wave and 7495 were new. The 2011 survey included 9765 respondents, of whom 8405 individuals had been in the past wave and 1360 were new. The 2014 survey included 7192 respondents, of whom 6067 had been in the previous wave and 1125 were new. Finally, the 2018 wave included 15674 respondents, of whom 3499 had been in the previous wave and 12175 new, which account for majority of the sample.

The second survey was the China health and retirement longitudinal study (CHARLS) conducted in 2011, 2013, and 2015(11). The CHARLS survey interviewed respondents aged 45 or older. The samples covered 450 villages or communities in 150 counties across China and a nationally representative sample. The baseline survey was conducted in 17,708 people in 2011 (**Table 1**), and the follow up was conducted in 2013 and 2015 when the latest dataset was available(11). The 2013 survey contained 18264 respondents, of whom 15196 had been in the survey in 2011 and 3068 were new. The 2015 follow-up survey contained 20,284 respondents, of whom 14,522 had been in the 2013 wave, and 5762 were new (12).

Table 1. Sample size and classification in each wave of CLHLS and CHARLS Surveys

Survey	Year	N	Follow-up	New sample
CLHLS				
	2002	16,064	16,064	
	2005	15,638	8,143	7,495
	2011	9,765	8,405	1,360
	2014	7,192	6,067	2,115
	2018	15,674	3,499	12,175
CHARLS				
	2011	17,708	17,708	
	2013	18,264	15,196	3,068
	2015	20,284	14,522	5,762

Measurement

Both surveys had collected detailed information from the participants on demographics, health status, family income, and occupation information. As part of the CLHLS and CHARLS, diastolic pressure and systolic blood pressure were measured and recorded. Blood pressure was measured in all participants of CLHLS and CHARLS surveys. Each participant was measured 2-3 times, at 45-second intervals by a trained nurse, and the average blood pressure was used for each wave of the surveys (8, 11). The definition of hyper-tension was mostly consistent between CLHLS and CHARLS. In the CLHLS survey, hypertension was defined as either 1) the mean systolic blood pressure (SBP) of 140 mmHg or above or diastolic blood pressure (DBP) of 90 mmHg or above, or 2) self-reported hypertension diagnosed by a hospital. In the CHARLS survey, hypertension was defined (13) as either 1) the mean systolic blood pressure (SBP) of 140 mmHg or above or diastolic blood pressure (DBP) of 90 mmHg or above, or 2)

self-reported currently on antihypertensive medications.

Statistical analysis

Hypertension was coded as a binary variable based on the criteria described above in each wave of the surveys. A cross-tabulation analysis was performed to obtain a prevalence of hypertension by each wave of participants' surveys and characteristics; a Chi-square test was used to assess the association of individual variables with hypertension. Sampling weights were used to obtain estimates of nationally representative. Weight in CHARLS data was estimated based on the sampling methods and the probability of each individual being selected (14). Weight in CLHLS data was estimated based on the estimated numbers of elderly persons by age, sex, and rural-urban residence derived from census data or 1% of mini-census data for the 22 provinces where the longitudinal survey was conducted (9).

RESULTS

The CLHLS survey

Figure 1 shows the prevalence of hypertension among older adults by demographics from 2002 to 2018 (see sample size distribution in Table S1). The prevalence appears linearly increased over the past two decades (**Figure 1a**). In 2002, 41% of the elderly were suffering from hypertension, and it gradually increased to 50% in 2014 and 52% in 2018.

Sex difference

Hypertension prevalence was different by sex among the elderly. The older women seemed more likely to have hypertension than the older men did **(Figure 1b**). While little difference in the hypertension was noted between women and men in 2002 (42% vs. 38.3%, 3.5%) and 2005 (45.7% vs. 46%, -0.3%), the sex difference in hypertension appears evident from 2011(48.1% vs. 44.6%, 3.5%) to 2014 (53.6% vs. 46.1%, 8.5%), and 2018 (54.1% vs. 49%, 5.5%) in which more new samples with younger age were added.

Age and oldest-old people

Age was associated with hypertension (**Figure 1c**). While hypertension increased over time, the prevalence in people aged 65-74 and 75-84 was higher than the oldest-old people at 85 or above. In 2018, 54.0% of older people aged 75 to 84 was suffering from hypertension, higher than that 51% in the oldest-old people. Interestingly, the oldest-old people also had a lower prevalence of hypertension than other older adults, consistently in 2005, 2011, and 2014 (Table S2).

Rural-urban difference

The elderly living in urban areas were more likely to be hypertensive than those in rural areas (**Figure 1d**). In 2002, the hypertension prevalence was 46.4% and 37% (diff. =9.6) in urban and rural areas. While both prevalence increased over the past two decades, the urban-rural difference in the prevalence reduced from 9.6 to 6 percentage (54.7% vs. 48.7%) in 2018, suggesting that hypertension increased faster among the rural elderly.

Hypertension was significantly different by geographic location (**Figure 1e**). Compared with those in western China, the elderly living in eastern China, where underwent a most rapid social and economic development, were more likely to be hypertensive. In 2002, the prevalence of hypertension was 44.3% and 33.5% (difference=9.8) for the elderly in the eastern and western China, respectively; Also, in 2018, the hypertension prevalence was 56% in the eastern and 46.4% in western China (difference=9.6). The regional difference in hypertension remained constant over more than one decade.

Socioeconomic status

The CLHLS survey also indicated an occupational difference in hypertension. The elderly engaged in agriculture, forestry, animal husbandry, or fishery sectors were less likely to be hypertensive than those in non-agricultural sectors. On the contrary, the elderly who were professionals, technical personnel, governmental and institutional personnel, self-employed were more likely to suffer from hypertension. In 2018, 49.3% of the elderly who used to be agricultural workers had hypertension while the prevalence was 58.1%, 57.0% in self-employed and professionals, respectively (**Figure 1f**).

Similarly, the elderly with higher income status were more likely to be hypertensive than the lower-income were. In 2018, 59.7% of the elderly in the high-income group suffered from hypertension, while 45.8% of the low-income people had (difference=13.9). The difference in hypertension prevalence between high- and low-income status was consistent in all 2002, 2005, 2011, 2014, and 2018 (**Figure 1g)**.

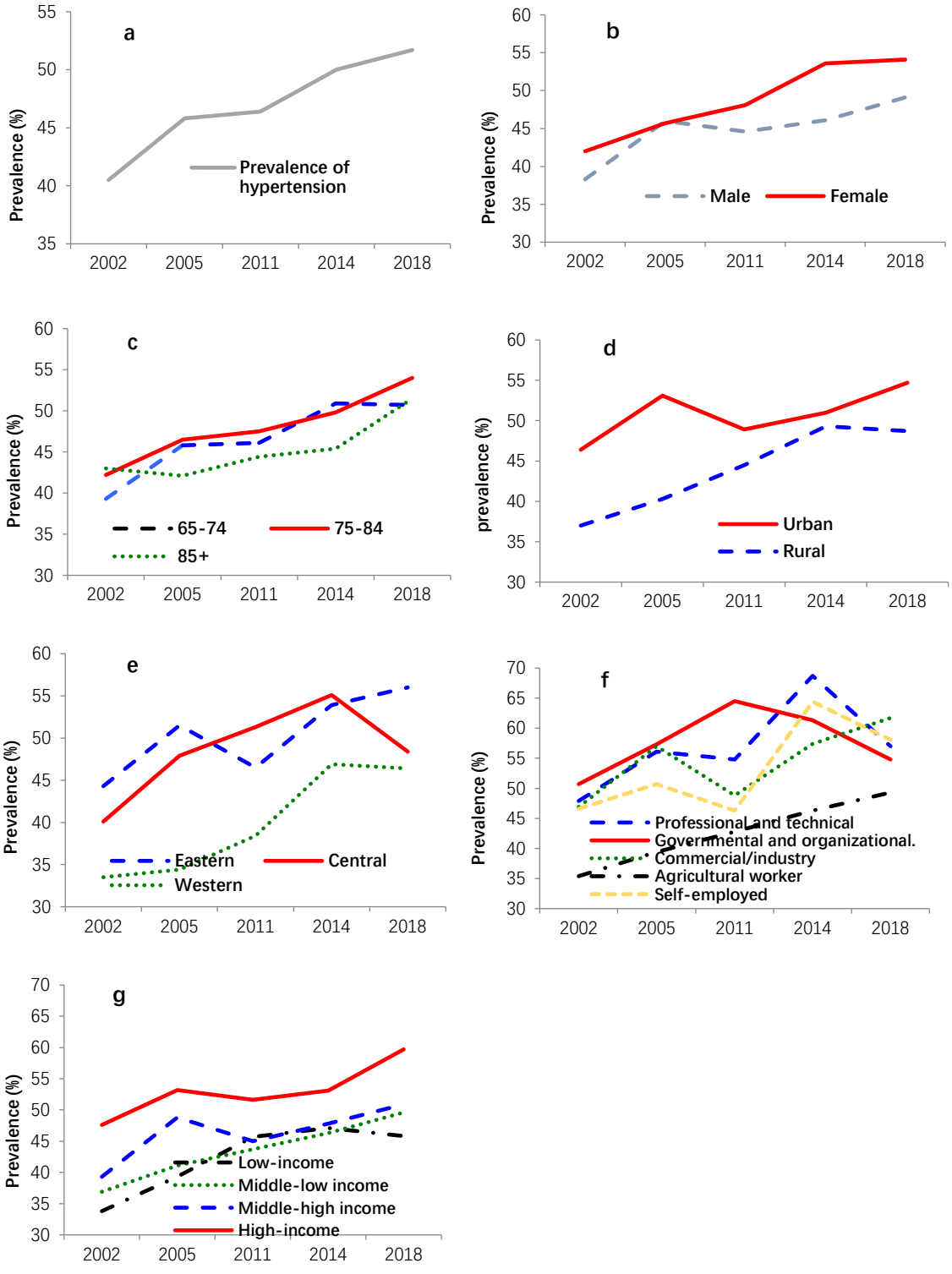

Figure 1. The elderly's hypertension by social and demographics from 2002 to 2018, China. a) General prevalence; b) by gender; c)age group; d) rural-urban residence; e)geographic location; f) major occupations; g) level of income.

The CHARLS survey

While the CHARLS sample mainly included middle-aged people, it provided a consistent validation of the estimates of hypertension prevalence by age group, urban living, and occupation (Table S3). *First,* it was noted that hypertension increased with age in all three waves of the survey (**Figure 2**), but a rapid increase with age was observed in 2015 when overall 33% of middle-aged samples was suffering from hypertension, which was on the average about five percentages higher than that in 2011 and two percentages higher than that in 2013 (**Table 2**).

Second, hypertension significantly increased with age in all three waves of the CHARLES survey. The prevalence was 42.8%, 43.7%, and 55.4% for the elderly aged 65-74, 75-84, and 85+ in 2015, respectively (**Table 2)**, which were very close to the estimates among older people in the CLHLS survey.

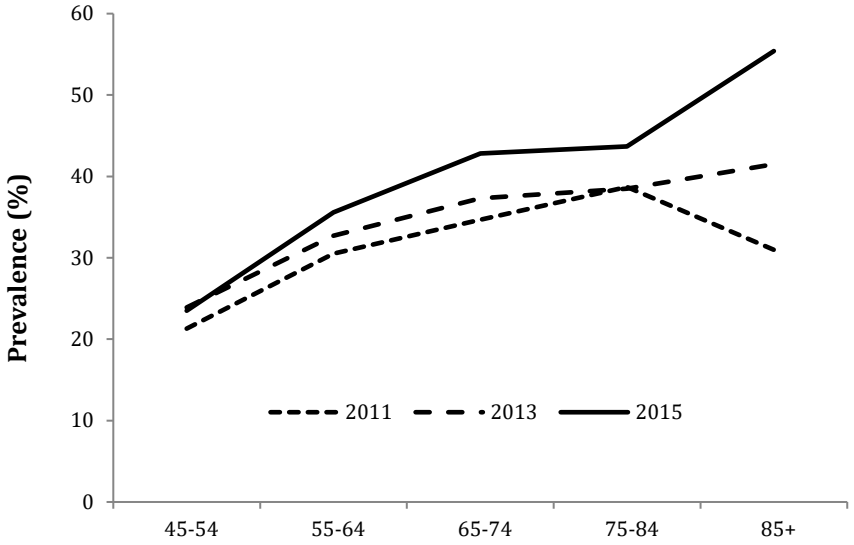

Figure 2. Prevalence of hypertension by age group in 2013 and 2015 among middle-aged and older adults

Also, urban living and occupation are significantly associated with hypertension in the sample, with more than 70% of sample in middle-aged (Table S3). People with urban residence were significantly associated with a higher prevalence of hypertension than those with rural residence consistently in all three waves of the CHARLS survey. In 2015, overall, 36.3% of the respondents were suffering from hypertension in the urban areas, while 31.4% in the rural areas (**Table 2)**; still, agricultural workers were relatively less likely to be hypertensive, 27.4% of agricultural workers had hypertension, which was lower than that in non-agricultural occupations, including retired, government or intuitional worker.

DISCUSSION

The analyses of data from the national-representative longitudinal surveys found that more than 50% of the elderly were suffering from hypertension, and it was significantly increased over the past two decades. The prevalence of hypertension in the elderly was similar between the CLHLS and CHARLS survey. Among the middle-aged people, the prevalence of hypertension was estimated at 30% in 2015, which is even lower than that from survey estimates in the general adult population of low-and middle-income countries in different continents, according to the WHO Study on global AGEing (SAGE) and adult health conducted from 2007-2010 (15).

Aging may play a significant role in developing hyper-tension, but there is a selection effect on the survivor. The oldest-old people (85+) consistently have a lower hypertension prevalence than the younger older adults of 65-85 do. This might be due to the selective effect on survivors, in which the elderly with hyper-tension might have died before the age of 85 years, so seniors over 85 years might be relatively healthier, therefore, may have a lower prevalence of hyper-tension. Additionally, the female elderly seems to be more prevalent in hypertension than males in the CLHLS survey, and this difference in hypertension between women and men has become more substantial in the past decade in China. However, we did not find a noted sex bias in the middle-aged people in the CHARLS survey. Of note, a cross-sectional analysis of a large

French adult sample aged 25 or above showed that women were less likely than men to develop hypertension, but this sex difference in hypertension diminished at the older age of 65 or above (16). There was also a study showing that women are more likely to have hypertension in urban areas but not in rural areas (17).

Table 2. Prevalence of hypertension among middle-aged and older adults in CHARLS survey

	2011				2013				2015			
	N	Cases	%	Sig	N	Cases	%	Sig	N	Cases	%	Sig
Overall	13728	3885	28.3		13139	4084	31.1		16440	5475	33.3	
Gender												
Male	6749	1859	27.6		6451	1980	30.7		8043	2694	33.5	
Female	6969	2023	29.0		6686	2103	31.5		8393	2777	33.1	
Age				**				**				**
45-54	4776	1017	21.3		4154	993	23.9		5110	1202	23.5	
55-64	5161	1576	30.5		4941	1616	32.7		5267	1873	35.6	
65-74	2514	873	34.7		2723	1015	37.3		3452	1478	42.8	
75-84	893	346	38.7		971	374	38.5		1320	577	43.7	
85+	100	31	31.0		111	46	41.5		190	105	55.4	
Residence				**				**				**
Urban	5300	1704	32.2		4965	1721	34.7		6326	2295	36.3	
Rural	8428	2181	25.9		8019	2315	28.9		9927	3118	31.4	
Region				*								
Eastern	4830	1485	30.8		5348	1629	30.5		5615	1949	34.7	
Central	4628	1246	26.9		4249	1290	30.4		4358	1592	36.5	
Western	4270	1154	27.0		3542	1165	32.9		3156	1122	35.5	
Occupation				**				**				**
Agricultural worker	7797	1805	23.2		7236	1883	26.0		8156	2238	27.4	
Never worked	273	111	40.5		183	84	45.9		220	82	37.2	
Retired	3921	1526	38.9		3939	1604	40.7		5382	2431	45.2	
Self-employed worker	618	159	25.7		767	219	28.6		1006	268	26.6	
Gov./Institution worker	280	70	25.0		262	86	32.7		342	100	29.3	
Company employee	350	92	26.3		281	84	30.0		429	117	27.2	
Farmer/individual firm	382	95	24.9		385	104	26.9		789	203	25.8	
Others	56	16	28.0		58	13	22.6		62	16	25.8	
Income				**								
Low income	3430	871	25.4		3014	956	31.7		3099	1090	35.2	
Middle-low income	3331	920	27.6		3116	960	30.8		3260	1204	36.9	
Middle-high income	3268	946	28.9		3219	983	30.6		3245	1165	35.9	
High income	3085	1011	32.8		3099	937	30.2		2852	994	34.9	

Note: **, P < 0.01; *, P < 0.05.

The disparity of hypertension exists between rural and urban, as well as the eastern and western China, consistently over the past two decades. However, the gap between rural-urban residences seemed to be diminishing. Generally, the elderly in the rural areas were willing to be engaged in agricultural work when-ever they have physical capability, which may help them maintain healthy blood pressure. Urban residences may be associated with unhealthy dietary lifestyle, physical inactivity, and environmental pollution that may increase hypertension risk. The fast increase in hypertension in rural areas in China might be due to the change in lifestyle in rural areas. In addition, a recent study based on the CHARLS survey shows that level of PM2.5 in the air significantly increases the risk of hypertension and more in women than men (18).

Socioeconomic status, such as income and occupations in the past, seems to play a role in the development of hypertension among the elderly in China but has some inconsistencies with other studies. A cohort study in Korea indicated that low-household income is associated with a high risk of hypertension in women (19), consistent with the ecological data that low-income countries tend to have a higher hypertension level. However, the income is not associated with hypertension in the middle-aged dominated sample of CHARLS. Data from the United States and Canada also indicated a significant inverse linear relationship that low household income is associated with hypertension risk (20). In addition, agricultural workers in China are significantly less likely to be hypertensive than all other occupations are. In contrast, other studies indicate that people with the lower socioeconomic status of occupations, such as salespersons and personal service workers, were significantly associated with hypertension (4).

The study provides relevant evidence for reducing the increasing trend of hypertension in the elderly in China, and it may have important implications for public health or potential clinical intervention.

SUPPLEMENTARY MATERIALS

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Table S1-S3

CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding the publication of this paper.

ARTICLE INFORMATION

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