

## Preplanned Studies

## Hypertension Prevalence, Awareness, Treatment, Control, and Associated Factors in the Labor Force Population — China, 2015

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### Summary

#### What is already known about this topic?

Hypertension has become a major public health problem worldwide because of its high prevalence and various complications, and it ranks the most important risk factor for cardiovascular diseases (CVDs).

#### What is added by this report?

The prevalence, awareness, treatment, and control of hypertension in the labor force population in 2015 in China were 21.4%, 26.1%, 19.6%, and 6.3%, respectively. Hypertension prevalence in the labor force population remains high and the control of hypertension is still very low.

#### What are the implications for public health practice?

Effective public health strategies targeting the labor force population, especially older adults, males, and overweight and obese participants are needed for hypertension prevention and control.

Hypertension is a major cardiovascular risk factor and an important public health challenge worldwide. Globally, nearly 1.13 billion people have hypertension but less than 20% have their condition under control (1). The prevalence of hypertension among adults in China increased substantially from 18% to 23.2% between 2002 and 2012 (2). The awareness, treatment, and control of hypertension have been increasingly emphasized, but previous studies mainly focused on the overall population and knowledge about some specific populations such as the labor force population is limited. The labor force population was defined as 18–59 years old according to the Labor Law of the People's Republic of China. This study aimed to provide updated and reliable data on the prevalence, awareness, treatment, control and associated factors of hypertension among the labor force population in China using data from a nationally representative sample of Chinese adults.

This study used the China Chronic Disease and

Nutrition Surveillance (CCDNS) in 2015, which used 298 surveillance points across 31 provincial-level administrative divisions (PLADs) and used a multi-stage stratified cluster randomized sampling method to select a representative sample of households. Local CDC invited eligible residents aged 18 years and above in the selected households to participate. Similar recruitment methods used in the CCDNS were reported elsewhere (3). Of the 88,250 households sampled, 123,155 subjects fulfilled criteria for being in the labor force population aged 18–59 years. We excluded 5,172 participants with missing systolic blood pressure (SBP) or diastolic blood pressure (DBP). Finally, 117,983 participants were included in the present analysis.

SBP and DBP were measured 3 times with a one-minute interval with an electronic sphygmomanometer (Omron HBP 1300) after the subjects had rested for 5 minutes in sitting position. Three readings of SBP and DBP were recorded and the average of the last two readings was used for data analysis. Information on sociodemographic characteristics (sex, age, residential area, educational level, and income), behavioral risk factors for chronic diseases (smoking, alcohol consumption, physical activity, salt intake), and body mass index (BMI) were collected through a questionnaire by face-to-face interviews with trained interviewers.

Hypertension was defined as SBP $\geq$ 140 mmHg or DBP $\geq$ 90 mmHg, or based on self-reported diagnosis of hypertension in hospitals at the township (community) level hospitals or above and had been taking anti-hypertensive medicine in the last 2 weeks. Awareness of hypertension was defined as a self-report of any previously diagnosed hypertension by health professionals.

Treatment of hypertension was limited to those with SBP $\geq$ 140 mmHg or DBP $\geq$ 90 mmHg in this surveillance and also self-reported taking a prescribed anti-hypertensive medicine over the past 2 weeks. Control of hypertension was defined as having

measured SBP<140 mmHg and DBP<90 mmHg among those with hypertension at survey.

Prevalence rates (with 95% CI\*) were estimated for all and for subgroups. Sampling weights were applied to all statistical descriptions and inferences to get nationally representative estimates. The post-stratification adjustment used the 2015 Chinese population estimates from the National Bureau of Statistics. Rao-Scott chi-square tests were conducted to test for group differences in prevalence. Logistic regression models were used to examine the trends for ordered categorical variables. Multivariable logistic regression models were fit to explore the factors associated with prevalence, awareness, treatment, and control of hypertension. All statistical analyses were conducted using SAS software (version 9.4, SAS Institute Inc., Cary, USA).

Overall, 21.4% (95% CI: 20.2%–22.6%) of the study population had hypertension, including 17.2% (95% CI: 16.1%–18.3%) newly diagnosed hypertension and 4.2% (95% CI: 3.9%–4.5%) self-reported hypertension. The prevalence of hypertension was significantly higher among men than women (25.3% vs. 17.4%,  $p<0.05$ ) and was higher among rural residents than urban residents (23.1% vs. 19.9%,  $p<0.05$ ). Hypertension prevalence increased with age, BMI, salt intake, and alcohol consumption and decreased with education level and annual household income per capita. The awareness, treatment, and control of hypertension were 26.1%, 19.6%, and 6.3%, respectively. The awareness, treatment, and control were higher among women than men (30.2% vs. 23.3% for awareness,  $p<0.05$ ; 23.6% vs. 16.8% for treatment,  $p<0.05$ ; 7.7% vs. 5.4% for the control,  $p<0.05$ ). It was also higher in older participants, urban residents, overweight and obese patients. (Table 1)

The treatment rate among those who were aware of their hypertension status was 75.1% (95% CI: 73.1%–77.0%). The control rate of hypertension among those receiving treatment was 32.2% (95% CI: 30.0%–34.4%). The treatment rate among those who were aware of their hypertension status increased with age ( $p<0.05$ ) but decreased for the control among those receiving anti-hypertensive treatment. Compared with people in rural areas, hypertensive participants in urban areas tended to get more treatment among those who were aware of their hypertension status and had better control among those receiving treatment ( $p<0.05$ ). (Table 2)

Logistic regression analysis in males and females showed that age, educational level, BMI, alcohol consumption and salt intake were associated with hypertension. Residential area and annual household income per capita were not associated with hypertension, but were associated with the awareness, treatment, and control of hypertension in both males and females. Prevalence of hypertension was higher in current smokers (25.1%) and former smokers (34.7%) than in never smokers (19.1%). However, when adjusted for other factors, current male smokers appeared to have a slightly lower hypertension rate (OR=0.90, 95% CI: 0.81–0.99) while there was no significance in females. (Table 3)

## Discussion

The findings from this study showed that the burden of hypertension and lack of treatment and management in China are serious threats to public health. The labor force population bears dual responsibilities from the society and the family and is also the foundation and driving force of the sustainable development of the country. The health of the labor force is related to socioeconomic development and is also key to preventing and reducing chronic diseases of the elderly population in the future. This study showed that about one-fifth of the labor force population in China had hypertension and only one-third of them were aware of their condition. In addition, about 4 out of 5 did not receive anti-hypertensive medication, resulting in an overall control rate of less than 10%.

The prevalence of hypertension in the labor force population was higher than that in 2002, with 13.9% vs. 9.1% and 39.1% vs. 29.3% in the age groups of 18–44 years and 45–59 years, respectively. The awareness and control rates of hypertension among those receiving treatment of hypertension have improved markedly compared with the results of the 2002 China National Nutrition and Health Survey (4). However, awareness and control rates are much lower than those in the developed world. In European countries, less than 20% of people with hypertension were unaware of their conditions, and less than 50% of patients did not control their hypertension effectively (5–6). Moreover, the awareness, treatment, and control rates among the labor force population were worse than those in some Asian countries such as Japan and

\* CI=Confidence Interval.

TABLE 1. Prevalence, awareness, treatment, and control of hypertension in the labor force population in China, 2015.

Characteristics	Prevalence			Awareness			Treatment			Control		
	Newly diagnosed (%) (95% CI)*	p value†	Self-reported (%) (95% CI)	p value	Total (%) (95% CI)	p value	(%) (95% CI)	p value	(%) (95% CI)	p value	(%) (95% CI)	p value
Total	17.2(16.1–18.3)	–	4.2(3.9–4.5)	–	21.4(20.2–22.6)	–	26.1(24.6–27.6)	–	19.6(18.2–20.9)	–	6.3(5.6–7.0)	–
Age (years)												
18–44	12.4(11.3–13.5)	<0.05	1.5(1.3–1.7)	<0.05	13.9(12.7–15.1)	<0.05	16.0(14.4–17.7)	<0.05	10.5(9.3–11.7)	<0.05	3.7(3.0–4.3)	<0.05
45–59	28.4(27.3–29.6)		10.6(10.0–11.3)		39.1(37.9–40.2)		34.5(32.8–36.2)		27.2(25.5–28.8)		8.5(7.6–9.4)	
Sex												
Male	21.0(19.6–22.5)	<0.05	4.3(3.9–4.6)	0.4439	25.3(23.7–26.8)	<0.05	23.3(21.6–24.9)	<0.05	16.8(15.4–18.2)	<0.05	5.4(4.7–6.1)	<0.05
Female	13.3(12.4–14.2)		4.1(3.8–4.4)		17.4(16.5–18.4)		30.2(28.4–32.0)		23.6(21.9–25.3)		7.7(6.7–8.7)	
Residential area												
Urban	15.5(14.0–16.9)	<0.05	4.5(4.0–4.9)	<0.05	19.9(18.2–21.6)	<0.05	29.0(26.8–31.1)	<0.05	22.4(20.5–24.2)	<0.05	8.4(7.3–9.4)	<0.05
Rural	19.2(18.2–20.2)		3.9(3.6–4.2)		23.1(22.1–24.0)		23.2(21.7–24.7)		16.8(15.4–18.2)		4.3(3.6–4.9)	
Educational level												
Illiterate or primary school	22.5(21.2–23.9)		5.4(4.9–6.0)		28.0(26.7–29.3)		26.4(24.3–28.5)		19.4(17.3–21.5)		5.6(4.4–6.8)	
Junior high school	18.2(17.1–19.3)	<0.05	4.1(3.6–4.6)	<0.05	22.3(21.1–23.5)	<0.05	25.0(22.9–27.1)	0.9494	18.4(16.5–20.3)	0.1823	5.5(4.6–6.4)	<0.05
Senior high school	14.8(13.0–16.6)		4.4(3.8–5.0)		19.2(17.0–21.4)		28.6(26.1–31.1)		22.9(20.7–25.0)		8.3(7.0–9.6)	
College and above	9.4(8.3–10.6)		2.2(1.7–2.7)		11.7(10.4–13.0)		24.6(20.2–29.0)		19.1(15.5–22.7)		8.7(6.4–11.0)	
Annual household income per capita (¥)												
<7,500	19.4(18.1–20.7)		4.3(3.8–4.5)		23.6(22.3–24.9)		24.1(22.1–26.1)		17.7(15.9–19.4)		4.4(3.5–5.3)	
7,500–15,000	18.9(17.8–20.1)		4.4(4.0–4.8)		23.3(22.2–24.5)		25.4(23.4–27.4)		18.9(17.1–20.6)		5.7(4.7–6.6)	
15,001–25,000	18.1(16.9–19.3)	<0.05	4.2(3.7–4.6)	0.0892	22.3(21.4–23.6)	<0.05	26.3(24.1–28.5)	<0.05	18.7(16.8–20.5)	<0.05	6.1(5.2–7.1)	<0.05
>25,000	14.5(12.5–16.4)		4.7(4.0–5.4)		19.2(16.8–21.6)		31.4(28.8–34.1)		24.6(22.2–27.0)		9.0(7.6–10.4)	
Body weight status (BMI categories)												
Underweight, BMI<18.5	5.0(3.7–6.2)		0.7(0.5–1.0)		5.7(4.4–7.1)		18.1(13.2–22.9)		13.0(8.9–17.0)		3.6(1.4–5.8)	
Normal weight, BMI: 18.5–23.9	10.8(9.9–11.7)		1.9(1.7–2.1)		12.6(11.7–13.6)		20.4(18.4–22.3)		14.8(13.2–16.4)		5.9(4.9–6.9)	
Overweight, BMI: 24–27.9	21.8(20.6–23.1)	<0.05	5.6(5.1–6.0)	<0.05	27.4(26.1–28.6)	<0.05	26.9(25.2–28.5)	<0.05	20.4(18.8–21.9)	<0.05	6.8(5.9–7.7)	0.5053
Obesity, BMI≥28	32.5(30.7–34.4)		10.0(9.2–10.8)		42.5(40.8–44.3)		31.0(28.7–33.3)		23.5(21.5–25.6)		6.0(4.9–7.2)	
Smoking												
Never	15.2(14.2–16.2)		4.0(3.7–4.2)		19.1(18.1–20.2)		26.6(25.1–28.2)		20.7(19.2–22.1)		6.6(5.7–7.4)	
Former smoker	25.0(22.8–27.3)	<0.05	9.7(8.4–11.0)	0.1604	34.7(32.7–36.8)	<0.05	36.9(32.8–41.1)	<0.05	28.0(24.2–31.8)	<0.05	9.6(6.6–12.7)	<0.05
Current smoker	21.1(19.5–22.8)		4.0(3.5–4.5)		25.1(23.3–26.9)		23.0(20.9–25.1)		15.9(14.2–17.6)		5.2(4.4–6.0)	

TABLE 1. (continued)

Characteristics	Prevalence			Awareness			Treatment			Control		
	Newly diagnosed (%) (95% CI)*	p value†	Self-reported (%) (95% CI)	Total (%) (95% CI)	p value	(%) (95% CI)	p value	(%) (95% CI)	p value	(%) (95% CI)	p value	
Excessive drinking§												
Yes	31.5(29.1–33.9)	<0.05	5.7(4.9–6.6)	37.3(34.7–39.8)	<0.05	24.0(21.6–26.4)	0.0491	15.4(13.2–17.6)	<0.05	4.4(3.3–5.4)	<0.05	
No	15.9(14.9–17.0)		4.1(3.8–4.3)	20.0(18.9–21.1)		26.4(24.9–27.9)		20.3(18.9–21.6)		6.6(5.9–7.4)		
Excessive salt intake§												
Yes	19.7(18.5–20.8)	<0.05	4.6(4.19–4.9)	24.2(23.0–25.4)	<0.05	25.8(24.0–27.6)	0.3497	18.8(17.3–20.4)	<0.05	5.5(4.7–6.2)	<0.05	
No	14.7(13.5–15.9)		3.8(3.57–4.1)	18.6(17.2–19.9)		26.7(24.9–28.5)		20.7(19.1–22.4)		7.5(6.3–8.6)		
Lack of physical activity§												
Yes	16.7(15.4–18.1)	0.2978	3.5(3.2–3.8)	20.2(18.9–21.6)	<0.05	22.6(20.5–24.7)	0.0001	17.2(15.4–19.1)	<0.05	5.47(4.6–6.4)	0.0827	
No	17.3(16.2–18.5)		4.4(4.1–4.7)	21.7(20.4–22.9)		26.9(25.4–28.5)		20.2(18.8–21.5)		6.50(5.7–7.3)		

\* CI, confidence interval.

† Rao-scott chi-square tests were conducted to test for differences in prevalence for unordered categorical variables and logistic regression models were used to examine the trends for ordered categorical variables.

§ According to the Dietary Guidelines for Chinese Residents, excessive drinking was defined as an average daily alcohol intake of at least 25 g for males and 15 g for females. Excessive salt intake was defined as an average daily intake more than 6 g. Physical activity insufficiency was defined as the length of moderate and high intensity activity less than 150 minutes per week.

TABLE 2. Treatment rate of hypertensive patients who were aware of their condition and control rate of those patients who received hypertension treatment in the labor force population in China, 2015.

Characteristics	Treatment rate of hypertensive patients who were aware of their condition (%) (95% CI)*			Control rate of those patients who received hypertension treatment (%) (95% CI)						
	Treatment by medical order	p value†	Treatment by symptoms	Total	p value	Treatment by medical order	p value	Treatment by symptoms	Total	p value
Total	73.7(72.2–75.8)	–	9.9(8.5–11.2)	75.1(73.1–77.0)	–	29.7(27.4–32.1)	–	1.5(1.0–1.9)	32.2(30.0–34.4)	–
Age (years)										
18–44	65.6(61.8–69.3)	<0.05	9.7(7.4–12.1)	65.5(61.6–69.3)	<0.05	30.3(25.7–34.8)	0.7839	1.8(0.6–3.00)	34.8(30.5–39.2)	0.2156
45–59	77.2(75.4–79.1)		9.9(8.5–11.4)	78.8(76.9–80.7)		29.5(27.3–31.7)		1.3(0.9–1.8)	31.3(29.1–33.5)	
Sex										
Male	70.8(68.4–73.3)	<0.05	9.3(7.7–10.8)	72.3(69.7–74.9)	<0.05	29.1(26.3–32.0)	0.5366	1.4(0.7–2.1)	31.3(29.1–34.6)	0.7261
Female	77.5(75.3–79.8)		10.6(8.6–12.6)	78.3(75.9–80.6)		30.3(27.5–33.1)		1.5(1.0–2.01)	32.5(29.8–35.3)	
Residence										
Urban	75.9(73.7–78.1)	<0.05	7.9(6.4–9.5)	77.2(74.6–79.7)	<0.05	35.4(31.8–39.0)	<0.05	0.9(0.4–1.5)	37.4(34.1–40.7)	<0.05
Rural	71.6(68.7–74.5)		12.3(10.3–14.3)	72.5(69.9–75.0)		22.3(19.9–24.7)		2.1(1.5–2.8)	25.3(22.8–27.8)	

TABLE 2. (continued)

Characteristics	Treatment rate of hypertensive patients who were aware of their condition (%) (95% CI)*				Control rate of those patients who received hypertension treatment (%) (95% CI)							
	Treatment by medical order	p value <sup>†</sup>	Treatment by symptoms	p value	Total	p value	Treatment by medical order	p value	Treatment by symptoms	p value	Total	p value
Educational level												
Illiterate or primary school	72.5(69.5–75.5)		12.6(10.4–14.9)		73.5(70.3–76.7)		26.2(22.0–30.3)		1.6(1.0–2.2)		28.9(24.8–33.0)	
Junior high school	72.4(69.1–75.8)	0.0543	9.8(7.4–12.2)	<0.05	73.5(70.4–76.7)	<0.05	27.6(23.9–31.3)	<0.05	1.6(0.8–2.4)	0.2149	29.8(26.0–33.6)	<0.05
Senior high	79.3(76.1–82.5)		6.7(4.9–8.5)		79.9(76.5–83.4)		34.8(30.9–38.6)		1.3(0.3–2.3)		36.2(32.4–40.0)	
College and above	74.9(67.8–82.1)		5.8(2.6–9.0)		77.7(72.4–83.1)		40.5(32.0–49.1)		0.7(0.5–1.8)		45.4(36.7–54.1)	
Annual household income per capita (¥)												
<7,500	72.9(69.0–76.8)		11.2(8.8–13.5)		73.2(69.9–76.4)		21.4(18.0–24.9)		1.9(0.8–3.0)		25.0(21.4–28.5)	
7,500–15,000	74.8(71.8–77.8)		10.2(8.0–12.4)		74.2(71.0–77.4)		28.2(24.1–32.3)		1.2(0.6–1.9)		30.1(26.2–34.0)	
15,001–25,000	69.4(65.5–73.4)	0.0664	9.6(7.0–12.2)	<0.05	71.0(66.8–75.1)	<0.05	30.8(26.6–35.0)	<0.05	1.3(0.6–2.0)	0.8742	32.5(28.2–36.8)	<0.05
>25,000	78.3(75.4–81.4)		6.8(5.1–8.4)		78.4(75.4–81.4)		33.2(28.9–37.5)		1.6(0.5–2.7)		36.6(32.5–40.6)	
Body weight status (BMI categories)												
Underweight, BMI<18.5	68.3(52.9–74.9)		13.3(6.2–20.4)		71.9(60.3–83.4)		23.5(9.7–37.4)		2.0(0.5–5.0)		27.6(13.9–41.4)	
Normal weight, BMI: 18.5–23.9	73.0(69.3–76.7)	0.3709	11.5(8.3–14.8)	0.2927	72.6(68.7–76.6)	0.1782	37.0(32.6–41.5)	<0.05	1.7(0.9–2.6)	<0.05	39.8(35.5–44.1)	<0.05
Overweight, BMI: 24–27.9	74.2(71.5–77.0)		9.2(7.5–10.9)		75.7(72.9–78.5)		30.4(27.5–33.3)		1.8(1.1–2.6)		33.6(30.5–36.6)	
Obesity, BMI≥28	74.6(71.5–77.6)		9.6(7.8–11.4)		75.9(72.9–78.9)		24.4(20.5–28.3)		0.8(0.4–1.3)		25.7(21.7–29.7)	
Smoking												
Never	76.6(74.5–78.1)		10.0(8.3–11.6)		77.7(75.7–79.7)		29.6(26.7–43.5)		1.4(0.9–1.9)		31.7(28.9–34.6)	
Former smoker	72.5(66.2–78.8)	<0.05	8.6(5.4–11.8)	0.9846	75.7(69.8–81.5)	<0.05	28.5(21.6–35.3)	0.7970	2.0(0.4–4.5)	0.7015	34.5(26.8–42.2)	0.6477
Current smoker	68.6(65.3–71.9)		10.1(8.2–12.0)		69.2(66.0–72.3)		30.3(26.9–33.8)		1.5(0.67–2.29)		32.5(29.0–36.0)	
Excessive drinking <sup>‡</sup>												
Yes	65.3(60.2–70.3)	<0.05	10.7(7.6–13.8)	0.5559	64.2(59.4–69.0)	<0.05	27.7(22.1–33.3)	0.4551	0.4(0.1–0.6)	<0.05	28.3(22.7–34.0)	0.1595
No	75.3(73.4–77.1)		9.8(8.4–11.2)		76.7(74.7–78.7)		30.0(27.6–32.4)		1.6(1.1–2.1)		32.7(30.4–34.9)	
Excessive salt intake <sup>‡</sup>												
Yes	71.3(69.0–73.6)	<0.05	11.5(9.5–13.4)	<0.05	72.9(70.6–75.3)	<0.05	26.2(23.7–28.7)	<0.05	1.6(1.0–2.1)	0.7235	28.9(26.3–31.6)	<0.05
No	77.4(74.7–80.2)		7.8(6.2–9.4)		77.8(74.6–80.9)		33.8(29.9–37.7)		1.4(0.7–2.1)		36.1(32.2–39.9)	
Lack of physical activity <sup>‡</sup>												
Yes	72.6(68.4–76.8)	0.4445	10.3(7.5–13.2)	0.7284	76.3(72.5–80.0)	0.4937	29.6(25.7–33.5)	0.9519	1.3(0.1–2.6)	0.7903	31.7(27.8–35.6)	0.8490
No	74.3(72.4–76.2)		9.8(8.4–11.2)		74.8(72.8–76.9)		29.7(27.2–32.2)		1.5(1.0–2.0)		32.2(29.8–34.7)	

\* CI, confidence interval.

† Rao-Scott chi-square tests were conducted to test for differences in prevalence for unordered categorical variables and logistic regression models were used to examine the trends for ordered categorical variables.

‡ According to the Dietary Guidelines for Chinese Residents, excessive drinking was defined as an average daily alcohol intake of at least 25 g for males and 15 g for females. Excessive salt intake was defined as an average daily intake more than 6 g. Physical activity insufficiency was defined as the length of moderate and high intensity activity less than 150 minutes per week.

TABLE 3. Associations between factors and hypertension awareness, treatment, and control among male and female labor force populations in China, 2015.

Characteristics	Having hypertension		Awareness		Treatment		Control	
	OR(95% CI)*	p value	OR(95% CI)	p value	OR(95% CI)	p value	OR(95% CI)	p value
<b>Male</b>								
Age (years) (ref: 18–44)								
45–59	2.70(2.47–2.95)	<0.05	2.75(2.34–3.23)	<0.05	3.42(2.85–4.10)	<0.05	2.79(2.03–3.82)	<0.05
Residential area (ref: Urban)								
Rural	0.95(0.85–1.05)	0.3037	0.77(0.65–0.91)	<0.05	0.75(0.64–0.88)	<0.05	0.61(0.47–0.79)	<0.05
Educational level (ref: Illiterate or primary school)								
Junior high school	1.01(0.91–1.13)	0.7974	1.18(0.99–1.41)	0.0660	1.27(1.01–1.59)	<0.05	1.25(0.90–1.74)	0.1755
Senior high	0.87(0.75–1.01)	0.0693	1.24(0.97–1.58)	0.0851	1.49(1.17–1.91)	<0.05	1.32(0.88–1.96)	0.1780
College and above	0.77(0.65–0.91)	<0.05	1.47(0.99–2.18)	0.0558	1.70(1.11–2.59)	<0.05	2.09(1.24–3.53)	<0.05
Annual household income per capita (¥) (ref: <7,500)								
7,500–15,000	0.94(0.84–1.05)	0.2424	0.99(0.84–1.18)	0.9149	0.91(0.75–1.10)	0.3031	0.94(0.63–1.41)	0.7776
15,001–25,000	0.98(0.86–1.11)	0.7285	1.06(0.84–1.35)	0.6034	0.91(0.73–1.13)	0.3836	1.05(0.70–1.58)	0.8121
>25,000	0.87(0.72–1.04)	0.1172	1.37(1.10–1.71)	<0.05	1.33(1.03–1.72)	<0.05	1.65(1.09–2.49)	<0.05
Body weight status (BMI categories) (ref: BMI: 18.5–23.9)								
Underweight, BMI<18.5	0.46(0.35–0.62)	<0.05	0.69(0.46–1.03)	0.0663	0.75(0.47–1.19)	0.2242	1.79(0.68–4.68)	0.2371
Overweight, BMI:24–27.9	2.17(1.99–2.36)	<0.05	0.99(0.68–1.47)	0.9901	1.08(0.68–1.70)	0.7501	1.89(0.77–4.63)	0.1670
Obesity, BMI≥28	5.04(4.49–5.66)	<0.05	1.39(0.90–2.14)	0.1344	1.42(0.88–1.26)	0.1523	1.44(0.57–3.68)	0.4442
Smoking (ref: Never smoking)								
Former smoker	1.22(1.03–1.44)	<0.05	2.15(1.74–2.65)	<0.05	1.87(1.47–2.36)	<0.05	2.33(1.46–3.72)	<0.05
Current smoker	0.90(0.81–0.99)	<0.05	1.25(1.07–1.45)	<0.05	1.05(0.88–1.26)	0.5890	1.25(0.94–1.65)	0.1216
Excessive drinking (ref: No) <sup>†</sup>								
Yes	1.82(1.69–1.97)	<0.05	0.96(0.84–1.10)	0.5768	0.84(0.70–1.01)	0.0562	0.75(0.55–1.04)	0.0798
Excessive salt intake (ref: No) <sup>†</sup>								
Yes	1.14(1.04–1.26)	<0.05	1.00(0.86–1.17)	0.9694	0.97(0.84–1.12)	0.6867	0.96(0.72–1.28)	0.7798
Lack of physical activity (ref: No) <sup>†</sup>								
Yes	1.01(0.90–1.14)	0.8403	0.79(0.66–0.93)	<0.05	0.78(0.65–0.94)	<0.05	0.75(0.56–1.01)	0.0542
<b>Female</b>								
Age (years) (ref: 18–44)								
45–59	4.46(4.05–4.91)	<0.05	2.69(2.30–3.16)	<0.05	3.12(2.61–3.73)	<0.05	2.31(1.61–3.32)	<0.05
Residential area (ref: Urban)								
Rural	0.99(0.89–1.10)	0.8977	0.90(0.77–1.06)	0.2255	0.86(0.72–1.04)	0.1193	0.60(0.44–0.82)	<0.05
Educational level (ref: Illiterate or primary school)								
Junior high school	0.74(0.66–0.83)	<0.05	1.01(0.85–1.20)	0.9065	1.08(0.89–1.31)	0.4492	1.08(0.75–1.55)	0.6982
Senior high	0.63(0.55–0.72)	<0.05	1.09(0.85–1.39)	0.4931	1.12(0.85–1.46)	0.4247	1.32(0.87–1.99)	0.1920
College and above	0.41(0.32–0.52)	<0.05	0.68(0.42–1.11)	0.1200	0.77(0.46–1.29)	0.3196	1.27(0.60–2.69)	0.5258

TABLE 3. (continued)

Characteristics	Having hypertension		Awareness		Treatment		Control	
	OR(95% CI)*	p value	OR(95% CI)	p value	OR(95% CI)	p value	OR(95% CI)	p value
Annual household income per capita (¥) (ref: <7,500)								
7,500–15,000	1.06(0.94–1.20)	0.3589	1.07(0.89–1.28)	0.5054	1.12(0.92–1.38)	0.2576	1.45(0.98–2.12)	0.0604
15,001–25,000	0.91(0.81–1.03)	0.1450	1.12(0.94–1.32)	0.1982	1.08(0.91–1.29)	0.3746	1.34(0.97–1.86)	0.0775
>25,000	0.93(0.79–1.08)	0.3315	1.30(1.07–1.58)	<0.05	1.37(1.11–1.70)	<0.05	1.63(1.18–2.27)	<0.05
Body weight status (BMI categories) (ref: BMI: 18.5–23.9)								
Underweight, BMI<18.5	0.63(0.48–0.84)	<0.05	2.20(1.34–3.63)	<0.05	2.08(1.16–3.74)	<0.05	1.83(0.62–5.37)	0.2745
Overweight, BMI:24–27.9	2.36(2.18–2.56)	<0.05	2.68(1.64–4.35)	<0.05	2.52(1.42–4.47)	<0.05	1.53(0.53–4.38)	0.4325
Obesity, BMI ≥28	5.09(4.54–5.71)	<0.05	3.86(2.34–6.38)	<0.05	3.76(2.07–6.83)	<0.05	1.95(0.62–6.14)	0.2566
Smoking (ref: Never smoking)								
Former smoker	0.92(0.54–1.55)	0.7418	1.41(0.65–3.04)	0.3870	1.39(0.61–3.16)	0.4392	1.45(0.65–3.22)	0.3630
Current smoker	0.86(0.69–1.08)	0.1823	1.17(0.82–1.67)	0.3946	1.36(0.92–2.00)	0.1206	2.21(1.41–3.48)	<0.05
Excessive drinking (ref: No) <sup>†</sup>								
Yes	0.92(0.68–1.25)	0.5872	0.48(0.34–0.67)	<0.05	0.38(0.26–0.56)	<0.05	0.16(0.06–0.42)	<0.05
Excessive salt intake (ref: No) <sup>†</sup>								
Yes	1.17(1.06–1.29)	<0.05	0.87(0.75–1.01)	0.0603	0.85(0.71–1.01)	0.0628	0.66(0.52–0.84)	<0.05
Lack of physical activity (ref: No) <sup>†</sup>								
Yes	0.99(0.88–1.13)	0.9741	0.95(0.78–1.17)	0.6450	1.04(0.86–1.27)	0.6775	1.23(0.85–1.78)	0.2807

\* CI, confidence interval.

<sup>†</sup> According to the Dietary Guidelines for Chinese Residents, excessive drinking was defined as an average daily alcohol intake of at least 25 g for males and 15 g for females. Excessive salt intake was defined as an average daily intake more than 6 g. Physical activity insufficiency was defined as the length of moderate and high intensity activity less than 150 minutes per week.

Republic of Korea (7–8). These disparities are partly due to barriers in the health care system such as lack of access to care, low patient health literacy, and costly medications in different development levels.

Among hypertensive patients, only 20% of the hypertensive population were self-reported and 17.2% were newly diagnosed with hypertension indicating that hypertension remained largely undetected partly because many patients experienced almost no symptoms and were unaware of their condition. This is especially true in rural areas where blood pressure measurements during the first visit and routine blood pressure screening among communities is underutilized. The multivariable logistic regression models showed that although the prevalence between urban and rural areas had no significance, labor force population in rural areas had lower odds for awareness, treatment, and control rates. Moreover, rural residents had higher control rates among treated hypertensive participants by symptoms but lower control rates

among treated hypertensive participants by medical order compared with counterparts in urban areas. This could be explained by the difference in the socioeconomic conditions and the access and quality of health services.

Age is one of the factors that affects the prevalence, awareness, treatment, and control of hypertension. The odds for hypertension were higher in older adults than that in younger adults especially in females, but younger adults had lower odds in the awareness, treatment, and control of hypertension both in males and females. The results indicate that younger adults are more likely to neglect their own health and have more adverse life habits, which may cause hypertension-related complications and increase the probability of mortality (9). Hypertensive patients aged 35 years and above were included in the National Basic Public Health Service Project, which were provided with free management services by the local primary health care workers, while the younger hypertensive

patients lack standardized management and have poor compliance. So popularizing the importance of self-management of hypertension is vitally important to initiating a healthy lifestyle and promote self-examination of hypertension to prevent hypertension from an early age.

Gender differences were also revealed in the prevalence, awareness, treatment, and control of hypertension. Women had a lower prevalence but were more likely to be aware of hypertension, take hypertension treatment, and control their condition when compared to men. Studies have shown that men usually face higher social pressure and have more opportunities to be exposed to risk factors of chronic diseases such as smoke and alcohol. Women have more contact with the health care system and are more likely to seek medical attention if they have an episode of illness.

This study found that income inequality was associated with the awareness, treatment, and control of hypertension. Those with lower annual household income tended to have lower rates of awareness, treatment, and control, which was consistent with findings in some other middle-income countries (10). Psychosocial mechanisms suggest that people with more economic resources may be less likely to feel frustrated or inferior when comparing to those with fewer economic resources (11). They also have more financial resources to cover related medical costs and can get more social support after being diagnosed with hypertension.

This study found an inverse association between smoke and hypertension in males and there was no association between smoke and hypertension in females. This is probably due to reverse causation and the fact that men with hypertension are more likely to be advised by their doctors to quit smoking. Additionally, we found that former male smokers were more aware of their hypertension and had better control than never-smokers. This could be explained by people knowing that they were hypertensive were more likely to quit smoking and paid more attention to their health status (12). This pattern was also found in a study from Canada (13). Other behavioral risk factors such as alcohol consumption, excessive salt intake and lack of physical activity were also related with hypertension. Having a healthy lifestyle is important for preventing hypertension.

This study was subject to a few limitations. First, this was a cross-sectional study, which cannot test causality or rule out reverse causation, particularly for

smoking. Second, the awareness and treatment status of hypertension were self-reported, which may incur errors and recall bias.

In conclusion, hypertension prevalence in the labor force population was high in China. Although the rate of awareness, treatment, and control of hypertension has increased markedly, challenges still exist in how to identify hypertensive individuals who are unaware of their hypertension and how to provide primary care. Effective public health strategies targeting at the labor force population, such as older adults, males, overweight and obese participants, are needed for hypertension prevention and management.

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