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Epidemiology

Epidemiology of Prehypertension and Associated Risk Factors in Urban Adults From 33 Communities in China

– The CHPSNE Study –

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Background: The Seventh Report of The Joint National Committee has recently introduced the prehypertension category of blood pressure (BP) status that needs monitoring and intervention. Little is known about the epidemiology of prehypertension in urban China, so this study aimed at estimating the prevalence of prehypertension and identifying risk factors in urban Chinese adults.

Methods and Results: Using a multistage cluster and random sampling method, a representative sample of 25,196 urban adults aged 18–74 years in northeast of China was selected from 2009 to 2010. The survey of BP and associated risk factors was carried out in 33 communities. Multiple logistic regression methods were used to identify risk factors for prehypertension. Overall, 40.5% of urban Chinese adults had prehypertension, with a prevalence of 47.7% and 33.6% in men and women, respectively. Multivariate logistic regression analysis revealed the risk factors of being overweight (adjusted odds ratio [aOR]=1.38, 95% confidence interval [CI]: 1.26–1.52), obesity (aOR=3.94, 95%CI: 2.99–5.20), central obesity (aOR=2.13, 95%CI: 1.96–2.32). Being female, and having a higher education level, higher family income and diet control were protective factors.

Conclusions: Prehypertension is common among urban residents in China, and is associated with many risk factors. Comprehensive lifestyle modifications need to be taken to decrease the incidence of prehypertension and to prevent prehypertension progressing to hypertension and cardiovascular disease. (*Circ J* 2012; **76:** 900–906)

Key Words: China; Prehypertension; Risk factors; Urban adults

During the past decade, China has experienced rapid economic development, followed by changes in lifestyle and diet, and cardiovascular disease (CVD) has become the leading cause of death in China.[1] Hypertension (blood pressure (BP) >140/90 mmHg) has been identified as the major risk factor for CVD and other vascular diseases.[2–5] However, some authors have reported that CVD risk increases steadily with even slightly elevated BP (>115/70 mmHg).[6] Thus, in 2003, the Seventh Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) introduced a new category of BP status termed "prehypertension" and defined as systolic BP (SBP) of 120–139 mmHg or diastolic BP (DBP) of 80–89 mmHg in adults aged 18 years or older, with the recommendation that healthcare providers monitor these patients closely.[7] In recent years, studies have assessed the prevalence and associated risk profiles of prehypertension, and the increased CVD risk in prehypertensive subjects has been confirmed in some reports.[6,8–12] However, few studies have assessed the epidemiology of prehypertension among Chinese, especially among urban adults. In addition, racial and ethnic differences are known to influence the prevalence and risks of prehypertension.[13,14] In this study, we assessed the prevalence of prehypertension and associated risk profiles in an urban Chinese adult population.

Methods

Sample Design

The Control Hypertension and Other Risk Factors to Prevent

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Stroke with Nutrition Education in Urban Area of Northeast China (CHPSNE) Study was a cross-sectional study of hypertension and stoke disease risk factors among urban residents of northeast China aged 18–74 years, and a detailed description of the study's methods have been given elsewhere.[15] A representative sample of urban Chinese residents was sampled during 2009–2010 by a 3-stage stratified sampling method. A total of 28,830 people were selected and invited to participate in the survey, which a total of 25,196 (12,413 men, 12,783 women) completed. The overall response rate was 87.4% and was similar between men and women.

Data Collection

Data were collected in examination centers at local health stations or community clinics in the participants' residential areas. During the visits, trained research staff administered a standard questionnaire in Chinese to obtain information on demographic characteristics, including age, sex, education, and occupation. The interview included questions related to the diagnosis and treatment of hypertension.

BP Measurement and Classification

Three BP measurements were obtained for each participant by trained and certified observers according to a common protocol adapted from procedures recommended by the American Heart Association.[16] BP was measured three times with the participant seated after a 5-min rest, and the time interval between each of the 3 measurements of BP was 2 min. In addition, participants were advised to avoid alcohol, cigarette smoking, coffee/tea, and exercise for at least 30 min before their BP measurements. A standardized mercuric-column sphygmomanometer was used, and 1 of 4 cuff sizes (pediatric, regular adult, large, or thigh) was chosen based on the circumference of the participant's arm.

The classification of normotensive, prehypertensive and hypertensive was based on the classification of BP from JNC-7.[7] Normal BP was defined as not being on antihypertensive medication and having SBP <120 mmHg and DBP <80 mmHg. Prehypertension was defined as not being on antihypertensive medication and having SBP of 120–139 mmHg or DBP of 80–89 mmHg.

Height and Weight Measurements

Body weight, body height, waist circumference (WC), and hip circumference were measured using a standardized protocol. Height was measured, to the nearest 0.5 cm, without shoes, back square against the wall tape, eyes looking straight ahead with a right-angle triangle resting on the scalp and against the wall. Weight was measured with a lever balance to the nearest 100 g, without shoes, in light undergarments. WC was defined as the midpoint between the lower rib and upper margin of the iliac crest, measured by a nurse using a tape with an insertion buckle at 1 end. WC was measured at 0.5 cm above the navel under minimal respiration and hip circumference at the level of maximum extension of the buttocks. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). According to the definition proposed by the World Health Organization (WHO), subjects with BMI ≥25 kg/m^2 and <30 kg/m^2 were classified as overweight and those with BMI ≥30 kg/m^2 were classified as obese. Central obesity is defined as WC ≥85 cm in men and ≥80 cm in women.[17]

Statistical Analysis

Continuous variables are given as the mean ± SD and categorical variables as the percentage in each subgroup. Comparisons of continuous variables between groups were performed by t-test. The associations between categorical variables were tested using contingency tables and the χ^2 test. We calculated adjusted odds ratios (ORs) with 95% confidence intervals (95% CI) for prehypertension and hypertension using univariate and multivariate logistic regression models. All data analyses were conducted using SAS software (Version 9.1; SAS Institute Inc, Cary, NC, USA). All statistical tests were 2-tailed, and P<0.05 was considered statistically significant. In the 5 age groups, the percentage of persons with prehypertension was greater in men than in women.

Table 1. Prevalence of Prehypertension and Hypertension by Sex and Age Group in an Urban Population, Northeast China

Age (years)	n	PHT (%)	HT (%)
Men			
18–34	5,028	55.1	19.8
35–44	2,560	48.6	30.8
45–54	2,469	43.9	41.2
55–64	1,426	36.8	52.7
65–74	930	31.9	56.5
Total	12,413	47.7	32.9
Women			
18–34	4,792	31.7	4.7
35–44	2,693	38.8	16.9
45–54	2,689	36.7	36.4
55–64	1,670	29.3	55.9
65–74	939	26.6	60.4
Total	12,783	33.6	24.7
All			
18–34	9,820	43.7	12.4
35–44	5,253	43.6	23.7
45–54	5,158	40.2	38.7
55–64	3,096	32.8	54.5
65–74	1,869	29.3	58.4
Total	25,196	40.5	28.7

PHT, prehypertension; HT, hypertension.

Results

The mean age of the subjects in this analysis was 41.7 years (SD 14.4 years). Of them, 7,746 individuals had normal BP, 10,213 were prehypertensive, and 7,237 were hypertensive. Approximately 40.5% of these urban Chinese adults had prehypertension. The overall prevalence rate of prehypertension was higher among men (47.7%) than women (33.6%). Among the men, there was a persistent, increasing trend of prehypertension prevalence associated with an increase in age, but among the women, the prevalence of prehypertension increased up to the age of 35–44 years and then decreased (Table 1).

Table 2 lists the baseline characteristics of the prehypertensive and normotensive subjects. Individuals with prehypertension (40.0±13.7) or hypertension (50.1±13.7) were significantly older than those with normal BP (36.0±12.3); 56.4% of the hypertensive, 58.0% of the prehypertensive and 31.1% of the normotensive individuals were males (P<0.001). Of these, 0.8% of the normotensive, 4.1% of the prehypertensive, and 11.4% of the hypertensive subjects were obese (BMI ≥30), and 16.1%, 29.3% and 42.5%, respectively, were overweight (25≤ BMI <30). The central obesity percent rate was signifi-

Table 2. Baseline Characteristics of Chinese Subjects With Normotension and Prehypertension

	NT (n=7,746)	PHT (n=10,213)	HT (n=7,237)	P value
Age (years) (mean±SD)	36.0±12.3	40.0±13.7	50.1±13.7	<0.001
Male, %	2,412 (31.1)	5,922 (58.0)	4,079 (56.4)	<0.001
Ethnic group, %				
Han nationality	7,146 (92.3)	9,343 (91.5)	6,680 (92.3)	0.074
Other	600 (7.8)	870 (8.5)	557 (7.7)	
Educational level, %				
No school	183 (2.4)	354 (3.5)	446 (6.2)	<0.001
Primary school	706 (9.1)	1,289 (12.6)	1,230 (17.0)	
Junior high school	4,310 (55.6)	6,103 (59.8)	4,323 (59.7)	
≥Senior high school	2,547 (32.9)	2,467 (24.2)	1,238 (17.1)	
Occupation, %				
Blue-collar worker	4,046 (52.2)	4,741 (46.4)	3,100 (42.8)	<0.001
White-collar worker	1,313 (17.0)	1,589 (15.6)	1,109 (15.3)	
Organization cadre	422 (5.5)	787 (7.7)	685 (9.5)	
Other	1,965 (25.4)	3,096 (30.3)	2,343 (32.4)	
Family income/year, %				
<10,000 RMB	525 (6.8)	1,003 (9.8)	956 (13.2)	<0.001
10,000–30,000 RMB	897 (11.6)	1,393 (13.6)	996 (13.8)	
30,000–50,000 RMB	3,989 (51.5)	5,381 (52.7)	3,638 (50.3)	
>50,000 RMB	2,339 (30.2)	2,436 (23.9)	1,647 (22.8)	
BMI group (kg/m^2), %				
<25	6,436 (83.1)	6,794 (66.5)	3,337 (46.1)	<0.001
≥25–<30	1,246 (16.1)	2,996 (29.3)	3,076 (42.5)	
≥30	64 (0.8)	423 (4.1)	824 (11.4)	
WC (cm), %				
Men <85, women <80	5,934 (76.6)	5,391 (52.8)	2,354 (32.5)	<0.001
Men ≥85, women ≥80	1,812 (23.4)	4,822 (47.2)	4,883 (67.5)	
Diabetes, %				
No	7,590 (98.0)	9,977 (97.7)	6,765 (93.5)	<0.001
Yes	156 (2.0)	236 (2.3)	472 (6.5)	
Family history of HT, %				
No	5,574 (72.0)	7,323 (71.7)	3,986 (55.1)	<0.001
Yes	2,172 (28.0)	2,890 (28.3)	3,251 (44.9)	
Cigarette smoking, %				
Never	6,009 (77.6)	6,511 (63.8)	4,660 (64.4)	<0.001
Current	1,578 (20.4)	3,343 (32.7)	2,173 (30.0)	
Former	159 (2.1)	359 (3.5)	404 (5.6)	
Alcohol consumption, %				
<2 drinks/day	6,695 (86.4)	7,826 (76.6)	5,561 (76.8)	<0.001
≥2 drinks/day	1,051 (13.6)	2,387 (23.4)	1,676 (23.2)	
Eating fried food, %				
Never	6,045 (78.0)	7,793 (76.3)	5,982 (82.7)	<0.001
Yes	1,701 (22.0)	2,420 (23.7)	1,255 (17.3)	
Controlled diet (low calorie and fat), %				
No	5,502 (71.0)	7,134 (69.9)	4,729 (65.3)	<0.001
Yes	2,244 (29.0)	3,079 (30.2)	2,508 (34.7)	

Data are n (%). Comparisons among subjects defined as NT, PHT and HT were performed with ANOVA or χ^2 test. NT, normotension; RMB, renminbi; BMI, body mass index; WC, waist circumference. Other abbrevistions see in Table 1.

cantly higher in hypertensive (67.5%) and prehypertensive subjects (47.2%) than in those who were normotensive (23.4%). Education status, occupation, family income, smoking, drinking, and lifestyle were significantly different between groups (P<0.001).

Univariate logistic regression showed that age, sex, ethnicity, education status, occupation, family income, BMI, WC, smoking, drinking, and eating fried food were significantly associated with prehypertension status for the whole sample (Table 3). After multiple logistic regression analysis, age, male sex, ethnicity, occupation, BMI and WC were the main risk factors. Compared with people aged 18–34 years, people

Table 3. Factors Associated With Blood Pressure Status (Normotension vs. Prehypertension) From Univariate and Multivariate Logistic Regression Models

	Univariate analysis		Multivariate analysis*	
	OR (95%CI)	P value	OR (95%CI)	P value
Age group (years): 18–34	1.00 (reference)		1.00 (reference)	
35–44	1.34 (1.24–1.44)	<0.001	1.20 (1.10–1.30)	<0.001
45–54	1.91 (1.75–2.07)	<0.001	1.51 (1.37–1.67)	<0.001
55–64	2.57 (2.27–2.91)	<0.001	1.88 (1.63–2.17)	<0.001
65–74	2.39 (2.03–2.80)	<0.001	1.63 (1.35–1.96)	<0.001
Male (ref: female)	3.05 (2.87–3.25)	<0.001	3.61 (3.31–3.93)	<0.001
Ethnic group				
Han nationality	1.00 (reference)		1.00 (reference)	
Other	1.11 (1.00–1.24)	0.062	1.18 (1.05–1.33)	0.005
Educational level (ref: no school)	1.00 (reference)		1.00 (reference)	
Primary school	0.94 (0.77–1.15)	0.573	0.82 (0.66–1.02)	0.088
Junior high school	0.73 (0.61–0.88)	<0.001	0.72 (0.58–0.88)	0.003
≥Senior high school	0.50 (0.42–0.60)	<0.001	0.51 (0.41–0.64)	<0.001
Occupation				
Blue-collar worker	1.00 (reference)		1.00 (reference)	
White-collar worker	1.04 (0.95–1.12)	0.453	1.10 (1.00–1.22)	0.026
Organization cadre	1.59 (1.40–1.80)	<0.001	1.58 (1.36–1.82)	<0.001
Other	1.35 (1.25–1.44)	<0.001	1.12 (1.03–1.21)	0.008
Family income/year				
<10,000 RMB	1.00 (reference)		1.00 (reference)	
10,000–30,000 RMB	0.81 (0.71–0.93)	0.003	1.09 (0.94–1.26)	0.229
30,000–50,000 RMB	0.71 (0.63–0.79)	<0.001	0.99 (0.87–1.12)	0.918
>50,000 RMB	0.55 (0.48–0.62)	<0.001	0.92 (0.80–1.06)	0.340
BMI group (kg/m^2) (ref: <25)	1.00 (reference)		1.00 (reference)	
≥25–<30	2.28 (2.12–2.45)	<0.001	1.38 (1.26–1.52)	<0.001
≥30	6.26 (4.80–8.16)	<0.001	3.94 (2.99–5.20)	<0.001
WC (cm)				
Men <85, women <80	1.00 (reference)		1.00 (reference)	
Men ≥85, women ≥80	2.93 (2.74–3.13)	<0.001	2.13 (1.96–2.32)	<0.001
Diabetes (ref: No)	1.00 (reference)		1.00 (reference)	
Yes	1.15 (0.94–1.41)	0.178	0.84 (0.63–1.05)	0.097
Family history of HT (ref: No)	1.00 (reference)		1.00 (reference)	
Yes	1.01 (0.95–1.08)	0.705	1.20 (1.12–1.30)	<0.001
Cigarette smoking				
Never	1.00 (reference)		1.00 (reference)	
Current	1.96 (1.82–2.10)	<0.001	0.82 (0.74–0.90)	<0.001
Former	2.08 (1.72–2.52)	<0.001	0.85 (0.69–1.04)	0.123
Alcohol consumption				
<2 drinks/day	1.00 (reference)		1.00 (reference)	
≥2 drinks/day	1.94 (1.79–2.10)	<0.001	1.05 (0.95–1.16)	0.428
Eating fried food				
Never	1.00 (reference)		1.00 (reference)	
Yes	1.10 (1.03–1.18)	0.006	1.01 (0.93–1.10)	0.793
Controlled diet (low calorie and fat)				
No	1.10 (reference)		1.00 (reference)	
Yes	1.06 (0.99–1.13)	0.087	0.87 (0.81–0.94)	<0.001

*Adjusted for sex, age, ethnicity, education, occupation, family income, BMI, WC, diabetes, family history of HT, smoking status, drinking status, eating fried food, and diet control.
OR, odds ratio; CI, confidence interval. Other abbrevistions see in Tables 1,2.

aged 35–44, 45–54, 55–64 and ≥65 years had more risks of getting prehypertension (adjusted odds ratio (aOR)=1.20, 1.51, 1.88, and 1.63, respectively). Males were at higher risk of developing prehypertension as compared with females (aOR=3.61, 95%CI: 3.31–3.93). Compared with blue-collar workers, prehypertension was higher in white-collar workers (aOR=1.10, 95%CI: 1.00–1.22) and organization cadres (aOR=1.58, 95%CI: 1.36–1.82). People who were overweight or obese are more likely to get prehypertension compared with people of normal weight (25≤ BMI <30, aOR=1.38; BMI ≥30,

aOR=3.94). Male and female participants with the same characteristics, apart from WC ≥85 (male) or ≥80 (female), had a higher risk of becoming prehypertensive (aOR=2.13, 95%CI: 1.96–2.32) than males with WC <85 and for females <80. In contrast, there was an inverse relationship between education level and the risk of prehypertension. Compared with those in the lowest education attainment group (no school), the risk of prehypertension decreased by 28% with education level of junior high school (aOR=0.72, 95%CI: 0.58–0.88) and 49% with senior high school (aOR=0.51, 95%CI: 0.41–0.64). Similarly, the occurrence of prehypertension was also negatively related to family income, though the relationship was not significant. In addition, controlled diet with low calorie and fat was significantly associated with a lower prevalence of prehypertension (aOR=0.87, 95%CI: 0.81–0.94).

To our surprise, the prevalence of prehypertension was higher in current smokers (47.1%) and former smokers (38.9%) than in never smokers (37.9%). However, when adjusted for all other factors, including age, the current and former smokers appeared to have a lower risk of developing hypertension, especially current smokers (aOR=0.82, 95%CI: 0.74–0.90). A similar pattern was also observed in drinking status: univariate analysis showed that subjects consuming ≥2 drinks per day appeared to have a higher risk for developing prehypertension than those consuming <2 drinks per day (aOR=1.94, 95%CI: 1.79–2.10); however, the adjusted OR for the prevalence of prehypertension decreased to nearly 1.0 and was not significant (95%CI: 0.95–1.16).

Discussion

Using the JNC-7 Report's criteria for BP classification, our findings showed that the overall prevalence of prehypertension in urban Chinese was approximately 40.5%, which exceeds that of many developing countries[9,18,19] and is even higher than that in developed countries and regions.[14,20] The overall prevalence of prehypertension in 15–74-year-old Jamaicans was estimated to be 30% in 2001.[9] The results from the Trabzon Hypertension Study showed that the prevalence of prehypertension in Turkish adults was only 14.5% (12.6% in women and 16.8% in men).[18] A recent study conducted in 5 Indian cities showed that the prevalence of prehypertension in Indian adults was only 28.7% (27.2% in women, and 30.0% in men).[19] Other published studies in developed countries of Asia reported that the prevalence of prehypertension was 31.6% in Korea,[20] 32% in Japan,[21] and 35.8% in Taiwan,[22] which are all lower values than the prehypertension percentage in the present study. Even compared with results from Europe and America, the prevalence of prehypertension in urban Chinese adults in northeast China is still higher. Results from the SUNSET study conducted in Europe showed that the overall prevalence of prehypertension was 32.8%.[14] In the United States, the prevalence of prehypertension in an adult population 18 years and older was 31% (41% in men and 23% in women).[23] Also, compared with other surveys in China, the prevalence of prehypertension in the present study is still higher. The results of the International Collaborative Study of Cardiovascular Disease in ASIA (InterASIA), conducted in 2000–2001, showed that the overall prevalence of prehypertension in Chinese aged 35–74 years from urban and rural areas was estimated to be 21.9%.[24] A recent cross-sectional survey of a representative sample of 19,003 suburban adults aged 18–76 years in Beijing reported that the prevalence of prehypertension was 35.7% (38.2% in men and 31.8% in women).[25] Similar to the present findings, several national surveys have also suggested a high prevalence of prehypertension in developing countries. Janghorbani et al[26] reported an even higher prevalence of prehypertension in Iranian adults (59.6% in men and 44.5% in women) than in the present study. Another survey conducted in rural adults aged ≥35 years old in northeast China showed a prevalence of prehypertension of 47.0% (51.2% in men and 42.6% in women).[27] Economic development, changes in lifestyle and diet, and an increase in life expectancy may explain the rapid increase in the prevalence and total number of prehypertension cases reported in developing countries. Compared with the results of InterASIA[24] and the results from Beijing,[25] the findings in the present study indicate that prehypertension has become a major public health problem in both urban and rural areas of northeast China, and emphasize the urgent need to develop strategies for preventing and treating prehypertension in these regions.

Multivariable logistic regression analysis revealed that age, sex, education level, occupation, family income, smoking, drinking, BMI, WC and lifestyle were significantly associated with the prehypertension status of urban Chinese adults. Higher education status was shown to be a protective factor. Compared with people with no schooling, people with some schooling may have had more opportunities to gain information about hypertension and develop healthy lifestyle habits, so their prevalence was low. Like previous findings [9,14,18–27] being overweight or obese is associated with prehypertension. Our study found that anthropometric indices of obesity (ie, BMI and WC) remain strong independent determinants of prehypertension status, even after controlling for age, sex and other lifestyle factors. Compared with people of normal weight, those who were obese had a nearly 4-fold higher risk of prehypertension. This result pinpoints the importance of obesity in the progression of hypertension. Evidence suggests that the prevalence of obesity and overweight has reached epidemic proportions worldwide.[28] In China, according to the China Nationwide Nutrition and Health Survey data, the prevalence of overweight and obesity in adults over 18 years of age has increased by 40% and 97%, respectively, from 14.6% in 1992 to 22.8% in 2002 for overweight, from 3.6% in 1992 to 7.1% in 2002 for obesity.[29] In our study, 33% of prehypertensive subjects were overweight or obese. Because weight reduction has been shown to lower the odds of hypertension by 77% over the long term,[30] weight loss is considered highly important for the present subjects with prehypertension.

Working in organization cadres appears to be associated with a higher risk of developing prehypertension than blue-collar work in urban adult Chinese (adjusted OR=1.58, 95%CI: 1.36–1.82), which may suggest an association between prehypertension and risk factors differences between organization cadres and blue-collar workers. For example, persons who work in organization cadres spend more time sitting in front of their computers and, accordingly, may not get enough exercise and/or may suffer from mental health problems caused by work-related stress. In addition, in the present study, 57.9% of organization cadre personnel were men, and their average age (40.5±15.4 years) was higher than that of blue-collar workers (37.8±13.3 years). We found that current smokers were at lower risk for prehypertension, an observation documented in other studies as well.[13,14,31] The reason for this association is unclear, and we will continue to study it.

After adjustment for the other factors, our results showed that a controlled diet with low calorie and fat was associated with lower prevalence of prehypertension among urban adults (aOR=0.87, 95%CI: 0.81–0.94), indicating that a healthy life-

style may be a good method of controlling high BP. The JNC-7 report recommends lifestyle modifications for all patients with prehypertension, including losing weight, increasing physical activity, and adopting the Dietary Approaches to Stop Hypertension (DASH) eating plan.[32–34] Patients who reported adopting these lifestyle modifications were found to be 6-fold more likely to have their hypertension under control.[35] However, the current study showed that urban Chinese are still facing the serious challenge of a high prevalence of prehypertension and multiple associated risk factors, about which both the general public and health professionals need to be better informed. Prehypertensive people need to understand the seriousness of hypertension and the importance of appropriate lifestyle modification, and healthcare professionals need to know about the guidelines for preventing hypertension and CVD.

Study Limitations

Two main limitations of the present study should be noted. First, because this was a cross-sectional study, the findings cannot be used to establish a conclusive cause-and-effect relationship between the risk factors and prevalence of prehypertension. Also, Bovet et al. have reported that BP tends to decrease lgreatly across repeated visits on separate days, and the prevalence of high BP based on repeated readings at a second visit will estimate fairly well the true prevalence in the population.[36] However, in the present study, "hypertension" based on only 1 visit (even if based on the mean of 3 readings), which may markedly overestimate the true prevalence of hypertension.

Conclusions

Our results indicate that prehypertension is very common in the general urban Chinese adult population and is related to being overweight, central obesity, and many other risk factors, which points to the health benefits of multifaceted lifestyle modification, including weight control and regular physical activity. More effort in implementing nationwide programs of prevention and control of hypertension and overweight, especially in urban northeast China, is needed to reduce the societal burden of hypertension in China.

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Disclosures

Declaration of Interest: The authors report no conflicts of interest and they alone are responsible for the content and writing of the paper.

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