Original Article

Prevalence, Awareness, Treatment, and Control of Hypertension in Rural Adults from Liaoning Province, Northeast China

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Liaoning Province is located in northeast China, which has distinct weather conditions, geographic characteristics and lifestyles compared with other regions of the country; the lifestyle differences are especially pronounced in the rural parts of this region, where there is a dearth of financial and other resources. However, information on the prevalence, awareness, treatment, and control of hypertension in these impoverished areas is very scarce. We therefore performed multistage cluster random sampling of a group of 29,970 adult residents (≥5 years of residency; ≥35 years of age) of the rural portions of Liaoning Province from 2005 to 2006. The sampling included a survey on blood pressure and associated risk factors. The overall prevalence of hypertension in the community was 36.2%, and 73.0% of hypertensives were unaware of their condition. Among the total group of hypertensives, only 19.8% were taking prescribed medication to lower their BP, and 0.9% had controlled hypertension. Of all subjects, 46.4% did not think that high blood pressure would endanger their lives. As to the reasons given by hypertensives who were aware of their hypertension for not taking antihypertensive medication, 47.4% reported that they lacked knowledge about the mortality of hypertension. The average salt intake in hypertensives was 16.6±9.9 g/day, and the percentages of smoking (44.3%), drinking (31.7%) and salt intake >6 g/day (86.8%) in hypertensives were high. Logistic regression analysis indicated that the relative risks (95% confidence interval [CI]) of overweight, obesity, smoking, drinking, increased salt intake and family history of hypertension for hypertension were 1.95 (range, 1.82–2.08), 2.92 (2.40–3.55), 1.19 (1.12–1.27), 1.16 (1.08–1.25), 1.26 (1.20–1.33) and 2.85 (2.66–3.05), respectively. A higher education level was found to be a protective factor. In conclusion, the prevalence of hypertension in adults living in the rural parts of Liaoning Province was high, and the rates of awareness, treatment, and control were unacceptably low, which may have been due to unique geographical characteristics, unwholesome lifestyles, greater sodium intake, lower education levels, and genetic risk factors. (*Hypertens Res* 2007; 30: 951–958)

***Key Words*: hypertension, rural population, northeast China, risk factors**

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Introduction

High blood pressure (HBP) is one of the most important modifiable risk factors for cardiovascular and renal disease in Western (*1*–*3*) and Asian (*4*, *5*) populations. In their study on a Japanese community, Ishizaka *et al*. reported that HBP was an extremely common finding and a risk factor for myocardial infarction, stroke, congestive heart failure, end-stage renal disease, and peripheral vascular disease (*6*). Recent cross-sectional studies in China have estimated that 129 million people aged 35–74 years have hypertension, indicating that the prevalence and absolute numbers of hypertension have increased dramatically during the past several decades (*7*, *8*). In fact, the estimated number of hypertension cases among Chinese adults increased from 30 million in 1960 to 59 million in 1980 and to 94 million in 1990 (*8*). Although the exact causes and mechanisms of hypertension are not known, it is generally believed that both genetic factors and environmental factors, such as higher sodium intake, cigarette smoking, and mental stress are involved in determining the levels of blood pressure (BP) and the prevalence of hypertension (*9*–*11*).

Liaoning Province is located in northeast China, which has distinct weather conditions, geographic characteristics and lifestyles compared with other regions of the country; the lifestyle differences are especially pronounced in the rural parts of this region, where there is a dearth of financial and other resources. During the winter months, the rural peoples of northeast China usually try to avoid going outdoors, and thus spend large amounts of time in their homes engaged in such activities as drinking, smoking, watching TV, and gambling. At the same time, the rural areas of China tend to have much poorer medical services and lower education levels than the urban areas. However, information on the prevalence, awareness, treatment, and control of hypertension in these impoverished areas is very scarce despite the increasing prevalence of hypertension. These adverse factors in the rural parts of northeast China led us to hypothesize that the prevalence of hypertension in the rural areas of Liaoning Province would be much higher than that in the other areas of China, and the awareness, treatment and control of hypertension would be much lower.

Methods

Sample Design

The present study enrolled subjects from the CHEAPS Study (Control of Hypertension and Other Risk Factors to Prevent Stroke at Low Cost in the Countryside of China). Briefly, a total of 30,214 persons were randomly selected from 64 villages in Fuxin County, Liaoning Province using a multi-stage, stratified clustering sampling scheme. Fuxin is located in the northwest part of Liaoning Province (longitude: 121°01' to 122°25' E; latitude: 41°44' to 42°34' N).The altitude of the residential area is 130–235 m above mean sea level. The mean annual air temperature is 6.5–7.5°C (range, −37.4–38.0°C). The total population in Fuxin county is about 730,000, living in 532 villages. A total of 29,970 persons (15,122 men and 14,848 women) completed the survey and examination, or 4.1% of the total population. The overall response rate was 99.2%. The age of the subjects was 35 to 85 years, with an average age of 51.3±11.9 years.

BP Measurement

Three BP measurements were obtained from each participant by trained and certified observers according to a common protocol adapted from procedures recommended by the American Heart Association. BP was measured three times with the participant in the sitting position after 5 min of rest. In addition, participants were advised to avoid alcohol, cigarette smoking, coffee/tea, and exercise for at least 30 min before their BP measurement. A standardized electronic sphygmomanometer (HEM-741C; Omron Healthcare Co., Kyoto, Japan) was used, and one of four cuff sizes (pediatric, regular adult, large, or thigh) was chosen on the basis of the circumference of the participant's arm.

All study investigators and staff members successfully completed a training program that oriented them both to the aims of the study and to the specific tools and methodologies employed. At the training sessions, interviewers were given detailed instructions on administration of the study questionnaire. All BP observers participated in a special training session on the use of a standardized protocol for measurement of BP. Certification as a BP observer required satisfactory performance during a written test on knowledge of preparing study participants for measuring BP, selecting correct cuff size, and using standard techniques for BP measurement; during a standardized videotape examination; and during concordant measurements of BP with an instructor. In addition, ethics committees and other relevant regulatory bodies in Liaoning Province in China approved the study. Informed consent was obtained from each participant before data collection.

Diagnostic Criteria

The hypertension status of the subjects was assessed based on the US Seventh Joint National Committee (JNC 7) report on the prevention, detection, evaluation, and treatment of high BP (*12*). Hypertension was defined as an average systolic BP (SBP) ≥140 mmHg, or an average diastolic BP (DBP) ≥90 mmHg, or self-reported current treatment for hypertension with antihypertensive medication within the 2 weeks prior to the interview. This definition excludes hypertensives whose BP has been reduced to a nonhypertensive range solely by the use of nonpharmacologic measures. Awareness of hypertension was defined as self-report of any prior diagnosis of

Table 1. Blood Pressure Levels (Mean±SD) and Prevalence of Hypertension in Rural Adult Population in Liaoning Province, Northeast China, 2005–2006

Age groups (years)	Variables	Male (n=15,122)	Female (n=14,848)	t (χ^2)	p
35–44	SBP (mmHg)	128.3±14.4	124.9±17.4	11.27	<0.001
	DBP (mmHg)	80.1±10.6	78.7±11.2	6.87	<0.001
	Prevalence (n (%))	1,136 (21.3)	1,037 (19.5)	5.07	0.024
45–54	SBP (mmHg)	133.4±18.1	133.4±21.9	0.17	0.867
	DBP (mmHg)	83.1±11.8	81.9±12.6	4.68	<0.001
	Prevalence (n (%))	1,508 (33.4)	1,555 (35.0)	2.57	0.109
55–64	SBP (mmHg)	140.1±22.0	142.3±25.6	3.50	<0.001
	DBP (mmHg)	85.3±12.6	84.6±13.3	2.26	0.024
	Prevalence (n (%))	1,401 (47.0)	1,432 (50.6)	7.60	0.006
65–74	SBP (mmHg)	146.5±24.2	150.2±27.4	3.97	<0.001
	DBP (mmHg)	85.4±13.1	84.9±13.9	1.06	0.291
	Prevalence (n (%))	921 (59.2)	885 (60.7)	0.65	0.424
≥75	SBP (mmHg)	148.3±25.1	153.2±27.0	3.67	<0.001
	DBP (mmHg)	84.0±14.2	84.0±14.1	0.06	0.952
	Prevalence (n (%))	441 (60.7)	538 (67.3)	7.19	0.007
Total	SBP (mmHg)	135.0±20.0	134.8±24.0	1.02	0.305
	DBP (mmHg)	82.8±12.0	81.6±12.8	7.77	0.001
	Prevalence (n (%))	5,407 (35.8)	5,447 (36.7)	2.80	0.094

SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 2. Percentage Distribution of Blood Pressure Levels in Rural Adult Population in Northeast China

Age groups (years)	Normotensive or controlled hypertension			Hypertension		
	Optimal	Normal	High normal	Stage 1	Stage 2	Stage 3
SBP (mmHg)	<120	120–129	130–139	140–159	160–179	≥180
DBP (mmHg)	<80	80–84	85–89	90–99	100–109	≥110
Male	1,977 (13.1)	3,475 (23.0)	4,306 (28.5)	3,127 (20.7)	1,312 (8.7)	925 (6.1)
35–44	892 (16.7)	1,678 (31.4)	1,643 (30.7)	826 (15.5)	202 (3.8)	103 (1.9)
45–54	602 (13.3)	1,015 (22.5)	1,403 (31.1)	937 (20.8)	337 (7.5)	218 (4.8)
55–64	302 (10.1)	522 (17.5)	768 (25.7)	742 (24.9)	369 (12.4)	281 (9.4)
65–74	121 (7.8)	191 (12.3)	334 (21.5)	430 (27.7)	268 (17.2)	211 (13.6)
≥75	60 (8.3)	69 (9.5)	158 (21.7)	192 (26.4)	136 (18.7)	112 (15.4)
Female	3,077 (20.7)	3,365 (22.7)	3,021 (20.4)	2,745 (18.5)	1,437 (9.7)	1,203 (8.1)
35–44	1,636 (30.8)	1,597 (30.0)	1,059 (19.9)	704 (13.2)	193 (3.6)	129 (2.4)
45–54	885 (19.9)	1,036 (23.3)	974 (21.9)	874 (19.7)	378 (8.5)	292 (6.6)
55–64	377 (13.3)	463 (16.4)	585 (20.7)	633 (22.4)	428 (15.1)	346 (12.2)
65–74	127 (8.7)	193 (13.2)	265 (18.2)	333 (22.8)	267 (18.3)	274 (18.8)
≥75	52 (6.5)	76 (9.5)	138 (17.3)	201 (25.1)	171 (21.4)	162 (20.3)

Values are n (%). SBP, systolic blood pressure; DBP, diastolic blood pressure.

hypertension by a health care professional among the population defined as having hypertension. Treatment of hypertension was defined as a self-reported use of pharmacological medication for the management of HBP within the 2 weeks preceding the participant's interview. Control of hypertension was defined as pharmacological treatment of hypertension associated with an average SBP <140 mmHg and an average DBP <90 mmHg.

During the clinic visit, height, weight and waist circumference (WC) were measured using a standardized protocol and body mass index (BMI) was calculated in kg/m^2. Normal weight, overweight, and obesity were defined as a BMI <25, 25 to 30, and ≥30 kg/m^2, respectively. Information on education level achieved, cigarette smoking, alcohol consumption, and family history of hypertension was collected. Daily salt intake was measured by investigating the total amount of salt consumed by a family for 1 year and dividing this value by the number of family members ×365.

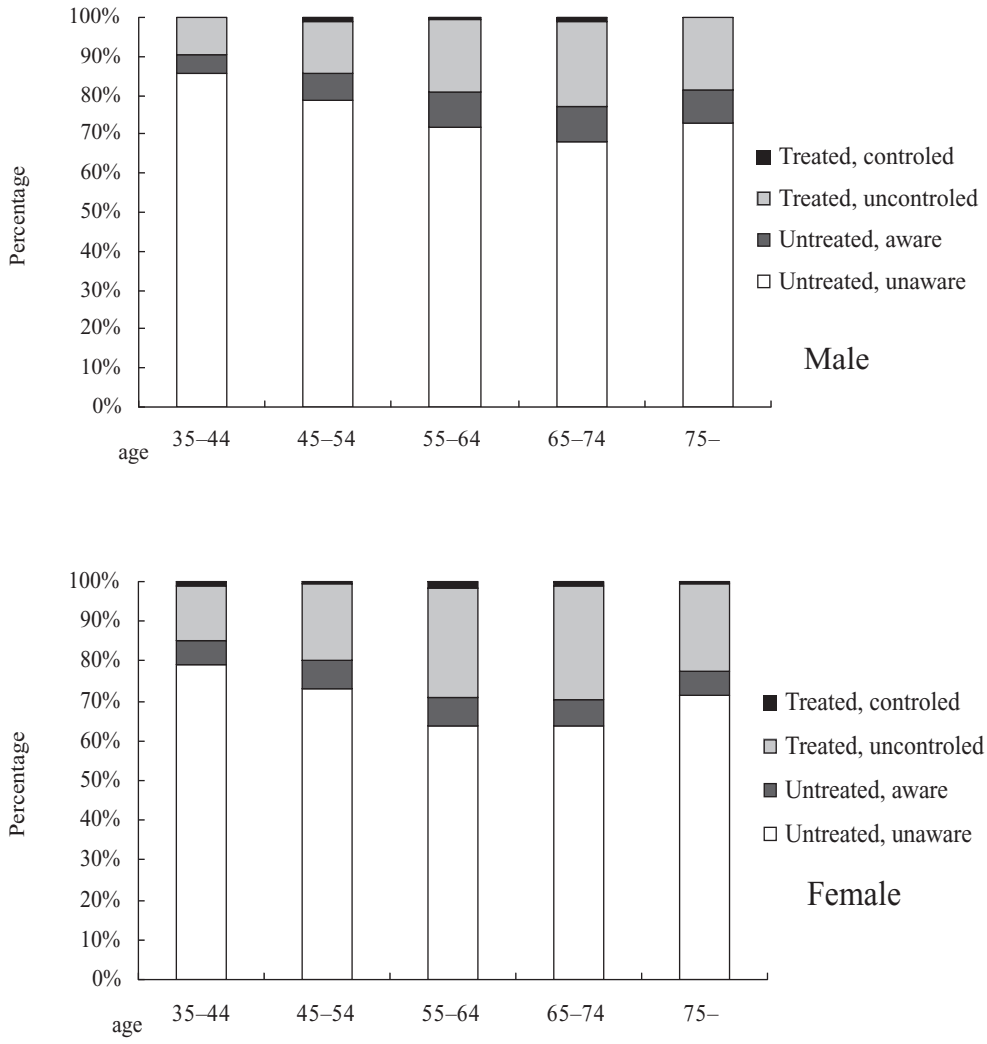

Fig. 1. *Distribution of hypertension across categories of unawareness, treatment, and control by age and gender.*

Statistical Methods

The population was stratified by age into five groups: 35 to 44, 45 to 54, 55 to 64, 65 to 74, and 75 years and older. Continuous variables were given as the mean±SD and categorical variables as the percentage in each subgroup. Associations between categorical variables were tested by the use of contingency tables and the χ^2 test. Comparisons between continuous variables between groups were performed by Student's *t*-test. Multivariate logistic regression analyses were used to test significant determinants of hypertension status. All data analyses were conducted using SAS 8.12 (Statistics/Data Analysis) software. A two-tailed probability value of <0.05 was considered to be statistically significant.

Results

Prevalence

Overall, 36.2% ($n=10,854$) of the 35- to 85-year-old adults of this Chinese population had hypertension. The overall prevalence of hypertension was slightly higher among women (36.7%) than among men (35.8%), but the difference was not statistically significant ($\chi^2=2.80$, $p=0.094$). As shown in Table 1, the prevalence of hypertension and the BP levels increased with age in both men and women. For the age group of 35 to 44 years, men had a higher rate of hypertension than women ($\chi^2=5.07$, $p=0.024$). However, the reverse was true for those ≥45 years of age, and especially for those in the range of 55 to 64 years ($\chi^2=7.60$, $p<0.01$) and those ≥75 years ($\chi^2=7.19$, $p<0.01$).

Table 3. Conditions about Blood Pressure in Hypertensives Aware of Having Hypertension in Rural Northeast China, 2005–2006

Condition of hypertension	Male	Female
Periodicity of BP measurement		
<1 week	70 (5.4)	88 (5.4)
<1 month	210 (16.2)	248 (15.2)
<3 month	261 (20.2)	332 (20.3)
<6 month	151 (11.7)	191 (11.7)
>6 month	243 (18.8)	311 (19.0)
Never measuring BP	358 (27.7)	466 (28.5)
Conditions of taking antihypertensive medication/year[†]		
Regularity	215 (16.6)	281 (17.2)
Interruption	354 (27.4)	563 (34.4)
Occasionally	320 (24.8)	415 (25.4)
Never taking medicine	404 (31.3)	377 (23.0)
Effect of antihypertensive medication[‡]		
Good	56 (6.3)	70 (5.6)
Acceptable	274 (30.8)	411 (32.6)
Dys-effect	454 (51.1)	648 (51.5)
Never measuring BP	105 (11.8)	130 (10.3)
The cause of not taking antihypertensive medication		
Lack of knowledge about dangerous of hypertension	190 (47.1)	180 (47.6)
Financial straits	115 (28.4)	105 (27.9)
Lack guidance	16 (3.9)	16 (4.3)
Troublesome	58 (14.4)	49 (13.0)
Other	25 (6.3)	27 (7.2)

Data are *n* (%). [†]Represent the time of taking antihypertensive medication/year, regularity: >9 months/year; interruption: 3 months/year to 9 months/year; occasionally: <3 months/year. [‡]Represent the time of controlling the BP (systolic BP <140 mmHg and diastolic BP <90 mmHg)/year, good: >9 months; acceptable: >6 months; dys-effect: <6 months. BP, blood pressure.

Distribution of BP

Gender- and age-specific estimates of the distribution of BP according to the classification system recommended by the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure are presented in Table 2. Overall, 36.1% of men and 43.4% of women had optimal or normal BP (SBP <130 mmHg and DBP <85 mmHg), whereas 28.5% of men and 20.4% of women had high normal BP. The prevalence of stage 1, 2, and 3 hypertension was 20.7%, 8.7%, and 6.1% in men and 18.5%, 9.7%, and 8.1% in women, respectively.

Awareness, Treatment, and Control of Hypertension

Figure 1 shows the levels of awareness, treatment, and control of hypertension for male and female hypertensives by age. Overall, 27.0% (2,929/10,854) of those with hypertension were aware of their diagnosis. More women (30.0%) were aware of their hypertension than were men (23.9%) ($\chi^2=51.61$, $p<0.001$). For age <75 years, the percentages of persons who were aware their hypertensive status increased with age in both men and women. Of those aware of having hypertension, 73.3% were treated. Furthermore, 4.5% of those treated became normotensive with treatment. Of all hypertensives, only 19.8% were taking prescribed medication to lower their BP, and 0.9% had controlled hypertension.

As shown in Table 3, of the hypertensives aware of having hypertension, only 21.0% reported that they were measuring their BP at least once per month, and only 16.9% took antihypertensive medication for their hypertension regularly. Of the hypertensives treated, only 6.3% in men and 5.6% in women had controlled their BP to a normal level for at least 9 months out of the year. The main reasons given by hypertensives who were aware of having hypertension for not taking their antihypertensive medication were lack of knowledge about the mortality of hypertension (47.4%) and financial straits (28.2%). Of all the participants, 46.4% did not think that HBP would endanger their lives, and only 30.9% were aware of the mortality of hypertension.

Risk Factors of Hypertension

For all the participants, the mean±SD salt intake was 15.5±9.5 g/day and the percentage of participants with a salt

Table 4. Factors Associated with the Prevalence of Hypertension from Multivariate Logistic Regression Models (*N*=29,970)

Variables	*n*	Prevalence of hypertension (%)	Multivariate analysis*
			OR (95% CI)
Age-groups (years)			
35–44	10,662	20.4	1.00 (reference)
45–54	8,591	34.2	2.04 (1.90–2.18)
55–64	5,816	48.7	4.04 (3.74–4.36)
65–74	3,014	59.9	6.74 (6.10–7.45)
≥75	1,527	64.1	8.49 (7.41–9.72)
Gender			
Male	15,122	35.8	1.00 (reference)
Female	14,848	36.7	1.11 (1.04–1.18)
Ethnic groups			
Han nationality	22,339	34.9	1.00 (reference)
Mongolian	7,158	40.2	1.22 (1.15–1.29)
Others	473	37.2	1.04 (0.84–1.27)
Educational level			
No school	2,696	59.4	1.00 (reference)
Primary school	11,004	39.5	0.79 (0.71–0.87)
Junior high school	14,389	29.1	0.73 (0.66–0.82)
≥Senior high school	1,881	38.5	0.85 (0.74–0.98)
Smoking status			
No	17,351	34.8	1.00 (reference)
Yes	12,619	38.1	1.19 (1.12–1.27)
Drinking status			
No	20,730	35.8	1.00 (reference)
Yes	9,240	37.3	1.16 (1.08–1.25)
Body weight			
Normal weight	23,899	33.0	1.00 (reference)
Overweight	5,563	48.0	1.95 (1.82–2.08)
Obesity	508	61.2	2.92 (2.40–3.55)
WC (cm)			
Male <85 or female <80	17,106	32.0	1.00 (reference)
Male ≥85 or female ≥80	12,864	41.9	1.36 (1.29–1.44)
Salt intake (g/day)			
<15.5	17,199	33.7	1.00 (reference)
≥15.5	12,771	39.7	1.26 (1.20–1.33)
Family history of hypertension			
No	25,288	33.0	1.00 (reference)
Yes	4,682	53.7	2.85 (2.66–3.05)

*Adjusted for age, gender, ethnicity, education, smoking status, drinking status, body mass index, WC, salt intake and family history of hypertension. OR, odds ratio; CI, confidence interval; WC, waist circumference.

intake <6 g/day was only 16.6%. The intake of table salt in hypertensives (16.6±9.9 g/day) was higher than that in normotensives (14.9±9.2 g/day) (t=14.8, p<0.01). BMI (23.6±3.3 *vs*. 22.8±2.8 kg/m^2) and WC (82.5±9.6 *vs*. 79.9±8.7 cm) also were significantly greater in hypertensives than in normotensives (all p<0.001). Among these subjects, 1.0% of the normotensives *vs*. 2.9% of the hypertensives were categorized as obese (BMI ≥30 kg/m^2) and 15.1% of the normotensives *vs*. 24.6% of the hypertensives were overweight (25 kg/m^2 ≤ BMI <30 kg/m^2) according to the WHO cut-off values using BMI. The rates of smoking, drinking and salt intake >6 g/day in hypertensives were 44.3%, 31.7% and 86.8%, respectively. After multiple logistic regression analysis, age, gender, ethnicity, smoking, drinking, salt intake every day, BMI, WC, and family history of hypertension were shown as main risk factors (Table 4). People with a status of overweight (25 kg/m^2 ≤ BMI <30 kg/m^2) or obese (BMI ≥30 kg/m^2) were more likely to be hypertensive than those with normal weight (odds ratio [OR]=1.95 and 2.92, respectively). Similarly, males with a WC ≥85 cm or females with a WC ≥80 cm were at greater risk of developing hypertension than males with a WC <85 cm or females with a WC <80 cm (OR=1.36 for both). Mongolian people appeared to have a 1.22-fold higher risk of developing hypertension than individuals of Han nationality (OR=1.22). A higher level of education was also shown to confer protection against the development of hypertension.

Discussion

This study represents the most reliable and up-to-date information on the current prevalence of hypertension, the extent to which hypertension is being treated and controlled, and risk factors for the disease in the rural adult population in northeast China. This study was conducted in a large representative sample of the Chinese adult rural population using standard protocols and instruments. Strict training processes for data collectors and vigorous quality assurance programs were employed to ensure the quality of the data collection. Additional strengths of the study include a high response rate, the use of three BP measurements, and detailed information on the history of hypertension and on pharmaceutical and treatment. For all these reasons, these data probably provide the most accurate and precise estimates of hypertension detection, treatment, and control, as well as data on the risk factors correlated with the disease, that are available for the general rural Chinese population from northeast China.

Overall, the results indicate that 36.2% of the adults aged ≥35 years in rural northeast China have hypertension. Only 27.0% of those with hypertension were aware of their diagnosis, only 19.8% were taking prescribed medication to lower their BP, and only 0.9% were taking antihypertensive medication and had a BP <140/90 mmHg. Of those aware of having hypertension, only 4.5% of those treated had a BP <140/90 mmHg. The results of the International Collaborative Study of Cardiovascular Disease in ASIA (InterASIA), conducted in 2000–2001, showed that the overall prevalence of hypertension in China was estimated to be 27.2%, and the percentages of awareness, treatment, and control of hypertension were 44.7%, 28.2% and 8.1%, respectively (*4*). Another investigation performed in Guangxi Province in southern China showed that the prevalence of hypertension and the percentages of awareness, treatment and control of hypertension in individuals of Han nationality were 16.0%, 20.9%, 15.3% and 10.4%, respectively (*13*). Compared with the results of the InterASIA and Guangxi studies, the findings in the present study indicate that hypertension has become a major public health problem in rural northeast China, and underscore the urgent need to develop strategies for preventing and treating hypertension in these regions of the country.

The results of this study demonstrate that hypertension was more prevalent among women than among men and that the prevalence increasesd with age. We also found that, for the age group of 35 to 44 years, men had a higher rate of hypertension than women, but the reverse was true for those ≥45 years of age. Other studies conducted among elderly subjects in other countries have similarly shown a higher prevalence of hypertension among women compared with men and an increase in the strength of this gender-related correlation with age (*13–15*). Hormonal factors, postmenopausal weight gain, and a different risk profile might account for the higher age-specific prevalence rates of hypertension among women compared with men. However, in contrast with our studies, earlier studies in China have reported that the levels of BP and prevalence of hypertension were higher in males than in females (*4*, *13*).

Multivariable logistic regression analysis revealed that ethnicity, education status, smoking, drinking, salt intake every day, BMI, WC and family history of hypertension were significantly associated with hypertension status for the whole sample. Mongolian individuals appeared to have a 1.22-fold higher risk of developing hypertension than individuals of Han nationality, which may suggest an association between hypertension and the genetic differences between Mongolian and Han people; we will continue to investigate this possible connection. Higher education status was shown to be a protective factor. Compared to people with no schooling, people with some schooling may have had more opportunities to gain information about hypertension and develop healthy lifestyle habits, so that their prevalence was low. In terms of risk factors, BMI and WC were very important. Evidence suggests that the prevalence of obesity and overweight have reached an epidemic proportion worldwide (*16*, *17*). In our study, 27.5% of hypertensives were overweight or obese. Because weight reduction has been shown to lower the odds of hypertension by 77% over the long term (*18*), weight loss was considered highly important for our subjects with hypertension.

Previous studies have revealed that alcohol in larger amounts (more than two drinks per day) and cigarette smoking increase BP and overall mortality (*11*, *15*, *19*, *20*). The mechanisms involved in the pressor effect of a moderate dose of alcohol primarily involve an increase in cardiac output and heart rate, although increased sympathetic nerve activity may also play a role (*21*). Cigarette smoking raises BP, probably through the nicotine-induced release of norepinephrine from adrenergic nerve endings. When smokers quit, a trivial rise in BP may occur, probably reflecting a gain in weight (*22*). In the same study, waist girth was shown to increase more in men who quit smoking than in male controls, and an increase in waist girth during follow-up was strongly predictive of incident hypertension. In the current manuscript, we also found that the prevalence of hypertension was positively correlated with alcohol consumption (OR=1.16) and cigarette smoking (OR=1.19).

JNC 7 recommends sodium reduction to a level of no more than 6 g/day in hypertensive patients (*12*); however, in the present group of subjects, the average salt intake was 15.5 g/day and the percentage of subjects with a salt intake <6 g/day was low (16.6%). High salt intake is associated with risks of HBP, stroke and stomach cancer mortality rates (*23*, *24*). In this regard, the results of the present study are consistent with previous findings. A significantly positive association was observed between salt intake and the prevalence of hypertension. Therefore, higher salt intake in the rural Chinese population may be one of the most important risk factors contributing to their higher prevalence of hypertension.

Finally, 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 dietary factors and prevalence of hypertension. Secondly, salt intake was measured based on the total amount of salt consumed by a family over 1 year, which may have underestimated or overestimated the actual level of salt intake.

In conclusion, hypertension was found to be highly prevalent in rural adults in northeast China, and the rates of awareness, treatment and control of hypertension were unacceptably low. In addition, the prevalence of hypertension was strongly associated with BMI, smoking, drinking, and salt intake. Subjects with higher education levels had a lower risk of hypertension. At the same time, to our consternation, 46.4% of the total subject group did not think that HBP would endanger their lives, and the percentages of smoking (44.3%), drinking (31.7%) and salt intake >6 g/day (86.8%) in hypertensives were high. These results underscore the urgent need for developing a HBP education program to coordinate the efforts for detection, prevention, and treatment of hypertension in the rural areas of northeast China.

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