

Burden of hypertension in China: a nationally representative survey of 174 621 adults

Running head: Burden of hypertension in China

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Abstract

Background: Hypertension is a major cause of cardiovascular disease. Periodic nationwide surveys are essential for monitoring secular trend of hypertension and its control in population. We assessed prevalence of hypertension and related awareness, treatment and control rates in Chinese adults in 2013-14.

Methods: A nationally representative survey recruited 174 621 adults aged>18 years from 31 provinces in mainland China between 2013 and 2014. Population-weighted prevalence of hypertension and related rates of awareness, treatment and control were calculated and compared by age, sex, region and other factors of interest.

Results: Overall, 27.8% of Chinese adults were hypertensive, with the adjusted prevalence higher in men than in women and increasing steeply with rising age. Of those with hypertension, 31.9% were previously diagnosed, of those diagnosed, 82.9% were treated, and of those treated, 34.6% had their blood pressure properly controlled, resulting in an overall control rates of 9.7% among those with hypertension. Despite similar prevalence, the awareness, treatment and control were much better in urban areas than in rural areas. Among hypertensive individuals, older age, higher levels of education or household income tended to be associated with better awareness, treatment and control rates. During 2013-14, 292 million adults in China had hypertension, representing an absolute increase of 139 million individuals since year 2002.

Conclusions: Among Chinese adults, more than one forth had hypertension and the prevalence has increased significantly during recent decades. Despite huge efforts, the levels of awareness, treatment and control rates of hypertension remain extremely low, foreshadowing substantial unnecessary disease burden.

1. Introduction

Hypertension is a leading cause of mortality and disability, causing almost 10 million deaths globally in 2013.[1] In China, it accounted for 2.5 million deaths (28% of total deaths) and 15% of total disability-adjusted life-years in 2013, mainly from stroke and ischaemic heart disease.[1, 2] It is well-established that appropriate control of hypertension, through drug therapy and/or lifestyle changes, can result in a significant reduction in cardiovascular morbidity and mortality.[3-5]

Over the last several decades, large population surveys of hypertension, either nationwide [6-8] or in specific regions [9-14], have been undertaken in China. These surveys showed consistently a rapid increasing trend in the hypertension prevalence, from 5.1% in 1959 to 18.0% in 2002 at national level.[6-8] Despite this, few studies have provided reliable estimates about prevalence and management of hypertension in the current decade. Moreover, there is still limited data about the current burden of hypertension in certain population subgroups, e.g., by region, and by different socioeconomic status. Appropriate understanding of these issues would be of particular relevance for development of cost-effective and targeted control strategies in China, where the patterns of dietary, physical activity and other lifestyle factors are also changing rapidly.[15-18]

We reported relevant findings from a large-scale nationally representative survey of 174 621 adults aged >18 years who were surveyed during 2013-14, as part of the China Chronic Disease and Risk Factors Surveillance (CCDRFS) survey, which covered all 31 provinces in the mainland China. The aims of the present report were to (i) examine the prevalence of hypertension, both overall and in certain population subgroups (e.g. by age, sex, region, and

socioeconomic); (ii) assess, among those with hypertension, levels of awareness, treatment and control rate; (iii) estimate the number of hypertension in China.

2. Methods

2.1 Survey methods

The 2013-14 China Chronic Disease and Risk Factors Surveillance (CCDRFS) survey was based at Chinese Center for Disease Control and Prevention's Disease Surveillance Points (DSP) system and organized by the National Center for Chronic and Non-communicable Disease Control and Prevention in Chinese Center for Disease Control and Prevention, and conducted between August 2013 and July 2014. Data were recorded by face-to-face interview, using a standardized questionnaire, on demographic characteristics, socioeconomic status, smoking, alcohol drinking, physical activities, dietary habits and history of hypertension and diabetes. Physical measurements (e.g. weight, height, hip circumference, blood pressure) and laboratory tests (e.g. blood glucose, lipid and HbA1c) were also undertaken for each participant. The ethics committee in China CDC approved the survey and a written informed consent was collected from each participant. The protocol of the survey abided by the ethical guidelines of the 1975 Declaration of Helsinki.

2.2 Sampling schemes

The survey used a stratified multistage sampling design to obtain a nationally representative sample of Chinese population. All 605 DSPs (rural county or urban street committee) in all 31 provinces in mainland China were listed as sampling frame, with all provinces stratified according to population size (high/low) and mortality rate (high/low).[19] A total of 298 DSPs were randomly selected, and within each sampled DSP, 4 rural townships or urban sub-districts were selected using the method of probability proportional to population size.

Within each selected township, 3 villages or residential communities were further selected using the similar sampling method. Subsequently, a residential group of at least 50 households was chosen from each sampled village or residential communities by simple random sampling. Households were eligible if one or more members aged 18+ years that had stayed in the survey site at least for 6 months in the last 12 months. Finally, one adult from each household was selected using Kish grid method. About 6.3% of the sampled families could not be accessed on three attempts in different 3 days, who were replaced by another household with a similar family structure in the same village or residential area. Overall, 176 740 participants were enrolled from 3576 village or residential communities.

2.3 Blood pressure measurement

Blood pressure was measured on a seated position by trained and qualified field workers, using an Omron digital BP device (HBP-1300) with a wide range cuff (9-17 inches), in a room with constant temperature around 25°C. Each participant was asked to avoid any vigorous activity, beverage containing caffeine like tea and coffee, and exposure to cold weather 1 hour before the measurement. Left upper arm measurement without cloth was preferred but not for the individuals with left arm disorders or disability. Blood pressure readings were first recorded on paper questionnaire and then double entered into an online data collection system. Each participant was measured three times with one minute interval and the average of the last two readings was used for analyses. Quality control was performed by national, provincial and local designated staff according to standard protocol. Five percent of all measurements were double checked randomly, and among them 95.5% were consistent with readings from quality control staff.

Hypertension was defined as individuals who received anti-hypertensive treatment in the

last two weeks, or had a measured mean SBP ≥ 140 mmHg or mean DBP ≥ 90 mmHg at survey. Based on the measured BP, participants were further classified into six categories,[20] i.e. Optimal (SBP <120 mmHg and DBP < 80 mmHg); Normal (SBP 120-129 mmHg and/or DBP 80-84 mmHg); High-normal (SBP 130-139 mmHg and/or DBP 85-89 mmHg); Stage 1 hypertension (SBP 140-159 mmHg and/or DBP 90-99 mmHg); Stage 2 hypertension (SBP 160-179 mmHg and/or DBP 100-109 mmHg); Stage 3 hypertension (SBP > 180 mmHg and/or DBP > 110 mmHg). Awareness of hypertension was defined as participants with hypertension who responded 'Yes' to the question of 'Have you ever been diagnosed as hypertension by a doctor?' and reported their condition was diagnosed in hospital at township level or above. Assessment of treatment for hypertension was limited to those with hypertension and also reported taking a prescribed antihypertensive medicine over the past two weeks. Control of hypertension was defined as having measured SBP <140 mmHg and DBP <90 mmHg among those with history of hypertension.

2.4 Statistical analysis

The present study excluded 1519 participants who had missing values of BP and/or other study variables of interest and all participants (600) from a survey site with extremely poor data quality of blood pressure measurement, leaving 174 621 individuals for the final analysis.

Basic characteristics were presented by certain hypertension relevant risk factors, such as demographic characteristics, education, annual household income, and lifestyle risk behaviors, etc. Particularly, two types of metrics were used to measure burden of hypertension: population weighted indicators and model adjusted indicators, with the former used to obtain unbiased estimation about the absolute burden or level of

hypertension and the latter to estimate relative burden for subgroup comparisons. The model adjusted indicators are able to attenuate possible bias due to unbalanced distribution of other related variables among subgroups, and therefore increase comparability.

According to the recommendations from the World Hypertension League Expert Committee,[21] crude and population weighted means, standard deviations (SD), median, 25th percentile (Q1) and 75th percentile (Q3) of SBP and DBP were firstly determined by age and gender. Age-sex adjusted means of SBP were then calculated for each calendar month in survey period to explore the seasonal variation of blood pressure. Due to the limited recruitment, we pooled data for January and February (Chinese New Year) and May-July (survey preparation and finishing period). Region and season adjusted means of SBP and DBP were then plotted against age (5-year interval) to examine their age trends. In addition, region-season adjusted distribution of BP level were examined by age and gender. Finally, population weighted prevalence of hypertension and related index were estimated and the model adjusted prevalence of them were determined by age, gender, region, season, prior CVD status, education and income. We tested the differences of these prevalence among nominal categories (e.g., gender, region, and season) and their trends along ordered variables (e.g., age, education, and income).

Weights were calculated for all analysis, especially for estimation of population weighted indicators. The weights consisted of two components: sampling weights accounting for unequal probabilities of sample selection, and post-stratification weights which harmonized the sample structure of survey with that of 2010 Chinese population census. Particularly, we took into account the age (5-year increments), gender, rural/urban residency, and provinces simultaneously when doing the post-stratification.[22] With consideration of the complex

design, the model adjusted means and prevalence were estimated and tested in design-based lineal regression and logistic regression, respectively.[22, 23] For 95% confidence intervals (CIs) and statistical tests, we estimated sampling error using Taylor series linearization with finite population correction. All analyses used SAS version 9.4 (SAS Institute Inc, Cary, North Carolina).

3. Results

Of the 174 621 participants, 57% were women, 54% were from rural areas and mean age was 51.6 (SD: 14.7) years for men and 51.5 (13.8) for women (table 1). Among men 52.9% smoked and 18.0% drank too much alcohol, as opposed to only 3.0% and 1.4% in women. Men tended to be better educated, and to have higher means of SBP and DBP and prevalence of CVD.

Overall, the population weighted mean of SBP was 127.8 (SD: 20.0) mmHg and DBP was 76.5 (SD: 11.4) mmHg, higher in men than women (SBP: 129.8 vs. 125.7; DBP: 78.3 vs. 74.7 mm Hg) (Table 2). Mean SBP increased linearly with age in both genders, while DBP increased with age until about 55 years and then fall thereafter (Table 2, Figure 1). Before age 60 years men had higher SBP, and after that the opposite was true. Mean DBP was higher at all ages in men than women, but the gender difference appeared to diminish with increasing age. There was a significant seasonal variation of blood pressure, particularly among rural residents, with the mean SBP being about 5 mm Hg higher in winter than in summer (Figure 2).

Table 3 presents region-season adjusted distribution of BP categories by age and gender.

Older people had higher BP level than younger ones. Women under age 55 years had more

preferable BP levels than men, but the opposite was true in those over age 65 years.

Overall, 27.8% (95% CI: 26.7-28.8) had hypertension (34.5% [33.2-35.9] in men and 29.5% [28.3-30.7] in women) (Table 4). Based on data from the 2010 Census, an estimated 292 million adults aged >18 years had hypertension, representing an absolute increase of 139 million individuals since year 2002.[7] Among hypertensive people, 31.9% (30.2-33.5) aware their condition (82.9% [81.5-84.2] treated among those aware of their condition), 26.4% [24.8-28.1] received anti-hypertensive treatment, and 9.7% (8.8-10.7) had their BP controlled (34.6% [32.7-36.5] controlled among those been treated). The prevalence of hypertension and the awareness, treatment and control rate among hypertensive people increased with age (all $P < 0.01$), but decreased for the control among those receiving antihypertensive treatment. Compared with men, hypertensive women tend to get better awareness, more treatment and better controlled for the disease ($P < 0.01$). The prevalence of hypertension was similar between urban and rural areas (32.3% vs. 31.6%, $P = 0.37$), but urban residents had relatively higher rates of awareness, treatment and control of hypertension (all $P \leq 0.01$). Marked seasonal variation of hypertension prevalence was also observed, with lowest prevalence in summer (27.8%) and highest in winter (35.9%). Better BP control was also found in summer than other seasons. In contrast to individuals without CVD, those who were previously diagnosed with CVD had higher prevalence, better awareness, treatment and control of hypertension, while control rates among the treated were similar in between. Better socioeconomic status, i.e. higher education was associated with lower prevalence of hypertension, and awareness, treatment and controlled of the condition tended to improve with higher education and income (all $P < 0.01$).

4. Discussion

This large nationwide survey showed that more than one fourth of Chinese adults aged 18 years and above were hypertensive in 2013-2014, and that despite the high prevalence, about 3 out of 5 hypertensive individuals were not aware of their condition, about two third were not receiving anti-hypertensive medication, resulting in less than 10% of hypertensive individuals not properly controlled. In 2013 almost 300 million Chinese adults had hypertension, among whom 264 million were not controlled, foreshowing substantial CVD burden. Female gender and high socioeconomic status was associated with preferable hypertension prevalence, awareness, treatment and control. Similar prevalence was found between urban and rural areas, but a large gap in between still existed in the detection, medication and control of hypertension.

Compared with the 2002 national survey, the prevalence of hypertension had increased from 18.0% in 2002 to 27.8% in 2013.).[7] The prevalence of hypertension now seen in China was generally comparable with that in many developed countries. For example, hypertension prevalence was 26.6% in 2008-2009 in Australia population;[24] 29.5% for US adults aged 18 years over in 2009-2010;[25] but they were higher than that in many developing countries, eg, 22% men and 26% women aged 20+ years in India;[26] and 21% in Thai people over age 15 years in 2009.[27] The rapid increase in prevalence of hypertension in China may be explained by a number of prevailing lifestyle risk factors, such as high salt and more fat consuming in diet, more weight gaining (especially in men), less physical activities.[15, 16, 18, 28-30] Rapid urbanization and rural-to-urban migration in the last decade may also change the lifestyle factors affecting BP in population.[31-33]

The comparison of hypertension prevalence between urban and rural residents are of great relevance in health policy making. The present study found this difference in China is trivial, which was inconsistent with some previous studies which demonstrated significant higher burden of hypertension among urban residents.[7, 13] One possible reason is the diminishing discrepancy between rural and urban residents in hypertension related risk factors. Our previous national survey reported a similar prevalence of current smoking and excessive drinking between areas in 2010 in China.[34] Misclassification of urban and rural areas might be another possible explanation. Outdated definition for urban and rural areas, which roughly considered district in city as urban and other areas as rural, has been broadly adopted by most important previous epidemiological surveys in the past decade.[7, 35-37] Classifying urban/rural at county level can never capture the true differences in between in a setting of rapid urbanization. Using the new national standard released in 2009,[38] we believe the present study is more appropriate to reflect the actual urban-rural disparity in hypertension prevalence.

Rates of awareness, treatment and control of hypertension among the hypertensive individuals have been improved after joint efforts paid by public health practitioners and health professionals in the last decade. In 2002, 24% of the hypertensive individuals were aware of their condition, 20% were receiving anti-hypertensive medicine, and 4.5% had their BP controlled.[7] However, awareness, treatment, and control of hypertension were still very poor in China, with the rates under the global average level.[39, 40] Compared with other developed countries, China ranks a much lower level on the awareness and control of hypertension, e.g. 70-80% awareness and 50% control rate in American around 2010,[25, 41, 42] and 65% control rate in Canadian adults in 2009.[43] Based on a systematic review of 35

countries data, our estimated awareness and control of hypertension were also lower than the average level of developing countries, despite a relatively high treatment rate.[40] The low awareness in China may be due to limited knowledge of the disease hazard, relevant risk factors and how to control of hypertension among primary health care provider and general population, especially among rural residents. Although required by the government regulation, BP measurement was not systematically or frequently checked when patients visiting a health clinic, thus fail to get diagnosed promptly. Lack of professional health personnel and essential antihypertensive medication may attribute to the low control rate of hypertension, particularly in less developed areas. Unhealthy lifestyles among hypertensive people, such as being physically inactive, smoking, heavy alcohol drinking or consuming more fatty diet may also contribute to the poor disease control.[17, 44, 45] In this study, we found treatment rate was quite high among those who were aware of their condition, but only one quarter of hypertensive individuals being treated have their BP controlled. This suggests ineffectiveness in our current treatment approach, low compliance to prescribed medication, or poor aggressiveness in hypertension management by health care providers.

In 2011, Chinese government set a goal for controlling hypertension, i.e. aiming to get 40% of hypertensive individuals covered in routine management by local health professionals and 60% of them get properly controlled by 2015. The present study implied that the goal had hardly been achieved by the end of 2015. Our further CCDRFS data will provide reliable source on monitoring the trend of hypertension control in China. Two key components could be included to improve hypertension control: reinforcing the primary health care system in terms of hypertension diagnosis, patient management and effective treatment,[46-48] and enhancing the primary prevention in general population, i.e. education on basic knowledge

of hypertension and modification of lifestyle risk factors.[49]

4.1 strengths

Well-designed sampling scheme and wide spread survey sites provide representativeness and generalizability of the findings to China as a whole. Large sample size, standardized survey tools, training and field implementation guarantee the reliability of the analysis. The geographic and socioeconomic diversity of the sample allows in-depth exploration into the data. In addition, the survey was conducted throughout a whole year, and therefore we were able to examine season effects on hypertension prevalence and relevant indicators. The winter peak in CVD mortality found in various population [50] implies that seasonal variation in BP should be taken into account in the diagnosis and treatment of hypertension. Central heating might help to control BP in winter, especially in areas with extremely cold weather.

4.1 limitations

As for the cross-sectional nature of the study, blood pressure was not measured in separate occasions, and diagnosis based on serial measures on one occasion might affect the prevalence estimation. Systematic bias may also be introduced by the seasonal variation of BP, i.e. BP measurements inversely associated with outdoor temperature, [51] which was also observed in the present study. With only a small portion of study sample been recruited in summer in the survey, the absolute hypertension burden might be overestimated, though model adjusted indicators was used to reduce the seasonal effect for comparisons across subgroups. However, we required that BP measurement must be taken indoors with constant temperature around 25°C, and thus the bias should be small.

5. Conclusions

In general, hypertension prevalence in China has increased rapidly during the last decade.

Although awareness and treatment of hypertension improved over the time, BP control was still unacceptably low among hypertensive individuals, leaving hundreds of millions of individuals at risk of CVD.

Authors' contribution: Prof. Linhong Wang had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Prof. Z. Chen, Prof. M. Zhou, Y. Li and L. Yang conceived the study design and the analytical plan. Y. Li performed statistical analysis. Y. Li and L. Yang prepared the first draft. Y. Li, L. Yang and Prof. Z. Chen finished the draft based on comments from other authors. Prof. Linhong Wang, Prof. Limin Wang, Y. Li, M. Zhang, Q. Deng, Z. Huang acquired the data.

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Figure legends

Figure 1. Adjusted mean SBP and DBP by age and gender*

* Means adjusted for region and season.

Figure 2 Region and season adjusted mean SBP and DBP by age and gender

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Table 1 Characteristic of participants in 2013-2014 CDRFS survey*

	Men – No. (%)	Women – No. (%)	Total – No. (%)
Total	74 674(42.8)	99 947(57.2)	174 621(100.0)
Age – years			
18-24	3130(4.2)	3022(3)	6152(3.5)
25-34	7932(10.6)	9748(9.8)	1 7680(10.1)
35-44	13 367(17.9)	18 993(19)	32 360(18.5)
45-54	17 422(23.3)	26 780(26.8)	44 202(25.3)
55-64	18 729(25.1)	24 783(24.8)	43 512(24.9)
65-74	10 054(13.5)	11 917(11.9)	21 971(12.6)
75+	4040(5.4)	4704(4.7)	8744(5)
Mean age (SD)	51.6(14.7)	51.5(13.8)	51.6(14.2)
Region			
Urban	32 864(44.0)	47874(47.9)	80 738(46.2)
Rural	41 810(56.0)	52073(52.1)	93 883(53.8)
Education			
Illiterate	14 272(19.1)	34 956(35.0)	49 228(28.2)
Primary school	15 453(20.7)	19 341(19.4)	34 794(19.9)
Junior high school	26 999(36.2)	27 511(27.5)	54 510(31.2)
Senior high school	12 092(16.2)	12 353(12.4)	24 445(14.0)
College graduate or above	5858(7.8)	5786(5.8)	11 644(6.7)
Annual household income per capita†			
Don't know/not sure/refused	16 593(22.2)	24 611(24.6)	41 204(23.6)
Q1(<1093 US\$)	16 103(21.6)	19 995(20.0)	36 098(20.7)
Q2(1093-1967 US\$)	10 656(14.3)	13 834(13.8)	24 490(14.0)
Q3(1968-3825 US\$)	16 755(22.4)	22 811(22.8)	39 566(22.7)
Q4(>3826 US\$)	14 567(19.5)	18 696(18.7)	33 263(19.0)
Tobacco using			
Never regular	26 488(35.5)	96 320(96.4)	12 2808(70.3)
Ex-smoker	8692(11.6)	641(0.6)	9333(5.3)
Current regular	39 494(52.9)	2986(3.0)	42 480(24.3)
Excessive drinking			
No	61 207(82.0)	98 518(98.6)	159 725(91.5)
Yes	13 467(18.0)	1429(1.4)	14 896(8.5)
Prior CVD			
No	72 267(96.8)	97 459(97.5)	169 726(97.2)
Yes	2407(3.2)	2488(2.5)	4895(2.8)
Survey season			
Winter (Dec-Feb)	9201(12.3)	11 793(11.8)	20 994(12.0)
Spring (Mar-May)	24 741(33.1)	34 589(34.6)	59 330(34.0)
Summer (Jun-Aug)	7259(9.7)	9 233(9.2)	16 492(9.4)
Autumn (Sep-Nov)	33 473(44.8)	44 332(44.4)	77 805(44.6)
Mean BMI (SD) – Kg/m ²	24.2(3.5)	24.4(3.7)	24.3(3.6)
Mean SBP (SD) – mmHg	133(19.6)	130.4(21.8)	131.5(20.9)
Mean DBP (SD) – mmHg	79.5(11.5)	76.2(11.4)	77.6(11.6)

* Numbers in parentheses are percentages unless otherwise indicated.

† Based on the exchange rate of 6.1 Chinese Yuan to US\$ 1 that was in effect on 31 December 2013

Table 2 Mean, standard deviation, median and quantiles of SBP and DBP in Chinese adults, 2013-2014

	Both genders				Men				Women			
	Mean	SD	Median	(Q1, Q3)*	Mean	SD	Median	(Q1, Q3)	Mean	SD	Median	(Q1, Q3)
SBP, mm Hg												
Overall (crude)	131.5	20.9	128.5	(117.0, 143.0)	133.0	19.6	130.0	(119.5, 143.5)	130.4	21.8	127.0	(115.0, 142.5)
Overall (weighted)	127.8	20.0	124.5	(114.0, 138.0)	129.8	18.3	127.0	(117.5, 139.0)	125.7	21.3	121.5	(110.5, 136.5)
Age group, years												
18-24	118.9	15.5	117.5	(109.0,126.0)	122.8	13.9	121.5	(114.0,129.0)	114.8	15.9	112.5	(104.5,121.0)
25-34	120.3	15.6	119.0	(110.0,128.0)	124.5	14.6	122.5	(115.0,131.5)	115.9	15.4	114.0	(105.5,123.0)
35-44	124.4	16.8	122.0	(113.0,133.0)	127.5	16.0	125.5	(117.0,135.5)	121.1	17.0	118.5	(110.0,129.0)
45-54	130.8	19.1	128.0	(117.5,141.0)	131.5	18.1	129.0	(119.0,141.0)	130.1	20.0	127.0	(116.0,141.0)
55-64	137.2	20.9	135.0	(122.5,149.5)	136.8	20.1	134.5	(122.5,148.5)	137.6	21.7	135.0	(122.5,150.5)
65-74	143.3	22.3	141.0	(127.5,156.5)	142.5	21.8	140.0	(127.0,155.5)	144.0	22.8	141.5	(127.5,158.0)
75+	144.5	23.2	142.0	(127.0,159.5)	142.8	22.1	141.0	(127.0,156.5)	145.8	24.0	143.0	(127.5,161.5)

Table 2 Mean, standard deviation, median and quantiles of SBP and DBP in Chinese adults, 2013-2014 (continued)

	Both genders				Men				Women			
	Mean	SD	Median	(Q1, Q3)*	Mean	SD	Median	(Q1, Q3)	Mean	SD	Median	(Q1, Q3)
DBP, mm Hg												
Overall (crude)	77.6	11.6	77.0	(70.0, 84.5)	79.5	11.5	79.0	(71.5, 86.5)	76.2	11.4	75.5	(68.5, 83.0)
Overall (weighted)	76.5	11.4	75.5	(69.0, 83.5)	78.3	11.3	77.5	(70.5, 85.0)	74.7	11.1	74.0	(67.0, 81.5)
Age group, years												
18-24	72.1	9.7	71.5	(65.5,78.0)	73.5	9.5	73.0	(67.5,79.5)	70.7	9.7	70.0	(63.5,76.5)
25-34	74.0	10.4	73.0	(67.0,80.0)	76.0	10.5	75.0	(69.0,82.0)	71.8	10.0	71.0	(65.0,77.5)
35-44	77.1	11.3	76.0	(69.5,83.5)	79.5	11.3	79.0	(72.0,86.0)	74.7	10.8	74.0	(67.5,81.0)
45-54	79.8	11.6	79.0	(72.0,87.0)	81.5	11.5	81.0	(73.5,88.5)	78.1	11.4	77.0	(70.0,85.0)
55-64	79.7	11.4	79.5	(72.0,86.5)	81.1	11.3	80.5	(73.5,88.0)	78.2	11.3	77.5	(70.5,85.0)
65-74	78.0	11.6	77.5	(70.0,85.0)	79.0	11.4	78.5	(71.0,86.0)	76.9	11.7	76.0	(69.0,84.0)
75+	75.0	11.6	75.0	(66.5,82.5)	75.6	11.6	75.0	(67.5,82.5)	74.5	11.6	74.0	(66.0,82.5)

*Q1 indicates the 25th percentile and Q3 indicates the 75th percentile.

Table 3. Distribution of blood pressure levels by age and gender*

		Optimal	Normal	High normal	Stage 1 hypertension	Stage 2 hypertension	Stage 3 hypertension
Men	18-24	40.7(36.7,44.6)	31.3(28.7,33.9)	17.2(14.8,19.6)	8.6(6.7,10.6)	1.3(0.7,1.9)	0.9(0.2,1.6)
	25-34	36.1(33.2,38.9)	29.6(27.9,31.4)	18.9(17.3,20.5)	11.8(10.4,13.3)	2.3(1.8,2.9)	1.2(0.7,1.7)
	35-44	29.0(27.3,30.6)	26.8(25.4,28.2)	20.4(19.2,21.6)	17.0(15.8,18.1)	5.1(4.3,5.9)	1.7(1.3,2.2)
	45-54	23.9(22.1,25.7)	22.7(21.6,23.7)	20.9(19.7,22.1)	22.1(20.6,23.6)	7.9(7.3,8.6)	2.5(2.1,3.0)
	55-64	17.6(16.1,19.2)	19.2(17.9,20.5)	21.2(19.9,22.5)	27.5(26.1,28.9)	10.5(9.4,11.5)	4.0(3.4,4.6)
	65-74	13.8(10.3,17.3)	15.9(14.1,17.7)	17.8(16.3,19.4)	31.5(29.1,33.8)	15.2(13.7,16.8)	5.8(4.7,6.9)
	75+	14.1(10.8,17.4)	18.8(14.8,22.7)	14.9(12.3,17.5)	31.3(26.8,35.7)	13.5(11.4,15.5)	7.5(5.1,10.0)
	Total †	24.8(23.4,26.1)	23.3(22.5,24.1)	19.2(18.5,19.9)	21.5(20.6,22.5)	8.0(7.4,8.6)	3.2(2.7,3.7)
Women	18-24	67.4(63.3,71.6)	18.8(16.7,21.0)	7.2(5.1,9.2)	5.0(3.5,6.4)	0.9(0.4,1.3)	0.7(0.2,1.3)
	25-34	63.3(60.0,66.6)	19.7(18.0,21.5)	8.3(7.3,9.2)	6.3(5.2,7.3)	2.1(1.3,2.9)	0.4(0.2,0.6)
	35-44	51.2(48.8,53.7)	22.0(20.7,23.3)	12.9(11.8,14.0)	9.6(8.8,10.4)	3.1(2.7,3.5)	1.3(0.9,1.6)
	45-54	31.2(29.7,32.8)	22.4(20.8,24.0)	17.0(16.1,17.9)	19.4(18.4,20.4)	7.1(6.5,7.7)	2.8(2.4,3.2)
	55-64	19.5(17.8,21.3)	17.9(16.9,18.9)	19.4(18.5,20.3)	27.6(26.5,28.8)	11.3(10.4,12.2)	4.2(3.6,4.9)
	65-74	11.8(10.4,13.2)	17.4(14.0,20.9)	16.5(15.1,17.9)	30.7(29.0,32.5)	15.0(13.3,16.7)	8.5(5.7,11.2)
	75+	12.5(8.6,16.5)	17.0(13.8,20.1)	14.7(12.7,16.7)	27.1(24.3,29.9)	17.8(14.8,20.7)	10.9(6.4,15.4)
	Total †	36.4(34.3,38.4)	19.6(18.7,20.4)	14.2(13.6,14.8)	18.1(17.3,19.0)	7.9(7.4,8.5)	3.8(3.1,4.5)
Both genders	18-24	54.0(50.9,57.1)	25.1(23.4,26.8)	12.2(10.4,14.0)	6.8(5.5,8.1)	1.1(0.7,1.5)	0.8(0.4,1.3)
	25-34	49.7(46.9,52.4)	24.7(23.4,26.0)	13.6(12.5,14.7)	9.0(8.0,10.1)	2.2(1.7,2.8)	0.8(0.5,1.1)
	35-44	40.1(38.3,41.8)	24.4(23.5,25.3)	16.7(15.8,17.6)	13.3(12.4,14.1)	4.1(3.6,4.6)	1.5(1.2,1.8)
	45-54	27.6(26.2,29.0)	22.5(21.4,23.6)	18.9(18.1,19.8)	20.8(19.7,21.8)	7.5(7.0,8.0)	2.7(2.4,3.0)
	55-64	18.6(17.2,20.0)	18.5(17.6,19.5)	20.3(19.5,21.1)	27.5(26.5,28.6)	10.9(10.1,11.7)	4.1(3.8,4.5)
	65-74	12.8(10.9,14.8)	16.7(14.9,18.4)	17.2(16.0,18.4)	31.1(29.4,32.9)	15.1(14.0,16.2)	7.1(5.6,8.6)
	75+	13.3(11.6,15.0)	17.9(14.7,21.0)	14.8(12.7,16.9)	29.1(26.1,32.1)	15.7(13.6,17.8)	9.3(5.9,12.6)
	Total ‡	30.6(29.0,32.1)	21.4(20.8,22.1)	16.7(16.2,17.2)	19.8(19.0,20.6)	8.0(7.5,8.4)	3.5(3.0,4.1)

* All analyses were adjusted for regions and survey months, and numbers in the parenthesis are 95% confidence intervals.

† In addition adjusted for age.

‡ In addition adjusted for age and sex.

Table 4. Prevalence and 95% CIs of hypertension, awareness, treatment and control among Chinese adults (%), 2013*

	Prevalence	Awareness among hypertension	Treatment among awareness	Treatment among hypertension	Control among treatment	Control among hypertension
Total †	27.8(26.7, 28.8)	31.9(30.2, 33.5)	82.9(81.5, 84.2)	26.4(24.8, 28.1)	34.6(32.7, 36.5)	9.7(8.8, 10.7)
Age ‡						
18-29	8.7(7.4,10.4)	10.1(6.7,15.0)	90.6(79.2,96.0)	9.0(5.8,13.7)	42.9(24.9,63.0)	4.0(2.3,6.8)
30-39	12.3(11.0,13.8)	13.2(10.6,16.2)	67.3(57.9,75.6)	8.9(7.1,11.1)	34.3(26.7,42.8)	3.4(2.5,4.6)
40-49	19.9(18.9,21.0)	21.5(19.3,23.8)	70.7(66.0,74.9)	15.1(13.5,17.0)	38.4(32.5,44.7)	6.3(5.1,7.8)
50-59	33.8(32.7,35.1)	30.9(29.0,32.8)	79.4(77.1,81.5)	24.3(22.5,26.1)	36.1(33.0,39.2)	9.5(8.2,10.8)
60-69	48.0(46.7,49.3)	37.1(35.4,38.7)	83.1(81.2,84.8)	30.5(28.7,32.3)	35.0(32.0,38.0)	11.2(9.8,12.8)
70+	61.1(59.7,62.5)	40.2(38.0,42.5)	85.3(83.2,87.3)	33.9(31.6,36.3)	31.8(28.8,34.9)	11.3(9.8,13.1)
P for trend	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Gender §						
Men	34.5(33.2,35.9)	24.2(22.4,26.1)	77.8(75.0,80.4)	18.5(16.8,20.2)	36.7(33.0,40.6)	7.2(6.2,8.3)
Women	29.5(28.3,30.7)	27.5(25.5,29.5)	82.2(79.9,84.3)	22.0(20.2,24.0)	34.5(30.8,38.4)	7.9(6.7,9.2)
P for difference	< 0.01	< 0.01	< 0.01	< 0.01	0.10	0.049
Region						
Urban	32.3(30.9,33.7)	32.5(30.2,34.9)	84.4(82.0,86.5)	26.8(24.6,29.2)	37.9(34.0,41.9)	10.1(8.8,11.7)
Rural	31.6(30.2,32.9)	20.1(18.4,21.9)	74.9(72.1,77.6)	14.9(13.4,16.5)	33.4(29.5,37.6)	5.5(4.6,6.6)
P for difference	0.37	< 0.01	< 0.01	< 0.01	0.01	< 0.01
Season #						
Winter (Dec-Feb)	35.9(33.6,38.3)	21.7(19.5,24.1)	73.5(68.5,78.0)	15.6(13.7,17.7)	30.8(25.2,37.0)	5.1(3.9,6.6)
Spring (Mar-May)	33.3(31.6,35.0)	26.2(24.1,28.5)	81.8(79.2,84.1)	21.0(19.1,23.1)	32.2(28.9,35.7)	7.0(6.1,8.0)
Summer (Jun-Aug)	27.8(25.2,30.7)	25.5(21.3,30.2)	80.5(73.5,86.0)	20.1(15.9,25.1)	43.3(34.7,52.2)	9.6(6.5,14.1)
Autumn (Sep-Nov)	31.0(29.4,32.6)	30.2(27.7,32.9)	83.6(81.4,85.6)	24.8(22.5,27.3)	36.7(33.0,40.6)	9.2(7.9,10.6)
P for difference	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Prior CVD **						
No	31.2(30.1,32.4)	24.3(22.7,26.0)	79.1(76.7,81.3)	18.8(17.3,20.5)	35.7(32.2,39.5)	7.2(6.2,8.3)
Yes	60.0(56.6,63.3)	59.6(54.6,64.5)	88.0(84.9,90.5)	50.7(45.3,56.2)	34.6(30.2,39.2)	15.0(12.8,17.5)
P for difference	< 0.01	< 0.01	< 0.01	< 0.01	0.50	< 0.01

Education **						
Illiterate	34.2(32.6,35.9)	21.1(19.3,23.1)	77.2(73.7,80.3)	15.9(14.1,17.8)	34.4(30.6,38.5)	6.1(5.2,7.2)
Primary school	31.8(30.4,33.1)	24.2(22.1,26.5)	79.4(76.4,82.1)	18.7(16.8,20.7)	33.8(29.7,38.2)	6.6(5.5,7.9)
Junior high school	32.7(31.3,34.3)	26.5(24.4,28.7)	80.8(78.2,83.1)	20.9(19.0,22.9)	34.9(30.9,39.1)	7.5(6.3,8.8)
Senior high school	30.3(28.6,32.0)	31.6(29.0,34.4)	82.2(78.3,85.6)	25.4(22.9,28.0)	37.1(32.7,41.9)	9.3(7.7,11.1)
College graduate or above	25.8(23.5,28.2)	33.6(30.2,37.1)	84.2(79.6,87.9)	27.8(24.8,31.0)	44.7(39.3,50.3)	12.1(9.9,14.8)
P for trend	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Annual household income per capita **						
Don't know/not sure/refused	31.5(29.9,33.0)	25.9(23.7,28.2)	79.8(76.5,82.7)	20.1(18.2,22.3)	36.1(31.9,40.6)	7.6(6.4,9.1)
Q1(<1093 US\$)	32.6(30.8,34.5)	22.8(20.6,25.2)	79.0(75.6,82.1)	17.6(15.5,19.9)	34.5(29.7,39.7)	6.5(5.3,8.1)
Q2(1093-1967 US\$)	32.6(31.0,34.3)	23.6(21.4,26.0)	77.7(73.9,81.1)	17.9(15.8,20.1)	31.8(27.3,36.6)	5.9(4.9,7.1)
Q3(1968-3825 US\$)	31.0(29.8,32.3)	26.5(24.6,28.4)	80.5(77.9,82.8)	20.9(19.2,22.7)	36.2(32.0,40.6)	7.9(6.7,9.3)
Q4(>3826 US\$)	32.2(30.3,34.2)	31.4(29.0,33.8)	83.1(80.2,85.7)	25.5(23.4,27.7)	38.7(34.3,43.2)	9.9(8.6,11.3)
P for trend ***	0.39	< 0.01	< 0.01	< 0.01	0.03	< 0.01

* Numbers in the parenthesis are 95% confidence intervals taking into account complex sample design. Least squared prevalence was used only for comparisons among subgroups not for estimating population of interested subgroup in China.

† Estimation is weighted to represent the total population of Chinese adults based on the 2010 Census data.

‡ Prevalence adjusted for gender, region and season.

§ Prevalence adjusted for age, region and season.

|| Prevalence adjusted for age, gender and season.

Prevalence adjusted for age, gender and region.

** Prevalence adjusted for age, gender, region and season.

*** Category "Don't know /not sure/refused" was excluded in the trend test.