

Survey on the Prevalence, Awareness, Treatment, and Control of Hypertension among Tibetans at High-altitude in China Ngawa

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Research article

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Abstract

Background:

The prevalence of hypertension in China increased recent years. There are some surveys reported the hypertension status in different regions in China. However, little data revealed the epidemic status of hypertension among Tibetans at high altitude area in Ngawa. In this study, we explored the prevalence, awareness, treatment and control of hypertension in this special population.

Methods:

The cross-sectional analysis data was collected from 2228 Tibetan residents in seven high-altitude areas of Ngawa from September 2018 to June 2019, using a stage cluster sampling method. All participants were measured their blood pressure by trained physicians and have completed the questionnaire in the local hospital and health clinics. Hypertension was defined as systolic blood pressure (SBP) \geq 140 mmHg and /or diastolic blood pressure(DBP) \geq 90 mmHg according to standards in China.

Results:

The prevalence rate of hypertension was 24.6% in this area, which was similar to previous survey results the general population in China (23.2%). The awareness rate (32.3%), treatment rate (21.7%), and control rate (6.2%) of hypertension in high altitudes were lower than in the plain area in China. Compared to the 2015 Sichuan rural survey, the awareness rate increased (32.3% vs 24.6%), but the treatment rate (21.7% vs 24.7%) and the control rate (6.2% vs 14.7%) remained low.

Conclusions:

From the results, we can come to a conclusion that the rates of awareness, treatment, and control of hypertension remain unexpected low in Tibetans, especially in female Tibetan at high altitude area of Ngawa. The related factors may include poor medical conditions, economic underdevelopment and traditional Tibetan customs. We hope to add some Tibetan data to the clinical epidemiology database of hypertension and hope the study can be used for future research.

Background

High morbidity and mortality of cardiovascular disease are rapidly becoming the leading cause of death worldwide recent years, and this is the case in China[1, 2]. Hypertension, as a major risk factor for cardiovascular disease, has affected 26.4% of the world's adult population (972 million) in 2000, and the ratio is expected to increase to 29.2% (1.56 billion) by 2025[3, 4, 5]. In China, the ratio is 23.2% (0.245 billion) according to the Nutrition and Health Survey in 2018[6].

Hypertension is a serious threat to Chinese. The average rate of the prevalence, awareness, treatment and control of hypertension is 37.2%, 36.0%, 22.9%, and 5.7% respectively in China [9–11]. Two studies further analyzed the relation between the prevalence of hypertension and the altitude. However, it was all in the general population, and the status of blood pressure of the Tibetans in Ngawa is rarely reported, especially in remote and underdeveloped high altitudes.

Ngawa Tibetan Autonomous Prefecture, located in the high altitude area of Sichuan Province, has unique geographic characteristics and different habits from other parts of China. The main residents in Ngawa are Ando Tibetan and White-horse Tibetan, who belong to different branches of the Tibetan. Having lived with the Han people for decades, their lifestyle and health may differ from traditional Tibetans. People here tend to eat a high-salt, fat-rich diet and lack vegetables. Unhealthy lifestyle may increase the risk of hypertension when medical resource is inadequate. In addition, in recent years, few reports have focused on the epidemiological features of cardiovascular disease in this region. Therefore, it is especially critical to access more epidemiological data on risk factors for cardiovascular disease to improve medical standards and health in this area. To achieve this goal, we explore the prevalence, awareness, treatment, and control of hypertension in this special population at high altitudes in the study.

Methods

Sampling Method and Subject Selection

Ngawa Tibetan Autonomous Prefecture is located in northwest of Chinese Sichuan province and consists of Maerkang city and 12 counties, where more than 536000 Tibetans live[12]. In our study, about 0.5% of all Tibetans from seven high-altitude areas (Maerkang City, Rangtang County, Jinchuan County, Aba County, Hongyuan County, Xiaojin County and Maoxian County) were selected as our study subjects by random sampling method (Fig. 1,2). In this survey, we excluded pregnant women, and patients with malignant tumors, mental health problems, and with severe cardiovascular disease such as coronary heart disease, stroke, macroangiopathy. Patients who were reluctant to complete all the required questions were also excluded from the survey. All subjects had signed an informed consent form after understanding the objectives and benefits of our study. This study was approved by the Ethics Committee of Sichuan Provincial People's Hospital (Chengdu, China).

Data Collection

Questionnaires were conducted by trained investigators during face-to-face interviews with subjects, whose blood pressure was measured by doctors in local hospitals and health clinics. The survey questionnaires included: (1) Demographic characteristics including age, gender, education, and location of residency; (2) Medical, personal, and family health history, involving a family history of hypertension, current and past use of medications. Family history of hypertension was defined as an immediate family member of a subject who was previously diagnosed with hypertension, such as a parent, child, brother, or

sister; (3) Health care access and behaviors, including medical check-ups in the past 2 years. The proportion for each choice was calculated by dividing the number of selected subjects by the total number of subjects.

Blood Pressure Measurement

Doctors performed BP measurements following American National Management of Essential Hypertension and Chinese Hypertension Guidelines [13, 14]. Each subject was measured with BP after a five-minute break, given two readings in a mercuric-column sphygmomanometer, and then averaged two measurements.

Definitions

Subjects were judged to have hypertension by an average SBP ≥ 140 mm Hg, and/or average DBP ≥ 90 mm Hg, and/or who had previously been diagnosed with hypertension or were currently taking antihypertensive medicines. Awareness of hypertension was defined as claiming to have ever been diagnosed with hypertension by doctors and /or knowing that they were taking antihypertensive drugs. Treatment of hypertension was judged by responding “yes” when asked if he was taking antihypertensive medicines. Control of hypertension was defined as over twice reading an average SBP < 140 mm Hg and an average DBP < 90 mm Hg. Weight and height measurement errors were respectively 0.2 Kg and 1 cm. Body mass index (BMI) was defined as weight (Kg) divided by squared height (m^2). According to the Chinese Guidelines for Prevention and Control of Adult Overweight and Obesity[15],overweight is defined as a BMI between 24 Kg/ m^2 and 28 Kg/ m^2 ; and obesity is defined as a BMI great than or equal to 28 Kg/ m^2 .Routine medical examination was defined as a regular check-up at least once every two years in public hospitals or clinics. The level of education was assessed as elementary school or lower, middle school, or high school or above.

Statistical Analyses

Baseline features were described as a mean (*SD*) for continuous variables and the number (proportion) for categorical variables. The categorical variables were compared by the χ^2 test. The linear trend across BMI groups was tested by the Mantel-Haenszel χ^2 statistic. Multivariate logistic regression models were used to explore the correlation between baseline features and prevalence, awareness, and control rate, which were calculated using odds(*ORs*) and corresponding 95% confidence intervals (95% *CI*s). *P* values less than 0.05 were considered statistically significant. All analyses were performed with SPSS 17.0.

Results

Demographic Characteristics

The results showed that the subjects were between 18 and 80 years old, with an average age of 45.00 ± 14.01. Male subjects were 1310(58.8%), while female were 918(41.2%). About 40% of subjects have a secondary school or lower education, and 63% of subjects (1404) were able to have a physical examination at least every 2 years (Table 1).

Table 1
Characteristics of Study Subjects, by Gender

Variable	Male(n = 1310),n(%)	Female(n = 918),n(%)	Total(n = 2228),n(%)
Age(yrs)	47.15 ± 14.29	41.93 ± 13.02	45.00 ± 14.01
BMI(Kg/m ²)	24.45 ± 2.53	22.25 ± 2.81	23.55 ± 2.86
Education level			
Elementary school or lower	506(42.6)	325(36.5)	831(40.0)
Middle school	214(18.0)	141(15.8)	355(17.1)
High school or above	467(39.3)	424(47.6)	891(42.9)
Altitude(m)			
1500 ~ 2500	346(26.4)	142(15.5)	488(21.9)
2500 ~ 3500	772(58.9)	596(64.9)	1368(61.4)
≥ 3500	192(14.7)	192(14.7)	372(16.7)
Region			
City	624(47.6)	484(52.7)	1108(49.7)
County	686(52.4)	434(47.3)	1120(50.3)
Regular check-up			
Yes	802(61.2)	602(65.6)	1404(63.0)
No	508(38.8)	316(34.4)	824(37.0)
The data came from subjects aged 18–80 with an average age of 45.00 ± 14.01, and from seven different high altitude regions in Ngawa.			

Prevalence, Awareness, Treatment, And Control Of Hypertension

Based on the measurement values taken at the interview, the mean SBP and DBP were 128.23 ± 14.06 and 79.08 ± 10.89 mm Hg. The result showed that the prevalence rate was 24.6% (548/2228); the awareness rate was 32.3%(177/548);the treatment rate was 21.7%(119/548); and the control rate was

only 6.2%(34/548). Only 16% of subjects (304) understand hypertension diagnosis standards correctly. About 53.3% of the subjects (1188) were not very clear about the criteria for diagnosis of hypertension.

Hypertension Status And Demographic Characteristics

The prevalence of hypertension in male was significantly higher than in female (30.0% vs 16.9%), but there is no statistical difference between the control rate and the gender (6.6% vs 5.2%) (Table 2). The prevalence of the under - 40 age group was significantly lower than in the 40–59 age groups, especially in the over-60 age group(5.9% vs 29.6%, 5.9% vs 52.9%, $P < 0.0001$). The awareness and treatment were higher in the 40–59 age group than in the group under 40 and the group over 60 ($P < 0.0001$), but the control rate was still low in these three different age groups (Fig. 3).

Table 2
Relationship between hypertension status and demographic characteristics

Characteristics	n	Prevalence, n(%)	Awareness, n(%)	Treatment, n(%)	Control, n(%)
Gender	<i>P</i>	< 0.0001*	0.002*	0.026*	0.525
Male	1310	393(30.0)	142(36.1)	95(24.2)	26(6.6)
Female	918	155(16.9)	35(22.6)	24(15.5)	8(5.2)
Age(yrs)	<i>P</i>	< 0.0001*	< 0.0001*	< 0.0001*	0.176
18–39	876	52(5.9)	5(9.6)	2(3.8)	1(1.9)
40–59	942	279(29.6)	116(41.6)	78(28.0)	22(7.9)
60–80	410	217(52.9)	56(25.8)	39(18.0)	11(5.1)
Education level	<i>P</i>	< 0.0001*	< 0.0001*	0.051	0.018*
Elementary school or lower	831	325(39.1)	79(24.3)	57(17.5)	12(3.7)
Middle school	355	65(18.3)	25(38.5)	19(29.2)	6(9.2)
High school or above	891	118(13.2)	50(42.4)	29(24.6)	12(10.2)
Family history	<i>P</i>	< 0.0001*	< 0.0001*	< 0.0001*	0.177
Yes	182	98(53.8)	62(63.5)	55(43.9)	9(9.2)
No	2046	450(22.0)	115(25.6)	76(16.9)	25(5.6)
Altitude(m)	<i>P</i>	< 0.0001*	< 0.0001*	0.246	0.039*
1500 ~ 2500	488	168(34.4)	72(42.9)	40(23.8)	16(9.5)
2500 ~ 3500	1368	252(18.4)	82(32.5)	58(23.0)	15(6.0)
≥ 3500	372	128(34.4)	23(18.0)	21(16.4)	3(2.3)
Region	<i>P</i>	< 0.0001*	0.026*	0.007*	0.294
City	1108	196(17.7)	75(38.3)	55(28.1)	15(7.7)
County	1120	352(31.4)	102(29.0)	64(18.2)	19(5.4)
BMI(Kg/m²)	<i>P</i>	< 0.0001*	< 0.0001*	0.121	0.221
< 24	1292	218(16.9)	66(30.3)	57(26.1)	17(7.8)
24–28(overweight)	794	259(32.6)	69(26.6)	48(18.5)	13(5.0)
≥ 28(obesity)	136	71(52.2)	42(59.2)	14(19.7)	2(2.8)

*: $P < 0.05$ was considered statistically significant.

Characteristics	n	Prevalence, n(%)	Awareness, n(%)	Treatment, n(%)	Control, n(%)
Regular check-up	<i>P</i>	< 0.0001*	0.003*	< 0.0001*	0.692
Yes	1404	268(19.9)	99(38.7)	73(28.5)	17(6.6)
No	824	280(34.0)	78(26.7)	46(15.8)	17(5.8)
Total	2228	548(24.6)	177(32.3)	119(21.7)	34(6.2)
*: <i>P</i> < 0.05 was considered statistically significant.					

In the higher education-level group, the prevalence is lower, the awareness rate and the treatment rate are higher, while in the lower education group, the opposite is true. Interestingly, the group of subjects with a family history of hypertension had higher prevalence, awareness and treatment rates than those without ($P < 0.0001$). Further analysis found that subjects with higher BMI were associated with higher hypertension prevalence and awareness ($P < 0.0001$). The region analysis found that the three rates of urban residents were lower than that of county residents ($P < 0.05$). Another finding was that people who had regular check-ups had a lower prevalence and higher awareness and treatment than those who rarely had it ($P < 0.01$). Altitude analysis showed significant difference in prevalence, awareness and control rates in individual high-altitude subgroups ($P < 0.001$, $P < 0.001$, $P = 0.039$). Unfortunately, the treatment and control rates of all subgroups in our study were lower than the Chinese average.

Multivariate Analyses About Prevalence, Awareness, And Treatment Of Hypertension

Female, age (under 60), altitude of 2500–3500 meters and high education level were significantly associated with higher prevalence of hypertension, while family history of hypertension, overweight and obesity were significantly associated with lower prevalence ($P < 0.001$, Fig. 4). Male, urban and plain areas, regular check-ups, family history of hypertension, high education, overweight and obesity were all obviously associated with higher awareness of hypertension ($P < 0.05$, Fig. 5). Age under 60, urban and family history of hypertension were associated with higher treatment of hypertension ($P < 0.05$, Fig. 6).

Discussion

This survey covered about 0.5% all Tibetans from seven different high-altitudes in Ngawa and the results were representative. It showed the prevalence rate of hypertension was 24.6%, which was similar to previous survey results in Tibet (23–56%)[16–18], in Sichuan province(25.2%)[19], and in nationally (23.2%) [6, 21, 22].

In our study, the awareness, treatment and control rate were 32.3%, 21.7% and 6.2% respectively, which were lower than in Guo's report (36.1%, 12.4%, and 30.5%)[23]. Compared with the 2015 Sichuan rural

survey, the awareness rate of hypertension in Tibetan has increased (32.3% vs 24.6%), but the treatment rate (21.7% vs 24.7%) and the control rate (6.2% vs 14.7%) need to be further improved[19].

Multivariate attributive analysis showed residents at high altitude had high risk of hypertension. Perhaps main reason is their special lifestyle in this area. Firstly, at high altitudes, food resources are limited and food diversity is insufficient. Secondly, people in Ngawa like to eat traditional salty yak butter milk tea, highland barley wine and Yak meat, which are specialties of the plateau area [25]. Finally, air-dried bacon is a common way to entertain guests in the area due to the alpine climate and traditional customs. People have unique diet that prioritizes meat, alcohol, and salt-rich food, which all increase the risk of hypertension.

We speculated that the low rate of awareness and treatment was due to their difficulty in obtaining medical examinations and health care knowledge at high altitudes. Although the level of government's health care in the region had improved in recent years, access to medical resources for the inhabitants of the Plateau is still insufficient. Hypertension remains a major public health problem in this special population. More methods and information communication technology could improve blood pressure control in Ngawa[26, 27].

There are significant differences in hypertension awareness and treatment rates in different age groups. The prevalence of hypertension in people over 60 years of age group was as high as 52.9% (Table 2). But the awareness and treatment rates was only 25.8% and 18% in this group. About 89% patients did not effectively control their blood pressure. Elderly patients may pay less attention to their health due to their lower education level and less medical knowledge, which leads to lower awareness and treatment rates. Another noteworthy is that nearly one-third of subjects in the 40–59 age groups had hypertension, and they were more likely to be taking anti-hypertensive medications than the older and younger groups, but the control rate (7.9%) was not satisfied. They are the backbone of society and the family, busy with work, neglecting to pay attention to their own health, which was also the reason for the lower awareness and treatment rate. Therefore, the level of health care in these areas needs to be further improved. But these patients would be benefited from appropriate therapy at most, and if treated, would have more control over their blood pressure [22].

It was disagreed with the results from other studies [28, 29], this study showed that female hypertension patients had lower effective awareness and treatment rate of BP than their male counterparts. We hypothesized that women in this group had low social status owing to their traditional customs. As a loyal housewife, women might not paying enough attention to their health, which may cause to low awareness and treatment rates in women patients. Further research is needed to confirm this hypothesis.

Although subjects with a family history of hypertension had 3.86-fold higher risk of developing hypertension (Fig. 4), fortunately, their awareness and treatment rate were higher. Maybe the high prevalence of the disease in their families helps them to better understand hypertension and prompts them to be more proactive in treating it. This trend was also mentioned in the Lebanon population in 2018[29].

In our study, obesity and overweight were associated with high prevalence of hypertension and subsequent awareness. Unfortunately, a larger proportion of patients remain uncontrolled. Other studies have received the same results as well [10, 20]. In our study, although subjects with a bachelor's degree or higher education had higher awareness rate, they did poor job of treating and controlling their blood pressure. This was also mentioned in the Jackson Heart Study [30]. The lower awareness rate was associated with lower education level and lower treatment rate was related to lack of medical care at high-altitudes. Low adherence may also reduce the control rate. Early detection and regular treatment guidelines were necessary to reduce low adherence in this area.

This study has some limitations. First, it was a cross sectional study, so it is limited in determining the direction of the association, as the exposure and the outcome are simultaneously assessed. Prospective studies are required for further investigation of these findings. Second, some of the selected residents, especially Tibetans over 70 years of age, were reluctant to go to the clinic for a check-up and fill out the questionnaire, which might lead to selection bias and cover up the actual survey data. Further epidemiological studies are needed to obtain more comprehensive information and data in order to develop appropriate prevention strategies and controls.

Conclusions

This study first time surveyed the hypertension epidemiology in Tibetans population in high altitude area Ngawa. From the results, we can come to a conclusion that the treatment and the control rate of hypertension is not optimistic in Tibetan, especially in female Tibetan in Ngawa area due to lack of medical condition, undeveloped economy or Tibetan's traditional customs. We hope to add some Tibetan data to the clinical epidemiology database of hypertension and hope the study can be used for future research.

Abbreviations

BMI

body mass index

SBP

Systolic blood pressure;

DBP

Diastolic blood pressure;

HBP

High blood pressure;

OR

Odds ratios;

CI

Confidence intervals;

SPSS

Declarations

Availability of data and materials

The data-set used and/or analyzed during the current study is available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The Medical Ethics Committee of Sichuan Provincial People's Hospital approved the survey in accordance with the guidelines of the Declaration of Helsinki. Verbal informed consent was obtained from all survey participants.

Consent for publication

Not applicable.

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Competing interests

The authors declare that they have no competing interests.

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Contributions

Tingxin Li and Lifeng Dan contributed equally to this work. Tingxin Li designed the study, participated in the statistical analysis and reviewed the manuscript. Lifeng Dan participated in the study design and

helped to draft the manuscript. Jinhong Wang and Lin Wang have been involved in drafting the manuscript and revising it critically for important intellectual content. All authors read and approved the final version of the manuscript.

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Figures

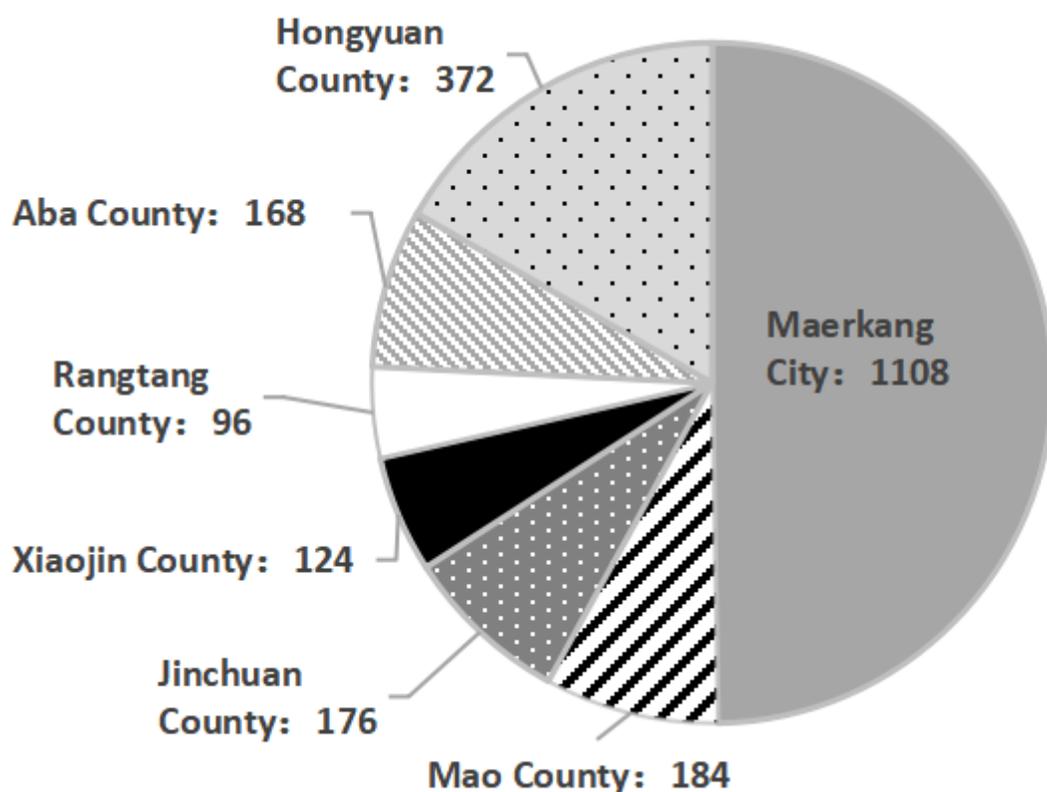


Figure 1

The regional distribution of samples (n)

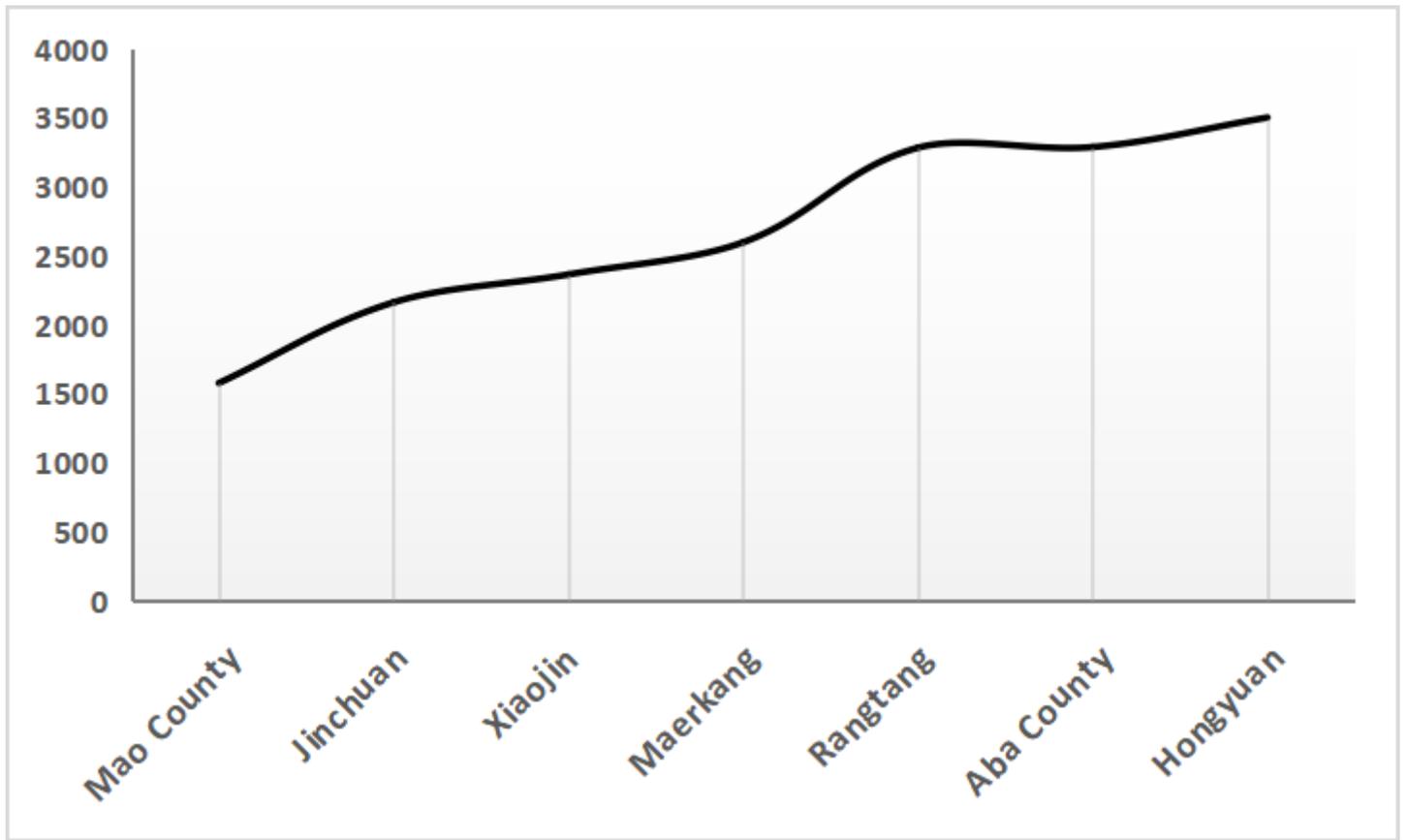


Figure 2

The regional distribution of altitude (m)

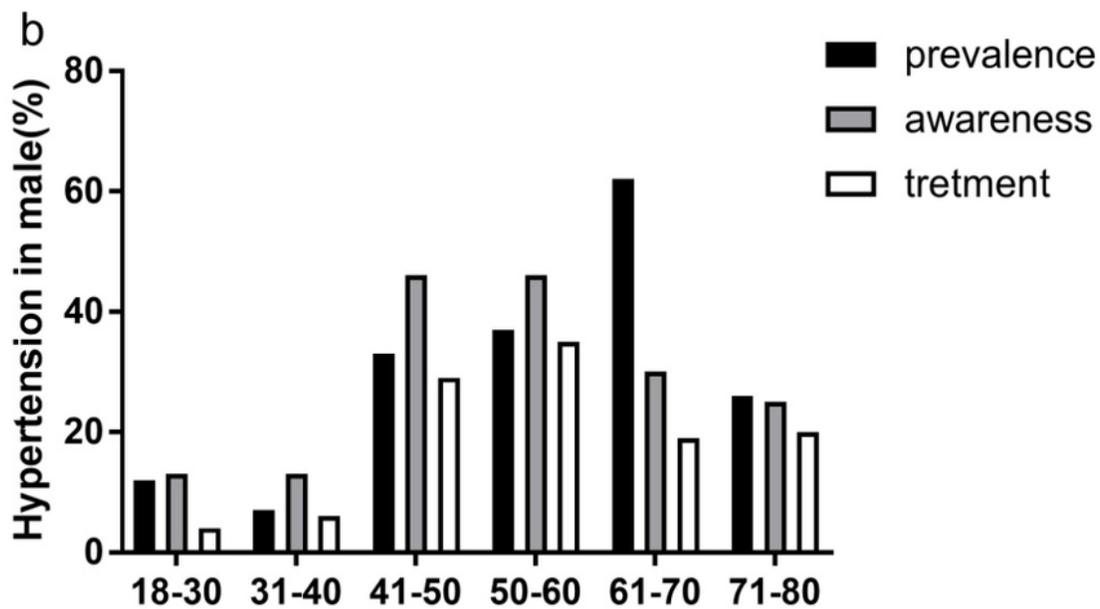
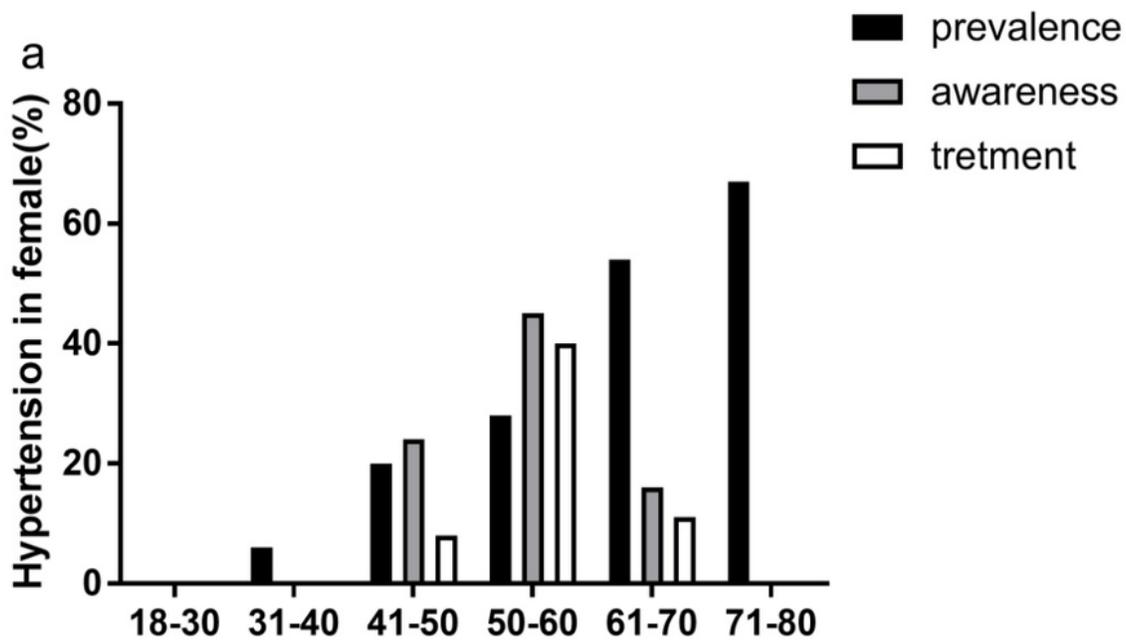
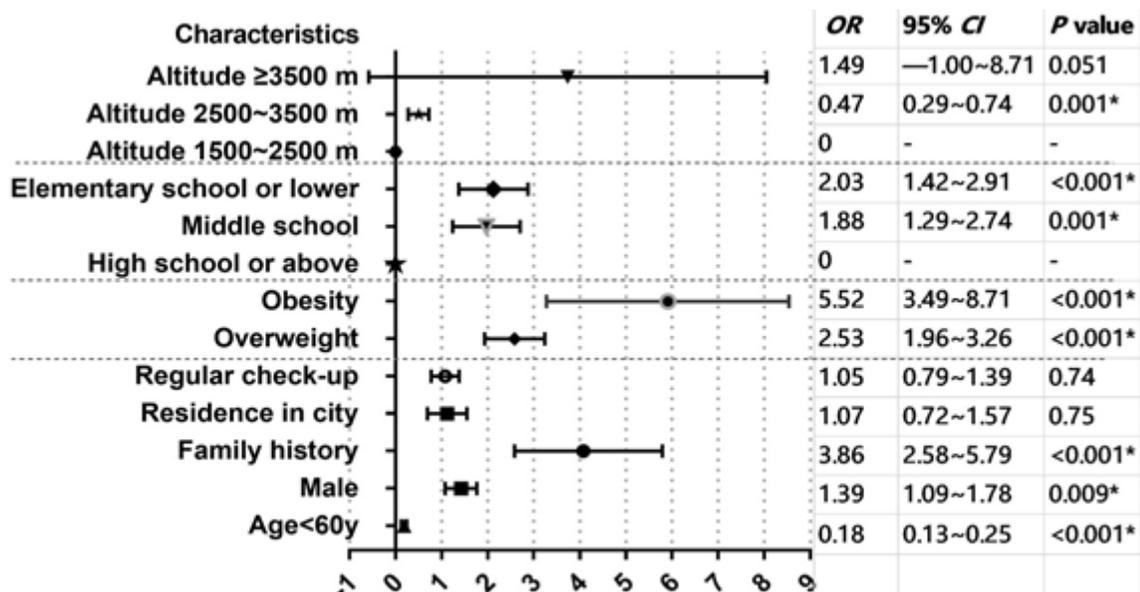


Figure 3 Prevalence, awareness and treatment rate of hypertension by age and sex.
a: Female; b: Male

Figure 3

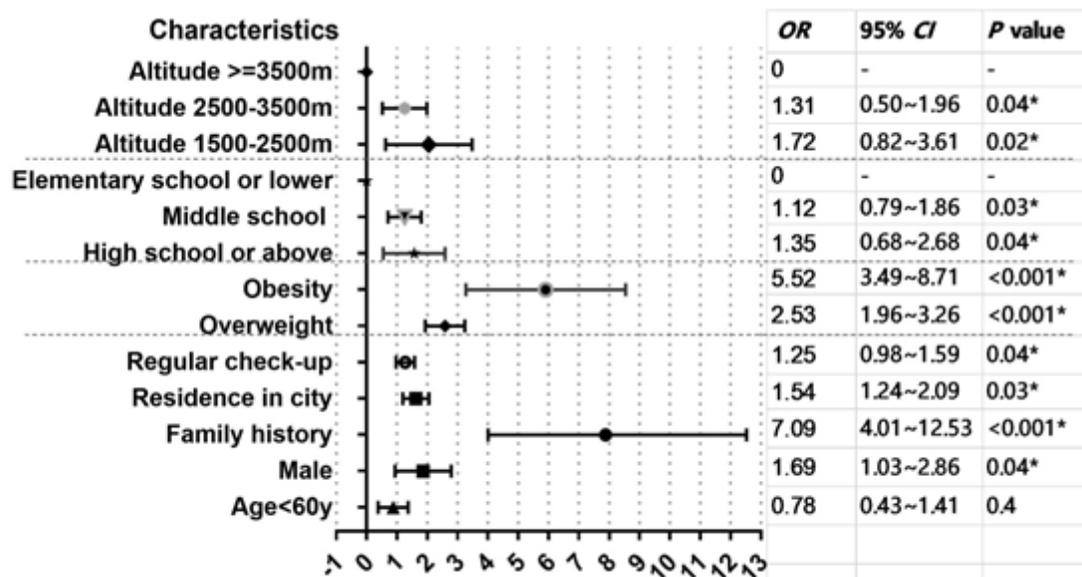
The prevalence/awareness/treatment rate of hypertension in different genders and age groups.



*: $P < 0.05$ was considered statistically significant.

Figure 4

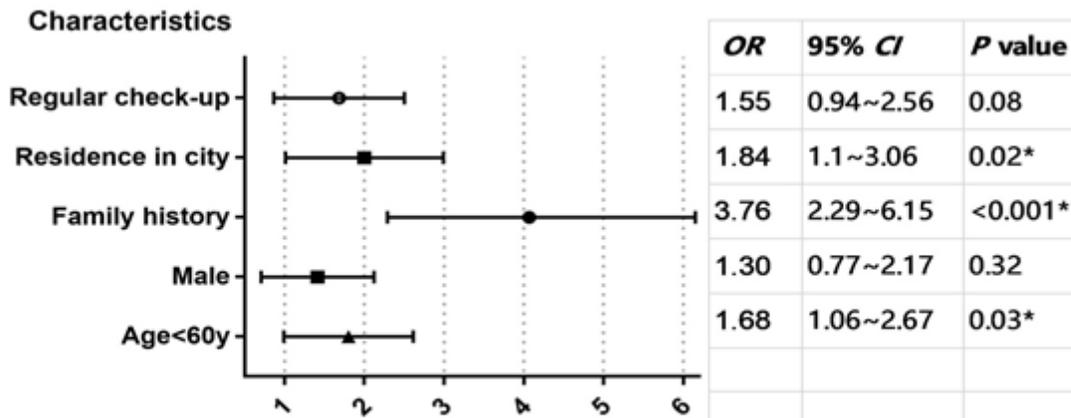
The prevalence Odds Ratio and 95% CI from Multiple Logistic Regression



*: $P < 0.05$ was considered statistically significant

Figure 5

The Awareness Odds Ratio and 95% CI from Multiple Logistic Regression



*: $P < 0.05$ was considered statistically significant.

Figure 6

The Treatment Odds Ratio and 95% CI from Multiple Logistic Regression