

Potential Impact of 2017 American College of Cardiology / American Heart Association High Blood Pressure Guideline on Chinese Adults—How to Face?

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Abstract

Background The current analysis was to estimate the percentage and number of Chinese adults with hypertension and recommended for pharmacological anti-hypertensive treatment according to the 2017 American College of Cardiology / American Heart Association (ACC/AHA) guideline as compared with the 2010 Chinese Guideline.

Methods We used the 2011 data of China Health and Nutrition Survey (CHNS). 12,499 Chinese adults aged ≥ 18 years with complete blood pressure (BP) values were selected for the present analysis.

Results The crude prevalence (95% CI) of hypertension according to the definitions from 2017 ACC/AHA guideline and the 2010 Chinese guideline was 58.0% (57.2% to 58.9%) and 25.4% (24.7% to 26.2%), respectively. Meanwhile, the percentage of recommended anti-hypertensive medications was 31.5% and 28.8%. Among adults who taking anti-hypertensive medications, the percentage of which had above goal BP level was 88.8% compared to 53.3%. Overall, 613.3 million Chinese adults (aged ≥ 18 years) met the definition for hypertension according to the 2017 ACC/AHA guideline, for which was 267.7 million according to the 2010 Chinese guideline. An additional 28.4 million (2.7%) Chinese adults were recommended anti-hypertensive medication.

Conclusions The present analysis revealed that 2017 ACC/AHA hypertension guideline will result in a substantial increase in the percentage and number of Chinese adults defined as having hypertension and a small increase in the percentage of adults who are recommended anti-hypertensive medications compared to the 2010 Chinese guideline. More intensive management and anti-hypertensive medications are suggested to improve the control rate of hypertension among Chinese adults.

Introduction

On November 13, 2017, the American College of Cardiology / American Heart Association (ACC/AHA) Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults was published¹. The guideline substantially updated the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7) in 2003² and provided more information on prevention and treatment of hypertension. The guideline will help us to give more intensive care for high blood pressure and reduced the incidence of cardiovascular disease such as stroke, heart attack, and heart failure. Paul Muntner et al³ indicated that the 2017 ACC/AHA guideline will increased the prevalence of hypertension from 31.9% to 45.6% using the representative sample of 2011–2014 National Health and Nutrition Examination Survey (NHANES), compared to JNC7 guidelines. However, the percentage of US adults who was recommended taking anti-hypertensive medication slightly increased 1.9% (from 34.3% to 36.2%). In addition, among US adults taking anti-hypertensive medication, 53.4% and 39.0% adults had blood pressure above the treatment goal according to the 2017 ACC/AHA and JNC7 guideline, respectively. A substantial proportion of US adults taking anti-hypertensive medication are recommended more intensive blood pressure lowering under the 2017 ACC/AHA guideline.

China is experiencing a high prevalence and a low rate of treatment and control of hypertension^{4, 5}. In the last decades, prevalence and incidence of hypertension increased steeply in China, especially in rural areas^{4, 6, 7}. Recently, a study consisted of 1.7 million adults (aged 35 to 75 years) revealed that the prevalence of hypertension was 44.7%, whereas the rate of taking hypertensive medications and achieving the BP goals in hypertensive patients was 30.1% and 7.2%⁵, respectively. Compared to the JNC7 guideline and Chinese guideline for high blood pressure, the 2017 ACC/AHA guideline recommends using lower systolic blood pressure (SBP) and diastolic blood pressure (DBP) levels to define hypertension (130/80 mmHg). The new definition has substantially increased numbers of hypertensive patients in US. What about the potential impact of the 2017 ACC / AHA guideline in China?

The current analysis was to, using the data from the China Health and Nutrition Survey (CHNS) in 2011, estimate the percentage and number of Chinese adults with hypertension and recommended for pharmacological anti-hypertensive treatment according to the 2017 ACC/AHA guideline as compared with the 2010 Chinese Guideline for the Management of Hypertension. In addition, we estimated percentage and number of Chinese adults taking anti-hypertensive medication with blood pressure above goal using targets from each guideline.

Methods

Study sample

CHNS is a follow-up survey of nutrition and food safety of the Chinese Center for Disease Control and Prevention in collaboration with the Population Center of the University of North Carolina in the United States. It aimed at developing a longitudinal and multipurpose survey which could help the group to measure kinds of health questions of interest such as sociological, economic and demographic questions to the CAPM (formerly the Chinese Academy of Preventive Medicine) and scholars⁸. Since 1989, CHNS has been conducted nine times (1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011) and covered nine provinces (Liaoning, Heilongjiang, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi and Guizhou), including urban and rural areas by income (low, middle, and high). CHNS used a multi-stage stratified cluster random sampling method and a weighted sampling scheme was used to randomly select four counties in each province⁹. We used the 2011 health data of residents to analyze. For the present analysis, the 2011 analysis was restricted to adult participants aged ≥ 18 years ($n = 13,052$). Participants were excluded if the three blood pressure (SBP or DBP) measurements were missed in this survey ($n = 553$), leaving 12,499 Chinese adults aged ≥ 18 years with complete blood pressure values for the present analysis.

Data collection

In CHNS, standard questionnaires were used to collect basic information and related biochemical indicators are measured in a national central lab in Beijing (medical laboratory accreditation certificate

ISO 15189: 2007) with strict quality control¹⁰. Blood pressure was measured by trained examiners using a mercury sphygmomanometer with a suitable cuff size according to a standard protocol⁵. Triplicate measurements were taken 10 minutes after rest, and the average of three measurements was used for the analysis¹¹. In addition, the questionnaire asked whether they have a history of eating high blood pressure drugs.

Cardiovascular disease (CVD) history was defined by a self-report of previous diagnoses of myocardial infarction and stroke. Definition of hypertension, recommended anti-hypertensive drug standards and recommended blood pressure targets for adults taking anti-hypertensive referred to the 2017 ACC/AHA and the 2010 Chinese guideline for the management of hypertension are presented in *Table 1*.

Statistical analysis

Continuous variables were presented as means and standard deviation, while categorical variables were expressed as percentages. We calculated the distribution of the Chinese adults across five groups including four groups did not take anti-hypertension population (SBP / DBP <120 / <80, 120–129 / <80, 130–139 / 80–89, and ≥ 140 / 90 mmHg) and a group taking anti-hypertensive drugs. Patients groups were compared by χ^2 tests for categorical variables or one-way analysis of variance for continuous variables. We calculated the percentage and number (95% CI) of adults with hypertension in China and the percentage and the number of people who recommended the use of anti-hypertensive based on the 2017 ACC/AHA guideline, the 2010 Chinese guideline, and the two guideline' difference (the 2017 ACC/AHA guideline but not the 2010 Chinese guideline). These calculations are performed in the general population and in different subgroups (such as different ages, sexes, etc). At the same time according to the above method to calculate the Chinese demographic and clinical characteristics that blood pressure above goal according to the 2017 ACC/AHA guideline and the 2010 Chinese guideline. Data from the sixth national census in 2010 was used to calculate the numbers of prevalent hypertension, recommendation of anti-hypertensive medications, and blood pressure above the goal. All analyses were performed with SPSS statistical software version 13.0 (SPSS Inc, Chicago, IL, USA) and SAS statistical software version 9.2 (SAS Institute Inc, Carey, NC, USA). A *P* value less than 0.05 was accepted as indicating statistical significance.

Results

The median age of the present study participants was 51.0 ± 15.2 years and 53.3% were women. 13.3% (1,663) of Chinese adults were taking anti-hypertensive medications. 32.0%, 9.7%, 30.1% and 14.6% of Chinese adults not taking anti-hypertensive medications had SBP/DBP levels of <120/80, 120–129/<80, 130–139/80–89, and ≥140/90 mmHg, respectively (*Table 2*). *Table 2* shows the baseline characteristics of study participants according to different BP subgroups. As expected, Chinese adults with higher blood pressure were older age more likely to be men and current smokers, and have diabetes and a history of stroke and coronary heart disease (All *P*<0.001).

The prevalence (95% CI) of hypertension according to the definitions from 2017 ACC/AHA guideline and the 2010 Chinese guideline was 58.0% (57.2% to 58.9%) and 25.4% (24.7% to 26.2%), respectively (*Table 3*).. The prevalence of hypertension was higher when defined by the 2017 ACC/AHA guideline compared to the 2010 Chinese guideline within all age, sex, and history of CVD sub-groups. In addition, the difference of prevalence defined by 2017 ACC/AHA but not 2010 Chinese guideline was significantly observed among different sub-groups ($P<0.05$) (*Table 3*)..

The percentage of recommended anti-hypertensive medications for Chinese adults was 31.5% and 28.8% according to the 2017 ACC/AHA guideline and 2010 Chinese guideline. An increase in the percentage of the population recommended anti-hypertensive medication by the 2017 ACC/AHA guideline compared to 2010 Chinese guideline was present in all different subgroups. The sub-group population with older age and a history of CVD had a relatively higher increase relative to adults with young age and without CVD history (*Table 4*).. Among Chinese adults with SBP/DBP of 130–139/80–89 mmHg, 12.0% were recommended anti-hypertensive medication according to the 2017 ACC/AHA guideline because they had diabetes, CVD history or they had SBP of 130–139 mmHg and were ≥ 65 years of age.

In 2011, 613.3 million Chinese adults (≥ 18 years) met the definition for hypertension according to the 2017 ACC/AHA guideline compared with 267.7 million Chinese adults according to the 2010 Chinese guideline (*Table 5*).. Using the recommendation from 2017 ACC/AHA guideline, 332.0 million Chinese adults not taking anti-hypertensive medications met criteria for treatment with anti-hypertensive medication in addition to nonpharmacological interventions whereas 303.6 million met criteria for treatment with nonpharmacological therapy on its own. An additional 28.4 million Chinese adults were recommended anti-hypertensive medication according to the 2017 ACC/AHA guideline compared with the 2010 Chinese guideline.

Among these Chinese adults taking anti-hypertensive medications, 88.8% had above goal BP according to the 2017 ACC/AHA guideline compared to 53.3% with above goal BP according to the 2010 Chinese guideline (*Table 6*).. Also, blood pressure above the goal, defined by the 2017 ACC/AHA guideline compared to the 2010 Chinese guideline, was more than 25 percentage points higher in each sub-group investigated except for those with age of 45–54 years.

Discussion

The present analysis indicates the potential impacts of 2017 ACC/AHA guideline definition of hypertension, recommendation for anti-hypertensive medication in addition to nonpharmacological interventions and blood pressure goals with anti-hypertensive drug treatment for Chinese adults (*Figure*).. The present analysis revealed that 2017 ACC/AHA hypertension guideline will result in a substantial increase in the percentage and number of Chinese adults defined as having hypertension. However, the percentage of adults who are recommended anti-hypertensive medications will only be a small increase (2.7%) according to the 2017 ACC/AHA guideline compared to the 2010 Chinese guideline. In addition, 35.5% of Chinese adults taking anti-hypertensive medication had a blood pressure above the goal defined

by the 2017 ACC/AHA guideline whereas they would have met the BP goal according to the 2010 Chinese guideline. More intensive management and anti-hypertensive medications are suggested to improve the control rate of hypertension among Chinese adults.

There is no doubt that the percentage and number of hypertension will have a substantial increase accompanying with the change in definition of hypertension according to the 2017 ACC/AHA guideline¹. The prevalence of hypertension among US adults will have a relative 40% increase (from 31.9% to 45.6%)³. However, the present analysis indicates that the prevalence of hypertension among Chinese adults will increase from 25.6% to 55.6% according to the 2017 ACC/AHA guideline and the number of having hypertension will also increased steeply from 260 million to 630 million. So many new prevalent cases will be diagnosed because of 2017 ACC/AHA guideline. How to face the challenge? In fact, the percentage of adults with SBP/DBP of 130–139/80–89 mmHg contributes to the deviation according to the 2017 ACC/AHA guideline. Although several observational studies have demonstrated an association between the blood pressure of 130–139/80–89 mmHg and the risk of incident CVD^{11–15}, the 2017 ACC/AHA writing committee still emphasized there is insufficient evidence to support a recommendation for anti-hypertensive drug treatment for these individuals can obtain more benefits³. However, it can provide an opportunity to discuss the value of nonpharmacological therapy in lowering blood pressure, to implement recommended lifestyle changes and to emphasize that blood pressure is a risk factor that can be controlled. Therefore, the aim of the definition is to raise these individuals awareness that implement recommended lifestyle changes and the definition of hypertension is mostly acceptable in China.

In addition, according to the 2017 ACC/AHA guideline, the recommended anti-hypertensive medication among US adults increased by 1.9%³, while in the present study, the recommended anti-hypertensive medication will increase from 28.8% to 31.5% according to the 2017 ACC/AHA guideline and the 2010 Chinese guideline. The corresponding number of having anti-hypertensive medication will increase 28.4 million. However, we have to demonstrate that we didn't consider the adults with CVD risk>10% because of the shortage of data in this study. So, the percentage and number of recommended anti-hypertensive medication will continue to increase if take the CVD risk into account. The 2017 ACC/AHA guideline using a combination of CVD risk and blood pressure levels to consider anti-hypertensive medications primarily based on the results of a diverse set of data from post-hoc randomized clinical trials, observational studies and computer simulation analyses^{16,17}. Large-scale RCTs focus on the issue regarding combination the CVD risk and blood pressure levels to consider anti-hypertensive medications should be further encouraged. In addition, using the pooling CVD risk equation is not fully popularized in clinical practice and is not feasible to evaluate in primary health care services in China. We also have to consider the overuse of anti-hypertensive drugs with the 2017 ACC/AHA guideline concerning recommended anti-hypertensive medication. Finally, we should consider the recommendation carefully and do some researches in diverse population to focus on the necessity of taking anti-hypertensive medications in China.

The control rate of hypertension is relatively low compared to the western countries though it is increasing in recent years^{4, 5}. According to the 2017 ACC/AHA hypertension guideline, the percentage of blood pressure above the goal increased from 39.0% to 53.4% in US and increase from 53.3% to 88.8% in China among adults taking anti-hypertensive medications. In fact, we temporarily suspend the definition of this target and whether it is suitable to Chinese adults, the benefits of anti-hypertensive medications reduce the CVD events are a common viewpoint. Therefore, whether refer to the 2017 ACC/AHA hypertension guideline or the 2010 Chinese hypertension guideline, it is urgent and necessary to further improve the control rate of hypertension and give more positive treatment and management for hypertension prevalent cases. The further management strategies of controlling of hypertension and reducing the burden of CVD events are essential to promote the Goal of Healthy China 2030.

The present study has strength that the study population is nationally and has certain representative. Meanwhile, some limitations should also be considered in light of these results. First, the blood pressure was measured only once which may induce the misclassification of blood pressure. Second, we did not have sufficient information on laboratory measurements such as cholesterol, serum glucose, and family history of CVD, etc to calculate the CVD risk which may help us to evaluate the exact impact of recommended anti-hypertensive medication to Chinese population.

In conclusion, the current analysis demonstrates 2017 ACC/AHA hypertension guideline has a potential impact on the prevalence of hypertension, recommended anti-hypertensive medications and control rate of Chinese hypertension population. The prevalence of hypertension will have a double substantial increase and the percentage of recommended anti-hypertensive medications has a small increase (2.7%). In addition, the control rate of hypertension will decrease sharply from 46.7% to 11.2% among adults taking anti-hypertensive medications. How to face the 2017 ACC/AHA hypertension guideline? Everything has two swords and we should pay more attention to the positive impact from 2017 ACC/AHA guideline and do some cost-effectiveness analysis regarding the guideline. Anyway, we should positively consider the control and management of hypertension, based on the real policies of China, further reduce the burden of CVD in China.

Declarations

Ethics approval and consent to participate:

This study complies with the Declaration of Helsinki, and the Shengjing Hospital of China Medical University Research Ethics Committee approved the research protocol.

Consent for publication:

Not applicable.

Availability of data and materials:

The datasets generated and/or analysed during the current study are available in the China Health Nutrition Survey repository. Web link to datasets: <https://www.cpc.unc.edu/projects/china>.

Competing interests:

The authors declare that they have no competing interests.

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Authors' contributions:

Y. J., Z. S., Y. X., J. Z., Z. L., X. G., Y. D. analyzed the data. Y. J. wrote the paper. Y. S., L. Z. designed the analysis and revised the paper, All authors had reviewed and agreed on the contents of this paper.

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Tables

Table 1. Blood pressure levels used to define hypertension, recommend anti-hypertensive medication, and treatment goal according to the 2017 ACC/AHA Guideline and the 2010 Chinese guideline

	Guideline - Definition of hypertension	
	2017 ACC/AHA	2010 Chinese Guideline
SBP, mmHg	≥130	≥140
DBP, mmHg	≥80	≥90
Guideline - Recommended anti-hypertensive medication		
	2017 ACC/AHA	2010 Chinese Guideline
SBP, mmHg		
General population	≥140	≥140
Aged ≥65 years	≥130	≥140
Diabetes	≥130	≥130
CHD or stroke	≥130	≥140
DBP, mmHg		
General population	≥90	≥90
Aged ≥65 years	≥80	≥90
Diabetes	≥80	≥80
CHD or stroke	≥80	≥90
Treatment goal among those taking anti-hypertensive medication		
	2017 ACC/AHA	2010 Chinese Guideline
SBP, mmHg		
General population	<130	<140
Aged ≥65 years	<130	<150
Diabetes or CHD or stroke	<130	<130
DBP, mmHg		
General population	<80	<90
Diabetes or CHD or stroke	<80	<80

SBP, systolic blood pressure; DBP, diastolic blood pressure; CHD, coronary heart disease.

Table 2. Characteristics of Chinese adults (aged ≥ 18 years) by blood pressure levels and anti-hypertensive medication use based on the 2011 China Health and Nutrition Survey (n=12,499)

Characteristics	SBP/DBP categories in mmHg among Chinese adults not taking anti-hypertensive medication				Taking anti-hypertensive medication (n=1,663)	P-Value [†]
	≤120/80 (n=4,027)	120-129/≤80 (n=1,218)	130-139/80-89 (n=3,768)	≥140/90 (n=1,823)		
Percentage of Chinese population	32.2	9.7	30.1	14.6	13.3	≤0.001
Population characteristics *						
Age, year	44.4±14.8	50.0±15.5	50.3±13.9	57.1±13.2	51.0±15.2	≤0.001
Women, %	63.9	48.9	46.8	44.2	53.3	≤0.001
Current smoking [‡] %	22.9	34.8	34.3	38.3	30.5	≤0.001
Diabetes, %	1.4	2.9	3.0	4.4	4.1	≤0.001
SBP, mmHg	108.1±8.1	123.2±3.1	124.5±8.3	144.6±15.3	124.5±17.7	≤0.001
DBP, mmHg	70.0±6.2	74.0±4.8	81.8±4.2	90.9±10.0	79.3±10.7	≤0.001
The history of coronary heart disease, %	0.4	0.4	0.5	0.7	0.9	≤0.001
The history of Stroke, %	0.4	0.9	0.6	1.4	1.6	≤0.001
The history of CVD [‡] , %	0.7	1.2	1.0	2.0	2.4	≤0.001

* Population characteristics in the table are percentage or mean (standard deviation).

[†]P-values were calculated by one-way ANOVA or chi-square test to compare differences within different blood pressure categories.

[‡]Defined by a self-report history of stroke and coronary heart disease.

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SBP: systolic blood pressure; DBP: diastolic blood pressure; CVD: cardiovascular disease.

Table 3. Prevalence (95% CI) of hypertension according to the definition from 2017 ACC/AHA guideline and the 2010 China Hypertension Guideline based on the 2011 China Health and Nutrition Survey (n=12,499)

	2017 ACC/AHA Guideline	2010 Chinese Hypertension Guideline	Difference (2017 ACC/AHA but not 2010 Chinese Hypertension Guideline)
Overall	58.0 (57.2, 58.9)	25.4 (24.7, 26.2)	32.6 (31.8, 33.4)
Age [years]			
18-34	30.3 (28.3, 32.4)	3.4 (2.6, 4.2)	26.9 (25.0, 28.9)
35-44	47.2 (45.2, 49.3)	10.4 (9.2, 11.7)	36.8 (34.8, 38.8)
45-54	61.1 (59.3, 62.9)	22.9 (21.3, 24.4)	38.2 (36.5, 40.0)
55-64	68.3 (66.6, 69.9)	35.5 (33.8, 37.2)	32.8 (31.1, 34.4)
65-74	72.9 (70.7, 75.1)	46.6 (44.1, 49.0)	26.3 (24.2, 28.5)
≥75	78.0 (75.1, 80.8)	51.4 (47.9, 54.8)	26.6(23.6, 29.7) [†]
Sex			
Men	64.4 (63.2, 65.6)	27.2 (26.1, 28.4)	37.2 (35.6, 38.4)
Women	52.5 (51.3, 53.7)	23.8 (22.8, 24.9)	28.6(22.5, 29.7) [†]
The history of CVD *			
Yes	85.1 (81.1, 89.2)	71.3 (66.2, 76.4)	13.9 (10.0, 17.8)
No	57.4 (56.5, 58.2)	24.3 (23.5, 25.0)	33.1(32.2, 33.9) [†]

*Defined by a self-report history of stroke and coronary heart disease.

[†]Chi-squaretest for Comparison among different subgroups, P<0.05.

2017 ACC/AHA guideline - 2017 American College of Cardiology / American Heart Association Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults.

Table 4. Percentage (95% CI) of Chinese adults meeting the definition for recommended anti-hypertensive medication according to the 2017 ACC/AHA Guideline and the 2010 China Hypertension Guideline based on the 2011 China Health and Nutrition Survey (n=12,499)

	Recommended anti-hypertensive medication		Difference (2017 ACC/AHA but not 2010 Chinese Hypertension Guideline)
	2017 ACC/AHA Guideline	2010 Chinese Hypertension Guideline	
Overall	31.5(30.7,32.3)	28.8(28.0,29.6)	2.7(2.4,3.0)
Age\years			
18-34	5.0(4.0,5.9)	5.0(4.0,5.9)	0.0(0.0,0.0)
35-44	12.4(11.1,13.8)	12.3(11.0,13.7)	0.1(0.03,0.2)
45-54	27.2(25.6,28.9)	27.2(25.6,28.8)	0.0(0.0,0.0)
55-64	40.1(38.4,41.9)	39.6(37.9,41.4)	0.5(0.2,0.7)
65-74	64.3(62.0,66.7)	50.9(48.5,58.4)	13.4(11.7,15.1)
≥75	68.8(65.6,72.0)	52.2(51.8,58.6)	13.6 (11.2,16.0) [†]
Sex			
Men	33.9(32.7,35.2)	31.1(29.9,32.3)	2.8(2.4,3.3)
Women	29.4(28.3,30.5)	26.8(25.7,27.8)	2.6(2.2,3.0)
The history of CVD *			
Yes	85.1(81.1,89.2)	73.9(69.0,78.9)	11.2(7.7,14.8)
No	30.2(29.4,31.0)	27.7(26.9,28.5)	2.5 (2.2,2.8) [†]

*Defined by a self-report history of stroke and coronary heart disease.

[†]Chi-squaretest for Comparison among different subgroups, P<0.05.

2017 ACC/AHA guideline - 2017 American College of Cardiology / American Heart Association Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults.

Table 5. Number of China adults, in million, meeting the definition for hypertension and the definition for treatment with anti-hypertensive medication according to the 2017 ACC/AHA Guideline and the 2010 China Hypertension Guideline based on the 2011 China Health and Nutrition Survey

	2017 ACC/AHA Guideline	2010 Chinese Hypertension Guideline		Difference (2017ACC/AHA vs 2010 Chinese)		
	Hypertension	Recommended anti-hypertensive medication	Hypertension	Recommended anti-hypertensive medication	Hypertension	
Overall	611.3 (602.9, 620.8)	332.0 (323.6, 340.4)	267.7 (260.3, 276.1)	303.6 (295.1, 312.0) (335.2, 352.0)	343.6 (335.2, 352.0)	28.4 (25.3, 31.6)
Age[years]						
18-34	50.1 (48.9, 55.0)	8.3 (6.6, 10.0)	5.6 (5.4, 8.0)	8.3 (6.1, 9.1)	44.5 (41.23, 0.0 (0.0, 0.0) 48.1)	
35-44	91.1 (85.6, 97.8)	24.0(19.9, 26.6)	20.1 (18.7,21.4)	23.9 (21.3, 27.3)	71.1(65.3, 75.6)	
45-54	145.5 (140.6, 152.8)	64.7(59.8, 69.7)	54.3 (50.9, 58.9)	64.7 (60.7, 69.8)	91.2 (85.9, 96.2)	
55-64	173.6 (165.0, 177.3)	102.3(96.3, 106.2)	90.5 (85.7, 93.7)	101.1 (97.2, 106.3)	83.1 (79.0, 89.3)	
65-74	97.2 (91.7, 103.9)	85.9 (83.0, 89.6)	62.1 (58.9, 66.9)	68.0 (63.8, 72.9)	35.1 (30.9, 37.8)	
≥75	53.2 (48.9, 55.0)	46.8 (43.2, 49.8)	35.1 (32.1, 37.5)	37.6 (33.4, 39.5)	18.1(17.2, 20.6)	
Sex						
Men	316.7 (311.8, 324.0)	167.0 (162.7, 172.6)	133.9 (128.5, 139.2)	153.0(148.8,157.8)	182.8 (178.7, 189.0)	
Women	294.6 (287.3, 299.5)	165.0(159.4, 169.3)	133.9 (128.5, 139.2)	150.6(145.7,154.8)	160.7 (154.6, 164.9)	
The history of CVD*						
Yes	22.0 (18.3, 24.5)	21.9(19.9, 23.24)	18.2 (16.1, 21.4)	18.8(18.2,21.3)	3.8 (2.4, 4.5) 2.7 (1.9, 3.8)	
No	589.3 (586.8, 593.0)	310.1(308.8, 312.1)	249.5 (246.3, 251.6)	284.7(282.3,288.4)	339.8 (338.8, 340.8)	

*Defined by a self-report history of stroke and coronary heart disease.

2017 ACC/AHA guideline - 2017 American College of Cardiology / American Heart Association Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults.

Table 6. Percentage (95% CI) of Chinese adults taking anti-hypertensive medication with blood pressure above goal according to the 2017 ACC/AHA Guideline and the 2010 China Hypertension Guideline based on the 2011 China Health and Nutrition Survey

	Blood pressure above goal according to:		Difference
	2017 ACC/AHA Guideline	2010 Chinese Hypertension Guideline	(2017 ACC/AHA but not 2010 Chinese Hypertension Guideline)
Overall	88.8 (87.2, 90.3)	53.3 (51.0, 55.7)	35.5 (33.1, 37.7)
Age\years			
18-34 [‡]	---	---	---
35-44	96.9 (92.6, 100.0)	71.9 (60.9, 82.9)	25.0 (14.4, 35.6)
45-54	90.1 (86.7, 93.5)	67.3 (62.0, 72.6)	22.8 (18.1, 27.5)
55-64	87.8 (85.1, 90.4)	62.1 (58.2, 66.0)	25.6 (22.1, 29.2)
65-74	88.6 (85.7, 91.6)	36.1 (31.6, 40.6)	52.5 (47.8, 57.2)
≥75	87.5 (83.6, 91.5)	41.5 (35.6, 47.4)	46.0 (40.0, 52.0) [†]
Sex			
Men	89.6 (87.3, 91.8)	53.2 (49.6, 56.8)	36.4 (32.9, 39.8)
Women	88.1 (86.0, 90.2)	53.5 (50.2, 56.7)	34.7 (31.6, 37.7)
The history of CVD*			
Yes	88.7 (84.2, 93.9)	48.4 (41.2, 55.6)	40.3 (33.3, 47.4)
No	88.8 (87.2, 90.4)	54.0 (51.4, 56.5)	34.8 (32.4, 37.2)

* Defined by a self-report history of stroke and coronary heart disease.

[†]Chi-squaretest for Comparison among different subgroups, $P<0.05$.

[‡]Small sample size ($n=2$) is not adapted to calculate the percentage.

2017 ACC/AHA guideline - 2017 American College of Cardiology / American Heart Association Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults.

Figures

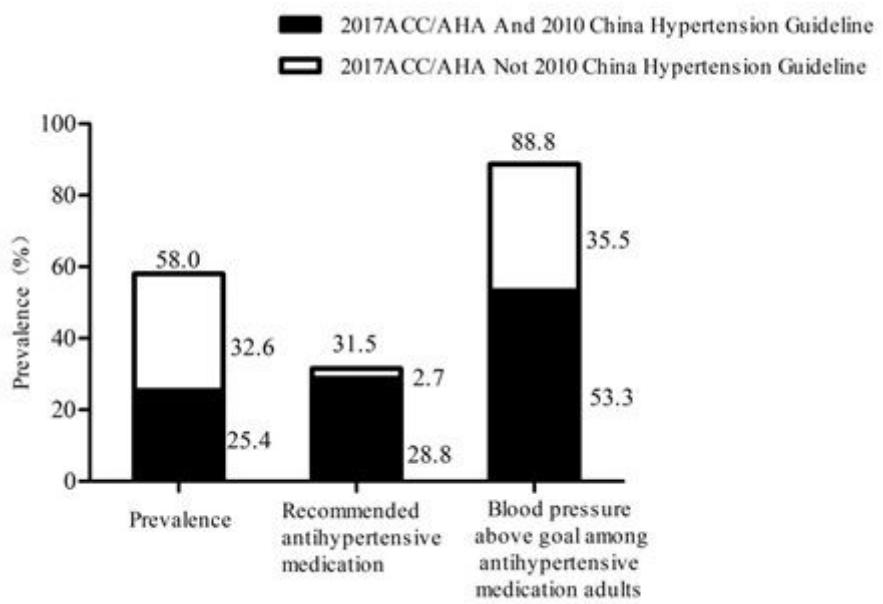


Figure 1

Figure 1. Prevalence of hypertension, recommendation for pharmacologic anti-hypertensive treatment, and blood pressure above goal among Chinese adults according to the 2017 ACC/AHA guideline and the 2010 China Hypertension guideline.

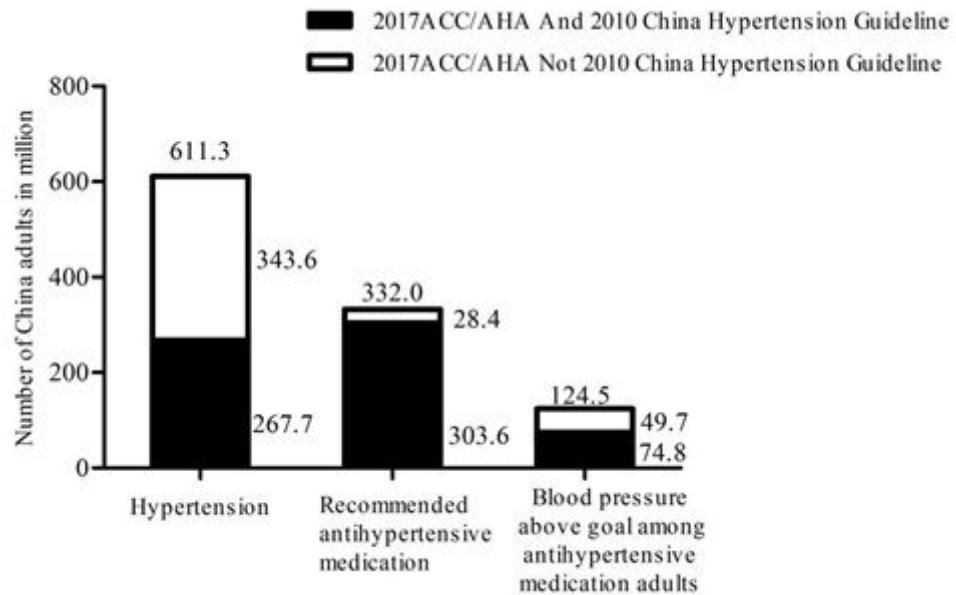


Figure 2

Figure 2. Numbers of hypertension, recommendation for pharmacologic anti-hypertensive treatment, and blood pressure above goal among Chinese adults according to the 2017 ACC/AHA guideline and the 2010 China Hypertension guideline.