Prevalence, awareness, treatment, and control of hypertension in the PERSIAN cohort study: JNC7 versus ACC/AHA guidelines

Short title: The impacts of hypertension definition in Iran

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Abstract

In this cross-sectional population-based study, we used the baseline data of the Prospective Epidemiologic Research Studies in IrAN (PERSIAN) cohort study collected in Iran from 2014 to 2020. The main outcomes were the prevalence of hypertension and proportion of awareness, treatment, and control based on the 2017 ACC/AHA guideline compared to the seventh report of the Joint National Committee (JNC7). Of the total of 163770 participants, aged 35 to 70 years, 55.2% were female. The sex-age standardized prevalence of hypertension was 22.3% (95% CI: 20.6-24.1) based on the JNC7 guideline and 36.5% (31.1-41.8) based on the ACC/AHA guideline. A total of 24312 participants [14.1% [10.1, 18.1]] were newly diagnosed based on the ACC/AHA guideline. Compared to adults diagnosed with hypertension based on the JNC7 guideline, the newly diagnosed participants were mainly young literate males who had low levels of risk factors and were free from conventional comorbidities of hypertension. About 30.7% (25.9, 35.4) of them (4.3% of the entire population) were eligible for pharmacologic intervention based on the ACC/AHA guideline. Implementation of the new guideline may impose additional burden on health systems. However, early detection and management of elevated blood pressure may reduce the ultimate burden of hypertension in Iran.

Key words: hypertension; Iran; 2017 ACC/AHA hypertension guideline; JNC7 hypertension guideline
Introduction

In 2017, the American College of Cardiology/American Heart Association (ACC/AHA) guideline was released\(^1\), in which lower thresholds (>=130/80 mmHg) were recommended for hypertension, and the upper end of prehypertension based on the seventh report of the Joint National Committee (JNC7)\(^2,3\) was reclassified as stage 1 hypertension. The rationale for this shift is the evidence showing that adults with blood pressure in this range have an approximately 2-fold increase in risk of cardiovascular diseases (CVDs) compared to adults with normal blood pressure.\(^4,5\) Additionally, recent randomized clinical trials have demonstrated benefits from a systolic blood pressure (SBP) lower than 130 mm Hg\(^6,7\) including the Systolic Blood Pressure Intervention Trial (SPRINT) which demonstrated substantial reduction in CVD events by applying an intensive systolic blood pressure target <120 mmHg.\(^8\) In a very recent study, Whelton et al reported that the stepwise rise in incident atherosclerotic CVDs and presence of coronary artery calcium begins at SBP levels as low as 90 mmHg.\(^9\) However, the implications of the new hypertension definitions are under debate. Using lower thresholds for definition of hypertension will lead to increase in estimated prevalence, which will impose additional burden on health systems especially in low-middle income countries with limited resources.\(^10-13\) On the other hand, early diagnosis and treatment of high blood pressure among adults previously classified in the category of “pre-hypertension” may lead to reduced all-cause and CVD-specific mortality and morbidity.\(^5,13\) Primordial prevention seems to be a necessity for maintaining optimal blood pressure levels even in adults free from traditional risk factors of CVD.\(^9\)
Studies demonstrate that all-cause mortality and cardiovascular deaths attributable to high blood pressure doubled in Iran since 1990 and hypertension is the most important risk factor responsible for mortality in both sexes.\textsuperscript{14,15} It is of utmost importance to explore the impacts of stricter definitions for high blood pressure prevalence, treatment, and control to reduce the burden of CVD in a country with a high prevalence of hypertension as a middle-income nation. The main objective of the current study was to determine the impact of the two guidelines on estimated prevalence, awareness, treatment, and control of hypertension among a very large group of Iranians residing in various regions across the country.
Results

A total of 163770 participants were recruited from 2014 to 2020, 115979 (70.8%) participants lived in urban areas and 47791 (29.2%) participants were rural dwellers. A total of 90397 participants (55.2%) were female. The mean (SD) age of the participants was 49.4 (9.2) years and 35.5% of participants were in the 35-44 age category. A total of 33675 participants (20.6%) had no schooling. Systolic and/or diastolic blood pressure was missing in 889 participants.

The sex-age standardized prevalence of hypertension was 22.3% (95% CI: 20.6-24.1) based on the JNC7 guideline and 36.5% (31.1-41.8) based on the 2017 ACC/AHA guideline, showing a 14.1% absolute increase and 63.7% relative increase (Figure 1). The prevalence of hypertension based on the JNC7 guideline was significantly higher among females compared to males. In contrast, there was no difference in hypertension prevalence between sexes based on the ACC/AHA guideline. The prevalence of hypertension was greater with age regardless of guideline (Figure 2).

A total of 24 312 (14.1% [10.1, 18.1]) participants who were classified in the category of “pre-hypertension” were reclassified into the hypertension category based on the ACC/AHA guideline (Figure 1). Compared to adults traditionally diagnosed with hypertension based on the JNC7 report, the newly-diagnosed hypertensive adults based on the ACC/AHA guideline were more commonly male (62.1% vs. 42.9%), were younger than 55 years old (75.8% vs. 46.7%), were literate (74.5% vs. 57.4%), had normal BMI (23.2% vs. 15.5%), had high physical activity (39% vs. 29.5%), were free from diabetes (87.1%, vs. 68.1%), were free from CKD (86.6% vs. 70.6%), had normal serum lipids (62.3% vs. 50.4%) and had low 10-year risk of ASCVD (90.1% vs. 52.9%).
vs. 72.5%) (Table 1). The shift from prehypertension based on JNC7 to stage 1 hypertension based on the ACC/AHA guideline was more prominent in males (Table 2).

The proportion of awareness among hypertensive adults was 77.5% (73.3-81.8) based on the JNC7 and 48.6% (41.9-55.4) based on the ACC/AHA guideline. Among the reclassified participants, awareness was just 2.9% (1.5-4.3). The reclassified participants aware of their elevated blood pressure compared to participants aware of their traditionally defined hypertension were mostly male (46.8% vs. 36.2%) and were less than 55 years old (64.9% vs. 42.9%), but the proportion of literacy was not different between the two groups. Awareness was higher among females and increased by age based on the ACC/AHA guideline (Figure 2).

The proportion of treatment among hypertensive adults was 82.2% (77.6-86.9) and 50.4% (43.3-57.5) based on the JNC7 and the ACC/AHA guidelines respectively. None of the reclassified participants were treated (Figure 1). Treatment also increased by age and was higher in females based on both guidelines (Figure 2).

The proportion of control among hypertensive adults was 63.7% (55.7-71.7) and 23.3% (14.6-32.0) based on the JNC7 and the ACC/AHA guidelines respectively. Control among hypertensive adults was higher in females.

The proportion of control among treated was 75.9% (70.2-81.6) and 46.3% (35.3-57.4) based on JNC7 and ACC/AHA respectively (Figure 1). Control among treated participants decreased along with increase in age based on the ACC/AHA guideline.

Finally, based on the JNC7 report, out of the untreated hypertensive adults, a total of 7242 participants (96.9% [95.7-98.0]) were eligible for pharmacologic treatment and based on the
ACC/AHA guideline, 15 258 participants (46.1% [41.6-50.6]) were eligible. Out of the reclassified participants, 7671 participants (30.7% [25.9-35.4]) were eligible for pharmacologic treatment (Figure 1). In short, among the entire study population, 14.1% were newly diagnosed with hypertension based on the ACC/AHA guideline, while only 30.7% of these newly diagnosed adults (4.3% of the entire population) were eligible for pharmacologic treatment.
Discussion

In the current study, representing a large number of the Iranian population, a total of 6.5 million and 10.7 million Iranians aged 35 to 70 years, have hypertension based on the JNC7 and the ACC/AHA guidelines, respectively. Although there was some heterogeneity in prevalence across study centers, the application of the ACC/AHA guideline uniformly led to increase in relative prevalence (by 63.7%) and decrease in relative awareness (37.3%), treatment (38.7%), control among hypertensive adults (63.4%), and control among treated adults (39.5%). Yet, the increase in prevalence observed in our study was still lower than previous studies in Iran, which reported a more than a 2-fold higher prevalence based on the ACC/AHA guideline.16-18 Less than 2-fold increases were also observed in other countries.10,11,19,20

The results of our study showed that a total of 24,312 adults who were previously classified in the category of “pre-hypertension”, were shifted to stage 1 of hypertension based on the ACC/AHA 2017 guideline. These adults were mainly young and educated males, and many of them free from other metabolic risk factors and comorbidities of high blood pressure with a low 10-year risk of CVD events. These findings may mean that apparently healthy young low-risk male adults may be prone to developing high blood pressure later in life and they shall be detected and managed at early stages, particularly considering the fact that the risk of CVD mortality in males is higher than females, specifically in younger age groups.5,21 Implementation of the guideline necessitates that the public be informed and health care professionals use the updated guideline in practice. The result will be a higher number of adults diagnosed with hypertension, who should refer to health care professionals and be managed. There will thus be
an apparent additional burden on health care systems. It is worth noting, however, that not all newly-diagnosed adults will require pharmacological treatment. Based on the new guideline, less than one third of the newly diagnosed adults, and mostly elderly groups, will require pharmacological treatment. Therefore, the guidance will not increase medication utilization among the majority, but will hopefully improve awareness and subsequent lifestyle modification before developing very high levels of blood pressure and its accompanying comorbidities later in their lives. The Heart Outcomes Prevention Evaluation (HOPE)-3 trial demonstrated that treatment of adults with intermediate CVD risk has no benefit. Meanwhile, there is recent evidence on cost-effectiveness of a low-cost community-based plan focused on non-pharmacologic but including pharmacologic intervention in three low-income countries (Bangladesh, India, and Sri Lanka). These results highlight the importance of an integrated non-pharmacological intervention among low- and intermediate-risk adults, as recommended in the 2017 ACC/AHA guideline, specifically feasible in low and middle-income countries.

The new definition by ACC/AHA was derived from observational studies and clinical trials, focused specifically on results of Systolic Blood Pressure Intervention Trial (SPRINT). There are, however, a number of other studies and trials that don’t support the new criteria and conclude that there is no additional benefit in implementing stricter definitions for hypertension. Additionally, although not all newly-labeled hypertensive adults will require pharmacological treatment, there will be an increase in clinical encounters imposing burden of health system infrastructure. Consequently, European guidelines, the National Institute of Clinical Excellence (NICE) guidelines, and the clinical practice guideline of the American College of Physicians and the American Academy of Family Physician have maintained the traditional
definition of hypertension in their latest updates.\textsuperscript{27-32} In actuality, there are more similarities between the guidelines than differences\textsuperscript{33} with the primary difference focused on the definition of stage 1 hypertension. The debate will remain unresolved until longitudinal large-scale studies are conducted on cost-effectiveness and adverse events of different approaches and guidelines.\textsuperscript{34-36}

Ultimately, it is worth mentioning that the apparent decrease in awareness, treatment, and control based on the ACC/AHA guideline is due to the fact that neither physicians and health care professionals are aware and use the new guideline in practice, nor the public are informed of the new criteria. Comparing awareness, treatment, and control between various guidelines will only be possible upon their implementation at large scale and for long time periods.

Our study has certain limitations. Despite the large scale of the study and the unique and standard protocol used in its design and implementation, there were variations in outcomes between centers. Therefore, we used study centers as the primary sampling units in our survey data analysis. The cross-sectional design of the study is another limitation that makes it impossible to explore and prove causal relationships. The third limitation is the exclusion of adults younger than 35 years from the study (based on the predetermined protocol of PERSIAN).

Conclusions

Overall, our results showed that implementation of the 2017 ACC/AHA guideline will lead to shifting a group of mainly young male adults to the category of stage 1 of hypertension. Future longitudinal studies are mandatory to explore whether the implementation of this strict
guideline is cost-beneficial in various settings, especially in low and middle income countries with limited resources. The results of this study demonstrated the “clustering” of metabolic risk factors, which necessitates an integrated approach towards primordial prevention of these risk factors.
Methods

Study design

The current study used data from the Prospective Epidemiologic Research Studies in IrAN (PERSIAN) cohort with a population-based cross-sectional design in the baseline recruitment phase. Detailed methods of PERSIAN are published elsewhere. In short, a total of 163 770 participants aged 35 to 70 years were recruited in 18 cohort centers located in 16 provinces in Iran between 2014 and 2020. Participants were recruited through cluster random sampling. The sample was selected to include all ethnic groups in Iran residing in regions with various climates. The exclusion criteria were unwillingness to participate in the study, living in the designated area for less than 9 months, and physical and psychosocial disability impeding the enrollment process.

In the first step, trained personnel visited households to invite eligible individuals (based on inclusion criteria) to participate in the study. If individuals agreed to participate, they were requested to refer to their local cohort center in overnight fasting state and to bring the medications they use. Upon arrival, written informed consent form was obtained from all participants. They underwent biospecimen collection (blood, urine, hairs, and nails) as well as anthropometric measurements, following protocols established by the US National Institutes of Health. A structured questionnaire including 482 items was filled out during a face-to-face interview. Demographic characteristics, socioeconomic status, lifestyle, past medical history and family history, and medication history were queried. PERSIAN was approved by the ethics committees of the Digestive Disease Research Institute in Tehran University of Medical Sciences.
and Health Services, and the Medical Sciences Universities supervising each cohort in local
study centers. All methods were carried out in accordance with relevant guidelines and
regulations. Participants in PERSIAN will be followed for up to 15 years.

**Definitions of outcomes**

The main outcomes in this study were prevalence, awareness, treatment, and control of
hypertension, and eligibility for treatment based on both JNC7\(^2,3\) and the 2017 ACC/AHA
guidelines.\(^1\) Treatment was defined as self-reported intake or the antihypertensive medications
that the participant brought with himself/herself to the study center. Awareness was defined as
self-reported history of being diagnosed with hypertension by a physician or a health care
professional. Trained personnel measured blood pressure in sitting position after 10 minutes of
rest, twice from the right arm and twice from the left arm, with one-minute interval between
each of the two consecutive measurements. The average of the second measurements from
right and left arms were calculated and considered as the level of blood pressure. Multiple cuff
sizes were available for use to best fit the participant’s arm.

**Definitions of determinants**

Demographic characteristics included sex, age, area of residence (rural, urban), and marital
status (married versus non-married). Socio-economic status was defined based on education
and wealth index. Education was defined in 5 levels: no schooling (<1 year of primary school),
primary school (1-5 years), middle school (6-8 years), high school (9-12 years), and university
(>12 years). Wealth index was calculated using multiple correspondence analysis (MCA) on
household assets and divided into 5 quintiles. For physical activity, metabolic equivalents of
tasks (METs) were calculated and divided into tertiles. Body mass index (BMI) was calculated and divided into four groups: underweight (<18.5 kg/m²), normal (≥18.5 and <25 kg/m²), overweight (≥25 and <30 kg/m²), and obese (≥30 kg/m²). A high waist to hip ratio (WHR) was defined as a ratio ≥ 0.9 in males or ≥0.85 in females. Diabetes was defined as self-reported usage of relevant medications or fasting blood sugar (FBS) ≥ 126 mg/dL. Dyslipidemia was defined as low density cholesterol (mg/dL) ≥ 160 and/or total cholesterol (mg/dl) ≥240 and/or high density cholesterol (mg/dL) < 40 and/or reporting a history of using lipid lowering medications. Chronic kidney disease (CKD) was defined as glomerular filtration rate (GFR) <60 ml/min. The 10-year risk of atherosclerosis CVD (ASCVD) based on the ACC/AHA guideline was calculated for all participants.40

**Statistical Analyses**

We calculated the sex and age standardized prevalence of hypertension, the proportion of awareness, treatment, and control among hypertensive patients, the proportion of control among treated patients, and the proportion of untreated adults who were eligible for pharmacologic intervention based on both guidelines. Given the cluster sampling, we used a complex survey design to obtain summary measures. We used sampling weights defined as the inverse probability of being selected in the survey based on data of the national census in 2016. For all estimates, 95% confidence intervals were reported. Data were analyzed using Stata software (version 14.1) (Stata Corp, College Station, TX, USA).
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Authors’ contributions

All authors either contributed to the conception or design of the work, or contributed to acquisition, analysis, or interpretation of data. SGS, FN, HP, and MP drafted the manuscript. FN, FK, AE, and RM critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

Declaration of Conflicting Interests

The Authors declare that there is no conflict of interest.

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Abbreviations

ACC: American College of Cardiology; AHA: American Heart Association; ASCVD: Atherosclerotic cardiovascular disease; BMI: Body Mass Index; CI: Confidence Interval; CKD: Chronic Kidney Disease; CVD: Cardiovascular Disease; DBP: Diastolic Blood Pressure; FBS: Fasting Blood Sugar; HDL: High-Density Lipoprotein; JNC7: seventh report of the Joint National Committee; LDL: Low-Density Lipoprotein; MCA: Multiple Correspondence Analysis; MET: Metabolic Equivalent of
Task; PERSIAN: Prospective Epidemiologic Research Studies in IrAN; SBP: Systolic Blood Pressure; WHR: Waist-to-Hip Ratio.

**Ethics Approval**

PERSIAN was approved by the ethics committees of the Digestive Disease Research Institute in Tehran University of Medical Sciences and Health Services, and the Medical Sciences Universities supervising each cohort in local study centers.

**Data Availability**

The data underlying this article will be shared on reasonable request to the corresponding author.
Figure legends:

Figure 1. Number and weighted prevalence of hypertension, and proportion of treatment, control, and eligibility for pharmacologic intervention among adults classified as hypertensive based on both guidelines and the group of adults reclassified based on ACC/AHA guideline.

a Prevalence of hypertensive participants among all study population

b Proportion of hypertensive participants who are treated

c Proportion of hypertensive participants who are untreated

d Proportion of control among treated hypertensive participants

e Proportion of untreated hypertensive participants eligible for pharmacologic intervention

Figure 2. Sex and age-specific prevalence of hypertension and proportion of awareness, treatment, and control based on the two guidelines
Table 1. Weighted prevalence of hypertension based on the 2017 ACC/AHA and JNC7 hypertension guidelines across socio-demographic groups, and increase in prevalence defined based on the ACC/AHA guideline

|                   | JNC7 (N=41,266) | ACC/AHA (N=65,578) | Reclassified participants (N=24,312) | Relative Difference in prevalence (%) |
|-------------------|-----------------|-------------------|--------------------------------------|--------------------------------------|
| **Sex**           |                 |                   |                                      |                                      |
| Male              | 18.9 (16.9, 20.9) | 36.1 (29.6, 42.6) | 17.2 (12.4, 22.1) | 91                                   |
| Female            | 25.9 (24.2, 27.7) | 36.8 (32.3, 41.4) | 10.9 (7.6, 14.1) | 42.1                                 |
| **Age categories**|                 |                   |                                      |                                      |
| 35-44             | 8.0 (6.7, 9.2)   | 21.9 (16.4, 27.5) | 14.0 (9.6, 18.4) | 173.8                                |
| 45-54             | 22.9 (20.4, 25.4) | 38.1 (31.8, 44.3) | 15.2 (10.9, 19.4) | 66.4                                 |
| 55-64             | 41.9 (39.2, 44.6) | 55.9 (50.6, 61.1) | 14.0 (10.4, 17.6) | 33.4                                 |
| >=65              | 57.5 (54.8, 60.9) | 68.4 (64.2, 72.6) | 10.5 (8.1, 13.0) | 18.1                                 |
| **Residence**     |                 |                   |                                      |                                      |
| Urban             | 22.5 (20.5, 24.5) | 35.5 (29.0, 42.0) | 13.0 (8.2, 17.8) | 57.8                                 |
| Rural             | 21.9 (18.2, 25.6) | 39.8 (33.5, 46.1) | 17.9 (15.1, 20.7) | 81.7                                 |
| **Marital status**|                 |                   |                                      |                                      |
| Non-married       | 31.5 (28.6, 34.4) | 43.2 (38.1, 48.2) | 11.7 (8.2, 15.1) | 37.1                                 |
| Married           | 21.6 (19.8, 23.3) | 35.9 (30.5, 41.4) | 14.3 (10.3, 18.4) | 66.2                                 |
| **Education**     |                 |                   |                                      |                                      |
| Illiterate (no schooling) | 36.0 (32.2, 39.8) | 49.6 (44.2, 55.1) | 13.6 (10.1, 17.2) | 37.8                                 |
| <= 5 years (primary) | 21.4 (18.8, 24.1) | 35.8 (30.9, 40.7) | 14.4 (10.6, 18.2) | 67.3                                 |
| 6-8 years (middle) | 15.3 (13.1, 17.4) | 30.0 (23.6, 36.4) | 14.7 (10.0, 19.5) | 96.1                                 |
| 9-12 years (secondary) | 15.7 (13.7, 17.7) | 29.5 (23.7, 35.4) | 13.8 (9.7, 18.0) | 87.9                                 |
| >12 years (university) | 15.5 (13.5, 17.5) | 29.8 (23.0, 36.5) | 14.3 (9.2, 19.3) | 92.3                                 |
| **Wealth index**  |                 |                   |                                      |                                      |
| Quintile 1 (poorest) | 27.8 (24.1, 31.6) | 42.8 (38.4, 47.1) | 14.9 (11.6, 18.3) | 54                                   |
| Quintile 2         | 24.5 (21.9, 27.0) | 39.2 (35.1, 43.2) | 14.7 (11.2, 18.2) | 60                                   |
| Quintile 3         | 22.5 (20.5, 24.4) | 36.4 (30.9, 41.8) | 13.9 (9.9, 17.9) | 61.8                                 |
| Quintile 4         | 19.5 (17.4, 21.7) | 33.3 (27.1, 39.6) | 13.8 (9.4, 18.2) | 70.8                                 |
| Quintile 5 (richest) | 19.5 (17.1, 21.9) | 33.0 (25.6, 40.4) | 13.5 (8.2, 18.8) | 69.2                                 |
| **Body Mass Index (kg/m²)** |             |                   |                                      |                                      |
| Underweight       | 5.1 (4.1, 6.2)   | 16.0 (11.3, 20.8) | 10.9 (6.5, 15.2) | 213.7                                |
| Normal            | 13.2 (11.4, 14.9) | 25.6 (20.8, 30.5) | 12.5 (9.0, 15.9) | 93.9                                 |
| Overweight        | 21.8 (19.3, 24.4) | 36.4 (29.7, 43.1) | 14.5 (10.1, 18.9) | 67                                   |
| Obese             | 31.9 (29.1, 34.8) | 47.1 (39.8, 54.4) | 15.2 (10.4, 19.9) | 47.6                                 |
| **Physical activity** |             |                   |                                      |                                      |
| Low activity      | 27.8 (25.6, 29.9) | 42.2 (36.3, 48.1) | 14.5 (9.9, 19.0) | 51.8                                 |
| Medium activity   | 22.8 (21.2, 24.4) | 36.0 (30.6, 41.4) | 13.2 (9.0, 17.3) | 57.9                                 |
| High activity     | 17.6 (16.0, 19.2) | 32.2 (27.4, 37.0) | 14.6 (11.0, 18.2) | 83                                   |
| **Waist to hip ratio** |         |                   |                                      |                                      |
| Normal            | 9.6 (8.3, 10.9)   | 22.0 (18.2, 25.9) | 12.4 (9.3, 15.5) | 129.2                                |
| High              | 25.8 (22.8, 28.3) | 40.1 (33.0, 47.2) | 14.5 (9.9, 19.2) | 56.6                                 |
| **Diabetes**      |                 |                   |                                      |                                      |
| No                | 18.0 (16.5, 19.4) | 32.4 (27.0, 37.8) | 14.4 (10.3, 18.6) | 80                                   |
| Yes               | 47.7 (45.2, 50.2) | 59.8 (54.6, 65.0) | 12.1 (9.0, 15.2) | 25.4                                 |
| **Dyslipidemia**  |                 |                   |                                      |                                      |
| No                | 17.5 (16.0, 19.0) | 31.2 (26.0, 36.5) | 13.7 (9.7, 17.7) | 78.3                                 |
| Yes               | 31.0 (28.8, 33.2) | 45.8 (40.7, 51.0) | 14.8 (10.9, 18.8) | 47.7                                 |
| **CVD history**   |                 |                   |                                      |                                      |
| No                | 18.7 (17.0, 20.5) | 33.5 (27.8, 39.1) | 14.7 (10.6, 18.9) | 79.1                                 |
| Yes               | 62.6 (59.5, 65.5) | 69.8 (65.8, 73.9) | 7.2 (5.2, 9.2) | 11.5                                 |
| **CKD**           |                 |                   |                                      |                                      |
| No                | 19.2 (17.2, 21.2) | 34.1 (28.0, 40.1) | 14.9 (10.6, 19.1) | 11.5                                 |
| Yes               | 37.1 (33.3, 40.8) | 47.7 (42.5, 52.9) | 10.6 (8.0, 13.2) | 28.6                                 |
| **High ASCVD risk** |             |                   |                                      |                                      |
| No                | 18.0 (16.6, 19.5) | 32.1 (26.9, 37.4) | 14.1 (9.9, 18.4) | 78.3                                 |
| Yes               | 61.6 (59.1, 64.2) | 75.6 (71.6, 79.7) | 14.0 (11.9, 16.1) | 22.7                                 |
|                          | JNC 7 % (95% CI) | ACC/AHA % (95% CI) | Absolute difference |
|--------------------------|------------------|--------------------|---------------------|
| **Males**                |                  |                    |                     |
| Normal                   | 58.3 (50.9 – 65.4) | 58.3 (50.9 – 65.4) | 0                   |
| Prehypertension or elevated blood pressure | 22.8 (17.6 – 29.1) | 5.6 (4.1 – 7.5)    | -17.2               |
| Stage 1 hypertension     | 16.8 (15.4 – 18.3) | 27.1 (23.3 – 31.2) | 10.3                |
| Stage 2 hypertension     | 2.1 (1.5 – 2.9)   | 9.0 (6.7 – 12.0)   | 6.9                 |
| **Females**              |                  |                    |                     |
| Normal                   | 59.2 (54.0 – 64.2) | 59.2 (54.0 – 64.2) | 0                   |
| Prehypertension or elevated blood pressure | 14.9 (11.3 – 19.3) | 4.0 (2.9 – 5.5)    | -10.9               |
| Stage 1 hypertension     | 24.3 (22.9 – 25.6) | 28.7 (26.1 – 31.5) | 4.4                 |
| Stage 2 hypertension     | 1.7 (1.2 – 2.3)   | 8.1 (6.2 – 10.6)   | 6.4                 |
| **Both sexes**           |                  |                    |                     |
| Normal                   | 58.8 (52.6 – 64.7) | 58.8 (52.6 – 64.7) | 0                   |
| Prehypertension or elevated blood pressure | 18.9 (14.6 – 24.2) | 4.8 (3.5 – 6.5)    | -14.1               |
| Stage 1 hypertension     | 20.5 (19.2 – 21.7) | 27.9 (24.8 – 31.1) | 7.4                 |
| Stage 2 hypertension     | 1.9 (1.3 – 2.6)   | 8.6 (6.5 – 11.2)   | 6.7                 |
Figure 1. Number and weighted prevalence of hypertension, and proportion of treatment, control, and eligibility for pharmacologic intervention among adults classified as hypertensive based on both guidelines and the group of adults reclassified based on ACC/AHA guideline.

a Prevalence of hypertensive participants among all study population

b Proportion of hypertensive participants who are treated

c Proportion of hypertensive participants who are untreated

d Proportion of control among treated hypertensive participants

e Proportion of untreated hypertensive participants eligible for pharmacologic intervention
Figure 2. Sex and age-specific prevalence of hypertension and proportion of awareness, treatment, and control based on the two guidelines.