Blood Pressure Targets and Absolute Cardiovascular Risk

Ayodele Odutayo, Kazem Rahimi, Allan J. Hsiao, Connor A. Emdin

Abstract—In the Eighth Joint National Committee guideline on hypertension, the threshold for the initiation of blood pressure–lowering treatment for elderly adults (≥60 years) without chronic kidney disease or diabetes mellitus was raised from 140/90 mm Hg to 150/90 mm Hg. However, the committee was not unanimous in this decision, particularly because a large proportion of adults ≥60 years may be at high cardiovascular risk. On the basis of Eighth Joint National Committee guideline, we sought to determine the absolute 10-year risk of cardiovascular disease among these adults through analyzing the National Health and Nutrition Examination Survey (2005–2012). The primary outcome measure was the proportion of adults who were at ≥20% predicted absolute cardiovascular risk and above goals for the Seventh Joint National Committee guideline (reclassified). The Framingham General Cardiovascular Disease Risk Score was used. From 2005 to 2012, the surveys included 12,963 adults aged 30 to 74 years with blood pressure measurements, of which 914 were reclassified based on the guideline. Among individuals reclassified as not in need of additional treatment, the proportion of adults 60 to 74 years without chronic kidney disease or diabetes mellitus at ≥20% absolute risk was 44.8%. This corresponds to 0.8 million adults. The proportion at high cardiovascular risk remained sizable among adults who were not receiving blood pressure–lowering treatment. Taken together, a sizable proportion of reclassified adults 60 to 74 years without chronic kidney disease or diabetes mellitus was at ≥20% absolute cardiovascular risk. (Hypertension. 2015;66:280-285. DOI: 10.1161/HYPERTENSIONAHA.114.04997)

Key Words: aged ■ epidemiology ■ hypertension

In the recently published Eighth Joint National Committee (JNC8) guideline for the management of high blood pressure in adults, the threshold for initiation of blood pressure–lowering treatment for elderly adults (≥60 years) without chronic kidney disease (CKD) or diabetes mellitus (DM) was raised from 140/90 mm Hg to 150/90 mm Hg.1 This change resulted in a sizable share of elderly adults in the United States being reclassified as not in need of additional blood pressure–lowering treatment.2 However, the committee was not unanimous in its decision to raise the blood pressure target, particularly because a large proportion of these adults may be at high cardiovascular risk.3 Indeed, the JNC8 guideline differs from other international guidelines, which recommend a target blood pressure of <140/90 mm Hg for individuals at high cardiovascular risk.4,5 Furthermore, a recent meta-analysis by the Blood Pressure Lowering Treatment Trialists’ Collaboration demonstrated that blood pressure–lowering results in consistent proportional reductions in vascular risk across risk strata but greater absolute reductions in those at highest absolute risk.6

There are currently no estimates on what proportion of elderly US adults without CKD or DM are at high 10-year absolute cardiovascular risk (>20%) based on the JNC8 guideline. Accordingly, we conducted this study to determine the absolute 10-year risk of cardiovascular disease in adults reclassified under the JNC8 guideline.

Methods

Study Sample

The National Health and Nutrition Examination Survey (NHANES) is a cross-sectional survey conducted by the National Centre for Health Statistics. The survey provides demographic and laboratory data on a representative sample of civilian noninstitutionalized US residents. Participants gave informed consent; NHANES procedures were approved by an institutional review board, and the procedures followed were in accordance with institutional guidelines. This study merged publicly available data sets from the NHANES 2005 to 2012 surveys, and the results are representative for the US population at the midpoint of this time period: January 1, 2009.

Definitions and Measurements

All nonpregnant adults aged 30 to 74 years were included in this study, in accordance with the original age limits used to derive the Framingham risk equation.7 Participant demographics were based on self-reported age, race, and sex. Blood pressure was measured in the mobile examination center, and details of the procedure are provided elsewhere.8 Similar to past studies,9,10 the first blood pressure measurement was used if only 1 measurement was obtained. Subsequent measurements (second, third, and fourth) were averaged according to NHANES guidelines.11 A percentage of 95.5 of adults had 3 blood
pressure measurements, 2.3% had 2 measurements, and 2.2% had 1 measurement.

Participant self-reporting was used to determine whether individuals were being treated for hypertension. Specifically, participants answering “yes” to the following question were coded as treated: Are you currently taking medication to lower your blood pressure? Participants with DM were identified based on self-report or an HbA1c level of ≥6.5%. Current smokers were identified based on self-reporting. Furthermore, participants with a history of coronary artery disease, angina, acute myocardial infarction, stroke, and congestive heart failure were identified based on self-reporting and were excluded because the original Framingham cohort did not include adults with prevalent cardiovascular disease.

Renal function was assessed based on the estimated glomerular filtration rate (eGFR), using serum creatinine and the isotope dilution mass spectrometry traceable Modification of Diet in Renal Disease equation, and the albumin-creatinine ratio. Adults with an eGFR ≤60 mL/min per 1.73 m² or albumin-creatinine ratio of 30 mg/g at any eGFR were considered as having CKD.15 eGFR values exceeding 200 mL/min per 1.73 m² were truncated at that level. The eGFR equation was: 175×(serum creatinine)−1.154×(age)−0.203×(0.742 if women)×(1.212 if black). Serum creatinine measurements for the 2005 to 2006 survey years were adjusted in accordance with NHANES guidelines to be comparable with standard creatinine measurements.

The JNC7 and JNC8 guidelines (prepared by the originally impaneled members) were used to determine which individuals were achieving blood pressure treatment goals.13 Adults were divided into 3 categories as follows: (1) adults meeting blood pressure goals under both JNC7 and JNC8 were referred to as “at target”; (2) adults above blood pressure goals for JNC7 but reclassified as at target under JNC8 were referred to as “reclassified”; and (3) adults above blood pressure goals for JNC7 and JNC8 were referred to as “above target”. It is noteworthy that the reclassified group is made up of adults <60 years with CKD or DM, adults 60 to 74 years without CKD or DM, and adults 60 to 74 years with CKD or DM. These individuals would have been considered as needing treatment (if untreated) or not at target (if treated) by JNC7 and not needing treatment (if untreated) or at target (if treated) by JNC8 (Table 1). Finally, for adults of age ≥70 years with CKD, the JNC8 guideline did not provide a blood pressure target. For this subgroup, we used a target of 140/90 mm Hg.15 Results were further stratified by whether adults were currently receiving blood pressure–lowering treatment.

Absolute 10-year risk of cardiovascular events was calculated using the Framingham General Cardiovascular Disease Risk Score.7 The Framingham risk equation predicts hard vascular events—fatal and nonfatal acute myocardial infarction and stroke—in addition to angina, transient ischemic attack, heart failure, and intermittent claudication. This equation was designed for the use by general practitioners and was chosen for our study given our focus on the management of hypertension in adults without established cardiovascular disease.

The proportion of adults with ≥20% absolute 10-year cardiovascular risk was the primary outcome. Our study also focuses on the reclassified group, with a specific interest on adults 60 to 74 years without CKD or DM.

Statistical Analysis

Variables of interest were assessed for missing data, and none were noted to have >10% of values missing. These missing values were considered missing at random and below the threshold of 10%, unlikely to introduce bias in a complete case analysis.

Statistical analyses were conducted using Stata 13 (Stata Corp, College Station, TX). Sample weights, which account for oversampling, survey nonresponse, and poststratification, were used to derive all estimates. An α level of 0.05 was used as the threshold for statistical significance. Binary variables were summarized using weighted proportions and 95% confidence intervals (95% CIs). Continuous variables were summarized using mean and 95% CIs.

Results

From 2005 to 2012, NHANES included 13 779 adults aged 30 to 74 years without established cardiovascular disease, of which 13 108 participants had blood pressure measurements and 12 963 could be classified for this study. Nine thousand nine hundred thirty-one (80.5%; 95% CI, 79.4%–81.5%) participants were at target, whereas 2118 participants (13.9%; 95% CI, 13.0%–14.8%) were above target and 914 participants (5.7%; 95% CI, 5.1%–6.3%) were reclassified. On the basis of population totals at the midpoint of the 2007 to 2008 year, there were 156.8 million adults between the age of 30 to 74 years, of whom 129.9 million were nonpregnant, without established cardiovascular disease, and had sufficient information to be classified for this study. Using the aforementioned proportion, our estimates correspond to 104.5, 18.1 million, and 7.4 million at target, above target, and reclassified adults

<table>
<thead>
<tr>
<th>Participant Group</th>
<th>At Target for JNC7 Guideline</th>
<th>At Target for JNC8 Guideline</th>
<th>Criteria for Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60 y, no CKD/DM</td>
<td>SBP &lt;140 mm Hg and DBP &lt;90 mm Hg</td>
<td>SBP &lt;140 mm Hg and DBP &lt;90 mm Hg</td>
<td>Above target: SBP ≥140 mm Hg or DBP ≥90 mm Hg, Reclassified: not applicable</td>
</tr>
<tr>
<td>&lt;60 y, CKD or DM</td>
<td>SBP &lt;130 mm Hg and DBP &lt;80 mm Hg</td>
<td>SBP &lt;140 mm Hg and DBP &lt;90 mm Hg</td>
<td>Above target: SBP &lt;140 mm Hg or DBP &lt;90 mm Hg, Reclassified: 80–89 mm Hg if SBP &lt;140 mm Hg</td>
</tr>
<tr>
<td>60-74 y, no CKD/DM</td>
<td>SBP &lt;140 mm Hg and DBP &lt;90 mm Hg</td>
<td>SBP &lt;150 mm Hg and DBP &lt;90 mm Hg</td>
<td>Above target: SBP &lt;140 mm Hg or DBP &lt;90 mm Hg, Reclassified: 140–149 mm Hg if DBP &lt;90 mm Hg</td>
</tr>
<tr>
<td>60-74 y, CKD or DM</td>
<td>SBP &lt;130 mm Hg and DBP &lt;80 mm Hg</td>
<td>SBP &lt;140 mm Hg and DBP &lt;90 mm Hg</td>
<td>Above target: SBP &lt;130 mm Hg or DBP &lt;80 mm Hg, Reclassified: 80–89 mm Hg if SBP &lt;140 mm Hg</td>
</tr>
</tbody>
</table>

CKD indicates chronic kidney disease; DBP, diastolic blood pressure; DM, diabetes mellitus; JNC7, Seventh Joint National Committee; JNC8, Eighth Joint National Committee; and SBP, systolic blood pressure.
in the United States, respectively. Table 2 shows the general and clinical characteristics of each of these subgroups.

There were 230 adults 60 to 74 years of age without CKD or DM that were reclassified (23.2%; 95% CI, 19.3%–27.8%). The mean age of this cohort was 65.2 years (95% CI, 64.5–66.0 years) and the mean systolic and diastolic blood pressures were 143.7 mm Hg (95% CI, 143.2–144.2 mm Hg) and 73.0 mm Hg (95% CI, 71.3–74.7 mm Hg). Notably, 52.9% (95% CI, 43.7%–61.9%) of the reclassified group reported a history of hypertension although 45.5% (95% CI, 36.4%–55.0%) reported currently receiving treatment (Table 2).

Using the Framingham risk score, the proportion of adults 60 to 74 years without CKD or DM at ≥20% absolute risk of a cardiovascular event was 44.8%, corresponding to 0.8 million adults in total (Table 3). This is compared with 14.0% in adults <60 years with CKD or DM and 47.0% in adults 60 to 74 years with CKD or DM. Notably, the proportion at high risk in the reclassified group was similar in adults 60 to 74 years without CKD or DM mellitus and adults with CKD or diabetes mellitus (Figure). The proportion at high cardiovascular risk also remained sizable among adults who were not receiving blood pressure–lowering treatment (Table 3).

### Table 2. General and Clinical Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (n=12963)</th>
<th>At Target (n=9931)</th>
<th>Above Target (n=2118)</th>
<th>All Reclassified Adults (n=914)</th>
<th>60–74 y Without CKD/DM (n=230)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US population (no. of million people)</td>
<td>129.9</td>
<td>104.5</td>
<td>18.1</td>
<td>7.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Age, y</td>
<td>48.7 (48.3–49.2)</td>
<td>47.4 (47.0–47.9)</td>
<td>53.3 (52.5–54.1)</td>
<td>56.4 (55.4–57.4)</td>
<td>65.2 (64.5–66.0)</td>
</tr>
<tr>
<td>Men, %</td>
<td>48.3 (47.4–49.1)</td>
<td>47.2 (46.2–48.1)</td>
<td>54.9 (52.4–57.4)</td>
<td>47.4 (42.6–52.2)</td>
<td>48.7 (41.0–56.4)</td>
</tr>
<tr>
<td>Race, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>10.7 (9.1–12.6)</td>
<td>9.4 (8.0–11.0)</td>
<td>17.5 (14.2–21.4)</td>
<td>12.7 (9.6–16.6)</td>
<td>9.0 (6.3–12.8)</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>70.2 (66.7–73.5)</td>
<td>71.1 (67.9–74.2)</td>
<td>65.4 (60.2–70.3)</td>
<td>69.6 (64.0–74.7)</td>
<td>80.9 (74.2–86.1)</td>
</tr>
<tr>
<td>Other</td>
<td>19.0 (16.7–21.7)</td>
<td>19.5 (17.1–22.0)</td>
<td>17.1 (14.2–20.4)</td>
<td>17.8 (14.1–22.1)</td>
<td>10.1 (6.6–15.2)</td>
</tr>
<tr>
<td>Current smoker, %</td>
<td>21.3 (20.1–22.6)</td>
<td>21.2 (19.8–22.6)</td>
<td>24.0 (21.5–26.8)</td>
<td>16.2 (13.4–19.4)</td>
<td>9.4 (5.6–15.2)</td>
</tr>
<tr>
<td>Clinical measurements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure, mm Hg</td>
<td>121.3 (120.7–121.8)</td>
<td>115.7 (115.3–116.1)</td>
<td>148.8 (147.7–149.9)</td>
<td>132.5 (131.5–133.5)</td>
<td>143.7 (143.2–144.2)</td>
</tr>
<tr>
<td>Diastolic blood pressure, mm Hg</td>
<td>72.5 (72.0–73.0)</td>
<td>70.3 (69.8–70.8)</td>
<td>83.9 (83.0–84.7)</td>
<td>75.9 (75.0–76.7)</td>
<td>73.0 (71.3–74.7)</td>
</tr>
<tr>
<td>Medical history</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>30.0 (28.7–31.2)</td>
<td>23.9 (22.7–25.3)</td>
<td>56.7 (54.0–59.4)</td>
<td>50.2 (45.7–54.6)</td>
<td>52.9 (43.7–61.9)</td>
</tr>
<tr>
<td>On blood pressure–lowering medication, %</td>
<td>21.4 (20.3–22.5)</td>
<td>17.1 (16.0–18.3)</td>
<td>37.8 (35.0–40.8)</td>
<td>41.2 (36.8–45.8)</td>
<td>45.5 (36.4–55.0)</td>
</tr>
<tr>
<td>Diabetes mellitus, %</td>
<td>10.1 (9.4–10.7)</td>
<td>6.6 (6.0–7.2)</td>
<td>18.8 (16.4–21.4)</td>
<td>18.7 (16.2–20.3)</td>
<td>20.1 (17.4–23.9)</td>
</tr>
<tr>
<td>Laboratory measurements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eGFR, mL/min per 1.73 m²</td>
<td>87.3 (86.5–88.1)</td>
<td>88.0 (87.2–88.8)</td>
<td>86.0 (84.5–87.5)</td>
<td>80.7 (78.6–82.8)</td>
<td>80.0 (78.3–81.7)</td>
</tr>
<tr>
<td>eGFR &lt;60 mL/min per 1.73 m² (%)</td>
<td>5.6 (4.9–6.3)</td>
<td>3.6 (3.1–4.2)</td>
<td>9.7 (7.7–12.1)</td>
<td>23.6 (19.3–28.6)</td>
<td>NA</td>
</tr>
<tr>
<td>Total cholesterol, mg/dL</td>
<td>203.0 (201.8–204.2)</td>
<td>201.6 (200.4–202.8)</td>
<td>210.6 (207.8–213.5)</td>
<td>204.2 (200.6–207.7)</td>
<td>211.5 (204.2–218.7)</td>
</tr>
<tr>
<td>HDL, mg/dL</td>
<td>53.4 (52.9–53.9)</td>
<td>53.6 (53.1–54.1)</td>
<td>52.7 (51.7–53.8)</td>
<td>52.1 (50.8–53.4)</td>
<td>56.9 (54.1–59.7)</td>
</tr>
<tr>
<td>10-y predicted cardiovascular risk</td>
<td>9.2 (8.9–9.5)</td>
<td>7.1 (6.9–7.3)</td>
<td>18.6 (17.6–19.6)</td>
<td>16.8 (15.7–17.8)</td>
<td>20.6 (19.1–22.2)</td>
</tr>
</tbody>
</table>

Note that the reclassified category includes adults aged <60 y with CKD/DM, 60–74 y with no CKD/DM, and 60–74 y with CKD/diabetes. CKD indicates chronic kidney disease; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; HDL, high-density lipoprotein; n, sample size; and NA, not available.
Furthermore, in the high cardiovascular risk group (absolute risk >21%) analyzed in the meta-analysis, a 4 and 8 mm Hg reduction in systolic blood pressure prevented 19 and 37 cardiovascular events per 1000 adults. The generalizability of the meta-analysis was further enhanced by the fact that patients with a wide range of blood pressure were included (mean systolic blood pressure, 158 mm Hg; SD, 21 mm Hg).14 Similarly, in a comparative modeling analysis of the provision of blood pressure–lowering treatment in the US adult population, the use of blood pressure–lowering treatment based on absolute risk would reduce the number of total cardiovascular events (coronary heart disease and stroke) by 900 000 over 5 years relative to traditional treat to target approach for the initiation of blood pressure–lowering treatment.15

There is also good evidence on the use of blood pressure lowering from <150 to <140 mm Hg. An earlier meta-analysis of 32 trials by the Blood Pressure Lowering Treatment Trialists’ Collaboration (BPLTTC), which included adults with a wide range of baseline systolic blood pressures (128–194 mm Hg), assessed whether the relative risk reduction associated with blood pressure lowering varied by baseline blood pressure.16 The proportion of vascular risk associated with blood pressure lowering was consistent across baseline blood pressures, irrespective of whether baseline blood pressure was examined as a categorical or continuous variable.16 The proportional reduction in vascular risk associated with blood pressure lowering was consistent across baseline blood pressures, irrespective of whether baseline blood pressure was examined as a categorical or continuous variable.16 The results suggest that blood pressure lowering from <150 to <140 mm Hg in adults 60 to 74 years would produce similar proportional reductions in vascular risk as blood pressure lowering at higher (>150 mm Hg) baseline blood pressures.

Previous researchers have expressed concern about the JNC8 guideline because adults 60 to 74 years without CKD or DM were likely to be at high cardiovascular risk.3,17,18 Our study was conducted to quantify what proportion of reclassified adults were at high cardiovascular risk and to determine the corresponding population estimate for this proportion. Our study cannot determine the clinical implications, if any, of the JNC8 guideline. This would only be possible through a prospective study. Instead, our study and the aforementioned meta-analyses by the BPLTTC suggest that further research is needed.
in relation to the blood pressure targets specified in the JNC8 guideline may be needed.

The safety of blood pressure lowering toward a threshold of 140/90 mm Hg has also been a key point of concern. However, 2 trials, Japanese trial to assess optimal systolic blood pressure in elderly hypertensive patient (JATOS) and valsartan in elderly isolated systolic hypertension (VALISH), provide evidence that lowering blood pressure toward this threshold does not result in a surplus of adverse events. Both trials set systolic blood pressure goals to lower than 140 mm Hg for the high-intensity group and 140 to 160 and 140 to 149 mm Hg for the low-intensity group, respectively. In JATOS, 1.6% of participants in both groups withdrew because of adverse events, and a similar pattern was noted for VALISH: 18.2% in the high-intensity group and 17.9% in the low-intensity group.19,20

Finally, the blood pressure target was also raised from 130/80 to 140/90 mm Hg for adults <60 years with CKD or DM. This change in the JNC8 guideline is consistent with international guidelines1 and randomized controlled trials demonstrating limited benefit from blood pressure lowering to <130/80 mm Hg in adults with CKD. However, additional study is required to determine whether more intensive blood pressure lowering may be more appropriate for adults with proteinuric kidney disease.

The key strength of our study is the use of a nationally representative data set, which allows our results to be generalizable to adults aged 30 to 74 years in the United States. However, our study also has limitations. First, we used blood pressure measurements collected at a single point in time and we lacked any trends in each individual’s blood pressure measures. Similarly, diagnosis of CKD was based on a single serum creatinine measurement. These factors could have resulted in random misclassification of adults. Finally, the Framingham risk equation may underestimate risk in adults with CKD.

Perspective

Our study demonstrates that 44.8% of reclassified adults 60 to 74 years of age were at ≥20% absolute cardiovascular risk, corresponding to 0.8 million adults. Additional research is needed to determine how practice patterns change after the release of the JNC8 guideline.

Acknowledgments

We thank Dr Karthik Tennankore for his statistical support.

Sources of Funding

A. Odutayo, C. Emdin, and A. Hsiao are funded by the Rhodes scholarship. K. Rahimi is funded by the National Institute for Health Research (CDF-2013-06-012).

Disclosures

None.

References


### Novelty and Significance

**What Is New?**
- In the Eighth Joint National Committee guideline on hypertension, the threshold for initiation of blood pressure–lowering treatment for elderly adults (≥60 years) without chronic kidney disease or diabetes mellitus was raised from 140/90 to 150/90 mm Hg. However, the committee was not unanimous in this decision, particularly because a large proportion of adults may be at high cardiovascular risk. We sought to determine the predicted absolute 10-year risk of cardiovascular disease in adults based on the Seventh Joint National Committee and Eighth Joint National Committee guidelines through an analysis of the National Health and Nutrition Examination Survey (2005–2012).

**What Is Relevant?**
- Hypertension is a leading cause of morbidity and mortality in the United States. The control of hypertension is a public health priority, and clinical guidelines are important in public health efforts to improve the management of hypertension. It is, therefore, critical to understand the general and clinical characteristics of adults that are recommended (or not recommended) for treatment under clinical guidelines.

**Summary**
From 2005 to 2012, the National Health and Nutrition Examination Survey included 12,963 adults aged 30 to 74 years with blood pressure measurements, of which 914 adults were reclassified based on the guideline. Using the Framingham risk score, the proportion of reclassified adults aged 60 to 74 years without CKD or diabetes mellitus at ≥20% absolute risk of a cardiovascular event was 44.8%, corresponding to 0.8 million adults in total. The proportion at high cardiovascular risk remained sizable among adults who were not receiving blood pressure–lowering treatment.
Blood Pressure Targets and Absolute Cardiovascular Risk

Ayodele Odutayo, Kazem Rahimi, Allan J. Hsiao, Connor A. Emdin

朱建华 审校

在最新发表的美国国家联合委员会 (Joint National Committee, JNC) 成年人高血压管理指南第8版 (JNC8) 中，将无慢性肾脏病或糖尿病的老年人 (≥60岁) 开始进行降压治疗的阈值由140/90 mm Hg升至150/90 mm Hg。然而，委员会对于该决定的意见并不一致，尤其是因为大部分≥60岁的患者可能存在高心血管风险。本研究通过对美国国家健康与营养调查 (National Health and Nutrition Examination Survey) (2005–2012) 的分析，根据美国国家联合委员会指南第8版，探究这些人群的10年心血管疾病绝对风险。主要结构指标为预测心血管绝对风险≥20%且高于美国国家联合委员会指南第7版的靶目标，但根据美国国家联合委员会指南第8版 (重新分类) 重新分类仍处于靶目标的成年人比例。采用Framingham综合心血管疾病风险评分 (Framingham General Cardiovascular Disease Risk Score)。从2005–2012年间的调查中，共计12 963例30~74岁有血压测量记录的成年人，根据指南其中有914例被重新分类。在重新分类为无需额外治疗的个体中，无慢性肾脏病或糖尿病的60~74岁成年人处于心血管绝对风险≥20%的比例为44.8%，这相当于80万美国成年人。在未接受降压治疗的成年人中，具有高危心血管风险的患者比例仍然相当可观。总之，重新分类的无慢性肾脏病或糖尿病的60~74岁成年人处于心血管绝对风险≥20%的比例相当高。

方法

研究样本

美国国家健康与营养调查 (National Health and Nutrition Examination Survey, NHANES) 是由美国国
相一致

家卫生统计中心开展的横断面调查。该调查提供有关

美国非社会福利机构收容的正常居住居民的代表性样

本的人口统计学和实验室数据。参加者提供知情同意

书；NHANES操作规程获得机构审查委员会的批准，

并根据机构审查委员会指南进行操作。本研究整合了从

NHANES 2005年至2012年的公开可用数据集，结果代表

该时间段的中间点2009年1月1日时美国人群的情况。

定义和测量

所有30~74岁非妊娠成年人纳入本研究中，与最

初推衍出Framingham风险方程式所采用的年龄限制

相同一致。参加者的人口统计学资料根据自我报告的年

龄;种族和性别。在移动检查中心(mobile examination
center)测量血压,操作详情另行提供[3]。与过去的研究

相似[9,10],如果仅获得1次测量结果,则采用第1次血压测

量值。根据NHANES指南，对于后续测量值(第2次、第3

次和第4次)进行平均[11]。95.5%的成年人有3次血压测量值，

2.3%有2次血压测量值，2.2%有1次血压测量值。

根据参加者的自我报告以确定个体是否进行了高血

压治疗。尤其是当参加者对以下问题回答为“是”时编码

为“进行治疗”：你目前是否使用降压药物?自我报告为

DM或HbA1c水平≥6.5%的参加者确定为DM患者。根据自

我报告确定目前吸烟者。此外，根据自我报告确定患有冠

状动脉疾病、心绞痛、急性心肌梗死、卒中和充血性心力

衰竭病史的参加者,并将其退出,原因是原始的

Framingham队列并未纳入患有常见心血管疾病的成年人。

根据估算的肾小球滤过率(estimated glomerular filtration rate, eGFR) [采用血清肌酐和同位素稀释质谱
法示踪的肾脏病膳食改良(Modification of Diet in Renal Disease)公式计算得出]以及白蛋白/肌酐比值评价肾脏
功能。成人eGFR<60 ml/min/1.73 m^2或任何eGFR水平时
白蛋白/肌酐比值为30 mg/g时,视为患有CKD[12]。eGFR超
过200 ml/min/1.73 m^2时截至该水平。eGFR方程为:2.15×
(血清肌酐)1.154×(年龄)0.203×(0.742,若为女性)×
(1.212,若为黑种人)。2005年至2006年调查的血清肌酐
值根据NHANES指南校正至能与标准肌酐测量值可比。

采用JNC7和JNC8指南 (由指南制定组原始成员预
备)来确定达到血压治疗靶目标的个体[11,12]。成年人被分
为以下3个类别：(1) 血压目标同时符合JNC7和JNC8指
南的成年人，作为“处于靶目标”；(2) 血压目标超出JNC7
指南，但处于JNC8指南靶目标需重新分类的成年人，作为
“重新分类”；(3) 血压目标同时超出JNC7和JNC8指南
的成年人，作为“超于靶目标”。值得注意的是，重新分类
组由患有CKD或DM的<60岁,无CKD或DM的60~74岁
以及患有CKD或DM的60~74岁成年人组成。这些个体
在JNC7指南中视为需要治疗(如果未经治疗)或未处于
靶目标(如果经过治疗)，而在JNC8指南中视为无需治疗
(如果未经治疗)或处于靶目标(如果经过治疗)(表1)。

最后，对于患有CKD的≥70岁成年人，JNC8指南并未提供
血压靶目标。对于该亚组，我们采用140/90 mm Hg的靶目

表1 将成年人分为处于靶目标、超于靶目标和重新分类各组的鉴别方法

<table>
<thead>
<tr>
<th>参加者分组</th>
<th>JNC7指南的靶目标</th>
<th>JNC8指南的靶目标</th>
<th>分组标准</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60岁, 无CKD/DM</td>
<td>SBP &lt;140 mm Hg和</td>
<td>SBP &lt;140 mm Hg和</td>
<td>处于靶目标: SBP &lt;140 mm Hg和DBP &lt;90 mm Hg</td>
</tr>
</tbody>
</table>
|                  | DBP <90 mm Hg和  | DBP <90 mm Hg和  | 超出靶目标: SBP >140 mm Hg或DBP >90 mm Hg
|                  |                  |                  | 重新分类: 不适用                                                                  |
| <60岁, CKD或DM   | SBP <130 mm Hg和 | SBP <140 mm Hg和 | 处于靶目标: SBP <130 mm Hg和DBP <80 mm Hg
|                  | DBP <80 mm Hg和  | DBP <90 mm Hg和  | 超出靶目标: SBP >140 mm Hg或DBP >90 mm Hg  |
|                  |                  |                  | 重新分类: 若DBP <90 mm Hg, SBP 130~139 mm Hg或  |
|                  |                  |                  | 若SBP <140 mm Hg, DBP 80~89 mm Hg  |
| 60~74岁, 无CKD/DM | SBP <140 mm Hg和 | SBP <150 mm Hg和 | 处于靶目标: SBP <140 mm Hg和DBP <90 mm Hg
|                  | DBP <90 mm Hg和  | DBP <90 mm Hg和  | 超出靶目标: SBP >150 mm Hg或DBP >90 mm Hg  |
|                  |                  |                  | 重新分类: 若DBP <90 mm Hg, SBP 140~149 mm Hg |
|                  |                  |                  |                                                                                   |
| 60~74岁, CKD或DM | SBP <130 mm Hg和 | SBP <140 mm Hg和 | 处于靶目标: SBP <130 mm Hg和DBP <80 mm Hg
|                  | DBP <80 mm Hg和  | DBP <90 mm Hg和  | 超出靶目标: SBP >140 mm Hg或DBP >90 mm Hg
|                  |                  |                  | 重新分类: 若DBP <90 mm Hg, SBP 130~139 mm Hg或  |
|                  |                  |                  | 若SBP <140 mm Hg, DBP 80~89 mm Hg  |

CKD (chronic kidney disease); CKD (diastolic blood pressure); DM (diabetes mellitus); JNC7 (Seventh Joint National
Committee); JNC8 (Eighth Joint National Committee)
Egfr 实验室测量值

高血压, 舒张压, 高血压, 病史

临床测量值

非西班牙裔白种人

非西班牙裔黑种人

种族, 性别, 年龄


c3. 年龄, 岁

59.4 (50.2~45.7)

60.7 (54.0~43.0)

21.4 (38.2~19.4)

10.7 (9.0~12.6)

70.2 (66.7~73.5)

19.0 (16.7~21.7)

21.3 (20.1~22.6)

收缩压, mm Hg

舒张压, mm Hg

高血压, %

糖尿病, %

实验室测量值

eGFR, ml/min/1.73 m

eGFR <60 ml/min/1.73 m2(%)

总胆固醇, mg/dL

HDL, mg/dL

10年预测心血管风险

需要指出的是, 重新分类组包括患有CKD/DM的<60岁, 无CKD/DM的60~74岁以及患有CKD/DM的60~74岁成年人。CKD (chronic kidney disease) ; 慢性肾脏病; DM (diabetes mellitus); 糖尿病; eGFR (estimated glomerular filtration rate); 估算的肾小球滤过率; HDL (high-density lipoprotein); 高密度脂蛋白; n; 样本量; NA (not available); 无法获得。
有230例无CKD或DM的60～74岁成年人被重新分类 (23.2%，95% CI, 19.3%～27.8%)。该队列的平均年龄为65.2岁 (95% CI, 64.5~66.0岁)，平均收缩压和舒张压为143 mm Hg (95% CI, 143.2~144.2 mm Hg) 和73.0 mm Hg (95% CI, 71.3~74.7 mm Hg)。值得注意的是，重新分类组的52.9% (95% CI, 43.7%~61.9%) 报告有高血压病史，但是45.5% (95% CI, 36.4%~55.0%) 报告目前接受治疗 (表2)。

采用Framingham风险评分，无CKD或DM的60～74岁成年人处于心血管事件绝对风险≥20%的比例为44.8%。总计相当于80万成年人 (表3)。患有CKD或DM的<60岁成年人的相应比例为14.0%，患有CKD或DM的60～74岁成年人为47.0%。显而易见，在重新分类组中60～74岁无CKD或DM与患有CKD或DM的成年人之间处于高风险的比例相似 (图)。在未接受降压治疗的成年人中，具有高心血管风险的比例也相当可观 (表3)。

### 讨论

在最新的JNC8指南中，将无CKD或DM的老年人 (≥60岁) 的血压靶目标升至150/90 mm Hg，但是其他成年人却采用统一的血压靶目标140/90 mm Hg。本研究揭示采用Framingham风险方程式，这些60～74岁成年人中有44.8%心血管绝对风险≥20%，此外，目前未接受降压治疗的成年人中，具有高心血管风险的比例也相当可观 (表3)。

由于最新证据提示是否开始降压治疗应该由心血管绝对风险决定，因此这一研究发现至关重要。在11项降压试验的患者个体数据进行的一项meta分析中，根据5年绝对风险将参加者分层为4等分 (基线5年风险的切点：从最低风险分层至最高风险分层分别为<11%、11%~15%、15%~21%和≥21%)[6]。4个风险分层的心血管事件 (卒中、心脏病发作、心力衰竭和心房颤性死亡) 风险成比例降低，绝对风险降低程度随着绝对风险最低分层至最高
分层而增加[9]。相应地，为预防1例心血管事件所需治疗人数从最低风险组的71人递减至最高风险组的26人[6]。此外，meta分析对高心血管风险组（绝对风险>21%）的分析显示，在每1000例成年人中收缩压降低4 mm Hg和8 mm Hg分别预防19例和37例心血管事件。纳入了大范围血压值（平均收缩压158 mm Hg；SD，21 mm Hg）患者的meta分析进一步提高[14]。同样，在美国成年人群中对降压治疗的一项比较建模分析中，与采用传统的治疗靶目标开始降压治疗相比，根据绝对风险进行降压治疗在5年中可以减少900000例总心血管事件(冠状动脉心脏病和卒中)[15]。所关注的结局指标为卒中（致命性和非致命性）、冠心病（致命性和非致命性急性心肌梗死、猝死）和心力衰竭（引起死亡或需要住院治疗)[16]。无论基线血压是作为分类变量还是连续变量，在不同基线血压水平开始降压治疗相比，在较低血压水平开始降压治疗相似的血管风险成比例降低[16]。这结果提示在60~74岁成年人中从<150 mm Hg开始降压治疗改变至从<140 mm Hg开始，结可以产生与在更高(>150 mm Hg)基线血压水平开始降压治疗相似的血管风险成比例地降低。

过去已有一些研究者对于JNC8指南表示了担忧，因为无CKD或DM的60~74岁成年人很有可能处于高心血管风险[3,17,18]。本研究旨在对重新分类成年人中处于高心血管风险的比例进行定量，并确定该比例的相应人口估计数。无论如何，本研究无法判定JNC8指南的临床意义，这仅能通过前瞻性研究来确定。取而代之的是，本研究以及上述BPLTTC进行的meta分析提示，对JNC8指南规定的血压靶目标需要开展进一步的研究。

血压降低的阈值转为140/90 mm Hg的安全性也是关注的关键点。然而，日本老年高血压患者最佳收缩压评估试验（Japanese trial to assess optimal systolic blood pressure in elderly hypertensive patient，JATOS）和缬沙坦治疗老年单纯收缩期高血压（valsartan in elderly isolated systolic hypertension，VALISH）这2项试验提供了证据显示，降低血压至该阈值不会导致不良事件的增加[3,19,20]。JATOS随机化4418例65~85岁成年人，而VALISH随机化3260例70~85岁成年人[19,20]。2项试验分别设置收缩压靶目标为高血压组<140 mm Hg，低血压组140~160 mm Hg和140~149 mm Hg[19,20]。在JATOS中，2个治疗组中均有1.6%的参与者由于不良事件而退出试验，VALISH试验观察到相似的模式：高强化组为18.2%，低强化组为17.9%[19,20]。最后，对于患有CKD或DM的<60岁成年人的血压靶目标也从130/80 mm Hg升至140/90 mm Hg。JNC8指南的这一改变与国际性指南相一致[3,17,21]，随机对照试验显示患有CKD的成年人血压降低至<130/80 mm Hg的获益有限[21]。然而，需要进行另外的研究以确定是否更为强化的降压治疗可能对蛋白尿性肾病成年人更合适。

本研究的关键优势是采用了具有全国代表性的数据集，可以使本研究结果对美国30~74岁成年人具有可概括性。然而，本研究也存在局限性。首先，我们采用的血压测量值是通过NHANES获得的一些参加者仅有1次血压测量值。而且，所有血压测量值在单个时间点采集，每一个体的血压测量值缺乏动态趋势。同样，CKD的诊断是根据单次的血清肌酐测量值。这些因素可能会导致随机性错误分类。最后，Framingham风险方程可能会低估患有CKD成年人的风险。

**观点**

本研究揭示了在重新分类的60~74岁成年人中处于心血管绝对风险≥20%的比例为44.8%，这相当于80万成年人，需要开展进一步的研究，以判断JNC8指南发布之后对临床实践模式的改变程度。

**致谢**

特此感谢Dr Karthik Tennankore对于统计学分析的支持。

**资金来源**

Rhodes scholarship为A. Odutayo、C. Emdin和A. Hsiao提供了资金。健康研究国立研究所(CDF-2013-06-012)为K. Rahimi提供了资金。

**利益声明**

无。

**参考文献**

3. Wright JT Jr, Fine LJ, Lackland DT, Ogedegbe G, Dennison Himmelfarb
有何新意?

在美国国家联合委员会高血压指南第8版中，将无慢性肾脏病或糖尿病的老年人（≥60岁）开始进行降压治疗的阈值由140/90 mm Hg升至150/90 mm Hg。然而，委员会对于该决定的意见并不一致，尤其是因为大部分患者可能存在高心血管风险。我们试图通过对美国国家健康与营养调查（2005~2012）的分析，基于美国国家联合委员会指南第7版和第8版，确定成年人的10年预测心血管疾病绝对风险。

有何相关意义?

高血压在美国是发病率和死亡率的一个主要原因。在公共健康方面应优先考虑对高血压的控制，力图改善高血压管理的临床指南对于公共健康至关重要。因此，了解临床指南推荐（或不推荐）治疗的患者的一般特征和临床特征相当关键。

新颖性和重要性

在美国家联合委员会高血压指南第8版中，将无慢性肾脏病或糖尿病的老年人（≥60岁）开始进行降压治疗的阈值由140/90 mm Hg升至150/90 mm Hg。然而，委员会对于该决定的意见并不一致，尤其是因为大部分患者可能存在高心血管风险。我们试图通过对美国国家健康与营养调查（2005~2012）的分析，基于美国国家联合委员会指南第7版和第8版，确定成年人的10年预测心血管疾病绝对风险。

总结

从2005年至2012年，美国国家健康与营养调查共计12963例30~74岁的成年人有血压测量记录，根据指南其中有914例被重新分类。采用Framingham风险评分，无CKD或糖尿病的60~74岁重新分类成年人处于心血管事件绝对风险≥20%的比例为44.8%，总计相当于80万成年人中，未接受降压治疗的成年人中，具有高心血管风险的比例甚为可观。