Abstract—Hypertension awareness, treatment, and control are lower among uninsured than insured adults. Time trends in differences and underlying modifiable factors are important for informing strategies to improve health equity. National Health and Nutrition Examination Surveys 1988 to 1994, 1999 to 2004, and 2005 to 2010 data in adults aged 18 to 64 years were analyzed to explore this opportunity. The proportion of adults with hypertension who were uninsured increased from 12.3% in 1988 to 1994 to 17.4% in 2005 to 2010. In 1988 to 1994, hypertension awareness, treatment, and control to <140/<90 mm Hg (30.1% versus 26.5%; P=0.27) were similar in insured and uninsured adults. By 2005 to 2010, the absolute gap in hypertension control between uninsured and insured adults of 21.9% (52.5% versus 30.6%; P<0.001) was explained approximately equally by lower awareness (65.2% versus 80.7%), fewer aware adults treated (75.2% versus 88.5%), and fewer treated adults controlled (63.1% versus 73.5%; all P<0.001). Publicly insured and uninsured adults had similar income. Yet, hypertension control was similar across time periods in publicly and privately insured adults, despite lower income and education in the former. In multivariable analysis, hypertension control in 2005 to 2010 was associated with visit frequency (odds ratio, 3.4 [95% confidence interval, 2.4–4.8]), statin therapy (1.8 [1.4–2.3]), and healthcare insurance (1.6 [1.2–2.2]) but not poverty index (1.04 [0.96–1.12]). Public or private insurance linked to more frequent healthcare, greater awareness and effective treatment of hypertension, and appropriate statin use could reverse a long-term trend of growing inequity in hypertension control between insured and uninsured adults. (Hypertension. 2014;64:00-00.) • Online Data Supplement

Key Words: healthcare disparities ■ healthy people programs ■ hypertension ■ insurance, health ■ medically uninsured

Hypertension affects ≈30% of US adults and is a major risk factor for coronary heart disease, stroke, and heart failure.1 Hypertension treatment and control reduce clinical complications.2 Given its prevalence and health impact, hypertension is a major public health topic included in Healthy People and Million Hearts goals.3,4

Uninsured adults are less likely to be aware of and treated for hypertension than insured adults, less likely to be controlled when treated, and more likely to experience clinical complications.5–11 In 2005 to 2008, hypertension control among adults aged 20 to 64 years was 28.7% in the uninsured, 53.4% in publicly insured, and 48.2% in privately insured groups.11 Differences in control were partially explained by more undiagnosed hypertension in the uninsured group.11

Although the extant literature provides substantial information, addressing several knowledge gaps could better inform strategies to improve hypertension control in uninsured adults. For example, time trends are important because a widening gap in hypertension control between uninsured and insured adults would suggest greater need for change than a declining gap.

Similarly, if the proportion of adults with hypertension who are uninsured is growing, then more resources are required than if the proportion is declining or unchanged. The uninsured adult population was growing before the 2008 financial crisis and increased subsequently.12,13 Even with healthcare reform, the number of uninsured in the United States is projected at 31 million.14

Previous studies did not quantify the contribution of lower awareness (undiagnosed hypertension) or differences in the proportion of aware patients treated or treated patients controlled to lower hypertension control in uninsured than insured adults. If lower hypertension awareness in the uninsured is the main contributor,10 then strategies for addressing the gap are simpler than if lower proportions of aware patients treated and treated patients controlled are also contributing importantly.3,9 And, if hypertension control is higher in adults with public than private insurance,10 and not explained by other differences between the 2 groups, then public insurance could be a better option for improving hypertension control in uninsured adults.

To address the knowledge gaps, analysis of National Health and Nutrition Examination Survey(s) (NHANES) data for...
1988 to 1994 and 1999 to 2010 was conducted in adults aged 18 to 64 years with hypertension. Findings were compared in adults with and without healthcare insurance and with public or private healthcare insurance. The analyses also sought to identify modifiable factors that could improve equity in control between insured and uninsured adults.

Methods

NHANES assesses a representative sample of the US civilian population. All adults provided written consent approved by the National Center for Health Statistics.

Participants included adults aged 18 to 64 years in NHANES 1988 to 1994, 1999 to 2004, and 2005 to 2010. Race/ethnicity was determined by self-report and separated into non-Hispanic white (white) and non-Hispanic black (black) race, Hispanic ethnicity, and other. Insurance during the past 12 months is defined by positive answer to “Are you covered by health insurance or some other kind of healthcare plan?” Private insurance was defined by positive response to “Are you covered by private insurance?” or “Are you covered by Medi-Gap?” Medicaid insurance was defined by positive response to “Are you covered by Medicaid” or “Are you covered by State Children’s Health Insurance program (SCHIP)” and Medicare insurance was defined by response to “Are you covered by Medicare?” Other government insurance was defined by response to ≥2 questions, “Are you covered by CHAMPUS/VA/military health care?” “Are you covered by Indian Health Service?”, “Are you covered by state-sponsored health plan?”, “Are you covered by other government insurance?”

Public insurance includes Medicaid, Medicare, and other government.

Poverty index was calculated by dividing family income by the poverty guidelines according to family size, appropriate year, and state. Educational status was determined by the highest grade or level of school completed or highest degree received.

Prescription Medications

NHANES participants were asked if they had taken prescription medications in the past 30 days. Those answering “yes” were asked to show containers for all medications taken during that time, and medication names were recorded. If no container was available, participants were asked to verbally report medication name.

Blood pressure (BP) was measured and reported per NHANES guidelines. Prevalent hypertension was defined by (1) systolic BP ≥140 and diastolic BP ≥90 mm Hg and (2) positive response to “Are you currently taking prescribed medication to lower your BP?” Awareness, treatment, proportion of treated hypertension controlled, and hypertension control (BP <140/90 mm Hg for all adults) were defined previously. Diabetes mellitus, including diagnosed and undiagnosed, and statin medication use were defined. Chronic kidney disease was defined as estimated glomerular filtration rate <60 mL/1.73 m² per minute and urine albumin:creatinine ≥300 mg/g, that is, values used to define a lower BP target, rather than ≥200 mg/g. Serum creatinine was adjusted across surveys. Cardiovascular disease including (1) coronary heart disease, (2) stroke, (3) congestive heart failure were defined. Medical visit frequency and cigarette smoker status were described.

Data Analysis

SAS version 9.4 (Cary, NC) survey procedures were used to account for NHANES complex sampling design. NHANES data were analyzed and reported using recommended guidelines. Data for hypertension prevalence, awareness, treatment, and control were age adjusted to the US 2010 census. Among adults aged 18 to 64 years in 2010, the proportion who were aged 18 to 44 years was 0.58 and who were aged 45 to 64 years was 0.42. For age-adjusting hypertension awareness, treatment, and control across time, additional weights were calculated because prevalent hypertension varies by age. The proportion of adults in each age group who were hypertensive was multiplied by their respective year 2010 weight for all adults. Weights were calculated by dividing the product for each age group by the sum of products for both groups in each survey.

PROC SURVEYMEANS was used to generate means and confidence intervals. PROC SURVEYFREQ was used to estimate proportions and confidence intervals. PROC SURVEYLOGISTIC was used to assess association between clinical variables and BP control. In each of these procedures, the appropriate weight was used in the analysis. Taylor series linearization was used for variance estimation and domain analysis for subpopulations of interest. For within-survey between-group (uninsured versus insured, private versus public insured) comparisons at each of 3 NHANES time periods, Rao–Scott χ² tests were used to assess differences in distributions of categorical variables and Wald F tests for differences in continuous variables.

To assess the contribution of lower awareness, treated/aware, and control/treated to lower BP control in uninsured adults, hypertension control was recalculated for uninsured adults with these 3 variables adjusted individually and sequentially to values in insured adults. P values <0.05 were considered statistically significant except within-group comparisons across 3 time periods wherein P values <0.017 (0.05/3 [Bonferroni correction]) were accepted as significant.

Results

The process for deriving population with hypertension aged 18 to 64 years is depicted in Figure S1 in the online-only Data Supplement; 1563 adults were without and 6067 (4390 private, 1377 public, 300 insurance unspecified or both public and private) adults had healthcare insurance.

Uninsured and Insured Adults

In adults aged 18 to 64 years with hypertension, the estimated number and percentage in the US population of uninsured grew from 2.82 million (12.3%) in 1988 to 1994 to 6.70 million (17.4%) in 2005 to 2010 (Table 1). The insured population grew numerically but decreased as a percentage of all hypertensive adults from 20.2 (87.7%) to 31.8 million (82.6%). In 1988 to 1994, uninsured adults were 4.5 years younger than insured adults and more likely to be women. In 2005 to 2010, the age difference declined to 2.6 years and percentages of uninsured men increased. Across time, uninsured adults were less likely to be white, although the majority was white. The percentage of uninsured Hispanic adults doubled between 1988 and 1994 and 2005 and 2010. Uninsured adults were more likely to have 0 to 1 and less likely to have ≥2 healthcare visits/y than insured adults.

BP was similar in uninsured and insured adults in 1988 to 1994, but higher in uninsured adults in 1999 to 2010. Statin use increased with time in insured and uninsured adults and was lower in 1999 to 2010 in the uninsured. Across time, prevalent cardiovascular disease and chronic kidney disease were not different between uninsured and insured adults. The uninsured were more likely to smoke cigarettes.

Mean family incomes were >3 times the federal poverty level among insured adults but less than twice the federal poverty level in uninsured adults. In general, <10% of insured adults had family incomes below the federal poverty level versus ≥25% of uninsured adults. Conversely, ≥75% of insured adults had family incomes of ≥200% of the federal poverty level versus <40% of uninsured. Educational attainment was higher in the insured than uninsured.

Hypertensive Adults With Private Versus Public Health Insurance

Among insured adults, the group with public insurance grew numerically and proportionately from 2.2 (11.4%) million in 1988 to 1994 to 6.4 million (20.7%) in 2005 to 2010, whereas the
Table 1. Adults With Hypertension Grouped by Uninsured vs Insured Status in 3 NHANES Time Periods

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Sample, n</td>
<td>408</td>
<td>463</td>
<td>692</td>
</tr>
<tr>
<td>Population, n</td>
<td>2,821,809</td>
<td>5,145,276</td>
<td>6,697,422</td>
</tr>
<tr>
<td>Group, %</td>
<td>12.3 (9.7–14.8)</td>
<td>15.2 (13.1–17.3)</td>
<td>17.4 (15.4–19.4)</td>
</tr>
<tr>
<td>Age, y</td>
<td>44.4 (42.7–46.1)</td>
<td>45.1 (43.9–46.3)</td>
<td>48.0 (46.7–49.2)</td>
</tr>
<tr>
<td>Sex, male, %</td>
<td>47.8‡ (41.1–54.6)</td>
<td>56.2 (51.3–61.1)</td>
<td>56.2 (51.7–60.8)</td>
</tr>
<tr>
<td>Race</td>
<td>White, %</td>
<td>54.8 (42.6–67.0)</td>
<td>51.9 (39.8–63.9)</td>
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<tr>
<td></td>
<td>Black, %</td>
<td>21.1 (15.9–26.3)</td>
<td>20.1 (13.6–26.6)</td>
</tr>
<tr>
<td></td>
<td>Hispanic, %</td>
<td>h 10.6 (7.7–13.5)</td>
<td>12.1 (9.6–17.3)</td>
</tr>
<tr>
<td></td>
<td>Other, %</td>
<td>13.5 (4.6–22.4)</td>
<td>6.8 (3.6–11.1)</td>
</tr>
<tr>
<td>HC visits/y</td>
<td>52.5 (45.5–59.5)</td>
<td>47.1 (40.9–53.2)</td>
<td>45.6 (40.4–50.9)</td>
</tr>
<tr>
<td></td>
<td>BMI, kg/m²</td>
<td>23.7 (20.5–27.4)</td>
<td>19.8 (17.2–22.3)</td>
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<tr>
<td></td>
<td>BP, mm Hg</td>
<td>138.9 (135.9–141.9)</td>
<td>142.0 (139.4–144.6)</td>
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<tr>
<td></td>
<td>DBP, mm Hg</td>
<td>85.0 (83.0–86.9)</td>
<td>83.6 (81.7–85.5)</td>
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<tr>
<td></td>
<td>Statin, %</td>
<td>6.8 (1.8–11.8)</td>
<td>8.0* (3.2–12.8)</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus, %</td>
<td>14.1 (7.7–20.5)</td>
<td>13.4 (6.6–17.1)</td>
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<tr>
<td></td>
<td>CVD, %</td>
<td>13.6 (8.7–17.6)</td>
<td>12.9 (8.1–17.7)</td>
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<td>CKD, %</td>
<td>5.4 (1.6–9.2)</td>
<td>7.9 (4.6–11.3)</td>
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<tr>
<td></td>
<td>Smoking, %</td>
<td>36.4† (29.2–43.6)</td>
<td>35.9† (30.0–41.0)</td>
</tr>
<tr>
<td></td>
<td>Poverty index</td>
<td>6.8 (1.8–11.8)</td>
<td>8.0* (3.2–12.8)</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>At least some college, %</td>
<td>24.0 (16.4–31.5)</td>
</tr>
</tbody>
</table>

Data are presented as mean (95% confidence intervals). Poverty index reflects family income divided by the federal poverty level (100%), ie, higher values reflect greater income. Symbols to the right of the number represent comparisons between groups within NHANES time period. Symbols to the left represent comparisons within group between NHANES time periods. Symbols in column 1 compare with column 2, column 2 with column 3 and column 3 with column 1. Symbols above the number indicate differences in distribution of values within time period for race and healthcare visits/y, poverty index and education. BMI indicates body mass index; BP, blood pressure; CKD, chronic kidney disease; CVD, cardiovascular disease; DBP, diastolic BP; HC, healthcare; NHANES, National Health and Nutrition Examination Survey; and SBP, systolic BP.

privately insured rose numerically but declined proportionately from 17.0 (88.6%) to 24.5 million (79.3%; Table 2). Adults with unspecified insurance type or both public and private insurance were not counted as publicly or privately insured. The estimated number of US adults aged 18 to 64 years with private or public insurance is >900000 less than the total insured number. Age was similar in both groups. Privately insured adults were generally more likely to be male, white, and have 0 to 1 healthcare visits/y than publicly insured adults. Self-reported statin use was comparable in publicly and privately insured adults and increased over time in both groups. Diagnosed diabetes mellitus, chronic kidney disease, and cigarette smoking were greater in the publicly than privately insured.

Mean family incomes were higher among privately insured, with a mean of 3.4 to 3.8 times the federal poverty level during the 3 NHANES time periods, than publicly insured adults, with a mean of 1.3 to 2.1 times the federal poverty level. Consistent with the differences in family incomes, privately
insured adults were less likely to have family incomes below or between 100% and 199% of the federal poverty level and more likely to have incomes ≥200% of the federal poverty level. Educational attainment was also greater in privately than publicly insured adults. Income and educational attainment were not different in uninsured and privately insured adults (widely overlapping 95% confidence intervals), except higher education among publicly insured in 2005 to 2010.

**Clinical Epidemiology of Hypertension in Uninsured and Insured Adults**

Hypertension control was similar in insured and uninsured adults in 1988 to 1994 (Figure 1). Hypertension control improved over time in insured but not uninsured adults and was higher among insured in 1999 to 2004 and 2005 to 2010. Prevalent hypertension and awareness were higher among insured than uninsured in 2005 to 2010 (Figure 2). Percentages
of aware patients treated were higher in insured than uninsured in all time periods. Percentages of treated adults controlled were greater among insured than uninsured in 1999 to 2004 and 2005 to 2010. Hypertension awareness, treatment, and proportion of treated patients controlled improved over time among insured but not uninsured adults. The percentage of aware patients treated rose over time in both groups. In treated adults, the number and classes of BP medications reportedly taken in the prior month were not different between groups.

Clinical Epidemiology of Hypertension in Publicly and Privately Insured Adults

Hypertension control improved over time in adults with public and private insurance but was not different between groups (Figure 1). Hypertension prevalence, awareness, treatment, aware adults treated, and treated adults controlled increased with time in the publicly and privately insured (Figure 2). Prevalent hypertension was greater in publicly insured adults across time. Hypertension awareness was greater in publicly than privately insured in 2005 to 2010. The percentage of aware adults treated for hypertension was greater in publicly insured adults in 1999 to 2004, whereas the reverse was true for percentages of treated adults controlled.

The contribution of 3 factors individually and cumulatively to lower BP control in the uninsured in 2005 to 2010 is provided in Table S2. If hypertension awareness in uninsured equaled insured adults, then BP control in the uninsured would have been 38.3% rather than 30.6%. The 21.9% absolute gap (30.6% versus 52.5%) would have been 14.1%, a 34.9% reduction. Raising percentages of aware adults treated or treated adults controlled to values in the insured increased BP control from 30.6% to 36.4% and 36.0%, or 26.5% and 24.7% of the control gap, respectively. When the 3 variables were raised sequentially, the hypertension control gap between insured and uninsured closed, and each variable had a nearly equal contribution to the gap.

Clinical variables associated with hypertension control in multivariable regression analysis among adults aged 18 to 64 years are depicted in Figure S3. Hypertension control improved with advancing age, increasing body mass index, diabetes mellitus, and clinical cardiovascular disease but was lower in adults who were male, black, and Hispanic. Hypertension control was higher in adults with ≥2 healthcare visits/y than those with 0 to 1 healthcare visits/y and those taking statins and with health insurance than those without. Only in 2005 to 2010, adults with at least some college education had higher BP control rates than adults with less than high school education.

Discussion

Hypertension control is lower and cardiovascular outcomes are less favorable in uninsured than insured US adults.5–10 Our NHANES study was designed to address several gaps in the literature, which could better inform strategies to improve hypertension control and outcomes for this population. Prior studies reported lower hypertension control in uninsured than insured adults during limited but not longer time periods. Constructing a longitudinal perspective from extant literature is confounded by differing definitions of hypertension and variable approaches to age adjustment. In our study, hypertension was consistently defined as BP ≥140/90 mm Hg and on treatment. All survey periods were adjusted to the US 2010 census. Hypertension control was not different between uninsured and insured adults in 1988 to 1994. A significant gap in hypertension control, with lower rates in uninsured than insured, was present in 1999 to 2010.

Prior studies did not address changes in the proportion of adults with hypertension who were uninsured. In this report, the percentage of uninsured adults with hypertension grew from 12.3%, or roughly 1 in 8, in 1988 to 1994, to 17.4%, or 1 in 6, in 2005 to 2010 (Table 1). Our first 2 findings indicate that the gap in hypertension control between the uninsured and insured grew as the proportion of adults with hypertension who were uninsured increased. These observations suggest that previous strategies to improve healthcare and outcomes for uninsured adults, for example, federally qualified and rural health centers,27,28 although important have not been sufficient to improve equity in hypertension control.

Previous studies did not quantify the impact of differences in percentages of awareness, aware adults treated, or treated adults controlled to the gap in hypertension control between insured and uninsured adults. When these 3 variables were raised individually in uninsured adults to levels in insured adults, BP control rose but remained <40% in the uninsured. Strategies to improve equity in hypertension control require attention to all 3 variables (Table S2).

The proportion of treated adults controlled was reportedly lower in uninsured than insured adults4 and confirmed in our report. Persistence on antihypertensive medication is reportedly lower in uninsured than insured adults,29 which could account for this observation (Figure 2). Yet, in insured and uninsured adults on treatment, the number and classes of antihypertensive medications reportedly taken in the prior month were not different (Table S1). NHANES does not assess pill splitting or missed doses, which may be greater among uninsured.

Modifiable and nonmodifiable variables related to hypertension control were also examined (Figure S3). Among fixed variables, increasing age, diabetes mellitus, and clinical
cardiovascular disease were associated with better hypertension control, whereas male sex, black race, and Hispanic ethnicity were associated with lower control. Although increasing age across the adult lifespan is associated with a decline in hypertension control, hypertension control increases with age ≤60 years but then declines with advancing age ≥60 years.30 Thus, the positive association between age and BP control in adults aged 18 to 64 years is not unexpected.

Hypertension control improved modestly but significantly with increasing body mass index, although obesity is associated with treatment-resistant hypertension.31,32 Our finding is consonant with a previous NHANES report that hypertension control improved more over time in obese than nonobese individuals.33 Hypertension control was also higher in patients with than without diabetes mellitus, although diabetes mellitus is associated with treatment-resistant hypertension.31,32 From 1997 through 2013,18,34 the systolic goal for patients with diabetes mellitus was <130 mm Hg, which likely improved control to <140 mm Hg. NHANES data (Figure S3) are consistent with the conclusion that clinicians treat hypertension more aggressively when cardiovascular risk is higher.30,32

Infrequent healthcare was linked to lower hypertension control and awareness. The uninsured use less healthcare than insured, differences transcending income,35 and

**Figure 2.** The prevalence of hypertension and the percentages of patients with hypertension who are aware, treated, aware adults treated, and treated adults controlled are shown. **Left.** Comparative data are provided for uninsured and insured patients. **Right.** Comparative data are provided for patients with private or public insurance. P values during time periods indicate differences between the 2 groups during that time interval. P values to the right of the group symbol for 2005 to 2010 indicate a significant change for the group designated during the 3 National Health and Nutrition Examination Survey (NHANES) time periods.
infrequent healthcare is a significant barrier to better hypertension control.\(^5\)\(^{,}\)\(^{30}\)\(^{,}\)\(^{36}\)\(^{,}\)\(^{37}\)

In multivariable analysis, insured adults aged 18 to 64 years were more likely to attain hypertension control than uninsured in 1999 to 2010. As one potentially modifiable factor, uninsured adults were less likely to report taking statins in 1999 to 2010, when their hypertension control remained flat and fell behind insured adults. Statins were positively related to hypertension control in adults aged 18 to 64 years. In a meta-analysis of 40 randomized, placebo-controlled trials, systolic BP was 2.6 mm Hg lower in adults randomized to statins than placebo.\(^38\)

In Anglo-Scandinavian Cardiac Outcome Trial (ASCOT),\(^39\) hypertensive patients randomized to atorvastatin were less likely to have treatment-resistant hypertension than patients on placebo. The observations are insufficient to support statin prescriptions for BP control. Yet, current cholesterol guidelines, which increase the number of hypertensive adults eligible for statins by 8 million,\(^40\) could potentially improve BP control and reduce the control gap if applied equally to the uninsured and insured.

Another objective was to assess hypertension control in publicly and privately insured adults because this might influence recommendations for insurance plans to improve health in the uninsured.\(^10\)\(^{,}\)\(^{41}\)\(^{,}\)\(^{42}\) Hypertension control was similar in adults with public and private insurance, although publicly insured adults were more likely to be black or Hispanic, factors negatively associated with hypertension control.\(^3\)\(^{,}\)\(^{16}\)\(^{,}\)\(^{29}\) Publicly insured adults had more obesity and diabetes mellitus than privately insured adults, 2 factors associated with BP control. Two factors restraining hypertension control in privately insured adults were the higher proportion of men and less frequent healthcare, which are linked to poorer hypertension control among adults aged 18 to 64 years. Men, even with healthcare insurance, are less likely than women to use healthcare services.\(^43\)

Adults with public insurance had lower incomes and educational attainment than those with private insurance. Poverty index was similar in uninsured and publicly insured adults across time. Yet, hypertension control improved in publicly insured but not uninsured adults, which is consistent with the finding that the poverty index was not associated with BP control. Educational attainment was also greater in privately than publicly insured patients across time. At least some college education was associated with better hypertension control than less than a high school education only in 2005 to 2010, which coincided with the only time period that publicly insured adults were more likely to have some college education than uninsured adults.

Study limitations include the NHANES design with repeated, representative cross-sectional samples of a small percentage of the US population. Confidence intervals are often large, which may mask real differences that might be seen with larger population samples. NHANES relies on 1 examination to define prevalent hypertension and control. Classification as hypertensive or nonhypertensive for untreated adults and control status in treated adults could change with repeated BP measurements on different days. The definition of hypertension based on national guidelines was consistently ≥140/90 mm Hg during the period of this report, that is, 1988 to 2010.\(^18\)\(^{,}\)\(^{34}\)\(^{,}\)\(^{44}\) Yet, goal systolic BP for patients with diabetes mellitus and chronic kidney disease was <130 mm Hg from 1997 to 2013.\(^18\)\(^{,}\)\(^{34}\)

Direct comparisons of prevalence, treatment, and control between 1988 and 1994 and 1999 and 2010 may be impacted by different control goals for selected populations.

**Perspective**

The percentage of uninsured among adults with hypertension grew from 12.3% in 1988 to 17.5% in 2005 to 2010. Uninsured adults did not participate in the substantial improvement in hypertension control over time documented among insured adults. In the uninsured, lower percentages of awareness, aware adults treated, and treated adults controlled contribute approximately equally to the disparity in hypertension control. Our analysis suggests that providing public or private healthcare insurance to uninsured adults and promoting appropriate healthcare utilization to diagnose, treat, and control hypertension and guideline-based statin therapy could promote equity in hypertension control and vascular outcomes.

**Sources of Funding**

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**Disclosures**

During the past 3 years, B.M. Egan received income as a consultant to Blue Cross Blue Shield South Carolina, Daiichi-Sankyo, Medtronic, and Novartis and research support from Daiichi-Sankyo, Medtronic, Novartis, and Takeda. The other authors report no conflicts.

**References**

Novelty and Significance

What Is New?
- Blood pressure (BP) control was similar in adults with and without health-care insurance in 1988 to 1994.
- Uninsured adults did not experience the large rise in BP control observed in insured adults between 1988 and 1994 and 2005 and 2010.

What Is Relevant?
- BP control was similar in adults with public and private health insurance from 1988 to 2010, although income and education were similar in uninsured and publicly insured adults and lower than privately insured adults.

What Is New?
- Healthcare insurance, ≥2 healthcare visits yearly, and statin medications were linked with better BP control.

Summary
To improve hypertension control in uninsured adults, healthcare insurance, regular healthcare, and guideline-based treatment for BP and cholesterol could be helpful.
The Growing Gap in Hypertension Control Between Insured and Uninsured Adults: National Health and Nutrition Examination Survey 1988 to 2010
Brent M. Egan, Jiexiang Li, James Small, Paul J. Nietert and Angelo Sinopoli

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THE GROWING GAP IN HYPERTENSION CONTROL BETWEEN INSURED AND UNINSURED ADULTS: NHANES 1988–2010

1Brent M. Egan, MD, 2Jiexiang Li, PhD, 3James Small, BS,  
3Paul J. Nietert, PhD, 1Angelo Sinopoli, MD

1University of South Carolina School of Medicine, Greenville  
   Greenville Health System  
   Care Coordination Institute  
   Greenville, SC

2College of Charleston  
   Mathematics Department  
   Charleston, SC

3Medical University of South Carolina  
   Public Health Sciences  
   Charleston, SC
### S1 Table. Hypertensive medication classification by insurance status in 3 NHANES time periods.

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<td>0.0-4.8</td>
<td>0.0-4.4</td>
<td>0.0-4.0</td>
</tr>
<tr>
<td>α₁,β-blocker</td>
<td>1.2</td>
<td>0.9</td>
<td>1.9</td>
</tr>
<tr>
<td>ACEI/ARB/DRI</td>
<td>†35.8</td>
<td>‡29.3</td>
<td>*35.7</td>
</tr>
<tr>
<td>β-blocker</td>
<td>19.0</td>
<td>21.2</td>
<td>29.5</td>
</tr>
<tr>
<td>dCCB</td>
<td>11.9</td>
<td>†12.1</td>
<td>11.9</td>
</tr>
<tr>
<td>ndCCB</td>
<td>12.8</td>
<td>†20.3</td>
<td>†12.6</td>
</tr>
<tr>
<td>Diuretic</td>
<td>48.5</td>
<td>46.6</td>
<td>36.7</td>
</tr>
<tr>
<td>Thiazide</td>
<td>33.8-63.3</td>
<td>42.1-51.1</td>
<td>27.7-45.7</td>
</tr>
<tr>
<td>Loop</td>
<td>42.2</td>
<td>37.1</td>
<td>32.5</td>
</tr>
<tr>
<td>K+-sparing, aldo antag</td>
<td>27.6-56.7</td>
<td>31.7-42.4</td>
<td>23.7-41.2</td>
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<tr>
<td>Loop</td>
<td>5.4</td>
<td>6.2</td>
<td>3.5</td>
</tr>
<tr>
<td>K+-sparing, aldo antag</td>
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<td>4.2-8.3</td>
<td>0.0-7.3</td>
</tr>
<tr>
<td>β-blocker</td>
<td>16.5</td>
<td>‡22.6</td>
<td>6.3</td>
</tr>
<tr>
<td>Sympatholytic</td>
<td>4.7-28.4</td>
<td>19.3-26.0</td>
<td>1.8-10.8</td>
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<tr>
<td>Vasodilator</td>
<td>6.5</td>
<td>†6.2</td>
<td>6.2</td>
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</tbody>
</table>

BP Meds=Antihypertensive medications; Rx=on antihypertensive treatment; Pt=Patient; ACEI=angiotensin converting enzyme inhibitor; ARB=angiotensin receptor blocker; DRI=direct renin inhibitor, CCB=calcium channel blocker; d=dihydropyridine; nd=non-dihydropyridine; aldo antag=aldosterone antagonist.

*p<0.05, †p<0.01, ‡p<0.001. Symbols and significance are the same as Table 1.
S2 Table. Impact of key clinical variables on differences in BP control between insured and uninsured adults 2005–2010.

<table>
<thead>
<tr>
<th></th>
<th>Insured, %</th>
<th>Uninsured, %</th>
<th>Change value of uninsured to insured (individual)</th>
<th>Change value of uninsured to insured (cumulative)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Awareness</td>
<td>Treatment</td>
<td>Control/Treated</td>
<td>Awareness</td>
</tr>
<tr>
<td>Aware</td>
<td>80.7%</td>
<td>88.5%</td>
<td>71.5%</td>
<td>80.7%</td>
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<tr>
<td>Treatment/Aware</td>
<td>65.2%</td>
<td>75.2%</td>
<td>49.0%</td>
<td>65.2%</td>
</tr>
<tr>
<td>Control/Treated</td>
<td>65.2%</td>
<td>75.2%</td>
<td>49.0%</td>
<td>65.2%</td>
</tr>
</tbody>
</table>

Percentages for aware, treatment/aware, and control/treated in the uninsured are changed to values in the insured both individually and cumulatively. The values changed in untreated to match treated are highlighted in bold italics. The impact of individual and cumulative changes in these variables on differences in BP control between the insured and uninsured are provided in the column on the far right.
S1 Figure. The independent relationship between selected clinical variables and BP control is depicted for the three NHANES time periods collectively and individually.

Legend: S1 Figure. Multivariable odds ratios and 95% confidence intervals depict the relationship of several clinical variables to hypertension control in adults 18–64 years old. Values for poverty index reflect a 100% increase, e.g., 100% vs. 200%. The reference group for education is less than high school. Results are shown for NHANES 1988–1994, 1999–2004, and 2005–2010 separately and for all three time periods combined. Statistical significance is assumed when the 95% confidence intervals do not cross the line of identity (1.0).