

Health Insurance Status and Hypertension Monitoring and Control in the United States

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Background: In this study, we examined whether insurance status (private, Medicare, Medicaid, no insurance) was associated with the odds of blood pressure (BP) monitoring and control.

Methods: We used data from the National Health and Nutrition Examination Surveys (NHANES) conducted in 1999 through 2002, defining hypertension as either self-report of elevated BP or an elevated BP value on examination. We conducted multivariate analyses adjusting for age, income, race/ethnicity, body mass index, and medical comorbidities.

Results: Among all hypertensive participants, only 58% of the uninsured had a BP check within 6 months, compared to 82% of the privately insured. Overall, uninsured individuals (adjusted odds ratio 0.63, 95% CI 0.44–0.92) were at lower odds of adequate BP control than the privately insured. Among treated participants, the uninsured were at lower odds of adequate control (adjusted OR 0.42, 95% CI 0.23–0.73) than the privately insured.

Among participants who self-reported hypertension but were not taking antihypertensive medications, the odds of elevated BP did not differ by insurance status. No differences in BP control were observed for participants with Medicare or Medicaid compared to those with private insurance, in any comparisons.

Conclusions: Lack of insurance is associated with lower rates of BP control among treated hypertensives, whereas the odds of elevated BP are similar among untreated hypertensives with different insurance status. Variation in BP control between the uninsured and privately insured with hypertension is likely related to differences in appropriate treatment intensification or adherence, rather than differences in rates of treatment initiation. Am J Hypertens 2007;20:348–353 © 2007 American Journal of Hypertension, Ltd.

Key Words: Health insurance, prevention and control, National Health and Nutrition Examination Survey (NHANES).

More than half of all hypertensive Americans are covered by Medicaid or Medicare, and many of these individuals are at risk of inadequate blood pressure (BP) management and control when compared to those with private insurance.¹ Historically, approximately 25% of all Medicare participants had no prescription drug coverage, and those with hypertension paid 95% of their antihypertensive medication expense out-of-pocket.² Data from the late 1980s showed that hypertensive individuals with Medicare who did not have private supplemental insurance were treated with antihypertensives at the same rate as uninsured persons.³ Although Congress recently enacted a Medicare prescription drug plan, designed to provide some medication coverage for Medicare recipi-

ents, many seniors will exceed the initial drug benefit cap and may remain at risk for inadequate BP control.⁴

Medicaid participants, despite historically having had a prescription drug benefit, often face restrictions in the number of covered medications, leading them to discontinue one or more of their essential medications.^{5,6} More than a quarter of both Medicare participants and Medicaid participants report cost-related nonadherence to their medication regimens.² An additional 12% of hypertensive individuals lack any health insurance coverage, and are also more likely to report going without needed treatment.^{3,7,8}

Using nationally representative data from the National Health and Nutrition Examination Surveys (NHANES)

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conducted in 1999 through 2002, we designed our study to assess whether insurance status was associated with (1) BP control among participants receiving antihypertensive medications and (2) BP values among untreated participants with hypertension. We hypothesized that privately insured participants on antihypertensive treatment would have greater odds of adequate BP control than those with no insurance, Medicaid, or Medicare, and that privately insured participants not on antihypertensive treatment would have lower odds of elevated BP than comparable participants with no insurance, Medicaid, or Medicare.

Methods

Study Population

The NHANES is conducted by the National Center for Health Statistics, using a stratified multistage probability design to obtain a representative sample of the civilian, noninstitutionalized US population. Details on the sampling strategy and weighting methods are available in electronic form.⁹ Starting in 1999, the NHANES has been continuously ongoing, with data released at 2-year intervals. The NHANES 1999–2000 and 2001–2002 questionnaires included 3496 adults with reported or documented hypertension. For this analysis, we only included persons 18 years of age and older.

The data collection protocol was approved by the Centers for Disease Control and Prevention Institutional Review Board. During a home interview, survey participants reported whether or not they were currently covered by health insurance, and if so, answered separate questions about coverage with private insurance, Medicare, or Medicaid. They also provided sociodemographic information, such as self-assigned race/ethnicity (non-Hispanic white, African American, Mexican American, other Hispanic, other race), as well as age, annual income, and level of education. Participants were asked whether a doctor or other health care provider had previously diagnosed them with hypertension, and if so, were asked about use of antihypertensive medication. Finally, participants provided clinical information including self-reported hypertension as well as current tobacco and alcohol use, and the frequency of contact with health professionals during the preceding 12 months.

Standardized medical examinations were conducted in a mobile examination center. Three or four BP measurements were obtained for each participant and the average BP reading was calculated from all available measurements. Quality control was safeguarded by procedural checklists, quarterly recertification, and review of the data to exclude systematic errors.¹⁰ Body weight and height were measured according to a standard protocol, and body mass index (calculated as weight in kilograms divided by the square of height in meters) was used as a measure of obesity. We excluded individuals who were interviewed but not examined ($n = 472$ in 1999–2000, $n = 683$ in 2001–2002) from this analysis.

Variable Definitions

We defined the cohort of persons with hypertension as persons with either (1) self-report of elevated BP, whom we considered to be “aware” of a hypertension diagnosis, or (2) an elevated BP value on examination, specifically either an average systolic reading of more than 140 mm Hg or an average diastolic reading of more than 90 mm Hg. Only participants who self-reported a hypertension diagnosis were asked about antihypertensive medication use. Therefore, all participants taking antihypertensives were classified as hypertensive for the purpose of this analysis. The high specificity of self-reported hypertension compared with BP findings on examination has been previously validated using data from NHANES participants.¹¹ The conventional definition of hypertension applied to data from NHANES excludes individuals who report having hypertension, are not currently taking antihypertensive medications, yet have normal BP values on examination. Because nonpharmacologic measures such as dietary modifications and physical activity can alone or in combination lower BP 10 to 15 mm Hg, this conventional definition likely misclassifies some individuals as nonhypertensive when they in fact have controlled, relatively mild hypertension.¹²

We conducted multiple sensitivity analyses, including restriction of the sample to individuals self-reporting elevated BP on two or more occasions and exclusion of untreated normotensive individuals who self-report hypertension ($n = 133$). Because results from these sensitivity analyses did not differ substantially from the main analysis, we report only the results from the original models.

As the primary independent variable, we defined four mutually exclusive categories of insurance coverage: (1) private insurance, with or without other insurance; (2) Medicare without private insurance (but including Medicaid), termed “Medicare alone;” (3) Medicaid (excluding Medicare); and (4) no health insurance. NHANES does not contain specific information on pharmacy benefits. However, almost all participants with private insurance and Medicaid were likely to have prescription drug coverage. Participants with Medicare but no supplemental private insurance, and those with no health insurance, did not have prescription drug coverage. We excluded persons with government insurance other than Medicare and Medicaid as small sample sizes precluded the generation of reliable estimates.

Statistical Analyses

We calculated the percentages of persons receiving a recent BP check, stratified by category of insurance coverage, for all participants with hypertension as well as the group who self-reported elevated BP. We also calculated the percentage of participants aware of their hypertension, with awareness defined as self-report of elevated BP, receiving antihypertensive drug therapy. All estimates were weighted to adjust for the differential probabilities of sampling and nonresponse, to represent the total civilian,

noninstitutionalized US population. Estimates with a sample size smaller than the recommended size for each calculated design effect were considered unreliable.⁹

We calculated percentages of all NHANES participants on antihypertensive medications that had either controlled (systolic BP <140 mm Hg along with diastolic BP <90 mm Hg) or uncontrolled BP by category of insurance. We used the same numerical BP criteria for hypertensive participants not receiving pharmacologic antihypertensive medications, with systolic BP values >140 mm Hg or diastolic BP values >90 mm Hg considered elevated. We then used multiple logistic regression analyses to explore the association between insurance coverage and BP for the entire hypertensive sample, groups of hypertensive participants receiving and not receiving antihypertensive therapy, as well as those participants who self-report hypertension. We excluded 503 cases with missing covariates from the multivariate analyses. Excluded subjects were more likely to have Medicare insurance and were therefore older. However, no statistical differences in race/ethnicity, gender, or body mass index were seen between included and excluded subjects. In addition to adjusting for sociodemographic and clinical variables (age, income, race/ethnicity, gender, body mass index) in each multivariate analysis, we constructed an unweighted self-report comorbidity score using items derived from the Self-Administered Comorbidity Score published by Sangha et al.¹³ We assigned participants 1 point for each of 11 possible comorbidities such as coronary heart disease, chronic lung disease, and

cancer. We also performed three sensitivity analyses, each adjusting for a potential confounder: the frequency of physician visits, participant alcohol use, and tobacco use. The results of these sensitivity analyses did not differ from those of the main models, and are therefore not described further. Results are expressed in terms of odds ratios, along with 95% confidence intervals. Because of a relatively high percentage of persons with hypertension control in certain groups, odds ratios may overestimate risk in the present study.

All analyses were performed with the use of SUDAAN (Research Triangle Park, NC), a statistical package that adjusts all estimates for the complex NHANES survey design. Because the observations contributed by each participant in the sample are weighted for the differential probabilities of selection and nonresponse, actual sample sizes are not reported along with percentages.

Results

The demographic distribution of this sample, stratified by insurance category, is shown in Table 1. The majority of persons with private insurance or Medicare alone were non-Hispanic whites. African Americans and Hispanics other than Mexican Americans were overrepresented in the groups with Medicaid or no health insurance, relative to their numbers in the overall population. Mexican Americans also represented a disproportionate number of the uninsured. Given the age-restricted criteria for Medicare

Table 1. Demographics and unadjusted mean blood pressure values among all NHANES 1999–2002 participants with hypertension*, by insurance status

	Private insurance (n = 2017)	Medicare without private insurance (n = 750)	Medicaid (n = 290)	No insurance (n = 439)
Demographics				
Race/ethnicity (%)				
Non-Hispanic white	78.3	78.5	45.9	50.1
Black, non-Hispanic	11.7	11.5	20.9	21.2
Mexican American	3.2	3.1	6.6	13.9
Other Hispanic	4.0	5.0	19.1	11.4
Other race	2.8	1.9	7.5	3.4
Age (y)				
Mean (SE)	55 (0.6)	72 (0.6)	56 (1.7)	44 (0.8)
Income (%)				
<200% FPL	22.7	55.7	92.2	73.5
Gender (%)				
Female	50.5	60.4	66	48.7
Body mass index				
Mean (SE)	30.1 (0.2)	28.5 (0.4)	31.0 (0.7)	31.3 (0.6)
Blood pressure values				
Systolic (mm Hg)				
Mean (SE)	137.5	148.0	136.7	136.6
Diastolic (mm Hg)				
Mean (SE)	77.1	68.9	75.0	79.4

FPL = Federal Poverty Level.

* Hypertension defined as either (1) self-report of elevated blood pressure or (2) examination findings of systolic blood pressure >140 mm Hg or diastolic blood pressure >90 mm Hg.

Table 2. Control, monitoring, and treatment among NHANES 1999–2002 participants with hypertension*, by insurance status

	Private insurance	Medicare without private insurance	Medicaid	No insurance
All participants with hypertension (<i>n</i> = 3496)*	(<i>n</i> = 2017)	(<i>n</i> = 750)	(<i>n</i> = 290)	(<i>n</i> = 439)
% with recent blood pressure monitoring	81.5%	88.6%	92.5%	57.5%
Mean systolic blood pressure in mm Hg (\pm SE)	137 \pm 0.5	147 \pm 1.1	138 \pm 2.0	137 \pm 1.6
Mean diastolic blood pressure in mm Hg (\pm SE)	78 \pm 0.6	69 \pm 1.2	76 \pm 1.5	80 \pm 1.2
% with adequately controlled blood pressure†	46.6	32.6	43.1	41.6
% aware of their hypertension diagnosis	75.0%	72.6%	78.6%	67.0%
Participants aware of their hypertension diagnosis (<i>n</i> = 2577)	(<i>n</i> = 1512)	(<i>n</i> = 543)	(<i>n</i> = 228)	(<i>n</i> = 294)
% with recent blood pressure monitoring	87.6%	93.9%	94.0%‡	64.8%
% on antihypertensive medications	69.4%	82.4%	74.7%	36.1%

* Hypertension defined as either (1) self-report of elevated blood pressure diagnosis or (2) examination findings of systolic blood pressure >140 mm Hg or diastolic blood pressure >90 mm Hg; † Adequate hypertension control defined as systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg; ‡ Estimate is unreliable, as the sample size was smaller than that recommended in the NHANES analytic guidelines for the design effect and estimated proportion.⁹

enrollment, persons with Medicare alone were primarily 65 years of age and older, whereas persons in other groups were primarily younger or middle-aged.

Table 2 shows the unadjusted percentages of monitoring and treatment among hypertensives. Approximately 90% of hypertensive persons with Medicare alone or Medicaid reported a BP check within the prior 6 months. In comparison, 82% of all hypertensive participants with private insurance, and only 58% of all uninsured hypertensive participants had a BP check within the prior 6 months (Table 2). These numbers were similar among the group aware of their hypertension. Treatment rates were highest for participants with Medicare alone, followed by those with Medicaid and private insurance. Uninsured participants had the lowest rates of treatment with antihypertensive medication.

Table 3 shows the adjusted odds ratios (AOR) of adequate hypertension control, and associated 95% confidence intervals (CI). The uninsured were at lower odds of

adequate BP control than those with private insurance, among all participants with hypertension (AOR 0.63, 95% CI 0.44–0.92), as well as those who were aware of their hypertension (AOR 0.54, 95% CI 0.36–0.81). These findings were related to a difference in control among treated patients. Among participants not taking antihypertensive therapy, there was no difference in the odds of elevated BP between the uninsured and the privately insured (AOR 0.96, 95% CI 0.61–1.50). No differences in hypertension control were seen in any analyses between privately insured participants and those with Medicare alone or with Medicaid.

Discussion

Our analysis yielded several important findings not explicitly reported in the peer-reviewed literature. Uninsured participants receiving antihypertensive treatment had greater odds of inadequate BP control when compared to the

Table 3. Adjusted odds ratios, with 95% confidence intervals, of adequate hypertension control* among 1999–2002 NHANES participants, by insurance status

	Private insurance	Medicare without private insurance	Medicaid	No insurance
All participants with hypertension	1.0 (ref)	0.80 (0.61–1.05)	0.75 (0.47–1.20)	0.63†† (0.44–0.92)
Participants with hypertension, on treatment	1.0 (ref)	0.86 (0.65–1.16)	0.72 (0.38–1.36)	0.42† (0.23–0.73)
Participants with hypertension, not on treatment	1.0 (ref)	—	—	0.96 (0.61–1.50)
All participants who self-report elevated blood pressure	1.0 (ref)	0.80 (0.60–1.08)	0.75 (0.44–1.27)	0.54† (0.36–0.81)

Adjusted for age, race/ethnicity, gender, BMI, comorbidity score.

Odds ratios for untreated Medicare and Medicaid participants were not tested due to sample size limitations.

* Adequate hypertension control defined as systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg; † *P* < .01; †† *P* < .05.

privately insured receiving treatment. However, among hypertensive participants not receiving pharmacologic antihypertensive therapy, the odds of elevated BP values for those with private insurance and those with no health insurance were similar. In addition, after controlling for age, body mass index, and medical comorbidities, individuals with Medicare but no supplemental insurance had similar odds of adequate BP control to privately insured participants, who generally receive prescription drug coverage. This finding is important in the context of the newly enacted Medicare Part D drug benefit, suggesting that the provision of a new prescription drug benefit alone may not improve BP control in the Medicare population.

Prior studies comparing BP control among those with and without insurance have reported mixed findings.^{14–16} Importantly, none of these studies have examined treatment with antihypertensive drugs as an explanatory factor in hypertension control. Our finding of a disparity in BP control among treated participants has several possible explanations. Uninsured participants who pay out-of-pocket are likely to be less adherent to multidrug regimens or regimens including expensive brand name medications.^{15,17} Also, many uninsured participants with hypertension rely on provider-donated samples for BP control, and are therefore dependent on the physician receiving regular and timely supplies of the particular brand and dose they are taking. Although few studies have been conducted on the harms and benefits of sample medication use, some evidence suggests that use of samples is associated with higher BP.¹⁸ In addition, we found that uninsured persons with hypertension have less frequent BP monitoring compared to the privately insured. Because frequent monitoring is important to guide up-titration of doses and the addition of new medications, the differences in monitoring may also help explain our finding of a difference in control.¹⁹ Finally, this difference in control could be related to a baseline disparity in the two groups receiving treatment, with greater severity of disease among the uninsured. This possibility is less likely given the young age of the uninsured participants relative to those with private insurance. Additional studies, with more detailed information on medication regimens and out-of-pocket expenses, would further explain these disparities in control among treated participants by insurance status.

The lack of an observed difference in the odds of elevated BP between privately insured and uninsured participants who self-report hypertension but are not receiving antihypertensive therapy was somewhat surprising. One might expect that providers will prescribe antihypertensive therapy more frequently to insured participants in poor control, thereby leaving a smaller number of untreated individuals with elevated BP compared to those without health insurance. In this sample, more than two-thirds of privately insured participants aware of their hypertension were taking antihypertensive medication, compared with only about one-third of uninsured participants. These findings together may suggest that uninsured

participants in this sample, who are younger overall than other groups, may have less severe hypertension on initial presentation. In that case, after the subset of privately insured participants with elevated BP is “shifted” into the treated group, rates of elevated BP values are similar among privately insured and uninsured participants who remain untreated. Alternatively, these findings may also indicate that other patient or provider factors in the setting of uncontrolled hypertension, such as patient beliefs about the efficacy of treatment or clinical inertia on the part of the physician, play an important role along with type of patient insurance in the decision to initiate antihypertensive therapy.^{20,21} Future longitudinal cohort studies examining medication treatment over time among insured and uninsured individuals would help to clarify this issue.

Overall, we found no differences in the odds of BP control between Medicare alone and privately insured participants, after adjusting for age, body mass index, and medical comorbidities. Individuals receiving Medicare account for a disproportionate number of cases with uncontrolled hypertension in the US, and a major proportion of the attributable risk is associated with increased age.^{16,22} Our analysis suggests that inadequate BP control among Medicare patients may be due primarily to factors other than the presence or absence of a prescription drug benefit, such as hypertension that is more difficult to control, a reluctance to treat isolated systolic hypertension in older persons or to use multidrug regimens in this age cohort.²³ A recent analysis examining the impact of drug benefit caps among Medicare beneficiaries found that hypertensive patients with prescription limits or “caps” used fewer medications and were less adherent to their prescribed regimens. However, patients with a cap had only slightly higher odds of poor control than those without caps, with no differences in control seen in a sensitivity analysis limited to patients who actually exceeded the cap.²⁴ Although this analysis did not include Medicare patients without drug coverage, it supports the idea that achieving adequate hypertensive control among older persons will require more than simply providing broader prescription drug coverage. Our findings suggest that the new Medicare Part D drug benefit in isolation may have only a limited effect in improving BP control within this vulnerable population of Medicare recipients without medication coverage.

Our study used cross-sectional data, and therefore cannot establish causal associations with certainty. Other limitations include the lack of data on specific participant medication regimens, pharmacy benefits, or out-of-pocket medication costs.

Although this analysis is somewhat limited in that it depends on self-reported data such as a history of elevated BP, other investigators have noted that self-report is an acceptable proxy for a history of hypertension.¹¹ We included in our analysis some participants who self-report a history of hypertension, but have a normal BP value on examination despite no pharmacologic treatment. We were

unable to distinguish between those participants who manage their BP with diet and exercise and others with labile, sometimes elevated BP, who had normal readings at the time of the NHANES examination. However, BP lability is unlikely to correlate with insurance status, and therefore we do not believe that this limitation introduces misclassification bias.

In conclusion, differences in BP control between privately insured and uninsured participants are primarily related to divergence among those individuals receiving antihypertensive treatment. Insurance status is not associated with elevated BP among untreated participants with a history of hypertension. These findings suggest that the difference in hypertension control explained by insurance status may not be due to a lack of initiating medications for the uninsured, but rather to a failure to appropriately titrate medication regimens, or increased rates of nonadherence to prescribed antihypertensive therapy among the uninsured. Further analyses to help guide interventions directed toward this issue should improve BP control and thereby reduce end-organ damage for the millions of hypertensive Americans without health insurance.

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