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Health Care Expenditures and Use Associated with Hypertension Among U.S. Adults

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Abstract

Introduction: This study seeks to estimate health care expenditures and use associated with hypertension, focusing on differences among racial and ethnic groups.

Methods: Data were from the 2019 Medical Expenditure Panel Survey, analyzed in 2023. The study sample included noninstitutionalized U.S. adults aged ≥18 years. Outcome variables were health care expenditures and events. Hypertension was determined by a self-reported diagnosis or diagnosis codes. Race and ethnicity were self-reported. A 2-part model was used to estimate expenditures associated with hypertension. A zero-inflated negative binomial model was used to estimate events associated with hypertension. Sampling designs were applied to generate nationally representative estimates.

Results: Hypertension was associated with $2,759 (95% confidence interval [CI]: $2,039, $3,479) in health care expenditures and 10.3 (95% CI: 9.3, 11.3) health care events, including prescriptions filled, in 2019 per person. Compared with non-Hispanic White adults, hypertension-associated health care expenditures were significantly lower among Hispanic adults (difference: −$1,877; 95% CI: −$3,389, −$364) and Asian adults (difference: −$2,452; 95% CI: −$4,093, −$811), and hypertension-associated health care events were significantly lower among Hispanic adults (difference: −3.8; 95% CI: −6.1, −1.6) and non-Hispanic Asian adults (difference: −4.1; 95% CI: −6.9, −1.2). Differences between non-Hispanic White adults and non-Hispanic Black

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CREDIT AUTHOR STATEMENT

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SUPPLEMENTAL MATERIAL

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adults were not statistically significant in health care expenditures (difference: −$954; 95% CI: −$2,849, $941) and events (difference: 0.3; 95% CI: −2.1, 2.8).

Conclusions: This study reveals differences in health care expenditures and use associated with hypertension among racial and ethnic groups. Future studies are needed to examine potential drivers of these differences.

INTRODUCTION

Hypertension is a major risk factor of heart disease and stroke, two leading causes of mortality in the United States.[1–3] According to data from the 2017 to 2020 National Health and Nutrition Examination Survey, 48.1% of U.S. adults (119.9 million) had hypertension, based on the criteria (blood pressure [BP] ≥ 130/80) set by the 2017 American College of Cardiology and American Heart Association's (ACC/AHA) guideline.[4,5] Previous studies have documented that hypertension disproportionately affects certain racial and ethnic subgroups.[4,6–8] For example, non-Hispanic Black adults, compared with their non-Hispanic White counterparts, exhibit a higher prevalence of hypertension and lower rate of BP control.[4,6–9] Moreover, Hispanic and non-Hispanic Asian adults are less likely to be cognizant of their hypertension status and less likely to achieve BP control, compared with non-Hispanic White adults.[6,7,10] These substantial variations in hypertension prevalence, awareness, and treatment contribute to disparities among racial and ethnic population subgroups in hypertension control and severe complications, including heart attack, stroke, and end-stage renal disease.[6–8,11]

Hypertension is one of the most financially burdensome chronic conditions in the United States.[8,12–14] The widespread prevalence and intricate clinical and behavioral management, along with treatment of associated complications, contribute significantly to national health care expenditures and use.[12–15] Previous studies using data from 2000 to 2014 estimated average health care expenditures associated with hypertension at approximately $1,500–$2,500 per person annually in the United States, resulting in total annual expenditures exceeding $100 billion for medical services.[12,13] Notably, a distinction exists between medical expenditures allocated explicitly for hypertension treatment versus medical expenditures associated with hypertension, which is likely to yield a more comprehensive estimate. For instance, the average annual medical expenditures associated with hypertension was $1,494 per person in 2013,[13] compared with $776 for direct hypertension treatment.[16]

Understanding health care expenditures and use associated with hypertension by race and ethnicity can guide tailored interventions and services to improve equity in hypertension treatment and management.[17,18] However, current literature lacks sufficient evidence on potential differences in hypertension-associated health care expenditures and use across racial and ethnic groups. Moreover, in previous studies estimating hypertension-associated medical services, hypertension was diagnosed based on the 140/90 mm Hg criteria.[12,13,19] Consequently, these estimates may not accurately reflect hypertension-related medical services provided under the new guideline. Furthermore, previous studies have primarily focused on healthc are expenditures, neglecting health care use. Hypertension control

and treatment require regular monitoring and medication prescriptions. Uncontrolled hypertension can lead to inpatient hospitalization and emergency department (ED) treatment. Investigating health care use might provide a broader perspective beyond financial costs and help comprehensively understand how health care services are accessed, used, and distributed among different demographic groups affected by hypertension.

This study seeks to comprehensively estimate health care expenditures and use associated with hypertension both overall and by race and ethnicity, using a nationally representative sample participating in the Medical Expenditure Panel Survey (MEPS). Evidence suggested an interactive relationship between coronavirus disease 2019 (COVID-19) and hypertension,[20,21] and the COVID-19 pandemic significantly altered the survey modes and response rates of the MEPS program.[22] To mitigate potential effects of COVID-19 on the health care expenditures and use for persons with hypertension, this study exclusively used data collected in 2019.

METHODS

Study Sample

This study used the 2019 MEPS household component full-year consolidated data file, medical condition file, and event files. Details on study design, sampling strategies, and composition of different panels of MEPS can be found elsewhere.[23] The full-year files provide data collected from nationally representative noninstitutionalized U.S. residents each year. The study sample was adults aged 18 years and older. Pregnant women and persons with a diagnosis of childhood hypertension (diagnosed at age 17 years or younger) were excluded. Information regarding pregnancy status had not been collected through questionnaires since 2017. Therefore, medical condition files were used to identify and exclude respondents with pregnancy-related events (*International Classification of Diseases, Tenth Revision, Clinical Modification* [ICD-10-CM] codes in Appendix Table 1). The public-use files of the MEPS study are deidentified. This activity was reviewed by CDC, deemed research not involving human subjects, and was conducted consistent with applicable federal law and CDC policy.

Measures

The exposure variable in this study was diagnosis of hypertension, determined by either a self-reported diagnosis of hypertension (not during pregnancy) or ICD-10-CM diagnosis codes (I10–I15) in the medical condition file. Outcome variables were all-cause health care expenditures and events,[16] both in total and by subtype (prescribed medications, outpatient services, inpatient services, and ED services). Expenditures in MEPS represent actual payments made to health care providers and facilities. Medication expenditures refer to expenditures for outpatient prescription medications, excluding prescriptions in inpatient settings. Outpatient expenditures encompass expenditures for both office-based and outpatient facilities and providers. Health care use was measured as the number of health care events.[16] A health care event was defined as a purchase or refill of prescribed medication, an outpatient visit, an inpatient hospitalization, an ED visit, or a home-based

service within a month, consistent with definitions used by the MEPS research team.[16] Sensitivity analysis that excluded prescription refills was conducted.

Information regarding race and ethnicity was self-reported. Respondents were categorized as Hispanic, non-Hispanic Asian, non-Hispanic Black, non-Hispanic White, and non-Hispanic Other. Other covariates included sex (male and female[reference]), age group (18–24, 25–34, 35–44, 45–54, 55–64, and ≥65 years [reference]), education level (fewer than 12, 12, 1–3 years of college, and 4 years of college and above [reference]), income level measured as % of poverty line (<100%, 100%–124%, 125%–199%, 200%–399%, and ≥400%[reference]), marital status (married[reference], widowed, divorced, separated, and never married), insurance coverage (any private[reference], public only, and uninsured), census region (Northeast[reference], Midwest, South, and West), current smoking status (yes and no[reference]), perceived mental health status (excellent[reference], very good, good, fair, and poor), high cholesterol diagnosis (yes and no[reference]) and comorbidity score based on the Charlson Comorbidity Index (CCI). Covariates were self-reported except for CCI.

CCI was calculated based on both self-reported data and ICD-10-CM diagnosis codes in the medical condition file. CCI includes 19 conditions and assigns a score (range; 1–6) to each condition.[24] In this analysis, cardiovascular diseases and renal diseases was excluded to calculate CCI scores because they are disease outcomes attributable to hypertension. Because the MEPS medical condition file only records the first 3 digits of ICD-10 diagnosis codes, this analysis could not differentiate between “liver disease, mild” and “liver disease, moderate to severe” or “diabetes without chronic complications” and “diabetes with chronic complications.” They were all assigned with a score of 1. Conditions that require more than 3-digit diagnosis codes could not be identified and were not included for analysis (Appendix Table 1). CCI score was categorized as 0[reference], 1, 2, and 3 and more, and used as a categorical variable.

Statistical Analysis

This study first provides descriptive statistics of study participants’ characteristics, including unweighted sample size, weighted percentages, and 95% confidence intervals (CIs). The means of health care expenditures and events among population subgroups were reported. A 2-part model was used to estimate health care expenditures associated with hypertension.[25] The first part was a logit model estimating probability of incurring any health care expenditures. The second part was a generalized linear regression with a log link and gamma distribution estimating expenditures associated with hypertension among participants with positive expenditures, controlling for the same covariates as in the first part (Appendix Methods). A zero-inflated negative binomial model was used to estimate number of health care events associated with hypertension.[26] A zero-inflated negative binomial model combines a negative binomial count model with a binary model to account for the excess zeros (Appendix Methods). An interaction term between hypertension diagnosis and participant’s race and ethnicity was added to each model to estimate expenditures and events associated with hypertension among each racial and ethnic group. For all models, the variables sex, age group, education level, income level, marital status, insurance coverage,

census region, current smoking status, perceived mental health status, high cholesterol diagnosis, and CCI score were controlled for.

Sampling procedures and weights were applied to generate nationally representative estimates. Predicted expenditures and number of events by hypertension status and the incremental differences in those predicted outcomes by hypertension status (the average marginal effects of hypertension) with 95% CIs were reported. Furthermore, differences in average marginal effects by race and ethnicity were reported. After obtaining annual per-person estimates from the above, a multiplication between annual per-person estimates and the number of U.S. adults with hypertension (i.e., weighted count of participants with hypertension) was used to obtain health care expenditures and use associated with hypertension at the national level.

Data management and analysis were conducted using Stata 17 (StataCorp, LLC, College Station, TX). The Stata command *margins* was used to obtain per-person estimates from each model. Statistical tests were 2-tailed with a significance level α=0.05.

RESULTS

Table 1 summarizes participants' characteristics. Among 21,167 participants, 32.8% had received a hypertension diagnosis. The racial and ethnic distribution included 62.5% non-Hispanic White, 16.5% Hispanic, 11.8% non-Hispanic Black, and 6.2% non-Hispanic Asian. Additionally, 26% of participants had income below 200% poverty line; 7.6% were uninsured, and 13.7% were current smokers. Approximately 30% of participants had one or more comorbidities defined by CCI, excluding cardiovascular and renal diseases. Prevalence of a hypertension diagnosis differed significantly among racial and ethnic groups, with rates of 24.0% among Hispanic adults, 26.0% among non-Hispanic Asian adults, 32.7% among non-Hispanic Other adults, 34.9% among non-Hispanic White adults, and 37.7% among non-Hispanic Black adults (Appendix Table 2).

Table 2 presents unadjusted per-person total health care expenditures and events among population subgroups. Among participants with hypertension, the total health care expenditures were $12,299 (95% CI: $11,671, $12,928) per person, compared with $4,678 (95% CI: $4,404, $4,952) for those without hypertension. The total number of health care events was 38.1 (95% CI: 37.0, 39.2) per person, compared with 13.2 (95% CI: 12.6, 13.7) for those without hypertension. Health care expenditures and events by subtype are presented in Appendix Tables 3 and 4.

Table 3 shows adjusted annual health care expenditures associated with hypertension per person, both overall and by race and ethnicity. Full regression results for the total health care expenditures model are presented in Appendix Table 5. The total health care expenditures associated with hypertension were $2,759 (95% CI: $2,039, $3,479). By race and ethnicity, total health care expenditures associated with hypertension were $3,301 (95% CI: $2,383, $4,219) for non-Hispanic White adults, $1,425 (95% CI: $180, $2,669) for Hispanic adults, $2,347 (95% CI: $545, $4,149) for non-Hispanic Black adults, and $849 (95% CI: −$559, $2,257) for non-Hispanic Asian adults. Compared with non-Hispanic White adults, health

care expenditures associated with hypertension were $1,877 lower (95% CI: −$3,389, −$364) for Hispanic adults, and $2,452 lower (95% CI: −$4,093, −$811) for non-Hispanic Asian adults. Overall, health care expenditures associated with hypertension were mainly driven by inpatient services ($1,000; 95% CI: $698, $1,302), outpatient services ($884; 95% CI: $576, $1,192), and medication prescriptions ($409; 95% CI: $59–$759). Compared with non-Hispanic White adults, non-Hispanic Asian adults had significantly lower expenditures associated with hypertension for outpatient services (difference: −$1,233; 95% CI: −$2,014, −$453) and inpatient services (difference: −$917; 95% CI: −$1,786, −$48).

Table 4 presents adjusted number of health care events associated with hypertension per person annually, both overall and by race and ethnicity. Full regression results for the total health care events model are reported in Appendix Table 6. Total number of health care events associated with hypertension was 10.3 (95% CI: 9.3, 11.3). By race and ethnicity, number of health care events associated with hypertension was 11.2 (95% CI: 9.9, 12.4) for non-Hispanic White adults, 7.3 (95% CI: 5.5, 9.2) for Hispanic adults, 11.5 (95% CI: 9.3, 13.7) for non-Hispanic Black adults, and 7.1 (95% CI: 4.3, 9.8) for non-Hispanic Asian adults. Compared with non-Hispanic White adults, number of health care events associated with hypertension was significantly lower for Hispanic adults (difference: −3.8; 95% CI: −6.1, −1.6) and non-Hispanic Asian adults (difference: −4.1; 95% CI: −6.9, −1.2). Overall, health care events associated with hypertension were mainly driven by medication prescriptions (6.8; 95% CI: 6.2, 7.3) and outpatient visits (2.1; 95% CI: 1.5, 2.7). Compared with non-Hispanic White adults, Hispanic adults had statistically significantly lower numbers of medication prescriptions (difference: −2.1; 95% CI: −3.4, −0.8) and inpatient visits (difference: −0.03, 95% CI: −0.06, −0.01) associated with hypertension, and non-Hispanic Asian adults had statistically significantly lower numbers of outpatient visits (difference: −1.9, 95% CI: −3.7, −0.0) and inpatient visits (difference: −0.05, 95% CI: −0.09, −0.02) associated with hypertension. Sensitivity analysis shows consistent relative relationships (Appendix Table 7).

The weighted count showed 79,463,177 U.S. adults had hypertension. Estimated annual national health care expenditures associated with hypertension were about $219.2 billion in the United States in 2019. This includes $32.5 billion in prescribed medication purchases, $70.2 billion in outpatient services, and $79.4 billion in inpatient services. The number of health care events associated with hypertension was about 817.4 million, including 538.2 million prescribed medication purchases, 168.1 million outpatient visits, 3.5 million inpatient visits, and 6.0 million ED visits (Appendix Table 8).

DISCUSSION

This study, using a nationally representative sample of U.S. adults, revealed that hypertension was associated with $2,759 health care expenditures and 10.3 health care events per person in 2019. Study findings also provide information regarding differences in health care expenditures and use associated with hypertension across racial and ethnic groups, which to the authors' knowledge have not been reported previously. This study found that Hispanic adults ($1,425) and non-Hispanic Asian adults ($849) exhibited significantly lower health care expenditures associated with hypertension, compared with

non-Hispanic White adults ($3,301). Similarly, differences were evident in the number of health care events associated with hypertension, with Hispanic (7.3) and non-Hispanic Asian (7.1) adults experiencing significantly fewer events, compared with non-Hispanic White adults (11.2).

This study highlights the substantial burden of hypertension on the health care system in the United States, with approximately $219 billion health care expenditures and about 817 million health care events associated with hypertension. The MEPS study reported that total health care expenditures were approximately $2.05 trillion, and total number of health care events was about 5.95 billion in 2019.[16] Results from this study indicated that hypertension was associated with more than 10% of the total health care expenditures and events at national level, emphasizing the urgent need for hypertension management approaches in the United States to reduce hypertension-related cost.

This study contributes to current literature in documenting differences in hypertension-associated health care expenditures and use across racial and ethnic groups. These findings indicate that Hispanic adults and non-Hispanic Asian adults had significantly lower health care expenditures and use associated with hypertension, compared with non-Hispanic White adults. This is consistent with literature indicating that Hispanic and non-Hispanic Asian populations generally have better health outcomes and less health care spending.[12,27–29] However, health care-seeking behavior is an intricate interplay of multifaceted factors, including socioeconomic status, sociocultural influences, and health care access. Hispanic health paradox is usually invoked to describe that despite facing socioeconomic disparities, Hispanic populations often exhibit unexpectedly favorable health outcomes, including better physical health and lower mortality.[30–32] Studies trying to unravel this paradox point out that this might be due to potential selection bias, or Hispanic people, on average, may not receive health care services they need.[30–33] On average, non-Hispanic Asian populations reported having higher income and better health than non-Hispanic White populations.[27,34–36] However, Asian populations were underrepresented in surveys and may also face significant challenges that affect their health care access and use. This includes diverse cultural backgrounds, language variations, and different socioeconomic statuses in the United States.[36–38]

Previous studies have documented significantly higher hypertension-related complications among non-Hispanic Black adults than among non-Hispanic White adults.[2,8,11] For example, non-Hispanic Black adults have a higher prevalence of cardiovascular disease, a twofold increase in stroke-related mortality, and a fivefold increase in the prevalence of end-stage renal disease, compared with non-Hispanic White adults.[2,8,11] However, this study did not observe significant differences in health care expenditures and use associated with hypertension between non-Hispanic Black adults and non-Hispanic White adults. One potential explanation might be that non-Hispanic Black adults have limited access to health care and intervention services compared with non-Hispanic White adults.[39–41] Previous studies reported that compared with non-Hispanic White people, non-Hispanic Black persons are more likely to be uninsured and more likely to be located in areas with limited access to health care facilities.[9,39,42] Previous studies also reported lower treatment

effectiveness, with treated but uncontrolled hypertension being significantly higher among non-Hispanic Black adults than non-Hispanic White adults.[6,43]

Another finding worth noting is that prevalence of hypertension diagnosis remained stable despite the new ACC/AHA guideline.[12,13] In 2019, hypertension diagnosis was 32.8%, significantly lower than the National Health and Nutrition Examination Survey estimates (48%),[4] underscoring the need for improved diagnostic strategies. Factors such as limited health care access, guideline implementation, and diagnostic challenges might contribute to undiagnosed hypertension.[5,44,45] The ACC/AHA guideline recommend patients use self-measured BP monitoring systems outside the clinic to improve diagnostic accuracy, increase patient engagement, and lower costs.[5]

Limitations

First, this study primarily used self-reported data, which can be subject to bias. For example, respondents might not be able to accurately report expenditures and use of medical services, and MEPS has insufficient resources to verify all data. Previous studies indicate that health care expenditures and use may be underreported in MEPS.[46,47] Second, this study used both self-reported data and medical condition files to identify patients with hypertension. However, this approach did not include persons who had hypertension but had not received a diagnosis or exclude persons who mistakenly recalled being diagnosed, which can result in misclassification and biased estimates. Finally, because of data limitations, this study was not able to examine potential drivers of differences in hypertension-associated health care expenditures and use among racial and ethnic subgroups. Future studies are needed to fully understand these differences.

CONCLUSIONS

This study, using nationally representative data, found that hypertension was associated with $2,759 in health care expenditures and 10.3 health care events per person, and $219 billion in health care expenditures and 817 million health care events in the United States in 2019. Significant differences exist across racial and ethnic groups, with Hispanic and non-Hispanic Asian adults demonstrating significantly lower health care expenditures and use, compared with non-Hispanic White adults. Despite documented disparities in hypertension-related complications, this study did not find statistically significant differences in expenditures or use between non-Hispanic White adults and non-Hispanic Black adults. In light of these findings, further research is warranted to explore the underlying factors contributing to the observed differences in health care expenditures and use among racial and ethnic groups affected by hypertension.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Participant Characteristics, Medical Expenditure Panel Survey, 2019 (*N*=21,167)

Variables	Unweighted *N*	Weighted %	95% CI
Hypertension diagnosis			
Yes	7,687	32.8	31.9–33.7
No	13,215	67.2	66.3–68.1
Race and ethnicity			
Hispanic	4,316	16.5	15.0–18.2
Non-Hispanic Asian	1,106	6.2	5.3–7.1
Non-Hispanic Black	2,983	11.8	10.7–12.9
Non-Hispanic White	12,100	62.5	60.7–64.4
Non-Hispanic Other	662	3.0	2.7–3.4
Sex			
Female	11,100	50.9	50.3–51.4
Male	10,067	49.1	48.6–49.7
Age group (years)			
18–24	2,117	11.5	10.8–12.1
25–34	3,138	17.0	16.2–17.8
35–44	3,325	16.2	15.5–16.9
45–54	3,408	16.6	15.9–17.3
55–64	3,780	17.1	16.4–17.8
≥65	5,399	21.7	20.8–22.6
Education			
Fewer than 12 years	3,380	13.2	12.4–14.1
12 years	6,392	27.2	26.2–28.3
1–3 years of college	4,877	26.1	25.2–27.0
4-year college and above	6,349	33.5	32.0–35.0
Income level (as % of poverty line)			
<100%	2,974	10.1	9.4–10.9
100%–124%	933	3.6	3.2–4.0

Variables	Unweighted *N*	Weighted %	95% CI
125%–199%	2,930	12.3	11.5–13.1
200%–399%	6,104	28.8	27.7–30.0
≥400%	8,226	45.2	43.5–46.9
Marital status			
Married	10,559	51.1	50.0–52.2
Widowed	1,557	6.2	5.9–6.6
Divorced	2,701	11.5	10.9–12.1
Separated	504	1.9	1.7–2.2
Never married	5,842	29.2	28.3–30.2
Health insurance coverage			
Any private insurance	13,214	68.8	67.5–70.2
Public insurance only	6,078	23.6	22.6–24.7
Uninsured	1,875	7.6	6.9–8.3
Census region			
Northeast	3,347	17.5	15.4–19.8
Midwest	4,456	20.7	19.1–22.5
South	7,918	37.9	35.4–40.4
West	5,446	23.9	21.8–26.1
Current smoker			
Yes	3,028	13.7	13.0–14.4
No	17,858	86.3	85.6–87.0
Mental health status			
Excellent	6,316	31.3	30.3–32.4
Very good	6,623	33.1	32.2–34.1
Good	6,041	26.9	26.1–27.8
Fair	1,677	7.1	6.7–7.6
Poor	381	1.5	1.3–1.7
High cholesterol diagnosis			
Yes	6,632	29.5	28.7–30.3

Variables	Unweighted *N*	Weighted %	95% CI
No	14,261	70.5	69.7–71.3
Comorbidity score			
0	13,823	67.9	67.2–68.7
1	4,587	20.5	19.9–21.0
2	1,812	7.8	7.3–8.2
≥3	945	3.8	3.5–4.2

Table 2.

Health care Expenditures and Use Among Population Subgroups

	Total expenditures		Total events	
Variables	**Costs ($)**	**95% CI**	**Number**	**95% CI**
Hypertension diagnosis				
Yes	12,299.4	11,671–12,928	38.1	37.0–39.2
No	4,678.2	4,404–4,952	13.2	12.6–13.7
Race and ethnicity				
Non-Hispanic White	8,208.7	7,841–8,576	24.8	24.0–25.5
Hispanic	4,465.7	3,886–5,045	12.6	11.7–13.6
Non-Hispanic Black	6,447.7	5,695–7,200	17.8	16.4–19.1
Non-Hispanic Asian	4,189.8	3,360–5,019	12.8	11.3–14.4
Non-Hispanic Other	8,756.7	6,665–10,849	26.9	22.9–30.8
Sex				
Female	7,745.9	7,342–8,149	24.5	23.8–25.3
Male	6,537.1	6,162–6,912	17.9	17.2–18.6
Age group (years)				
18–24	2,663.4	2,168–3,159	7.6	6.9–8.4
25–34	3,101.7	2,699–3,505	9.3	8.6–10.1
35–44	4,447.5	3,913–4,981	14.4	13.2–15.7
45–54	6,692.4	6,057–7,328	20.2	19.0–21.4
55–64	10,030.5	9,118–10,943	27.7	26.3–29.1
≥65	12,789.5	12,105–13,474	38.7	37.5–39.9
Education				
Fewer than 12 years	6,649.3	5,864–7,434	22.3	20.7–23.9
12 years	7,006.1	6,508–7,504	20.6	19.7–21.6
1–3 years of college	7,393.2	6,779–8,008	22.0	20.8–23.1
4-year college and above	7,302.2	6,772–7,832	21.1	20.2–21.9
Income level (as % of poverty line)				
<100%	8,218.8	7,395–9,042	28.4	26.3–30.6

Variables	Total expenditures		Total events	
	Costs ($)	95% CI	Number	95% CI
100%–124%	7,052.7	5,978–8,128	23.9	21.3–26.5
125%–199%	6,858.3	6,024–7,692	21.6	20.0–23.3
200%–399%	6,394.4	5,913–6,876	19.4	18.4–20.3
≥400%	7,483.7	7,016–7,951	20.6	19.8–21.4
Marital status				
Married	7,390.7	6,994–7,787	21.1	20.4–21.8
Widowed	13,494.5	12,371–14,618	41.8	39.4–44.2
Divorced	9,744.7	8,824–10,665	30.0	28.3–31.6
Separated	9,007.3	6,830–11,184	30.3	26.6–33.9
Never married	4,238.5	3,832–4,645	13.2	12.3–14.1
Health insurance coverage				
Any private insurance	6,837.4	6,513–7,161	18.6	18.0–19.1
Public insurance only	10,012.8	9,367–10,659	34.6	33.2–36.1
Uninsured	1,084.8	908–1,262	4.4	3.7–5.0
Census region				
Northeast	7,439.7	6,890–7,990	23.1	21.8–24.4
Midwest	8,289.8	7,563–9,017	23.7	22.4–25.0
South	6,497.6	6,063–6,932	20.7	19.6–21.8
West	6,990.0	6,366–7,614	18.8	17.8–19.9
Current smoker				
Yes	6,965.5	6,184–7,747	22.2	20.5–23.8
No	7,163.9	6,858–7,470	21.2	20.6–21.8
Mental health status				
Excellent	5,183.2	4,761–5,605	14.5	13.8–15.2
Very good	6,088.0	5,652–6,524	18.2	17.4–19.0
Good	8,374.3	7,761–8,987	25.9	24.7–27.1
Fair	13,645.8	12,211–15,081	41.6	38.8–44.3
Poor	15,551.7	12,638–18,465	48.0	41.1–54.8

Variables	Total expenditures		Total events	
	Costs ($)	95% CI	Number	95% CI
High cholesterol diagnosis				
Yes	11,968.2	11,381–12,555	37.8	36.6–39.0
No	5,179.2	4,881–5,477	14.5	13.9–15.0
Comorbidity score				
0	4,407.7	4,137–4,678	13.6	13.1–14.1
1	9,912.0	9,274–10,550	31.8	30.6–33.1
2	17,914.1	16,339–19,490	44.4	42.1–46.8
≥3	19,289.3	17,054–21,525	53.8	50.5–57.1

Table 3.

Adjusted[a] Health care Expenditures (95% CI) Associated with Hypertension, Overall and By Race and Ethnicity

Categories	Overall	NH White	Hispanic	NH Black	NH Asian	NH Other
Total expenditures						
Hypertension						
Yes	8,831 (8,290, 9,372)	10,162 (9,450, 10,873)	5,544 (4,509, 6,578)	8,034 (6,823, 9,244)	4,520 (3,433, 5,607)	10,690 (7,277, 14,103)
No	6,072 (5,689, 6,455)	6,860 (6,383, 7,338)	4,119 (3,393, 4,846)	5,686 (4,448, 6,924)	3,671 (2,806, 4,536)	6,559 (4,203, 8,915)
Difference	**2,759 (2,039, 3,479)**	**3,301 (2,383, 4,219)**	**1,425 (180, 2,669)**	**2,347 (545, 4,149)**	849 (−559, 2,257)	**4,131 (93, 8,169)**
Difference from NH White			**−1,877 (−3,389, −364)**	−954 (−2,849, 941)	**−2,452 (−4,093, −811)**	830 (−3,193, 4,852)
Medication						
Hypertension						
Yes	2,031 (1,832, 2,231)	2,292 (2,061, 2,524)	1,091 (914, 1,268)	2,156 (1,455, 2,856)	1,185 (796, 1,575)	2,930 (1,829, 4,031)
No	1,623 (1,375, 1,870)	1,785 (1,498, 2,071)	1,119 (631, 1,608)	1,592 (941, 2,243)	652 (323, 981)	3,062 (465, 5,660)
Difference	**409 (59, 759)**	**507 (122, 893)**	−28 (−548, 492)	564 (−444, 1,571)	**533 (62, 1,004)**	−132 (−2,777, 2,512)
Difference from NH White			−536 (−1,171, 100)	56 (−883, 995)	26 (−529, 580)	−640 (−3,245, 1,966)
Outpatient						
Hypertension						
Yes	3,206 (2,938, 3,474)	3,830 (3,481, 4,180)	1,854 (1,299, 2,408)	2,660 (2,150, 3,171)	1,590 (1,211, 1,969)	2,872 (2,027, 3,717)
No	2,322 (2,174, 2,470)	2,740 (2,547, 2,933)	1,350 (1,097, 1,604)	1,837 (1,441, 2,232)	1,733 (1,169, 2,296)	1,942 (1,496, 2,388)
Difference	**884 (576, 1,192)**	**1,091 (679, 1,502)**	503 (−96, 1,103)	**824 (190, 1,457)**	−143 (−814, 529)	930 (−60, 1,920)
Difference from NH White			−587 (−1,327, 152)	−267 (−987, 453)	**−1,233 (−2,014, −453)**	−161 (−1,166, 845)
Inpatient						
Hypertension						
Yes	2,005 (1,742, 2,267)	2,300 (1,972, 2,628)	1,371 (901, 1,842)	1,786 (1,295, 2,276)	789 (128, 1,451)	2,588 (994, 4,182)
No	1,005 (869, 1,142)	1,153 (966, 1,339)	674 (416, 932)	972 (578, 1,366)	559 (188, 930)	750 (354, 1,146)
Difference	**1,000 (698, 1,302)**	**1,147 (769, 1,526)**	**698 (169, 1,227)**	**814 (171, 1,456)**	230 (−533, 993)	**1,838 (170, 3,505)**
Difference from NH White			−449 (−1,074, 175)	−333 (−1,001, 334)	**−917 (−1,786, −48)**	691 (−976, 2,357)
Emergency department						
Hypertension						

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Categories	Overall	NH White	Hispanic	NH Black	NH Asian	NH Other
Yes	292 (257, 326)	310 (265, 355)	216 (149, 284)	332 (254, 410)	121 (54, 187)	510 (293, 726)
No	236 (213, 260)	258 (229, 286)	151 (122, 181)	260 (183, 336)	160 (71, 248)	324 (164, 484)
Difference	**55 (13, 98)**	**52 (0, 105)**	65 (−7, 137)	72 (−34, 179)	−39 (−160, 82)	186 (−95, 466)
Difference from NH White			13 (−68, 93)	20 (−90, 130)	−92 (−224, 41)	133 (−151, 418)

Note: Boldface indicates statistical significance ($p<0.05$).

[a]Model controlled for sex, age group, education level, income level, marital status, insurance coverage, census region, current smoking status, perceived mental health status, high cholesterol diagnosis, and comorbidity score based on the Charlson Comorbidity Index (CCI).

Table 4.

Adjusted[a] Health care Events (95% CI) Associated with Hypertension, Overall and By Race and Ethnicity

Categories	Overall	NH White	Hispanic	NH Black	NH Asian	NH Other
Total events						
Hypertension						
Yes	27.4 (26.5, 28.2)	31.6 (30.5, 32.7)	17.2 (15.6, 18.8)	23.7 (22.0, 25.4)	16.8 (14.5, 19.1)	29.9 (26.1, 33.7)
No	17.1 (16.5, 17.6)	20.4 (19.7, 21.2)	9.9 (8.9, 10.9)	12.2 (10.7, 13.8)	9.7 (8.1, 11.3)	19.8 (16.7, 22.9)
Difference	**10.3 (9.3, 11.3)**	**11.2 (9.9, 12.4)**	**7.3 (5.5, 9.2)**	**11.5 (9.3, 13.7)**	**7.1 (4.3, 9.8)**	**10.1 (5.6, 14.6)**
Difference from NH White			**−3.8 (−6.1, −1.6)**	0.3 (−2.1, 2.8)	**−4.1 (−6.9, −1.2)**	−1.0 (−5.5, 3.5)
Medication						
Hypertension						
Yes	15.1 (14.7, 15.6)	17.1 (16.5, 17.7)	10.1 (9.2, 11.0)	13.6 (12.7, 14.5)	9.4 (8.0, 10.7)	18.3 (15.6, 21.1)
No	8.3 (8.0, 8.7)	10.0 (9.5, 10.4)	5.0 (4.5, 5.5)	5.9 (5.1, 6.8)	3.6 (2.9, 4.2)	11.8 (9.6, 14.0)
Difference	**6.8 (6.2, 7.3)**	**7.2 (6.4, 7.9)**	**5.1 (4.1, 6.1)**	**7.7 (6.5, 8.8)**	**5.8 (4.3, 7.3)**	**6.5 (3.5, 9.5)**
Difference from NH White			**−2.1 (−3.4, −0.8)**	0.5 (−0.8, 1.8)	−1.4 (−3.0, 0.3)	−0.6 (−3.6, 2.4)
Outpatient						
Hypertension						
Yes	9.4 (8.9, 9.9)	11.2 (10.6, 11.9)	5.4 (4.5, 6.3)	7.5 (6.7, 8.4)	5.6 (4.2, 7.0)	9.1 (7.3, 10.8)
No	7.3 (7.0, 7.6)	8.8 (8.4, 9.2)	4.1 (3.5, 4.7)	5.1 (4.3, 6.0)	5.0 (3.9, 6.2)	7.8 (6.3, 9.3)
Difference	**2.1 (1.5, 2.7)**	**2.5 (1.7, 3.2)**	**1.3 (0.2, 2.4)**	**2.4 (1.1, 3.6)**	0.6 (−1.3, 2.4)	1.3 (−1.0, 3.6)
Difference from NH White			−1.1 (−2.4, 0.1)	−0.1 (−1.5, 1.3)	**−1.9 (−3.7, −0.0)**	−1.2 (−3.5, 1.2)
Inpatient						
Hypertension						
Yes	0.11 (0.10, 0.12)	0.13 (0.12, 0.14)	0.07 (0.05, 0.08)	0.11 (0.09, 0.13)	0.04 (0.01, 0.06)	0.13 (0.08, 0.18)
No	0.07 (0.06, 0.08)	0.08 (0.07, 0.09)	0.05 (0.03, 0.06)	0.08 (0.05, 0.10)	0.03 (0.02, 0.05)	0.09 (0.05, 0.14)
Difference	**0.04 (0.03, 0.06)**	**0.06 (0.04, 0.07)**	**0.02 (0.00, 0.04)**	0.03 (−0.00, 0.06)	0.00 (−0.02, 0.03)	0.04 (−0.03, 0.11)
Difference from NH White			**−0.03 (−0.06, −0.01)**	−0.03 (−0.06, 0.01)	**−0.05 (−0.09, −0.02)**	−0.02 (−0.09, 0.05)
Emergency department						
Hypertension						

Categories	Overall	NH White	Hispanic	NH Black	NH Asian	NH Other
Yes	0.26 (0.24, 0.28)	0.27 (0.25, 0.29)	0.21 (0.17, 0.26)	0.33 (0.28, 0.38)	0.10 (0.05, 0.14)	0.38 (0.26, 0.50)
No	0.18 (0.17, 0.20)	0.19 (0.18, 0.21)	0.14 (0.12, 0.16)	0.22 (0.19, 0.26)	0.08 (0.03, 0.13)	0.31 (0.20, 0.41)
Difference	**0.08 (0.05, 0.10)**	**0.08 (0.05, 0.10)**	**0.07 (0.02, 0.12)**	**0.11 (0.05, 0.17)**	0.02 (−0.06, 0.09)	0.07 (−0.10, 0.24)
Difference from NH White			0.00 (−0.06, 0.05)	0.03 (−0.03, 0.09)	−0.06 (−0.14, 0.02)	−0.01 (−0.17, 0.16)

Note: Boldface indicates statistical significance ($p<0.05$).

[a]Model controlled for sex, age group, education level, income level, marital status, insurance coverage, census region, current smoking status, perceived mental health status, high cholesterol diagnosis, and comorbidity score based on the Charlson Comorbidity Index (CCI).