

Appendix

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

Yu Wang, Jun Soo Lee, Lisa M. Pollack, Ashutosh Kumar, Sally Honeycutt, Feijun Luo.

Appendix Methods

Estimating Health Care Expenditures Associated with Hypertension

A 2-part model was used to estimate health care expenditures associated with hypertension because the outcome variable has a significant number of 0 values.¹⁻² In this study, 14.8% of participants did not incur any health care cost, 34.9% of them did not have prescribed medication cost, 24.2% did not have outpatient cost, 93.0% did not have inpatient cost, and 86.2% did not have emergency department (ED) cost in 2019.

1. Part I is a binary model (logistic regression in this study) that estimates the probability of the outcome being greater than 0.

$$\Pr(Y > 0|X) = \frac{1}{1 + \exp(-X\beta)}$$

Where X is a vector of predictors, and β is a vector of coefficients. In this study, X were hypertension diagnosis, race and ethnicity, the interaction between hypertension diagnosis and race and ethnicity, 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).

2. Part II estimates the positive values of outcome, conditional on the outcome variable being greater than 0. Because medical expenditures have a skewed distribution, this study used a generalized linear regression with a log link and gamma distribution for the second part of the model.

$$E(Y|Y > 0) = X\gamma + \varepsilon$$

Where X is again the vector of predictors, γ is a vector of coefficients for the positive outcomes. ε represents the error term. This study used the same set of covariates for both parts.

Estimating Health Care Events Associated with Hypertension

A zero-inflated negative binomial (ZINB) model was used to estimate the number of health care events associated with hypertension because of the outcome being count data with excess 0 values.³ In this study, 16.0% of participants did not have any health care event, 34.8% of them did not have any prescribed medication, 24.0% did not have any outpatient visit, 93.0% did not have any inpatient visit, and 85.2% did not have ED visit in 2019. A ZINB model combines a negative binomial count model with a binary model to account for the excess 0s.

1. Zero-Inflation Model: a logistic regression that estimates the probability of an excess 0.

$$\Pr(Y = 0|\mathbf{Z}) = \frac{1}{1 + \exp(-\mathbf{Z}\boldsymbol{\alpha})}$$

Where $\mathbf{Z}$ is a vector of predictors for the zero-inflation part, and $\boldsymbol{\alpha}$ is a vector of coefficients for the zero-inflation model. In this model, $\mathbf{Z}$ were 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). Hypertension diagnosis, race and ethnicity, and the interaction between hypertension diagnosis and race and ethnicity were not included in the zero-inflation part.

2. Count Model: it was assumed that the count part of the model follows a negative binomial distribution. The expected count (mean) in the count model part is,

$$E(Y) = \exp(\mathbf{X}\boldsymbol{\delta})$$

Where $\mathbf{X}$ is the vector of predictors for the count part, and $\boldsymbol{\delta}$ is a vector of coefficients for the count model. $\mathbf{X}$ included hypertension diagnosis, race and ethnicity, the interaction between hypertension diagnosis and all other covariates.

References

1. Deb P, Norton EC. Modeling health care expenditures and use. *Annu Rev Public Health*. 2018;39:489-505. doi: 10.1146/annurev-publhealth-040617-013517
2. Belotti F, Deb P, Manning WG, Norton EC. twopm: Two-part models. *The Stata Journal*. 2015;15(1):3-20. doi:10.1177/1536867X1501500102
3. Jones, A. (2007). *Applied Econometrics for Health Economists: A Practical Guide* (2nd ed.). CRC Press. <https://doi.org/10.1201/9781785230141>

Appendix Table 1. *International Classification of Diseases, Tenth Revision (ICD-10) Codes for Pregnancy and Charlson Comorbidity Index (CCI)*

Condition	Points	ICD-10 code from Medical Condition File
Pregnancy		Oxx, Z33, Z34, Z36, Z37, Z39, F53, A34
Dementia	1	F00, F01, F02, F03, G30
Chronic pulmonary disease	1	J40–J47, J60–J67
Rheumatic disease	1	M05, M06, M32, M33, M34
Peptic ulcer disease	1	K25, K26, K27, K28
Liver disease	1	B18, K70–K77
Diabetes	1	E10, E11, E12, E13, E14
Hemiplegia or paraplegia	2	G81, G82
Any malignancy	2	C00–C26, C30–C34, C37–C41, C43, C45–C58, C60–C76, C81–C85, C88, C90–C97
Metastatic solid tumor	6	C77, C78, C79, C80
HIV infection, no AIDS	3	B20, B21, B22, B24
AIDS	6	No HIV or AIDS cases in MEPS

Appendix Table 2. Hypertension Diagnosis Among Population Subgroups

	Weighted %	95% CI	P-value
Race and ethnicity			0.0000
Hispanic	24.0	22.4–25.7	
Non-Hispanic Asian	26.0	23.1–29.2	
Non-Hispanic Black	37.7	35.3–40.2	
Non-Hispanic White	34.9	33.6–36.1	
Non-Hispanic Other	32.7	29.0–36.6	
Sex			0.0001
Female	31.4	30.2–32.6	
Male	34.3	33.1–35.4	
Age group (years)			0.0000
18–24	1.8	1.3–2.6	
25–34	7.9	6.8–9.2	
35–44	18.1	16.4–19.8	
45–54	31.6	29.6–33.7	
55–64	47.8	45.7–49.9	
≥65	67.7	66.2–69.1	
Education			0.0000
Fewer than 12 years	38.3	36.2–40.6	
12 years	36.6	35.0–38.2	
1–3 years of college	31.7	30.0–33.4	
4-year college and above	28.5	27.2–29.9	
Income level (as % of poverty line)			0.0000
<100%	39.2	37.0–41.4	
100%–124%	37.7	33.6–42.0	
125%–199%	34.9	32.6–37.3	
200%–399%	32.5	31.0–34.1	
≥400%	30.6	29.4–31.8	
Marital status			0.0000
Married	35.5	34.3–36.7	
Widowed	68.8	66.0–71.4	
Divorced	46.4	44.1–48.6	
Separated	41.1	36.2–46.0	
Never married	14.0	12.9–15.2	
Health insurance coverage			0.0000
Any private insurance	28.5	27.5–29.6	
Public insurance only	50.7	48.8–52.5	
Uninsured	16.1	14.0–18.4	
Census region			0.0000
Northeast	31.1	28.9–33.3	
Midwest	33.3	31.3–35.4	

South	35.7	34.1–37.4	
West	29.0	27.4–30.7	
Current smoker			0.0228
Yes	34.9	32.7–37.2	
No	32.3	31.4–33.3	
Mental health status			0.0000
Excellent	25.3	24.0–26.7	
Very good	30.6	29.2–32.1	
Good	39.2	37.5–40.9	
Fair	46.6	43.9–49.2	
Poor	48.6	42.6–54.6	
High cholesterol diagnosis			0.0000
Yes	64.6	63.0–66.1	
No	19.5	18.6–20.4	
Comorbidity score			0.0000
0	23.5	22.6–24.5	
1	46.5	44.6–48.4	
2	59.1	56.7–61.5	
≥3	69.4	65.7–72.9	

Appendix Table 3: Health Care Expenditures Among Population Subgroups: by Subtype

	Medication		Outpatient		Inpatient		Emergency	
	\$	95% CI	\$	95% CI	\$	95% CI	\$	95% CI
Hypertension diagnosis								
Yes	3026.8	2799 – 3255	4053.0	3761 – 4345	3098.6	2732 – 3465	339.9	308 – 372
No	1095.1	944 – 1246	1928.4	1800 – 2057	744.5	629 – 860	214.6	192 – 238
Race and ethnicity								
Non-Hispanic White	1929.9	1757 – 2103	3132.9	2960 – 3305	1719.0	1530 – 1908	271.8	247 – 297
Hispanic	997.2	827 – 1168	1459.0	1174 – 1744	978.7	677 – 1281	170.0	137 – 203
Non-Hispanic Black	1716.2	1326 – 2106	2044.8	1739 – 2351	1483.3	1130 – 1836	282.8	227 – 339
Non-Hispanic Asian	983.0	609 – 1357	1579.8	1214 – 1945	652.4	230 – 1075	181.6	81 – 282
Non-Hispanic Other	2825.1	1799 – 3851	2520.8	1905 – 3136	1960.4	567 – 3353	427.2	286 – 568
Sex								
Female	1767.0	1619 – 1914	2982.0	2799 – 3165	1461.8	1284 – 1640	280.9	251 – 311
Male	1669.8	1471 – 1869	2233.4	2065 – 2402	1561.0	1339 – 1783	229.0	200 – 258
Age group (years)								
18–24	343.4	225 – 461	1000.3	780 – 1221	390.1	148 – 633	228.3	164 – 293
25–34	761.5	536 – 987	1313.3	1088 – 1538	412.8	219 – 607	199.4	158 – 241
35–44	1076.4	838 – 1315	1962.4	1692 – 2233	682.0	456 – 908	210.2	171 – 249
45–54	1768.4	1416 – 2121	2444.2	2188 – 2700	1411.1	1039 – 1783	305.5	245 – 366
55–64	2605.0	2165 – 3045	3533.8	3136 – 3931	2444.2	1880 – 3008	301.9	250 – 354
≥65	2938.9	2663 – 3214	4375.3	4077 – 4674	2918.9	2583 – 3255	272.2	241 – 303
Education								
Fewer than 12 years	1729.0	1485 – 1973	1707.6	1489 – 1926	1684.5	1174 – 2195	276.4	238 – 315
12 years	1676.9	1491 – 1863	2178.7	1975 – 2382	1838.3	1545 – 2132	273.6	238 – 309
1–3 years of college	1731.2	1502 – 1960	3005.3	2668 – 3343	1329.9	1066 – 1593	299.0	250 – 348
4-year college and above	1754.6	1497 – 2013	3052.6	2818 – 3287	1316.1	1077 – 1556	200.0	169 – 231
Income level (as % of poverty line)								
<100%	2222.5	1913 – 2532	2335.6	1963 – 2708	1733.3	1380 – 2087	311.3	264 – 358

100%–124%	2095.9	1561 – 2631	2228.6	1660 – 2797	1318.8	971 – 1666	234.1	171 – 297
125%–199%	1790.3	1439 – 2141	2218.1	1820 – 2616	1323.7	984 – 1664	300.4	243 – 358
200%–399%	1508.6	1326 – 1691	2328.7	2121 – 2537	1471.3	1224 – 1718	268.0	233 – 303
≥400%	1691.7	1479 – 1905	2997.0	2805 – 3189	1551.5	1295 – 1808	224.2	195 – 254
Marital status								
Married	1844.8	1655 – 2035	2831.8	2661 – 3003	1617.3	1387 – 1848	231.2	203 – 259
Widowed	2921.1	2528 – 3315	3869.1	3405 – 4333	2907.1	2439 – 3375	359.8	285 – 435
Divorced	2152.4	1819 – 2486	3640.3	3178 – 4102	2292.8	1792 – 2794	331.5	277 – 386
Separated	2382.2	1796 – 2968	2690.0	1791 – 3589	2409.2	905 – 3913	381.0	238 – 524
Never married	1028.9	838 – 1220	1557.7	1345 – 1770	658.5	492 – 826	237.2	196 – 278
Health insurance coverage								
Any private insurance	1548.3	1395 – 1701	2767.7	2600 – 2936	1452.7	1273 – 1633	254.5	228 – 281
Public insurance only	2703.5	2456 – 2951	2869.0	2666 – 3072	2130.8	1841 – 2420	290.8	261 – 321
Uninsured	202.5	101 – 304	420.8	294 – 547	100.5	34 – 167	153.1	107 – 199
Census region								
Northeast	1716.5	1486 – 1947	2728.5	2410 – 3047	1256.8	1051 – 1463	230.0	196 – 264
Midwest	1913.2	1670 – 2156	3026.5	2680 – 3373	2122.8	1741 – 2504	267.3	224 – 310
South	1745.0	1488 – 2002	2305.6	2105 – 2506	1286.6	1095 – 1479	264.4	233 – 296
West	1512.0	1293 – 1731	2661.4	2390 – 2933	1519.5	1156 – 1883	249.3	207 – 291
Current smoker								
Yes	2101.8	1631 – 2573	1976.0	1739 – 2213	1712.0	1264 – 2160	325.6	266 – 385
No	1665.7	1546 – 1785	2728.0	2580 – 2876	1449.2	1292 – 1607	244.2	223 – 265
Mental health status								
Excellent	1040.0	890 – 1190	2089.6	1871 – 2308	1156.9	909 – 1405	180.1	151 – 209
Very good	1485.8	1291 – 1680	2459.1	2255 – 2663	1105.0	868 – 1342	231.8	200 – 264
Good	2226.7	1915 – 2538	2910.1	2653 – 3167	1773.5	1475 – 2072	286.2	246 – 326
Fair	3509.2	3005 – 4013	4164.0	3443 – 4885	2941.4	2248 – 3635	529.8	413 – 647
Poor	3190.8	2327 – 4054	4158.4	3185 – 5132	4131.1	2265 – 5997	462.2	332 – 593
High cholesterol diagnosis								
Yes	3059.0	2803 – 3315	4141.6	3867 – 4417	2729.0	2394 – 3064	340.5	301 – 380
No	1172.4	1032 – 1313	1987.2	1855 – 2119	1018.1	870 – 1166	220.3	199 – 242

Comorbidity score								
0	800.0	695 – 905	1806.4	1683 – 1930	846.9	706 – 988	205.9	183 – 229
1	2957.4	2599 – 3316	3177.4	2943 – 3412	2093.9	1740 – 2447	322.7	276 – 369
2	5134.5	4360 – 5909	5904.0	5107 – 6701	4228.5	3425 – 5032	363.9	297 – 430
≥ 3	4494.4	3994 – 4995	7270.9	6150 – 8392	4660.0	3336 – 5984	553.6	424 – 683

Appendix Table 4: Health Care Events Among Population Subgroups: by Subtype

	Medication		Outpatient		Inpatient		Emergency	
	#	95% CI	#	95% CI	#	95% CI	#	95% CI
Hypertension diagnosis								
Yes	23.7	23.0 – 24.5	12.2	11.7 – 12.7	0.19	0.17 – 0.20	0.35	0.33 – 0.37
No	5.9	5.6 – 6.2	6.0	5.8 – 6.3	0.05	0.04 – 0.05	0.15	0.14 – 0.16
Race/ethnicity								
Non-Hispanic White	13.4	12.9 – 13.9	9.6	9.2 – 9.9	0.11	0.10 – 0.12	0.23	0.22 – 0.24
Hispanic	7.1	6.5 – 7.7	4.5	3.9 – 5.1	0.06	0.05 – 0.07	0.16	0.14 – 0.18
Non-Hispanic Black	10.4	9.5 – 11.4	6.0	5.4 – 6.6	0.10	0.08 – 0.12	0.27	0.24 – 0.30
Non-Hispanic Asian	6.4	5.3 – 7.4	5.3	4.3 – 6.4	0.04	0.02 – 0.05	0.09	0.05 – 0.13
Non-Hispanic Other	16.5	13.6 – 19.5	8.7	7.2 – 10.2	0.11	0.08 – 0.15	0.35	0.26 – 0.44
Sex								
Female	13.4	13.0 – 13.9	9.3	9.0 – 9.7	0.10	0.09 – 0.11	0.25	0.23 – 0.26
Male	9.9	9.4 – 10.3	6.7	6.3 – 7.1	0.09	0.08 – 0.09	0.19	0.17 – 0.20
Age group (years)								
18-24	3.1	2.7 – 3.5	3.5	3.0 – 4.0	0.03	0.02 – 0.04	0.16	0.13 – 0.18
25-34	3.9	3.5 – 4.2	4.6	4.0 – 5.1	0.03	0.02 – 0.03	0.15	0.13 – 0.17
35-44	7.0	6.3 – 7.7	6.4	5.6 – 7.1	0.05	0.04 – 0.06	0.17	0.15 – 0.20
45-54	11.5	10.6 – 12.3	7.4	6.8 – 8.0	0.08	0.06 – 0.09	0.21	0.18 – 0.23
55-64	16.8	15.8 – 17.7	9.3	8.7 – 9.9	0.11	0.09 – 0.13	0.21	0.19 – 0.24
≥65	22.0	21.2 – 22.9	13.9	13.3 – 14.5	0.22	0.20 – 0.23	0.35	0.33 – 0.38
Education								
Less than 12 years	14.3	13.2 – 15.4	6.5	5.8 – 7.2	0.12	0.10 – 0.13	0.31	0.28 – 0.34
12 years	12.4	11.7 – 13.1	6.8	6.4 – 7.2	0.12	0.10 – 0.13	0.25	0.23 – 0.27
1-3 years of college	11.9	11.2 – 12.5	8.6	8.0 – 9.2	0.09	0.08 – 0.10	0.24	0.21 – 0.26
4-year college and above	10.0	9.5 – 10.5	9.3	8.9 – 9.8	0.07	0.06 – 0.08	0.14	0.13 – 0.15
Income level (as % of poverty line)								
<100%	17.9	16.6 – 19.3	8.7	7.5 – 9.8	0.16	0.13 – 0.18	0.39	0.35 – 0.44

100%–124%	15.2	13.3 – 17.0	7.1	5.9 – 8.4	0.15	0.12 – 0.18	0.35	0.29 – 0.41
125%–199%	13.0	11.8 – 14.3	7.1	6.5 – 7.8	0.11	0.09 – 0.13	0.30	0.26 – 0.33
200%–399%	11.1	10.4 – 11.8	6.9	6.6 – 7.3	0.09	0.08 – 0.09	0.21	0.20 – 0.23
≥400%	10.0	9.5 – 10.5	8.9	8.5 – 9.3	0.07	0.07 – 0.08	0.15	0.14 – 0.16
Marital status								
Married	11.4	10.9 – 11.9	8.2	7.8 – 8.6	0.09	0.08 – 0.09	0.17	0.16 – 0.19
Widowed	24.8	23.2 – 26.4	13.7	12.5 – 15.0	0.27	0.23 – 0.30	0.47	0.41 – 0.52
Divorced	17.6	16.5 – 18.7	10.5	9.7 – 11.3	0.14	0.12 – 0.16	0.32	0.29 – 0.36
Separated	19.9	16.8 – 23.1	8.7	7.4 – 9.9	0.14	0.09 – 0.19	0.37	0.30 – 0.45
Never married	6.5	6.0 – 7.1	5.5	5.0 – 6.0	0.05	0.04 – 0.06	0.19	0.17 – 0.21
Health insurance coverage								
Any private insurance	9.4	9.0 – 9.7	7.7	7.4 – 8.0	0.07	0.07 – 0.08	0.16	0.15 – 0.17
Public insurance only	21.4	20.4 – 22.4	11.0	10.4 – 11.7	0.18	0.17 – 0.20	0.41	0.38 – 0.44
Uninsured	2.3	1.8 – 2.7	1.6	1.3 – 1.9	0.02	0.01 – 0.03	0.12	0.10 – 0.15
Census region								
Northeast	12.3	11.5 – 13.0	9.2	8.4 – 9.9	0.09	0.08 – 0.11	0.22	0.19 – 0.24
Midwest	13.3	12.5 – 14.1	8.7	8.1 – 9.3	0.12	0.11 – 0.14	0.24	0.22 – 0.27
South	12.0	11.2 – 12.8	7.2	6.8 – 7.7	0.09	0.08 – 0.10	0.22	0.21 – 0.24
West	9.3	8.7 – 9.9	7.9	7.4 – 8.5	0.07	0.06 – 0.08	0.19	0.17 – 0.21
Current smoke								
Yes	13.9	12.8 – 15.0	6.9	6.1 – 7.7	0.12	0.10 – 0.14	0.32	0.28 – 0.36
No	11.4	11.0 – 11.8	8.2	8.0 – 8.5	0.09	0.08 – 0.09	0.20	0.19 – 0.21
Mental health status								
Excellent	7.2	6.8 – 7.6	6.0	5.6 – 6.4	0.06	0.05 – 0.07	0.14	0.12 – 0.15
Very good	9.5	9.0 – 10.0	7.3	6.9 – 7.6	0.06	0.06 – 0.07	0.17	0.16 – 0.19
Good	15.0	14.2 – 15.9	9.3	8.7 – 9.8	0.11	0.10 – 0.13	0.26	0.24 – 0.28
Fair	25.0	23.3 – 26.7	14.2	12.6 – 15.8	0.21	0.18 – 0.24	0.50	0.43 – 0.57
Poor	28.8	24.4 – 33.3	15.9	12.1 – 19.6	0.28	0.19 – 0.37	0.62	0.48 – 0.75
High cholesterol diagnosis								
Yes	22.9	22.0 – 23.8	12.6	12.1 – 13.1	0.17	0.16 – 0.19	0.33	0.31 – 0.36
No	7.0	6.7 – 7.4	6.2	5.8 – 6.5	0.06	0.06 – 0.07	0.17	0.16 – 0.18

Comorbidity score								
0	6.4	6.2 – 6.7	5.9	5.6 – 6.2	0.05	0.05 – 0.06	0.15	0.14 – 0.16
1	19.4	18.5 – 20.3	10.6	10.1 – 11.2	0.14	0.12 – 0.15	0.30	0.28 – 0.33
2	27.1	25.3 – 29.0	14.6	13.6 – 15.6	0.24	0.21 – 0.27	0.42	0.38 – 0.47
≥ 3	32.8	30.4 – 35.1	18.0	16.5 – 19.5	0.31	0.26 – 0.36	0.57	0.47 – 0.67

Appendix Table 5. Regression Results from a 2-Part Model Using Total Health Care Expenditures as the Outcome

VARIABLES	Part I: logistic regression		Part II: generalized linear regression	
	Coefficient	95% CI	Coefficient	95% CI
Hypertension diagnosis				
Yes	1.15	0.85 – 1.44	0.35	0.25 – 0.46
No	Ref		Ref	
Race and ethnicity				
Non-Hispanic White	Ref		Ref	
Hispanic	-0.77	-0.94 – -0.61	-0.05	-0.24 – 0.14
Non-Hispanic Black	-0.72	-0.92 – -0.51	0.04	-0.18 – 0.26
Non-Hispanic Asian	-0.94	-1.20 – -0.67	-0.29	-0.54 – -0.05
Non-Hispanic Other	0.05	-0.37 – 0.47	0.01	-0.36 – 0.38
Hypertension * Race and ethnicity				
Hypertension * Hispanic	-0.09	-0.56 – 0.38	-0.17	-0.43 – 0.10
Hypertension * NH ^a Black	-0.18	-0.64 – 0.28	-0.09	-0.37 – 0.19
Hypertension * NH Asian	-0.54	-1.18 – 0.10	-0.21	-0.57 – 0.14
Hypertension * NH Other	-0.49	-1.57 – 0.60	0.10	-0.36 – 0.57
No hypertension or NH White	Ref		Ref	
Sex				
Male	-0.72	-0.84 – -0.60	-0.08	-0.15 – 0.00
Female	Ref		Ref	
Age group (years)				
18–24	-0.68	-0.98 – -0.39	-0.62	-0.86 – -0.39
25–34	-0.89	-1.16 – -0.62	-0.55	-0.72 – -0.39
35–44	-0.69	-0.95 – -0.42	-0.37	-0.51 – -0.23
45–54	-0.66	-0.94 – -0.38	-0.25	-0.36 – -0.14
55–64	-0.39	-0.69 – -0.10	-0.02	-0.14 – 0.09
≥65	Ref		Ref	
Education				
Less than 12 years	-0.70	-0.89 – -0.51	-0.15	-0.30 – 0.00
12 years	-0.73	-0.88 – -0.57	-0.05	-0.17 – 0.07
1–3 years of college	-0.36	-0.53 – -0.19	-0.02	-0.13 – 0.09
4-year college and above	Ref		Ref	
Income level (as % of poverty line)				
<100%	-0.37	-0.59 – -0.15	-0.10	-0.26 – 0.06
100%–124%	-0.47	-0.75 – -0.19	-0.21	-0.40 – -0.02
125%–199%	-0.28	-0.46 – -0.09	-0.13	-0.29 – 0.04
200%–399%	-0.27	-0.42 – -0.12	-0.14	-0.25 – -0.02
≥400%	Ref		Ref	
Marital status				
Married	Ref		Ref	

Widowed	0.32	-0.07 – 0.71	0.06	-0.05 – 0.18
Divorced	-0.03	-0.24 – 0.18	0.12	0.00 – 0.24
Separated	0.27	-0.12 – 0.65	0.31	-0.04 – 0.67
Never married	-0.18	-0.34 – -0.01	0.02	-0.11 – 0.15
Health insurance coverage				
Any private insurance	Ref		Ref	
Public insurance only	-0.10	-0.27 – 0.07	-0.00	-0.11 – 0.10
Uninsured	-1.21	-1.42 – -1.01	-0.94	-1.11 – -0.76
Census region				
Northeast	Ref		Ref	
Midwest	0.40	0.19 – 0.62	0.10	-0.01 – 0.20
South	0.06	-0.14 – 0.26	-0.07	-0.16 – 0.02
West	0.19	0.01 – 0.38	0.04	-0.07 – 0.15
Current smoke				
Yes	-0.30	-0.45 – -0.14	-0.04	-0.16 – 0.07
No	Ref		Ref	
Mental health status				
Excellent	Ref		Ref	
Very good	0.15	-0.00 – 0.31	0.08	-0.03 – 0.19
Good	0.24	0.08 – 0.39	0.35	0.24 – 0.46
Fair	0.71	0.44 – 0.99	0.73	0.58 – 0.88
Poor	1.04	0.44 – 1.63	0.83	0.58 – 1.08
High cholesterol diagnosis				
Yes	0.99	0.80 – 1.18	0.19	0.11 – 0.27
No	Ref		Ref	
Comorbidity score				
0	Ref		Ref	
1	0.89	0.70 – 1.07	0.44	0.34 – 0.53
2	1.18	0.80 – 1.56	0.86	0.74 – 0.98
≥3	1.44	0.68 – 2.20	0.82	0.68 – 0.97

^a NH: Non-Hispanic

Appendix Table 6. Regression Results from a Zero-Inflated Negative Binomial Model Using Total Health Care Events as the Outcome

VARIABLES	Zero-Inflation Model		Count Model	
	Coefficient	95% CI	Coefficient	95% CI
Hypertension diagnosis				
Yes			0.44	0.39 – 0.48
No			Ref	
Race and ethnicity				
Non-Hispanic White			Ref	
Hispanic			-0.43	-0.54 – -0.32
Non-Hispanic Black			-0.44	-0.57 – -0.31
Non-Hispanic Asian			-0.53	-0.70 – -0.37
Non-Hispanic Other			-0.02	-0.18 – 0.14
Hypertension * Race and ethnicity				
Hypertension * Hispanic			0.12	-0.02 – 0.26
Hypertension * NH ^a Black			0.23	0.08 – 0.37
Hypertension * NH Asian			0.11	-0.10 – 0.32
Hypertension * NH Other			-0.02	-0.21 – 0.16
No hypertension or NH White			Ref	
Sex				
Male	0.79	0.61 – 0.97	-0.26	-0.30 – -0.21
Female	Ref		Ref	
Age group (years)				
18–24	1.06	0.49 – 1.63	-0.74	-0.87 – -0.61
25–34	1.54	1.02 – 2.06	-0.54	-0.63 – -0.46
35–44	1.30	0.80 – 1.80	-0.29	-0.37 – -0.22
45–54	1.27	0.74 – 1.79	-0.22	-0.28 – -0.16
55–64	0.68	0.14 – 1.22	-0.10	-0.15 – -0.05
≥65	Ref		Ref	
Education				
Less than 12 years	0.96	0.66 – 1.26	-0.13	-0.22 – -0.05
12 years	1.03	0.76 – 1.29	-0.15	-0.21 – -0.10
1–3 years of college	0.54	0.24 – 0.84	-0.03	-0.10 – 0.03
4-year college and above	Ref		Ref	
Income level (as % of poverty line)				
<100%	0.62	0.30 – 0.93	0.06	-0.04 – 0.16
100%–124%	0.80	0.41 – 1.18	-0.05	-0.16 – 0.06
125%–199%	0.45	0.12 – 0.77	-0.09	-0.18 – -0.01
200%–399%	0.41	0.17 – 0.65	-0.11	-0.17 – -0.06
≥400%	Ref		Ref	
Marital status				
Married	Ref		Ref	
Widowed	-0.75	-1.62 – 0.11	0.06	-0.00 – 0.13

Divorced	0.04	-0.30 – 0.38	0.12	0.06 – 0.18
Separated	-0.32	-0.88 – 0.24	0.25	0.13 – 0.38
Never married	0.37	0.15 – 0.60	0.13	0.05 – 0.21
Health insurance coverage				
Any private insurance	Ref		Ref	
Public insurance only	0.23	-0.01 – 0.47	0.20	0.16 – 0.25
Uninsured	1.41	1.16 – 1.67	-0.69	-0.81 – -0.56
Census region				
Northeast	Ref		Ref	
Midwest	-0.66	-0.97 – -0.36	0.01	-0.06 – 0.09
South	-0.13	-0.40 – 0.13	-0.08	-0.16 – -0.00
West	-0.18	-0.44 – 0.09	-0.08	-0.16 – 0.00
Current smoke				
Yes	0.15	-0.09 – 0.39	-0.06	-0.13 – 0.01
No	Ref		Ref	
Mental health status				
Excellent	Ref		Ref	
Very good	-0.19	-0.45 – 0.07	0.13	0.08 – 0.18
Good	-0.11	-0.34 – 0.13	0.42	0.36 – 0.48
Fair	-0.69	-1.11 – -0.27	0.78	0.69 – 0.87
Poor	-1.51	-2.42 – -0.59	0.83	0.67 – 0.98
High cholesterol diagnosis				
Yes	-1.75	-2.20 – -1.30	0.30	0.25 – 0.34
No	Ref		Ref	
Comorbidity score				
0	Ref		Ref	
1	-1.02	-1.34 – -0.70	0.47	0.42 – 0.52
2	-1.82	-2.70 – -0.95	0.54	0.48 – 0.59
≥3	-1.75	-3.37 – -0.14	0.63	0.56 – 0.71

^a NH: Non-Hispanic

Appendix Table 7. Sensitivity Analysis: Adjusted^a total health care events and prescribed medication purchases (without refills) associated with hypertension, overall and in each racial and ethnic group.

	Overall	NH White	Hispanic	NH Black	NH Asian	NH Other
Total events						
Hypertension						
Yes	19.1	22.3	11.6	16.1	12.1	19.6
	(18.5, 19.8)	(21.5, 23.2)	(10.4, 12.8)	(15.0, 17.2)	(10.5, 13.7)	(17.3, 21.9)
No	13.3	15.8	7.8	9.7	8.7	13.9
	(12.9, 13.7)	(15.3, 16.4)	(7.0, 8.5)	(8.5, 10.9)	(7.2, 10.1)	(11.9, 15.9)
Difference	5.8	6.5	3.8	6.4	3.4	5.7
	(5.0, 6.6)	(5.5, 7.5)	(2.4, 5.2)	(4.7, 8.0)	(1.2, 5.7)	(2.7, 8.6)
Difference from NH White			-2.7	-0.1	-3.1	-0.8
			(-4.3, -1.1)	(-1.9, 1.6)	(-5.3, -0.8)	(-3.9, 2.2)
Medication						
Hypertension						
Yes	6.9	7.9	4.4	6.0	4.6	7.6
	(6.7, 7.0)	(7.7, 8.1)	(4.1, 4.7)	(5.7, 6.3)	(4.1, 5.0)	(6.8, 8.4)
No	4.1	4.9	2.4	2.9	2.1	4.9
	(3.9, 4.2)	(4.7, 5.1)	(2.2, 2.6)	(2.6, 3.2)	(1.7, 2.4)	(4.2, 5.6)
Difference	2.8	3.0	2.0	3.1	2.5	2.7
	(2.6, 3.0)	(2.7, 3.3)	(1.6, 2.3)	(2.7, 3.5)	(2.0, 3.1)	(1.8, 3.6)
Difference from NH White			-1.0	0.1	-0.5	-0.3
			(-1.5, -0.6)	(-0.4, 0.6)	(-1.1, 0.1)	(-1.2, 0.6)

^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).

Appendix Table 8. Estimated Health Care Expenditures and Events Associated with Hypertension at National Level^a

Variables	Health care expenditures (\$)^b	Number of health care events^b
Total	219,224.7	817.4
Medication	32,462.4	538.2
Outpatient	70,219.7	168.1
Inpatient	79,440.8	3.5
Emergency department	4,390.1	6.0

^a Weighted count showed 79,463,177 US adults had hypertension in 2019.

^b Number presented in millions.