Understanding the Decline of Blood Pressure Control among the U.S. Population Using Multivariate Decomposition Analysis

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Summary: Hypertension is a leading risk factor for morbidity and mortality, yet blood pressure control (BPC) has declined among U.S. adults in recent years. To examine the sociodemographic and clinical factors contributing to this trend, we conducted a multivariate decomposition analysis using data from three NHANES waves (2013-2020) from the CardioStats package, supplemented with additional NHANES variables. We performed multivariate logistic regression to identify factors associated with BPC and applied decomposition analysis to assess changes between 2013-2016 and 2013-2020. Decomposition partitions changes into endowment (shifts in characteristic distributions) and coefficient effects (shifts in associations). Age, gender, race, comorbidities, physical activity, antihypertensive use, and food security were associated with BPC. Most of the BPC decline was driven by the endowment effect, with additional contributions from coefficient effects related to age, gender, and cardiovascular disease. This approach provides a clearer understanding of the drivers behind BPC decline, helps disentangle population-level shifts from changes in effect sizes, and can guide interventions and policies.

Introduction

Hypertension is a modifiable risk factor of numerous diseases including cardiovascular disease, chronic kidney disease, and neurocognitive impairments. It is one of the leading contributors of morbidity and mortality worldwide and in the U.S. (Mills, Stefanescu & He, 2020). Hypertension affects nearly half of the U.S. adult population and contributes to significant healthcare expenditures and disparities in cardiovascular outcomes (CDC, 2023). Racial and ethnic disparities in hypertension prevalence are well documented, with hypertension disproportionately affecting non-Hispanic African American population (Aggarwal et al., 2021). These disparities can be exacerbated by structural and socioeconomic factors, including healthcare and medication access, nutrition, and lifestyle. Blood pressure (BP) control is defined as a systolic BP of <130 mmHg and a diastolic BP of <80 mmHg, and can be achieved through medications and lifestyle changes (Whelton et al., 2017, Flack and Adekola, 2020, Carey et al., 2022). Despite the availability of effective management, BP control rates have declined in the U.S. in recent years (Muntner et al., 2020). The factors associated with the decrease, however, are unclear. Understanding these factors is important to inform effective interventions and policy responses. This study examines socioeconomic and demographic factors associated with declining BP control in the U.S. between 2013 and 2020 using nationally representative data from National Health and Nutrition Examination Survey (NHANES).

Methods

Data source: To understand the characteristics associated with the decrease of BP control, we conducted a multivariate decomposition analysis using NHANES data (National Center for Health Statistics, 2025). NHANES is a cross-sectional, nationally representative survey conducted by the Centers for Disease Control and Prevention serially every 2 years since 1999. NHANES employs a multistage probability sampling design to capture health and

nutritional data from the U.S. civilian, non-institutionalized population. Participants undergo structured interviews, physical examinations, and laboratory testing. For the current analysis, we restricted the sample to those over 18 and meeting the American College of Cardiology criteria for hypertension (Whelton et al., 2017).

Data Preparation: For this analysis, we used the curated dataset from the CardioStats package which includes covariates on demographics, hypertension, antihypertensive medications, and comorbidities from all waves of NHANES survey. Based on the current evidence, we selected additional covariates from the NHANES questionnaires on healthcare utilization, health insurance, alcohol use, food security, poverty levels, depression, physical activity, and sleep duration. We restricted current analysis to the three waves of NHANES surveys: 2013-2014, 2015-2016, and 2017-2020. The coding of responses for some questions varied across waves. To ensure consistency, we standardized these variables across survey waves before analysis. The alcohol use question varied across waves: the questionnaires in 2013-2014 and 2015-2016 waves two allowed numeric responses (0-365), while in 2017-2020 categorical frequency options were used. Reported alcohol use was notably higher in the third wave, likely due to differences in response formats. To ensure comparability, we excluded alcohol use data from the third wave. The family size question was removed from the latest wave as part of the survey design. Sampling weights, strata, and clusters were applied to account for the complex survey design, ensuring national representativeness.

Data Analysis: We used the categorized version of all the variables, which were described using frequencies and percentages in Table 1. To compare the prevalence of BP control over survey waves, we conducted multivariate logistic regressions with survey wave as the main explanatory variable and reported adjusted odds ratios (aOR) and adjusted prevalence ratios (aPR) with corresponding 95% confidence intervals and *p* values. To understand the underlying causes of change of BP control over time, we employed multivariate

decomposition regression (Powers et al., 2011). In this approach, the overall change in BP control is decomposed into two components: the characteristic component (endowment), which reflects changes in the distribution of explanatory variables over time, and the coefficient component (effect), which captures changes in the relationship between these variables and BP control. This approach quantifies the contribution of shifts in population characteristics versus changes in their effects to the observed change. To quantify the contribution of each predictor to the decomposition components, we used a detailed decomposition approach. Since nonlinear decompositions are sensitive to variable ordering, we applied the method proposed by Yun (2004), which uses weights derived from a first-order Taylor linearization to ensure order invariance. This approach partitions the endowment and coefficient components into covariate-specific contributions, providing a robust solution to path dependency. Covariates from the multivariate logistic model with p values less than 0.05 were selected for the decomposition analysis. The decomposition uses the prevalence of selected indicators at all time points and coefficients from separate multivariate logistic models predicting BP control Decompositions were performed to assess the decline in BP control between the 2013-2014 and 2015-2016 surveys and between the 2013-2014 and 2017-2020 surveys. We used the **devcon** package and **mvdcmp** command in STATA to implement the standard detailed decomposition logit model. Data preparation, cleaning, and analysis was performed using STATA 18 (StataCorp., 2023).

Results

The analytical sample included 5692, 5551, and 8010 individuals in 2013-2014, 2015-2016, and 2017-2020 waves, respectively. Sociodemographic and clinical characteristics of the study participants were comparable across survey waves and are presented in Table 1. The prevalence of blood pressure control declined over time, from 67.3% in 2013-2014 to 63.8% in 2017-2020. Younger adults (18-44) had the highest BP control rates, while older adults

(75+) had the lowest, with a more pronounced decline in control over time. Black individuals have the lowest control rates among racial and ethnic groups across all waves. Marital status, education, insurance, smoking, and comorbid conditions such as chronic kidney disease (CKD), diabetes, and cardiovascular disease (CDK) were associated with BP control, with those with chronic diseases generally having lower control (Table 2). After adjusting for covariates, BP control was associated with age, with 45-64, 65-74, and 75+ having lower odds of BP control compared to younger adults and women had higher odds of BP control than men ($p<0.05$ across all waves). Black individuals had significantly lower odds of BP control compared to non-Black individuals ($p<0.001$). CVD was consistently associated with poorer BP control ($p<0.05$). Engaging in vigorous recreational activity was positively associated with BP control ($p<0.05$). Obesity (body mass index [BMI] $\geq$30) was linked to lower BP control, with stronger effects for higher BMI categories ($p<0.01$). Hypertension medication use was associated with higher odds of BP control across all waves ($p<0.001$). The results of the multivariate logistic regression are presented in Table 3. In the 2013-14 and 2015-16 model multivariate decomposition model, the endowment effect of **0.003982** (p = 0.041) shows that 15.4% of the BP control difference is explained by differences in characteristics while 84.64% of the BP control gap is due to differences in the effects of the characteristics rather than their distribution across groups. Similarly, 15.36% of the BP control gap between 2013-14 and 2015-16 is due to differences in group characteristics (Endowments) while 84.64% of the gap is due to differences in how these characteristics affect BP control (Coefficients). The detailed breakdown of decomposition models is presented in Table 4.

Discussion

Our analysis reveals that the decline in BP control is driven both by shifts in population characteristics and changes in the strength of associations between these characteristics and

BP control. Notably, most of the BP control decline can be attributed to changes in the effects of the identified characteristics rather than the characteristics themselves, i.e., the way these characteristics affect BP control has changed over the years. This finding underscores that addressing disparities in BP control requires not only targeting demographic and health factors but also understanding how the influence of these factors has evolved across different populations. For example, the worsening BP control among Black individuals and older adults suggests that systemic barriers and changing clinical dynamics may be amplifying existing inequities. Based on these findings, expanding access to care, improving medication adherence, and integrating weight management and chronic disease interventions into hypertension programs may help mitigate disparities. However, as the effect of certain characteristics on BP control changed over time, a one-size-fits-all approach may be insufficient. It is important to understand how these characteristics affect specific populations, including those older populations, black individuals, or those experiencing food insecurity.

Unlike black-box approaches that generate predictions which at times may be hard to translate into actionable evidence of public health interventions, methods like decomposition framework provides interpretable insights into the mechanisms underlying BP control trends. This approach offers a clearer roadmap for intervention design and policy development by distinguishing whether the observed decline is driven by changes in population characteristics or shifts in their effects.

Conclusion

A decomposition analysis provided insight into the drivers of declining BP control in the U.S. population. Future interventions should address both changes in demographic factors and the shifting impact of these characteristics on hypertension control.

Table 1. Sociodemographic and Clinical Characteristics of Adults with Hypertension in Across Three NHANES Waves

	2013-2014	2015-2016	2017-2020	Combined
	%	*%*	*%*	*%*
Age				
18 to 44	47.8	45.4	45.1	46.1
45 to 64	34.4	34.6	34.6	34.6
65 to 74	10.8	12.2	12.7	11.9
75+	7.0	7.8	7.5	7.4
Gender				
Man	48.3	48.3	48.9	48.5
Woman	51.7	51.7	51.1	51.5
Race				
Non-Hispanic White	65.6	63.8	63.8	64.4
Non-Hispanic Black	11.5	11.4	11.2	11.3
Non-Hispanic Asian	5.3	5.7	5.5	5.5
Hispanic	14.9	15.5	15.4	15.3
Other	2.8	3.7	4.1	3.5
Marital status				
Never Married	18.8	17.6	19.0	18.5
Currently Married	62.5	64.4	62.5	63.1
Previously Married	18.7	18.0	18.5	18.4
Educational level				
High school or lower	38.1	36.3	37.5	37.2
Higher	61.9	63.7	62.5	62.8
Saw mental health professional in the past year				
Yes	8.6	9.5	11.5	9.8
No	91.4	90.5	88.5	90.2
Has health insurance				
Yes	82.0	86.5	87.1	85.2
No	18.0	13.5	12.9	14.8
Smoking				
Never	57.2	57.2	58.3	57.5
Former	23.2	24.6	25.1	24.3
Current	19.6	18.2	16.6	18.2
Alcohol				
12+ drinks last year	76.4	74.7		75.5
>12 drinks last year	23.6	25.3		24.5
Chronic kidney disease				
No	85.9	86.6	86.6	86.3
Yes	14.1	13.4	13.4	13.7
Diabetes				
No	89.7	88.6	87.7	88.7
Yes	10.3	11.4	12.3	11.3
Cardiovascular disease				
No	92.2	92.2	90.9	91.8
Yes	7.8	7.8	9.1	8.2
Depressive symptoms				
No/minimal	76.7	76.3	75.0	76.0
Mild	14.9	16.4	16.8	16.0
Moderate	5.4	4.7	5.8	5.3
Moderately severe	2.0	1.8	1.7	1.8
Severe	1.0	0.9	0.7	0.9
Sleep duration in hours				
Short (<7)	34.4	19.5	23.9	25.9
Normal (7-9)	62.8	70.2	66.3	66.4
Long (>9)	2.8	10.3	9.8	7.6
Living alone				
Yes	20.5	22.9		21.7

No	79.5	77.1		78.3
Family size				
One	20.5	22.9		21.7
2 to 3	44.8	43.6		44.2
4 to 5	27.0	25.5		26.2
5+	7.7	8.0		7.8
Children 5 years				
0	80.4	82.3		81.4
1	13.6	11.7		12.6
2	4.9	5.0		5.0
3+	1.2	0.9		1.1
Vigorous recreational activities	74.7	70.6	70.1	71.8
Moderate recreational activities	55.3	52.9	52.4	53.5
Walking or biking for at least 10 minutes/day	76.5	79.6	79.2	78.4
Body mass index				
<25.0	30.9	29.1	27.3	29.1
25.0 to 29.9	32.2	31.4	31.0	31.5
30.0 to 34.9	20.0	21.5	21.4	21.0
35.0+	17.0	18.1	20.2	18.4
Sedentary hours				
≤4	24.6	32.0	40.9	32.5
>4	75.4	68.0	59.1	67.5
Poverty-to-income ratio				
>1.0	16.1	14.4	12.8	14.5
1.0 to 1.9	21.5	20.5	18.9	20.3
2.0 to 2.9	28.4	28.4	28.3	28.4
3+	34.0	36.7	40.0	36.8
Hypertension medication use				
No	76.4	76.7	76.1	76.4
Yes	23.6	23.3	23.9	23.6
Food security				
No	75.8	71.2	72.6	73.2
Marginal	9.4	10.8	11.2	10.4
Low	8.7	10.1	9.0	9.3
Very low	6.2	7.9	7.3	7.1
Secondhand smoking				
No	72.6	76.0	74.0	74.2
Yes	27.4	24.0	26.0	25.8
Healthy diet				
Excellent	7.8	8.1	6.8	7.6
Very good	23.6	21.2	22.0	22.3
Good	42.2	41.8	40.6	41.5
Fair	21.4	22.2	24.4	22.7
Poor	4.9	6.7	6.3	5.9

Table 2. Prevalence of Blood Pressure Control by Participant Characteristics Across Three NHANES Waves

	2013-2014		2015-2016		2017-2020		Difference	
	% [95% CI]	P-value	% [95% CI]	P-value	% [95% CI]	P-value	2013 – 2015	2013 – 2017
Overall	**67.3 [65.9, 68.7]**		**64.1 [61.7, 66.4]**		**63.8 [61.6, 66.0]**		**3.2**	**3.5**
Age		<0.001		<0.001		<0.001		
18 to 44	81.8 [80.1, 83.3]		79.0 [75.5, 82.1]		77.9 [75.4, 80.2]		2.8	2.2
45 to 64	59.0 [55.7, 62.2]		55.6 [50.1, 61]		56.9 [53.1, 60.5]		3.4	1.9
65 to 74	45.4 [39.9, 51.1]		50.2 [45.5, 55]		50.4 [46.8, 54.0]		-4.8	-3.5
75+	42.8 [35.6, 50.4]		36.6 [31.2, 42.4]		34.5 [30.1, 39.1]		6.2	5.0
Gender		0.001		0.003		0.004		
Man	63.7 [61.1, 66.2]		60.8 [56.9, 64.4]		61.4 [58.4, 64.3]		2.9	1.8
Woman	70.7 [68.3, 72.9]		67.2 [64.7, 69.6]		66.2 [63.6, 68.8]		3.5	2.7
Race		<0.001		<0.001		<0.001		
White	67.4 [65.1, 69.6]		63.9 [60.6, 67.1]		64.3 [60.6, 67.8]		3.5	2.2
Black	57.9 [54.6, 61.1]		57.7 [54.8, 60.5]		54.1 [51.0, 57.2]		0.2	1.3
Asian-American	70.4 [65.7, 74.7]		62.9 [57.1, 68.4]		65.4 [62.3, 68.4]		7.5	4.2
Hispanic	73.3 [70.8, 75.7]		68.7 [66.3, 71.1]		69.1 [66.8, 71.2]		4.6	3.0
Other	65.2 [54.4, 74.7]		69.0 [60.6, 76.4]		61.7 [55.3, 67.6]		-3.8	0.0
Marital status		<0.001		<0.001		<0.001		
Never married	75.0 [71, 78.6]		73.2 [69.8, 76.4]		75.7 [72,0, 79.0]		1.8	0.4
Currently married	66.2 [63.7, 68.6]		64.2 [61.2, 67.1]		61.9 [59.4, 64.4]		2.0	2.1
Previously married	58.0 [53.6, 62.3]		50.6 [45.9, 55.4]		53.0 [49.4, 56.6]		7.4	4.1
Educational level		0.013		0.107		<0.001		
High school or lower	64.6 [62.6, 66.5]		61.7 [58.2, 65.1]		57.3 [54.4, 60.1]		2.9	3.3
Higher	68.9 [66.5, 71.2]		65.4 [62.1, 68.7]		66.3 [63.3, 69.1]		3.5	2.1
Saw mental health professional in the past year		0.288		0.446		0.106		
Yes	69.2 [65.2, 73]		67.1 [57,0, 75.8]		67.7 [61.9, 72.9]		2.1	1.3
No	67.1 [65.5, 68.6]		63.8 [61.4, 66.1]		63.4 [61.2, 65.5]		3.3	2.3
Has health insurance		0.107		0.030		0.195		
Yes	66.7 [65, 68.4]		63.2 [60.5, 65.9]		63.4 [60.8, 66.0]		3.5	2.3

No	69.8 [66.4, 73.0]		70.0 [64.4, 75.0]		66.4 [62.9, 69.7]		-0.2	0.9
Smoking status		0.005		0.013		<0.001		
Never	69.6 [68.2, 70.9]		66.2 [64, 68.3]		67.3 [64.4, 70.1]		3.4	1.9
Former	61.8 [57.3, 66.1]		57.8 [51.5, 64]		57.7 [53.3, 61.9]		4.0	2.8
Current	67.2 [64.1, 70.2]		66.1 [60.2, 71.6]		61.0 [57.1, 64.8]		1.1	2.2
Chronic kidney disease		<0.001		<0.001		<0.001		
No	70.4 [68.8, 72.0]		67.2 [64.3, 70.0]		66.5 [64.0, 68.8]		3.2	2.4
Yes	48.2 [42.9, 53.6]		43.9 [38.6, 49.4]		46.9 [43.2, 50.5]		4.3	1.8
Diabetes		<0.001		<0.001		<0.001		
No	69.5 [68.1, 71.0]		66.0 [63.0, 68.9]		66.3 [64.1, 68.4]		3.5	2.2
Yes	47.7 [41.8, 53.8]		48.9 [43.6, 54.2]		46.4 [41.9, 50.9]		-1.2	0.0
Cardiovascular disease		0.001		0.011		<0.001		
No	68.1 [66.7, 69.5]		64.9 [62.2, 67.4]		65.9 [63.4, 68.2]		3.2	1.8
Yes	57.3 [51.8, 62.6]		55.0 [47.8, 61.9]		43.5 [38.4, 48.8]		2.3	5.7
Depression		0.192		0.645		0.557		
No/minimal	68.2 [66.6, 69.8]		64.6 [61.8, 67.2]		64.2 [61.4, 67.0]		3.6	2.5
Mild	65.5 [60.9, 69.9]		65.8 [60.8, 70.4]		62.8 [57.6, 67.8]		-0.3	0.8
Moderate	62.3 [54.6, 69.5]		62.9 [52.0, 72.6]		62.0 [55.9, 67.8]		-0.6	-0.1
Moderately severe	62.7 [52, 72.3]		59.0 [41.6, 74.4]		66.4 [55.6, 75.7]		3.7	0.0
Severe	78.0 [56.5, 90.6]		75.2 [60.8, 85.6]		50.1 [30.7, 69.5]		2.8	9.2
Depressive symptoms		0.054				0.531		
No	68.2 [66.6, 69.8]		64.6 [61.8, 67.2]		64.2 [61.4, 67.0]		3.6	2.5
Yes	65.1 [61.9, 68.1]		65.0 [60.4, 69.4]		62.5 [57.9, 66.9]		0.1	0.9
Sleep duration in hours		0.355		0.045		0.387		
Short (<7)	67.1 [64.7, 69.5]		59.6 [55.1, 63.9]		62.9 [60.6, 65.3]		7.5	3.2
Normal (7-9)	67.6 [65.9, 69.3]		65.5 [62.5, 68.4]		64.4 [61.7, 67.0]		2.1	1.8
Long (>9)	61.5 [50.7, 71.4]		64.1 [58.7, 69.2]		61.7 [55.4, 67.6]		-2.6	-1.3
Vigorous recreational activities		<0.001		<0.001		<0.001		
Yes	80.2 [78.1, 82.0]		72.6 [67.5, 77.3]		75.4 [72.2, 78.4]		7.6	4.3
No	62.9 [61.0, 64.8]		60.5 [57.7, 63.2]		58.9 [56.4, 61.4]		2.4	2.1

Moderate recreational activities	<0.001		0.002		<0.001			
Yes		70.3 [68.2, 72.2]		67.8 [64.8, 70.6]		67.4 [64.6, 70.1]	2.5	1.8
No		64.9 [62.8, 66.9]		60.8 [57.3, 64.2]		60.6 [57.8, 63.3]	4.1	2.8
Walking or biking for at least 10 minutes/day	0.073		0.180		0.278			
Yes		70.4 [66.7, 73.8]		66.3 [62.7, 69.8]		65.5 [62.6, 68.3]	4.1	2.9
No		66.3 [64.5, 68.2]		63.5 [60.6, 66.3]		63.4 [60.6, 66.1]	2.8	1.9
Body mass index		<0.001		<0.001		<0.001		
<25.0		77.4 [75.3, 79.3]		74.7 [71.0, 78.0]		74.5 [71.0, 77.8]	2.7	1.8
25.0 to 29.9		69.2 [66, 72.2]		63.4 [59.3, 67.2]		64.6 [61.7, 67.4]	5.8	3.5
30.0 to 34.9		61.0 [57.8, 64.2]		60.8 [55.3, 66.0]		56.5 [51.2, 61.6]	0.2	1.6
35.0+		53.0 [48.2, 57.6]		52.7 [48.0, 57.4]		56.0 [51.5, 60.5]	0.3	-1.0
Sedentary hours		0.279		0.728		0.0511		
≤4		68.7 [65.9, 71.4]		64.3 [60.4, 68.1]		65.9 [63.0, 68.6]	4.4	2.6
>4		68.3 [65.8, 70.7]		65.2 [60.2, 69.9]		64.7 [60.7, 68.4]	3.1	2.0
Poverty-to-income ratio		0.372		0.61		0.004		
>1.0		68.9 [66.0, 71.6]		67.3 [63.6, 70.8]		64.1 [59.7, 68.3]	1.6	1.9
1.0 to 1.9		64.5 [60.0, 68.9]		64.1 [60.4, 67.6]		61.5 [57.9, 65.0]	0.4	1.0
2.0 to 2.9		67.7 [64.1, 71.0]		63.8 [59.1, 68.3]		59.8 [56.6, 62.8]	3.9	3.9
3+		67.8 [65.1, 70.4]		65.1 [60.3, 69.6]		68.2 [63.4, 72.7]	2.7	0.8
Hypertension medication use		<0.001		<0.001		<0.001		
No		73.8 [72.1, 75.4]		70.5 [67.9, 72.9]		70.2 [68.0, 72.3]	3.3	2.3
Yes		46.3 [41.7, 51.0]		43.0 [38.0, 48.2]		43.7 [41.0, 46.5]	3.3	2.0
Food security		0.275		0.737		0.982		
No		66.7 [65.0, 68.4]		63.9 [60.8, 66.9]		64.3 [61.0, 67.4]	2.8	2.4
Marginal		70.7 [64.5, 76.3]		64.7 [59.1, 70.0]		63.9 [60.5, 67.1]	6.0	6.8
Low		69.5 [63.3, 75.1]		63.6 [56.6, 70.1]		63.9 [59.4, 68.1]	5.9	5.6
Very low		64.0 [58.3, 69.4]		67.0 [61.8, 71.9]		63.6 [58.9, 68.1]	-3.0	0.4

Secondhand smoking		0.318		0.529		0.493		
No	66.8 [65.0, 68.6]		63.7 [60.8, 66.6]		63.6 [61.3, 65.8]		3.1	3.2
Yes	68.6 [65.6, 71.4]		65.2 [60.8, 69.4]		64.5 [61.2, 67.7]		3.4	4.1
Healthy diet		0.053		0.234		0.007		
Excellent	74.0 [68.9, 78.5]		66.2 [59.2, 72.6]		60.7 [52.3, 68.5]		7.8	13.3
Very good	65.7 [60.5, 70.6]		61.5 [56.5, 66.2]		67.9 [64.2, 71.4]		4.2	-2.2
Good	68.6 [66.1, 70.9]		65.3 [62.9, 67.6]		65.3 [62.2, 68.3]		3.3	3.3
Fair	65.9 [62.5, 69.2]		65.1 [59.8, 70.0]		60.1 [56.8, 63.3]		0.8	5.8
Poor		59.2 [52.5, 65.6]		59.2 [52.7, 65.3]		58.1 [51.8, 64.0]	0.0	1.1

Table 3. Characteristics associated with Blood Pressure Control Across Three NHANES Waves

	2013-2014				2015-2016				2017-2020				Combined			
	aOR [95% CI]	P-value	aPR	P-value	aOR [95% CI]	P-value	aPR	P-value	aOR [95% CI]	P-value	aPR	P-value	aOR [95% CI]	P-value	aPR	P-value
Age																
18 to 44	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
45 to 64	0.35 (0.27 – 0.45)	<0.001	0.76 (0.70 – 0.82)	<0.001	0.41 (0.32 – 0.54)	<0.001	0.78 (0.72 – 0.85)	<0.001	0.48 (0.38 – 0.60)	<0.001	0.81 (0.75 – 0.87)	<0.001	0.41 (0.36 – 0.47)	<0.001	0.78 (0.75 – 0.81)	<0.001
65 to 74	0.19 (0.13 – 0.26)	<0.001	0.59 (0.51 – 0.69)	<0.001	0.36 (0.27 – 0.46)	<0.001	0.74 (0.67 – 0.81)	<0.001	0.41 (0.32 – 0.54)	<0.001	0.76 (0.69 – 0.84)	<0.001	0.31 (0.26 – 0.37)	<0.001	0.70 (0.65 – 0.74)	<0.001
75+	0.16 (0.10 – 0.25)	<0.001	0.55 (0.45 – 0.68)	<0.001	0.21 (0.15 – 0.31)	<0.001	0.56 (0.47 – 0.68)	<0.001	0.22 (0.15 – 0.32)	<0.001	0.53 (0.44 – 0.64)	<0.001	0.20 (0.16 – 0.25)	<0.001	0.55 (0.49 – 0.62)	<0.001
Gender																
Man	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Woman	1.79 (1.41 – 2.27)	<0.001	1.17 (1.10 – 1.25)	<0.001	1.66 (1.28 – 2.14)	0.001	1.16 (1.07 – 1.26)	0.001	1.33 (1.08 – 1.64)	0.010	1.09 (1.02 – 1.17)	0.017	1.56 (1.37 – 1.77)	<0.001	1.14 (1.10 – 1.19)	<0.001
Black																
No	1.72 (1.46 – 2.01)	<0.001	1.19 (1.13 – 1.26)	<0.001	1.57 (1.35 – 1.82)	<0.001	1.15 (1.09 – 1.22)	<0.001	1.65 (1.33 – 2.05)	<0.001	1.19 (1.10 – 1.28)	<0.001	1.64 (1.50 – 1.80)	<0.001	1.18 (1.14 – 1.22)	<0.001
Yes	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Marital status																
Never	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Currently	0.96 (0.68 – 1.35)	0.804	0.99 (0.92 – 1.06)	0.662	0.97 (0.71 – 1.34)	0.865	1.00 (0.92 – 1.08)	0.901	0.72 (0.59 – 0.89)	0.004	0.93 (0.88 – 0.97)	0.004	0.87 (0.74 – 1.03)	0.097	0.97 (0.93 – 1.00)	0.080
Previously	0.98 (0.64 – 1.51)	0.936	1.00 (0.89 – 1.11)	0.940	0.84 (0.58 – 1.22)	0.333	0.95 (0.85 – 1.05)	0.280	0.74 (0.56 – 0.99)	0.045	0.93 (0.84 – 1.04)	0.184	0.85 (0.70 – 1.04)	0.122	0.96 (0.90 – 1.02)	0.185
Educational																
High school or lower	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Higher	1.12 (0.86 – 1.46)	0.383	1.03 (0.95 – 1.11)	0.474	1.04 (0.86 – 1.25)	0.694	1.01 (0.95 – 1.07)	0.730	1.10 (0.88 – 1.37)	0.386	1.03 (0.96 – 1.12)	0.388	1.09 (0.96 – 1.23)	0.178	1.03 (0.98 – 1.07)	0.221
Saw a mental health professional in the past year																
Yes	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
No	1.01 (0.75 – 1.34)	0.964	1.00 (0.93 – 1.07)	0.893	1.04 (0.67 – 1.60)	0.863	1.02 (0.90 – 1.16)	0.723	1.01 (0.71 – 1.44)	0.935	1.01 (0.91 – 1.12)	0.888	1.01 (0.83 – 1.23)	0.924	1.00 (0.95 – 1.06)	0.873
Has health insurance																
Yes	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
No	0.87 (0.72 – 1.06)	0.150	0.97 (0.92 – 1.02)	0.248	0.92 (0.69 – 1.22)	0.541	0.99 (0.91 – 1.07)	0.761	0.87 (0.69 – 1.10)	0.243	0.97 (0.90 – 1.04)	0.365	0.90 (0.79 – 1.02)	0.094	0.98 (0.94 – 1.01)	0.225
Smoking status																
Never	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Former	1.21 (0.90 – 1.63)	0.187	1.05 (0.97 – 1.15)	0.221	0.98 (0.70 – 1.38)	0.913	0.99 (0.88 – 1.11)	0.847	0.86 (0.70 – 1.04)	0.112	0.95 (0.88 – 1.01)	0.105	0.99 (0.86 – 1.15)	0.929	0.99 (0.95 – 1.05)	0.820
Current	0.98 (0.77 – 1.25)	0.866	0.99 (0.93 – 1.06)	0.810	1.18 (0.88 – 1.57)	0.250	1.05 (0.97 – 1.14)	0.212	0.76 (0.59 – 0.99)	0.043	0.92 (0.84 – 1.00)	0.062	0.97 (0.84 – 1.12)	0.647	0.99 (0.95 – 1.04)	0.763
Chronic kidney disease																
No	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Yes	0.58 (0.44 – 0.76)	0.001	0.81 (0.72 – 0.91)	0.001	0.54 (0.38 – 0.76)	0.002	0.77 (0.66 – 0.90)	0.003	0.84 (0.67 – 1.07)	0.154	0.93 (0.84 – 1.03)	0.139	0.65 (0.55 – 0.75)	<0.001	0.83 (0.78 – 0.89)	<0.001
Diabetes																
No	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Yes	1.08 (0.78 – 1.49)	0.623	1.00 (0.86 – 1.15)	0.950	1.12 (0.79 – 1.59)	0.514	1.03 (0.88 – 1.20)	0.692	1.03 (0.80 – 1.32)	0.820	0.99 (0.88 – 1.10)	0.811	1.08 (0.92 – 1.28)	0.331	1.01 (0.94 – 1.08)	0.829
Cardiovascular disease																
No	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Yes	1.99 (1.40 – 2.83)	0.001	1.30 (1.14 – 1.48)	0.001	2.03 (1.43 – 2.88)	0.001	1.31 (1.16 – 1.49)	<0.001	0.86 (0.65 – 1.16)	0.312	0.92 (0.79 – 1.06)	0.218	1.44 (1.21 – 1.72)	<0.001	1.16 (1.08 – 1.25)	<0.001
Depressive symptoms																
No	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Yes	1.09 (0.88 – 1.34)	0.396	1.02 (0.96 – 1.08)	0.533	1.09 (0.85 – 1.40)	0.464	1.02 (0.95 – 1.11)	0.505	1.10 (0.84 – 1.44)	0.483	1.03 (0.95 – 1.13)	0.449	1.08 (0.94 – 1.25)	0.269	1.02 (0.98 – 1.07)	0.284
Sleep duration in hours																
Short (<7)	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Normal (7-9)	0.96 (0.82 – 1.12)	0.592	0.99 (0.95 – 1.03)	0.466	1.16 (0.89 – 1.52)	0.250	1.05 (0.96 – 1.14)	0.285	0.90 (0.78 – 1.03)	0.107	0.96 (0.92 – 1.01)	0.082	0.99 (0.89 – 1.09)	0.759	0.99 (0.96 – 1.02)	0.589

	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Long (>9)	1.05 (0.54 – 2.04)	0.875	1.02 (0.84 – 1.25)	0.825	1.18 (0.85 – 1.64)	0.309	1.04 (0.94 – 1.16)	0.391	0.87 (0.62 – 1.22)	0.401	0.95 (0.84 – 1.07)	0.384	0.99 (0.81 – 1.21)	0.918	0.99 (0.93 – 1.06)	0.858
Vigorous recreational activities																
No	1.37 (1.13 - 1.65)	0.003	1.07 (1.02 - 1.11)	0.006	1.07 (0.85 - 1.36)	0.548	1.02 (0.96 - 1.08)	0.529	1.32 (1.06 - 1.63)	0.015	1.07 (1.01 - 1.14)	0.030	1.24 (1.10 - 1.41)	0.001	1.05 (1.02 - 1.09)	0.002
Yes	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Moderate recreational activities																
No	0.97 (0.82 - 1.14)	0.708	1.00 (0.95 - 1.05)	0.936	1.20 (0.95 - 1.53)	0.119	1.06 (0.99 - 1.14)	0.096	0.99 (0.80 - 1.22)	0.907	0.99 (0.93 - 1.07)	0.838	1.04 (0.93 - 1.17)	0.501	1.01 (0.98 - 1.05)	0.445
Yes	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Walking or biking for at least 10 minutes/day																
No	0.92 (0.71 - 1.17)	0.463	0.97 (0.91 - 1.04)	0.415	0.76 (0.59 - 0.97)	0.033	0.92 (0.86 - 0.99)	0.021	0.82 (0.68 - 1.00)	0.045	0.94 (0.89 - 1.00)	0.054	0.83 (0.73 - 0.94)	0.005	0.95 (0.91 - 0.98)	0.004
Yes	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Body mass index																
<25.0	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
25.0 to 29.9	0.87 (0.73 - 1.04)	0.118	0.98 (0.93 - 1.03)	0.325	0.72 (0.59 - 0.88)	0.004	0.92 (0.88 - 0.98)	0.007	0.81 (0.65 - 1.01)	0.055	0.96 (0.91 - 1.02)	0.151	0.80 (0.71 - 0.89)	<0.001	0.96 (0.93 - 0.98)	0.003
30.0 to 34.9	0.61 (0.49 - 0.76)	<0.001	0.88 (0.83 - 0.95)	0.001	0.63 (0.49 - 0.82)	0.002	0.89 (0.83 - 0.97)	0.008	0.56 (0.41 - 0.76)	0.001	0.84 (0.76 - 0.94)	0.003	0.61 (0.52 - 0.71)	<0.001	0.88 (0.84 - 0.92)	<0.001
35.0+	0.35 (0.26 - 0.47)	<0.001	0.73 (0.66 - 0.81)	<0.001	0.42 (0.30 - 0.59)	<0.001	0.77 (0.69 - 0.86)	<0.001	0.54 (0.43 - 0.68)	<0.001	0.84 (0.77 - 0.91)	<0.001	0.44 (0.38 - 0.51)	<0.001	0.78 (0.74 - 0.82)	<0.001
Sedentary hours																
≤4	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
>4	1.08 (0.92 - 1.25)	0.324	1.02 (0.98 - 1.06)	0.370	1.11 (0.90 - 1.37)	0.322	1.03 (0.96 - 1.09)	0.381	0.81 (0.65 - 1.01)	0.065	0.93 (0.87 - 1.00)	0.048	0.98 (0.88 - 1.09)	0.709	0.99 (0.96 - 1.02)	0.594
Poverty-to-income ratio																
>1.0	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
1.0 to 1.9	0.91 (0.71 - 1.16)	0.413	0.97 (0.90 - 1.05)	0.421	0.87 (0.71 - 1.07)	0.178	0.97 (0.91 - 1.03)	0.235	1.04 (0.77 - 1.41)	0.789	1.02 (0.92 - 1.12)	0.758	0.94 (0.81 - 1.08)	0.349	0.98 (0.94 - 1.02)	0.405
2.0 to 2.9	1.01 (0.79 - 1.28)	0.947	1.00 (0.94 - 1.07)	0.976	0.86 (0.63 - 1.16)	0.295	0.96 (0.88 - 1.05)	0.362	0.94 (0.75 - 1.17)	0.555	0.98 (0.91 - 1.05)	0.523	0.91 (0.79 - 1.05)	0.200	0.98 (0.94 - 1.02)	0.226
3+	0.91 (0.72 - 1.14)	0.378	0.97 (0.92 - 1.04)	0.401	0.92 (0.67 - 1.28)	0.603	0.99 (0.90 - 1.08)	0.769	1.31 (0.96 - 1.78)	0.083	1.10 (1.00 - 1.20)	0.056	1.02 (0.87 - 1.20)	0.767	1.01 (0.97 - 1.06)	0.538
Hypertension medication use																
No	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Yes	0.65 (0.50 - 0.84)	0.002	0.83 (0.75 - 0.91)	0.001	0.56 (0.45 - 0.71)	<0.001	0.78 (0.70 - 0.88)	<0.001	0.65 (0.55 - 0.77)	<0.001	0.81 (0.75 - 0.88)	<0.001	0.63 (0.56 - 0.71)	<0.001	0.81 (0.77 - 0.86)	<0.001
Food security																
No	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Marginal	0.99 (0.68 - 1.42)	0.934	1.00 (0.91 - 1.10)	0.969	0.95 (0.69 - 1.29)	0.710	0.98 (0.90 - 1.08)	0.734	1.07 (0.90 - 1.27)	0.410	1.03 (0.97 - 1.08)	0.314	0.99 (0.85 - 1.16)	0.908	1.00 (0.95 - 1.05)	0.994
Low	0.95 (0.63 - 1.42)	0.775	0.99 (0.89 - 1.11)	0.877	0.92 (0.60 - 1.41)	0.683	0.97 (0.86 - 1.10)	0.655	1.09 (0.84 - 1.42)	0.497	1.03 (0.94 - 1.12)	0.539	0.98 (0.80 - 1.20)	0.838	1.00 (0.94 - 1.06)	0.883
Very low	0.72 (0.49 - 1.06)	0.092	0.92 (0.82 - 1.03)	0.138	1.05 (0.69 - 1.59)	0.807	1.01 (0.90 - 1.15)	0.810	1.13 (0.94 - 1.36)	0.197	1.05 (0.99 - 1.11)	0.130	0.95 (0.79 - 1.15)	0.606	0.99 (0.94 - 1.05)	0.784
Secondhand smoking																
No	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Yes	0.91 (0.73 - 1.13)	0.368	0.98 (0.92 - 1.04)	0.452	1.02 (0.77 - 1.36)	0.872	1.01 (0.93 - 1.10)	0.826	1.05 (0.89 - 1.25)	0.541	1.02 (0.96 - 1.08)	0.483	0.98 (0.87 - 1.12)	0.804	1.00 (0.96 - 1.04)	0.893
Healthy diet																
Excellent	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Very good	0.56 (0.36 - 0.88)	0.016	0.87 (0.78 - 0.96)	0.012	0.74 (0.48 - 1.14)	0.159	0.91 (0.80 - 1.03)	0.129	1.22 (0.85 - 1.74)	0.262	1.06 (0.95 - 1.19)	0.292	0.80 (0.63 - 1.02)	0.072	0.94 (0.88 - 1.00)	0.049
Good	0.63 (0.42 - 0.94)	0.025	0.89 (0.82 - 0.97)	0.014	0.91 (0.61 - 1.35)	0.608	0.97 (0.87 - 1.09)	0.595	1.15 (0.87 - 1.52)	0.310	1.05 (0.96 - 1.15)	0.306	0.89 (0.72 - 1.09)	0.245	0.96 (0.91 - 1.02)	0.193
Fair	0.60 (0.39 - 0.95)	0.030	0.89 (0.80 - 0.98)	0.027	0.94 (0.61 - 1.45)	0.765	0.99 (0.87 - 1.12)	0.810	0.88 (0.61 - 1.27)	0.465	0.96 (0.85 - 1.09)	0.498	0.79 (0.63 - 1.00)	0.047	0.93 (0.87 - 1.00)	0.044
Poor	0.38 (0.27 - 0.54)	<0.001	0.77 (0.68 - 0.87)	<0.001	0.70 (0.45 - 1.09)	0.108	0.90 (0.79 - 1.02)	0.097	0.80 (0.52 - 1.23)	0.295	0.92 (0.80 - 1.07)	0.290	0.61 (0.48 - 0.77)	<0.001	0.86 (0.80 - 0.92)	<0.001
Survey wave																
2013-2014	n/a		n/a		n/a		n/a		n/a		n/a		1.00		1.00	
2015-2016	n/a		n/a		n/a		n/a		n/a		n/a		0.94 (0.79 - 1.11)	0.460	0.98 (0.93 - 1.03)	0.480
2017-2020	n/a		n/a		n/a		n/a		n/a		n/a		0.87 (0.75 - 1.01)	0.074	0.96 (0.92 - 1.00)	0.066

Table 4.

	2013-14 and 2013-16		2013-14 and 2017-20	
	Endowments	**Coefficient**	**Endowments**	**Coefficient**
Age				
18 to 44	2.60E-03***	7.32E-03	1.48E-03**	1.77E-02**
45 to 64	-1.80E-05	4.45E-03	-1.77E-05	2.49E-03
65 to 74	8.91E-04***	-6.80E-03**	7.78E-04*	-7.72E-03**
75+	7.80E-04***	2.11E-03	3.26E-04**	1.03E-03
Gender				
Man	-5.36E-05***	-3.40E-03	1.95E-04**	-8.32E-03*
Woman	-2.92E-04***	3.72E-03	-6.85E-05**	8.82E-03*
Black				
No	-2.39E-04***	1.13E-02	-3.16E-04**	1.87E-03
Yes	-1.42E-05***	-1.45E-03	-6.73E-05**	-2.30E-04
Chronic kidney disease				
No	-4.59E-04***	-4.84E-04	-2.88E-04**	1.77E-02
Yes	-2.54E-04***	7.34E-05	-6.07E-05**	-2.76E-03
Cardiovascular disease				
No	4.18E-04***	-8.28E-03	-1.99E-05***	-5.75E-02**
Yes	1.09E-04***	6.78E-04	-3.62E-04***	5.77E-03**
Vigorous recreational activities				
No	-9.53E-04***	5.86E-03	-5.91E-04**	-5.87E-05
Yes	-7.97E-04***	-1.42E-02	-4.19E-04**	1.39E-04
Body mass index				
<25.0	8.49E-04***	4.32E-04	9.49E-04**	1.58E-03
25.0 to 29.9	2.94E-04***	9.21E-03	1.55E-04**	6.68E-03
30.0 to 34.9	1.87E-04	-2.15E-03	1.08E-04	3.77E-03
35.0+	1.08E-03***	-3.82E-03	1.51E-03**	-9.09E-03*
Hypertension medication use				
No	-2.32E-04***	-7.42E-03	-8.53E-05**	-3.00E-04
Yes	-5.61E-05***	2.25E-03	1.10E-04**	9.52E-05
Food security				
No	4.95E-04	7.04E-03	1.38E-04	2.91E-03
Marginal	-2.12E-04	3.31E-03	-1.57E-04	2.64E-03
Low	-7.46E-05	1.38E-03	-1.21E-05	4.48E-04
Very low	5.92E-04*	-4.32E-03*	2.07E-04	-2.38E-03
Walking or biking for at least 10 minutes/day				
No	2.58E-05	3.64E-03	1.37E-05	2.14E-03
Yes	3.22E-05	-1.40E-02	2.07E-05	-8.29E-03
Overall	4.58E-03	2.09E-02	3.40E-03	1.87E-02
Percentage	17.99%	82.02%	15.36%	84.64%

Legend: *p*<0.05 (*), *p*<0.01 (**), *p*<0.001 (***); values without asterisks are not statistically significant.

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