

# Trends in Hypertension Control and Management Disparities in U.S. Adults: A NHANES Analysis from 1999-2020

Yiying Wu, Yi Huang

February 2, 2024

# Introduction: Background

## Background

- Hypertension is a leading risk factor for cardiovascular diseases, affecting public health worldwide and prominently in the U.S.

## Problem

- Following an initial improvement in blood pressure control among U.S. adults with hypertension from 1999-2000 to 2007-2008, there was a stagnation and subsequent decrease post-2013 (Muntner P, et al., 2020).

# Introduction

## Motivation

- This study aims to explore the reasons behind recent declines in hypertension control.

## Study Objective

- Examining the trends, awareness, and medication use in stage 2 hypertension among U.S. adults in 1999-2020.
- Assessing the impact of demographic factors and comorbid conditions on hypertension control.
- This study used 1999-2020 National Health and Nutrition Examination Survey (NHANES) data.

# Definition & Study Outcomes

- **Study population:** U.S. adults (larger than 18 years old) with hypertension defined by the JNC7 guideline
- **Uncontrolled Hypertension:** Systolic blood pressure  $\geq 140$  mm Hg or diastolic blood pressure  $\geq 90$  mm Hg
- **Awareness:** Self-report of a prior diagnosis of antihypertensive medication.
- **Medication Use:** Self-reported use of antihypertensive medication

# Statistical Analysis

- ① Weighting and multiple year adjustment
- ② Multiple Imputation to address missing data
- ③ Logistic Regression Models accounts for complex survey design  
(Heeringa, S., West, B.T. and Berglund, P.A., 2017):

The model can be expressed as:

$$\log\left(\frac{\pi}{1 - \pi}\right) = X\beta = \beta_0 + \beta_1X_1 + \dots + \beta_nX_n$$

- Variance is estimated using the linearization method
- Using Rubin's multiple imputation combining rule to combine both between and within imputation variance (Little, R.A. and Rubin, D.B., 2019)

# Results

- Gap in high blood pressure treatment!
  - **Hypertension control:** Among U.S. adults with stage 2 hypertension, 52% are uncontrolled.
  - **Awareness:** Among those with hypertension, 80% of them are aware of their condition.
  - **Medication Use:** Among those aware, 71% of them are taking medication.
- $0.80 \times 0.71 \approx 56.8\%$  of those with stage 2 hypertension are being medicated.

# Results

Table 1: Participant Characteristics, Awareness, and Medication Use Among US Adults with Hypertension, 1999-2020

Characteristic	Hypertension N = 20,409 <sup>1</sup>	Uncontrolled N = 11,082 <sup>2</sup>	Awareness N = 16,297 <sup>3</sup>	Medication Use N = 14,690 <sup>4</sup>
Age	61 (50, 71)	60 (49, 72)	61 (51, 72)	62 (53, 72)
Race/Ethnicity				
Non-Hispanic White	9,056 (70%)	4,692 (67%)	7,240 (70%)	6,616 (71%)
Hispanic/Asian/Other	5,716 (16%)	3,278 (17%)	4,368 (15%)	3,863 (14%)
Non-Hispanic Black	5,637 (14%)	3,112 (15%)	4,689 (15%)	4,221 (15%)
Gender				
Male	10,064 (48%)	5,590 (49%)	7,665 (46%)	6,751 (45%)
Female	10,435 (52%)	5,492 (51%)	8,632 (54%)	7,939 (55%)
BMI				
<25	4,045 (19%)	2,645 (24%)	2,856 (17%)	2,497 (16%)
25 to 30	6,525 (33%)	3,651 (33%)	5,098 (32%)	4,591 (32%)
30+	9,147 (48%)	4,447 (43%)	7,778 (51%)	7,079 (52%)
Unknown	692	339	565	523
Diabetes	5,376 (22%)	2,450 (18%)	4,817 (25%)	4,611 (26%)
Chronic Kidney Disease	6,542 (26%)	3,726 (28%)	5,560 (28%)	5,127 (29%)
History of CVD	4,241 (18%)	1,949 (15%)	3,900 (21%)	3,704 (22%)

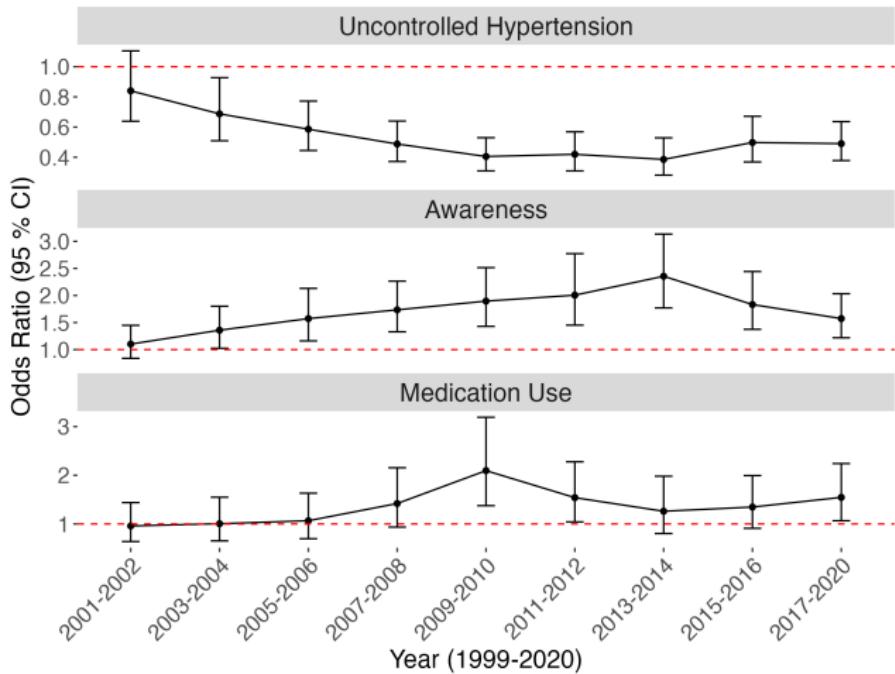
<sup>1</sup> Stage 2 Hypertension Prevalence: There are 20,409 participants with hypertension in the dataset.

<sup>2</sup> Uncontrolled Among Those participants with hypertension: 11,082 (52%) of them are uncontrolled according to 140/90 mmHg cut off.

<sup>3</sup> Awareness Among Those participants with hypertension: 16,297 (80%) of them are aware of their condition.

<sup>4</sup> Medication Usage Among Aware Participants: 14,690 (71%) of them are taking medication.

# Results



**Figure 1:** Odds Ratios and 95% CI of Uncontrolled Stage 2 Hypertension, Awareness, and Self-reported Antihypertensive Medication Use in US Adults by Year

# Results

Table 2: Odds Ratios and 95% CI of Uncontrolled Stage 2 Hypertension, Awareness, and Medication Use in US Adults, 1999-2020

Characteristic	Hypertension Uncontrolled N = 20,409	Awareness N = 20,409	Medication Use N = 16,297
Age	0.99 (0.99, 1.01)	1.02 (1.01, 1.02)	1.05 (1.04, 1.05)
Race/Ethnicity			
Non-Hispanic White	Ref	Ref	Ref
Hispanic/Asian/Other	1.43 (1.29, 1.59)	0.79 (0.70, 0.89)	0.71 (0.60, 0.84)
Non-Hispanic Black	1.44 (1.31, 1.58)	1.12 (0.99, 1.26)	0.86 (0.74, 1.01)
Gender			
Male	Ref	Ref	Ref
Female	0.84 (0.77, 0.91)	1.38 (1.24, 1.54)	1.59 (1.39, 1.81)
BMI			
< 25	Ref	Ref	Ref
25 to 30	0.62 (0.55, 0.71)	1.70 (1.47, 1.96)	1.48 (1.22, 1.79)
30+	0.50 (0.44, 0.57)	2.73 (2.41, 3.10)	1.70 (1.37, 2.12)
Diabetes	0.68 (0.60, 0.76)	2.03 (1.73, 2.38)	2.32 (1.83, 2.95)
Chronic Kidney Disease	1.43 (1.31, 1.57)	1.22 (1.09, 1.36)	0.77 (0.64, 0.93)
History of CVD	0.65 (0.59, 0.72)	3.14 (2.68, 3.68)	1.72 (1.34, 2.19)

SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure.

Stage 2 Hypertension: SBP  $\geq$  140 mm Hg or DBP  $\geq$  90 mm Hg.

# Discussion

## Findings

- A gap in high blood pressure treatment: 56.8% of those with stage 2 hypertension are being medicated.
- Overall increase in awareness since 1999, but a notable decline in recent years.
- Level of medication use has not shown significant improvement.
- Women and people with diabetes or history of CVD tend to pay more attention to blood pressure management.

## Limitations

- Potential inaccuracies in self-reported data and the exclusion of certain variables that might influence the outcomes.

# References

- ① Centers for Disease Control and Prevention. Facts about Hypertension. URL <http://www.cdc.gov/bloodpressure/facts.htm/> [Accessed 22 Dec. 2023.]
- ② Centers for Disease Control and Prevention. NHANES tutorials - Variance Estimation module. URL <https://www.cdc.gov/nchs/nhanes/tutorials/VarianceEstimation.aspx> [Accessed 22 Dec. 2023.]
- ③ Centers for Disease Control and Prevention. NHANES tutorials - weighting module. URL <https://www.cdc.gov/nchs/nhanes/tutorials/Weighting.aspx> [Accessed 22 Dec. 2023.]
- ④ Heeringa, S., West, B.T. and Berglund, P.A. (2017) Applied Survey Data Analysis. Boca Raton, FL: CRC Press, Taylor and Francis Group.
- ⑤ Muntner P, et al. (2020) Trends in Blood Pressure Control Among US Adults With Hypertension, 1999-2000 to 2017-2018. JAMA 324(12):1190–1200. <https://doi.org/10.1001/jama.2020.14545>
- ⑥ Little, R.A. and Rubin, D.B. (2019). Statistical Analysis with Missing Data, Third Edition. John Wiley & Sons.

# Thank you!

We would like to express our gratitude to ENAR DataFest for giving us this opportunity!

For more information, feel free to email us at

Yiying Wu, email: [yw3996@cumc.columbia.edu](mailto:yw3996@cumc.columbia.edu)

Yi Huang, email: [yh3554@cumc.columbia.edu](mailto:yh3554@cumc.columbia.edu)