# Trends in Stage 2 Hypertension Management in U.S. Adults: A Comprehensive Analysis (1999-2020)

YiyingWu, Yi Huang

January 16, 2024

# Content

1. Introduction
2. Methodology
3. Results
4. Discussion
5. References

# 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 is motivated by the need to investigate the reasons behind this decline and to identify factors contributing to the diminishing control of hypertension in recent years.

**Study Objective**

- Examining the trends, awareness, and medication use in stage 2 hypertension among U.S. adults.
- Assessing the impact of demographic factors and comorbid conditions on hypertension control.

# Methodology

# Methodology

1. Weighting and multiple year adjustment
2. Multiple Imputation to address missing data
3. Logistic Regression Models (Dobson, 2008):

Suppose there are $n$ covariates $X_i$, $i = 1, \ldots n$, the model can be expressed as:

$$log(\frac{\pi}{1-\pi}) = X\beta = \beta_0 + \beta_1 X_1 + \ldots + \beta_n X_n$$

- $\pi$ is the risk
- $\frac{\pi}{1-\pi}$ is the odds
- $\beta_0$ is the log odds for $X_i's = 0$
- $\beta_i$ is the log odds ratio per unit change of $X_i$, holding all other covariates fixed

# Results

Table 1: Participant Characteristics and Comorbidity Status of Uncontrolled Stage 2 Hypertension, Awareness, and Medication Use in US Adults, 1999-2020

| Characteristic | Stage 2 Hypertension N = 56,017 [1] | Awareness N = 10,923 [2] | Medication Use N = 6,891 [3] |
|---|---|---|---|
| Age | 64 (52, 74) | 65 (54, 75) | 68 (59, 77) |
| Race/Ethnicity | | | |
| Non-Hispanic White | 4,627 (42%) | 2,841 (41%) | 2,223 (42%) |
| Hispanic/Asian/Other | 3,221 (29%) | 1,909 (28%) | 1,406 (27%) |
| Non-Hispanic Black | 3,075 (28%) | 2,141 (31%) | 1,664 (31%) |
| Gender | | | |
| Male | 5,510 (50%) | 3,249 (47%) | 2,338 (44%) |
| Female | 5,413 (50%) | 3,642 (53%) | 2,955 (56%) |
| BMI | | | |
| <25 | 2,584 (24%) | 1,423 (21%) | 1,067 (21%) |
| 25 to 30 | 3,604 (34%) | 2,202 (33%) | 1,700 (33%) |
| 30+ | 4,408 (42%) | 3,057 (46%) | 2,359 (46%) |
| Unknown | 327 | 209 | 167 |
| Diabetes | 2,410 (22%) | 1,867 (27%) | 1,661 (31%) |
| Chronic Kidney Disease | 3,653 (33%) | 2,702 (39%) | 2,272 (43%) |
| History of CVD | 1,920 (18%) | 1,588 (23%) | 1,395 (26%) |

[1] Stage 2 Hypertension Prevalence: Among the 56,017 participants, 10,923 (19%) have stage 2 hypertension.

[2] Awareness Among Those with Stage 2 Hypertension: 6,891 (63%) of them are aware of their condition.

[3] Medication Usage Among Aware Participants: 5,293 (77%) of them are taking medication .

# Results
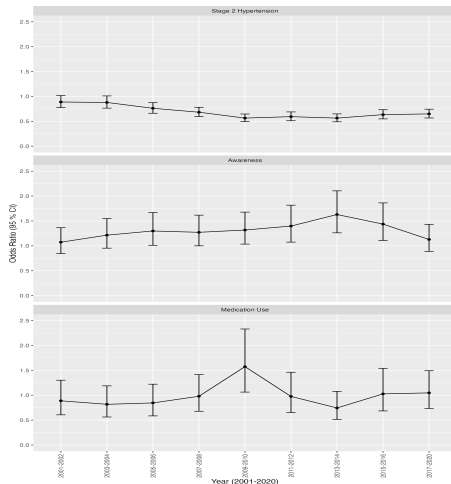


**Figure 1:** Odds Ratios and 95% CI of Uncontrolled Stage 2 Hypertension, Awareness, and Self-reported Antihypertensive Medication Use in US Adults by Year

# Results

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

| Characteristic | Model 1: Stage 2 Hypertension | | Model 2: Awareness | | Model 3: Medication Use | |
| | N = 56,017 | | N = 10,923 | | N = 6,891 | |
| | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value |
|---|---|---|---|---|---|---|
| Age | 1.06 (1.06, 1.06) | < 0.0001 | 1.02 (1.01, 1.02) | < 0.0001 | 1.06 (1.05, 1.07) | < 0.0001 |
| Race/Ethnicity | | | | | | |
| Non-Hispanic White | Ref | Ref | Ref | Ref | | |
| Hispanic/Asian/Other | 1.23 (1.14, 1.33) | < 0.0001 | 0.98 (0.86, 1.13) | < 0.0001 | 0.93 (0.76, 1.15) | 0.0517 |
| Non-Hispanic Black | 2.09 (1.94, 2.24) | < 0.0001 | 1.49 (1.32, 1.70) | < 0.0001 | 1.38 (1.15, 1.66) | < 0.0001 |
| Gender | | | | | | |
| Male | Ref | Ref | Ref | Ref | | |
| Female | 0.83 (0.78, 0.89) | < 0.0001 | 1.24 (1.10, 1.40) | < 0.0001 | 1.39 (1.17, 1.65) | < 0.0001 |
| BMI | | | | | | |
| < 25 | Ref | Ref | Ref | Ref | | |
| 25 to 30 | 1.16 (1.06, 1.26) | < 0.0001 | 1.41 (1.21, 1.64) | < 0.0001 | 1.26 (1.00, 1.65) | 0.0050 |
| 30+ | 1.57 (1.44, 1.70) | < 0.0001 | 2.26 (1.93, 2.64) | < 0.0001 | 1.62 (1.28, 2.03) | < 0.0001 |
| Diabetes | 1.02 (0.93, 1.12) | 0.0652 | 1.68 (1.42, 1.98) | < 0.0001 | 2.10 (1.63, 2.70) | < 0.0001 |
| Chronic Kidney Disease | 1.72 (1.59, 1.87) | < 0.0001 | 1.56 (1.36, 1.77) | < 0.0001 | 1.10 (0.91, 1.34) | 0.0335 |
| History of CVD | 0.84 (0.76, 0.92) | < 0.0001 | 2.79 (2.33, 3.36) | < 0.0001 | 1.61 (1.26, 2.05) | < 0.0001 |

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

Stage 1 Hypertension: SBP $\geqslant$ 130 mm Hg or DBP $\geqslant$ 80 mm Hg.

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

# Discussion

# Discussion

**Data source**

- NHANES data (1999-2020).

**Method**

- Descriptive statistics and logistic regression

**Findings**

- Significant gap in high blood pressure treatment
- Overall increase in awareness and treatment since 1999, but a notable decline in recent years.
- Age, race, BMI, and additional health conditions, particularly diabetes, have a considerable impact on high blood pressure management.

**Limitations**

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

# References

1. Dobson, A.J. (2008) An introduction to generalized linear models, Third Edition. Chapman & Hall.

2. "Facts about Hypertension." Centers for Disease Control and Prevention, 6 July 2023. URL http://www.cdc.gov/bloodpressure/facts.htm/ [Accessed 22 Dec. 2023.]

3. 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

4. "Nhanes tutorials - Variance Estimation module". Centers for Disease Control and Prevention, URL https://wwwn.cdc.gov/nchs/nhanes/tutorials/VarianceEstimation.aspx [Accessed 22 Dec. 2023.]

# References

**5** "Nhanes tutorials - weighting module". Centers for Disease Control and Prevention, URL https://wwwn.cdc.gov/nchs/nhanes/tutorials/Weighting.aspx [Accessed 22 Dec. 2023.]

**6** Rubin, D.B. (2018). Flexible Imputation of Missing Data, Second Edition. Chapman and Hall/CRC.