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Short communication

Changes in blood pressure measurement prevalence among United States adults with hypertension before and during the COVID-19 pandemic

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ABSTRACT

Background: The Coronavirus Disease 2019 (COVID-19) pandemic disrupted health care, with particularly profound effects on persons with chronic conditions like hypertension.
Objectives: In this study, we examined changes in the prevalence of blood pressure (BP) measurements by a healthcare professional among adults aged ≥ 18 years with hypertension before and during the COVID-19 pandemic in the United States (US).
Methods: This study utilized the National Health Interview Survey data from April to December of the 2019 and 2021 modules of the survey. A total of 15,855 participants were included in the analytic sample. The prevalence of BP measurements taken by a health professional was calculated and the association between survey year and BP measurements was evaluated using adjusted and unadjusted logistic regression models.
Results: Overall, the prevalence of BP measurements by a health professional among US adults with hypertension decreased from 95.9 % in the pre-pandemic period to 94.7 % in the pandemic period. Adults with hypertension were less likely (OR: 0.76, 95 % CI: 0.63–0.91) to report having had a BP measurement taken by a health professional during the pandemic compared to before the pandemic.
Conclusion: Self-measured BP monitoring with clinical support could ensure continuous and improved care of individuals with hypertension, especially when circumstances could interrupt healthcare access.

1. Introduction

Early in the Coronavirus Disease 2019 (COVID-19) pandemic, facility closures and reluctance to seek care systematically disrupted medical care. These disruptions particularly affected people with chronic conditions, including hypertension, and were more acutely felt among racial and ethnic minorities, who were less likely to seek care even during a medical emergency (Czeisler et al., 2020).

However, the implications of these disruptions on blood pressure (BP) measurements and associated racial and ethnic disparities have not been fully studied in the United States (US). In Massachusetts, the proportion of individuals who had uncontrolled hypertension and a reported BP measure declined by 90 % during the COVID-19 pandemic (Nielsen et al., 2022). Another study found decreased BP monitoring among Medicare beneficiaries with hypertension during the pandemic (Beckman et al., 2021). Moreover, only about one-quarter of adults with hypertension had optimum BP control prior to the pandemic (Ostchega et al., 2018). Since BP monitoring is crucial for BP control, these declines in BP measurement during the pandemic may have contributed to decreased BP control among people with hypertension (Laffin et al., 2022).

To determine changes in BP measurements during the COVID-19 pandemic, our study compared the prevalence of BP measurements taken by a health professional among individuals with hypertension before and during the pandemic, while also examining racial and ethnic differences in this prevalence.

2. Methods

Using the 2019 and 2021 Sample Adult modules of the US National Health Interview Survey (NHIS) (National Center for Health Statistics, 2022), we identified 22,137 participants aged ≥ 18 years with hypertension, defined as reporting a hypertension diagnosis or taking BP medication. We excluded 5,708 participants who took the survey in January through March of each year, coinciding with the timing of the COVID-19 pandemic's emergence, and 574 participants with missing data. The analytic sample included 15,855 participants.

The exposure was survey year categorized as pre-COVID-19

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pandemic (April-December 2019) and during the COVID-19 pandemic (April-December 2021). The outcome was report of a BP measurement in the past 12 months (answering "within the past year [anytime less than 12 months ago]" to the question "When was the last time you had your blood pressure checked by a doctor, nurse, or other health professional?").

Covariates were age group (18–44, 45–64, ≥65 years), sex, race and ethnicity (non-Hispanic White [NHW], non-Hispanic Black [NHB], non-Hispanic American Indian or Alaska Native [NHAIAN], non-Hispanic Asian [NHA], other and multiple races, and Hispanic), education level, family income to poverty threshold ratio (<100 %, ≥100 % and < 200 %, ≥200 %), employment status, medical insurance coverage, and urban–rural classification.

We calculated descriptive statistics for each covariate and compared covariates across the two time periods using a Wald test. Using logistic regression, we examined unadjusted and adjusted associations between survey year and having a BP measurement. Adjusted models included covariates described above and interaction between survey year and race and ethnicity. We tested this interaction's significance using a Wald test ($p = 0.006$). To account for the complex sample design, all analyses used adjusted sample weights reflecting the use of three-quarters of the annual data (National Center for Health Statistics, 2022).

R v4.1.3 was used for analysis (R Core Team, 2020). NHIS data are deidentified and publicly accessible. This analysis was reviewed by the Centers for Disease Control and Prevention (CDC) and was conducted consistent with applicable federal law and CDC policy. It was determined by CDC to not be human subjects research requiring institutional review board approval.

3. Results

Our analysis represented 153,229,548 US adults aged ≥ 18 years with hypertension (Table 1). Approximately half (50.3 %) were female and two-thirds (66.1 %) were NHW. Compared to the pre-pandemic period, US adults with hypertension during the pandemic reported higher educational attainment ($p < 0.001$), higher family income ($p = 0.002$), and having medical insurance ($p < 0.001$).

The overall prevalence of reporting a BP measurement taken by a health professional among adults with hypertension decreased from 95.9 % in the pre-pandemic period to 94.7 % during the pandemic period (unadjusted odds ratio [OR] = 0.76, 95 % confidence interval [CI] = 0.63, 0.91) (Table 2). In the adjusted analysis, the association between having had BP measured by a health professional during the pandemic period compared to the pre-pandemic period differed significantly by race and ethnicity. NHAIAN and NHB adults reported the highest prevalence of reported BP measurements taken by a health professional in the pre-pandemic period (98.7 % and 97.3 % respectively) (Table 2). NHAIAN adults had the largest decline in BP measurement prevalence taken by a health professional (5.3 percentage points [pp]) while other racial and ethnic groups (except Hispanic adults) had a 1.1 to 2.2 pp decrease in the prevalence of BP measurements taken by a health professional during the pandemic period. However, the prevalence of BP measurements taken by a health professional significantly decreased for only NHW adults (adjusted OR: 0.66, 95 % CI: 0.52–0.83). For all other racial and ethnic groups, observed prevalence decreases were not statistically significant.

4. Discussion

In the US, the prevalence of BP measurement by a healthcare professional for individuals with hypertension significantly decreased during the COVID-19 pandemic compared to the pre-pandemic period, with differences by race and ethnicity. Despite hypertension affecting nearly half of US adults, hypertension control is inadequate (Ostchega et al., 2018; Centers for Disease Control and Prevention, 2023). BP measurements guide acute and long-term decisions for hypertension

Table 1
Characteristics of adults aged ≥ 18 years with reported hypertension, pre-COVID-19 pandemic (April-December 2019) and COVID-19 (April-December 2019) pandemic periods, United States.

	Pre-COVID-19 pandemic period[a] (N=8,152)% (95 % CI)	COVID-19 pandemic period[a] (N=7,703)% (95 % CI)	Overall (N=15,855)% (95 % CI)	p-value
Weighted population	76,324,775	76,904,773	153,229,548	
BP measurement in the last year	95.9 % (95.3 %, 96.4 %)	94.7 % (94.0 %, 95.2 %)	95.3 % (94.9 %, 95.7 %)	0.003
Age (years)				0.1
18–44	17.1 % (16.0 %, 18.2 %)	17.7 % (16.5 %, 18.9 %)	17.4 % (16.5 %, 18.2 %)	
45–64	41.3 % (40.0 %, 42.6 %)	39.3 % (38.0 %, 40.6 %)	40.3 % (39.3 %, 41.2 %)	
≥65	41.7 % (40.4 %, 43.0 %)	43.1 % (41.8 %, 44.4 %)	42.4 % (41.4 %, 43.4 %)	
Sex				0.2
Female	50.9 % (49.5 %, 52.2 %)	49.7 % (48.4 %, 51.0 %)	50.3 % (49.4 %, 51.2 %)	
Male	49.1 % (47.8 %, 50.5 %)	50.3 % (49.0 %, 51.6 %)	49.7 % (48.8 %, 50.6 %)	
Race and ethnicity				>0.9
Non-Hispanic Black	14.7 % (13.3 %, 16.3 %)	14.6 % (13.2 %, 16.0 %)	14.6 % (13.5 %, 15.9 %)	
Non-Hispanic Asian	4.2 % (3.51 %, 4.98 %)	4.1 % (3.54 %, 4.83 %)	4.2 % (3.66 %, 4.72 %)	
Non-Hispanic American Indian or Alaskan Native	0.9 % (0.48 %, 1.77 %)	0.7 % (0.41 %, 1.27 %)	0.8 % (0.46 %, 1.47 %)	
Non-Hispanic White	66.0 % (63.9 %, 68.0 %)	66.3 % (64.2 %, 68.2 %)	66.1 % (64.3 %, 67.9 %)	
Other and Multiple races	1.9 % (1.55 %, 2.32 %)	1.9 % (1.51 %, 2.28 %)	1.9 % (1.61 %, 2.19 %)	
Hispanic	12.3 % (10.9 %, 13.9 %)	12.5 % (11.1 %, 14.0 %)	12.4 % (11.1 %, 13.7 %)	
Education				<0.001
Less than high school	16.8 % (15.4 %, 18.2 %)	12.0 % (11.0 %, 13.2 %)	14.4 % (13.5 %, 15.4 %)	
High school diploma	28.6 % (27.4 %, 29.9 %)	30.9 % (29.5 %, 32.3 %)	29.7 % (28.8 %, 30.7 %)	
Some college or associate's degree	30.6 % (29.4 %, 32.0 %)	27.2 % (26.1 %, 28.4 %)	28.9 % (28.0 %, 29.9 %)	
Bachelor's degree	14.8 % (13.9 %, 15.7 %)	19.0 % (17.9 %, 20.1 %)	16.9 % (16.2 %, 17.6 %)	
Master's degree or higher	9.2 % (8.49 %, 9.99 %)	10.9 % (10.1 %, 11.7 %)	10.0 % (9.45 %, 10.7 %)	
Employment status				0.2
Worked last week	46.8 % (45.3 %, 48.3 %)	45.5 % (44.2 %, 46.9 %)	46.1 % (45.1 %, 47.2 %)	
Did not work last week	53.2 % (51.7 %, 54.7 %)	54.5 % (53.1 %, 55.8 %)	53.9 % (52.8 %, 54.9 %)	
Family income to poverty threshold ratio				0.002
<100 %	12.9 % (11.8 %, 14.0 %)	10.9 % (10.0 %, 11.9 %)	11.9 % (11.2 %, 12.7 %)	
≥100 % and < 200 %	20.1 % (18.9 %, 21.4 %)	18.9 % (17.8 %, 20.0 %)	19.5 % (18.7 %, 20.3 %)	
≥200 %	67.0 % (65.4 %, 68.6 %)	70.2 % (68.8 %, 71.5 %)	68.6 % (67.5 %, 69.7 %)	
Medical Insurance Coverage				<0.001
Insured	92.7 % (91.8 %, 93.5 %)	94.5 % (93.8 %, 95.2 %)	93.6 % (93.0 %, 94.2 %)	
Uninsured	7.3 % (6.47 %, 8.20 %)	5.5 % (4.81 %, 6.21 %)	6.4 % (5.82 %, 6.98 %)	
Urban-Rural Classification				0.14

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Table 1 (*continued*)

	Pre-COVID-19 pandemic period[a] (N=8,152)% (95 % CI)	COVID-19 pandemic period[a] (N=7,703)% (95 % CI)	Overall (N=15,855)% (95 % CI)	p-value
Large central metro	26.8 % (24.5 %, 29.3 %)	26.7 % (24.5 %, 29.0 %)	26.8 % (24.7 %, 29.0 %)	
Large fringe metro	24.0 % (21.7 %, 26.6 %)	22.8 % (20.8 %, 25.1 %)	23.4 % (21.4 %, 25.7 %)	
Medium and small metro	31.4 % (28.4 %, 34.6 %)	33.5 % (30.7 %, 36.6 %)	32.5 % (29.7 %, 35.4 %)	
Nonmetropolitan	17.7 % (16.1 %, 19.4 %)	16.9 % (15.4 %, 18.4 %)	17.3 % (16.0 %, 18.7 %)	

Abbreviations: CI, confidence interval; NHIS, National Health Information Survey.

Notes: All estimates are weighted according to NHIS sampling methodology. P-values are calculated using Wald tests.

[a] The pre-COVID-19 pandemic period is defined as interviews occurring April-December 2019. The COVID-19 pandemic period is defined as interviews occurring April-December 2021.

Table 2

Prevalence of reported BP measurement among adults aged ≥ 18 years with reported hypertension, pre-COVID-19 pandemic (April-December 2019) and COVID-19 pandemic (April-December 2021) periods by race and ethnicity, United States.

	Reported BP measure in the past 12 months			
	Pre-COVID-19 pandemic[a] (N=8,152)% (95 % CI)	COVID-19 pandemic[a] (N=7,703)% (95 % CI)	Percentage point difference (95 % CI)	Odds ratio (95 % CI)
Overall	95.9 (95.3, 96.4)	94.7 (94.0, 95.2)	−1.2 (−1.3, −1.2)	0.76 (0.63, 0.91)[b]
Non-Hispanic White	96.3 (95.6, 96.9)	94.9 (94.2, 95.6)	−1.4 (−1.4, −1.3)	0.66 (0.52, 0.83)[c]
Non-Hispanic Black	97.3 (95.8, 98.2)	96.2 (94.7, 97.3)	−1.1 (−1.1, −0.9)	0.71 (0.39, 1.29)[c]
Non-Hispanic Asian	93.4 (88.5, 96.3)	91.2 (86.4, 94.4)	−2.2 (−2.1, −1.9)	0.64 (0.29, 1.40)[c]
Non-Hispanic American Indian or Alaskan Native	98.7 (94.0, 99.7)	93.4 (83.7, 97.5)	−5.3 (−10.3, −2.2)	0.16 (0.02, 1.31)[c]
Other and Multiple races	94.6 (86.9, 97.9)	93.1 (86.8, 96.5)	−1.5 (−0.1, −1.4)	0.68 (0.19, 2.46)[c]
Hispanic	92.8 (90.3, 94.7)	92.9 (90.8, 94.6)	0.1 (0.5, −0.1)	0.91 (0.57, 1.48)[c]

Abbreviations: CI, confidence interval; NHIS, National Health Information Survey.

Notes: All estimates are weighted according to NHIS sampling methodology.

[a] The pre-COVID-19 pandemic period is defined as interviews occurring April-December 2019. The COVID-19 pandemic period is defined as interviews occurring April-December 2021.

[b] Unadjusted odds ratio comparing the pre-COVID-19 pandemic to COVID-19 pandemic periods from a bivariate model.

[c] Adjusted odds ratio comparing the pre-COVID-19 pandemic to COVID-19 pandemic periods from a multivariable model including interaction of pandemic period and race and ethnicity.

management and help identify potential complications. Our study's results support a continued focus on improving BP measurements outside healthcare settings, including implementing self-measured BP monitoring (SMBP) with clinical support, supporting web-based clinical counseling, and enhancing the ability to report remote BP measurements.

A declining national prevalence of BP measurements taken by a health professional during the pandemic is consistent with other localized studies (Gotanda et al., 1979. 2022,; Meador et al., 2022), likely reflecting decreased healthcare access or reliance on telehealth appointments without access to SMBP (Czeisler et al., 2020). In localized studies, the prevalence of BP measurements declined in the early pandemic period compared to the pre-pandemic periods, and patients without BP measurements increased from 0.5 % in December 2019 to 27.2 % in March 2021 (Gotanda et al., 1979. 2022,; Meador et al., 2022). However, the number of total BP measurements including SMBP increased during the COVID-19 pandemic compared to similar pre-pandemic months (Shah et al., 2022), suggesting the importance of SMBP use and reporting.

SMBP allows for more frequent BP monitoring and, with proper clinical support, facilitates BP control while improving trust, increasing healthcare engagement, and more quickly achieving BP goals (Wall et al., 2022; Lee et al., 2023). SMBP with clinical support could also provide opportunities for uninterrupted care during future systemic disruptions. However, SMBP implementation, particularly the technology to transmit data from patients to clinicians, needs to be optimized (Wall et al., 2022).

This study has limitations. Hypertension and BP measurement status were self-reported. Patients may also be misclassified if they incorrectly recalled when their last BP measure occurred. Likewise, NHIS does not include a measure of blood pressure control. Additionally, the 12-month review of BP measurements exceeds the time of maximal healthcare disruption during COVID-19-related mitigation measures; reported differences may therefore, underestimate the true impact. NHIS does not capture SMBP use, therefore we were unable to explore SMBP's direct role in the observed changes. Finally, small sample sizes for some racial and ethnic groups may have limited the ability to find a significant difference.

In conclusion, US adults with hypertension were less likely to report BP measurements during the pandemic. Efforts such as SMBP could ensure continuous and improved care of persons with hypertension.

CRediT authorship contribution statement

Baffour Otchere: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Adam S. Vaughan:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **LaTonia Richardson:** Writing – review & editing. **Hilary K. Wall:** . **Fátima Coronado:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention. The authors have no conflicts of interest. All authors have approved this manuscript. Data are publicly available and, therefore, IRB review was not necessary for this analysis.

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