

ORIGINAL ARTICLE

Analysis of older adult blood pressure readings and hypertension treatment rates among the unsheltered population of Miami-Dade County

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Abstract

Objective: To assess prevalence of elevated blood pressure readings, rates of established hypertension diagnosis, and blood pressure control medication prescription rates in a cohort of older people experiencing unsheltered homelessness presenting to a Street Medicine clinic in Miami-Dade County, Florida. In addition, we will compare outcomes found in the study cohort to that of the general population.

Methods: Demographic information, clinical history, blood pressure control medication prescription, and blood pressure measurements were taken by a Street Medicine team of medical providers. The team routinely provides medical evaluations and care for people experiencing unsheltered homelessness who reside in rough sleeper tent encampments located on the street. Clinical information and vitals were recorded in REDCap. De-identified data from patients 65 years and above were downloaded and compared to a general population data set—the Centers for Disease Control National Health and Nutrition Examination Survey (CDC NHANES) 2017–2020 Pre-pandemic cohort. Data analysis was performed using R Studio version 4.3.2.

Results: Blood pressure was reported in 120 distinct interactions with older people experiencing homelessness. Compared to the age-matched NHANES data, older people experiencing unsheltered homelessness were at significantly increased relative risk for elevated blood pressure within the range of Stage 1 Hypertension ($RR: 3.914$, $95\% CI: 2.560-5.892$, $P < 0.001$), and within range of Stage 2 Hypertension ($RR: 5.550$, $95\% CI: 4.272-7.210$, $P < 0.001$). According to NHANES, 49.6% of adults over 60 with diagnosed hypertension receive treatment. Of study participants, 69% of those with elevated blood pressure had previously received a diagnosis of hypertension and 15.9% on medication to control blood pressure.

Conclusion: Our cohort of older people experiencing unsheltered homelessness had higher rates of elevated blood pressure and reduced rates of hypertension diagnosis and treatment as compared to the general population. Older people experiencing unsheltered homelessness are a growing population, and future research should seek

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to evaluate and understand older adult care vulnerabilities, including chronic disease management, to improve health outcomes for those who are aging, hypertensive, and unhoused.

KEYWORDS

hypertension, unhoused persons, shelterless persons

1 | INTRODUCTION

Currently, persons aged 65 and older make up 23% of people experiencing homelessness (PEH) in the United States,¹ and these numbers are expected to increase exponentially over the next 10 years.² Older adults experience high rates of hypertension, a chronic disease where management is heavily reliant on the health care system for prevention, diagnosis, and medication management.³ Hypertension can initially present as asymptomatic but leads to serious morbidity and mortality if not properly managed.^{4,5} The increasing prevalence of older adult PEH² heightens the need to assess hypertension prevalence and management trends among this population.

Many studies conducted on PEH populations primarily focus recruitment efforts on people living in shelters.⁶⁻⁸ It is also important to consider hypertension rates in older adults experiencing *unsheltered* homelessness (PEUH).⁸ Studies that compare PEUH to shelter-based PEH have found these two populations experience different health vulnerabilities.⁹⁻¹⁴ For example, a study by Treglia et al.⁹ found that shelter-based PEH tend to use inpatient hospital services at greater rates than PEUH, likely indicating their sheltered status grants them at least a slight reduction in barriers of entry to the health care system. Grouping shelter-based PEH with PEUH in terms of blood pressure data may mask findings within each subgroup, thereby possibly skewing our understanding of hypertension rates in each subgroup. Using specific language when reporting results for this population is particularly important since there exist so many other factors that can limit precision when studying older PEUH, most of which are more difficult to address. The tremendous health barriers affecting this subpopulation include lack of primary care access, low patient retention rates, transportation/mobility barriers complicating study design, and low patient attrition rates. There is added inaccuracy generated from grouping together the risks and needs of older PEUH vs. PEH who are sheltered.¹⁵⁻¹⁸

The research reported here is based on our Street Medicine clinic in Miami, Florida. Our research will enhance our knowledge about regional diversity regarding PEUH health access. In the United States, literature published on PEUH is largely from studies conducted in the northeastern geographic region and from California.^{1,6,8-11,16,18-20} While PEUH represent approximately 30% of the total PEH population nationally, it has been estimated that they make up an even greater percentage in warmer states.² The southeastern states are among the warmest in the continental United States, consisting entirely of subtropical and tropical climate zones.²¹ Along with environmental climate differences, PEUH in

southeastern states face a distinct political climate impacting their ability to access health care. In the United States, health insurance policies differ from state to state. California and most states in the northeast have Medicaid expansion, substantially increasing health insurance coverage for at-risk populations.²²⁻²⁴ Studies conducted in states with Medicaid expansion are reporting results from states with reduced barriers to health care, and PEUH in those states, as a result of the expansion, have easier access to health care. PEUH in the southeast face policies that exacerbate their inability to access housing and health care, limiting the generalizability of results published in other regions.^{7,22,23} For example, a study on PEUH primary care utilization in Los Angeles, California found less than 10% of PEUH routinely use a primary care physician.¹³ These numbers may be further reduced among PEUH living in southeastern states where Medicaid is more limited.

Our aim in this paper is to provide benchmark blood pressure data for an older PEUH cohort in Miami-Dade County, Florida. In doing so, we hope to provide an initial estimation of needs and trends in blood pressure for an under-researched geographic region to enhance the current literature.

1.1 | Background on Street Medicine

The term "Street Medicine" was coined by physician Jim Withers who designed the first Street Medicine program in the early 1990s.²⁵ By providing care to PEUH directly on the street, Dr. Withers was effectively able to bypass numerous barriers precluding PEUH from accessing traditional health care systems.²⁵ Since the 1990s, Street Medicine models have been adopted across the United States and internationally, and now may include a variety of different outreach approaches and health care delivery strategies. However, the central tenets remain the same. Care is provided through a "mobile clinic" wherein all necessary supplies are transported in vehicles, portable kits, and knapsacks. Without waiting areas or exam rooms, the clinics operate as a "clinic without walls," designed to handle prevention medicine and follow-up care in the extra-clinical environment. By providing care in this way, Street Medicine has been able to effectively mitigate disease outbreaks, prevent toxic sequelae stemming from untreated chronic diseases, and build trust and rapport in a community that rarely has access to welcoming provider relationships when receiving medical care.²⁵⁻²⁷

Our research was conducted in partnership with Miami Street Medicine (MSM), a 501c nonprofit registered with the Florida

Department of Health. MSM was founded in 2018 by a group of medical students who sought to bring medical care directly to people living in squatter-driven encampments located around Jackson Memorial Hospital, known as the Miami Medical District—where the students trained. MSM merged in 2020 with local community-based nonprofit Dade County Street Response (DCSR) so they could work in tandem to provide free medical care and case management to PEUH in Miami-Dade County.²⁸ Funding for equipment and medications is charity-based and nonprofit grant-sourced.

With DCSR, MSM conducts weekly outreach efforts called “street rounds” where a multidisciplinary care team of medical professionals carrying medical equipment traverses the radial blocks surrounding Jackson Memorial Hospital. The weekly street round schedule is spread by word of mouth. At street rounds, PEUH are approached while located at their rough sleeping quarters—in tents, sleeping bags, or blankets located on sidewalks, in encampments, or in areas under overpasses. Patients are asked if they would like to receive medical care. If they say yes, the patient is then evaluated on the street. Patients can receive baseline medical assessments and prevention care, such as vital screening and vaccinations, as well as treatment such as wound care and emergency triage.^{10,26,28,29} By conducting outreach in this way, PEUH living in the area have an opportunity to receive care they may not otherwise be able to access.^{25,28}

2 | METHODS

MSM research protocols for participant recruitment and informed consent comply with regulations outlined by the Florida Department of Health and were approved by their Human Services Office for Human Research Protections,³⁰ as well as with the University of Miami Institutional Review Board.

Participant Recruitment: Patients who consented to medical management by the physicians and staff had the option to separately consent to have their results made available for research purposes. Refusing to participate in research did not preclude patients from medical care. Inclusion criteria for this paper were self-reported age ≥ 65 and experiencing unsheltered homelessness at the time of consent. All eligible patients who received care between February 2021 and February 2023 were asked about study participation ($n=527$), of which 60% ($n=315$) consented to having their results used for research. Enrolled participants had the option to refuse to answer any questions and could end the encounter at any time.

Self-Reported Data: During the patient encounter, clinic staff documented patients' medical history, including previous hypertension diagnosis, as well as demographic information—age, gender, race, and ethnicity. Miami Street Medicine staff conduct medical histories on-site in English, Spanish, and Haitian Creole, and have a dial-in translation service for patients with any other primary language preferences.

Blood Pressure Medication: Enrolled participants were asked to present any prescription medication bottles to MSM staff. For

enrolled participants, study-relevant medications were entered into the REDCap database and de-identified before being downloaded and sent to the research team for analysis.

Blood Pressure Measurement: Blood pressure is routinely measured for each patient presenting at clinical street encounters. Blood pressure is measured by physicians, residents, and medical students volunteering for MSM. Blood pressure measurements followed the standard AHA protocol guidelines and used an Omron HEM 907XL blood pressure monitor.^{31,32} While blood pressure was measured, patients sat on a portable stool with their arm relaxed at the level of their heart. The pressure cuff was placed on either the left or right upper arm while the patient's feet were firmly on the floor.³¹

Operational Definitions of Blood Pressure Readings: This study follows the 2017 American College of Cardiology/American Heart Association Hypertension guidelines for hypertension classification.³¹ The AHA defines Stage 1 Hypertension as systolic blood pressure of 130–139 mmHg and diastolic blood pressure of 80–89 mmHg, and Stage 2 Hypertension as systolic blood pressure above 140 mmHg and diastolic blood pressure above 90 mmHg.¹⁵ To be diagnosed with hypertension, the AHA requires such readings on two visits. Given that many PEUH do not return for treatment, we often cannot formally diagnose hypertension in these patients. Therefore, when participants in this study were found to have elevated blood pressure, at levels consistent with hypertension, these patients were classified as having “*measured* hypertension” rather than “*diagnosed* hypertension.”

Statistical Analysis: Patient information was stored in a HIPAA-compliant REDCap database. Only physicians involved directly with patient care had access to the patient's chart in REDCap. Pertinent patient information was de-identified before being downloaded and sent to researchers in an Excel data spreadsheet for analysis. Blood pressure levels and basic demographic data obtained on Miami Street Medicine rounds were compared to age-matched data from the Center for Disease Control's free online National Health and Nutrition Examination Survey (NHANES).³³ Statistical analysis was performed using R Studio version 4.3.2. Average blood pressure levels of NHANES and PEUH were compared using an independent two-tailed *t* test.

Comparisons were then stratified by demographic data and AHA Stage 1 and Stage 2 Hypertension categories (measured in PEUH, diagnosed in NHANES).³¹ The demographic information for PEUH and the NHANES dataset were also further stratified, and blood pressure averages, as well as the relative risk of hypertension (measured in PEUH, diagnosed in NHANES), were compared across groups sorted by gender, race, and ethnicity.

3 | RESULTS

De-identified blood pressure recordings and demographic information were obtained from 120 PEUH above the age of 65 years on street rounds. Full demographic information, blood pressure averages, and hypertension stages, diagnosed for NHANES

and measured for PEUH, as well as relative risk scores, *P* values, and 95% confidence intervals (CI), can be found in Table 1.

Compared to NHANES, older PEUH had a significantly greater percentage of participants who identified as males and of African American race. Compared to the NHANES cohort, PEUH had significantly fewer people identifying as Non-Hispanic White. Both systolic and diastolic blood pressure were significantly higher in the PEUH population compared to the NHANES population. The average measured systolic blood pressure for PEUH was 142 mmHg, which is above national average levels and would be characterized at the level of AHA Stage 2 Hypertension if obtained at two visits.

When stratifying PEUH measured hypertension prevalence, PEUH were found to have higher rates of measured hypertension at both Stage 1 and Stage 2 levels. PEUH and NHANES participants' Stage 1 Hypertension results can be found in Table 2. There was an increased risk of measured hypertension in PEUH groups vs. diagnosed hypertension in NHANES for every race and ethnicity, with the exception of Non-Hispanic White participants. Male gender was associated with a significant increase in risk of elevated blood pressure in the PEUH cohort vs. NHANES. When stratifying measured Stage 1 Hypertension by participant gender, the female PEUH group only had two participants, and as such they were not compared to the NHANES dataset.

Table 3 reports findings on PEUH vs. NHANES participants with blood pressure levels meeting Stage 2 Hypertension. PEUH were found to be at increased risk of measured Stage 2 Hypertension in every demographic group when compared to the NHANES cohort. Similar to the measured Stage 1 Hypertension results, PEUH were at increased risk for measured Stage 2 Hypertension in every racial and demographic group except Non-Hispanic White. Male PEUH were at significantly increased

risk for measured Stage 2 Hypertension compared to males in the NHANES cohort.

As a secondary analysis, we investigated self-reported rates of established hypertension diagnosis and blood pressure control medication prescription rates for NHANES participants vs. PEUH. NHANES reports their participant medication use data in 20-year age cohorts. NHANES reports that 49.4% of people over the age of 60 previously diagnosed with hypertension were prescribed and adherent to blood pressure control medication. While 69% of PEUH participants whose blood pressure at clinic was found to be elevated self-reported that they had been told their blood pressure was elevated on at least one other occasion, only 15.9% reported ever being diagnosed with clinical hypertension or had ever been prescribed any blood pressure medication. PEUH, then, were not only at significantly increased risk of measured hypertension compared to the NHANES diagnosed hypertension rate (RR: 4.880, 95% CI: 4.055–5.873, $P < 0.001$); PEUH who did provisionally meet AHA clinical hypertension criteria were at increased risk for having their hypertension go undiagnosed and untreated (RR: 1.666, CI 1.470–1.905, $P < 0.0001$).

4 | DISCUSSION

PEUH presenting to a mobile street clinic outreach team in Miami-Dade County had increased rates of elevated blood pressure measurements when compared to older adults in the NHANES population. Yet they were less likely to have been given a formal clinical hypertension diagnosis and were less likely to have a blood pressure control medication prescription. Studies on shelter-based older PEH have also found higher rates of hypertension as compared to datasets representative of a general population sample.

TABLE 1 Characteristics of study participants.

Demographic characteristics	Mean (SD) or No. (%), PEUH <i>n</i> = 120	NHANES (SD) or No. (%) <i>n</i> = 4987	Relative Risk	<i>P</i> Value	95% CI
Gender					
Male	89 (74%)	2465 (49%)	1.501	<0.001*	1.345–1.674
Female	31 (26%)	2522 (51%)	0.511	<0.001*	0.377–0.693
Race and ethnicity, <i>n</i>					
Hispanic / Latinx	30 (25%)	964 (19%)	1.293	0.110	0.94–1.772
Non-Hispanic African American	59 (49%)	1333 (27%)	1.839	<0.001*	1.525–2.219
Non-Hispanic White	11 (9%)	1964 (39%)	0.262	<0.001*	0.149–0.461
Other/Not recorded	20 (17%)	726 (15%)	1.145	0.513	0.763–1.718
Blood pressure, avg					
Systolic	142 (22.4)	131 (20.0)		<0.001*	6.371–13.630
Diastolic	89 (13.8)	75 (11.6)		<0.001*	11.892–16.111
Hypertension					
Stage 1	21 (17.5%)	223 (4.4%)	3.914	<0.001*	2.560–5.892
Stage 2	43 (36.0%)	322 (6.5%)	5.550	<0.001*	4.272–7.210

* indicates significant outcomes.

TABLE 2 Stage 1 Hypertension stratified data table PEUH & NHANES.

Demographic characteristics	PEUH Stage 1 HTN mean (SD) or n=21(17.5%)	NHANES Stage 1 HTN mean (SD) or n=223 (4.4%)	Relative Risk	P Value	95% CI
Gender, no. (%)					
Male	19 (90%)	118 (53%)	1.710	<0.001*	1.420-2.059
Female	2 (10%)	105 (47%)	-	-	-
Race and ethnicity, No. (%)					
Hispanic/Latinx	4 (19%)	38 (17%)	1.118	0.814	0.441-2.828
African-American	10 (49%)	74 (33%)	1.435	0.145	0.883-2.332
Non-Hispanic White	2 (10%)	74 (33%)	0.287	0.066	0.076-1.087
Other	5 (24%)	37 (17%)	1.435	0.388	0.632-3.257

* indicates significant outcomes.

TABLE 3 Stage 2 Hypertension stratified data table PEUH & NHANES.

Demographic characteristics	PEUH Stage 2 HTN prevalence n=43 (36.0%)	NHANES Stage 2 HTN prevalence n=322 (6.5%)	Relative risk	P Value	95% Confidence Intervals
Gender, no. (%)					
Male	31 (72%)	181 (56%)	1.246	0.044*	1.006-1.543
Female	13 (28%)	139 (43%)	0.680	0.110	0.424-1.092
Race and ethnicity, No. (%)					
Hispanic/Latinx	8 (19%)	60 (19%)	0.998	0.996	0.513-1.943
African American	24 (56%)	150 (43%)	1.198	0.223	0.896-1.602
Non-Hispanic White	4 (9%)	72 (22%)	0.416	0.072	0.160-1.081
Other	8 (19%)	40 (12%)	1.498	0.251	0.752-2.984

* indicates significant outcomes.

For example, a study of New York City shelter-based older adults reported that participants had increased odds of hypertension (OR=1.34) compared to a control group of housed older adults.³⁴

Increased risk of hypertension in PEH relative to the general population can be attributed to several factors. PEH have increased rates of behaviors known to increase hypertension risk, including higher smoking rates, poor diet, and high levels of sodium in average daily nutritional intake.³⁵⁻³⁸ Studies on health care use in PEH populations have reported cost to be a significant barrier to medication access, likely impacting adherence to antihypertensives.³⁵⁻⁴⁰ PEH also navigate an environment that poses logistical and practical barriers to lifestyle changes necessary for blood pressure control and maintenance, including barriers to obtaining fresh produce and reduced access to blood pressure monitoring equipment.^{34,35,37-39,41} Research on PEH has reported that the impact of high rates of disease burden for PEH (including PEUH) contributes to early signs of aging.⁴² Housing insecurity has been associated more broadly with an increased rate of physiologic aging contributing to a significant reduction in life expectancy. Crimmins et al. referred to *early aging of the poor* in their study of NHANES data from 1999 to 2004 that found stratification by poverty status produced several notable differences, including earlier presence and increased prevalence of diseases associated with physiologic aging.⁴² Hayward et al. determined low socioeconomic status (SES) to be associated with earlier onset of age-related disease by 5 to 10 years.⁴²⁻⁴⁴ Early aging

impacts the age of onset for chronic diseases such as hypertension, affecting cardiovascular disease morbidity and mortality rates in this population.

Traditionally, older adults are defined in medical literature as age 65 and older.⁴²⁻⁴⁴ Results of studies such as those conducted by Hayward et al. and Crimmins et al. have called into question the age at which older adult care should begin for low SES and housing-insecure patients, and recommend defining older adults in at-risk populations earlier in the life course to better match onset of age-associated diseases.³²⁻⁴⁴ Doing so would have clinical relevance for primary care physicians who are tasked to manage chronic diseases, such as hypertension, in vulnerable patient populations. Our findings could potentially support lowering the age for defining older adults for at-risk populations, as measured hypertension prevalence in the PEUH cohort far surpassed hypertension prevalence in the general age-matched population represented by NHANES data, and findings remained consistent even when comparing diagnosis rates for the 20-year age cohorts which started at age 60. Given our findings, primary care physicians whose patient populations include a high prevalence of PEUH may choose to screen PEUH more often or begin screening PEUH at younger ages. Hypertension is also associated with other comorbid conditions that present with increased physiologic age, such as lipid and cholesterol levels.^{45,46} Further research should evaluate these clinically significant biomarkers among PEUH as well.

In our cohort, increased rates of measured hypertension were likely compounded by reduced diagnosis and medication prescription rates. Our results show that 31% of the cohort presented with an elevated blood pressure reading without a previous hypertension diagnosis. These findings indicate that older PEUH experience barriers beyond preventing access to treatment. Participants with elevated blood pressure are likely facing barriers preventing them from obtaining a diagnosis of hypertension. Previous studies on older adult PEUH diagnosed with hypertension show they face numerous barriers to accessing disease monitoring and management services.^{6,9,12-14,19,20} However, participants in these studies already have overcome a significant barrier to care compared to one-third of our older PEUH cohort, as their hypertension was diagnosed. Future research should aim to better determine the prevalence of undiagnosed hypertension among older PEUH and investigate barriers that prevented them from obtaining their diagnosis. Effective root cause analysis will substantially improve research studies and outreach efforts aimed at improving and treating older PEUH hypertension.

Although our study provides insight into current levels of older PEUH-measured hypertension and blood pressure medication trends, the study is not without limitations. A key limitation of our study is the relatively small PEUH sample size. Yet despite the small sample size, the study does provide initial information indicating that unsheltered older adult populations in the Southeastern United States may be at greater risk of high blood pressure and poor blood pressure control compared to the general population. A strength of our study is that our research methods are easily reproducible. Future research should consider replicating our observational study with larger older PEUH cohorts to further understand and categorize blood pressure trends in this population.

Our primary limitation is that we cannot formally diagnose hypertension given that we have only one blood pressure measurement. We recognize that one-time data does not give us the opportunity to correct for technical sources of error or the white coat hypertension effect and does not allow for formal AHA diagnosis that requires at least two measurements above cutoffs. However, the fact that 69% of our study participants with elevated blood pressure reported being previously informed of having elevated blood pressure tentatively suggests that our approach to PEUH hypertension measurement is reliable.

Receiving a diagnosis of hypertension, even if the patient is asymptomatic, is important as there are proven effective strategies to control blood pressure,³⁷ including medications³⁸ and lifestyle changes that prevent the progression of the disease.³⁹ Hypertension is a common chronic disease in older adult populations, and when untreated, hypertension contributes to older adult frailty due to multisystem vulnerability, comorbidities, and increased risk of adverse events.^{40,41} Unfortunately, few of these strategies have been critically analyzed within the context of older PEUH care. Future research should develop and test protocols to determine the most effective strategies to address hypertension control in the population of older, unhoused adults. In addition,

future research should assess the potential for Street Medicine to manage hypertension care, including diagnostic and follow-up screening for older PEUH, as Street Medicine organizations may help reduce barriers to primary care in this population. Doing so could improve health access and reduce morbidity and mortality of disease, given the increased prevalence and disease burden in the older PEUH population.

5 | CONCLUSION

Older PEUH presenting to a street medicine team during clinical encounters run by Miami Street Medicine in Miami Dade County were five times more likely to have elevated blood pressure compared to an age-matched NHANES dataset. Both systolic and diastolic blood pressure were significantly higher in the PEUH population compared to the NHANES population. The average PEUH systolic blood pressure found was 142 mmHg, above the cutoff for AHA Stage 2 hypertension. Hypertension is one of the most common diseases in older adult populations, and primary care is often necessary for disease management, including clinical diagnosis, patient education, and blood pressure monitoring and treatment.² Future research should aim to better understand and categorize current hypertension trends in the PEUH population, as well as the potential associated gaps in primary care. These studies will help inform targeted outreach efforts to better address the relatively low rates of diagnosis and management of hypertension in this group, which stand in contrast to the relatively high prevalence of elevated blood pressure measurements found in this vulnerable and growing community.

AUTHOR CONTRIBUTIONS

SS had full access to all the data in the study and takes responsibility for the integrity and accuracy of the data. Study concept and design: SS, OM, JL, AH. Acquisition and analysis of data: SS, AM, AH, SP, OM. Interpretation of data: All authors. Drafting of the manuscript: SS, OM, AM, SP, JS. Critical revision of the manuscript for important intellectual content: All authors. Administrative, technical, or material support: AH, JL, JS, GM. Study Supervision: AH, JL, JS, GM.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

ETHICS STATEMENT

MSM research protocols for participant recruitment and informed written consent comply with regulations outlined by the Florida Department of Health and were approved by their Human Services Office for Human Research Protections, as well as with the University of Miami Institutional Review Board #20230265.

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