



Socioeconomics, Ethnogeriatrics, and Social Determinants of Health: Correlations in Hypertension Patients

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ABSTRACT

This study explores the impact of Social Determinants of Health (SDOH): diet/nutrition, food insecurity, physical activity, ethno geriatrics, and socio economic factors on hypertension patients living in underserved, low income, and urban communities. Baseline data from January to May 31, 2021, was compared to post data in June and July 2021. This two fold research attempted to predict what cultural factors lead to compliance in achieving lower blood pressure levels. Investigations of the statistical differences between variables were used in a multivariate analysis and were compared amongst pre and post data. Research questions and hypothesis testing that guided this study included. Hypothesis testing for the research questions was completed to determine if we should reject or fail to reject the null hypothesis. Post data showed that there was a statistical significance in the patients' race, ethnicity, age, FPL (Federal Poverty Level) status, food insecurities, and nutrition counseling. Additionally, the post data proved that blood pressure levels decreased tremendously from 169/90 to 130/80 after the implementation of SMBP devices. Limitations and additional research are discussed as well as considerations for future researchers when performing this research in the selected communities.

Keywords: Ethno geriatrics; Social determinants; Hypertension patients; Hypothesis testing; Urban communities

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INTRODUCTION

Hypertension (HTN) amongst racial and ethnic communities has remained a persistent health concern worldwide, especially in the United States. In the United States alone, it is estimated that there are nearly 116 million people living with a diagnosis of controlled or uncontrolled hypertension. Amongst those living with this disease, Blacks have exhibited a higher prevalence when compared with other races and ethnic groups. Hypertension or blood pressure is the measure of the force of blood pushing against the blood vessel walls (WebMD, 2019). Hypertension (HTN) is known as “the silent killer,” and affects millions of people in multiple age ranges and ethnicities. This disease can be caused by several factors such as smoking, lack of physical activity, being overweight, excess salt consumption, and genetics. According to the centers for disease control and prevention, high blood pressure affects one in three adult Americans, but people do not even know they have HTN with the aforementioned factors that impact hypertension, there are other important variables such as socio-economic status, ethno geriatrics, social determinants of health, and compliance that play bigger roles in the care of patients. Additionally, there is another factor that has impacted the low-income and underserved patients suffering with hypertension. The recent outbreak of the novel Coronavirus (COVID-19) has swept across the world and most heavily in the United States. As the world passed the one-year mark for COVID-19, healthcare professionals, especially those in low-income, under-served, ethnic, and rural communities have seen great declines in health outcomes within the populations they serve. Reported data from 1,099 patients who were confirmed positive for COVID-19; for 15% of this group, the single highest risk factor of infection was hypertension. The relationship between COVID-19 and hypertension remains unknown, but there are preliminary data points that HTN is a prevalent comorbidity among patients admitted with COVID-19. With few studies conducted in HTN, COVID-19 and health disparities, the full impact of the pandemic is unknown with only limited data being released [1-5].

Statement of Problem

It is unknown to what extent COVID-19 has impacted patients diagnosed with HTN living in low income, vulnerable, and underserved communities. Hypertension (HTN) remains the leading cause of premature death in the United States (national center for health statistics, 2017). Risk factors such as prediabetes and obesity increase the risk of HTN in all age groups. Recent data has revealed that the use of antihypertensive medication among patients with an HTN diagnosis was only 62% effective. What is also unknown is to what extent or level of rigor do patients follow a medication regimen at home. Although we live in the age of technology, Ostchega estimate that only 25% of U.S. adults with

hypertension engage in some form of home blood pressure monitoring. In April 2020, many insurance companies began expanding coverage and defining reimbursement for telemedicine services. In the U.S., at least 15% of physicians work in practices that use telemedicine and adoption by private insurers has increased by 50%. The approval of such services became priority when Managed Care Organizations (MCOs) began seeing an increase in patients who were not receiving the recommended check ups and instead were using emergency rooms and urgent care facilities for basic needs. Funding for essential programs was launched so patients with chronic care conditions could monitor their health from the safety of their home. Some of the solutions to chronic care conditions were the use of electronic processes and communication technologies referred to as e-health; and m-health which is the use of telemedicine and mobile health. The focus of the additional funding has been for the group of patients who are unable to make regular doctor appointments. In many cases, this group comes from a socially complex and economically disadvantaged population that faces cost, poor health literacy, and other social determinant barriers. Improving hypertension control was the focus for the population in this study. Specifically, to minimize the number of individuals who could not achieve blood pressure control, Self-Measured Blood Pressure Monitoring (SMBP) was developed so that patients could evaluate their measurement outside the clinic with additional support in an effective manner. Many factors impact how this demographic of patients will achieve holistic health while trying to coexist in society. With a weakened economy that has extended beyond health to encompass household incomes, individual livelihoods, and nutritional intake, disadvantaged patients are still projected to increase the cost on the healthcare system. This cascading effect impacts the patient’s ability to afford medications, attend medical appointments, or eat a healthy diet to keep blood pressure levels below 140/90 which is considered an optimal level. Qualifications to participate in this study included non-compliant nutritional and medication patients, patients who required SMBP devices due to missed appointments, and at least three consecutive readings above 140/90. This research will contribute to clinical practice by giving health care providers data on patient compliance based on their culture to adhere to small scaled lifestyle changes such as home based self-blood pressure monitoring and following a nutritional, patient educational, and medication regime [6-10].

Purpose Statement

The purpose of this quantitative research study is twofold; first to evaluate whether the following social determinants of health: diet/nutrition (food insecurity), physical activity, ethno geriatrics, and socio economic factors impact hypertensive diagnosed patients living in underserved and vulnerable urban communities. Second, this study will also attempt to

predict what cultural factors lead to compliance in achieving lower blood pressure levels. Compliance meaning patient medication after study enrollment. Adherence and self-monitoring of HTN. Changes were measured from baseline to 2 months

Definition of Terms

For a better understanding of this study, the following terms are operationally defined.

Hypertension and Uncontrolled Hypertension.

The current definition of Hypertension (HTN) is Systolic Blood Pressure (SBP) values of 130 mmHg or more and/or Diastolic Blood Pressure (DBP) more than 80 mmHg. Uncontrolled hypertension is defined as an average systolic blood pressure of 130 mmHg or an average diastolic blood pressure of greater than 80 mmHg amongst those with hypertension.

Self-Measured Blood Pressure

This refers to Self-Measured Blood Pressure (SMBP) monitoring by the patient outside the clinical setting, either at home or elsewhere.

Social Determinant of Health

Social determinants of health or SDOH refers to the conditions in the environments in which people are born, live, learn, work, play, and worship, and affect a wide range of health, functioning, and quality of life outcomes and risks.

Ethno Geriatrics

This term refers to components of geriatric care that considers the influence of ethnicity and culture on the health and well being of older adults.

Patient Compliance

This refers to the process whereby the patient follows the prescribed and dispensed regimen as intended by the prescriber and dispenser.

Food Insecurity

Food insecurity is defined as the disruption of food intake or eating patterns because of a lack of money and other resources.

LITERATURE REVIEW

A literature review was conducted to provide a foundation of knowledge on the causes of hypertension linked to food insecurity, health factors, ethno geriatrics, and culture based compliance and social determinants of health.

Food Insecurity and Hypertension

Food insecurity is defined as limited or inadequate access to food, often related to individual factors such as poverty,

disability, and systematic factors like transportation or grocery store access. There is a complex relationship between Social Determinants of Health (SDOH), food insecurities, and health disparities which needs to be understood. The premise of healthcare has always been looked upon as being within a clinical setting, whereas societal wellbeing is contingent upon health being a factor outside of the clinical walls. There is a lack of current research focusing on elements such as SDOH, COVID-19, and chronic care conditions such as hypertension used a population based sample to evaluate associations between food insecurities and risk factors including hypertension, hyperlipidemia, and diabetes. Using laboratory data to confirm results, the researchers were able to quantify the prevalence for each condition. The study was conducted from 1999-2004 on 31,126 individuals that were over the age of 18 but less than 65 years old. The study found that Latino households were more likely to be food insecure than White households. Additional analysis found that low educational attainment, low household income, lack of health insurance, and tobacco use was associated with these individuals. This study provided evidence and linkage to household incomes of below 200% of the Federal Poverty Level (FPL) contributing to the clinical evidence of hypertension found that as the likelihood of food insecurity increased, health disparities also increased. Ultimately, the health outcomes were linked to inadequate access to fresh fruits and vegetables (food insecurity). Individuals in these areas could either not afford to purchase necessary food for the desired lifestyle change, or there was not a location nearby or accessibility to local neighborhoods or communities [11-14].

Health Factors, SDOH, and Hypertension

In the United States, nearly 50% of adults are living with hypertension. Research on the SDOH factors and the impact on HTN levels are still not well understood. Despite various efforts to understand and improve the unique and complex health behaviors, researchers have chosen to examine individual provider and patient characteristics. One characteristic that is not fully explainable is medication adherence. Hensley, et al. found that social support, food insecurity, poverty, and lack of transportation are associated with hypertension and medication adherence in patients. A study by Donneyong, et al. uncovered four major categories relating to health factors, SDOH, and HTN. The factors included poverty, weak social support, healthy built environment, and food insecurity. Each of the factors within this study had sub topics that were used for measuring factors of social determinants of health. Factors of measurement included percent below the poverty line, uninsured percentage, residential segregation, severe housing problems, food insecurities, limited access to healthy foods, and food environment index. The study findings highlighted the following factors as having an impact on HTN and medication adherence: poverty/food insecurity, weak social support, unhealthy built environments, and African American females who live in rural counties. This study reinforces the theory that SDOH play a critical role in an individual's ability to achieve compliant or non-compliant HTN levels. Individuals

without the resources were found to be less compliant in adhering to medical instructions involving antihypertensive medication. It is important to learn more about the patients and tailor an approach that fits each individual need. While tailoring an approach may seem cumbersome, it is necessary when looking to achieve total health. A Study by Dawson, Walker, Gregory, and Egede studied the relationship between Social Determinants of Health (SDoH) and systolic blood pressure in United States immigrants. SDoH includes factors such as where people are born, live, work, and age that contribute to several health inequities and preventable disparities, many of which can be prevented. Such lifestyles affect a person's risk for developing chronic diseases such as hypertension. Due to limited research in the area of SDoH and its link to poor health outcomes, the study used a theory based model that incorporated SDoH and specific factors to examine the relationship between antecedent factors (region/country of origin, ethnicity/race, life course socioeconomic status), predisposing factors (*i.e.* age, sex, marital status, education, employment, household income, subjective social status, homelessness, and immigrant stress), enabling factors (*i.e.* healthcare access, insurance status, perceived discrimination, perceived stress, health literacy, self-efficacy, acculturation), and need factors, and blood pressure control in a diverse population of immigrants in the Midwestern United States. The study found that socioeconomic status, age, sex, and being homeless to be associated with increased systolic blood pressure. This study is consistent with prior literature by Howell. Where age and male sex were found to be positively associated with higher levels of HTN [15-17].

Ethno geriatrics

Ethno geriatrics refers to the influence of culture, race, and ethnicity on health care for older people from diverse ethno racial populations. Taking this into consideration, medical providers need to have cultural competence when addressing health disparities within the community health setting. It has been shown that multi-cultural patients experience higher comorbidities, shorter life expectancies, and disabilities than non-hispanic Whites performed a study examining the differences in self-care behaviors for hypertension, the results showed African American women were more likely to consume recommended amounts of fruits and vegetables but less likely to engage in physical activity to manage hypertension than white women. Furthermore, African American elders are more likely to incorporate nontraditional self-care strategies such as home remedies for chronic illness management than White elders. Three out of four adults older than the age of 65 have three or more chronic conditions such as Diabetes (DM), obesity, cardiovascular disease, congestive heart failure, renal insufficiency, and not the least of which is hypertension sought to address the complexities of hypertension in individuals who are older and have several additional considerations. Their study focused on blood pressure target levels and comorbidities. The study reviewed the epidemiology of the aging process and found that normal HTN in men and women will increase by 85% at the age of 55, or the patient will develop hypertension over

the next 20 to 25 years. This prevalence amongst older Americans is due to factors that are generally not considered. The main consideration was vascular changes in patients. The structural changes as a person ages contributed to the arterial pulse wave velocity. This is interesting as this suggests an answer to the issue of hypertension development within this unknown phenomenon. The ethno geriatric implications of hypertension have heightened with COVID-19. The disproportionate impact of COVID-19 exposed some of the manifold disparities with social determinants of health. Higher rates of preexisting conditions such as diabetes, hypertension, and other chronic medical conditions amongst the geriatric population are often ignored if the patient is uninsured and within the group of population that is vulnerable and underserved.

African American Culture

When examining the cultural dynamic of ethno geriatrics, age and culture impact HTN levels. There has been insufficient evidence to support those lifestyle modifications, socioeconomic factors, and genetic factors correlate to developing or living with HTN. The two populations with the highest prevalence of HTN are Hispanic and African American. A study by Peters examined Hispanic and African American cultures to determine correlations between the Theory of Planned Behavior (TPB) and patient compliance. The researchers concluded that the attitude, subjective norms, and perceived behavioral control of these groups played a major part in the future patterns and habits of the individuals. Perceived behavioral control will ultimately predict actual health behaviors. The examination of culture and medication compliance must be segmented, as different cultures have different attitudes, normative beliefs, and control beliefs formed focus groups and collected data based on the TPB model. Results of the analysis found that African Americans possess a "circle of culture" mind set. This mind set symbolizes what is acceptable and provides boundaries based on heritage and culture as well as separates insiders from outsiders. Beliefs regarding strategies to prevent and or reduce HTN resulted in self-care measures. When focusing on the main reasons for medication adherence, participants expressed that there was a lack of trust in physicians and reluctance to seek medical care. This generational distrust of the health care system can be linked to the Tuskegee experiment, where black men were denied treatment for syphilis so doctors could study the disease's progression. This distrust was also linked to HTN control claiming that patients are getting conflicting HTN readings and suspicious motives for prescribing antihypertensive medications. Similar to research the relationship between adherence to diet and physical activity using socio cognitive approaches (self-efficacy and social support). These study findings addressed the dietary culture that inhibited decreased adherence for diet and physical activity. This portion of adherence is related to social support. As African Americans are less likely to receive medical care due to mistrust and racial bias amongst physicians, many individuals find themselves seeking support from family members, friends, and associates to reach goals.

This is culturally unacceptable due to various factors, such as misguided health recommendations.

Hispanic Culture

The hispanic population in the United States is comprised of various genetic backgrounds and distinct cultures. This population has consistently shown a lower prevalence of HTN compared to non-hispanic whites and blacks. A study by the National Health and Nutrition Examination Survey (NHANES) examined data on this population that was comprised of HTN data: Age, sex, race/ethnicity (Mexican American, white, black), and BMI. Compared to blacks and whites, Hispanic subjects were not receiving treatment for hypertension. While examining BMI and age, it was noticed that the prevalence increased with Hispanic women and men who were from Puerto Rico and the Dominican Republic; this population was 2.6 times more likely to have hypertension. Researchers found that because this disease is asymptomatic, it goes undetected. When detected and treated, Mexican Americans had significantly lower HTN control rates than whites and blacks. Although the rates were lower, the decreases suggested that the advances in antihypertensive medication are not meaningful. Understanding the distinct culture in this study meant understanding that most subjects did not have a primary care physician and used the emergency room as their primary source of care. Machismo image amongst men was heavily sought to be projected, while any signs of illness was culturally unacceptable. Finally, it was seen as being fatalism (e.g., "It is god's will") within this cultural community as a large contributor to not seeing a physician for health related factors, especially hypertension. Ultimately, culture plays a huge role when examining medication adherence and assessing the impact of medical care. The medical distrust and beliefs patients display speaks volumes and translates to a person's health status and wellbeing.

Social Determinants of Health and Hypertension

Social determinants of health are conditions in places where people live, learn, work, and play that affect a wide range of health risks and outcomes. There are five main areas as defined by healthy people 2030:

- **Healthcare access and quality:** the connection between people's access to and understanding of health services and their own health. This area also includes health insurance coverage and health literacy.
- **Education access and quality:** the connection of education to health and wellbeing. Included within this topic is graduating from high school, higher education enrollment, educational attainment, language and literacy, and early childhood development.
- **Social and community context:** This context is two-fold. Positive relationships help reduce negative impacts. These include relationships and interactions with family, friends, co-workers, and the community. Negative relationships include not being able to control factors such as

discrimination, unsafe neighborhoods, incarceration, and/or being unable to afford the basic needs.

- **Economic stability:** The connection between financial resources people may have. This includes income, cost of living, and socioeconomic status-and their health. Key areas are also highlighted such as poverty, employment, food security, and housing stability.
- **Neighborhood and built environment:** The connection between where a person lives and their wellbeing. Topics include quality of housing, access to transportation, availability of healthy foods, air and water quality, and neighborhood crime and violence.

These conditions are typically observed from a community centered aspect. This model is often referred to as the community centered health home or CCHH model. Using the CCHH model, the patient is screened at the clinic for social determinants of health factors that can impact health outside of the clinical walls. The defining attribute of the CCHH is translating high priority medical conditions into active involvement in community advocacy and change. Using the Protocol for Responding to and Assessing Patients Assets, Risks and Experiences (PRAPARE) tool, data elements are collected such as employment, food insecurity, housing, utility needs, substance abuse, transportation, education, and physical activity to help meet the patient's population needs. The issue with this model and study is that it is not deployed into all communities that need it. With the unavailability of this model, there is an oversight of need; this is an element that is often overlooked within studies concerning SDOH. Therefore, while this approach is appropriate, it will not be a complete study unless all elements are fulfilled for patient total wellbeing. When examining issues with hypertension as it relates to SDOH, the state of Texas puts patients in a unique situation. The medicaid eligibility expansion of the Affordable Care Act (ACA) was ruled not to be required by the US Supreme Court. This ruling impacted millions of low income patients from being able to access affordable and timely care. Angier, Hogue, Marino, Green, Holderness examines the impact of this ruling and how it affects healthcare access and services for patients at risk, diagnosed, and undiagnosed with hypertension. This study also examines these factors as it relates to social determinants of health at both the individual and community level which also influences diagnosis and care. This study had four aims as it compared prevalence, hypertension incidence, screening, treatment, and management. The researchers used a similar dataset to this study from community health centers. The study's period range was from January 1, 2012, to December 31, 2016. This span of study allowed for understanding from a short, medium, and long term impact of the ACA. Social determinants of health metrics within the study included built in environment, race/ethnic composition, neighborhood resources, neighborhood socioeconomic composition, and social deprivation index (poor access to healthcare and poor health outcomes than a measure of poverty). While this study was able to pull in the largest dataset relevant to this project, the study had several limitations that prevented confidence in the data. This study was unable to identify patients who died

during the study's time period as well as missing data from services documented in inaccessible parts of the electronic medical record. A major limitation included data not collected from other providers that patients may have visited such as emergency rooms or other healthcare providers. This limitation is common for researchers as most areas have not developed a health information exchange mechanism amongst all healthcare providers. After reducing errors in the data, this study can be used to tailor treatment plans and healthcare access for low income and vulnerable populations.

METHODOLOGY

A two group, pre and post intervention design was selected to assess the success of SMBP (self-measured blood pressure) devices with interventions such as compliance (medication/appointment), diet/nutrition and exercise, socio economic factors, and SDOH (cohort 1). Cohort 2 included patients who were not participating in the SMBP device program. Pre intervention data was collected beginning January 1, 2021, and ending May 31, 2021. Post intervention data began June 1, 2021, and was collected weekly. The project is on going and expected to be completed when patients have achieved consistent compliance with blood pressure readings.

Design

The aim of this study was to find relationships between hypertension, socioeconomic factors, social determinants of health, and ethno geriatrics. This study will use a pre and post design to measure the outcomes of interest prior to administering the SMBP device and addressing SDOH and ethno geriatrics. Variables in the study include blood pressure levels, socioeconomic factors, social determinants of health, and ethno geriatrics. Each variable, except for ethno geriatrics, has additional categorizations that are associated for further identification. Those are:

- **Blood pressure levels**
 - **Compliant:** Less than 140/90.
 - **Non-Compliant:** Greater than or equal to 140/90.
- **Socioeconomic Factors:**
 - **Federal Poverty Levels (FPL):** Determined by salary, number of members in the household, and the department of health and human services FPL scale.
- **Social Determinants of Health (SDOH)**
 - Food insecurities
 - Diet and exercise

Participants

The data set included existing patients of the clinic. Patients were asked if they were willing to participate in the study of the use of SMBP devices at their medical appointment or through clinical outreach *via* phone call or push message. Informed consents and appointments were scheduled for patients who confirmed interest in participating in the program. During the medical appointment, the medical staff

educated each patient on how to use the device, who to call if there was an error, how to pair the device with their phone, and the interventions that are recommended while in this program. Participation in this study required that clinic patients be 18 years or older and have a diagnosis of HTN. Demographics for the eligible 3,200 patients include 60% hispanic, 30% African American or black, 5% white, and 5% other (Asian, more than one race, native American, or Pacific Islander). While there are only 3,200 patients, there is a potential of an additional 2,000 patients who are almost in pre hypertension stage.

Research Questions/Hypothesis

The following research questions/hypothesis will guide this study.

- R₁: Is there a relationship between socioeconomic factors and hypertension levels in patients?
- H₀: Socio-economic factors do not have a statistically significant effect on HTN.
- H_a: Socio-economic factors have a statistically significant effect on HTN.
- R₂: Is there a relationship between SDOH factors and HTN levels in patients?
- H₀: SDOH factors do not have a statistically significant effect on HTN.
- H_a: SDOH factors have a statistically significant effect on HTN.
- R₃: Is there a relationship between cultural backgrounds and HTN levels in patients?
- H₀: Cultural backgrounds do not have a statistically significant effect on HTN.
- H_a: Cultural backgrounds have a statistically significant effect on HTN.
- R₄: Is there a relationship between patient compliance and HTN level in patients?
- H₀: Patient compliance does not have a statistically significant effect on HTN.
- H_a: Patient compliance has a statistically significant effect on HTN.

Data Collection

Access health community health center, Inc. is based in Richmond, Texas with 5 satellite locations in Brookshire, Stafford, Sugar Land, Missouri City, and East Missouri City (EFB). Each of these locations, except for Stafford, treats adult patients. Each year access health reports clinical quality measures to the Health Resource and Service Administration (HRSA) within the Uniform Data Systems Report (UDS). Within this reporting, there is a focus on hypertension and compliance rating. For a patient to be counted in this measure, patients must be age 18 or older, with the diagnosis of hypertension (including essential hypertension) and have a medical visit during the measurement period. Data is recorded and reported through the nurse triage process and the Electronic Medical Record (EMR) or through transmission from the SMBP device to the patient portal, then to the EMR.

From this point, data can be extracted with reporting tools that will enable additional fields of data collection to be analyzed. Examples of additional fields are appointment information (no shows, kept appointments, and cancellations), additional services used such as dental and behavioral health, and if the patient was referred to an outside entity for additional services. The Health Resources and Services Administration (HRSA) generally want the data grouped by race and ethnicity so that trends and action items can be targeted. Blood pressures are taken to determine if the diastolic and systolic are below or above 140/90. Whether in the clinic or the home, it is encouraged to retake the blood pressure after an abnormal reading. The goal is to ensure that the patient has a lower blood pressure reading at the visit closest to the end of the measurement year. This gives the clinicians time to work with the patient to get readings under control. It is also important to note that quality assurance is audited and discussed monthly at Quality Improvement meetings with medical staff. Plan Do Study Act (PDSA) model is continuously used to look for areas of improvement.

Sociodemographic Variables

Sociodemographic data is collected and are made available monthly for executive leadership and quality improvement/performance improvement committee members. This study included the following Sociodemographic variables: Age, income level, education, race and ethnicity, city of origin, and zip codes, and SDOH survey results. Blood pressure readings, socio economic factors, SDOH, ethno geriatrics, and medical appointment compliance/patient compliance were used as dependent variables for this study.

Data Analysis

A multivariate analysis was used to determine how each of the factors impact blood pressure readings. The four categories for research include:

- **Socio-Economic Status**
 - Insurance Status/type
 - Percentage under the Federal Poverty Level
- **Social Determinants of Health (SDOH)**

- Food Insecurity
- City of origin
- **Cultural Background**
 - Age
 - Race
 - Ethnicity
 - Gender
- **Patient Compliance**
 - Nutrition

There have been previous studies conducted on samples of 500 patients or less but are not focused on one geographical location limiting what can be done to mitigate high HTN levels in underserved and vulnerable communities. This study addresses each of the factors that were previously addressed as well as adds to previous literature. Lastly, this study observes blood pressure readings from inside the clinical setting (pre data) and in the patient's setting of the home (post data).

The data was analyzed using STATA with controlled variables. An initial overview of the data in the multivariate model was examined. Additional analysis was used to determine if the data had multicollinearity and heteroskedasticity.

Preliminary Analysis

The following tests were conducted to determine multicollinearity:

- Examining VIFs (Variance Inflation Factors) to determine if the VIF exceeded four, which warrants further investigation. VIFs greater than 10 will require correction.
- Regression analysis (pre and post data) to determine statistical significance.

Using these steps as well as examining the multivariate regression, it was determined that VIF values were less than four, which indicated that there is not multicollinearity present in the data ([Table 1](#)).

Table 1: Variance Inflation Table (VIF).

Variable	VIF	1/VIF
Ethnicity	3.76	0.266
Race	3.84	0.26
Sex	1.06	0.94
Age	1.19	0.838
FPL	1.13	0.886
Food Insecurity	1.07	0.935
Nutrition	1.09	0.92
Insurance	1.08	0.929

BMI Ratio	1.09	0.915
City	1.05	0.95

Note: Mean VIF=1.64

Heteroscedasticity

Additional analysis was conducted to test for heteroscedasticity. If heteroscedasticity was present in the data, the model violates the assumption, thus unreliable and bias data will be present. The initial investigation of the data will be performed by running a fitted residuals graph on residuals. Because the residuals were roughly the same size for all values of X, it was concluded that heteroskedasticity is not severe enough to warrant concern (Figure 1). For each of the research questions, the null hypothesis assumes no statistical significance or correlation on hypertension levels. For additional analysis in this model, p-values, f-statistic value, t-value, and r-square values were also observed. This analysis was conducted with a 95% confidence interval and alpha level of 0.05.

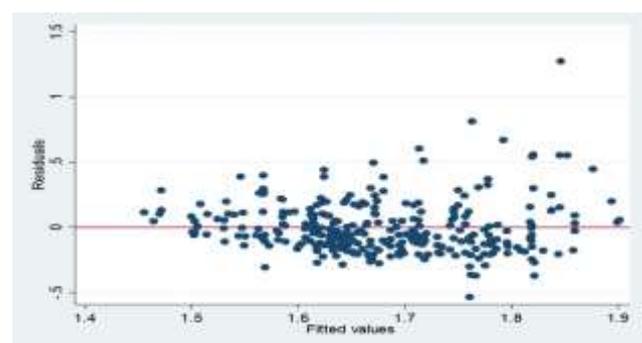


Figure 1: Heteroscedasticity testing.

Note: Initial test on a scatter plot to determine heteroskedasticity.

RESULTS

Prior to testing the hypothesis, baseline data was analyzed to gain an understanding of the results and consistency amongst the populations. This analysis found that the factors of ethnicity, race, age, and insurance status had a statistical significance to blood pressure readings. Overall summary statistics for the pre cohort showed that there were 1,221 participants with a mean blood pressure of 1.865 or 169/90. Participants who identified as hispanic and white as well as not hispanic and black or African American were found to have the highest prevalence of high blood pressure within the cohort (Table 2). Table 3 shows the participant's demographic breakdown.

Table 2: T-Values and P-Values relating to blood pressure.

Variable	T-Value	P-Value	95% CI	
			LL	UL
Ethnicity	3.41	0.001	0.047	0.173
Race	5.94	0	0.041	0.082
Sex	-0.91	0.363	-0.081	0.029
Age	13.33	0	0.013	0.018
FPL	1.04	0.297	-0.007	0.022
Food Insecurity	0.8	0.426	-0.02	0.047
Nutrition	0.75	0.454	-0.093	0.207
Insurance	3.48	0.001	0.016	0.058
BMI Ratio	0.95	0.342	-0.002	0.006
City	4.42	0	0.002	0.005

Note: Number of studies=1,221, R-square=.9408. CI=Confidence Interval; LL=Lower Limit; UL=Upper Limit

Table 3: Demographic distribution of patients cohort 1.

Baseline characteristic	Full sample	
	n	%
Gender		
Male	484	40%
Female	737	60%
Age		
Group 0 (18-30)	8	1%
Group 1 (31-45)	160	13%
Group 2 (46-64)	670	55%
Group 3 (65+)	383	31%
Ethnicity		
Hispanic	577	47%
Not Hispanic	642	53%
Other	2	0%
Race		
American Indian	5	0%
Asian	143	12%
Black or AA	391	32%
Declined	6	0%
Native Hawaiian	2	0%
White	674	55%

Note: N=1,221. Participants were on average 59 years old. Average blood pressure=160/90

Post data analysis was used to test the research questions as well as similarities in disparities for post data participants. Overall summary statistics for post cohort data shows 298 participants who opted into the program with a mean blood pressure of 1.67 or 130/80. Leading these participants were

patients who identified as hispanic (white) and non-hispanic black or African American and Asian ([Table 4](#)).

Table 4: Demographic distribution of patient's cohort 2.

Baseline characteristic	Full sample	
	n	%
Gender		
Male	99	33%
Female	199	67%

Age		
Group 0 (18-30)	7	1%
Group 1 (31-45)	64	21%
Group 2 (46-64)	188	63%
Group 3 (65+)	39	13%
Ethnicity		
Hispanic	185	62%
Not Hispanic	11	4%
Other	2	1%
Race		
American Indian	3	1%
Asian	36	12%
Black or AA	64	21%
Declined	2	1%
Native Hawaiian	1	0%
White	192	64%

Note: N=298. Participants were on average 57.98 years old, average blood pressure 130/80

Findings for Research Question One

- R₁: Is there a relationship between socio-economic factors and HTN levels in patients?
- H₀: Socio economic factors do not have a statistically significant effect on HTN.
- H_a: Socio economic factors have a statistically significant effect on HTN.

As shown in **Tables 5 and 6**, a multivariate analysis was employed to examine the relationship between patient’s socio economic factors (insurance status/type and FPL) and

HTN levels. No statistical significance was found for patients who had CHIP, commercial, medicare, and Texas marketplace. A statistical significance was found for patients who had Medicaid at p=.03. Additional analysis for patients who were 100% or below the FPL showed a statistically significant effect on HTN levels at p=.0047. With all combining factors, the null hypothesis was rejected as FPL .047<0.05. For the variable off insurance, we fail to reject the null hypothesis as Insurance Status/type=.665>0.05.

Table 5: T-values and P-values relating to blood pressure and socioeconomic factors.

Variable	T-Value	P-Value	95% CI	
			LL	UL
FPL	2	0.047	0.003	0.051
Insurance	0.43	0.665	-0.019	0.03

Note: Number of studies=298, R-square=.9838. CI=Confidence Interval; LL= Lower Limit; UL= Upper Limit; FPL=Federal Poverty Level; Number of studies=298; R-square=.9838.

Table 6: Detailed look at FPL and insurance status.

Variable	T-Value	P-Value	95% CI	
			LL	UL
FPL				
100% or below	4.41	0	0.62	1.63

101-150%	5.28	0	0.86	1.89
Over 200%	2.92	0.004	0.34	1.75
Unknown	4.81	0	0.71	1.7
Insurance				
CHIP	-0.29	0.769	-0.49	0.36
Commercial	1.3	0.194	-0.04	0.2
Medicaid	2.14	0.033	0.01	0.25
Medicare	-0.2	0.841	-0.15	0.12
Self-Pay	1.19	0.235	-0.03	0.13

Note: Number of studies=298; R-square=.9838; CI=Confidence Interval; LL=Lower Limit; UL= Upper Limit; FPL=Federal poverty level

Findings for Research Question Two

- R₂: Is there a relationship between SDOH factors and HTN levels in patients?
- H₀: SDOH factors do not have a statistically significant effect on HTN.
- H_a: SDOH factors have a statistically significant effect on HTN.

As shown in **Table 7** a multivariate analysis was employed to examine the relationship between SDOH factors of food insecurity and city of origin, and HTN levels. With HTN ratios increasing by one point, food insecurity negativity rates

decreased by 0.42. Specifically, patient's readings post intervention proved to be statistically significant. Patients who resided in specific cities such as Beasley Hempstead, Needville, and Rosenberg, Texas showed high correlations with SDOH factors with the highest factor being food insecurity identification. With all combining factors we reject the null hypothesis of SDOH which was further categorized into city of origin and food insecurity. Statistical significance was found at p=.009 for city of origin and p=.04 for food insecurity.

Table 7: City of origin and food insecurity status.

Variable	T-Value	P-Value	95% CI	
			LL	UL
City of origin	2.63	0.009	0.001	0.007
Food insecurity	-1.97	0.049	-0.084	0

Note: Number of studies=298; R-square=.9838; CI=Confidence Interval; LL=Lower Limit; UL= Upper Limit. Each city and food insecurity status that was report was below p <.05, which proved significance.

Findings for Research Question Three

- R₃: Is there a relationship between cultural background and HTN levels in patients?
- H₀: Cultural background does not have a statistically significant effect on HTN.
- H_a: Cultural background factors have a statistically significant effect on HTN.

A multivariate analysis was employed to examine the relationship between patients with diverse cultural backgrounds (race, ethnicity, age, and gender), and HTN levels. Patients who identified as white, black, or African American, Asian, American Indian, and other all showed a

statistically significant p value of 0.00. Age of the patients showed significance amongst all age groups with a collective statistically significance of p=0.00. Gender did not show a statistically significant effect on HTN levels (Table 8). Therefore, the research question of cultural background in influencing HTN levels found correlations for patients based on age and ethnicity. With all combining factors we fail to reject the null hypothesis based on gender (p=.440), and reject the null hypothesis related to race (p=0.00), ethnicity (p=0.001), and age (p=0.00).

Table 8: T-Values and P-Values relating to blood pressure and ethno geriatrics.

Variable	T-Value	P-Value	95% CI	
			LL	UL
Ethnicity	3.41	0.001	0.05	0.207
Race	3.87	0	0.022	0.07
Sex	0.77	0.44	-0.033	0.075
Age	7.32	0	0.115	0.201

Note: Number of studies=298; R-square=.9408; CI=Confidence Interval; LL=Lower Limit; UL=Upper Limit

Findings for Research Question Four

- R₄: Is there a relationship between patient compliance and HTN level in patients?
- H₀: Patient compliance does not have a statistically significant effect on HTN.
- H_a: Patient compliance has a statistically significant effect on HTN.

As shown in [Table 9](#), a multivariate analysis was employed to examine the relationship between patient compliance and HTN levels. Patient compliance with nutrition counseling

showed a statistically significant impact on HTN levels. Patients who did attend nutrition classes showed a statistically significant effect with a p value = 0.00. Patients who did not attend nutrition counseling were shown to be non-compliant in their BMI status. Therefore, patient compliance was a significant predictor of optimal HTN levels. With all combining factors we must reject the null hypothesis relating to nutrition counseling (p=0.00) and fail to reject the null hypothesis relating to BMI (p= .051).

Table 9: T-Values and P-Values relating to blood pressure and patient compliance.

Variable	T-Value	P-Value	95% CI	
			LL	UL
Nutrition	3.87	0	0.253	0.777
BMI	-1.63	0.103	-0.002	0

Note: Number of studies=298; R-square=.9408; CI=Confidence Interval; LL=Lower Limit; UL=Upper Limit

DISCUSSION

This study was conducted with the purpose of evaluating the impact of whether the following social determinants of health: diet/nutrition (food insecurity), ethno geriatrics, and socio economic factors impact hypertensive diagnosed patients living in underserved, vulnerable, and urban communities. Second, this study attempted to predict what cultural factors lead to compliance in achieving lower blood pressure levels. The SMBP (Self-Measured Blood Pressure) program was initiated in community health centers in 2021 with the goal to reduce blood pressure levels in the underserved, vulnerable, and low income communities. Medically diagnosed hypertension patients with three or more readings that were above 140/90 were included in the study. Patients with SMBP devices received an advantage as care teams and continuous monitoring took place to ensure compliance. With the additional factors present, patients with the devices experienced lower blood pressure levels as multiple blood pressure readings were allowed for inclusion into the study. The decrease from 169/90 to 130/80 is indicative that patients can control their hypertension rates regardless of race, ethnicity, or socio economic status. Not

having to physically take time off from work, pay a deductible, or worry about missing an appointment, the SMBP devices are free and are monitored by the care team on a frequent basis. Notably, there were strong correlations between race, ethnicity, FPLs (Federal Poverty Levels), nutrition counseling, city of origin, age, and food insecurity. This significance addressed all three research questions but ruled out some aspects of the study that included specific insurance coverage, BMI percentage, and gender. Findings of this study illustrate those programs such as the SMBP program, increase participant's motivation to monitor their BP levels and lead healthier lifestyles.

Influencing Ethno geriatrics

The intervention of giving patients a SMBP (Self-Measured Blood Pressure) device addresses the main concerns surrounding hypertension and health factors. The Theory of Planned Behavior (TPB) with the overarching themes of "circle of culture," attitude, perceived behavioral control, and subjective norms play a large role in how individuals in different cultures view and choose to believe in certain topics. Although the theory of planned behavior was not studied directly, the topic proved to be heavily embedded within the

topic of Ethno geriatrics. The circle of culture theme embodies the collective identity of a person. This theory, proposed by Icek Ajzen has been applied to healthcare to determine important variables that affect self-care behaviors in the control of hypertension. Future research should include the TPB model for a deeper understanding of patient beliefs and behaviors.

CONCLUSION

The approach to hypertension in the low income, underserved, and vulnerable communities are highlighted amongst those patients who have additional factors that affect their overall HTN levels. Race and ethnicity are not modifiable risk factors, but other factors could be amenable to intervention. Risk factors that emerge and impact compliance are within the ethno geriatrics topic. Further discoveries on topics such as theory of planned behavior gives the researchers a guidebook to understanding more about individuals who may have incurred or passed down trauma from previous experiences. These experiences shape the cultural viewpoint of individuals and their respective communities. This project increased the understanding of SDOH and economic barriers of individuals who need additional assistance and will reach beyond the clinical walls. Although the needs may differ from patient to patient, there is a tremendous opportunity to expand on the Community Centered Health Home (CCHH) model. This model requires traditional silos to be broken down so that the patient's needs can be addressed. There is a tremendous opportunity to expand on this scope of work and dive into these communities to further investigate this disease and causes of it. Challenging as it may be, data is still needed from large, randomized control groups so that the approach taken can be inclusive of patient care.

LIMITATIONS

With the population being low-income and underserved, there are various disadvantages that hindered participation. While smart phones are common, patients would need access to Wi-Fi, cellular signals that are not limited, and the capability to know how to work the device. These three items alone can eliminate 50% of the eligible population. Additionally, patient education is critical when discussing the benefits of the SMBP program. With the ever changing landscape of telehealth and technology, patients who are not familiar or comfortable with this type of data sharing most likely opted to not participate.

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