The Association Between Physical Activity and Hypertension Among United States Minority Adults

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Introduction

Problem, Significance & Purpose of Study

Understanding and addressing factors that contribute to the leading cause of death in Americans is vital to confronting the epidemic that is cardiovascular disease and hypertension. (Kochanek, Murphy, Xu, & Arias, 2019). Cardiovascular disease, or heart disease, is defined as conditions involving the blocking or narrowing of blood vessels, which can have negative consequences, including stroke, heart attack, or angina (Mayo Clinic Staff, 2018).

Cardiovascular disease has many risk factors. Family history, genetics, diabetes, age, gender, ethnicity, and socioeconomic status are among the risk factors that cannot be changed and are collectively referred to as non-modifiable risk factors (World Heart Federation, 2017). Conversely, modifiable risk factors are risk factors that individuals can take measures to change. Cardiovascular disease has many modifiable risk factors, including physical inactivity, use, diet, obesity, and hypertension (World Heart Federation, 2017). Hypertension is the strongest of all the modifiable risk factors for cardiovascular diseases (Kjeldsen, 2017). Hypertension, also known as high blood pressure, occurs when the blood's force that pushes against the blood vessel's walls is steadily abnormally high (American Heart Association, 2016).

To understand the risk factors of hypertension, we consider the lifestyle factors that play a role important, specifically physical activity. We define *physical activity* as "any bodily movement produced by skeletal muscles that result in energy expenditure" (Caspersen, Powell, & Christenson, 1985, p. 126). Being physically active has a significant effect on cardiovascular health as it prevents the development of cardiovascular disease and modifies other cardiovascular disease risk factors such as hypertension positively. Conversely, an increase in mortality from cardiovascular disease is directly linked to physical inactivity (U.S. Department of Health and

Human Services, 1996). Existing literature on hypertension and physical activity strongly supports that physical activity plays a role in preventing hypertension. Interventional studies conducted to analyze the relationship between hypertension and physical activity have shown that exercise has a favorable effect on reducing blood pressure (Diaz and Shimbo, 2013).

Limited existing evidence supports the findings that moderate-intensity activities provide almost all the benefits of physical activity and reduce cardiovascular disease risk factors (U.S. Department of Health and Human Services, 1996). However, limited research exists on the precise effects of light/moderate-intensity activity and the number of minutes of light/moderate-intensity activity on having hypertension and cardiovascular disease. There is controversy surrounding how intense exercise should be to increase cardiovascular health, as some studies indicate that reducing cardiovascular disease risk results from strenuous activity. In contrast, other studies have suggested the link between less intense activity and reduced cardiovascular disease risk (Siscovick et al., 1997). A decrease in both diastolic and systolic blood pressure has been shown in individuals with hypertension when the effects of endurance exercise training were studied (U.S. Department of Health and Human Services, 1996). However, research shows that improvements in cardiovascular disease risk factors are not likely to be optimal if the intensity of physical activity is not high enough (McConnell, Gordon, & Scott, 1995). The purpose of this study is to examine the data and evidence on the role of the presence and quantity of light/moderate physical activity and determine its association with cardiovascular disease and its risk factor, hypertension.

By performing secondary data analysis of the existing data from the 2018 National Health Interview Survey (NHIS), we hope to answer the research question “Does participating in light/moderate-intensity activity and the length of participation affect preventing the

development of cardiovascular disease and hypertension in U.S. adults?". This study aims to determine whether the presence of light/moderate physical activity is associated with the decrease in the prevalence of cardiovascular disease and hypertension and whether the relationship between physical activity and cardiovascular disease and hypertension is dependent on the amount of time in minutes an individual participates in light/moderate-intensity activity. Based on previous research findings, we hypothesize that the absence of cardiovascular disease and hypertension is positively associated with light/moderate activity. More specifically, U.S. adults who have not been told they have cardiovascular disease and hypertension engage in a higher duration in minutes of light/moderate-intensity activity weekly than U.S. adults who have been told they have cardiovascular disease and hypertension.

In the United States, there is an overall decrease in the number of deaths due to cardiovascular disease over several decades; however, the number of deaths in race-ethnic disparities resulting from cardiovascular diseases remains persistent (Balfour, 2015). Compared with White Americans, the prevalence of risk factors, such as hypertension, are significantly higher in minority groups (Ferdinand, 2005). However, these minority groups are underrepresented, and in turn, there are fewer contributions for recommendations for the management of risk factors leading to higher rates of cardiovascular diseases in minority groups.

African Americans have the highest prevalence of hypertension globally, and the number of cases continues to increase (Ferdinand, 2005). Furthermore, hypertension related to cardiovascular disease mortality is 3 to 5 times higher in African Americans than whites (Ferdinand, 2005). Although non-Hispanic whites have similar prevalence rates of hypertension compared to whites, Mexican Americans have almost triple the risk than whites (Ferdinand,

2005). Lastly, South Asians have a hypertension prevalence rate of 36.4% in men and 37.5% in women (Ferdinand, 2005).

However, most of this data was weighed or extrapolated since minority groups are growing at a fast pace; there needs to be more attention drawn to minority groups and their related health data. The current data is limited or nonexistent at the national level.

Research Question

Does participating in light- or moderate-intensity activity and the length of participation have an effect on preventing the development of cardiovascular disease and hypertension in U.S minority adults?

Hypotheses

Not having cardiovascular disease and hypertension is positively associated with light- or moderate-activity. More specifically, U.S. minority adults who have not been told they have cardiovascular disease and hypertension engage in higher duration in minutes of light- or moderate-intensity activity weekly than U.S. adults who have been told they have cardiovascular disease and hypertension.

Method

Data Source

This study is a secondary data analysis that examines data provided by the 2018 National Health Interview Survey, a nationally representative survey of the non-institutionalized civilian population in the United States administered by the National Center for Health Statistics (National Health Interview Survey [NHIS], 2019). The survey excludes institutionalized residents, such as persons in long-term care facilities, correctional facilities, U.S. nationals residing in foreign countries, and military active-duty members (NHIS, 2019). The NHIS

conducts sampling and interviewing monthly (NHIS, 2019) and continues throughout the year (National Center for Health Statistics [NCHS], 2019). The information collected from the NHIS survey provides cross-sectional data on demographic characteristics and numerous health topics, allowing for continued surveillance of national health.

Sampling Procedure

The 2018 NHIS applied an area probability design, including stratification and clustering sampling techniques, to generate a nationally representative sample (NCHS, 2019). Stratification and clustering techniques allow for the sampling of large and diverse populations to be efficient, cost-effective, manageable, and timely. All states are stratified, and samples are produced from each state and the District of Columbia. Clusters of addresses are designated within geographic areas, specifically within a single county, a group of small and neighboring counties, or a statistically metropolitan region (NCHS, 2019). Unlike previous NHIS sampling designs, the 2018 NHIS did not employ oversampling techniques for any minority subpopulations, which included persons who identified as black, Hispanic, and Asian (NCHS, 2019).

Data Collection

This study uses data collected from the core questions in the NHIS Family and Sample Adult modules. The NHIS Family module provides data from the Household and Family Core questionnaires (NHIS, 2018). The Household questionnaire collects and provides limited demographic data of all individuals residing within each household included in the NHIS sampling frame (NCHS, 2019). The Family Core questionnaire is conducted on each family. It collects additional information on socio-demographic characteristics and health status indicators, including injuries, limitations, and access to and use of health insurance coverage and health care services (NCHS, 2019).

The Sample Adult module contains information collected from the Sample Adult Core questionnaire and Supplements (NHIS, 2018). The Sample Adult core questionnaire is administered on one randomly selected adult, aged 18 years or more, from each family and gathers additional data on health and health care services (NCHS, 2019). The Supplement includes an assortment of additional questions intended to gather more detailed information on various health topics related to health status and health-related behaviors, including topics pertaining to heart disease and stroke prevention (NHIS, 2018).

Survey data are collected during personal interviews by the United States Census Bureau field representatives trained in NCHS protocols (NCHS, 2019). Exceptions are granted for telephone interviews if the survey requires follow-up, respondent requests a telephone interview, or if travel conditions are prohibitive (NCHS, 2019). Sample adult respondents provided self- or proxy-reported answers. Field representatives used computer-assisted personal interviewing (CAPI) computer software to administer the NHIS questionnaires and record respondents' answers (NCHS, 2019).

Measures

U.S. Minority Adults

The primary demographic characteristics included in this study were the race and Hispanic origin of U.S. adult respondents who were aged 18 years and over at the time of the survey. The Household Composition questionnaire gathered information on demographic characteristics. Respondents were asked to indicate their race as either being only White, Black or African American, American Indian or Alaska Native (AIAN), Asian, or indicate that they identify with multiple races. Respondents were also asked to identify their Hispanic origin from a comprehensive list that included Hispanic, Latino, and Spanish origins. Adult respondents

confirmed their age by providing their age (in years) and their date of birth (day, month, year). All adult respondents included in the analysis are defined as U.S. residents because all persons included in the 2018 NHIS questionnaire have been previously identified as non-institutionalized civilians residing in the United States. This study defines U.S. minority adults as adult persons (age 18 and over) who identify as being either (1) Black or African American, AIAN, or Asian; (2) being of Hispanic origin; (3) or some combination of race and Hispanic origin.

Light-Moderate Physical Activity

Independent variables for adult engagement in light-moderate physical activities (LMPAs) were assessed using two continuous variables, MODMIN (duration) and MODFREQW (frequency), from the Adult Health Behavior section in the Sample Adult questionnaire (NCHS, 2018). Respondents were asked questions about the duration (minutes or hours) and frequency (per session, day, week, month, or year) of their engagement in LMPAs that prompted only light sweating or a slight increase in breathing or heart rate for at least ten minutes. Adults provided self-reported responses that included both the duration and frequency of engagement in LMPAs, an unsure response, or they declined to answer. Only adults who self-reported participating in at least 10 minutes of LMPA per session and at least once per week were included in the analysis.

Hypertension

Adult respondents' (the sample adult) hypertension status, the dependent variable, was assessed with the dichotomous HYPEV variable from the Sample Adult questionnaire. Respondents were asked if they have ever been told by a doctor or health professional that they had hypertension or high blood pressure. Respondents self-reported their hypertension status and provided either a positive response (yes), negative response (no), an unsure response, or they

declined to answer. Adult respondents were identified as having hypertension if they provided a positive response to the question.

Proposed Statistical Analysis

Data provided by the 2018 NHIS were analyzed using Statistical Analysis Software (SAS), a statistical software package. A logistic regression analysis was conducted to assess whether the duration and frequency of engagement in LMPA were associated with the risk of hypertension. The odds ratio (OR) was calculated for hypertension using a logistic regression model. The interpretation of the parameter estimate and exponential beta coefficient is also provided.

Additionally, hypertension status among adult respondents was also compared independently by race and Hispanic origin while simultaneously controlling for the LMPA variables, duration, and frequency. To allow for comparisons among race and Hispanic origin categories, the independent, continuous variables for LMPA were re-coded to the following four categorical variables:

1. < 30 minutes each session and <5 times per week
2. < 30 minutes each session and ≥five times per week
3. 30 minutes each session and <5 times per week
4. 30 minutes each session and ≥five times per week

Results

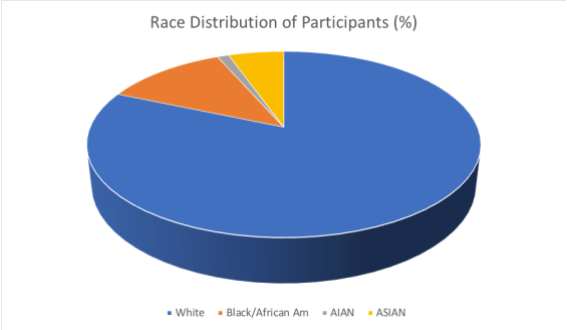
Baseline Characteristics

Figure 1 summarizes the characteristics of the 15,582 individuals included in the original sample based on the 2018 NHIS data. A majority of the sample population is white, making up over 79.37% of the sample population, followed by blacks/African Americans, which

account for 11.70% of the sample, Asians with 5.31%, and American Indians/Alaskan Natives accounting for 1.16% of the sample. In regards to ethnicity, 87.9% are not of Hispanic or Spanish origin. Only 12.51% of the sample are of Hispanic descent.

Figure 1. Baseline Characteristics of Study Participants

A.



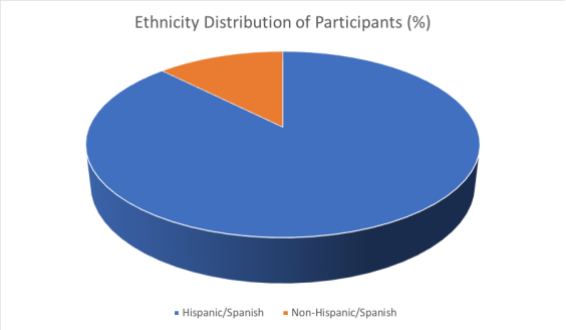
White: 79.37%

Black/African American:11.70%

AIAN:1.16%

Asian: 5.31%

B.



Hispanic/Spanish: 12.51%

Non-Hispanic/Spanish:87.9%

Figure 1. Illustrates the racial and ethnic makeup of the study participants. A Majority of participants are white, non-Hispanic/Spanish.

Duration of Light to Moderate Physical Activity and Race/Ethnicity

As indicated in **Figure 2**, the sample average of minutes of light to moderate physical activity per session of the sample is 47.7 minutes with a standard deviation of 52.7 minutes. Whites, on average, had the most prolonged period of physical activity per session (48.3 minutes). On average, American Indians/ Alaskan natives (AIAN) spent 51.9 minutes engaged in light to moderate physical activity. Black/ African Americans had a mean of 44.9 minutes per session, while Asians accounted for the lowest average with 42.3 minutes. The standard deviations varied across all races. Whites and blacks/African Americans had similar standard

deviations (53 minutes and 53.1 minutes, respectively). Asians had the lowest standard deviation (45.4 minutes). Similar trends are apparent amongst participants' ethnicity: Hispanics had an average of 48.4 minutes of light-moderate physical activity (standard deviation of 53.1 minutes), and non-Hispanics/Spanish had an average of 47.5 minutes (standard deviation of 52.5 minutes).

Frequency of Light to Moderate Physical Activity Per Week and Race/Ethnicity

Asians had the highest frequency among races of light-moderate physical activity per week (5.06 times/week), followed by Blacks/African Americans (5.05 times/week). Whites had an average frequency of 4.9 times/week, and AIAN had the lowest frequency (4.8 times/week). Blacks/African Americans had the highest standard deviation of 4.4 times/week, followed by Asians with 4.3 times/week, then whites (standard deviation of 4.0 times/week), and finally AIAN with a standard deviation of 3.4 times/week. Participants that did not identify as Hispanic/Spanish, on average, engaged in physical activity more frequently than non-Hispanics. Hispanics/Spanish participants only engaged in light-moderate physical activity 4.7 times/week (standard deviation of 3.8 times/week). While non-Hispanic/Spanish participants had an average frequency of 4.9 times/week (standard deviation of 4.1 times/week).

Duration of Light-Moderate Physical Activity (minutes)

Race/Ethnicity	Number of Observations (N)	Mean	Standard Deviation
White	12964	48.303	53.065
Black/African American	1562	44.962	51.118
Asian	867	42.336	45.354

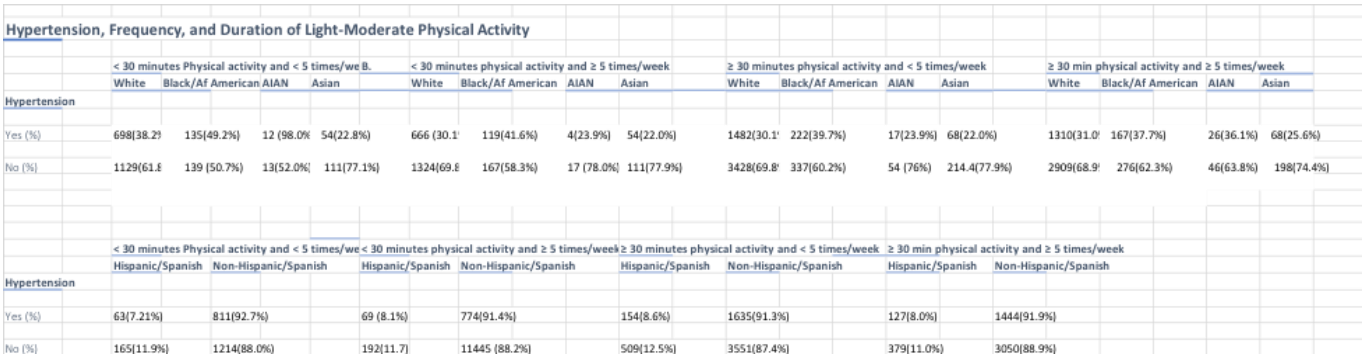
AIAN	189	51.942	49.870
Hispanic/Spanish	1658	48.462	53.175
Non- Hispanic/Spanish	13924	47.589	52.594

Figure 2. Summary of data illustrated duration of Light-Moderate Physical Activity in minutes per session across all races and ethnicities.

Hypertension, Frequency, and Duration of Light- Moderate Physical Activity Across Races and Ethnicities

Figure 3 depicts the frequency and duration of light-moderate Physical Activity amongst the races/ ethnicities. Logistic regression was performed to calculate the hypertension question response based on duration and frequency of physical activity. Binary logistic regression was completed through the Statistical Analysis Software (SAS). For every one unit change in minutes of light-moderate physical activity (OR=.999), there was a .0007 increase. For every one unit change of frequency of light-moderate physical activity (OR=.997), there was a .002 increase. The likelihood ratio chi-square is 5.60, $p < .0001$, $\beta = 1.97$. P-value indicates that the results were statistically significant. Across all durations and frequencies of physical activity, Asians had the lowest percent of hypertension. Among participants that reported to have less than 30 minutes of physical activity, less than five times a week, blacks had the highest percentage of 'Yes' to hypertension (49.5%). Asians had the lowest percentage of 'No' to having hypertension in the same condition (22.8%). Of the participants that reported to have engaged in less than 30 minutes of physical activity more than or equal to 5 times per week, blacks had the highest percentage of 'Yes' to hypertension (41.6%), and Asians had the highest percentage of 'No' (77.9%). Across all treatments, blacks had the highest percentage of 'Yes' responses to hypertension.

Figure 3. Hypertension, Frequency, and Duration of Light-moderate Physical Activity



Hypertension, Frequency, and Duration of Light-Moderate Physical Activity

	< 30 minutes Physical activity and < 5 times/we				< 30 minutes physical activity and ≥ 5 times/week				≥ 30 minutes physical activity and < 5 times/week				≥ 30 min physical activity and ≥ 5 times/week			
	White	Black/Af American	AIAN	Asian	White	Black/Af American	AIAN	Asian	White	Black/Af American	AIAN	Asian	White	Black/Af American	AIAN	Asian
Hypertension																
Yes (%)	698(38.2	135(49.2%)	12 (98.0%	54(22.8%)	666 (30.1	119(41.6%)	4(23.9%)	54(22.0%)	1482(30.1	222(39.7%)	17(23.9%)	68(22.0%)	1310(31.0	167(37.7%)	26(36.1%)	68(25.6%)
No (%)	1129(61.8	139 (50.7%)	13(52.0%	111(77.1%)	1324(69.8	167(58.3%)	17 (78.0%)	111(77.9%)	3428(69.8	337(60.2%)	54 (76%)	214.4(77.9%)	2909(68.9	276(62.3%)	46(63.8%)	198(74.4%)

	< 30 minutes Physical activity and < 5 times/we		< 30 minutes physical activity and ≥ 5 times/week		≥ 30 minutes physical activity and < 5 times/week		≥ 30 min physical activity and ≥ 5 times/week	
	Hispanic/Spanish	Non-Hispanic/Spanish	Hispanic/Spanish	Non-Hispanic/Spanish	Hispanic/Spanish	Non-Hispanic/Spanish	Hispanic/Spanish	Non-Hispanic/Spanish
Hypertension								
Yes (%)	63(7.21%)	811(92.7%)	69 (8.1%)	774(91.4%)	154(8.6%)	1635(91.3%)	127(8.0%)	1444(91.9%)
No (%)	165(11.9%)	1214(88.0%)	192(11.7)	11445 (88.2%)	509(12.5%)	3551(87.4%)	379(11.0%)	3050(88.9%)

Figure 3 displays the number and percentages, and percent of participants across various racial groups and physical activity levels have been told they have hypertension.

Discussion

Summary and Interpretation of Statistical Test Results

For each one-minute increase in low-moderate physical activity, we see a 0.001% decrease in odds of having hypertension. For each one session increase in low-moderate physical activity, we see a 0.003% decrease in odds of having hypertension. These results are initially counterintuitive considering Asian Americans had, on average, the lowest duration of light-moderate physical activity. However, they had the highest frequency of physical activity sessions per week, and Asian Americans were most likely to answer ‘no’ to having hypertension. This observation suggests, similar to the logistical regression results, that frequency of engagement in low-moderate physical activity presents a stronger negative correlation to hypertension than the duration of low-moderate physical activity.

Connection to Broader Literature

The results enhance existing literature in this area and are consistent with other findings. Broader literature concludes that an increase in low-moderate physical activity has an inverse relationship with having hypertension. The findings suggest that for every increase in physical activity, there is a decrease in the prevalence of hypertension. However, there is still limited

research on how low-moderate physical activity may impact the prevalence of hypertension in minority groups. However, there is sufficient research on the impacts of vigorous activity.

Limitations

The data set was missing around 9,314 observations; this is 36.64% of respondents. The data and results may be influenced by the exclusion of institutionalized civilians (e.g., long-term care facilities). Finally, physical activity and hypertension data may be subject to recall bias due to self- and proxy-reporting.

Implications

There seems to be a weak association between light-moderate physical activity and hypertension. Data analysis suggests that the frequency of participation in low-moderate physical activity has a stronger association with hypertension than the duration of low-moderate physical activity. Therefore, if an individual wanted to prevent the development of hypertension based on these statistical results, engaging in more than four low-moderate activity sessions per week would be more beneficial than incrementing the duration of their current low-moderate physical activities. However, with more than 30% of the data missing, further analysis should be conducted with higher data retention.

Alternative Approaches

Future research designs to explore the association between physical activity and hypertension as a risk factor for developing cardiovascular disease should employ a more extensive diversity of variables for physical activity levels beyond low-moderate. An additional moderate-high physical activity level would provide further analysis of the association between physical activity and hypertension. An alternative statistical analysis test could be performed on the data if both continuous independent variables were labeled and categorized to conduct a Chi-

Squared Test. Research to determine which categories would be appropriate for labeling data would be necessary. In addition, data set organization and participant follow-up should be reinforced to avoid the loss of important observations.

References

Balfour, P. C., Jr, Rodriguez, C. J., & Ferdinand, K. C. (2015). The role of hypertension in race-ethnic disparities in cardiovascular disease. *Current Cardiovascular Risk Reports*, *9*(4), 18. https://doi.org/10.1007/s12170-015-0446-5

Ferdinand K. C. (2005). Managing cardiovascular risk in minority patients. *Journal of the National Medical Association*, *97*(4), 459–466.

Logit Regression: SAS Data Analysis Examples. (2020). Retrieved April 29, 2020, from https://stats.idre.ucla.edu/sas/dae/logit-regression/

National Center for Health Statistics. (2018). *2018 National Health Interview Survey, Sample Adult.* ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2018/samadult_layout.pdf

National Center for Health Statistics. (2019). *2018 National Health Interview Survey (NHIS) survey description.* Division of Health Interview Statistics, National Center for Health Statistics, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2018/srvydesc.pdf

National Health Interview Survey. (2018). *CAPI manual for NHIS field representatives.* United States Census Bureau.

National Health Interview Survey. (2019). *2018 National Health Interview Survey (NHIS) public use data release.* Centers for Disease Control and Prevention.

ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2018/readme.pdf