Associations of Physical Activity with CVD Risk Factors, Stress, and Quality of Life in Hispanics/Latinos

by

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Dissertation

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This dissertation is dedicated to my parents, Manuel and Ana; to my sisters, Pamela and Michelle; and to my grandparents Jesus and Martha, and Elia. I would not have been able to reach this stage without your unconditional love and support.

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LIST OF ABBREVIATIONS

PA	Physical Activity
MVPA	Moderate to Vigorous Physical Activity
CV	Cardiovascular
CVD	Cardiovascular Disease
HCHS/SOL	Hispanic Community Health Study/Study of Latinos
SCAS	Sociocultural Ancillary Study
NHIS	National Health Interview Survey
NHANES	National Health and Nutrition Examination Survey
BMI	Body Mass Index
HRQoL	Health-Related Quality of Life
MCS	Mental Component Score
PCS	Physical Component Score
PR	Prevalence Ratios
CI	Confidence Intervals

SUMMARY

Using Hispanic Community Health Study/Study of Latino (HCHS/SOL) samples, the current study examined the associations of accelerometer-measured physical activity (PA) with cardiovascular disease (CVD) risk factors including blood glucose, total cholesterol, blood pressure, body mass index (BMI), and smoking. CVD risk factors were examined at adverse levels and ideal levels, as well as overall low cardiovascular (CV) risk (defined as all ideal levels of CVD risk factors). Subsequently, this study examined whether psychosocial stress (comprised of chronic, traumatic, and perceived stress) moderated the association between PA and CVD risk factors. Lastly, this study examined the association between PA and health-related quality of life (HRQoL). Poisson and multivariate linear regression models were used to conduct these analyses. Findings demonstrated significant association with all CVD risk factors, except smoking. We found that effect modification occurred by chronic stress for diabetes, marginally for hypercholesterolemia, and smoking. We also observed effect modification by traumatic stress for smoking. Findings also demonstrated an association between PA and the physical component score (PCS) of the HRQoL measure, the Short Form-12 (SF-12). These data provide evidence regarding the positive associations with accelerometer-measured PA and CVD risk factors, with a call for consideration and inclusion of psychosocial stress into preventive efforts, and ultimately continue the development of strategies to increase levels of PA to improve overall HRQoL.

I. INTRODUCTION

Physical activity (PA) is defined as any bodily movements produced by skeletal muscles that results in energy expenditure and this could be leisure activity, transportation or occupation activity (Caspersen, 1985). PA can also be classified as structured or incidental, where structured PA or exercise is planned, purposeful activity to promote health and physical fitness (Caspersen, 1985). Moderate to vigorous PA (MVPA), particularly during leisure time and in 10-minute bouts, has been associated with reduced risk of adverse levels of CVD risk factors (HHS, 2008; Mozaffarian et al., 2015). Self-reported PA data can be evaluated by domain which includes PA done for the purposes of leisure time, occupation, and transportation. Evidence on domain-specific PA and CVD risk factors demonstrate that leisure time PA can reduce risk of diabetes by 34% among women and 11% among men (Bassuk & Manson, 2005). Additionally, active transportation such as walking to work has been associated with lower odds of hypertension and diabetes (Furie & Desai, 2012), and occupational PA has been positively associated with higher HDL-cholesterol levels (Sofi et al., 2007).

However, with emerging use of device-measured PA data, for example accelerometers, there is a need to also establish the associations between accelerometer-measured PA and CV health. Research thus far using accelerometers has shown significant increasing linear trends in daily MVPA with lower blood pressure, BMI, and fasting plasma glucose (Barreira, Harrington, & Katzmarzyk, 2014). These associations have not been systematically evaluated among diverse Hispanic/Latino individuals, yet

there is a need given existing evidence of different PA profiles among Hispanic/Latino adults (Marquez, Neighbors, & Bustamante, 2009). Examining these associations may elucidate PA behaviors that can either be beneficial or detrimental to CV health among the diverse population of Hispanic/Latino adults.

Evaluation of the literature regarding the benefits of PA on health resulted in the creation of the PA guideline recommendations in 2008 by the US Department of Health and Human Services. The PA guideline recommendations are to engage in at least 150 minutes of moderate intensity or 75 minutes of vigorous intensity aerobic PA per week, or the equivalent of both, for bouts of at least 10 minutes. For additional benefits, 300 minutes of moderate intensity or 150 minutes of vigorous intensity per week were recommended. Meeting PA guideline recommendations were inversely associated with blood pressure, glucose levels, diabetes, hypertension, BMI and obesity (Luke, Dugas, Durazo-Arvizu, Cao, & Cooper, 2011). However, in regard to Hispanic/Latino health, these studies predominantly included Mexican American participants and results may not generalize to other Hispanic/Latino groups given the differences in prevalence of CVD risk factors found in observational studies (Daviglus et al., 2012b; Daviglus, Pirzada, & Talavera, 2014). According to 2014 National Health Interview Survey (NHIS), only half of American adults met the PA guideline recommendations for aerobic activity, and only 41.3% of Hispanics/Latinos were adherent to PA guidelines which was less than their African American and white counterparts (Mozaffarian et al., 2015).

PA and exercise are considered to be primary prevention against 35 chronic conditions, many of them CV-related. For example, there is evidence of PA improving health conditions such as metabolic syndrome, obesity, prediabetes, type 2 diabetes, and hypertension (Booth, Roberts, & Laye, 2012). Insufficient PA ultimately results in decreased quantity and quality years of life (Booth et al., 2012), and poor CV health via lowered vascular resistance, arterial stiffness, oxidative stress, inflammation, and psychosocial stress (Diaz & Shimbo, 2013).

CVD is a leading cause of death among Hispanic/Latino adults in the US (CDC/NCHS, 2016). The prevalence of CVD risk factors is high in this population, as demonstrated in HCHS/SOL with 80% of men and 71% of women having at least one major CVD risk factor (Daviglus et al., 2012b). Findings from HCHS/SOL also show that the prevalence of low CV risk (i.e. favorable levels of all major CVD risk factors) was only 8.4% and varied by Hispanic/Latino background (Daviglus et al., 2016). The role of adverse levels of CVD risk factors in the development of CVD has been established; however, the associations and importance of healthy behaviors with ideal CV health are beginning to be explored. Research has identified adverse and ideal levels of CVD risk factors predict CVD events (Dong et al., 2012). Research on ideal CV health has led to the development of concepts like Life's Simple 7, which is achieving ideal BMI, ideal levels of PA, ideal healthy diet score, ideal total cholesterol, ideal blood pressure, ideal fasting plasma glucose, and no smoking (Lloyd-Jones et al., 2010).

The development of CVD has also been associated with psychosocial factors, including stress. Psychosocial stress is defined as aversive or demanding conditions that tax or exceed the behavioral resources of the organism (Lazarus, 1966). Dimensions of this include work, family life, life events which can result in low perceived control with contributing factors being lack of social support, socioeconomic status, and depression (Hjemdahl, Rosengren, & Steptoe, 2012). Experiencing stress also influences neuroendocrine systems, autonomic activity, immune function, metabolic processes, and brain structure (Hjemdahl, Rosengren, & Steptoe, 2012).

About 75.6% of HCHS/SOL participants reported at least one chronic stressor, 80.7% reported at least one traumatic stressor and chronic stress was associated with increased odds of diabetes and hypertension (Gallo, Roesch, et al., 2014). Given the frequent occurrence of low socioeconomic status and sociocultural context of Hispanics/Latinos in the US the opportunity of stressful circumstances is high. Little is known about the interaction between PA and psychosocial stress in relation to CVD risk factors. Furthermore, limitations of the previous literature include the lack of racial/ethnic minorities in studies, the primary focus on youth, and the need for device measured PA (Gerber, Borjesson, Ljung, Lindwall, & Jonsdottir, 2016).

In addition, the complexity of the sources and domains of stress proves to be an overall challenge in examining the role of psychosocial stress on health. Stress has been measured as perceived stress, chronic stress, traumatic event stress (Isasi, Parrinello, et al., 2015), occupational stress (Juster et al., 2011), acculturative stress (Torres, Driscoll,

& Voell, 2012). The incorporation of various measures of both stress and accelerometer-measured PA can provide information on an important gap in the literature for Hispanic/Latino adults. Evidence that addresses these topics may inform the design of clinical and community interventions to help maintain or improve health, and specifically aid in informing practitioners about specific CVD risk factors that may be amenable to PA.

Ultimately, the goal for health promotion and disease prevention is to maintain or improve an individual's quality of life. An important construct in health research is health-related quality of life (HRQoL), defined as the impact of health on an individual's well-being in the physical, mental, and social domains of life as well as their perceived ability to function (Hays & Morales, 2001). A commonly used measure is the Short-Form 12 (SF-12) which can be easily administered and contains a physical component score (PCS) and a mental component score (MCS) (Hanmer & Kaplan, 2016). This measure has been used across populations and HRQoL has been observed to be a predictor of all-cause mortality and CVD incidence and mortality (Saquib et al., 2013). International research has also demonstrated positive associations with the domain of leisure time PA and physical and mental domains of HRQoL (Balboa-Castillo, León-Muñoz, Graciani, Rodríguez-Artalejo, & Guallar-Castillón, 2011; Eime, Harvey, & Payne, 2014; Nakamura et al., 2014; Wendel-Vos, Schuit, Tijhuis, & Kromhout, 2004). The analysis of device-measured PA has only recently been included in assessing the association of PA with HRQoL. Findings show similar positive associations to those observed with self-report

data (Loprinzi, 2015), and analyses to evaluate differences by non-bout and 10-min bouts of PA also demonstrate a positive association between PA and HRQoL (Loprinzi & Davis, 2016). To our knowledge, no studies have examined the association between accelerometer-measured PA and HRQoL by physical and mental health domains, nor in Hispanics/Latinos.

II. THE ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MODERATE TO VIGOROUS PHYSICAL ACTIVITY AND CARDIOVASCULAR DISEASE RISK FACTORS AMONG HISPANIC/LATINO ADULTS: FINDINGS FROM THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (HCHS/SOL)

A. ABSTRACT

Background: Moderate to vigorous physical activity (MVPA) is an established health behavior that prevents adverse levels of cardiovascular disease (CVD) risk factors, however, less is known about its association with ideal levels of CVD risk factors. Little is known about the prevalence of these associations among Hispanic/Latino adults in the US. **Objective:** To describe the associations between accelerometer-measured MVPA and adherence to PA guideline recommendations with CVD risk factors (defined as 1. adverse levels; 2. ideal levels; 3. overall low cardiovascular [CV] risk) among Hispanic/Latino adults. **Methods:** Cross-sectional data from 12,008 adults ages 18-74 in 2008-11, who participated in HCHS/SOL and had complete data on study variables, were analyzed using complex survey design methods. Accelerometer data (non-bouts and 10-minute bouts) were categorized into 4 levels based on MVPA (inactive, low, moderate, and high) and also dichotomized based on adherence to PA guideline recommendations. Standard national recommendations to determine adverse and ideal levels of blood glucose, total cholesterol, blood pressure, body mass index (BMI), and smoking were used. Low CV risk was defined as ideal levels in all CVD risk factors. Poisson regression models were used to derive adjusted prevalence and adjusted prevalence ratios of CVD risk factors with 95% confidence intervals. **Results:** Higher MVPA was associated with lower prevalence of diabetes, hypercholesterolemia, hypertension, and obesity. Higher MVPA was associated with higher prevalence of ideal blood glucose, total cholesterol, blood pressure, BMI, and overall low CV risk. Non-adherence to PA guideline recommendations was associated with higher adverse levels, lower ideal levels of CVD risk factors (except for smoking), and lower low CV risk. **Conclusion:** In a sample of Hispanic/Latino adults in the US, accelerometer-measured MVPA was significantly associated with both adverse and ideal levels of CVD risk factors and overall low CV risk. Future studies may use these findings to target efforts to lower the burden of adverse CVD risk factors and achieve ideal CVD risk factors for this population.

B. INTRODUCTION

Cardiovascular disease (CVD) prevention has centered on targeting the five major CVD risk factors: diabetes, hypercholesterolemia, hypertension, obesity, and smoking (Havranek et al., 2015). CVD is the leading cause of death among US Hispanic/Latino adults (Balfour, Ruiz, Talavera, Allison, & Rodriguez, 2016). Compared to other racial/ethnic groups, Hispanics/Latinos have a lower mortality rate; however, the high prevalence of CVD risk factors may result in an overwhelmingly high rate of CVD-related mortality in the coming decades (Dominguez, Penman-Aguilar, Man-Huei Chang, R Moonesinghe, Castellanos, & Rodriguez-Lainz, 2015; Rodriguez et al., 2014). Physical activity (PA), in particular of moderate to vigorous physical activity (MVPA), has been demonstrated to maintain and improve cardiovascular (CV) health. Thus, promoting engagement in PA has been included as a major component of preventive efforts (US DHHS, 2010). A limitation of this work has been the lack of representation of diverse populations, namely Hispanics/Latinos whom as a group are very diverse as well as are growing as a population. In 2016 there were an estimate 57 million Hispanics/Latinos and by 2060 this population is projected to reach 119 million (Colby & Ortman, 2015). The lack of representation in population-based studies has resulted in incomplete information on relevant associations for CVD prevention.

Until 1970 Hispanics/Latinos were not recorded as an individual entity for US Census data, and not until 2007, the National Health and Nutrition Examination Surveys (NHANES) started to oversample for all Hispanic/Latino groups (Rodriguez et al., 2014).

National data until then had mainly Mexican American participants which led to instances of overgeneralization of observed associations from Mexican Americans to all Hispanics/Latinos (Daviglus et al., 2012b). More recently, data available by Hispanic/Latino background demonstrated marked differences in health indicators and chronic conditions. This information is invaluable as it will allow practitioners to better understand this diverse population, and it better informs the efforts towards disease prevention.

Historical context is also important to consider in regard to engagement in PA. Marginalized populations, such as Hispanics/Latinos across the US, face systemic differences in environmental factors which may be compounded by more social inequalities (e.g., racial/ethnic discrimination, poor education, and poor occupation quality) that are significant barriers to being physically active, thus contributing to the differences among those who are socially disadvantaged to advantaged (Lee & Cubbin, 2009). As discussed by Lee and Cubbin (Lee & Cubbin, 2009), the *Ecological Model of Physical Activity* describes the multiple spheres of influence (i.e., micro-, meso-, exo-, macro-environmental) on an individual's behavior such that PA and chronic conditions are outcomes of the societal infrastructure. Following this framework which is based on Bronfenbrenner's Ecological Model (Brofenbrenner, 1977), the changes needed to positively influence PA levels at individual- and population-levels for Hispanics/Latinos warrants multi-level efforts to further develop the infrastructure to support physically active communities (Yancey et al., 2007). At the base of these efforts is the availability of

data, where the association between PA and CVD risk factors among Hispanic/Latino adults can provide foundational information to communities, organizations, and decision-makers to support community members to be physically active (Whitt-Glover, Crespo, & Joe, 2009; Yancey et al., 2007).

An ongoing challenge in PA research has been related to measurement of PA. Until recently, research on PA was based only on self-reported questionnaires. Critiques of self-report include the potential for bias due to social desirability, which may overestimate actual PA levels. Emerging research has incorporated the use of device-measured PA, namely the use of accelerometers to measure the intensity of PA (Bassett, Troiano, Mcclain, & Wolff, 2015). Based on accelerometer data, adults have been found to engage in much lower amounts of MVPA compared to their self-reported MVPA (Troiano, McClain, Brychta, & Chen, 2014). This lack of concordance is to be expected as accelerometer and self-reported measures capture distinct aspects of PA (Troiano et al., 2014). Interestingly, in HCHS/SOL, it has been reported that 65% of participants met PA guidelines recommendations per self-report; yet accelerometer data show a significantly lower amount of device-measured MVPA (Arredondo et al., 2016). Additional main findings from the landmark HCHS/SOL included that there is a high prevalence of CVD risk factors, low prevalence of ideal level of CVD risk factors, and a low prevalence of overall low CV risk (Daviglus et al., 2012a, 2016). In addition to examining associations of PA with adverse levels of CVD risk factors, there has been an increased interest in the prevalence of ideal CVD risk factors. To our knowledge there

has been no study examining the association between accelerometer-measured MVPA and meeting PA guideline recommendations with adverse CVD risk factors, ideal CVD risk factors, and ideal CV health among a large diverse cohort of Hispanic/Latino adults in the US (HHS, 2008).

The overall aim of this study is to describe the associations between accelerometer-measured MVPA with CVD risk factors (defined as 1. *adverse levels*; 2. *ideal levels*; 3. *overall low CV risk*) among US Hispanics/Latinos. The primary aims of the study are to examine the association between accelerometer-measured MVPA and adverse levels of CVD risk factors, ideal levels of CVD risk factors, and overall low CV risk. Followed by examination of the association between adhering to the 2008 PA guideline recommendations and adverse levels of CVD risk factors, ideal levels of CVD risk factors, and overall low CV risk. Additional analyses include examination of all associations using accelerometer-measured MVPA in 10-minute bouts given that the recommendations are to engage in MVPA in at least 10-minute bouts. We hypothesized that higher MVPA will be associated with lower prevalence of adverse CVD risk factors and higher prevalence of ideal CVD risk factors.

Information from this study may provide a baseline for the association of MVPA and CVD risk factors in this diverse population, and delineate both strengths and areas for improvement concerning this association. The data may also provide support for more effective PA interventions and policies that reduce adverse health outcomes, and improve overall health and curb the high prevalence and incidence of CVD.

C. METHODS

1. Study Description

The HCHS/SOL was a community-based cohort study, which aims to evaluate the health risks and protective factors for CVD and other chronic conditions among a diverse sample of Hispanic/Latino adults in the US. This study included four sites (Bronx, NY; Chicago, IL; Miami, FL; San Diego, CA) and each were selected based on their peer-reviewed study proposal and geographical location. Recruitment of participants was conducted using a stratified two-stage probability sample of household address via selected census tracts to ensure socioeconomic diversity, proximity to the HCHS/SOL study clinic site, and this was done to reduce potential sources of bias in the study. This study enrolled self-identified Hispanic/Latino adults (N=16,415) of Dominican, Central American, Cuban, Mexican, Puerto Rican, and South American backgrounds between ages 18-74, and the study oversampled for persons aged 45-74 years (Sorlie et al., 2014). Participants were ineligible if they were unable to physically travel to the study site, complete the study questionnaires or clinical examination, or if they were relocating in the subsequent 6 months (Lavange et al., 2010). Baseline examinations were standardized across study sites and took place between 2008 and 2011. Data collection was approximately 7 hours in duration. Protocol to ensure the safety of participants during the examination were instituted at each site, participants were informed of medically important examination results and referred to medical providers if needed. This study was approved by the institutional review boards in each study site institution as well as the

coordinating center located at the University of North Carolina. An informed consent was obtained for all participants at the beginning of the baseline examination visit; detailed information of study design, sampling, and implementation has been previously reported (Lavange et al., 2010; Sorlie et al., 2010). The baseline examination questionnaires and testing were conducted in the participant's preferred language.

2. Measures

a. Physical Activity

This study's main exposure (i.e., independent variable) measure was PA. The Actical Accelerometer (model 198-0200-03; Minimiter Respironics, Bend, OR) recorded the frequency, duration, and intensity of PA during the time the accelerometer was worn. Participants were fitted with a belt and were instructed to wear the accelerometer for seven days at the hip, above the iliac crest and to only remove for swimming, showering, and sleeping (Arredondo et al., 2016). Accelerometers were distributed on the day of baseline examination.

Adherence to accelerometer-use was defined as having at least three days with a minimum of ten hours per day of data. Accelerometer data were processed with epoch length of 1 minute and non-wear time was determined by using the Choi algorithm, which defined non-wear time as 90 consecutive minutes of zero counts, allowing only 1-2 minutes of nonzero counts within a 30-minute window upstream and downstream of the 90-minute timeframe (Choi, Liu, Matthews, & Buchowski, 2011). Participants adherent

to accelerometer-use were included in this analysis and overall adherence to accelerometer-use among HCHS/SOL participants has been reported (Evenson et al., 2015).

We used accelerometer-measured MVPA (minutes/week) as an ordinal variable in four categories which represent the following categories: inactive, low MVPA, moderate MVPA, and high MVPA in non-bouts and in 10-minute bouts. We used a categorical variable in order to capture more of the variability in engagement in MVPA within the sample. We also used accelerometer-measured MVPA as a dichotomous variable based on adherence to the 2008 PA guideline recommendations. The ordinal and dichotomous variables were derived using the average of total moderate and/or vigorous minutes within a day across adherent days and then the average was multiplied by 7 (for each day of the week).

For the ordinal four category MVPA variable, the inactive category was defined as engaging in between 0 and 1 minute of moderate or vigorous PA per week. Low MVPA was defined as engaging in between (i) 1 and 150 minutes of moderate PA, (ii) 1 and 75 minutes of vigorous PA, or (iii) 1 and 150 minutes of MVPA on average per week. Moderate MVPA was defined as engaging in between (i) 150 and 300 minutes of moderate PA, (ii) 75 and 150 minutes of vigorous PA, or (iii) 150 and 300 minutes of MVPA on average per week. High MVPA was defined as engaging in (i) more than 300 minutes of moderate PA, (ii) more than 150 minutes of vigorous PA, or (iii) more than 300 minutes of MVPA on average per week. For the dichotomous MVPA variable,

adherence to the 2008 PA guideline recommendations was defined as engaging in (i) 300 or more minutes of moderate PA, (ii) 150 or more minutes of vigorous PA, or (iii) more than 300 minutes of MVPA (HHS, 2008).

b. Cardiovascular Disease Risk Factors

This study's main outcome (dependent variable) was CVD risk factors as defined in using three different measures described below.

i. Adverse Levels of Cardiovascular Disease Risk Factors

Each adverse CVD risk factor was dichotomized to indicate the presence or absence of the risk factor for each participant using standardized ranges. Fasting blood samples were used to determine glucose levels and total cholesterol levels. *Diabetes* was defined as fasting blood glucose ≥126 mg/dL, glucose tolerance test with a 2-hour plasma glucose test ≥ 200 mg/dL, hemoglobin A1c ≥ 6.5% or taking glucose regulating medications (American Diabetes, 2010). *Hypercholesterolemia* was defined as total cholesterol ≥ 240 mg/dL or taking cholesterol-lowering medications (NCEP, 2001; Stone et al., 2014). Blood pressure was measured three times in the seated position with a sphygmomanometer and *hypertension* was defined as systolic blood pressure ≥ 140 mm Hg, diastolic blood pressure ≥ 90 mm Hg, or taking antihypertensive medications (Krakoff et al., 2014). *Body mass index* was determined by measuring participants' height and weight, and calculated by dividing weight (kg) by height in meters squared (m^2) and

obesity was defined as a body mass index of 30 or more (NHLBI, 1998). *Smoking* on some or all days was self-reported by participants (HHS, 2014). The prevalence of adverse CVD risk factors among Hispanic/Latino adults in HCHS/SOL cohort has been reported (Daviglus et al., 2012a).

ii. Ideal Levels of Cardiovascular Disease Risk Factors

Each CVD risk factor has an ideal level and we dichotomized each to indicate the presence or absence of the ideal CVD risk factor using standardized ranges. *Ideal glucose* level was defined as fasting blood glucose <100 mg/dL, glucose tolerance test with a 2-hour plasma glucose test ≥ 200 mg/dL, hemoglobin A1c <5.7%, not currently taking glucose regulating medication, and no history of diabetes (American Diabetes, 2010). *Ideal total cholesterol level* was defined as <200 mg/dL, and not taking cholesterol-lowering medications (NCEP, 2001). *Ideal blood pressure* level was defined as systolic blood pressure <120 mm Hg, diastolic blood pressure <80 mm Hg, and not taking antihypertensive medications (Krakoff et al., 2014). *Ideal BMI* was defined as <25 kg/m^2 (NHLBI, 1998). *Ideal smoking status* was defined as not currently smoking (HHS, 2014).

iii. Low Cardiovascular Risk

Overall, low CV risk was defined as having ideal levels in all CVD risk factors. The prevalence of ideal CVD risk factors and low CV risk among Hispanic/Latino adults in HCHS/SOL cohort has been previously reported (Daviglus et al., 2016).

c. Covariates

The following covariates were collected via using questionnaires administered by trained interviewers. Socio-demographic data was collected using personal identifiers and personal information questionnaires. Age was dichotomized into 18-44 years or 45 years or more. Sex was dichotomized into female or male. Education was categorized into three groups: participants who did not have a high school diploma/GED, those with at most high school/GED, and those with more than a high school diploma/GED. Annual household income included the income of all household members, and this covariate was categorized into less than $30,000, more than $30,000, or missing. Diet quality was assessed by using the Alternative Heathy Eating Index (AHEI) 2010, a 24-hour recall with scores categorized into tertiles where higher scores indicate a better diet quality. Alcohol intake was categorized into three groups, those who never drank alcohol before, former drinkers, and current drinkers. Years of residence in the US was dichotomized into less than 10 years or 10 years and more. Health insurance was dichotomized into having no health insurance or currently being insured. Study site was recorded for each participant and the study sites were the Bronx, NY, Chicago, IL, Miami, FL, and San Diego, CA. Hispanic/Latino background was categorized into seven groups to include Dominican, Central American, Cuban, Mexican, Puerto Rican, South American, or more than one background group.

3. Statistical Analysis

Descriptive statistics were computed for the analytic sample covariates, adverse CVD risk factors, ideal CVD risk factors, and overall low CV risk by accelerometer-measured MVPA categories (non-bouts) in addition to adherence to PA guideline recommendations (non-bouts). Poisson regression models were used to compute adjusted prevalence and adjusted prevalence ratios of adverse CVD risk factors, ideal CVD risk factors, and overall low CV risk by accelerometer-measured MVPA (non-bouts and 10-minute bouts) and adherence to PA guideline recommendation (non-bouts). For prevalence ratios, models for each adverse CVD risk factor were adjusted for covariates and the remaining four adverse CVD risk factors. Models for each ideal CVD risk factor were adjusted for covariates and the remaining four ideal CVD risk factors. Analyses for low CV risk was adjusted for only covariates. High MVPA and meeting PA guideline recommendations were the referents for the respective variables. We also assessed Goodness of Fit graphically shown in **Figure 2**. To account for the complex survey designs of HCHS/SOL we used sampling weights, clusters, and strata in all analyses. We applied a sampling weights derived by using inverse probability weights to account for missing accelerometer data. All analyses were conducted using Stata Statistical Software, Release 14 (StataCorp LP, College Station, TX).

D. RESULTS

1. Descriptive Statistics

The analytic sample for this study included N=12,008 from the HCHS/SOL cohort study (**Table I**). The majority of the sample had low MVPA levels (59.4%) and did not meet 2008 PA guideline recommendations (61.3%). In the inactive category, the majority of the sample was 45 years and older (76.9%), female (63.5%), had greater than high school education/GED (39.3%), less than a $30,000 annual household income (70.6%), resided in the US for more than 10 years (77.9%), and had health insurance (67.1%). Overall in the high MVPA category (16.5%), the majority were between 18-44 years old (72.2%), and male (66.8%). Similar to those in the inactive category, the majority also had greater than high school education/GED (38.2%), less than a $30,000 annual household income (61.3%), resided in the US for more than 10 years (74.7%), and had health insurance (54.4%).

In our sample, 14.4% had diabetes, 42.2% had hypercholesterolemia, 24.2% had hypertension, 39.5% were obese, and 20.5% were current smokers. For ideal levels of CVD risk factors, 54.9% had ideal glucose, 53.4% had ideal total cholesterol, 49.7% had ideal blood pressure, 23.1% had ideal BMI, and 79.5% were not current smokers. Lastly, 8.4% had low CV risk in our sample.

2. Poisson Regression Models

a. Adverse Levels of Cardiovascular Disease Risk Factors

i. Diabetes

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of diabetes is 19.6% for the inactive, 16.1% for low MVPA, 13.0% for moderate MVPA, and 13.0% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of diabetes is 16.1% for the inactive, 14.6% for low MVPA, 12.3% for moderate MVPA, and 14.6% for high MVPA (**Table III**). The adjusted prevalence of diabetes among those who do not meet PA guideline recommendations (non-bouts) is 16.3% and 13.0% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of diabetes (p-value for association = 0.0003, p-value for trend = 0.0001). Compared to those engaging in high MVPA, the prevalence of diabetes is 1.51 (1.17, 1.94) times higher for the inactive, 1.24 (1.03, 1.49) times higher for low MVPA, and 1.00 (0.79, 1.25) times lower for moderate MVPA (**Table V**). There was no significant association between accelerometer-measured MVPA in 10-minute bouts and diabetes (p-value for association = 0.0203, p-value for trend = 0.2862). Compared to those engaging in high MVPA in 10-minute bouts, the prevalence of diabetes is 1.11 (0.79, 1.54) times higher for the inactive, 1.00 (0.72, 1.38) for low MVPA, and 0.84 (0.58, 1.22) times lower for moderate MVPA (**Table VI**). *PA guideline recommendations:* Overall, those

who do not meet PA guideline recommendations (non-bouts) have a 1.25 (1.12, 1.40) times higher prevalence of diabetes compared to those who are adherent (p-value for association = <0.001) (**Table VII**).

ii. Hypercholesterolemia

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of hypercholesterolemia was 44.9% for the inactive, 45.0% for low MVPA, 42.7% for moderate MVPA, and 37.4% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of hypercholesterolemia is 46.2% for the inactive, 40.8% for low MVPA, 37.9% for moderate MVPA, and 41.1% for high MVPA (**Table III**). The adjusted prevalence of hypercholesterolemia among those who do not meet PA guideline recommendations (non-bouts) is 44.9% and 40.3% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of hypercholesterolemia (p-value for association = 0.0020, p-value for trend = 0.0199). Compared to those engaging in high MVPA, the prevalence of hypercholesterolemia is 1.20 (1.01, 1.42) times higher for inactivity, 1.20 (1.10, 1.32) times higher for low MVPA, and 1.14 (1.03, 1.26) times higher for moderate MVPA (**Table V**). There was no significant association between accelerometer-measured MVPA in 10-minute bouts and hypercholesterolemia (p-value for association = 0.0001, p-value for trend = 0.0591). Compared to those engaging in

high MVPA in 10-minute bouts, the prevalence of hypercholesterolemia is 1.12 (0.97, 1.30) times higher for the inactive, 0.99 (0.86, 1.15) times lower for low MVPA, and 0.92 (0.78, 1.09) times lower for moderate MVPA (**Table VI**). *PA guideline recommendations:* Overall, those who do not meet PA guideline recommendations (non-bouts) have a 1.11 (1.04, 1.19) times higher prevalence of hypercholesterolemia compared to those who are adherent (p-value for association = 0.001) (**Table VII**).

iii. Hypertension

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of hypertension is 30.1% for the inactive, 26.8% for low MVPA, 22.9% for moderate MVPA, and 21.8% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of hypertension is 26.3% for the inactive, 24.9% for low MVPA, 24.3% for moderate MVPA, and 21.9% for high MVPA (**Table III**). The adjusted prevalence of hypertension among those who do not meet PA guideline recommendations (non-bouts) is 27.0% and 22.5% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of hypertension (p-value for association = 0.0004, p-value for trend = 0.0001). Compared to those engaging in high MVPA, the prevalence of hypertension is 1.38 (1.15, 1.67) times higher for the inactive, 1.23 (1.07, 1.42) times higher for low MVPA, and 1.05 (0.91, 1.21) times higher for moderate MVPA (**Table V**). We observe

no significant association between accelerometer-measured MVPA in 10-minute bouts and hypertension (p-value for association = 0.2344, p-value for trend = 0.1112) (**Table VI**). *PA guideline recommendations:* Overall, those who do not meet PA guideline recommendations (non-bouts) have a 1.20 (1.09, 1.32) times higher prevalence of hypertension compared to those who are adherent (p-value for association = <0.001) (**Table VII**).

iv. Obesity

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of obesity is 54.6% for the inactive, 42.3% for low MVPA, 34.5% for moderate MVPA, and 31.5% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of obesity is 42.0% for the inactive, 37.8% for low MVPA, 31.0% for moderate MVPA, and 31.6% for high MVPA (**Table III**). The adjusted prevalence of obesity among those who do not meet PA guideline recommendations (non-bouts) is 42.7% and 33.3% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of obesity (p-value for association = <0.0001, p-value for trend = <0.0001). Compared to those engaging in high MVPA, the prevalence of obesity is 1.73 (1.43, 2.10) times higher for the inactive, 1.34 (1.20, 1.51) times higher for low MVPA, and 1.10 (0.96, 1.26) times higher for moderate MVPA (**Table V**). There is a significant

association between accelerometer-measured MVPA in 10-minute bouts and obesity (p-value for association = <0.0001, p-value for trend = 0.0002). Compared to those engaging in high MVPA in 10-minute bouts, the prevalence of obesity is 1.33 (1.10, 1.61) times higher for the inactive, 1.19 (0.99, 1.45) times higher for low MVPA, and 0.98 (0.77, 1.24) times lower for moderate MVPA (**Table VI**). *PA guideline recommendations:* Overall, those who do not meet PA guideline recommendations (non-bouts) have a 1.28 (1.19, 1.38) times higher prevalence of obesity compared to those who are adherent (p-value for association = <0.001) (**Table VII**).

v. Smoking

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of smoking is 26.1% for the inactive, 20.4% for low MVPA, 18.3% for moderate MVPA, and 20.0% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of smoking is 20.3% for the inactive, 19.8% for low MVPA, 17.4% for moderate MVPA, and 22.0% for high MVPA (**Table III**). The adjusted prevalence of smoking among those who do not meet PA guideline recommendations (non-bouts) is 20.6% and 19.1% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* We observe no significant association between accelerometer-measured MVPA (non-bouts) and prevalence of smoking (p-value for association = 0.1362, p-value for trend = 0.0700) (**Table V**). We also observe no significant association between accelerometer-measured

MVPA in 10-minute bouts and smoking (p-value for association = 0.3582, p-value for trend = 0.8803) (**Table VI**). *PA guideline recommendations:* Furthermore, there is no association between meeting PA guideline recommendations (non-bouts) and smoking (p-value for association = 0.176) (**Table VII**).

b. Ideal levels of CVD Risk Factors-

i. Ideal Glucose

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of ideal glucose is 45.0% for the inactive, 51.3% for low MVPA, 54.6% for moderate MVPA, and 56.8% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of ideal glucose is 50.8% for the inactive, 54.6% for low MVPA, 56.5% for moderate MVPA, and 53.7% for high MVPA (**Table III**). The adjusted prevalence of ideal glucose among those who do not meet PA guideline recommendations (non-bouts) is 51.2% and 55.5% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of ideal glucose (p-value for association = 0.0050), however we did not find a significant linear trend (p-value for trend = 0.0813). Compared to those engaging in high MVPA, the prevalence of ideal glucose is 0.79 (0.59, 1.06) times lower for the inactive, 0.90 (0.85, 0.96) times lower for low MVPA, and 0.96 (0.90, 1.03) times lower for moderate MVPA (**Table V**). There is a significant association between

accelerometer-measured MVPA in 10-minute bouts and ideal glucose (p-value for association = 0.0050), however we did not find a significant linear trend (p-value for trend = 0.2424). Compared to those engaging in high MVPA in 10-minute bouts, the prevalence of ideal glucose is 0.94 (0.84, 1.06) times lower for the inactive, 1.02 (0.91, 1.14) times higher for low MVPA, and 1.05 (0.92, 1.20) times higher for moderate MVPA (**Table VI**). *PA guideline recommendations:* Overall, those who do not meet PA guideline recommendations (non-bouts) have a 0.92 (0.88, 0.96) times lower prevalence of ideal glucose compared to those who are adherent (p-value for association = <0.001) (**Table VII**).

ii. Ideal Total Cholesterol

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of ideal total cholesterol is 43.4% for the inactive, 49.9% for low MVPA, 53.9% for moderate MVPA, and 53.0% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of ideal total cholesterol is 49.2% for the inactive, 53.7% for low MVPA, 51.9% for moderate MVPA, and 50.6% for high MVPA (**Table III**). The adjusted prevalence of ideal total cholesterol among those who do not meet PA guideline recommendations (non-bouts) is 49.8% and 53.5% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of ideal total cholesterol (p-value for

association = 0.0474), however we did not find a significant linear trend (p-value for trend = 0.0771). Compared to those engaging in high MVPA, the prevalence of ideal total cholesterol is 0.82 (0.63, 1.06) times lower for the inactive, 0.94 (0.88, 1.01) times lower for low MVPA, and 1.02 (0.95, 1.08) times higher for moderate MVPA (**Table V**). There is a significant association between accelerometer-measured MVPA in 10-minute bouts and ideal total cholesterol (p-value for association = 0.0226), however we did not find a significant linear trend (p-value for trend = 0.8618). Compared to those engaging in high MVPA in 10-minute bouts, the prevalence of ideal total cholesterol is 0.97 (0.86, 1.10) times lower for the inactive, 1.06 (0.95, 1.19) times higher for low MVPA, and 1.03 (0.90, 1.17) times higher for moderate MVPA (**Table VI**). *PA guideline recommendations:* Overall, those who do not meet PA guideline recommendations (non-bouts) have a 0.93 (0.88, 0.98) times lower prevalence of ideal total cholesterol compared to those who are adherent (p-value for association = 0.008) (**Table VII**).

iii. Ideal Blood Pressure

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of ideal blood pressure is 30.7% for the inactive, 46.9% for low MVPA, 50.6% for moderate MVPA, and 50.5% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of ideal blood pressure is 47.4% for the inactive, 47.6% for low MVPA, 51.4% for moderate MVPA, and 56.6% for high MVPA (**Table III**). The adjusted prevalence of ideal blood pressure among those who do

not meet PA guideline recommendations (non-bouts) is 46.5% and 50.5% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of ideal blood pressure (p-value for association = 0.0012, p-value for trend = 0.0072). Compared to those engaging in high MVPA, the prevalence of ideal blood pressure is 0.61 (0.41, 0.90) times lower for the inactive, 0.93 (0.87, 0.99) times lower for low MVPA, and 1.00 (0.93, 1.08) times lower for moderate MVPA (**Table V**). There is a significant association between accelerometer-measured MVPA in 10-minute bouts and ideal blood pressure (p-value for association = 0.0035, p-value for trend = 0.0004). Compared to those engaging in high MVPA in 10-minute bouts, the prevalence of ideal blood pressure is 0.84 (0.75, 0.94) times lower for the inactive, 0.84 (0.75, 0.94) times lower for low MVPA, and 0.91 (0.80, 1.03) times lower for moderate MVPA (**Table VI**). *PA guideline recommendations:* Overall, those who do not meet PA guideline recommendations (non-bouts) have a 0.92 (0.88, 0.97) times lower prevalence of ideal blood pressure compared to those who are adherent (p-value for association = 0.001) (**Table VII**).

iv. Ideal Body Mass Index

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of ideal BMI is 12.6% for the inactive, 20.3% for low MVPA, 24.9% for moderate MVPA, and 28.5% for high MVPA (**Table II**). For 10-

minute bouts of MVPA, the adjusted prevalence of ideal BMI is 20.5% for inactivity, 24.2% for low MVPA, 26.5% for moderate MVPA, and 25.6% for high MVPA (**Table III**). The adjusted prevalence of ideal BMI among those who do not meet PA guideline recommendations (non-bouts) is 20.1% and 26.4% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of ideal BMI (p-value for association = <0.0001, p-value for trend = 0.0031). Compared to those engaging in high MVPA, the prevalence of ideal BMI is 0.44 (0.24, 0.81) times lower for the inactive, 0.71 (0.63, 0.80) times lower for low MVPA, and 0.87 (0.77, 0.99) times lower for moderate MVPA (**Table V**). There is a significant association between accelerometer-measured MVPA in 10-minute bouts and ideal BMI (p-value for association = 0.0033, p-value for trend = 0.0283). Compared to those engaging in high MVPA in 10-minute bouts, the prevalence of ideal BMI is 0.80 (0.64, 1.00) times lower for the inactive, 0.95 (0.77, 1.17) times lower for low MVPA, and 1.03 (0.82, 1.31) times higher for moderate MVPA (**Table VI**). *PA guideline recommendations:* Overall, those who do not meet PA guideline recommendations (non-bouts) have a 0.76 (0.68, 0.85) times lower prevalence of ideal BMI compared to those who are adherent (p-value for association = <0.001) (**Table VII**).

v. No Smoking

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of non-smoking is 75.4% for the inactive, 79.7% for low MVPA, 81.8% for moderate MVPA, and 79.9% for high MVPA (**Table II**). For 10-minute bouts of MVPA, the adjusted prevalence of non-smoking is 79.8% for the inactive, 80.3% for low MVPA, 82.1% for moderate MVPA, and 76.9% for high MVPA (**Table III**). The adjusted prevalence of non-smoking among those who do not meet PA guideline recommendations (non-bouts) is 79.5% and 81.0% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is no significant association between accelerometer-measured MVPA (non-bouts) and prevalence of non-smoking (p-value for association = 0.2315, p-value for trend = 0.2091) (**Table V**). There is no significant association between accelerometer-measured MVPA in 10-minute bouts and non-smoking (p-value for association = 0.4246, p-value for trend = 0.4994) (**Table VI**). *PA guideline recommendations:* Furthermore, there is no association between meeting PA guideline recommendations (non-bouts) and non-smoking (p-value for association = 0.191) (**Table VII**).

C. Low Cardiovascular Risk

Adjusted prevalence in non-bouts and 10-minute bouts of MVPA: For non-bouts of MVPA, the adjusted prevalence of low CV risk is 0.5% for the inactive, 6.7% for low MVPA, 8.8% for moderate MVPA, and 10.6% for high MVPA (**Table II**). For 10-minute

bouts of MVPA, the adjusted prevalence of low CV risk is 6.2% for the inactive, 8.7% for low MVPA, 11.2% for moderate MVPA, and 9.7% for high MVPA (**Table III**). The adjusted prevalence of low CV risk among those who do not meet PA guideline recommendations (non-bouts) is 6.6% and 9.6% among those who are adherent (**Table IV**). *Adjusted prevalence ratios in non-bouts and 10-minute bouts of MVPA:* There is a significant association between accelerometer-measured MVPA (non-bouts) and prevalence of low CV risk (p-value for association = <0.0001, p-value for trend = 0.0016). Compared to those engaging in high MVPA, the prevalence of low CV risk is 0.05 (0.01, 0.34) times lower for inactivity, 0.63 (0.49, 0.80) times lower for low MVPA, and 0.83 (0.64, 1.07) times lower for moderate MVPA (**Table V**). There is a significant association between accelerometer-measured MVPA in 10-minute bouts and low CV risk (p-value for association = 0.0004, p-value for trend = 0.0127). Compared to those engaging in high MVPA in 10-minute bouts, the prevalence of low CV risk is 0.64 (0.41, 0.99) times lower for inactivity, 0.89 (0.59, 1.35) times lower for low MVPA, and 1.15 (0.70, 1.89) times higher for moderate MVPA (**Table VI**). *PA guideline recommendations:* Overall, those who do not meet PA guideline recommendations (non-bouts) have a 0.69 (0.57, 0.83) times lower prevalence of low CV risk compared to those who are adherent (p-value for association = <0.001) (**Table VII**).

E. DISCUSSION

Epidemiological studies on CVD have not always included Hispanic/Latino adults, and as such, we have had incomplete information on CV health for this population. The gap in knowledge is substantial given the low representation of Hispanic/Latino adults in large epidemiological studies, and this may impede preventive efforts to address improvements in CV health, such as engaging communities to participate in MVPA.

Evidence on the levels of PA demonstrate the low levels among Hispanic/Latino adults in the US, for example, NHANES III (1988-1991) data demonstrated that Mexican Americans have the highest rates of not engaging in leisure time PA compared to other racial/ethnic groups (Crespo, Keteyian, Heath, & Sempos, 1996). More recently, HCHS/SOL (2008-2011) data demonstrated the low average of MVPA per day among participants as measured by accelerometer (Arredondo et al., 2016). Examining levels of PA is important for surveillance purposes, and can be taken further by examining associations with CVD risk factors to provide benchmarks for the Hispanic/Latino population. PA is an important CVD risk factor as well as a point of opportunity for disease prevention and disease management. We will discuss our findings by CVD risk factors, grouping the adverse and ideal levels to show the varying associations detected.

1. Diabetes and Ideal Glucose

Diabetes is a metabolic condition that is characterized by insulin dysregulation and is an established risk factor for CVD (Mozaffarian et al., 2015). Research has shown that physically active individuals, with as little as 30 minutes of moderate-intensity PA per day, have a 30-50% lower risk of developing type II diabetes and PA positively influences insulin resistance, insulin sensitivity, glycemic control (Bassuk & Manson, 2005). Using the 2003-2006 National Health and Nutrition Examination Survey, the authors examined the association between accelerometer-measured MVPA and CV health metrics and found significant linear trends in mean daily MVPA for fasting plasma glucose (Barreira et al., 2014).

In our study were able to establish the prevalence ratios for the associations of MVPA and diabetes as well as ideal glucose levels. We observed significant associations between MVPA and diabetes and ideal glucose levels, and detected a linear trend. We observe a consistent pattern of lower prevalence of diabetes and higher prevalence of ideal glucose with each increasing MVPA category. However, across all combinations of non-bouts and 10-minute bouts for diabetes and ideal glucose (except non-bouts and low MVPA), each confidence interval includes the prevalence ratio of another category, which does not allow us to conclude with confidence that each category of MVPA is distinct from the other; only that it is different from high MVPA. Still, our study demonstrates that Hispanic/Latino adults who do not meet PA guideline

recommendations have a 25% higher prevalence of diabetes and an 8% lower prevalence of ideal glucose levels.

The importance and urgency to target diabetes among Hispanic/Latino adults has been demonstrated by the 79% increased incidence rates between 2006 and 2010, compared to their African American counterparts' 12.6% change (CDC, 2013). The high prevalence of diabetes, a major CVD risk factors, as has led to excess mortality among Hispanic/Latino adults (Vega, Rodriguez, & Gruskin, 2009). In addition, prolonged presence of diabetes has been associated with increased limitation on activities of daily living among older Mexican American (Wu et al., 2003a) and complications from diabetes have also been associated with major cognitive decline (Wu et al., 2003b). Strategies for diabetes among Hispanic/Latino adults warrants multi-level efforts tailored to their context (Castro, Shaibi, & Boehm-Smith, 2009), and there may be a need for additional tailoring of PA for diabetes management and control (Colberg et al., 2016).

2. Hypercholesterolemia and Ideal Total Cholesterol

Hypercholesterolemia has been linked to the development of atherosclerosis, which is a leading cause of myocardial infarctions and strokes. There has been inconsistent information on the association between engaging in MVPA and total cholesterol levels. Using the 2003-2006 NHANES, researchers found no significant linear trend between accelerometer-measured MVPA and total cholesterol level (Barreira et al., 2014); however there is other evidence that shows PA positively influencing

dyslipidemia (Bassuk & Manson, 2005). Given the high prevalence of hypercholesterolemia among Hispanic/Latino adults (Daviglus et al., 2012b; Qureshi et al., 2017) and the potential for improvements via engaging in MVPA, an understanding of the prevalence by MVPA categories is essential to target efforts of Hispanic/Latino health.

Our findings support studies that report an association between accelerometer-measured MVPA and hypercholesterolemia. We observed a significant association between non-bouts of MVPA with hypercholesterolemia and ideal total cholesterol levels, and detected a linear trend for non-bouts of MVPA and hypercholesterolemia. The nature of each association, however, is distinct from each other, which may provide insight on the varying results in other studies. For non-bouts of MVPA and hypercholesterolemia, the prevalence ratios for the inactive and low MVPA are the same, but in combination with the significant linear trend may suggest a divide between inactive and low MVPA from moderate MVPA, with the latter being the more preferable. For 10-minute bouts of MVPA and hypercholesterolemia, we do not observe a linear trend which suggests that the association is driven by the lower prevalence of hypercholesterolemia among those engaging in high MVPA compared to the other MVPA categories, and may indicate that high MVPA in 10-minutes is preferable.

For ideal total cholesterol levels, we observe a consistent pattern of significant associations and no significant linear trends in non-bouts and 10-minute bouts of MVPA. We can only conclude that the prevalence of ideal total cholesterol level among those in

the high MVPA category is different from the other categories. Still, our study demonstrates that Hispanic/Latino adults who do not meet PA guideline recommendations have an 11% higher prevalence of hypercholesterolemia and a 7% lower prevalence of ideal total cholesterol levels. While these percentages maybe considered small, at the population level this has the potential to reduce the burden of disease among Hispanic/Latino communities (Yancey et al., 2007).

3. Hypertension and Ideal Blood Pressure

The prevalence of hypertension among Hispanic/Latino adults is high in the US, and a significant proportion does not have treatment or control of hypertension (Sorlie et al., 2014). Population-based strategies for primary prevention of hypertension have emphasized engaging in moderate PA as it has been proven to be efficacious in preventing hypertension, and the need to target high risk populations has been highlighted (Whelton et al., 2002). There is substantial evidence of the positive influence of engaging in high levels of PA on hypertension (Bassuk & Manson, 2005). Using the 2003-2006 National Health and Nutrition Examination Survey, researchers observed a significant linear trend between accelerometer-measured MVPA and blood pressure (Barreira et al., 2014).

The findings of our study align with much previous research, as we observed significant associations with non-bouts of MVPA and hypertension, but not with 10-minute bouts of MVPA. We observed significant associations and linear trends with non-

bouts and 10-minutes bouts of MVPA and ideal blood pressure. The discordance between non-bouts and 10-minute bouts of MVPA might have been due to the lack of sensitivity of processing the accelerometer data in 10-minute bouts. For 10-minute bouts, we find that all three confidence intervals overlap, which may cover potential associations. This may suggest that bouts in 2-minutes or 5-minutes may be more suitable to detect differences. Another possible explanation is that non-bouts of MVPA represent activity throughout the day and encompasses various types of activity, and this may be what is driving the lower prevalence of hypertension, compared to 10-minute bouts which likely reflect only one activity for 10 continuous minutes. This could pair well with emerging sedentary literature explaining that activity throughout the day is important to consider, in addition to engagement in exercise (Qi, Strizich, Merchant, et al., 2015). In future studies, we can examine this statistically across different health conditions. Nonetheless, our study demonstrates that Hispanic/Latino adults who do not meet PA guideline recommendations have a 20% higher prevalence of hypertension and an 8% lower prevalence of ideal blood pressure.

4. Obesity and Ideal Body Mass Index

Hispanic/Latino adults in the US are overwhelmingly overweight or obese and this has major health implications across the lifespan. The continued rise of obesity among the Hispanic/Latino population is a result of complex structural issues which require political-economic context considerations as well as community level context in

order to support healthy behaviors among Hispanic/Latino communities that may prevent increases in obesity (Isasi, Ayala, et al., 2015). Previous work has demonstrated the association between increasing accelerometer-measured MVPA with a lower percent of those who are obese (Tudor-Locke, Brashear, Johnson, & Katzmarzyk, 2010). There is also evidence of significant linear trends between daily MVPA and BMI (Barreira et al., 2014). Data using HCHS/SOL has also demonstrated that accelerometer-measured MVPA was significantly higher for normal weight participants compared to the obese group (Palta et al., 2015). Our study supports these findings as we observed significant associations and linear trends for non-bouts and 10-minute bouts of MVPA with obesity and ideal BMI. A caveat being that only non-bouts of MVPA and obesity have distinct confidence intervals that do not overlap. Our study demonstrates that Hispanic/Latino adults who do not meet PA guideline recommendations have a 28% higher prevalence of obesity and a 24% lower prevalence of ideal BMI.

There is a research that shows PA positively influences weight and weight management (Bassuk & Manson, 2005), and while there is preference to use more precise measures of obesity (Rao et al., 2015), research has shown that various measures of obesity are correlated with unfavorable metabolic conditions (Qi, Strizich, Hanna, et al., 2015). When considering the impact of PA on obesity, we can consider evidence demonstrating that across BMI categories, there is improved identification of mortality risk with self-reported MVPA (Loprinzi, Sng, & Addoh, 2016) which shows the importance of MVPA. Furthermore, studies examining physical inactivity and obesity

show that each are independently associated with cardiovascular disease risk and comorbid conditions, and that PA reduces the risk of all-cause mortality across all BMI classifications (Dankel, Loenneke, & Loprinzi, 2017). However, there continues to be a gap in discussing PA in regard to the high burden of obesity among Hispanic/Latino adults. Our study provides evidence on the lower prevalence of obesity and higher prevalence of ideal BMI with increasing MVPA among a diverse sample of Hispanic/Latino adults.

5. Smoking and No Smoking

PA and smoking are both modifiable behaviors that influence the development of CVD. There is evidence of higher MVPA being associated with lower cigarette cravings (Haasova, Warren, Thompson, Ussher, & Taylor, 2016). Research has demonstrated the inverse association between PA and smoking, while other research shows no associations between these two behaviors (Azagba & Asbridge, 2013; Kaczynski, Manske, Mannell, & Grewal, 2008; Poortinga, 2007). There is also counterintuitive evidence where smoking was associated with higher total energy expenditure among African men (Gonseth et al., 2014) and the investigators suggest that there may be confounders that were unaccounted for in their study. Research examining the association between accelerometer-measured MVPA and CV health with NHANES 2003-2006 data found no significant linear trends with smoking (Barreira et al., 2014). The findings of our study support these results; we observe no significant associations between accelerometer-

measured MVPA (non-bouts and 10-minute bouts) and smoking among Hispanic/Latino adults. Important to consider for future research is regard to smoking is the extent of nicotine dependence. Research examining the association between smoking and PA may be detected based on inclusion of nicotine dependence (Azagba & Asbridge, 2013; Mesquita et al., 2015).

6. Low Cardiovascular Risk

The ultimate goal of CVD preventive efforts is to be at low CV risk and achieve ideal CV health. Research demonstrates negative associations between accelerometer-measured MVPA and blood glucose, systolic blood pressure, and BMI among a sample of Mexican American, White and Black participants thereby suggesting a rank ordering by activity level (Luke et al., 2011). Overall, for the HCHS/SOL cohort there is a 6.8% prevalence of low CVD risk and less than 1% prevalence of ideal cardiovascular health as defined by Life's Simple 7's (Daviglus et al., 2016; González et al., 2016). Importantly, MVPA was assessed via self-report which reveals a large proportion (65%) of Hispanic/Latino participants adhere to PA guidelines recommendations (Arredondo et al., 2016). An important component would be to assess the association of accelerometer-measured MVPA with low CV risk, as defined by ideal CV health indicators, in order to provide more information regarding the discordance with higher MVPA per self-report and high burden of CVD risk factors.

The findings in our study show consistently across non-bouts and 10-minute bouts of MVPA that there is a significant association and linear trend with low CV risk. There is a consistent pattern demonstrating a higher prevalence of low CV risk with increasing MVPA category. For non-bouts of MVPA there is no overlapping of confidence intervals or prevalence ratios within the remaining confidence intervals, however with the 10-minute bouts there is some overlap which only allows for the conclusion that each MVPA category is different from high MPA and there appears to be a linear trend. In addition, our study demonstrates that Hispanic/Latino adults who do not meet PA guideline recommendations have a 31% lower prevalence of being low CV risk.

F. CONCLUSION

In sum, our study observed significant associations with accelerometer-measured MVPA and all adverse CVD risk factors, ideal CVD risk factors, and low CV risk, with the exception of smoking. While we used different cut-points for adverse and ideal levels of CVD risk factors, we are able to determine that adverse and ideal CVD risk factors are not the inverse of each other. Consistently with increasing categories of MVPA, there is a lower prevalence of adverse CVD risk factors and a higher prevalence of ideal CVD risk factors and overall low CV risk. Future studies should also examine individuals in the intermediate levels of having or preventing development of CVD risk factors. Overall, engaging in higher MVPA and adhering to PA guideline recommendations was associated with a higher prevalence of low CV risk. This study can serve as a benchmark

for the prevalence of CVD risk factors by accelerometer-measured MVPA, and it provides evidence on the benefits of engaging in high MVPA among Hispanic/Latino adults. This information is needed in order to continue efforts to address health inequities (Sampson et al., 2016). While our study is cross-sectional and we cannot establish causality, we can expect that this longitudinal study will provide evidence of the inverse relationship between engaging in MVPA and CVD risk factors, and ultimately CVD (Bellew, Bauman, Martin, Bull, & Matsudo, 2011). In addition, it is possible that upon learning of presence of CVD risk factors, the participant was told to engage in higher levels of MVPA by providers thus the nature of the association might be altered.

For this study, we used accelerometer-measured MVPA and this has its own limitations where we are only able to gage the intensity of participants' PA, so we are unable to determine what types of activities are leading the health benefits. However, there is evidence of benefits of leisure time and workplace activity on components of metabolic syndrome among a sample of Mexicans residing in Mexico, suggesting that all physical activity is beneficial (Méndez-Hernández et al., 2009). Accelerometer data do not include swimming activity, which is a form of MVPA. Another limitation of this study is that while it is a diverse cohort, it is not nationally representative such that results may not be generalizable to all Hispanics/Latinos in the US. However, this is the largest cohort study of Hispanic/Latino adults, which incorporates the diversity of Hispanic/Latino backgrounds.

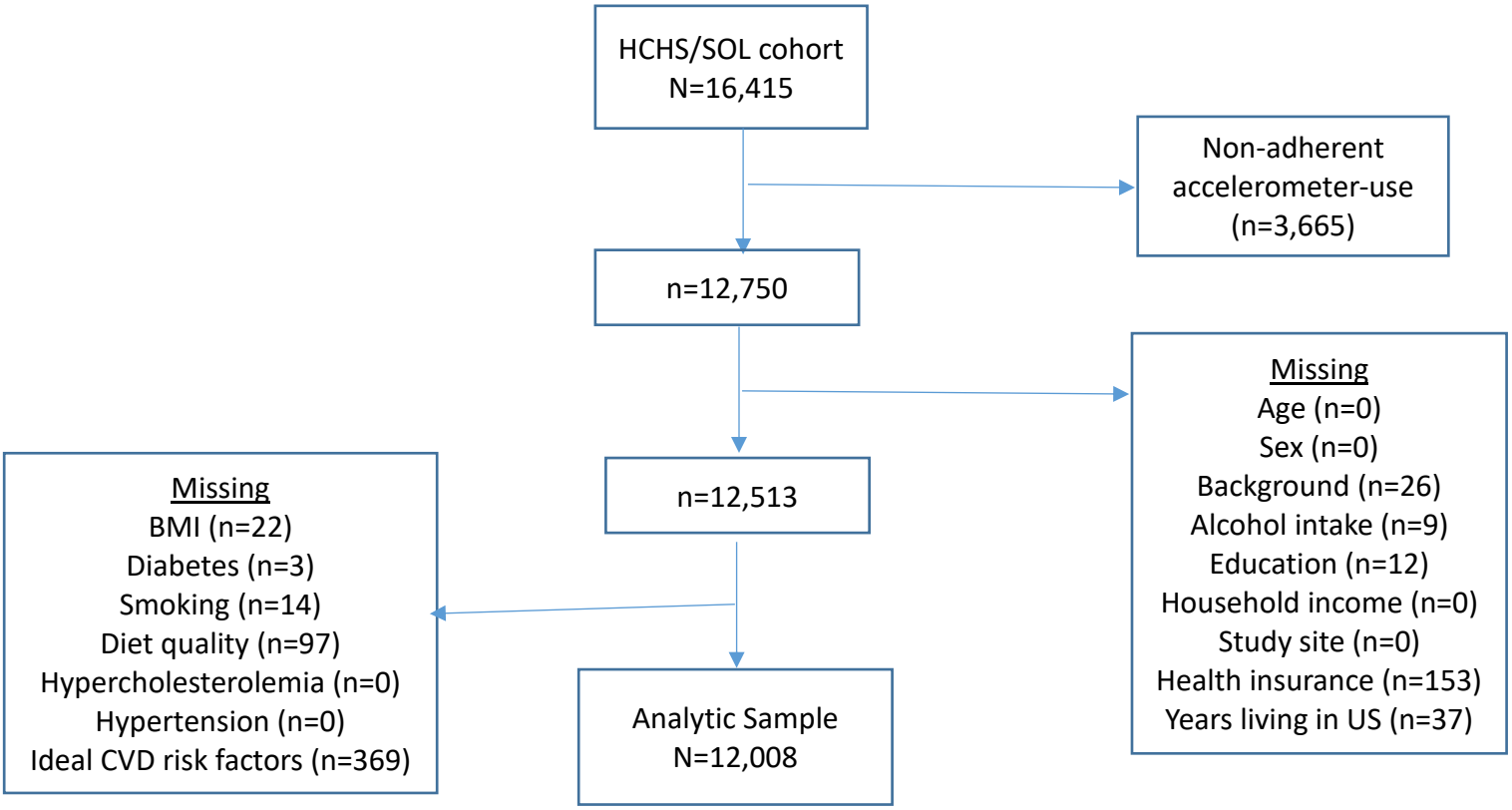

Figure 1. Consort diagram for Chapter II

TABLE I

DESCRIPTIVE STATISTICS FOR HISPANIC/LATINO ADULTS BY MVPA CATEGORIES AND ADHERENCE TO PA GUIDELINE RECOMMENDATIONS (NON-BOUTS): HCHS/SOL (N=12,008)

		MVPA Categories[a]					Adherence to PA Guidelines[b]		
	All	**Inactive**	**Low**	**Moderate**	**High**	**p-value**	**No**	**Yes**	**p-value**
Unweighted N	**12,008**	**230**	**7,129**	**2,666**	**1,983**		**7,359**	**4,649**	
Total (%)	100	1.9	59.4	22.2	16.5	--	61.3	38.7	--
Demographic Characteristics									
Age (years) (%)									
18-44	59.7	23.1	53.5	67.4	72.2	**<0.0001**	52.5	69.6	**<0.0001**
≥ 45	40.3	76.9	46.5	32.6	27.8		47.5	30.4	
Female (%)	52.2	63.5	61.8	45.8	33.2	**<0.0001**	61.1	40.1	**<0.0001**
Education (%)									
< High School	31.9	35.3	32.2	31.8	31.0	0.4193	32.3	31.4	0.0717
High School	28.1	25.5	26.8	29.1	30.9		26.8	29.9	
> High School	40.0	39.3	41.0	39.1	38.2		40.9	38.7	
Household Income (%)									
< $30,000	60.8	70.6	61.2	58.7	61.3	0.1953	61.5	59.9	0.1749
$30,000	32.9	22.2	32.2	35.0	33.6		31.9	34.3	
Missing	6.3	7.1	6.6	6.3	5.2		6.7	5.8	
AHEI Diet Score (%)									
0-44.9	40.1	31.1	40.4	38.4	42.1	0.4374	40.1	40.1	0.9388
45-51.9	33.8	40.5	33.4	35.7	32.1		33.7	34.1	
52-77.7	26.1	28.4	26.2	25.8	25.8		26.3	25.8	
Alcohol Intake (%)									

TABLE I

DESCRIPTIVE STATISTICS FOR HISPANIC/LATINO ADULTS BY MVPA CATEGORIES AND ADHERENCE TO PA GUIDELINE RECOMMENDATIONS (NON-BOUTS): HCHS/SOL (N=12,008)

		MVPA Categories[a]					Adherence to PA Guidelines[b]		
	All	**Inactive**	**Low**	**Moderate**	**High**	**p-value**	**No**	**Yes**	**p-value**
Unweighted N	**12,008**	**230**	**7,129**	**2,666**	**1,983**		**7,359**	**4,649**	
Never	18.8	34.7	21.8	15.1	13.1	**<0.0001**	22.2	14.2	**<0.0001**
Former	29.2	27.6	29.7	28.2	29.1		29.6	28.6	
Current	52.0	37.8	48.5	56.7	57.8		48.1	57.2	
Years living in US (%)									
< 10	28.6	22.1	30.0	28.4	25.3	**0.0331**	29.8	27.0	**0.0410**
≥ 10	71.4	77.9	70.0	71.6	74.7		70.2	73.0	
Health Insurance (%)	50.3	67.1	48.1	51.0	54.4	**0.0003**	48.7	52.5	**0.0221**
Study Site (%)									
Bronx, NY	27.8	22.7	19.7	33.1	45.4	**<0.0001**	19.8	38.7	**<0.0001**
Chicago, IL	16.0	14.5	15.6	16.5	16.6		15.6	16.6	
Miami, FL	30.3	41.9	38.1	21.1	16.2		38.2	19.4	
San Diego, CA	25.9	20.9	26.6	28.3	21.7		26.4	25.3	
Background (%)									
Dominican	9.7	7.1	7.7	12.3	12.7	**<0.0001**	7.7	12.5	**<0.0001**
Central American	7.5	5.2	7.5	7.9	7.3		7.5	7.6	
Cuban	20.8	32.9	27.8	13.2	8.5		27.9	11.1	
Mexican	37.8	26.0	36.7	41.2	38.1		36.4	39.8	
Puerto Rican	15.3	21.0	12.4	15.8	22.8		12.7	19.0	
South American	4.9	5.2	4.5	5.7	5.4		4.5	5.6	

TABLE I

DESCRIPTIVE STATISTICS FOR HISPANIC/LATINO ADULTS BY MVPA CATEGORIES AND ADHERENCE TO PA GUIDELINE RECOMMENDATIONS (NON-BOUTS): HCHS/SOL (N=12,008)

		MVPA Categories[a]					Adherence to PA Guidelines[b]		
Unweighted N	**All 12,008**	**Inactive 230**	**Low 7,129**	**Moderate 2,666**	**High 1,983**	**p-value**	**No 7,359**	**Yes 4,649**	**p-value**
Other/ More than one	3.8	2.6	3.4	3.9	5.1		3.4	4.4	
Adverse Levels of CVD Factors[c]									
Diabetes (%)	14.4	36.8	17.4	10.0	9.1	**<0.0001**	18.0	9.6	**<0.0001**
Hypercholesterolemia (%)	42.2	60.0	45.3	39.1	35.2	**<0.0001**	45.7	37.3	**<0.0001**
Hypertension (%)	24.2	57.2	28.9	17.6	15.3	**<0.0001**	29.8	16.5	**<0.0001**
Obesity (%)	39.5	65.3	43.5	34.4	31.4	**<0.0001**	44.2	33.1	**<0.0001**
Smoking (%)	20.5	25.5	20.1	19.3	22.6	0.2818	20.3	20.8	0.6703
Ideal Levels of CVD Risk Factors[d]									
Blood Glucose (%)	54.9	34.0	51.5	59.4	61.6	**<0.0001**	51.0	60.4	**<0.0001**
Total Cholesterol (%)	53.4	33.2	48.8	59.5	61.3	**<0.0001**	48.3	60.3	**<0.0001**
Blood Pressure (%)	49.7	20.0	47.3	54.0	54.5	**<0.0001**	46.4	54.2	**<0.0001**
Body Mass Index (%)	23.1	8.2	20.3	26.1	29.0	**<0.0001**	19.9	27.4	**<0.0001**
No Smoking (%)	79.5	74.5	79.9	80.7	77.4	0.2818	79.7	79.2	0.6703
Low CV Risk[e]									
Low CV Risk (%)	8.4	0.2	7.1	9.7	11.3	**<0.0001**	6.9	10.4	**<0.0001**

Note: Values are weighted for study design and nonresponse.

Abbreviations: PA: Physical Activity. MVPA: Moderate to vigorous physical activity. AHEI: Alternative Healthy Eating Index. CVD: Cardiovascular Disease. CV: Cardiovascular.

[a]MVPA Categories: Inactive: no activity beyond baseline activities of daily living. Low: activity beyond daily living, but fewer than 150 minutes of moderate-intensity PA per week or 75 minutes of vigorous-intensity, or the equivalent combination of both. Medium: 150-300 mins of moderate-intensity activity per week, or 75-150 mins of vigorous-intensity, or the equivalent combination of both. Activity should be in episodes of at least 10 mins. High: more than 300 mins of moderate-intensity activity per week, or more than 150 mins of vigorous-intensity, or the equivalent combination of both. Activity should be in episodes of at least 10 mins.

[a]Adherence to PA guidelines: Adherence to PA recommendations: Engage in 150 mins or more of moderate PA; 75 mins or more of vigorous PA; or a combination of moderate and vigorous for 150 mins or more per week.

[c]Adverse levels are defined as: Diabetes: fasting blood glucose ≥126 mg/dL, glucose tolerance test with a 2-hour plasma glucose test ≥ 200 mg/dL, hemoglobin A1c ≥ 6.5% or taking glucose regulating medications. Hypercholesterolemia: total cholesterol ≥ 240 mg/dL or taking cholesterol-lowering medications. Hypertension: systolic blood pressure ≥ 140 mm Hg, diastolic blood pressure ≥ 90 mm Hg, or taking antihypertensive medications. Obesity: body mass index of 30 or more. Smoking on some or all days was self-reported by participants.
[d]Ideal blood glucose level: fasting blood glucose <100 mg/dL, hemoglobin A1c < 5.7%, not currently taking glucose regulating medication, and no history of diabetes. Ideal total cholesterol: <200 mg/dL, and not taking cholesterol-lowering medications. Ideal blood pressure: systolic blood pressure <120 mm Hg, diastolic blood pressure <80 mm Hg, and not taking antihypertensive medications. Ideal BMI: <25 kg/m^2. Ideal smoking status: not currently smoking.
[e]Low CV risk is defined as having ideal levels of all major CVD risk factors.

TABLE II
ADJUSTED[a] PREVALENCE OF ADVERSE LEVELS OF CVD RISK FACTORS, IDEAL LEVELS OF CVD RISK FACTORS, AND LOW CV RISK PER ACCELEROMETER (NON-BOUTS) MVPA CATEGORIES: HCHS/SOL (N=12,008)

Unweighted N=12,008	Inactive % (95% CI)	Low % (95% CI)	Moderate % (95% CI)	High % (95% CI)
Adverse Levels of CVD Risk Factors				
Diabetes	19.6 (15.9, 23.4)	16.1 (15.2, 17.1)	13.0 (11.2, 14.7)	13.0 (10.8, 15.2)
Hypercholesterolemia	44.9 (38.3, 51.4)	45.0 (43.4, 46.6)	42.7 (40.1, 45.2)	37.4 (34.2, 40.5)
Hypertension	30.1 (26.1, 34.2)	26.8 (25.6, 28.1)	22.9 (21.0, 24.8)	21.8 (19.0, 24.6)
Obesity	54.6 (45.8, 63.4)	42.3 (40.6, 44.1)	34.5 (31.8, 37.3)	31.5 (28.2 34.7)
Smoking	26.1 (17.8, 34.4)	20.4 (18.8, 22.0)	18.3 (16.3, 20.3)	20.0 (17.6, 22.4)
Ideal Levels of CVD Risk Factors				
Blood Glucose	45.0 (32.0, 58.0)	51.3 (49.7, 52.9)	54.6 (52.5, 56.8)	56.8 (53.8, 59.8)
Total Cholesterol	43.4 (32.4, 54.3)	49.9 (48.1, 51.7)	53.9 (51.6, 56.1)	53.0 (50.3, 55.7)
Blood Pressure	30.7 (18.7, 42.8)	46.9 (45.2, 48.6)	50.6 (48.3, 52.9)	50.5 (47.8, 53.3)
Body Mass Index	12.6 (5.2, 20.0)	20.3 (18.8, 21.7)	24.9 (22.7, 27.2)	28.5 (25.7, 31.2)
No Smoking	75.4 (67.6, 83.1)	79.7 (78.1, 81.2)	81.8 (79.7, 83.9)	79.9 (77.2, 82.5)
Low CV Risk				
Low CV Risk	0.5 (0, 1.5)	6.7 (5.7, 7.7)	8.8 (7.4, 10.3)	10.6 (8.6, 12.7)

Abbreviations: MVPA: moderate to vigorous physical activity.
Note: See Table 1 for definitions of MVPA categories, adverse levels of CVD risk factors, ideal levels of CVD risk factors, and low CV risk. Values are weighted for study design and nonresponse.
[a]Adjusted for age, sex, education, annual household income, diet quality (AHEI), alcohol intake, years living in the US, health insurance, study site, and Hispanic/Latino background.

TABLE III
ADJUSTED[a] PREVALENCE OF ADVERSE LEVELS OF CVD RISK FACTORS, IDEAL LEVELS OF CVD RISK FACTORS, AND LOW CV RISK PER ACCELEROMETER (10-MINUTE BOUTS) MVPA CATEGORIES: HCHS/SOL (N=12,008)

	Inactive	**Low**	**Moderate**	**High**
Unweighted N=12,008	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Adverse Levels of CVD Risk Factors				
Diabetes	16.1 (15.1, 17.2)	14.6 (13.5, 15.8)	12.3 (10.0, 14.6)	14.6 (9.9, 19.3)
Hypercholesterolemia	46.2 (44.3, 48.1)	40.8 (39.0, 42.6)	37.9 (33.9, 42.0)	41.1 (35.5, 46.8)
Hypertension	26.3 (25.0, 27.6)	24.9 (23.5, 26.3)	24.3 (20.5, 28.2)	21.9 (17.0, 26.8)
Obesity	42.0 (40.1, 43.9)	37.8 (35.8, 39.8)	31.0 (26.6, 35.3)	31.6 (25.9, 37.4)
Smoking	20.2 (18.5, 21.9)	19.8 (18.2, 21.5)	17.4 (14.5, 20.3)	22.0 (17.4, 26.5)
Ideal Levels of CVD Risk Factors				
Blood Glucose	50.8 (48.9, 52.6)	54.6 (52.9, 56.4)	56.5 (52.7, 60.3)	53.7 (47.8, 59.7)
Total Cholesterol	49.2 (47.1, 51.3)	53.7 (51.8, 55.5)	51.9 (48.3, 55.5)	50.6 (45.0, 56.2)
Blood Pressure	47.4 (45.6, 49.2)	47.6 (45.8, 49.3)	51.4 (47.9, 54.8)	56.6 (50.7, 62.6)
Body Mass Index	20.5 (18.8, 22.1)	24.2 (22.6, 25.8)	26.5 (22.9, 30.1)	25.6 (20.4, 30.8)
No Smoking	79.8 (78.1, 81.6)	80.3 (78.8, 81.9)	82.1 (79.0, 85.2)	76.9 (71.5, 82.3)
Low CV Risk				
Low CV Risk	6.2 (5.1, 7.3)	8.7 (7.5, 9.8)	11.2 (8.4, 14.1)	9.7 (5.8, 13.7)

Note: See Table 1 for definitions of MVPA categories, adverse levels of CVD risk factors, ideal levels of CVD risk factors, and low CV risk. Values are weighted for study design and nonresponse.
[a]Adjusted for age, sex, education, annual household income, diet quality (AHEI), alcohol intake, years living in the US, health insurance, study site, and Hispanic/Latino background.

TABLE IV
ADJUSTED[a] PREVALENCE OF ADVERSE LEVELS OF CVD RISK FACTORS, IDEAL LEVELS OF CVD RISK FACTORS, AND LOW CV RISK PER ADHERENCE TO PA GUIDELINES (NON-BOUTS): HCHS/SOL (N=12,008)

	No	Yes
Unweighted N=12,008	% (95% CI)	% (95% CI)
Adverse Levels of CVD Risk Factors		
Diabetes	16.3 (15.4, 17.2)	13.0 (11.7, 14.3)
Hypercholesterolemia	44.9 (43.3, 46.5)	40.3 (38.3, 42.4)
Hypertension	27.0 (25.7, 28.2)	22.5 (20.7, 24.2)
Obesity	42.7 (40.9, 44.4)	33.3 (31.3, 35.2)
Smoking	20.6 (19.0, 22.1)	19.1 (17.6, 20.6)
Ideal Levels of CVD Risk Factors		
Blood Glucose	51.2 (49.6, 52.8)	55.5 (53.8, 57.3)
Total Cholesterol	49.8 (47.9, 51.6)	53.5 (51.7, 55.3)
Blood Pressure	46.5 (44.9, 48.2)	50.5 (48.8, 52.2)
Body Mass Index	20.1 (18.7, 21.6)	26.4 (24.5, 28.3)
No Smoking	79.5 (78.0, 81.0)	81.0 (79.4, 82.5)
Low CV Risk		
Low CV Risk	6.6 (5.6, 7.6)	9.6 (8.4, 10.8)

Note: See Table 1 for definitions of PA guidelines, adverse levels of CVD risk factors, ideal levels of CVD risk factors, and low CV risk. Values are weighted for study design and nonresponse.
[a]Adjusted for age, sex, education, annual household income, diet quality (AHEI), alcohol intake, years living in the US, health insurance, study site, and Hispanic/Latino background.

TABLE V
ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MVPA (NON-BOUTS) AND ADVERSE LEVELS OF CVD RISK FACTORS , IDEAL LEVELS OF CVD RISK FACTORS, AND LOW CV RISK (PR [95% CI]): HCHS/SOL (N=12,008)

Unweighted N=12,008	Inactive vs. High MVPA[e] PR (95% CI)	Low vs. High MVPA PR (95% CI)	Moderate vs. High MVPA PR (95% CI)	p-value for association	p-value for trend
Adverse Levels of CVD Risk Factors					
Diabetes	1.51 (1.17, 1.94)	1.24 (1.03, 1.49)	1.00 (0.79, 1.25)	**0.0003**	**0.0001**
Hypercholesterolemia	1.20 (1.01, 1.42)	1.20 (1.10, 1.32)	1.14 (1.03, 1.26)	**0.0020**	**0.0199**
Hypertension	1.38 (1.15, 1.67)	1.23 (1.07, 1.42)	1.05 (0.91, 1.21)	**0.0004**	**0.0001**
Obesity	1.73 (1.43, 2.10)	1.34 (1.20, 1.51)	1.10 (0.96, 1.26)	**<0.0001**	**<0.0001**
Smoking	1.31 (0.93, 1.84)	1.02 (0.88, 1.18)	0.92 (0.78, 1.08)	0.1362	0.0700
Ideal Levels of CVD Risk Factors					
Blood Glucose	0.79 (0.59, 1.06)	0.90 (0.85, 0.96)	0.96 (0.90, 1.03)	**0.0050**	0.0813
Total Cholesterol	0.82 (0.63, 1.06)	0.94 (0.88, 1.01)	1.02 (0.95, 1.08)	**0.0474**	0.0771
Blood Pressure	0.61 (0.41, 0.90)	0.93 (0.87, 0.99)	1.00 (0.93, 1.08)	**0.0012**	**0.0072**
Body Mass Index	0.44 (0.24, 0.81)	0.71 (0.63, 0.80)	0.87 (0.77, 0.99)	**<0.0001**	**0.0031**
No Smoking	0.94 (0.85, 1.05)	1.00 (0.96, 1.04)	1.02 (0.98, 1.07)	0.2315	0.2091
Low CV Risk					
Low CV Risk	0.05 (0.01, 0.34)	0.63 (0.49, 0.80)	0.83 (0.64, 1.07)	**<0.0001**	**0.0016**

Note: See Table 1 for definitions of MVPA categories, adverse levels of CVD risk factors, ideal levels of CVD risk factors, and low CV risk. Values are weighted for study design and nonresponse.

[a]Adjusted for age, sex, education, annual household income, diet quality (AHEI), alcohol intake, years living in the US, health insurance, study site, and Hispanic/Latino background.

TABLE VI
ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MVPA (10-MINUTE BOUTS) AND ADVERSE LEVELS OF CVD RISK FACTORS, IDEAL LEVELS OF CVD RISK FACTORS, AND LOW CV RISK (PR [95% CI]): HCHS/SOL (N=12,008)

Unweighted N= 12,008	Inactive vs. High PR (95% CI)	Low vs. High PR (95% CI)	Moderate vs. High PR (95% CI)	p-value for association	p-value for trend
Adverse Levels of CVD Risk Factors					
Diabetes	1.11 (0.79, 1.54)	1.00 (0.72, 1.38)	0.84 (0.58, 1.22)	**0.0203**	0.2862
Hypercholesterolemia	1.12 (0.97, 1.30)	0.99 (0.86, 1.15)	0.92 (0.78, 1.09)	**0.0001**	0.0591
Hypertension	1.20 (0.95, 1.52)	1.14 (0.90, 1.44)	1.11 (0.84, 1.48)	0.2344	0.1112
Obesity	1.33 (1.10, 1.61)	1.19 (0.99, 1.45)	0.98 (0.77, 1.24)	**<0.0001**	**0.0002**
Smoking	0.92 (0.73, 1.15)	0.90 (0.72, 1.14)	0.79 (0.60, 1.05)	0.3582	0.8803
Ideal Levels of CVD Risk Factors					
Blood Glucose	0.94 (0.84, 1.06)	1.02 (0.91, 1.14)	1.05 (0.92, 1.20)	**0.0050**	0.2424
Total Cholesterol	0.97 (0.86, 1.10)	1.06 (0.95, 1.19)	1.03 (0.90, 1.17)	0.0226	0.8618
Blood Pressure	0.84 (0.75, 0.94)	0.84 (0.75, 0.94)	0.91 (0.80, 1.03)	**0.0035**	**0.0004**
Body Mass Index	0.80 (0.64, 1.00)	0.95 (0.77, 1.17)	1.03 (0.82, 1.31)	**0.0033**	**0.0283**
No Smoking	1.04 (0.96, 1.12)	1.04 (0.97, 1.13)	1.07 (0.98, 1.16)	0.4246	0.4994
Low CV Risk					
Low CV Risk	0.64 (0.41, 0.99)	0.89 (0.59, 1.35)	1.15 (0.70, 1.89)	**0.0004**	**0.0127**

Note: See Table 1 for definitions of MVPA categories, adverse levels of CVD risk factors, ideal levels of CVD risk factors, and low CV risk. Values are weighted for study design and nonresponse.
[a]Adjusted for age, sex, education, annual household income, diet quality (AHEI), alcohol intake, years living in the US, health insurance, study site, and Hispanic/Latino background.

TABLE VII
ASSOCIATION BETWEEN ADHERENCE TO PA GUIDELINES (NON-BOUTS) AND ADVERSE LEVELS OF CVD RISK FACTORS, IDEAL LEVELS OF CVD RISK FACTORS, AND LOW CV RISK (PR [95% CI]): HCHS/SOL (N=12,008)

	No	**p-value**
Unweighted N= 12,008	PR (95% CI)	
	Adverse Levels of CVD Risk Factors	
Diabetes	1.25 (1.12, 1.40)	**<0.001**
Hypercholesterolemia	1.11 (1.04, 1.19)	**0.001**
Hypertension	1.20 (1.09, 1.32)	**<0.001**
Obesity	1.28 (1.19, 1.38)	**<0.001**
Smoking	1.08 (0.97, 1.20)	0.176
	Ideal Levels of CVD Risk Factors	
Blood Glucose	0.92 (0.88, 0.96)	**<0.001**
Total Cholesterol	0.93 (0.88, 0.98)	**0.008**
Blood Pressure	0.92 (0.88, 0.97)	**0.001**
Body Mass Index	0.76 (0.68, 0.85)	**<0.001**
No Smoking	0.98 (0.96, 1.01)	0.191
	Low CV Risk	
Low CV Risk	0.69 (0.57, 0.83)	**<0.001**

Note: See Table 1 for definitions of PA guidelines, adverse levels of CVD risk factors, ideal levels of CVD risk factors, and low CV risk. Values are weighted for study design and nonresponse.

[a]Adjusted for age, sex, education, annual household income, diet quality (AHEI), alcohol intake, years living in the US, health insurance, study site, and Hispanic/Latino background
.

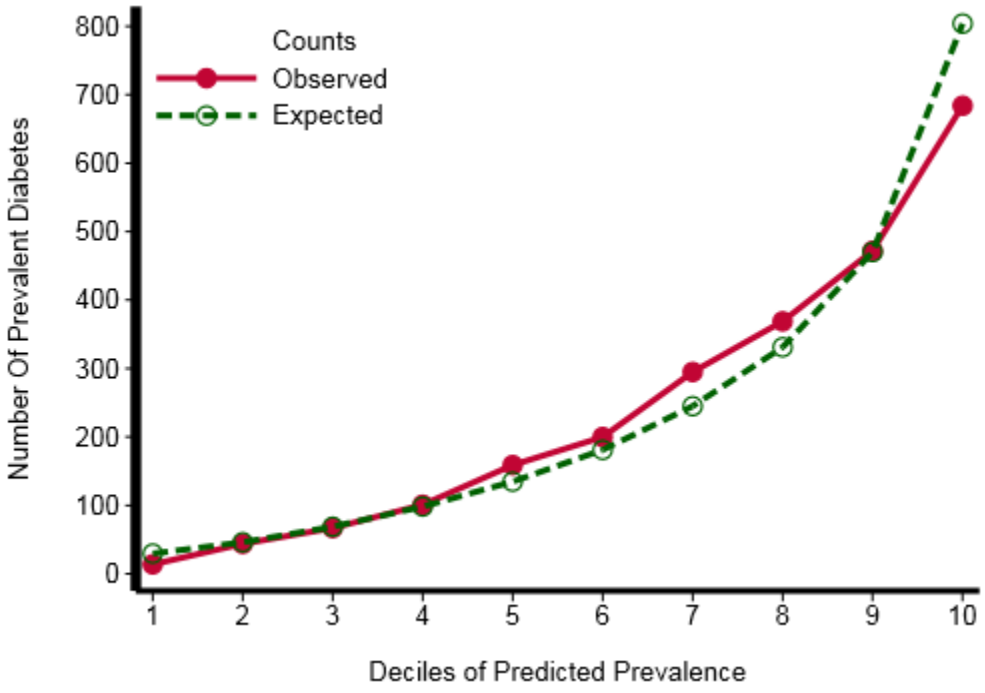

Figure 2. Goodness of fit for Chapter II: Diabetes

III. THE ROLE OF PSYCHOSOCIAL STRESS ON THE ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MODERATE TO VIGOROUS PHYSICAL ACTIVITY AND CARDIOVASCULAR DISEASE RISK FACTORS AMONG HISPANIC/LATINO ADULTS: THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (HCHS/SOL) SOCIOCULTURAL ANCILLARY STUDY (SCAS)

A. ABSTRACT

Background: Moderate to vigorous physical activity (MVPA) is associated with lower risk of cardiovascular disease (CVD) and chronic stress (CS) is associated with increased risk of CVD risk factors such as hypertension or diabetes. Little is known about potential interactions between MVPA and psychosocial stressors (CS, traumatic stress (TS), perceived stress (PS)) in relation to CVD risk factors. **Objective:** To assess whether the associations of MVPA with CVD risk factors are modified by the presence of psychosocial stressors. **Methods:** Cross-sectional data from 3669 adults ages 18-74 in 2008-11 who participated in the HCHS/SOL Sociocultural Ancillary Study and had complete information on key variables were analyzed using complex survey design methods. Questionnaires were administered to collect the psychosocial stress measures. Each measure was assessed continuously and for illustrative purposes categorized into tertiles, where tertiles represent the number of stressors for CS and TS, and a score of PS. CS assessed stressors which had occurred for 6 months or more. TS assessed exposure to traumatic events throughout the lifetime. PS assessed stressors which had occurred in the last month. Accelerometer data (non-bouts) were categorized into 4 levels based on MVPA (inactive, low, moderate, and high) and CVD risk factors included diabetes, hypercholesterolemia, hypertension, obesity, smoking, and presence of multiple CVD risk factors (3 or more). Poisson regression models were used to derive adjusted prevalence ratios and 95% confidence intervals. **Results:** For associations without psychosocial stress, we observed significant associations between accelerometer-measured MVPA and all CVD risk factors. We observed an interactions between MVPA and CS for diabetes (p-value for interaction = 0.076), hypercholesterolemia (p-value for interaction = 0.106), and smoking (p-value for interaction = 0.090). We observed an interaction between MVPA and TS for smoking (p-value for interaction = 0.032). **Conclusion:** For higher CS, with increasing MVPA there is a higher prevalence of diabetes and hypercholesterolemia compared to those with lower CS. For higher CS and TS, with increasing MVPA there is a higher prevalence of smoking. Further evaluation is needed to determine physical activity recommendations to prevent diabetes, hypercholesterolemia, and smoking among those with CS and TS.

B. INTRODUCTION

Physical activity (PA) is an established behavior that prevents cardiovascular disease (CVD) among other chronic conditions (HHS, 2008). PA levels low in the general population and disparities in PA by racial/ethnic groups has implication for health and development of chronic diseases given the strong associations between being active and better health. Engaging in moderate to vigorous physical activity (MVPA) has been associated with lower cardiovascular disease (CVD), which is currently the leading cause of mortality in the US (Mozaffarian et al., 2015). Efforts to increase MVPA at the population level have the potential to make an impact in prevalence of CVD, where even small changes improve health outcomes (Yancey et al., 2007). However, as practitioners we must ensure that approaches to disease prevention avoid unintentionally widening existing disparities. Consideration of contextual factors may prove to be important and they necessitate more strategic efforts in order to implement solutions.

Contextual factors for underrepresented and underserved populations often result in persistent societal pressures, financial strains, family-related concerns, health concerns, and thus are multiple sources of psychosocial stress, and Hispanic/Latino adults in the US recently reported the highest level of stress (APA, 2015). Psychosocial stress is defined as aversive or demanding conditions that tax or exceed the behavioral resources of the organism (Lazarus, 1966) and it relates to low perceived control (Hjemdahl et al., 2012). Psychosocial stress includes stress types such as chronic stress, traumatic stress, and

perceived stress. Chronic stress has been associated with poor cardiovascular health (Brotman, Golden, & Wittstein, 2007), accelerating atherosclerosis (Black & Garbutt, 2002; Brotman et al., 2007), myocardial infarctions, cardiac regulation, and sudden death (Dimsdale, 2008). The relationship between psychosocial stress and CVD events (e.g., non-fatal myocardial infarction, stroke, heart failure) is largely mediated by behavioral factors such as PA, smoking, and alcohol intake (Hamer, Molloy, & Stamatakis, 2008). There are also associations of psychosocial stress with CVD risk factors such as diabetes, hypertension, and obesity (Block, He, Zaslavsky, Ding, & Ayanian, 2009; Krajnak, 2014).

Evidence evaluating the moderating effect of PA on the stress-disease relationship has found PA to be protective against the negative health outcomes of chronic stress, yet the strength of association was weak (Gerber & Pühse, 2009). To our knowledge, there are no studies examining psychosocial stress types as potential moderators on the association between PA-disease relationship, specifically in regard to CVD risk factors, and in the research available there was little to no representation of Hispanic/Latino adults such that previous findings are not generalizable to Hispanics/Latinos in the US. In 2014, based on National Health Interview Survey (NHIS), only half of the US adult population met the current 2008 PA guideline recommendations and Hispanic/Latino adults were 41.3% less likely to meet recommendations (Mozaffarian et al., 2015). Interestingly, based on HCHS/SOL, 65% of participants met PA guideline recommendations per self-report (Arredondo et al., 2016), yet the prevalence in

HCHS/SOL of CVD risk factors was substantial (Daviglus et al., 2012b). These findings suggest that we are missing important information on the association between engaging in MVPA and CVD risk factors, and the role of psychosocial stress.

The first aim of this study is to examine the cross-sectional association between accelerometer-measured MVPA with CVD risk factors (i.e., diabetes, hypercholesterolemia, hypertension, obesity, and smoking) and presence of multiple CVD risk factors in this sample. We hypothesize a significant association of higher MVPA with lower prevalence of all CVD risk factors. The second and main aim of the study is to assess whether the cross-sectional associations of MVPA and CVD risk factors are modified by psychosocial stress (i.e., chronic, traumatic, and perceived stress) in this diverse cohort of US Hispanic/Latino adults. We hypothesize that psychosocial stress will modify the association between MVPA and CVD risk factors, and that among those with high psychosocial stress, the association of engaging in high MVPA and a low prevalence of each CVD risk factor will be attenuated. Findings from this study will inform practitioners about the role of psychosocial stress on efforts to reduce the burden of CVD risk factors via MVPA.

C. METHODS

1. Study Description

The HCHS/SOL is a community-based cohort study, which aims to evaluate the health risks and protective factors for CVD and other chronic conditions among a diverse

sample of Hispanic/Latino adults in the US. This study includes four US field centers (Bronx, NY; Chicago, IL; Miami, FL; San Diego, CA) and enrolled self-identified Hispanic/Latino adults (N=16,415) of Dominican, Central American, Cuban, Mexican, Puerto Rican, South American or more than one background between ages 18-74 with varying degrees of health condition.

Recruitment and baseline examination of participants took place between 2008 and 2011. Recruitment was conducted using a stratified two-stage probability sample of household address via selected census tracts to ensure socioeconomic diversity, accessibility to the HCHS/SOL study site, and reduce potential sources of bias in the study. Oversampling was implemented for adults aged 45-74 (Lavange et al., 2010). Participants were ineligible if they were unable to physically travel to the field center, complete the study questionnaires, or if they were relocating in the subsequent 6 months (Sorlie et al., 2010).

Baseline examinations were standardized across all sites, were approximately 7 hours in duration, and were conducted in the preferred language of the participant. Data on sociodemographic characteristics, clinic examinations, and questionnaire information were collected. Protocol to ensure the safety of participants during the examination were instituted at each site, participants were informed of medically important examination results and referred to medical providers if needed. Informed consent was obtained for all participants at the beginning of the baseline examination visit.[2] This study was approved

by the Institutional Review Boards for each of the field center institutions and the coordinating center located at the University of North Carolina.

a. The HCHS/SOL Sociocultural Ancillary Study

The Sociocultural Ancillary Study (SCAS) is a cross-sectional study with a subsample of HCHS/SOL cohort which aims to evaluate the associations between psychosocial factors and CVD prevalence among Hispanic/Latinos adults. HCHS/SOL participants indicated interest in future studies, and were willing to complete a second visit within 9 months of their baseline examination were eligible to participant in SCAS. Data collection for SCAS was conducted between February 2010 and June 2011 where participants (N=5,313) were interviewed and completed interviewer-administered questionnaires for 1-2 hours. SCAS participants are comparable to the HCHS/SOL cohort study in regard to representation of study sites and Hispanic/Latino background, as well as the oversampling for adults aged 45-74. The exception was high SES participants were not well represented in SCAS (Gallo, Penedo, et al., 2014).

2. Measures

a. Physical Activity

Physical activity was assessed by the Actical accelerometer (model 198-0200-03; Minimiter Respironics, Bend, OR) and all HCHS/SOL cohort study participants were given an accelerometer. The accelerometer recorded the frequency, duration, and

intensity of PA during the time worn. Participants were fitted with a belt and instructed to wear the accelerometer for seven days at the hip above the iliac crest, and to remove only for swimming, showering, and sleeping (Arredondo et al., 2016). The overall prevalence of PA in HCHS/SOL has been reported (Arredondo et al., 2016).

Adherence to accelerometer-use was defined as having at least three days with a minimum of ten hours per day of data (Matthews et al., 2016). The adherence to accelerometer in HCHS/SOL participants has been reported (Evenson et al., 2015). Accelerometer data were processed with epoch length of 1 minute and non-wear time was determined by using the Choi algorithm. The Choi algorithm defined non-wear time as 90 consecutive minutes of zero counts, allowing only 1-2 minutes of nonzero counts within a 30-minute window upstream and downstream of the 90-minute timeframe (Choi et al., 2011; Keadle, Shiroma, Freedson, & Lee, 2014). Participants who were adherent to accelerometer use were included in the analytic sample.

b. Psychosocial Stress Types

Psychosocial stress data were collected only for SCAS participants. Psychosocial stress was characterized by assessing chronic, traumatic, and perceived stress via interviewer-administered questionnaires. *Chronic stress* was assessed by a total number of stressors (range: 0-8) derived from the 8-item Chronic Burden scale (Bromberger & Matthews, 1996). This questionnaire aimed to capture stressors occurring for six months or more in the domains of finances, occupation, personal relationships, as well as

participants' health status or that of close individuals. *Traumatic stress* was assessed by the total number of traumatic events during lifetime (range: 0-10) and was derived from a 10-item questionnaire (Norris, 1990). Each item captures a traumatic event that may have occurred at any point during participants' lifetime and includes assault, natural disaster, combat, or serious car accident. *Perceived stress* was assessed by a total score based on stressors that occurred within the last month, the score ranged from 0-40, and was derived from a 10-item questionnaire (Cohen, Kamarck, & Mermelstein, 1983). Each item captured how often participants found their lives to be unpredictable, uncontrollable, and overloaded within the previous month. These measures have been shown to be psychometrically sound and appropriate for use among Hispanics/Latinos in previous research (Gallo, Penedo, et al., 2014; Gallo, Roesch, et al., 2014; Isasi, Parrinello, et al., 2015).

c. Cardiovascular Disease Risk Factors

Data on CVD risk factors are available for all HCHS/SOL cohort study participants via fasting blood samples and standardized protocol. All CVD risk factors were dichotomized to indicate presence or absence of the risk factor. Presence of diabetes was a fasting blood glucose ≥126 mg/dL, glucose tolerance test with a 2-hour plasma glucose test ≥ 200 mg/dL, hemoglobin A1c ≥ 6.5% or taking glucose regulating medications (American Diabetes, 2010). Presence of hypercholesterolemia was a serum cholesterol ≥ 240 mg/dL or taking cholesterol-lowering medications (NCEP, 2001; Stone

et al., 2014). Presence of hypertension was a systolic blood pressure ≥ 140 mm Hg, or diastolic blood pressure ≥ 90 mm Hg, and/or taking antihypertensive medications (Krakoff et al., 2014). Three blood pressure readings were taken in a seated position. Presence of obesity was a body mass index (BMI) of 30 or more (NHLBI, 1998). Presence of smoking was defines as smoking on some or all day (HHS, 2014). We assessed the presence of multiple CVD risk factors as a separate outcome variable and it was defined as having three or more of the risk factors above, in any combination. The prevalence of CVD risk factors among Hispanic/Latino adults in HCHS/SOL cohort has been reported elsewhere (Daviglus et al., 2012b).

d. Covariates

The covariates used in this study were available for all participants in the HCHS/SOL cohort study, and were chosen based upon the literature describing factors important to consider when evaluating Hispanic/Latino health. Questionnaires were administered to collect demographic information. Age and sex were dichotomized into 18-44 or 45+ years, and female or male, respectively. Education was categorized into three groups, no high school or GED, at most high school/GED, and more than a high school or GED. Annual household income was categorized into less than or more than $30,000. Health insurance was dichotomized into yes or no insurance. Years of residence in the US was dichotomized in less than 10 years or 10 years or more. HCHS/SOL study sites were the Bronx, NY, Chicago, IL, Miami, FL, or San Diego, CA. Hispanic/Latino backgrounds

included Central American, Cuban, Dominican, Mexican, Puerto Rican, South American, or more than one background. Continuous variables included sleep duration (self-reported), diet quality per the Alternative Heathy Eating Index (AHEI) 2010 which ranges from 0-110 with higher scores indicating better diet quality. Alcohol intake was those who never drank alcohol before, former drinkers, and current drinkers.

3. Statistical Analysis

Descriptive statistics were computed for accelerometer-measured MVPA, psychosocial stress types, and covariates. Poisson regression models were used to examine the associations of MVPA with all CVD risk factors (diabetes, hypercholesterolemia, hypertension, obesity, smoking, and multiple CVD risk factors) where a p-value at or less than 5% was deemed as statistically significant. Subsequently, models assessed the potential effect modification of each psychosocial stress type (chronic, traumatic, and perceived stress) on the association between MVPA and CVD risk factors, and a p-value at or less than 10% was deemed statistically significant (Marshall, 2007). The distribution of accelerometer-measured MVPA was skewed such that to improve the symmetry of the distribution we $\log_2$-transformed this variable and thereby increase our statistical power to detect interactions. Tukey's ladder of powers approach (Tukey, 1957) was used to select the best transformation. The rationale for a transformation was suggested by Cornfield et al. (Cornfield, Gordon, & Smith, 1961) and

later extended by Kay and Little et. al (Kay & Little, 1987) which designated a Poisson regression model to be appropriate (Cornfield et al., 1961; Hayat & Higgins, 2014).

To improve the fit of the models, each psychosocial stress type was modeled separately and continuously, adjusting for covariates. Effect modification was evaluated by the MVPA and psychosocial stress type (multiplicative) interaction term. For each significant interaction, we provide (a) a figure on log scales and (b) tables with the adjusted prevalence ratios for CVD risk factors. For the figures we have chosen to create tertiles of stress and use intervals of MVPA with 10 minutes. The midpoints of stress tertiles and MVPA intervals were selected to represent the tertile and interval for illustrative purposes; these measures were used continuously in all analyses. We opted for tertiles in the figures in order to have groups of equal sizes to compare across tertiles. Furthermore, for ease of interpretation we have exponentiated the beta-coefficients to derive the adjusted prevalence ratios in the tables presented. We also assessed Goodness of Fit graphically shown in **Figure 8**.

To account for the complex survey designs of HCHS/SOL we used sampling weights, clusters, and strata in all analyses. Additionally, for analyses with accelerometer data we applied a specific sampling weights to account for missing accelerometer data. Stata Statistical Software, Release 14 (StataCorp LP, College Station, TX) was used for all analyses.

D. RESULTS

1. Descriptive Statistics

The unweighted analytic sample of the study was N=3,669, we present the descriptive statistics by CVD risk factors: diabetes, hypercholesterolemia, hypertension, obesity, smoking, and multiple CVD risk factors (**Table VIII**). This sample was 53.5% female, 40.3% had more than a high school diploma or GED, 68.9% had an annual income less than $30,000, 73.9% had lived in the US for 10 years or more, and 52.1% had health insurance. Averages included 24.1 minutes/day of MVPA, 1.8 chronic stressors, 2.1 traumatic stressors, and a score of 14.7 for perceived stress. Hispanic/Latino backgrounds included Dominican (7.3%), Central American (18.7%), Cuban (11.2%), Mexican (38.9%), Puerto Rican (14.7%), South American (5.1%), and more than one Hispanic/Latino background group (4.1%).

2. Bivariate Associations

We examined the association between accelerometer-measured MVPA with all CVD risk factors, and we observed significant associations with all: diabetes (p <0.001), hypercholesterolemia (p = 0.001), hypertension (p <0.001), obesity (p <0.001), smoking (p = 0.051), and multiple CVD risk factors (p <0.001). The adjusted prevalence ratios with 95% confidence intervals (CI) range from 0.88 (0.83, 0.92) for diabetes to 1.06 (1.00, 1.13) for smoking (**Table IX**).

3. Poisson Regression Models

We presented the adjusted prevalence ratios and 95% CI for main effects (MVPA and psychosocial stress type) and interactions (**Table X**). The degree of effect modification for each interaction is depicted in **Figure 4-7**. Interactions were observed with accelerometer-measured MVPA and chronic stress for diabetes (**Figure 4**, *p* for interaction = 0.076), marginally significant for hypercholesterolemia (**Figure 5**, *p* for interaction = 0.106), and smoking (**Figure 6**, *p* for interaction = 0.090). Interactions were observed with traumatic stress for smoking (**Figure 7**, *p* for interaction = 0.032). We observed no significant interactions with perceived stress for any CVD risk factors.

a. Diabetes

Figure 4 illustrates the effect modification by chronic stress on the association between accelerometer-measured MVPA and diabetes (*p* for interaction = 0.076). Overall, with increasing MVPA the rate of decline in diabetes prevalence appeared to be greater for the lowest tertile of chronic stress compared to the highest tertile. **Table XI** presents the adjusted prevalence ratios for diabetes based on tertiles of chronic stress and MVPA. For diabetes, in the lowest tertile of chronic stress, compared to 10 minutes of MVPA, engaging in 30 minutes had a 9% lower prevalence and engaging in 150 minutes had a 40% lower prevalence. In the highest tertile of chronic stress, 30 minutes had a 4% lower prevalence and engaging in 150 minutes had a 9% lower prevalence.

b. Hypercholesterolemia

Figure 5 illustrates the marginally significant effect modification by chronic stress on the association between accelerometer-measured MVPA and hypercholesterolemia (*p* for interaction = 0.106). Overall, with increasing MVPA the rate of decline in hypercholesterolemia prevalence appeared to be greater for the lowest tertile of chronic stress compared to the highest tertile. **Table XII** presents the adjusted prevalence ratios for hypercholesterolemia based on tertiles of chronic stress and MVPA. For hypercholesterolemia, in the lowest tertile of chronic stress, compared to 10 minutes of MVPA, engaging in 30 minutes had an 11% lower prevalence and engaging in 150 minutes had a 26% lower prevalence. In the highest tertile of chronic stress, 30 minutes had 1% lower prevalence and engaging in 150 minutes had a 2% lower prevalence.

c. Smoking

Figure 6 illustrates the effect modification by chronic stress on the association between accelerometer-measured MVPA and smoking (*p* for interaction = 0.090). Overall, with increasing MVPA there was an increased rate of smoking prevalence, and it appeared to be greater for the highest tertile of chronic stress. **Table XIII** presents the adjusted prevalence ratios for smoking based on tertiles of chronic stress and MVPA. For smoking in the lowest tertile of chronic stress, compared to 10 minutes of MVPA, engaging in 30 minutes had a 3% higher prevalence and engaging in 150 minutes had a

6% higher prevalence. In the highest tertile of chronic stress, 30 minutes had a 23% higher prevalence and 150 minutes had a 68% higher prevalence.

Figure 7 illustrates the effect modification by traumatic stress on the association between accelerometer-measured MVPA and smoking (*p* for interaction = 0.032). Overall, with increasing MVPA there was an increased rate of smoking prevalence, and it appeared to be greater for the highest tertile of traumatic stress. **Table XIV** presents the adjusted prevalence ratios for smoking based on tertiles of traumatic stress and MVPA. For smoking in the lowest tertile of traumatic stress, compared to 10 minutes of MVPA, engaging in 30 minutes had a 3% higher prevalence and engaging in 150 minutes had a 7% higher prevalence. In the highest tertile of traumatic stress, 30 minutes had a 22% higher prevalence and 150 minutes had a 65% higher prevalence.

E. DISCUSSION

This was the first study conducted to our knowledge that examined the role of psychosocial stress on the association between accelerometer-measured MVPA and CVD risk factors. The benefits of engaging in PA are well established, and health promotion efforts especially among Hispanic/Latino communities are needed given this population's low levels of engagement in MVPA. Consideration of factors detrimental to health, such as chronic or traumatic stress, should also be accounted for in the strategizing for health promotion efforts. The current literature has examined the moderating effects of PA on the stress to disease relationship, however in cases where stressors persist, we have less

information and we do not know the influence of the stressors when individuals engage in high MVPA.

1. Diabetes

In our study, the cross-sectional association between accelerometer-measured MVPA and diabetes varied by the number of chronic stressors. A previous study in HCHS/SOL SCAS found chronic stress was associated with higher prevalence of diabetes (Gallo et al., 2014). Our results contribute to those findings and suggest that participants with higher chronic stress were at a disadvantage, given the more pronounced benefits of MVPA observed among those who reported fewer chronic stressors. Studies with the aim to increase levels of PA among those at risk for diabetes should consider the degree to which chronic stressors are present and work with community members to assist in efforts to reduce chronic stressors. The need for inclusion of psychosocial factors in addition to traditional risk factors has been demonstrated (Hackett & Steptoe, 2016). There is evidence of the association between low amounts of PA or increased sedentary behavior and diabetes (Brugnara et al., 2016), but our study shows that it is also important to consider instances of higher MVPA where there may not be a stress-buffering effect of PA, and the benefits of PA on diabetes prevalence may be attenuated.

Our findings have major implications given the disproportionate high rates, health complications, and mortality due to diabetes among Hispanic/Latino adults (Vega et al.,

2009). Given the challenges and barriers to support more active communities, upon reaching community members, preventive efforts should encompass psychosocial factors such as chronic stress especially in regard to diabetes. Importantly, evidence from HCHS/SOL SCAS demonstrated that among non-diabetics reporting higher chronic stress was associated with poor glucose regulation as measured by fasting glucose, postload glucose, and HbA1c levels, such that our findings may also have implication for non-diabetics (McCurley et al., 2015). There is substantial evidence on the benefits of MVPA improving control of diabetes and improvement of glucose metabolism (Castro et al., 2009; Sloane et al., 2006), our findings showed that chronic stress may have a role in this association among Hispanic/Latino adults.

2. Hypercholesterolemia

In our study, the cross-sectional association of accelerometer-measured MVPA and hypercholesterolemia varied by chronic stress, with a marginal statistical significance for interaction. Our findings suggest that participants with higher chronic stress were at a disadvantage given the more pronounced benefits of MVPA among those reporting fewer chronic stressors. Preventive efforts among Hispanic/Latino adults addressing hypercholesterolemia are needed, in HCHS/SOL this was the CVD risk factor with the highest prevalence at 31.1% (Daviglus et al., 2012b). Our study provides evidence of the impact of chronic stress compared to perceived stress, where other studies examining PA, via cardiorespiratory fitness, as a potential effect modifier have found the stress-buffering

effects on triglycerides and LDL levels (Gerber et al., 2016; Holmes, Ekkekakis, & Eisenmann, 2009). There is also evidence on the beneficial impact of engaging in MVPA on lower levels of HDL cholesterol (Stefanick et al., 1998), as well as evidence on the impact of stress on elevated levels of HDL cholesterol (Chuang et al., 2010), such that addressing chronic stressors specifically may allow for more pronounced benefits of PA, especially among Hispanic/Latino adults. The high burden of hypercholesterolemia in addition to the high burden of stress (APA, 2015) among Hispanic/Latino adults points to the need for incorporating measures and strategies to address chronic stress within PA interventions. Our study demonstrates the potential to reduce the prevalence of hypercholesterolemia by addressing both chronic stress and increasing MVPA.

3. Smoking

In this study, we observed interactions with chronic and traumatic stress for the association between MVPA and smoking. The patterns of the effect modification were unexpected in that among participants in the highest tertiles of chronic and traumatic stress, those who engaged in higher MVPA had a higher prevalence of smoking. In HCHS/SOL SCAS, traumatic stress was associated with higher prevalence in smoking (Gallo, Roesch, et al., 2014), psychological distress was also associated with smoking (Castañeda, Rosenbaum, Holscher, Madanat, & Talavera, 2015), and other similar findings of psychosocial stress being associated with smoking and relapse after attempting to quit smoking (Slopen et al., 2013). Smoking is a known coping strategy for

stress utilized especially by vulnerable populations (Harwood, Salsberry, Ferketich, & Wewers, 2007). There is literature demonstrating the mixed results on the association between PA and smoking (Kaczynski et al., 2008), but there is some evidence on effect modification between affective state with PA on smoking initiation (Torchyan et al., 2016). For these interaction effects, those with low PA and low happiness as well as high PA and high happiness were more likely to initiate smoking. Other research has demonstrated that smokers who quit have progressively higher levels of PA in the years after quitting compared to those who continue smoking (Auer et al., 2014). In our study, we found that those experiencing either high chronic stress or traumatic stress, and who were also engaging in high MVPA had a higher prevalence of smoking. Possible explanations for this include that those reporting more chronic or traumatic stress are coping with their stress by smoking, and the higher amounts of MVPA is driven by higher levels of occupation- or transportation-based MVPA. Increased levels of MVPA could also be due to participants engaging in more PA to reduce stress, as knowledge about benefits may be increasing. Another possible explanation is that as a byproduct of smoking participants may be more active because they need to go to designated areas to smoke which could result in the accumulation of more PA (Bandiera et al., 2015). More studies are needed to explore this effect modification by chronic and traumatic stress on the association between MVPA and smoking.

This study has several strengths including the methodology for recruitment, enrollment, and examination of study participants. We used accelerometer-measured

MVPA as well as multiple measures of psychosocial stress for this analysis as well as standardized protocol for measurements of CVD risk factors. Participants in this study are also a rapidly growing segment of the US population, and their diversity was reflected in this cohort study. Limitations include that this is a cross-sectional study so we cannot determine causality. While we assessed different domains of psychosocial stress, chronic and traumatic stress were counts for the number of stressors while perceived stress was a score. We did not necessarily examine severity of each stressor or the role that depression and/or anxiety might play in our results given the strong associations with both engaging in MVPA and CVD risk factors, diabetes in particular. Another limitation is that there is gap in data collection of MVPA via accelerometer and the psychosocial stress questionnaires. In this study we have made the assumption that the stress reported during the ancillary study is reflective of stress at time of the baseline examination.

F. CONCLUSION

Examination of these associations in this manner allow for a contextual assessment that more resembles the everyday circumstances. Research on the benefits of PA on CVD are well established and preventive efforts centered on reducing CVD risk factors highlight PA as one of the leading modifiable behaviors (Mozaffarian et al., 2015). Our study has shown that chronic stress and traumatic stress modify the association between accelerometer-measured MVPA and CVD risk factors among a diverse sample of Hispanic/Latino adults. These findings suggest the need for inclusion

of psychosocial stress measures and strategies to address chronic and traumatic stress in conjunction with efforts to increase PA, especially in Hispanic/Latino adults, for the purposes of CVD prevention. Future directions for research include exploring the continuum of stress to depression, and how depression may play a role on the association between MVPA and CVD risk factors. In addition to self-reported psychosocial stress, examining measures of allostatic load may also provide a useful lens and present implications for interventions. Also identifying the major stressors experienced by Hispanic/Latino adults and what support can be created to maintain or improve health.

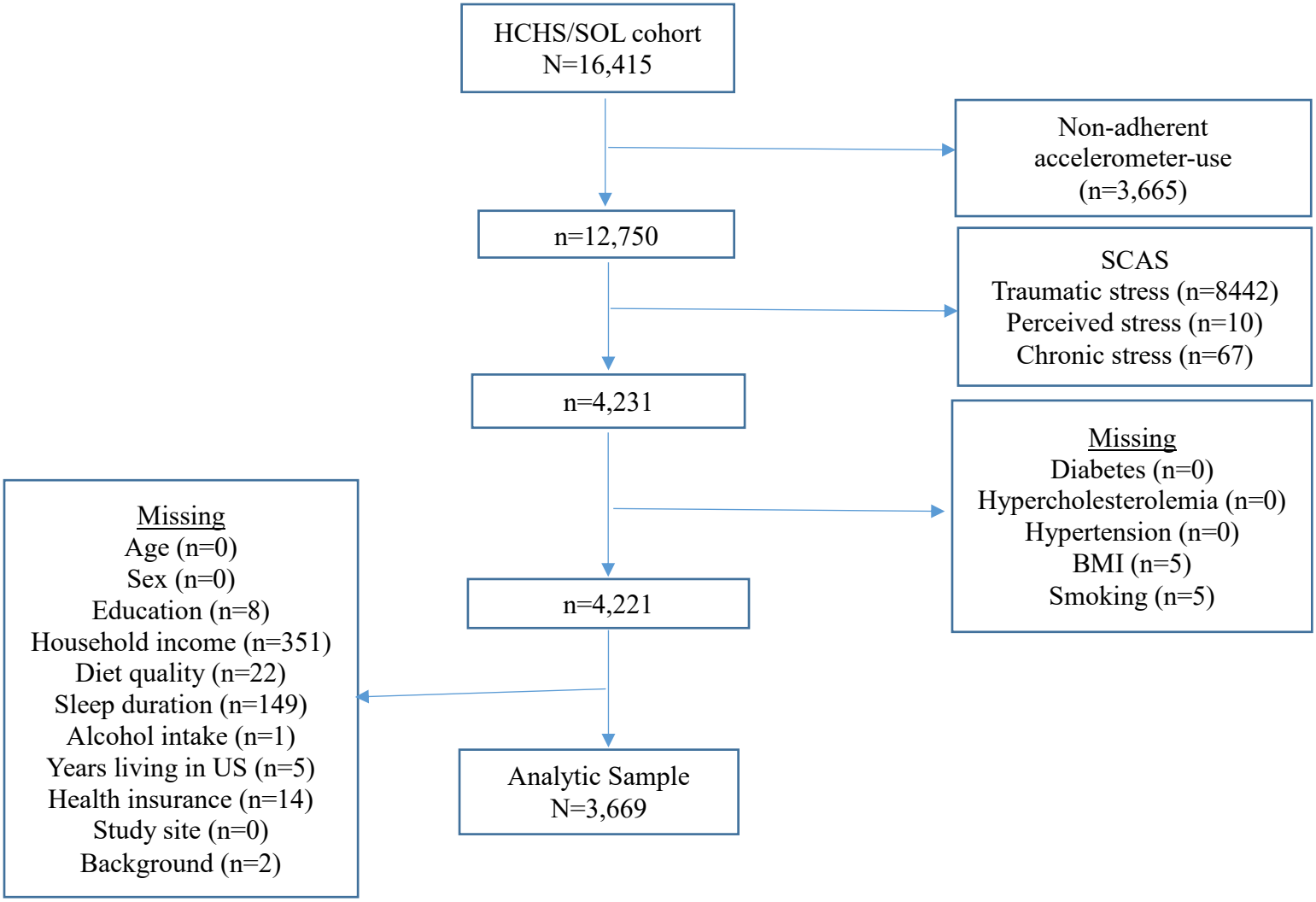

Figure 3. Consort diagram for Chapter III

TABLE VII
DESCRIPTIVE STATISTICS FOR OVERALL SAMPLE AND PREVALENCE OF CVD RISK FACTORS: HCHS/SOL SCAS[a] (N=3,669)

	All	CVD Risk Factors											
		Diabetes[b]		Hypercholesterolemia[c]		Hypertension[d]		Obesity[e]		Smoking[f]		≥ 3 Risk Factors[g]	
Unweighted N	3,669	2,993	736	1,981	1,688	2,486	1,183	2,126	1,543	3,052	617	3,031	638
Demographic Characteristics													
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Age (%)													
18-44	58.3	64.5	23.2***	68.1	45.0***	71.1	20.8***	60.6	54.8**	58.5	57.4	64	22.6***
≥ 45	41.7	35.5	76.8	31.9	55.1	28.9	79.2	39.4	45.3	41.5	42.6	36	77.4
Female (%)	53.5	53.6	53.1	61.1	43.1***	54.7	50.0	52.0	55.7	56.2	42.1**	54.1	49.5
Education (%)													
< HS	31.5	29.4	43.3***	27.9	36.4	29.5	37.3**	27.9	37.0**	29.7	39.2**	29.8	42.0**
HS	28.2	29.2	22.4	30.2	25.4	29.5	24.2	29	26.9	28.2	27.9	29	23.3
> HS	40.3	41.4	34.3	41.9	38.2	41	38.5	43.1	36.1	42.1	32.9	41.2	34.7
Income (%)													
<$30,000	68.9	66.9	80.1***	66.1	72.8*	66.9	74.9**	67.8	70.6	67.5	74.7	67.2	79.5***
$30,000	31.0	33.1	19.6	33.9	27.1	33.1	25.0	32.1	29.4	32.4	25.3	32.8	20.2
Missing	0.1	0.04	0.3	0.1	0.1	0.04	0.2	0.1	0.0	0.1	0.0	0.04	0.3

TABLE VII
DESCRIPTIVE STATISTICS FOR OVERALL SAMPLE AND PREVALENCE OF CVD RISK FACTORS: HCHS/SOL SCAS[a] (N=3,669)

	All	CVD Risk Factors											
		Diabetes[b]		Hypercholesterolemia[c]		Hypertension[d]		Obesity[e]		Smoking[f]		≥ 3 Risk Factors[g]	
Unweighted N	3,669	2,993	736	1,981	1,688	2,486	1,183	2,126	1,543	3,052	617	3,031	638
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Alcohol Intake (%)													
Never	19.3	18.3	25.1***	18.7	20.2	17	26.2***	19.7	18.8	21.8	9.1***	18.6	24.1**
Former	30.2	29	36.8	29.5	31.2	30	31.0	28.7	32.5	32.3	21.6	29.8	33.1
Current	50.5	52.7	38.0	51.8	48.6	53.1	42.8	51.6	48.7	45.9	69.4	51.7	42.8
Years Living in US (%)													
< 10	26.1	27.9	16.3**	29.3	21.8	28.1	20.3**	29.8	20.6**	28.2	17.7**	28.2	13.4***
≥ 10	73.9	72.1	83.7	70.7	78.2	71.9	79.7	70.2	79.4	71.8	82.3	71.8	86.7
Health Insurance (%)													
Yes	52.1	50.2	62.5**	51.6	52.7	48.1	63.6**	51.0	53.7	52.0	52.3	49.7	66.9***
Study Site (%)													
Bronx	29.6	29.9	28.0	31.6	27.0**	29.6	29.7***	28.4	31.6	28.2	35.7**	29.2	32.2***
Chicago	16.6	16.2	18.8	16.4	16.9	18.5	11.1	16.4	16.9	17	15.1	16.9	14.8
Miami	27.1	26.6	30.0	22.8	32.8	23.1	38.8	26.7	27.6	26.3	30.3	25.3	38.1
SD	26.7	27.3	23.2	29.2	23.3	28.8	20.4	28.5	24.0	28.5	18.9	28.6	14.9
Background (%)													
Dom.	7.3	7.5	6.2**	7.4	7.1*	7.7	5.9***	7.6	6.8**	7.9	4.8***	7.8	4.1***

TABLE VII
DESCRIPTIVE STATISTICS FOR OVERALL SAMPLE AND PREVALENCE OF CVD RISK FACTORS: HCHS/SOL SCAS[a] (N=3,669)

	All	CVD Risk Factors											
		Diabetes[b]		Hypercholesterolemia[c]		Hypertension[d]		Obesity[e]		Smoking[f]		≥ 3 Risk Factors[g]	
Unweighted N	3,669	2,993	736	1,981	1,688	2,486	1,183	2,126	1,543	3,052	617	3,031	638
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
CA	18.7	18	22.9	15.2	23.5	14.6	31.0	18.2	19.6	17.5	23.9	16.6	32.0
Cuban	11.2	11.6	9.3	12.9	9.1	11.3	11.2	12.4	9.5	12.5	6.2	11.3	10.7
Mexican	38.9	39.4	36.2	41.6	35.3	43.7	24.9	41.2	35.4	41.4	28.6	41.5	22.8
PR	14.7	13.8	19.8	12.9	17.1	12.7	20.3	12.1	18.6	12.3	24.4	13.2	23.7
SA	5.1	5.3	4.2	4.6	5.9	5.3	4.5	5.4	4.7	5.6	3.0	5.3	4.0
Other	4.1	4.5	1.4	5.5	2.1	4.7	2.2	3.2	5.4	2.9	9.1	4.3	2.7
Sleep[1] (M)	8.0	8	7.9	8.0	7.9	8.0	7.8	8.1	7.8	8.0	7.8	8.0	7.7
	(7.9,8.1)	(7.9,8.1)	(7.7,8.0)	(7.9,8.2)	(7.8,8.0)	(7.9,8.1)	(7.7,7.9)	(8.0,8.2)	(7.6,7.9)	(7.9,8.1)	(7.6,8.1)	(7.9,8.1)	(7.6,7.9)
Diet[2] (M)	48	47.5	50.4	47.3	48.9	47.5	49.3	48.2	47.6	48.5	45.6	47.8	49.1
	(47.5,48.4)	(47.1,48.0)	(49.6,51.3)	(46.8,47.8)	(48.3,49.4)	(47.0,48.0)	(48.6,49.9)	(47.6,48.7)	(47.1,48.2)	(48.1,49.0)	(44.7,46.4)	(47.3,48.2)	(48.1,50.0)
Physical Activity													
MVPA (M)	24.1	25.3	17.2	25.1	22.7	26.0	18.3	25.9	21.3	22.7	29.9	25.2	17.0
	(22.3,25.9)	(23.3,27.3)	(15.0,19.4)	23.2,27.0)	(19.8,25.7)	(23.8,28.3)	(16.6,20.1)	(24.0,27.9)	(18.5,24.0)	(21.2,24.2)	(24.6,35.1)	(23.2,27.2)	(14.4,19.6)
Psychosocial Stressors[3]													
Chronic Stress (M)													

TABLE VII
DESCRIPTIVE STATISTICS FOR OVERALL SAMPLE AND PREVALENCE OF CVD RISK FACTORS: HCHS/SOL SCAS[a] (N=3,669)

	All	CVD Risk Factors											
		Diabetes[b]		Hypercholesterolemia[c]		Hypertension[d]		Obesity[e]		Smoking[f]		≥ 3 Risk Factors[g]	
Unweighted N	3,669	2,993	736	1,981	1,688	2,486	1,183	2,126	1,543	3,052	617	3,031	638
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
	1.8	1.7	2.4	1.8	1.9	1.7	2.1	1.7	2.0	1.8	2.2	1.7	2.4
	(1.7,1.9)	(1.6,1.9)	(2.2,2.6)	(1.6,1.9)	(1.8,2.0)	(1.6,1.9)	(2.0,2.2)	(1.6,1.8)	(1.9,2.2)	(1.6,1.9)	(2.0,2.3)	(1.6,1.9)	(2.2,2.6)
Traumatic Stress (M)													
	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.1	2.2	2.0	2.7	2.1	2.2
	(2.0,2.2)	(2.0,2.2)	(1.9,2.3)	(2.0,2.3)	(2.0,2.3)	(2.0, 2.2)	(2.0,2.3)	(2.0,2.2)	(2.0,2.4)	(1.9,2.1)	(2.4,2.9)	(2.0,2.2)	(2.0,2.5)
Perceived Stress (M)													
	14.7	14.7	14.8	15	14.3	14.8	14.4	14.6	14.9	14.4	15.8	14.7	14.6
	(14.3,15.1)	(14.3,15.1)	(14.1,15.5)	(14.5,15.5)	(13.9,14.8)	(14.3,15.3)	(13.9,15.0)	(14.0,15.1)	(14.5,15.4	(14.0,14.9)	(15.2,16.5)	(14.3,15.1)	(14.0,15.3)

Abbreviations: HS: High School. SD: San Diego. D: Dominican. CA: Central American. PR: Puerto Rican. SA: South American.
Note: Values in parenthesis are 95% Confidence Intervals (CI).
[a]Values (except N) are weighted for survey design and nonresponse.
[b]Diabetes mellitus was defined as fasting glucose ≥126 mg/dL, 2-hour-postload plasma glucose ≥200 mg/dL, hemoglobin A_{1c} ≥6.5%, or use of diabetes medications.
[c]Hypercholesterolemia was defined as total cholesterol ≥240 mg/dL, high-density lipoprotein cholesterol <40 mg/dL, low-density lipoprotein cholesterol ≥160 mg/dL, or receiving treatment.
[d]Hypertension was defined as systolic blood pressure ≥140 mm Hg, diastolic blood pressure ≥90 mm Hg, or receiving treatment.
[e]Obesity was defined as a body mass index ≥30, calculated as weight in kilograms divided by height in meters squared.
[f]Smoking was defined as currently smoking cigarettes.
[g]≥3 Risk factors includes combination of any of the CVD risk factors.
[1]Sleep score refers to mean number of hours of sleep per day (self-reported).
[2]Diet scores was assessed using the Alternative Healthy Eating Index (AHEI); range is 0-110.
[3]Psychosocial stressors: Chronic stress score range: 0-8. Traumatic stress score range: 0-10. Perceived stress score: 0-40.
*p<0.05, **p<0.01, ***p<0.001; Comparisons were performed using the overall Rao-Scott Pearson Chi-Square test for categorical variables.

TABLE IX
ASSOCIATION OF ACCELEROMETER-MEASURED MVPA WITH CVD RISK FACTORS (PR [95% CI]): HCHS/SOL SCAS[a] (N=3,669)

	CVD Risk Factors											
Unweighted N=3,669	**Diabetes**		**Hypercholesterolemia**		**Hypertension**		**Obesity**		**Smoking**		**≥ 3 Risk Factors**	
	PR[c] (95% CI[d])	**p-value**	**PR 95% CI**	**p-value**	**PR 95% CI**	**p-value**	**PR 95% CI**	**p-value**	**PR 95% CI**	**p-value**	**PR 95% CI**	**p-value**
Total MVPA[b]	0.88 (0.83,0.92)	**<0.001**	0.94 (0.90,0.97)	**0.001**	0.92 (0.89,0.96)	**<0.001**	0.92 (0.88,0.95)	**<0.001**	1.06 (1.00,1.13)	**0.051**	0.86 (0.82,0.91)	**<0.001**

[a] Adjusted for age, sex, education, annual household income, health insurance, years of residence in the US, study site, Hispanic/Latino background, sleep duration, diet quality, and alcohol intake.
[b] MVPA: Moderate to Vigorous Physical Activity
[c] PR: Prevalence Ratio
[d] CI: Confidence Interval

TABLE X
MAIN EFFECTS AND INTERACTIONS OF PSYCHOSOCIAL STRESS TYPE WITH ACCELEROMETER-MEASURED MVPA BY CVD RISK FACTORS (PR [95% CI]): HCHS/SOL SCAS (N=3,669)

	CVD Risk Factors											
Unweighted N=3,669	**Diabetes**		**Hypercholesterolemia**		**Hypertension**		**Obesity**		**Smoking**		**≥3 Risk Factors**	
	PR (95% CI)	**p-value**	**PR (95% CI)**	**p-value**	**PR (95% CI)**	**p-value**	**PR (95% CI)**	**p-value**	**PR (95% CI)**	**p-value**	**PR (95% CI)**	**p-value**
Chronic Stress												
Total MVPA	0.83 (0.77, 0.91)	<0.001	0.91 (0.86, 0.95)	<0.001	0.90 (0.85, 0.96)	0.001	0.91 (0.86, 0.95)	<0.001	1.01 (0.93, 1.10)	0.805	0.88 (0.80, 0.98)	0.015
Chronic Stress	1.04 (0.95, 1.15)	0.393	0.96 (0.88, 1.03)	0.260	0.99 (0.92, 1.07)	0.781	1.02 (0.94, 1.10)	0.709	0.97 (0.84, 1.10)	0.606	1.15 (1.04, 1.28)	0.009
Total MVPA x Chronic Stress	**1.03 (1.00, 1.05)**	**0.076**	***1.02 (1.00, 1.04)***	***0.106***	1.01 (0.99, 1.03)	0.289	1.01 (0.99, 1.03)	0.534	**1.03 (1.00, 1.06)**	**0.090**	1.00 (0.96, 1.03)	0.859
Traumatic Stress												
Total MVPA	0.86 (0.79, 0.93)	<0.001	0.94 (0.89, 0.99)	0.029	0.94 (0.90, 1.00)	0.033	0.94 (0.89, 1.00)	0.037	0.99 (0.90, 1.08)	0.773	0.90 (0.83, 0.98)	0.015
Traumatic Stress	0.95 (0.87, 1.05)	0.310	0.99 (0.93, 1.06)	0.750	1.02 (0.96, 1.08)	0.478	1.05 (0.97, 1.13)	0.226	0.99 (0.88, 1.12)	0.900	1.09 (1.00, 1.18)	0.064
Total MVPA x Traumatic Stress	1.01 (0.99, 1.04)	0.386	1.00 (0.98, 1.02)	0.847	0.99 (0.97, 1.01)	0.237	0.99 (0.97, 1.01)	0.249	**1.03 (1.00, 1.06)**	**0.032**	0.98 (0.95, 1.01)	0.158
Perceived Stress												
Total MVPA	0.82 (0.74, 0.91)	<0.001	0.95 (0.89, 1.02)	0.142	0.90 (0.83, 0.98)	0.014	0.96 (0.93,0.99)	0.02	0.97 (0.83, 1.12)	0.649	0.91 (0.82, 1.02)	0.103
Perceived Stress	0.99 (0.97, 1.02)	0.505	1.00 (0.98, 1.02)	0.956	1.00 (0.98, 1.01)	0.607	1.00 (0.99,1.01)	0.80	0.99 (0.95, 1.03)	0.534	1.01 (0.99, 1.03)	0.327
Total MVPA x Perceived Stress	1.00 (1.00, 1.01)	0.182	1.00 (0.99, 1.00)	0.700	1.00 (1.00, 1.01)	0.546	1.00 (1.00,1.00)	0.73	1.01 (1.00, 1.01)	0.170	1.00 (0.99, 1.00)	0.256

[a] Adjusted for age, sex, education, annual household income, health insurance, years of residence in the US, study site, Hispanic/Latino background, sleep duration, diet quality, and alcohol intake.
[b] MVPA: Moderate to Vigorous Physical Activity
[c] PR: Prevalence Ratio
[d] CI: Confidence Interval

Figure 4. Effect modification by tertiles of chronic stress in the association between accelerometer-measured MVPA and diabetes (N=3,669)

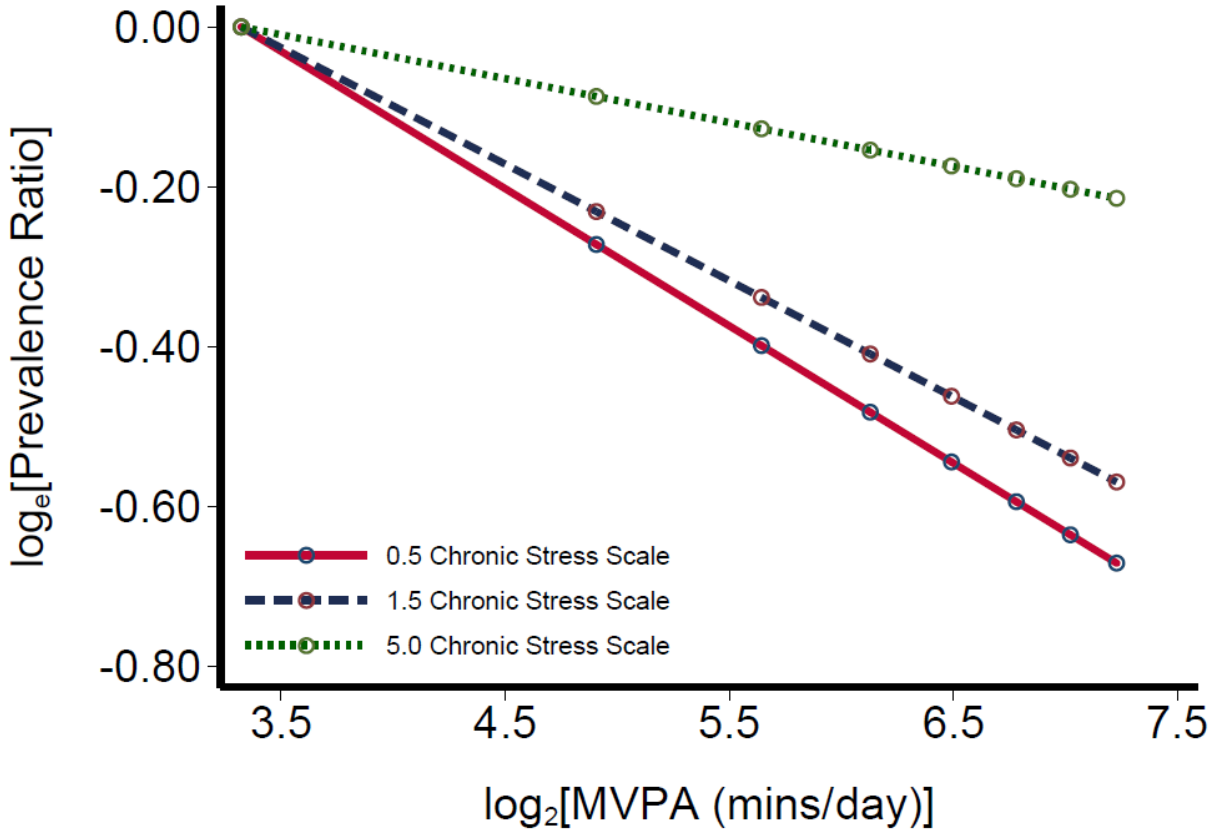

TABLE XI
EFFECT MODIFICATION BY TERTILES OF CHRONIC STRESS IN THE ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MVPA AND DIABETES[a] (PR [95% CI]): HCHS/SOL SCAS (N=3,669)

Intervals	Midpoint	0 - 1 Chronic Stressor PR (95% CI)	1 - 2 Chronic Stressors PR (95% CI)	2 - 8 Chronic Stressors PR (95% CI)
[0, 20)	10	1.00	1.00	1.00
[20, 40)	30	0.81 (0.74, 0.89)	0.84 (0.78, 0.91)	0.96 (0.86, 1.08)
[40, 60)	50	0.74 (0.64, 0.85)	0.78 (0.70, 0.87)	0.95 (0.80, 1.13)
[60, 80)	70	0.69 (0.58, 0.82)	0.74 (0.65, 0.84)	0.94 (0.76, 1.15)
[80, 100)	90	0.66 (0.55, 0.80)	0.71 (0.61, 0.82)	0.93 (0.73, 1.18)
[100, 120)	110	0.63 (0.52, 0.78)	0.69 (0.59, 0.81)	0.92 (0.71, 1.19)
[120, 140)	130	0.61 (0.49, 0.77)	0.67 (0.57, 0.80)	0.92 (0.70, 1.21)
[140, 160)	150	0.60 (0.47, 0.76)	0.66 (0.55, 0.79)	0.91 (0.68, 1.22)

[a] Adjusted for age, sex, education, annual household income, health insurance, years of residence in the US, study site, Hispanic/Latino background, sleep duration, diet quality, and alcohol intake.

Figure 5. Effect modification by tertiles of chronic stress in the association between accelerometer-measured MVPA and hypercholesterolemia (N=3,669)

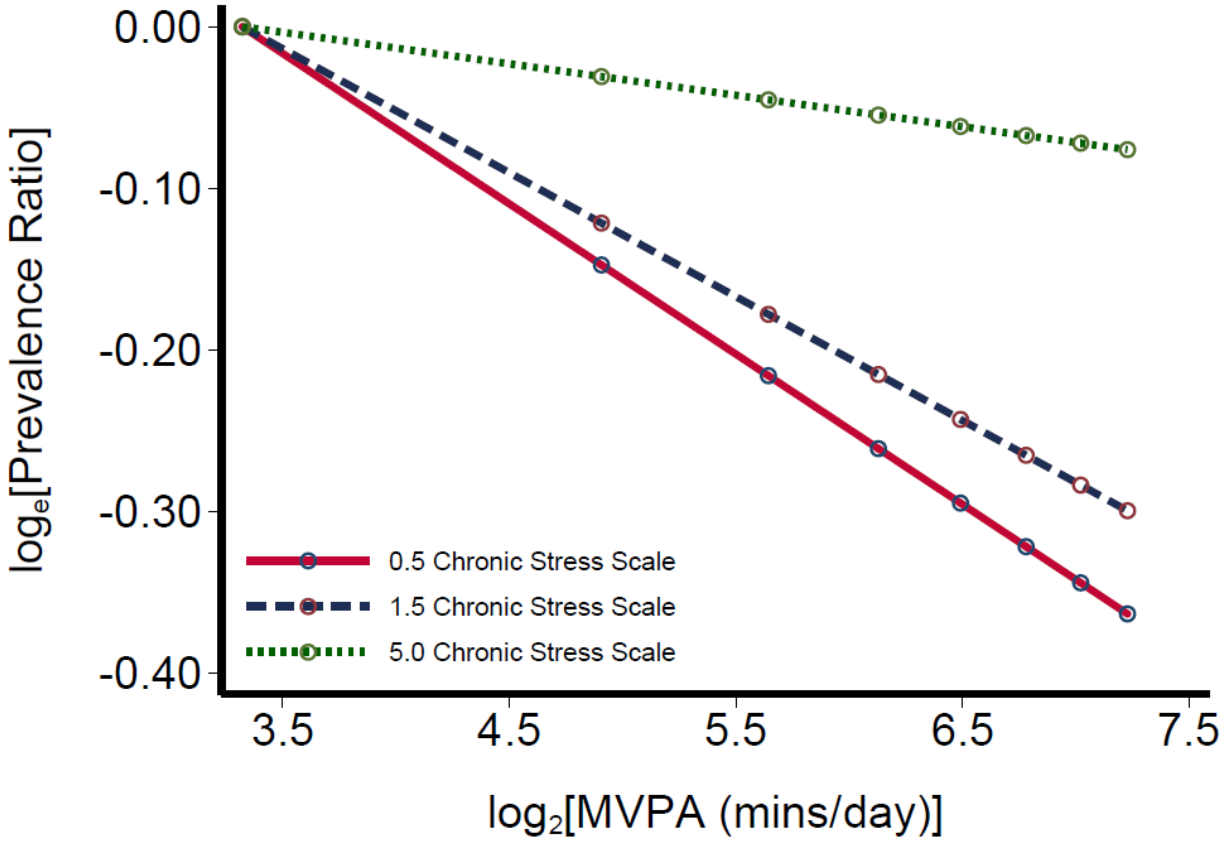

TABLE XII
EFFECT MODIFICATION BY TERTILES OF CHRONIC STRESS IN THE ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MVPA AND HYPERCHOLESTEROLEMIA[a] (PR [95%CI]): HCHS/SOL SCAS (N=3,669)

Intervals	Midpoint	0 - 1 Chronic Stressor PR (95% CI)	1 - 2 Chronic Stressors PR (95% CI)	2 - 8 Chronic Stressors PR (95% CI)
[0, 20)	10	1.00	1.00	1.00
[20, 40)	30	0.89 (0.84, 0.94)	0.91 (0.87, 0.95)	0.99 (0.90, 1.10)
[40, 60)	50	0.84 (0.77, 0.91)	0.87 (0.81, 0.93)	0.99 (0.86, 1.15)
[60, 80)	70	0.81 (0.73, 0.89)	0.84 (0.77, 0.92)	0.99 (0.83, 1.18)
[80, 100)	90	0.78 (0.70, 0.88)	0.83 (0.75, 0.91)	0.99 (0.81, 1.21)
[100, 120)	110	0.77 (0.68, 0.87)	0.81 (0.73, 0.90)	0.99 (0.79, 1.23)
[120, 140)	130	0.75 (0.66, 0.86)	0.80 (0.71, 0.89)	0.98 (0.78, 1.25)
[140, 160)	150	0.74 (0.64, 0.85)	0.79 (0.70, 0.89)	0.98 (0.77, 1.26)

[a] Adjusted for age, sex, education, annual household income, health insurance, years of residence in the US, study site, Hispanic/Latino background, sleep duration, diet quality, and alcohol intake.

Figure 6. Effect modification by tertiles of chronic stress in the association between accelerometer-measured MVPA and smoking (N=3,669)

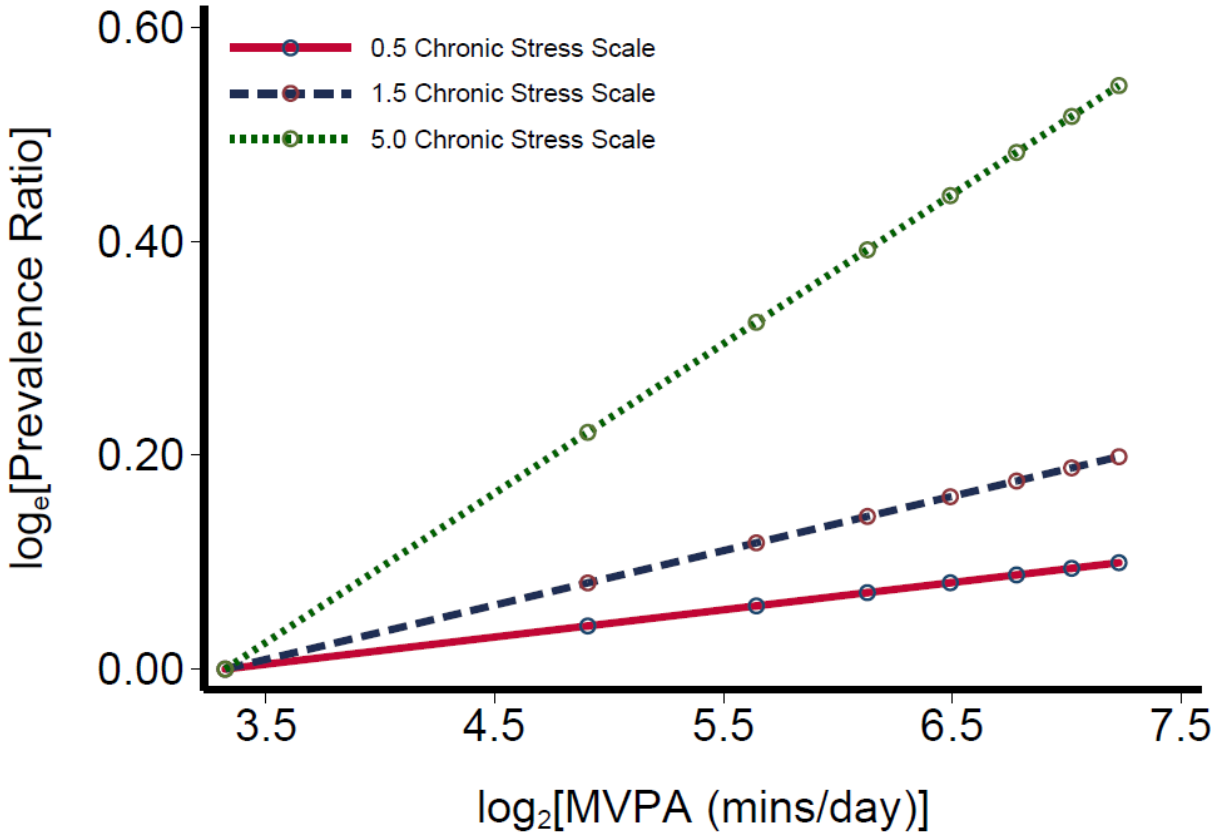

TABLE XIII
EFFECT MODIFICATION BY TERTILES OF CHRONIC STRESS IN THE ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MVPA AND SMOKING[a] (PR [95% CI]): HCHS/SOL SCAS (N=3,669)

Intervals	Midpoint	0 - 1 Chronic Stressor PR (95% CI)	1 - 2 Chronic Stressors PR (95% CI)	2 - 8 Chronic Stressors PR (95% CI)
[0, 20)	10	1.00	1.00	1.00
[20, 40)	30	1.03 (0.92, 1.14)	1.07 (0.98, 1.17)	1.23 (1.05, 1.44)
[40, 60)	50	1.04 (0.89, 1.21)	1.10 (0.97, 1.25)	1.36 (1.08, 1.71)
[60, 80)	70	1.05 (0.87, 1.26)	1.13 (0.96, 1.31)	1.45 (1.10, 1.92)
[80, 100)	90	1.05 (0.85, 1.30)	1.14 (0.96, 1.36)	1.52 (1.11, 2.08)
[100, 120)	110	1.06 (0.84, 1.33)	1.16 (0.96, 1.40)	1.58 (1.12, 2.23)
[120, 140)	130	1.06 (0.83, 1.36)	1.17 (0.95, 1.43)	1.63 (1.13, 2.36)
[140, 160)	150	1.06 (0.82, 1.38)	1.18 (0.95, 1.46)	1.68 (1.14, 2.47)

[a] Adjusted for age, sex, education, annual household income, health insurance, years of residence in the US, study site, Hispanic/Latino background, sleep duration, diet quality, and alcohol intake.

Figure 7. Effect modification by tertiles of traumatic stress in the association between accelerometer-measured MVPA and smoking (N=3,669)

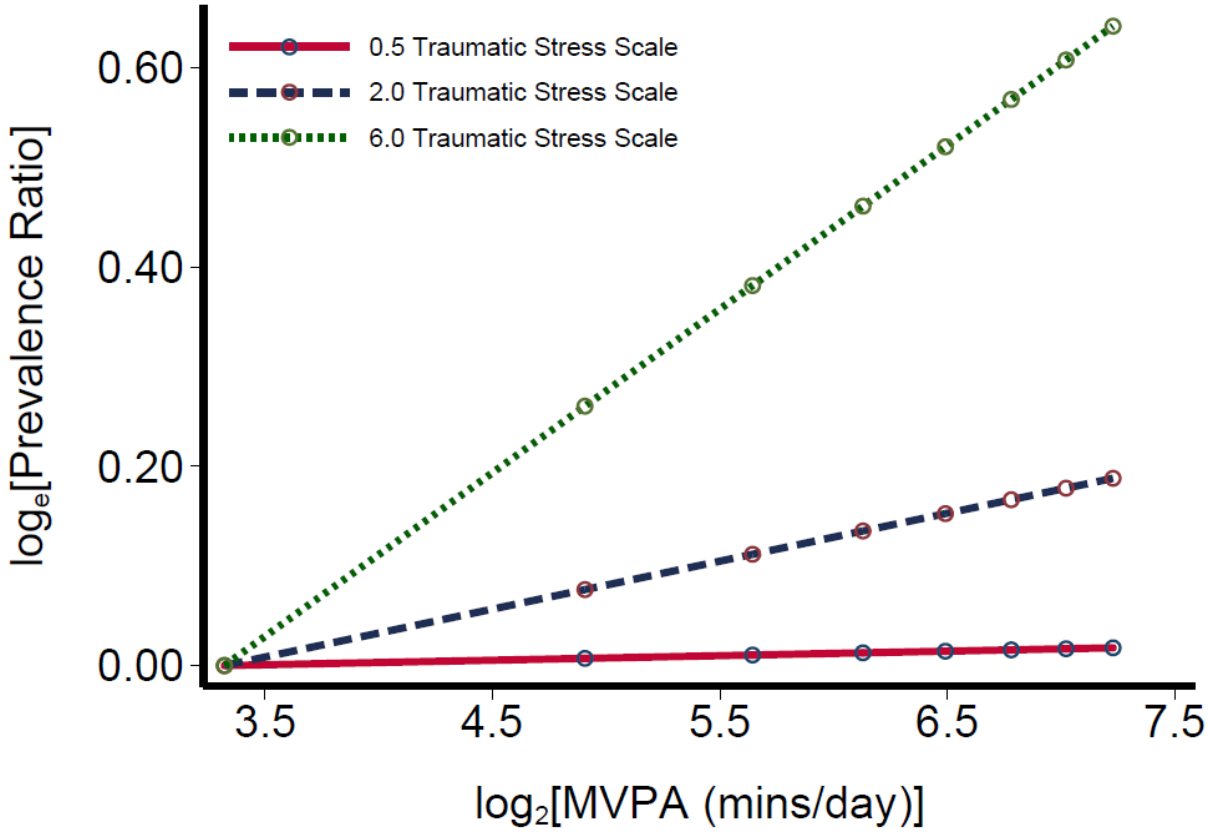

TABLE XIV
EFFECT MODIFICATION BY TERTILES OF TRAUMATIC STRESS IN THE ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MVPA AND SMOKING[a] (PR [95% CI]): HCHS/SOL SCAS (N=3,669)

Intervals	Midpoint	0 - 1 Traumatic Stressor PR (95% CI)	1 - 3 Traumatic Stressors PR (95% CI)	3 - 9 Traumatic Stressors PR (95% CI)
[0, 20)	10	1.00	1.00	1.00
[20, 40)	30	1.03 (0.92, 1.15)	1.08 (0.99, 1.17)	1.22 (1.05, 1.43)
[40, 60)	50	1.04 (0.88, 1.22)	1.11 (0.98, 1.26)	1.34 (1.07, 1.68)
[60, 80)	70	1.05 (0.86, 1.27)	1.14 (0.98, 1.33)	1.43 (1.09, 1.87)
[80, 100)	90	1.05 (0.84, 1.31)	1.16 (0.98, 1.38)	1.50 (1.10, 2.03)
[100, 120)	110	1.06 (0.83, 1.35)	1.17 (0.97, 1.42)	1.55 (1.11, 2.17)
[120, 140)	130	1.06 (0.82, 1.37)	1.19 (0.97, 1.45)	1.60 (1.12, 2.29)
[140, 160)	150	1.07 (0.81, 1.40)	1.20 (0.97, 1.48)	1.65 (1.13, 2.40)

[a] Adjusted for age, sex, education, annual household income, health insurance, years of residence in the US, study site, Hispanic/Latino background, sleep duration, diet quality, and alcohol intake.

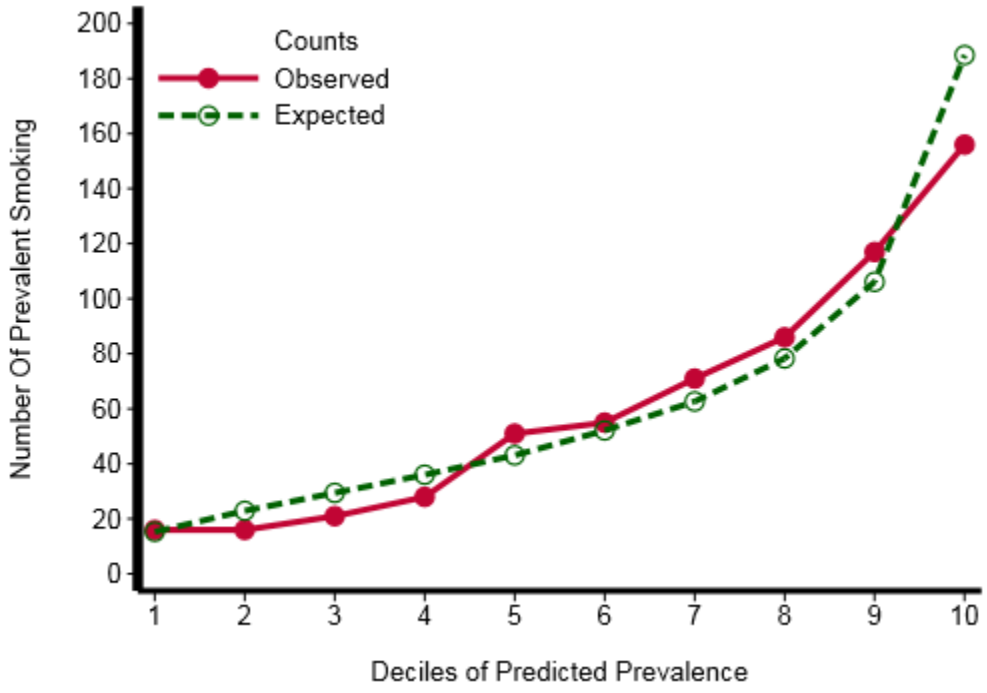

Figure 8. Goodness of fit for Chapter III: Smoking

IV. THE ASSOCIATION BETWEEN MODERATE TO VIGOROUS PHYSICAL ACTIVITY AND HEALTH-RELATED QUALITY OF LIFE AMONG HISPANIC/LATINO ADULTS IN THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (HCHS/SOL)

A. ABSTRACT

Background: Moderate to vigorous physical activity (MVPA) is associated with better health, but research examining associations between MVPA and health-related quality of life (HRQoL) is limited among Hispanics/Latinos in the US. **Objective:** To assess whether accelerometer-measured MVPA is associated with (a) HRQoL, and its (b) mental component score (MCS) and (c) physical component score (PCS). **Methods:** Cross-sectional data from 12,179 adults ages 18-74 in 2008-11, who participated in HCHS/SOL and had complete data on study variables, were analyzed using complex survey design methods. MVPA was assessed by accelerometer and grouped into 4 levels based on MVPA: inactive, low, moderate, and high. HRQoL was assessed with the Short-Form 12 (SF-12) with the MCS and PCS, and each was analyzed continuously. Multivariate linear regression models were used to derive adjusted means with 95% confidence intervals (CI), and linear trends. **Results:** The adjusted means for MCS were 50.5 (47.0, 53.7) for inactivity, 49.1 (48.5, 49.6) for low MVPA, 49.8 (49.2, 50.5) for moderate MVPA, 49.2 (48.4, 50.0) for high MVPA, and no significant linear trend (p-value = 0.64). For PCS, the adjusted means were 46.8 (44.9, 48.6) for inactivity, 49.4 (49.1, 49.7) for low MVPA, 50.6 (50.1, 51.2) for moderate MVPA, 51.3 (50.8, 51.8) for high MVPA, and a significant linear trend (p-value = <0.001). For total SF-12 score, the adjusted means were 97.1 (92.7, 101.5) for inactivity, 98.4 (97.8, 99.1) for low MVPA, 100.5 (99.8, 101.1) for moderate MVPA, 100.6 (99.7, 101.4) for high MVPA, and a significant linear trend (p-value = <0.001). **Conclusion:** In a sample of Hispanic/Latino adults in the US, accelerometer-measured MVPA was significantly associated with the PCS and total score for HRQoL, but not MCS. Future studies should evaluate if increases in MVPA lead to improvement in HRQoL among Hispanic/Latino adults.

B. INTRODUCTION

Health-related quality of life (HRQoL) is defined as the impact of health on an individual's well-being in the physical, mental, and social domains as well as their perceived ability to function (Lazarus, 1966). Marginalized populations are disproportionately at risk of experiencing limitations and disability conditions. For example, evidence exists that Hispanics/Latinos tend to have lower QoL than their non-Hispanic/Latino white and black counterparts (Coverdill, Lopez, & Petrie, 2011). Furthermore, among older Hispanic/Latino adults the physical functioning component of HRQoL played a role in the association between frailty and mortality (Masel, Ostir, & Ottenbacher, 2010), and was associated with depressive symptoms (Chavez-Korell, Benson-Flórez, Rendón, & Farías, 2014).

Physical activity (PA) has been associated with HRQoL, but the majority of studies are based on self-reported MVPA. Accelerometer-measured MVPA associations have only recently been reported and findings show similar results as those observed with self-report PA data (Loprinzi & Davis, 2016). While there are also different measures of HRQoL to our knowledge no studies have examined the association between accelerometer-measured MVPA with not only total HRQoL, but the mental component score (MCS), and the physical component score (PCS). The evidence that does exist on Hispanic/Latino populations on the association between MVPA and HRQoL demonstrates counter-intuitive results. A study conducted with Hispanics/Latinos of Puerto Rican and Dominican backgrounds observed that Hispanic/Latino older adults

engaged in sufficient total MVPA, but had significantly worse total HRQoL compared to Chinese and African American older adults (Kwon et al., 2015). The aim of this study was to examine the linear association between accelerometer-measured MVPA and HRQoL among a diverse cohort of Hispanic/Latino adults. We hypothesize that greater accelerometer-measured MVPA will be positively associated with better physical, mental, and total HRQoL.

C. METHODS

1. Study Description

The HCHS/SOL is a community-based cohort study, which aims to evaluate the health risks and protective factors of chronic conditions among a diverse sample of Hispanic/Latino adults in the US. This study includes four US field centers (Bronx, NY; Chicago, IL; Miami, FL; San Diego, CA) and enrolled self-identified Hispanic/Latino adults (N=16,415) of Puerto Rican, Mexican, Dominican, Cuban, Central American, and South American backgrounds between ages 18-74 with varying degrees of health condition.

Recruitment and baseline examination of participants took place between 2008 and 2011. Recruitment was conducted using a stratified two-stage probability sample of household address via selected census tracts to ensure socioeconomic diversity, accessibility to the HCHS/SOL study site, and reduce potential sources of bias in the study. Oversampling was implemented for adults aged 45-74 (Lavange et al., 2010).

Participants were ineligible if they were unable to physically travel to the field center, complete the study questionnaires, or if they were relocating in the subsequent 6 months (Sorlie et al., 2010).

Baseline examinations were standardized across all sites, were approximately 7 hours in duration, and conducted in the preferred language of the participant. Data on sociodemographic characteristics, clinic examinations, and questionnaire information were collected. Protocol to ensure the safety of participants during the examination were instituted at each site, participants were informed of medically important examination results and referred to medical providers if needed. Informed consent was obtained for all participants at the beginning of the baseline examination visit.

2. Measures

a. Physical Activity

The Actical Accelerometer (model 198-0200-03; Minimiter Respironics, Bend, OR) recorded the frequency, duration, and intensity of PA during the time the accelerometer was worn. Participants were fitted with a belt and were instructed to wear the accelerometer for seven days at the hip, above the iliac crest and to only remove for swimming, showering, and sleeping (Arredondo et al., 2016). Accelerometer data were processed with epoch length of 1 minute and non-wear time was determined by using the Choi algorithm, which defined non-wear time as 90 consecutive minutes of zero counts, allowing only 1-2 minutes of nonzero counts within a 30-minute window upstream and

downstream of the 90-minute timeframe (Choi et al., 2011). Adherence to accelerometer-use was defined as having at least three days with a minimum of ten hours per day of data (Matthews et al., 2016). Participants adherent to accelerometer-use were included in this analysis and adherence among HCHS/SOL participants has been reported (Evenson et al., 2015).

We used accelerometer-measured MVPA (minutes/week) as an ordinal variable in four categories which represent inactivity, low MVPA, moderate MVPA, and high MVPA in non-bouts. Inactivity was defined as engaging between 0 and 1 minute of moderate or vigorous PA per week. Low MVPA was defined as engaging between (i) 1 and 150 minutes of moderate PA, (ii) 1 and 75 minutes of vigorous PA, or (iii) 1 and 150 minutes of moderate/vigorous PA on average per week. Moderate MVPA was defined as engaging between (i) 150 and 300 minutes of moderate PA, (ii) 75 and 150 minutes of vigorous PA, or (iii) 150 and 300 minutes of moderate/vigorous PA on average per week. High MVPA was defined as engaging in (i) more than 300 minutes of moderate PA, (ii) more than 150 minutes of vigorous PA, or (iii) more than 300 minutes of moderate/vigorous PA on average per week. This ordinal variable was derived using the average of total moderate and/or vigorous minutes within a day across adherent days and then the average was multiplied by 7 (for each day of the week).

b. Health-Related Quality of Life (SF-12 v.2)

The SF-12 v. 2 questionnaire is a standardized and widely used assessment of HRQoL. This questionnaire, with a total of twelve questions, yields the MCS and PCS, and total HRQoL score. The MCS and PCS were derived based on standardized protocols, and were assessed continuously in this study (Ware et al., 2002). This measure includes eight health dimensions: physical functioning, physical role limitations, emotional role limitations, pain, general health, vitality, social functioning, and mental health. Examples of questions are as follows:

Question 1: In general, would you say your health is excellent, very good, good, fair, or poor.

Question 2: Does your health now limit you in these activities? (a) moderate activities, such as moving a table, pushing a vacuum clean, bowling or playing golf *and* (b) climbing several flights of stairs, with response options (i) yes, limited a lot (ii) yes, limited a little or (iii) no, not limited at all.

Question 3/4: During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health/ any emotional problems (such as feeling depressed or anxious)? With response options (i) all of the time (ii) most of the time (iii) some of the time (iv) a little of the time *or* (v) none of the time.

c. Covariates

The covariates used in this study were chosen based upon the literature describing the factors important to consider when evaluating Hispanic/Latino health and determined to be potential confounders of the association between MVPA and HRQoL.

A personal information questionnaire was administered to collect demographic information. The following covariates were used in this study: mean age and age dichotomized into 18-44 years and 45 years and older. Sex was dichotomized to female or male, and marital status was categorized into single, married/living with partner, or separated/divorced/widower. Education was categorized into less than high school diploma or GED, high school diploma or GED, and more than high school diploma or GED. Annual household income was categorized into less than $30,000 per year, between $30,000 - $50,000, more than $50,000, or not reported. Occupation was categorized into non-skilled worker, service worker, skilled worker, professional, or other occupation. Self-reported sleep duration in hours and the Alternative Heathy Eating Index (AHEI) 2010 diet quality score were used as continuous variables. Alcohol intake was categorized into three groups, those who never drank alcohol before, former drinkers, and current drinkers. Preferred language was determined by the language chosen for the baseline examination, and could be either Spanish or English. Years of residence in the US and immigrant generation were dichotomized into less than 10 years or more than 10 years, and 1st or 2nd and more generations, respectively. Health insurance was dichotomized into having no health insurance or currently being insured. Study site was

recorded for each participant and the HCHS/SOL field sites were the Bronx, NY, Chicago, IL, Miami, FL, and San Diego, CA. The covariate Hispanic/Latino background was categorized into seven groups to include Dominican, Central American, Cuban, Mexican, Puerto Rican, South American, or more than one background group.

3. Statistical Analysis

The analytic sample was comprised with complete data on the study variables, with the exception of occupation and sleep duration. Descriptive statistics for covariates and HRQoL were age-adjusted and reported by categories of accelerometer-measured MVPA. Multivariate linear regression models were used to examine the association between accelerometer-measured MVPA and the MCS, PCS, and total HRQoL score, separately. Adjusted means with 95% confidence intervals (CI) are presented in the results for MCS, PCS, and total HRQoL score by categories of accelerometer-measured MVPA: inactive, low MVPA, moderate MVPA, and high MVPA.

Analyses were conducted using a model to account for the various chronic conditions that might have influenced the association between MVPA and HRQoL. The model adjusted for age, sex, education, annual household income, study site, and Hispanic/Latino background, marital status, diet quality, alcohol intake, health insurance, preferred language, length of residence in the US, immigrant generation, as well as cardiovascular disease, stroke, kidney disease, liver disease, cancer, and inflammation or swelling of joints. Furthermore, we included occupation and sleep duration separately to

assess any significant changes to the estimates. To account for the complex survey designs of HCHS/SOL we used sampling weights, clusters, and strata in all analyses. We applied specific sampling weights to account for missing accelerometer data.

D. RESULTS

1. Descriptive Statistics

The analytic sample included N= 12,179 from the HCHS/SOL cohort study. Overall, 1.7% were categorized as inactive, 56.0% in low MVPA, 23.2% in moderate MVPA, and 19.1% in high MVPA. The mean age for the inactive was 54.8 years, 43.4 years for low MVPA, 38.1 years for moderate MVPA, and 36.6 years for high MVPA. Females were the majority in the inactive (62.8%) and low MVPA (61.2%) categories, while males are the majority of moderate (54.4%) and high (66.9%) MVPA. Across MVPA categories, the majority had more than a high school diploma, an annual household income of less than $30,000, preferred Spanish, and resided in the US for more than 10 years. For HRQoL, the mental component score (MCS) mean was 48.9 in the inactive category, 48.8 in low MVPA, 50.2 in moderate MVPA, and 49.8 in high MVPA. The physical component score (PCS) was 45.1 in the inactive category, 49.6 in low MVPA, 50.7 in moderate MVPA, and 50.8 in high MVPA (**Table XV**).

2. Multivariable Linear Regression Models

a. Total Health-Related Quality of Life (SF-12 v.2)

The model shows an adjusted means and 95%CI of 97.14 (92.74, 101.53) for the inactive category, 98.44 (97.84, 99.05) for low MVPA, 100.45 (99.78, 101.11) for moderate MVPA, 100.55 (99.66, 101.43) for high MVPA, and a significant linear trend (p-value for trend = <0.001). For the model with occupation, the adjusted means were 106.26 (99.54, 112.99) for the inactive category, 100.55 (99.82, 101.28) for low MVPA, 101.76 (101.00, 102.51) for moderate MVPA, and 101.84 (100.89, 102.80) for high MVPA, and no significant linear trend (p-value for trend = 0.10). For the model with sleep duration, the adjusted means were 96.91 (92.38, 101.43) for the inactive, 98.42 (97.80, 99.03) for low MVPA, 100.45 (99.80, 101.10) for moderate MVPA, and 100.61 (99.70, 101.51) for high MVPA, and a significant linear trend (p-value for trend <0.001) (**Table XVI**).

b. Mental Component Score (MCS)

The model shows an adjusted means of 95% CI of 50.37 (47.00, 53.74) for the inactive category, 49.05 (48.53, 49.57) for low MVPA, 49.82 (49.20, 50.45) for moderate MVPA, 49.23 (48.42, 50.03) for high MVPA, and no significant linear trend (p-value for trend = 0.64). For the model with occupation, the adjusted means were 56.43 (49.46, 63.39) for the inactive category, and close to 50.00 for the low, moderate, and high MVPA, and no significant linear trend (p-value for trend = 0.80). For the model with

sleep duration, the adjusted means were 50.10 (46.57, 53.64) for the inactive category, and close to 49.00 for the low, moderate, and high MVPA, and no significant linear trend (p-value for trend = 0.49) (**Table XVI**).

c. Physical Component Score (PCS)

The model shows an adjusted means and 95% CI of 46.77 (44.89, 48.64) for the inactive, 49.39 (49.10, 49.69) for low MVPA, 50.62 (50.09, 51.15) for moderate MVPA, 51.32 (50.81, 51.83) for high MVPA, and a significant linear trend (p-value for trend <0.001). For the model with occupation, the adjusted means were 49.84 (46.86, 52.81) for the inactive category, 50.38 (49.97, 50.78) for low MVPA, 51.26 (50.53, 51.99) for moderate MVPA, and 51.57 (50.98, 52.16) for high MVPA, and a significant linear trend (p-value for trend <0.001). For the model with sleep duration, the adjusted means were 46.80 (44.91, 48.69) for the inactive, 49.42 (49.12, 49.71) for low MVPA, 50.66 (50.12, 51.21) for moderate MVPA, and 51.31 (50.79, 51.83) for high MVPA, and a significant linear trend (p-value for trend <0.001) (**Table XVI**).

E. DISCUSSION

In this study with a sample of Hispanic/Latinos adults in the US, we found a linear association between accelerometer-measured MVPA and total HRQoL score and

the physical component score (PCS). A study with a cross-sectional and longitudinal analysis observed that engaging in PA, sleep, and sedentary behavior were associated with better HRQoL with both the mental component score (MCS) and physical component score (PCS), however, only longitudinally engaging in PA was associated with physical component score (PCS) (Bayán-Bravo et al., 2009). A large proportion of the literature on PA and HRQoL focuses on the older adult population, and it appears that the association between PA and physical component score (PCS) continues with aging. A study among community-dwelling older adults observed an improvement in physical function as a result of PA (Kelley, Kelley, Hootman, & Jones, 2009), and another study demonstrated that components of physical frailty, such as difficulty with walking and balance in addition to psychological and social frailty, predicted future scores of QoL (Gobbens & van Assen, 2014). Importantly, individuals who engage in MVPA and met PA recommendation were found to have better HRQoL (Vuillemin et al., 2005). Our study contributes to the literature in understanding this association among a diverse Hispanic/Latino population who is known to have difference patterns of MVPA, as well as in general being a younger population. The associations seen in older groups has implications for the healthy aging of Hispanic/Latino adults. In addition, results in our study can provide information adults less than 65 years who have largely not been included in this research.

To our knowledge, few studies have evaluated the association between accelerometer-measured MVPA and HRQoL, but the limited research does demonstrate

similar findings. Accelerometer-measured MVPA was independently and positively associated with the physical component score (PCS), but not mental component score (MCS) among older adults (Withall et al., 2014). The findings of our study are supported by previous work, however our findings contribute to a better understanding of this association among Hispanic/Latino adults. The association we observed between accelerometer-measured MVPA with the physical component score (PCS) of HRQoL has implications for the role that MVPA may have on improving HRQoL among Hispanic/Latino adults. A study using the National Health Interview Survey (NHIS), a nationally representative sample of US adults, observed that 21.4% of Hispanic/Latino adults had a disability or physical limitations (Coustasse, Emmett, Patel, & Pekar, 2009). In addition, higher rates of disability or physical limitations were observed among Puerto Ricans compared to African Americans while Cubans had lower rates than non-Hispanic/Latino whites. While the causes of disability are wide ranging, disability or physical limitations due to health conditions may be preventable by engaging in MVPA (Buchner, 2003; Pahor et al., 2014). Measures for HRQoL, such as SF-12, capture disability and physical limitations. While our study is cross-sectional and it could be that those with better HRQoL engage in more activity, previous studies have shown the positive impact of engaging in MVPA on physical health as well as the detrimental influence of low amounts of MVPA (Fishman et al., 2016).

The linear association we were able to detect in our sample demonstrated that higher MVPA corresponds with a higher physical component score (PCS). The

implications of higher scores may also extend to comorbid conditions, and cardiovascular disease risk factors in particular. Researchers have estimated a small clinically significant change in the physical component score (PCS) to be approximately 2 units for diabetes (Edelman, Olsen, Dudley, Harris, & Oddone, 2002), and approximately ranging from 3 to 5 units for hypertension (Samsa et al., 1999). For the physical component score (PCS) in our study, we observed a change of 2.6 from the inactive category to low MVPA; 3.8 from the inactive category to moderate MVPA; 4.5 from the inactive category to high MVPA; and a marginal change of 1.9 from low MVPA to high MVPA. This illustrates the extent of improved health with increasing MVPA. Although, this can be subject to reverse causation where only individuals capable of engaging in higher MVPA have HRQoL, prospective studies are needed to examine this association longitudinally.

Our total sample had lower physical component score (PCS) compared to nationally representative values for non-institutionalized US adults (Hanmer & Kaplan, 2016). For Hispanic/Latino adults there may be many factors that play a role in their HRQoL (Finch, Hummer, Kol, & Vega, 2001), and strategies that ameliorate the negative influences are warranted. Accessibility to areas that promote increasing MVPA levels and addressing barriers to becoming physical active are plausible options to help address HRQoL and physical health in particular. Our findings suggest that recommendations to increase levels of MVPA may not only have a beneficial impact on health among Hispanic/Latino adults, but may also positively influence HRQoL which has established implications for their livelihood long-term. This study included adults ages 18-74, and

there are known health benefits for engaging in MVPA across the lifespan, and research on HRQoL has demonstrated the importance of engaging in MVPA for older adults. Furthermore, the current demographic shift among Hispanic/Latino adults toward a rapidly growing aging population suggests that the findings of this study are especially salient. Limitations of this study include the associations are cross-sectional such that we cannot establish causality and the possibility of reverse causation. We did not stratify results by Hispanic/Latino background or sex, and this may not accurately depict the associations in the analyses. We also did not assess these associations by specific conditions, although we did adjust for many in our final model.

F. CONCLUSION

This study evaluated the linear association between accelerometer-measured MVPA and HRQoL, specifically the mental component score (MCS) and the physical component score (PCS) among a cohort of Hispanic/Latino adults. We observed a significant linear association of accelerometer-measured MVPA with physical component score (PCS) and total HRQoL, but not mental component score (MCS). Our findings are supported by previous studies using self-reported MVPA and contribute to the use of accelerometer-measured MVPA as well as evaluating this association among diverse sample of Hispanic/Latino adults in the US. The findings of this study provide evidence to continue to address barriers to engaging in MVPA for Hispanic/Latino communities.

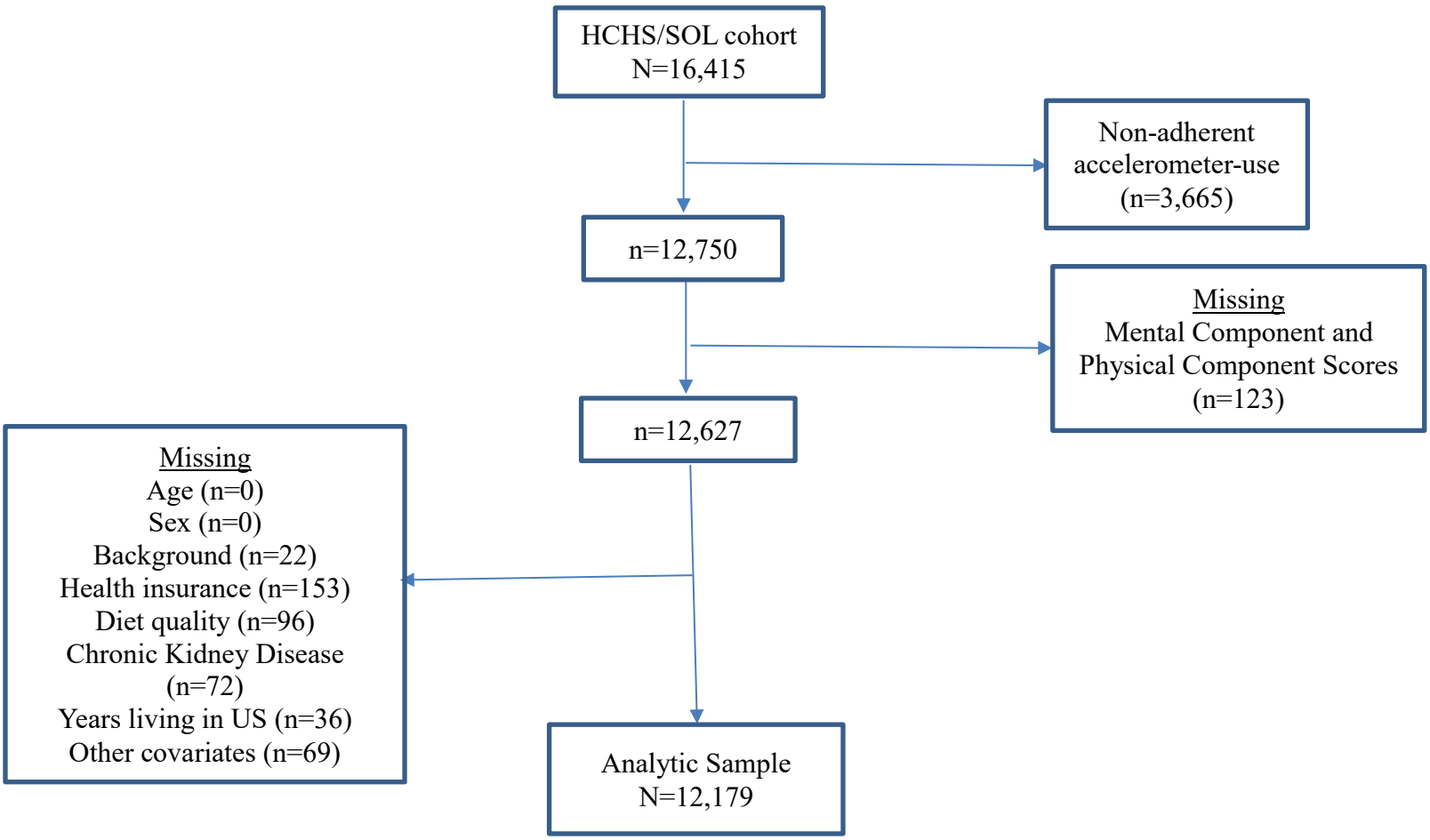

Figure 9. Consort diagram for Chapter IV

TABLE XV
DESCRIPTIVE STATISTICS FOR HISPANIC/LATINO ADULTS BY ACCELEROMETER-MEASURED MVPA CATEGORIES: HCHS/SOL (N=12,179)

Unweighted N=12,179	Accelerometer-Measured MVPA Levels*				
	Inactive (n=228)	**Low** (n=7,216)	**Moderate** (n=2,710)	**High** (n=2,025)	**p-value**
All,[a] %	1.7	56.0	23.2	19.1	<0.001
Age in years, M (SE)	54.8 (3.1)	43.4 (0.3)	38.1 (0.4)	36.6 (0.4)	<0.001
Age, %					
18-44 years	23.4	53.9	67.8	71.7	<0.001
≥ 45 years	76.6	46.1	32.2	28.3	
Female, %	62.8	61.2	45.6	33.1	<0.001
Marital Status, %					
Single	41.4	30.2	37.1	40.8	<0.001
Married or Living with Partner	39.2	53.3	46.6	43.8	
Separated, Divorced, or Widower	19.4	16.6	16.3	15.3	
Education, %					
< High School	28.5	31.1	33.6	32.9	0.27
High School	32.3	27.9	28.1	29.4	
> High School	39.2	41.0	38.3	37.7	
Household Income, %					
< $30,000	50.0	42.0	40.3	42.7	0.02
$30,000 - $50,000	28.4	37.5	36.8	38.0	

TABLE XV
DESCRIPTIVE STATISTICS FOR HISPANIC/LATINO ADULTS BY ACCELEROMETER-MEASURED MVPA: HCHS/SOL (N=12,179)

	Inactive (n=228)	**Low** (n=7,216)	**Moderate** (n=2,710)	**High** (n=2,025)	**p-value**
		(Cont.)			
> $50,000	6.5	11.3	13.8	11.6	
Not Reported	15.1	9.2	9.2	7.7	
Occupation, N (%) (n=6,343)					
Non-skilled Worker	11 (12.4)	1032 (25.3)	498 (27.1)	432 (33.3)	0.002
Service Worker	5 (21.1)	745 (20.5)	292 (20.3)	156 (14.4)	
Skilled Worker	7 (16.6)	760 (22.2)	375 (23.0)	310 (24.9)	
Professional	6 (12.1)	450 (15.4)	161 (12.1)	129 (11.1)	
Other Occupation	7 (37.8)	522 (16.6)	258 (17.5)	187 (16.3)	
Sleep[b], M (SE) (n=11,746)	8.3 (0.1)	8.0 (0.0)	7.9 (0.0)	7.8 (0.0)	<0.001
Diet Quality[c], M (SE)	46.0 (0.6)	47.0 (0.2)	48.4 (0.3)	48.2 (0.3)	<0.001
Alcohol Intake, %					
Never	31.4	20.9	15.5	13.8	<0.001
Former	23.8	29.3	28.8	30.5	
Current	44.7	49.8	55.8	55.7	
Preferred Language, %					
Spanish	67.7	77.8	75.7	67.1	<0.001

TABLE XV
DESCRIPTIVE STATISTICS FOR HISPANIC/LATINO ADULTS BY ACCELEROMETER-MEASURED MVPA: HCHS/SOL (N=12,179)

	Inactive (n=228)	**Low** (n=7,216)	**Moderate** (n=2,710)	**High** (n=2,025)	**p-value**
			(Cont.)		
English	32.3	22.2	24.3	32.9	
Years Living in US, %					
<10 years	27.4	30.2	27.1	23.6	0.07
≥10 years	72.6	69.8	72.9	76.4	
Immigrant Generation, %					
1st	76.8	77.6	75.5	70.4	<0.001
2nd or more	23.2	22.4	24.5	29.6	
Health Insurance, %	60.1	47.3	52.3	56.7	<0.001
Study Site, %					
Bronx	23.1	20.2	32.6	44.7	<0.001
Chicago	17.3	16.2	16.0	16.1	
Miami	37.0	36.3	22.7	17.6	
San Diego	22.5	27.3	28.6	21.6	
Hispanic/Latino Background, %					
Dominican	7.5	7.9	12.1	12.4	<0.001
Central American	5.9	7.5	7.7	7.0	
Cuban	28.3	26.1	14.0	10.0	

TABLE XV
DESCRIPTIVE STATISTICS FOR HISPANIC/LATINO ADULTS BY ACCELEROMETER-MEASURED MVPA: HCHS/SOL (N=12,179)

	Inactive (n=228)	**Low** (n=7,216)	**Moderate** (n=2,710)	**High** (n=2,025)	**p-value**
			(Cont.)		
Mexican	30.7	37.6	40.9	36.7	
Puerto Rican	19.0	12.8	16.2	23.7	
South American	5.0	4.3	5.8	5.5	
Other/More than one	3.6	3.8	3.4	4.6	
Health-Related Quality of Life, M (SE)					
MCS-12	48.9 (1.6)	48.8 (0.3)	50.2 (0.3)	49.8 (0.4)	0.0175
PCS-12	45.1 (1.1)	49.6 (0.2)	50.7 (0.3)	50.8 (0.3)	<0.001
Total Score	94.0 (1.8)	98.4 (0.4)	100.9 (0.4)	100.6 (0.5)	<0.001

Abbreviations: Mean: M. SE: Standard error.
[a]Means (except age and age group) and standard errors were weighted and adjusted for age. Proportions were weighted and adjusted for age. Frequencies are unweighted.
[b]Sleep duration in hours per day.
[c]Diet quality was measured using the Alternative Healthy Index Score (AHEI); range 0-110.
[*]MVPA categories are defined as: Inactive: ≥ 0 but <1 for moderate, and ≥ 0 but < 1 for vigorous activity on average per week. Low activity: ≥ 1 but < 150 mins of moderate or ≥ 1 but < 75 mins of vigorous; or ≥ 1 but < 150 mins of moderate/vigorous activity on average per week. Medium activity: ≥ 150 mins but < 300 mins of moderate, or ≥ 75 mins but < 150 of vigorous; or ≥150 but < 300 mins of moderate/vigorous activity on average per week. High activity: ≥ 300 minutes (mins) of moderate, or ≥ 150 mins of vigorous, or ≥ 300 mins of moderate/vigorous activity on average per week [derived from total mins per day with 1535-3961 counts/min for moderate activity, and ≥ 3962 counts/min for vigorous activity; and ≥ 1535 counts/min for moderate/vigorous activity- applies to all categories].

TABLE XVI
ASSOCIATION BETWEEN ACCELEROMETER-MEASURED MVPA AND HRQoL (MEAN [95% CI]): HCHS/SOL (N=12,179)

Unweighted N=12,179	**Inactive** Adjusted[a] Mean (95% CI)	**Low** Adjusted Mean (95% CI)	**Moderate** Adjusted Mean (95% CI)	**High** Adjusted Mean (95% CI)	**p-value for trend**
Total SF-12 score					
	97.1 (92.7, 101.5)	98.4 (97.8, 99.1)	100.5 (99.8, 101.1)	100.6 (99.7, 101.4)	**<0.001**
MCS					
	50.5 (47.0, 53.7)	49.1 (48.5, 49.6)	49.8 (49.2, 50.5)	49.2 (48.4, 50.0)	0.64
PCS					
	46.8 (44.9, 48.6)	49.4 (49.1, 49.7)	50.6 (50.1, 51.2)	51.3 (50.8, 51.8)	**<0.001**

[a]Adjusted for age, sex, education, household income, study site, and Hispanic/Latino background, marital status, diet quality, alcohol intake, health insurance, preferred language, length of stay in the US, immigrant generation, and cardiovascular disease, stroke, kidney disease, liver disease, inflammation or swelling of joints, and cancer.
[*]MVPA categories are defined as: Inactive: ≥ 0 but <1 for moderate, and ≥ 0 but < 1 for vigorous activity on average per week. Low activity: ≥ 1 but < 150 mins of moderate or ≥ 1 but < 75 mins of vigorous; or ≥ 1 but < 150 mins of moderate/vigorous activity on average per week. Medium activity: ≥ 150 mins but < 300 mins of moderate, or ≥ 75 mins but < 150 of vigorous; or ≥150 but < 300 mins of moderate/vigorous activity on average per week. High activity (referent): ≥ 300 minutes (mins) of moderate, or ≥ 150 mins of vigorous, or ≥ 300 mins of moderate/vigorous activity on average per week [derived from total mins per day with 1535-3961 counts/min for moderate activity, and ≥ 3962 counts/min for vigorous activity; and ≥ 1535 counts/min for moderate/vigorous activity- applies to all categories]

.

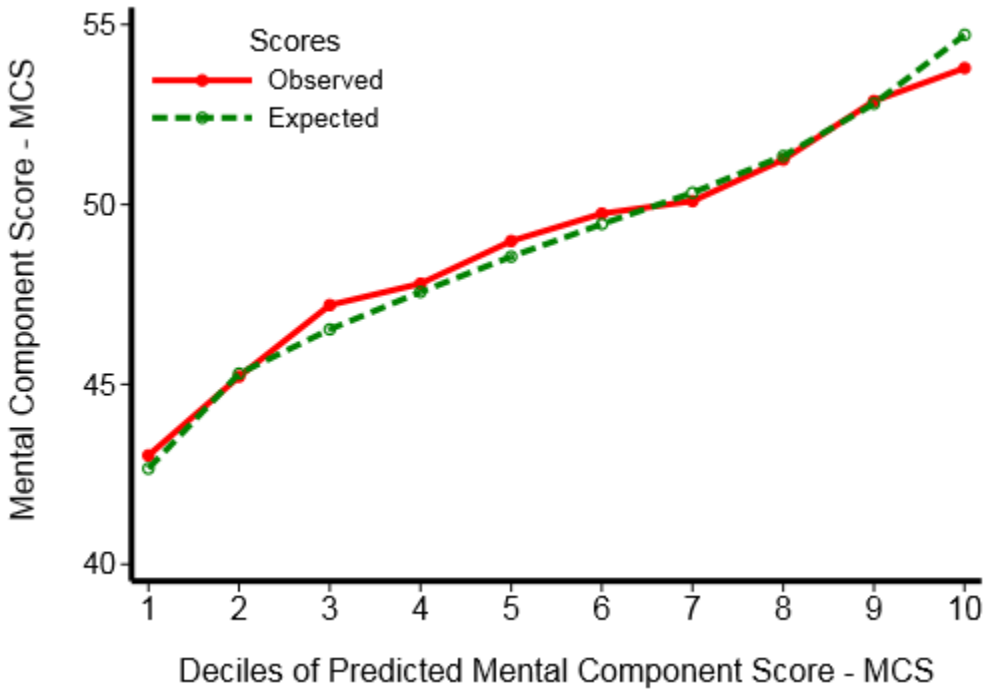

Figure 10. Goodness of fit for Chapter IV: Mental component score (MCS)

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VII. VITA

Priscilla M. Vásquez, MPH

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EDUCATION

Doctor of Philosophy Candidate in Kinesiology

University of Illinois at Chicago

Fall 2013 to Present

Master in Public Health, Community Health Sciences

University of Illinois at Chicago

May 2013

Bachelor of Arts in Literature

University of California, San Diego

February 2011

EXPERIENCE

Training in CVD Epidemiology & Related Chronic Diseases in Minority Populations

T-32 Pre-Doctoral Fellow at the Institute for Minority Health Research. *Fall 2015-present*

- Development of skills in Epidemiology and Biostatistics
- Research in Latino populations and cardiovascular diseases

LUCID Study: Latinos Unique scenario, Cognitive Impairment addressed via Dance

Data Collector. *Summer 2015-Fall 2015*

- Conduct cognition, balance, and walking testing at baseline and mid-intervention among participants with mild cognitive impairments
- Conduct all data collection in Spanish

BAILA Study: Being Active, Increasing Latinos Healthy Aging

Research Assistant. *Summer 2013-present*

- Recruitment for the multi-site dance study in Chicago
- Conduct cognition, balance, and walking testing at baseline and post-intervention for participants

Mycelia Project

Interviewer. *Summer 2013-Fall 2014*

- Facilitate the completion of a Photovoice project in a community garden
- Conduct interviews of participants perceptions of their community

Barriers to Colorectal Cancer Screening Study

Research Assistant. *Fall 2012-Summer 2013*

- Recruit, enroll, interview participants into screening study
- Collaborate and coordinate with research team and clinical staff for the implementation of the study

Chancellor's Committee on the Status of Latinos (CCSL)

Graduate Assistant. *July 2012-July 2013*

- Utilize Dreamweaver to update, manage, and maintain website
- Manage internal documentation of committee meetings

James A. Ferguson Fellowship- Infectious Diseases Research

Fellow. *May 2012-July 2012*

- A Center for Disease Control and Prevention funded fellowship that allowed for the development and completion of a research project under the mentorship an established researcher and physician
- Focus on a research project in sexually transmitted disease and infection among urban adolescent girls in the Baltimore, Maryland area that participated in a technology-based intervention for the duration of a year

UIC School of Public Health- Health Policy and Administration Department

Research Assistant*. November 2011-May 2012*

- Conduct literature reviews on breast cancer screening practices, culture and health in respect to cancer, Superfund site, and medically underserved areas
- Collect and organize data from online resources including census data, Chicago community area data, EPA data on Superfund, TRI sites as well as Brownfield sites

ORGANIZATIONS

American Heart Association| American Stroke Association

Student Member. *Spring 2016-present*

American College of Sports Medicine (ACSM)

Student Member. *Spring 2014-present*

- Ad Hoc Committee on Diversity Action Student Representative. *Spring 2015*

Society of Behavioral Medicine (SBM)

Student Member. *Spring 2014-Spring 2015*

Gerontological Society of America (GSA)

Student Member. *Fall 2013-Spring 2015*

Midwest American College of Sports Medicine (MWACSM)

Student Member. *Fall 2013-present*

- ACSM Midwest Chapter Leadership and Mentoring Program. *Fall 2013*

American Public Health Association (APHA)

Student Member. *Spring 2012-Spring 2013*

UIC INVOLVEMENT

Latino Cultural Center (LCC) Ambassadors Group

Ambassador. *Spring 2016*

- Advocate on behalf of LCC's mission within the UIC, Latino communities in the city of Chicago, and provide counsel on issues sought by LCC staff

Chancellor's Committee on the Status of Latinos (CCSL)

Committee Member. *Fall 2014-present*

- Assist in the organizing of the issues and concerns of Latino faculty, staff, students, and workers in order to advise the Chancellor

Hispanic Serving Institution Taskforce (HSI Taskforce)

Graduate Student Representative. *Spring 2014-present*

- Represent graduate student body in the discussion of attaining HSI designation

Latina/o Graduate Student Association (LGSA)

Board Member. *Summer 2014-present*

- Assisted in the foundation of this organization at UIC. *Fall 2012-present*

Minority Students for the Advancement of Public Health (MSAPH)

Student Body Member and Secretary. *Fall 2011-Spring 2013*

- Maintain communication among board members, document board and general meetings
- Facilitate planning of MSAPH events

Minority Health in the Midwest Conference Board

Communications Co-Chair. F*all 2011-Spring 2012*

- Publicize Annual UIC SPH Student-led conference to different organizations, schools, professionals, and students through creative marketing and mass emails
- Attend bi-monthly meetings to update and continue preparation for event

PUBLICATIONS

Marquez, DX, Wilson, RS, Aguiñaga, S, **Vasquez, P**, Fogg, LF, Yang, Z, Wilbur, J,

Hughes, S, & Spanbauer, C. (In press) Regular Latin dancing and health education may improve cognition of late middle-aged and older Latinos. Journal of Aging and Physical Activity.

Vasquez, P, Marquez, DX, Durazo-Arvizu, RA, Argos, M, Odoms-Young, A, Lamar, M, & Daviglus, ML. (In preparation) The association between physical activity and cardiovascular disease risk factors among Hispanic/Latino adults: Findings from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)

Vasquez, P, Marquez, DX, Durazo-Arvizu, RA, Argos, M, Carrion, V, Gallo, LC, Sotres-Alvarez, D, Odoms-Young, A, Lamar, M, Isasi, C, Castañeda, S, Perreira, K, Lash, J, Talavera, G, & Daviglus, ML. (In preparation) The role of psychosocial stress on the association between physical activity and cardiovascular disease risk factors among Hispanic/Latino adults: The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) Sociocultural Ancillary Study.

Vasquez, P, Marquez, DX, Durazo-Arvizu, RA, Argos, M, Odoms-Young, A, Lamar, M, Sotres-Alvarez, D, Gonzalez, H, Tarraf, W, Castañeda, S, Perreira, K, Mossavar-Rahmani, Y, & Daviglus, ML. (In preparation) The association between physical activity

and health-related quality of life among Hispanic/Latino adults in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)

Marquez, DX, Aguiñaga, S, **Vasquez, P**, Marques, I, & Martinez, M. (In preparation) "Physical activity interventions in Latino populations." Physical activity in diverse populations: Examining the evidence and strategies for practice (Melissa Bopp, Editor). Taylor and Francis, London.

Gonzalez, H, Tarraf, W, Davis, S, Gallo, L, Weir, B, Fornage, M, Daviglus, M, Schneiderman, N, Kaplan, R, Perreira, K, Ramos, A, **Vasquez, P**, & Lamar, M. (In preparation) The prevalence of mild cognitive impairment among diverse Hispanic/Latinos: HCHS/SOL SOL-INCA.

Vasquez, P, Marquez, DX, & Durazo-Arvizu, R. (In preparation) Body mass index and mortality in Hispanic/Latinos in the United States.

POSTER PRESENTATIONS

Vasquez, P, Marquez, DX, Durazo-Arvizu, RA, Argos, M, Carrion, V, Gallo, LC, Sotres-Alvarez, D, Odoms-Young, A, Lamar, M, Isasi, C, Castañeda, S, Perreira, K, Lash, J, Talavera, G, & Daviglus, ML (Meeting date: March 7-10, 2017) The role of traumatic stress on the association between physical activity and cardiovascular disease risk factors. American Heart Association| American Stroke Association- EPI Lifestyle, Portland, Oregon.

Vasquez, P, Aguiñaga, S, Wilson, RS, Fogg, LF, Wilbur, J, Hughes, S, & Marquez, DX Influence of Latin dance on physical activity among community dwelling older Latino adults. Poster to be presented at American Heart Association| American Stroke Association- EPI Lifestyle 2016, Phoenix, Arizona, March 2016.

Aguiñaga, S, **Vasquez, P,** Logsdon, R, & Marquez DX. Sedentary behavior, depression, and weight status among older Latinos with mild cognitive impairment. Poster presented at the Sedentary Behavior and Health Conference at the University of Illinois at Urbana-Champaign, October, 2015.

Vasquez, P, Wilson, RS, Fogg, LF, Wilbur, J, Hughes, S, & Marquez, DX. Increasing physical activity among older Latino adults. Poster to be presented at the annual meeting of the Gerontological Society of America, Washington, D.C., November 2014.

Marquez, DX, Caceres, M, Aguiñaga, S, **Vasquez, P,** & Janicek, SJ. Lessons learned in conducting health-related randomized controlled trials with older Latinos. Symposium presented at the annual meeting of the Gerontological Society of America, Washington, DC, November, 2014.

Vasquez, P, Aguiñaga, S, Wilson, RS, Fogg, LF, Wilbur, J, Hughes, S, & Marquez, DX. Increasing physical activity among older Latino adults. Poster presented at the International Conference on Aging in the Americas, Boulder, Colorado, September 2014.

Aguiñaga, S, **Vasquez, P,** Wilson, RS, Fogg, LF, Wilbur, J, Hughes, S, & Marquez, DX. Latin dance and health education: Influence on cognitive function. Poster presented at the International Conference on Aging in the Americas, Boulder, Colorado, September 2014.

Aguiñaga, S, **Vasquez, P,** Wilson, RS, Fogg, LF, Wilbur, J, Hughes, SL, & Marquez, DX. X. Latin dance and health education: Influence on cognitive function. Poster presented at the annual meeting of the Society of Behavioral Medicine, Philadelphia, PA, April, 2014.

Vasquez, P, & Trent, M. Feasibility and preliminary effectiveness of text messaging to reduce STI disparities among urban youth. Poster presented at the Pediatric Academic Society. Washington, D.C., May 2013.

Vasquez, P, Benitez, J, Chukwudozie, I, & Kim, S. Superfund & Brownfield Sites: Elevated cancer rates in disadvantaged communities of Cook County, IL. Poster presented at the American Public Health Association, San Francisco, CA, October 2012.

SYMPOSIUM

Marquez, DX, Caceres, M, Aguiñaga, S, **Vasquez, P,** & Janicek, SJ. Lessons learned in conducting health-related randomized controlled trials with older Latinos. Symposium to be presented at the annual meeting of the Gerontological Society of America, Washington, DC, November, 2014.

VOLUNTEER EXPERIENCES

Cook County Hospital- Fantus Clinic

Survey Administrator. *Fall 2012*

- Assisted patients in completely computer-based assessment prior to primary care doctor appointment
- Assessment captured quality of life and symptoms of patients

Health Fair at St. Pius Parish

Translator. *August 2012*

- Explain to patients the definition and importance Body Mass Index (BMI)
- Assist by taking height and weight measurements of adults and children

HIV/AIDS Screenings Event

Translator. *July 2012*

- Filled out forms for those who were seeking HIV/AIDS screening tests
- Translated for Spanish-speakers

Shaping our Health by Influencing Food Trends (SHIFT) Event

Group Facilitator. *May 2012*

- Group discussion with high school students about food, media, and food choices
- Provide a recording of the discussion to the research group

Woodlawn 3rd Annual Summit

Notetaker- Breakout Session: Green Healthy Neighborhoods Land Use Plan. *March 2012*

- Attend the Opening Session and a breakout session discussing the triumphs and challenges that the Woodlawn community area faces
- Provide a detailed summary of the topics discussed during the session

Center of Excellence in the Elimination of Disparities (CEED@Chicago)

Volunteer. *November 2011-Spring 2013*

- Transcribe phone conferences to maintain communication between coalitions
- Provide synopsis of previous literature reviews on the theoretical and practical frameworks of food production, distribution, and consumption

Common Threads Volunteer- Bethune Elementary School

Group Leader*. September 2011-December 2011*

- Teach elementary students (primarily minority and low-income) how to cook and eat nutritiously, and learn about different cultures through food
- Volunteered in special events: Michael Nye's *Hunger & Resilience* exhibit at St. James Cathedral, Kids Run at a Nest West Side community run

American Red Cross

Administrative Support. *February 2011-April 2011*

- Handle high volume of calls from event organizers seeking to form a partnership with the American Red Cross in an effort to fund-raise for the 'Japan and The Pacific Tsunami' Relief Fund
- Collect and organize mandatory forms for the partnerships and answer questions from callers

CERTIFICATION/TRAINING

Collaborative Institutional Training Initiative (CITI Program) *Spring 2014-Spring 2016*

- Human Research, Social/Behavioral Research Investigators and Key Personnel

Health Insurance Portability and Accountability Act (HIPPA) *Fall 2015-present*

Physical Activity and Public Health Research Course

National Institute of Public Health, Cuernavaca, Morelos, Mexico. *July 27,2015-August 1, 2015*

- Latin American and international efforts to address public health concerns
- Research methods for physical activity research

First Aid/CPR/AED Certification

October 2013, 2015

- Attained the up-to-date protocol for First Aid/CPR/AED

Sister to Sister Intervention

Trainee. *June 2012*

- Provide one-on-one counseling in a medical setting to African American women about sexual health
- Aim of intervention is to provide women with tools to reduce their risk of HIV/sexually transmitted diseases

California Department of Public Health: Certified Phlebotomy Technician I

Certification Number: 4411-0616

Date: March 2010

Chula Vista Family Clinic

Lab Technician (Internship). *January 2011-February 2011*

- Perform venipunctures and finger-sticks in a fast-pace lab with all-age patients, in a predominantly Latino community
- Centrifuge blood samples and record the results of the glucose test