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Does Marriage, Employment and Having Children Matter? A Secondary Analysis on Physical Activity Levels, Leisure Time Physical Activity, and Social Roles Among Women in the United States

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DOES MARRIAGE, EMPLOYMENT AND HAVING CHILDREN MATTER?
A SECONDARY ANALYSIS ON PHYSICAL ACTIVITY LEVELS, LEISURE
TIME PHYSICAL ACTIVITY, AND SOCIAL ROLES AMONG WOMEN IN
THE UNITED STATES

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DEDICATION

I would like to dedicate this dissertation to the women out there who are

continually striving to take care of themselves. We see you and you can do it.

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I would like to offer my sincere appreciation to those who have encouraged me and supported me throughout my journey.

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ABSTRACT

Background: Social roles, such as being married, employed, or having children, have been shown to have independent negative relationships with moderate to vigorous physical activity (MVPA) levels among women. Increasing the number of women with children that meets physical activity guidelines is critical to reduce chronic disease and early mortality in this population. However, few studies have examined the relationship between holding multiple social roles, MVPA, and leisure-time physical activity (LTPA) among women with children. The study had two aims: 1) to determine the relationship between objectively measured MVPA by social roles and 2) to examine the frequency of specific leisure time physical activities by social role. In addition, mean daily MVPA minutes and status of meeting MVPA guidelines among women with children by social role were measured. For this study, social role is defined as employment status, marital status, and phase of motherhood, which is defined by age category of youngest child (< 6 years, 7-13 years, and > 13 years).

Methods: The sample consisted of women (ages 18-60) from the 2003-2006 National Health and Nutrition Examination Survey (NHANES). Each participant wore an accelerometer (ActiGraph-AM 7164) for at least four days with at least 10 hours of daily wearing. Prevalence of types of LTPA and minutes of MVPA by social role was analyzed among women with children by social role was also examined. Adjusted multiple linear regression analysis was used to examine the association between daily mean MVPA minutes and all social roles: marital status, employment status, and age

range of youngest child. Bivariate analysis was used to determine prevalence of LTPA and status of meeting MVPA guidelines.

Results: For the first aim, employment status and phase of motherhood were associated with MVPA after controlling for the participant's age, race, education, household income, and participant BMI ($p=.0000$). Homemakers compared to employed women had less daily MVPA ($p=0.036$) and women whose youngest child was under 6 ($p=0.008$) or over 13 ($p=0.006$) had significantly less daily MVPA minutes per day compared to women whose youngest child was between the ages of 6 and 13.

For the second aim, walking was the most frequently reported LTPA activity by social role among the participant sample. In the bivariate analysis, women whose youngest child was over the age of 13 were less likely to meet MVPA guidelines (29%) compared to women whose youngest child was under 6 (42%) or between the ages of 6 and 13 (46%).

Conclusion: Results from our study indicate that employment status and phase of motherhood should be considered when developing policies or interventions to increase MVPA among women with children. In addition, our study found that walking is a popular LTPA among women with children across social roles. Overall, understanding the influence of social roles on MVPA and LTPA among women with children can help to address the challenges in increasing PA among women with children.

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LIST OF ABBREVIATIONS

ACSM .... American College of Sports and Medicine

AHA .... American Heart Association

BMI .... Body Mass Index

CAPI .... Computer Assisted Personal Interview

CDC .... Centers for Disease Control

CPM .... Counts Per Minute

DHQ .... Demographic Health Questionnaire

DMQ .... Demographics Questionnaire

GLTEQ .... Godin Leisure Time Exercise Questionnaire

KPAS .... Kaiser Physical Activity Survey

LPA .... Light Physical Activity

LTPA .... Leisure Time Physical Activity

MEC .... Medical Examination Center

MET .... Metabolic Equivalent

MVPA .... Moderate to Vigorous Physical Activity

NCD .... Non-communicable Diseases

NCHS .... National Center for Health Statistics

NHANES .... National Health and Nutrition Examination Survey

NHIS .... National Health and Interview Survey

OCQ .... Occupational Questionnaire

PA ....Physical Activity

PAM...Physical Activity Monitor

PSU ....Primary Sampling Units

RHQ ....Reproductive Health Questionnaire

WHO ....World Health Organization

YRBSS... Youth Risk Behavior Surveillance Survey

CHAPTER 1

INTRODUCTION

1.1. PROBLEM STATEMENT

Physical activity has been recognized as an important factor in increasing longevity, quality of life, and reducing risks of early mortality and comorbidities such as heart disease, stroke, some cancers, and diabetes (WHO, 2018). However, most Americans do not meet minimum recommendations for physical activity to gain health benefits (CDC, 2015a). In addition, women are more likely than their male counterparts to participate in less physical activity at every stage of the life course (CDC, 2014).

Research, policies, and interventions have targeted women in an attempt to reduce the mortality, morbidity, and cost (estimated at up to 131 billion U.S. dollars yearly) related to inadequate physical activity (Carlson et al., 2015). However, to address inadequate physical activity among women, it is imperative to consider social roles, such as becoming employed, getting married, and having children, which are life transitions that are associated with declining physical activity among women (Brown & Trost, 2003).

Although objective data are available, little research has been done to determine daily average minutes of Moderate to Vigorous Physical Activity (MVPA) among women and the association between MVPA levels and social roles such as marriage, employment, and motherhood. In addition, there is limited understanding of which type of leisure time physical activity (LTPA) are preferred among women with children by

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marital status, employment status, and age of youngest child. This study utilized a national sample of women with objectively measured moderate to vigorous activity (MVPA) and to examine the association between MVPA and LTPA by marital status, employment status, and age category of youngest child. Data were obtained from the 2003–2006 National Health and Nutrition Examination Survey, which includes accelerometer data, for 476 women (18–60 years) to conduct this study. The theoretical framework that guided the study is the "Ecological Model of Four Domains of Active Living" which acknowledges the influence of family situation and occupation on physical activity (Sallis et al., 2006).

The study addressed the following specific aims:

Specific Aim 1:

Determine the relationship between objectively measured MVPA and marital status, employment status, and phase of motherhood (age of youngest child being < 6 years, 7-13 years, or > 13 years) controlling for race/ethnicity, mother's age, income, education, and BMI.

Hypotheses

   a. Women who are employed will have higher daily mean MVPA than unemployed women

   b. Women who are married will have lower daily mean MVPA than women who are not married

   c. Among women with children, those with children aged 6 and under, daily mean MVPA will be lower compared to women whose youngest child is 6 years of age or older

Specific Aim 2:

Examine the frequency of specific types of leisure time physical activities among women with children, in addition to measuring mean daily MVPA minutes and status of meeting MVPA guidelines among women with children by social role. Social role is defined as employment status, marital status, and phase of motherhood (age of youngest child being < 6 years, 7-13 years, or > 13 years).

Hypothesis

a. Among the participant sample of women with children, the most popular types of LTPA will vary by marital status, employment status, and phase of motherhood.

This research adds to the body of literature by addressing physical activity among women with children from the lens and context of social roles, namely, employment status, marital status, and age of child. The following chapters will address: 2) background and significance, 3) Methodology, 4) Manuscripts for Specific Aim 1 and manuscript for Specific Aim 2, and 5) Summary, Implications, and Recommendations.

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CHAPTER 2

BACKGROUND AND SIGNIFICANCE

2.1. DEFINITION OF PHYSICAL ACTIVITY

"Physical activity (PA) is defined as any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen et al., 1985). Physical activity and exercise are not synonymous; rather, exercise is a means of engaging in physical activity (WHO, 2018). Exercise is defined as any activity that seeks to maintain or improve physical activity, regardless of whether it is structured, planned, or repetitive (WHO, 2018).

2.2. PHYSICAL ACTIVITY INTENSITY

Physical activity is measured commonly by intensity. To estimate physical activity intensity, researchers typically use level classifications such as vigorous, moderate, light, or sedentary activity. These level classifications are usually denoted by name and acronyms, such as Vigorous Physical Activity (VPA), Moderate to Vigorous Physical Activity (MVPA), Moderate Physical Activity (MPA), and Light Physical Activity (LPA). These level classifications are classified METs, metabolic equivalents, values and are linked to specific activities to which these values are classified. A MET is defined as the ratio of an activity's metabolic rate and the resting metabolic rate (Tudor-Locke et al., 2011). Based on the model proposed by Pate (1995), a coding method of classifying physical activity intensity is by rate of energy expenditure. METs value

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assigned are: light, < 3 METs; moderate, 3-6 METs; and vigorous, > 6 METs (Pate, 1995).

2.3. TYPES OF PHYSICAL ACTIVITY

In addition to PA intensity levels (i.e. VPA, MVPA, MPA, LPA, and sedentary), PA may also be classified by context or type such as leisure time, occupational physical activity, and transportation physical activity (See Table 2.1) (Troiano et al., 2008; U.S. Department of Transportation, 2016). VPA includes running, singles tennis, aerobics, and jump rope, while MPA would include walking, hiking, doubles tennis, pushing a lawnmower (B. E. Ainsworth et al., 1993). In literature, VPA and MPA are often combined and considered MVPA (>3 METs). LPA, such as slow walking, light chores, or light gardening involves an energy expenditure of 1.6-2.9 METs (Pate et al., 2008). Contexts in which physical activity can be performed includes occupational (for example, construction work), transportation (e.g. walking or cycling to work), and Leisure-Time Physical Activity (LTPA) (i.e. walking, dancing, or swimming) (Caspersen et al., 1985; Troped et al., 2003; WHO, 2018). Sedentary behavior, described as resting quietly, studying, sitting, or watching television involves energy expenditure of 1.0-1.5 METs (Pate et al., 2008).

2.4. PHYSICAL ACTIVITY RECOMMENDATIONS

The World Health Organization (WHO), Physical Activity Guidelines for America association, American Heart Association (AHA), and American College and Sports Medicine (ACSM) all concur with the following guidelines: 150 minutes per week of moderate intensity exercise (i.e. walking) or 75 minutes per week of vigorous exercise (i.e. running) (American College and Sports Medicine & American Heart Association, 2007; US Department of Health and Human Services, 2008, 2008). In addition to aerobic

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activity and avoiding sedentary behavior, recommendations also include strength training at least twice a week and stretching all major muscle groups (American College and Sports Medicine & American Heart Association, 2007; CDC, 2015a; WHO, 2017). The purposes of physical activity recommendations are to increase quality of life, longevity, and reduce risk factors, morbidity, and comorbidities associated with sedentary behavior.

2.5. PHYSICAL ACTIVITY AND RISK OF MORBIDITY, COMORBIDITY, AND QUALITY OF LIFE

Participation in physical activity reduces the risk for non-communicable diseases (NCD), increases quality of life, mental well-being, and reduces incidence of obesity (CDC, 2014). World Health Organization (WHO) estimates that physical inactivity is the 4th leading cause of death, responsible for an estimated 3.2 million deaths annually (WHO, 2017). Negative health outcomes associated with insufficient physical activity are higher rates of hypertension, obesity, heart disease, cancer, stroke, accelerated brain aging, metabolic syndrome, and diabetes (Flegal et al., 2016; Heron, 2016; National Center for Health Statistics, 2016; C. Ogden et al., 2013; Tucker et al., 2016; Willey et al., 2016). In 2014, the top ten causes of death were responsible for 74% of all deaths occurring in the United States (Heron, 2016). Research indicates that increasing physical activity reduces the risk for the following NCDs in the top 10 (See Figure 2.1), including: #1) heart disease, #2) cancer #4) cerebrovascular disease (i.e. stroke), #5) Alzheimer's disease, #7) diabetes mellitus, and #9) kidney disease (Heron, 2016; Reiner et al., 2013) (Figure 2.1).

2.6. CARDIOVASCULAR DISEASE

Cardiovascular disease is the leading cause of death among women (Heron, 2016). Hypertension, an important risk factor for cardiovascular disease, increases the

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risk for having a stroke or kidney failure, the 4th and 9th top causes of death among women, respectively (CDC, 2018b; Heron, 2016).   According to the American Heart Association, physical inactivity is a risk factor for heart disease (Lloyd-Jones et al., 2010). Physical activity has as direct effect on blood pressure and can be used to manage mild to moderate hypertension (Carpio-Rivera et al., 2016; Ghadieh & Saab, 2015). Evidence suggests that there is a consistent and general reduction of risk of hypertension when meeting PA recommendations of 150 MVPA minutes per week (Lackland & Voeks, 2014).

Exercise has become a part of clinical therapy in stable cases of cardiac artery disease, after myocardial infarctions, and heart failure (reduced ejection fraction) (Gielen, 2017).   Furthermore, myocardial infarction, the process of myocardial cell death, is indicated by the elevation of cardiac troponins in the blood stream. Research indicates that cardiac troponins are positively related to sedentary behavior (Harrington et al., 2017).

2.7. TYPE 2 DIABETES

Type 2 diabetes is a condition where cells stop responding to insulin (reduced insulin sensitivity) leaving glucose in the bloodstream (CDC, 2017a). Although this serious condition which is can lead to kidney failure, heart disease, stroke, and vision loss, the disease outcome and prognosis is modifiable (CDC, 2018c). Physical activity is positively associated with increased insulin sensitivity in people with type 2 diabetes and those without diabetes (Albright et al., 2000; Andrews et al., 2011). In type 2 diabetics and nondiabetics, vigorous activity, specifically high intensity exercise, can improve blood glucose from 1-3 days post-training (Adams, 2013). Furthermore, exercise also

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improves nerve functioning related to diabetic foot, a condition in which can lead to amputations for diabetes (Matos et al., 2018).

2.8. CANCER

Studies suggest that physical activity reduces the incidence of cancer (I. M. Lee, 2003; WHO, 2018). Hypotheses suggests that the effects of physical activity on biological mechanisms such as hormones, insulin release, and body composition and the effect on the body alters cancer (Friedenreich et al., 2010). Adhering to physical activity recommendations can result in health benefits that are associated with reduced risk of colorectal cancer (Vries et al., 2010). The risk of breast cancers is decreased by increasing dosage of moderate, or vigorous physical activity (Wu et al., 2013). In addition, survival rates may be increased among cancer survivors, including breast cancer survivors who participate in physical activity (i.e. walking) (Holmes et al., 2005; Ibrahim & Al-Homaidh, 2011). This may be due to lower odds of recurrence, which are influenced by physical activity. These cancer biomarkers include immunity, insulin circulation, and inflammation (Ballard-Barbash et al., 2012).

2.9. OBESITY

Obesity, defined as a body mass index (BMI, kg/m2) in excess of, 30 kg/m^2. is related to the leading causes of preventable death, such as heart disease, stroke, type 2 diabetes, and certain cancers (CDC, 2018a). In addition, risk of the disease and consequences are increased by the presence of obesity (Bray, 2004). Additional consequences of obesity relate to the increase in adipose tissue, joint issues and sleep apnea (Bray, 2004). CDC estimates that over 1/3 of women in the U.S. are obese (36.5%) (C. L. Ogden et al., 2014). Despite shorter life expectancy of those who are

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obese, medical costs may be higher (Nagai et al., 2012). Estimates of medical costs associated with obesity were approximately 147 billion dollars in 2008 (CDC, 2018a).

Recommendations of lifestyle modification to decrease incidence of obesity involves physical activity (Wadden et al., 2012). Physical activity is associated with an increased likelihood of weight loss and weight gain prevention (Choi et al., 2012). Furthermore, those who are physical active have smaller increases in waist circumference that their less active counterparts (Choi et al., 2012; Kyryliuk et al., 2015; Barbara Sternfeld et al., 2004).

2.10. PHYSICAL ACTIVITY AND MENTAL HEALTH

In addition, to physical benefits, those who engage in adequate PA increase the likelihood of improved mental health and prevention of depression. Low levels of LTPA is independently associated with cognitive decline, a risk factor to dementia (Willey et al., 2016). Engaging in regular physical activity, moderate or vigorous, may lower risk for anxiety and depression (De Mello et al., 2013; Mammen & Faulkner, 2013b; Robertson et al., 2012). Furthermore, a study by Searle et al (2011) indicates general practitioners generally believe physical activity assists in managing depressive symptoms.

2.11. COST OF PHYSICAL INACTIVITY

A review found that insufficient physical activity is related to all-cause mortality and comorbidities such as cardiovascular disease, type 2 diabetes, metabolic syndrome and some cancers (Rezende et al., 2014). These health impacts also have an economic cost. Carlson et al (2015) estimated that yearly, $117-$131 billion dollars were associated with inadequate physical activity. This data was analyzed using the National Health Interview Survey (2004-2010) and Medical Expenditure Panel survey (2006-

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2011) (Carlson et al., 2015). Inadequate or insufficient physical activity was defined as adults either reporting no physical activity or reporting levels that were below recommended guidelines. The National Health Interview Survey and the Medical Expenditure Panel survey linked data from both surveys and an econometric model was used to conduct the analysis (Carlson et al., 2015).

Another study examined the relationship between physical activity and heath service utilization and cost in the United States (Kang & Xiang, 2017). Again, data used were from the Medical Expenditure Panel-Household Survey (2007-2011). Regular physical activity was defined as exercising at least three times per week. Results found that adults who engaged in regular physical activity had lower costs in in-patient, emergency room, home health care, and prescription medicine costs (Kang & Xiang, 2017). In addition, adults who engaged in regular physical activity spent less on in-patient, office visits, and home health care (Kang & Xiang, 2017).

In conclusion, there are many benefits associated with physical activity and achieving recommended physical activity levels. Benefits such as increased quality of life, ability to perform activities of daily living, and increased longevity have been documented (CDC, 2015b; Warburton et al., 2010). Overall, it is clear that increasing physical activity is a major factor in achieving optimal health.

2.12. WOMEN AND PHYSICAL ACTIVITY

Despite the potential benefits of engaging in PA at the recommended level, only 49% of adults in the United States meet physical activity aerobic guidelines (Blackwell et al., 2014a). From 1988-2010, adults reporting no leisure time physical activity increased from 19.1% to 51.7% and from 11.4% to 43.5% among women and men, respectively (Ladabaum et al., 2014).

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Across the life span, women are generally less active than their male counterparts (CDC, 2014; Nader et al., 2008; Telford et al., 2016; Troiano et al., 2008; Trost et al., 2002). According to National Health Interview Survey (2014), only 45% of women meet sufficient levels of aerobic guidelines for PA and 54% are inactive or sufficiently inactive (Blackwell et al., 2014a). Fifty-one percent of women meet neither aerobic or muscle strengthening guidelines and only 17.6% of U.S. women meet full guidelines for aerobic activity and muscle-strengthening activity (Blackwell et al., 2014a). As research indicates that women do not meet recommended physical activity levels, understanding the factors that are associated with PA and how these factors interrelate with one another and interact with PA is critical to understanding how to physical activity levels among women.

Specific intervention and education efforts in addition to broad-based policy, program, and environmental initiatives are needed to increase physical activity among women (Baker et al., 2015; Prince et al., 2014; van Sluijs et al., 2011). These efforts should be based on understanding determinants that influence intensity, duration, and type of physical activity (Addy et al., 2004; Bauman et al., 2012; Beighle & Morrow, 2014; Brownson et al., 2001; Cleland et al., 2015; Dishman et al., 1985; Flegal et al., 2016; Giles-Corti & Donovan, 2002; Horodyska et al., 2015; Li et al., 2012; Soderlund, 2016; Solmon, 2015).

2.13. LIFE TRANSITION AND PHYSICAL ACTIVITY

The transition to adulthood for women includes changes in the areas of location, educational pursuits, employment, living arrangement, relationship status, and social roles (Allender et al., 2008). Due to a variety of reasons presented in the sections below, inverse effects may occur between experiencing a life change and engaging in physical

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activity (Larouche et al., 2012a; Taniguchi & Shupe, 2014). Below is a review of the evidence that examines life changes among women and the implications for physical activity and identifies gaps in current research on physical activity levels among women.

2.14. MARITAL STATUS AND PHYSICAL ACTIVITY

Change in a relationship status, such as marriage, is considered a life change event as it is a significant change that can occur across the life course (Allender et al., 2008). Although literature indicates that marriage may have health benefits, such as contributing to reduced risk heart disease and improved medication adherence with diabetes, the associations between physical activity and being married are mixed in literature (Haines et al., 2018; J. Liu et al., 2014; Lo et al., 2016). Most literature indicates that marriage in women is associated with a decrease in PA although there is some evidence for no association and an increase in PA (Allender et al., 2006, 2008; Berge et al., 2011; Engberg et al., 2012a; Ortega et al., 2011). These are presented below.

A longitudinal study with over 20,000 Australian women found a negative association between physical activity levels and marriage over a period of three years. Results of the self-report analyses indicated getting married was associated with increased odds of decreasing physical activity (Brown & Trost, 2003). Another Australian study, using self-reported data for over 11,000 women (aged 20-27) again found that those who were married had the lowest odds of being active (Uijtdewilligen et al., 2015).

A 19-year longitudinal study in Germany also examined the impact of relationship status on physical activity (Rapp & Schneider, 2013). Through self-report data collected on over 11,000 married couples, analyses found that there was a negative

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effect of marriage on physical activity which continued into old age for women, even after adjusting for age and presence of children (Rapp & Schneider, 2013).

A 12-year longitudinal Finnish study found that a change in relationship status meant a negative change in physical activity behavior (Josefsson et al., 2018). The study examined the association between change in relationship status and change in smoking, alcohol consumption, BMI and physical activity. Data was collected in four phases and found that all behaviors showed associations with relationship status change (Josefsson et al., 2018). Specifically, physical activity decreased when entering a relationship and decreased after losing or exiting that relationship (Josefsson et al., 2018).

Brown and Trost (2003) augments the conclusions above that marriage is associated with a decrease in physical activity. A four-year follow-up longitudinal study indicated that Australian women (n=7281) who reported being active at baseline were more likely to report being inactive if they married at follow-up (Brown & Trost, 2003). Recommendations concluded with advising strategies to promote physical activity specific to life-change events (Brown & Trost, 2003).

There are studies where the results indicate that marriage is not associated with physical activity changes. Ortega (2010) reported only modest reductions in physical activity among Texas women (after changing from single to married). In addition, Hull (2010) found through a University of Pittsburgh study (n=638) that changing from single to married was not significantly associated with a change in physical activity status. However, both Ortega and Hull had low sample sizes (n=37; n=60, respectively) regarding the sub-group of women participants who were in the category that changed from single to married (Hull et al., 2010; Ortega et al., 2011).

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Berge (2011) found increases in physical activity among married women whose spouses promoted health behaviors. The results of this population-based cohort study (n=1212) indicated that the likelihood in participating in >3.5hrs of physical activity per week was associated with health promotion attitudes and behaviors of their spouse (Berge et al., 2011). Those whose spouse promoted healthy behaviors were more likely to participate in more than 3.5hrs of physical activity per week, compared to young women whose spouses did not promote healthy behavior (Berge et al., 2011).

Allender (2008) also found that transition from single status to marriage was associated with significant positive changes. Over the course of 10 years, a population-based sample (n=558) reported their marital status and their physical activity levels through structured interviews (Allender et al., 2008). Those who were single did not have significant change in their physical activity while those who were married experienced a decline pre-marriage followed by a rise and leveling off of physical activity levels (Allender et al., 2008).

Overall, the relationship between marriage and health indicators vary and may coincide with relationship quality (W. J. Brown et al., 2009; Robles, 2014; Smith et al., 2014). Evidence indicates that there is change in physical activity levels after marriage and these changes can mean a decrease in physical activity for some.

Overall, studies in the literature may not address the intersectionality of marriage with physical activity or if marriage is examined, motherhood or employment status may not be addressed. By not addressing marriage, or only addressing marital status, independent of related social roles approach can misrepresent the key life event changes and mechanisms through that simultaneously impact physical activity. Therefore, it is

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appropriate to examine the association of marriage with physical activity while including relevant coexisting variables.

2.15. MOTHERHOOD AND PHYSICAL ACTIVITY

Parenthood overall is correlated with a decline in physical activity among women (Bellows-Riecken & Rhodes, 2008; Brown & Trost, 2003; Hamilton & White, 2010; Hull et al., 2010; Larouche et al., 2012a; McIntyre & Rhodes, 2009). Women are less likely to exercise or participate in physical activity through all stages of the life course compared to their male counterparts and this holds true in parenthood as well (Bellows-Riecken & Rhodes, 2008). Studies have captured qualitative and quantitative data to explain and describe the reduction of physical activity that coincides with the onset of parenthood among women.

Reduction of physical activity among women who become parents starts at the pregnancy stage. Transition stages, such as pregnancy and post-partum, are correlated with lower physical activity levels (Evenson et al., 2004; Huberty et al., 2016). Women who are pregnant perceive that they: 1) are already active, 2) lack time to participate in physical activity, 3) lack motivation, and 4) lack social support (Coll et al., 2017). In addition, women may not know physical activity guidelines that they should be meeting (Connelly et al., 2015). Moderate to vigorous physical activity levels begin to decline during the third trimester of pregnancy and continue postpartum (Evenson & Wen, 2010; Gaston & Cramp, 2011; Pereira et al., 2007).

After birth, physical activity levels continue to decline. As women transition into motherhood, perceptions regarding time available to exercise, level of fatigue, social support and childcare needs change as well (McIntyre & Rhodes, 2009). Therefore, it is not surprising that insufficient physical activity levels almost double postpartum (6

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months) among women (12.6% to 21.7%) (Pereira et al., 2007). Predictors of decreasing physical activity after pregnancy include working long hours during first trimester, weight retention after pregnancy, and lack of childcare (P. R. Brown et al., 2001; Pereira et al., 2007). Also, mothers may perceive that they are "already active" (Schmidt et al., 2006). This may be supported by studies that indicate mothers of young children participate in more light physical activity through caretaking duties and therefore may engage in more overall activity than their counterparts without children (Gaston et al., 2014; Schmidt et al., 2006). Caretaking duties, including chores, may increase by two hours per day for women post-birth which can reduce availability of leisure time for physical activity (Craig & Mullan, 2010; Yavorsky et al., 2015)

As the mother moves from having an infant to a young child, research indicates that physical activity levels still do not meet recommendations. In fact, children at home (<16 years of age) increase the likelihood of insufficient physical activity among mothers (Berge et al., 2011; Gaston et al., 2014; B. Sternfeld et al., 1999; Uijtdewilligen et al., 2014). Younger children (<5 years of age) in the home negatively influence activity levels and available leisure time for parents (B. Sternfeld et al., 1999). Two studies found that mothers were less likely to enjoy exercise with young children as it inhibited their choice of activity and enjoyment (Freysinger, 1994; Henderson, 1996). Studies measuring impact of parenthood on physical activity found that having a child under six was associated with the lowest amount of MVPA and that mothers participated in 7.7 less minutes per day of MVPA than their counterparts without children (Adamo et al., 2012; Gaston et al., 2014).

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As the child ages, mothers may increase their MVPA, but their sedentary time may increase, also. A study by Gaston et al (2014) found that mothers whose children were in the age range of 12-15 engaged in more sedentary time than women without children. However, results also indicated that parents engaged in more LPA than non-parents, though less MVPA (Gaston et al., 2014).

Having even one child lowers a women's odds of being physically active (Uijtdewilligen et al., 2015). Barriers to inactivity among mothers may include low self-efficacy, low prioritization, and inadequate planning of physical activity (Mailey et al., 2016). Suggestions for overcoming these barriers include focusing on increasing self-efficacy to overcome exercise barriers, reducing the perspective that these barriers are insurmountable, and providing assistance to parents in the areas of planning for and engaging in exercise (Mailey et al., 2016).

An active 35-year-old woman who is married with two children shared her perspective in nine interviews for a qualitative study that explored identity and physical activity (McGannon & Schinke, 2013). Themes that emerged were that there was a patriarchal discourse and an identity as a "super mother" or "good mother" that was driving behavior relative to physical activity (McGannon & Schinke, 2013). With the patriarchal discourse, the interviewee discussed that at a nuclear family with, the husband was the provider of the household, and the woman's role centered on childcare and domestic labor (McGannon & Schinke, 2013). In addition, as a super mother, to care for the family, other pursuits (i.e. career, personal hobbies, exercise) can be sacrificed to fulfill that role (McGannon & Schinke, 2013). In addition, mothers who do not fulfill the role of taking care of the house and care for the children may be perceived as inadequate.

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Time spent on personal pursuits, therefore, was accompanied by guilt (McGannon & Schinke, 2013). In addition, interviews from her husband revealed that he supported working out as long as it did not affect him or the kids (McGannon & Schinke, 2013). This discourse suggests that there are social impediments to physical activity for mothers and partner support may inhibit self-efficacy.

A 2002 intervention with 554 Australian women, with young children (ages 2-5), found that women who attended a group session where they shared strategies were significantly more likely to meet PA guidelines compared to women who only received print interventions and/or surveys (Miller et al., 2002). Limitations of the study were that PA levels of the participants were measured through self-report, which increases the probability that social desirability influenced reported physical activity levels. In addition, although PA strategies were implemented for group 3 participants following the group session, the study found that the intervention effect was small at 8-weeks follow-up and changes were not significantly different from the other groups at long-term follow-up (Miller et al., 2002). However, results indicate partner support from women in similar life stages may be related to self-efficacy and increasing PA levels among this population (Miller et al., 2002).

Self-efficacy and exercise readiness were constructs found to be correlated to short-term increases in physical activity among low-income mothers (Clarke et al., 2007; Fahrenwald et al., 2004; Jordan et al., 2008). Low-income mothers who lost weight during an 8-week nutrition and physical activity program reported fewer perceived physical activity barriers than those who did not lose weight (Clarke et al., 2007). Moms on the Move, an intervention program for U.S. women on WIC (a food supplement

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program) found that provider-counseling approach was significantly correlated to higher physical activity levels (Fahrenwald et al., 2004). Limitations are that providing counseling and comprehensive physical activity programs to low-income mothers may not be sustainable for the long-term due to cost needed to maintain increases of PA in large population (Fahrenwald et al., 2004). In addition, self-efficacy and exercise readiness has already been correlated to PA many studies, however, there is limited evidence that self-efficacy and exercise readiness can influence long-term increases in PA if external challenges related to life transitions, social roles, and time available to exercise are not addressed.

A systemic review of twelve interventions of mothers with children found that counseling on mother-specific barriers and encouraging community involvement in intervention development and implementation improved effectiveness (Hartman et al., 2011). Out of the 12 interventions selected for the review, only six had positive or significant reviews (Hartman et al., 2011). Factors that were present in effective interventions were: 1) formative research, 2) based in theory, 3) behavior change strategies, 4) evidenced-based strategies and/or target-audience based (Hartman et al., 2011). Fahrenwald et al (2004) incorporated counseling about perceived barriers and worked with mothers to plan how to overcome these barriers. These strategies were subsequently used in the intervention.

Overall, the literature indicates that transition to motherhood and motherhood is associated with barriers to exercise among women. Barriers commonly found among all mothers are fatigue, lack of motivation, and lack of time. Whereas other barriers are more specific to employment status, marital status, and phase of motherhood. These

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barriers include managing work-life balance, navigating structured schedules, finding care for children during exercise, and obtaining the support of a spouse (i.e. spouse agrees to care for the children while mother exercises). It is clear that to address physical activity deficiencies, barriers specific to being a mother must be addressed.

2.16. EMPLOYMENT AND PHYSICAL ACTIVITY AMONG WOMEN

Macro-economic changes such as deindustrialization within the 20th and 21st century has influenced the employment industry in which services and knowledge is being provided in lieu of goods (Rind & Jones, 2014). This restructuring of the workforce may be associated with declining levels of physical activity throughout the population. Literature indicates that employment is related to a decrease in physical activity and increase in sedentary behavior among U.S. men and women (Castillo-Retamal & Hinckson, 2011; Kwak et al., 2016; Larouche et al., 2012a). Long work hours, stress, and sedentary behavior at work increase the risk of overall physical inactivity among adults (Kirk & Rhodes, 2011).

The percentage of women in the workforce has increased steadily from the 1970's and in 2015, 129 million or 51.7% of the civilian population in the workforce were women (Department of Labor, 2016). Currently, 57% of women participate in the U.S. labor force and 52 million full time workers are women (U.S. Bureau of Labor Statistics, 2017). In addition, most women (70%) who are employed have children under the age of 18 (Department of Labor, 2016; U.S. Department of Labor, 2013).

As occupational factors contribute to physical inactivity, the work environment must consider designing workplaces that promote and increase physical activity (Chin et al., 2016). As sedentary levels have steadily increased, employers have begun to incorporate strategies in the form of incentives, such as step contests, Fitbit contests,

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replacing a desk with a treadmill while doing desk work, financial incentives, promotion of interrupted sitting periods, and promotion of exercising right after work (Audrey et al., 2014; Ben-Ner et al., 2014; Buckley et al., 2015; Feuerhahn et al., 2014).

To improve progress in reducing sedentary activity related to occupation, research needs to include gender differences for occupation, household activities and caregiving activities (Kirk & Rhodes, 2011). For example, women in the U.S. have higher sedentary time than unemployed women (Kwak et al., 2016; L et al., 2014). In addition, data may need to differentiate between low income mothers versus higher income working mothers, as lower income mothers may experience higher schedule variability that interferes with their ability to have predictable household routines (Agrawal et al., 2018).

Overall, work policies influence PA levels and BMI of employees (Sonnentag & Pundt, 2016). Factors include longer work hours, short break times, and rigid work schedules can impact the flexibility and available time to participate in physical activity (Dixon, 2009). As the workforce continues to be diversified in gender and family structure, employers must consider how work policies can negatively or positively influence the health of the population.

2.17. THE INTERSECTION OF EMPLOYMENT, MOTHERHOOD, AND PHYSICAL ACTIVITY

Life changes, such as marital status, parental status, and employment status are complex factors that are associated with PA levels among women. These life changes are interrelated, and the interaction of these roles can have varying impact on PA levels. For example, a married, homemaker, with children may have different barriers compared to an unmarried, employed mother of children. The sections below highlight the

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associations reported in the literature between the marital status, parental status, employment status, and PA levels among women.

Overall, previous research indicates that marriage is negatively associated with PA levels among women; however, factors such as parental status, and employment status may account for different PA levels and barriers between married and unmarried women. For example, Hull et al. (2010) found that marriage in of itself was not a significant predictor of physical activity change when controlling for children. After children were born, PA levels significantly decreased among married couples (Hull et al., 2010). In addition, Bellow-Riecken et al (2008) finding concurs as women with children, regardless of employment status were 2.2.-2.8 times more likely to be inactive compared to their married and unmarried counterparts, respectively. Finally, Verhoef et al. (1992) found that married parents were least likely to exercise when examining women's PA in the context of social roles, such as parenthood, marital status, and employment status.

However, barriers to PA levels among married and unmarried women may differ. In a study where 90% of the participants were married and 74% were employed found the barriers most frequently cited to PA was perceived lack of time and competing responsibilities (Mailey et al., 2016). Prioritization and planning mediators between the relationship of perceived lack of time and exercise among the mainly married participants (Mailey et al., 2016). Dixon et al. (2009) found that in addition to guilt to prioritizing themselves (by exercising) above their children, married women felt guilty prioritizing themselves above their spouse/partner by exercising. This "guilt" put a strain on the time available to exercise (Dixon, 2009). Another barrier stated was a lack of "practical support" by spouses, such as caring for the children while the mother exercised (Dixon,

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2009). One mother stated that her spouse considered "his exercise" more of a priority

that hers (Dixon, 2009). Mailey et al (2014) found that among an intervention group of

mainly married mothers, sequencing intervention activities to first build autonomy was an

important step in assisting the mothers to prioritize, plan, and reducing their perception of

barriers. However, employed, single mothers considered themselves as having the "lone

wolf syndrome" when it came to exercising and that a barrier was finding someone to

exercise with who could align with their schedule (Dixon, 2009). Both married and

unmarried women stated not feeling confident or "twenty-years old" (in a gym-setting)

were psychological barriers to working out (P. R. Brown et al., 2001; Dixon, 2009).

Overall, marriage and being unmarried are associated with perceived barriers

among women to engaging in PA. Limitations of PA studies are that few focused on

single mothers and PA levels versus the PA levels of their married counterparts. Many

studies, while not specifically targeting married women, are primarily composed of

married participants. Scare research in this area may lead to significantly divergent PA

levels among non-married women and married women. Dlugonski et al. (2013), found

that controlling for education and income, unmarried mothers report significantly less

physical activity than married mothers and their non-married counterparts.

When employment and parenthood intersect among women physical activity

levels typically decline (Engberg et al., 2012a). A four-year longitudinal study among

women found that those who changed their physical activity status from "active" to

"inactive" were more likely to have gotten married, started employment, changed

employment , or given birth to a child (Brown & Trost, 2003). Larouche et al (2012)

found that even women who considered themselves "very active" significantly decreased their physical activity levels upon beginning employment or giving birth.

For employed and stay-at-home mothers, higher and multiple workload demands may lead to lower intentions to participate in physical activity (Shukri et al., 2016). Pew Research Center found that stay-at-home mothers may have more leisure time, compared to their employed counterparts, but they also spend more time in caregiving and house cleaning activities (Cohn et al., 2014b). Employment comes with its own set of challenges in navigating work-life balance. Parents report that work interferes with family and family interferes with work (M. Bennett et al., 2016). Fujimura et al. (2014) found that family commitments were strong determinants of work-life balance among women. Women identify themselves as "juggling" multiple roles such as: employer, partner, mother, as well as daughter, friend, and in some cases, caregiver of elderly parents (Doble & Supriya, 2010; Emslie & Hunt, 2009). Emslie et al (2009) identified that work commitments and work-related stress can negatively impact women's health. These multiple roles may create conflict in maintaining healthy-preserving behaviors, such as physical activity.

For both mothers who are employed and for those who are homemakers, fatigue and exhaustion can impact a their perception of well-being and time availability for exercise (BKin et al., 2009; Cullati, 2014; Fuller et al., 2003). Studies found that challenges mothers face when trying to incorporate physical activity in their daily regimen included: lack of time, lack of energy, and lack of motivation as barriers (BKin et al., 2009; Cullati, 2014; Hull et al., 2015).

Activities that predict lower physical activity among working mothers include: commitments in the home, work hours, structural influences (time, energy, and money), commitment to others, lack of childcare, and lack of social support (P. R. Brown et al., 2001; Mailey et al., 2014; Pereira et al., 2007). Additional barriers to exercise among employed mothers are guilt about using additional childcare and guilt about taking time during the work hours to exercise (Mailey et al., 2014).

Overall, interventions and research studies that consider social factors may be more effective for improving physical activity levels among women with multiple and diverse roles. For employed women, organizational changes may be effective, as studies indicate that organizations that value and support employees in work-life balance issues improve employee perception of work-life balance and life satisfaction (Abendroth & den Dulk, 2011; Burke, 2013; Reddy et al., 2010). Cramp et al (2006) found that an intervention which included exercise training and self-regulatory behavioral skills training, produced greater improvements in physical activity among mothers than exercise training alone (without self-efficacy training). In addition, the intervention also provided a childcare option (Cramp & Brawley, 2006). Among single mothers, Dlugonski et al (2014) found that planning was positively associated with physical activity levels.

As trends change, research must accommodate to those changes to promote healthy behavior among all population. The percentage of stay-at-home mothers is currently rising again in the U.S. after declining since 1972 (Cohn et al., 2014a). An estimated 30% of all mothers are not employed outside the home or consider themselves to be stay-at-home (Cohn et al., 2014a). Furthermore, Bell at el. (2005) found that

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married women with children, not employed outside the home, were most likely to be physical inactive, compared to other groups. This may suggest a need for interventions supporting physical activity among women who adopt more traditional roles, such as homemaker.

Parents who also work report that maintaining work-life balance is a struggle and has inherent conflicts that negatively impact physical activity levels. A Canadian study that conducted focus groups and interviews on 34 working women with children found that the barriers of partnered women and single women were identical (Tavares et al., 2009). Both groups perceived that work deadlines, housework (groceries, laundry, etc.), work/stress load, exhaustion, inflexible work hours (i.e. 1-hour lunch), and lack of money (gym membership) prevented them from meeting physical activity guidelines (Tavares et al., 2009). When the participants were asked about solutions, most solutions given were interpersonal and organizational changes, rather than individual level changes (Tavares et al., 2009). Solutions included: flexible work hours and longer lunches, on-site gym with company assistance in paying for membership, and social support from spouse (Tavares et al., 2009). Individual level changes mentioned was scheduling social activities that involve physical activity and adhering to exercise schedule (Tavares et al., 2009).

Another qualitative study interviewed 44 U.S. working women with children (Dixon, 2009). All mothers were faculty/staff at University with a wide range of children's ages, ranging from six months to 25 years of age (Dixon, 2009). Most participants described being physically active prior to having children (Dixon, 2009). Similar to the Canadian study, U.S. working mothers reported lack of time, inflexibility in their work schedule, lack of spousal support, and cost of gym membership as barriers

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to exercise (Dixon, 2009). Both groups identified working outside of typical work hours and taking on extra work projects were their norm and an expectation, especially if they wanted some form of promotion (Dixon, 2009). Focus group responses differed from Canadian working mothers in that U.S. working mothers identified feeling "guilt" in being away from their child (Dixon, 2009). In addition, unlike U.S. study group participants, the Canadian mothers reported that they felt social pressure to involve their children in multiple extracurricular activities, which reduced their leisure-time (Tavares et al., 2009).

Hamilton et al (2010) examined exercise barriers and beliefs among 21 U.S. women and 19 U.S. men who were all parents and varied in work status. Both men and women identified time pressures around PA and how it interfered with other commitments (Hamilton & White, 2010). For example, if they participated in PA, it took away from either work, family, or housework (Hamilton & White, 2010). Men expressed that they believed women would disapprove of PA unless it was integrated with family activities; however, women believed that their husbands would approve of PA activity as long as it did not impact their spouse's responsibilities (Hamilton & White, 2010). Overall, main PA inhibitors were inflexible schedules, exhaustion, lack of motivation, household chores, and lack of access to PA facilities with childcare (Hamilton & White, 2010). Differing from the previous studies mentioned, women mentioned that lacking of control of their time when their children were ill or injured impacted their inhibited their ability to work out regularly (Hamilton & White, 2010).

2.18. WOMEN AND LEISURE TIME PHYSICAL ACTIVITY

Physical activity occurs in a behavioral context (Kowal & Fortier, 2007). Therefore, understanding what types of physical activities women with children engage is

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an important complement to understanding the intensity of the physical activity performed (e.g. vigorous versus moderate intensity) and amount of time women spent performing specific activity. Furthermore, to understand how to encourage physical activity among women, increase self-efficacy, and mitigate barriers, it is important to know what leisure time physical activities (LTPA) are most appealing to women by social role.

LTPA in simple terms is physical activity that occurs during leisure time (Caspersen et al., 1985). These activities can include, but are not limited to walking, hiking, aerobics, (non-commute), or even housework or yardwork (WHO, 2018). Previous studies have indicated there are slight differences between LTPA preferences among men and women. Using self-reported data from the National Health and Nutrition examination survey, Dai (2015) found that although men and women reported walking as their most prevalent LTPA, the most reported activities after walking differed. Men's most reported activities after walking were bicycling and yard work and women's most reported activities were aerobics and dance.

When specifically looking among women by age, Fan (2013) hypothesized that physical activity decreased by age and LTPA would differ by age group. Results indicated that although there were declines in PA participation for ages 55-64 and for 75+, there was also a decline in PA from 35-44 (Fan et al., 2013). In addition, regarding LTPA, Fan (2013) found that LTPA preferences were similar across all age groups, with walking was the most popular activity, with dance and treadmill as the second and third most population activity.

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Although both studies addressed LTPA among women, neither study spoke specifically to women with children, nor marital status, employment status, or age of children addressed in either study. In addition, both Fan (2013) and Dai (2015) used self-report data when analyzing time spent in physical activity, not objectively measured MVPA (Dai et al., 2015; Fan et al., 2013). To address the needs with women with children, it is critical to understand which LTPAs are most prevalent among this sub-group and furthermore, how much physical activity they are participating in daily, using objective measurement. Finally, understanding the association between social roles (i.e. employment status, marital status, or parenthood status) and LTPA and LTPA preferences would assist in developing tailored interventions or policies.

In conclusion, as women age, it is inevitable that their life circumstances will change. These changes are not solitary but continuous, simultaneous, and interacting. In addition, interventions have been created to address physical inactivity among women; however, many interventions focus on psychosocial determinants such as self-efficacy and social support and do not address the overlapping social factors of employment, marital status, and phase of motherhood (i.e. age range of children). Few interventions consider marital status, employment status, and age of children in women.

Women with children may experience differential challenges related to employment, marital status, and having children that influence their ability to maintain adequate levels of physical activity long-term. Therefore, understanding the social context in which women with children increase their physical activity and what activities are most likely to be sustainable is important for public health practitioners and policymakers in health promotion.

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2.19. GAPS

Having an accurate understanding of physical activity levels and LTPA among women with children can support and improve the success of policies, initiatives, and interventions targeting women with children (M. Bennett et al., 2016; Christenson & Staines, 1990; B. Sternfeld et al., 1999). Although there are data available regarding women with children and physical activity levels of women with children, there is less understanding about how social factors such as employment status, phase of motherhood (having very young, young, or older children), and marital status, may be associated with physical activity levels or LTPA. Our review of the literature reveals that there are gaps due to several factors, which include a prevalence of qualitative over quantitative methods to assess PA among women and a prevalence of self-reported physical activity studies versus studies that objectively report physical activity (i.e. accelerometers). There is a predominance of a research examining limited (versus multi-factor focus) social factors (i.e. employment status, parenthood status, or marital status) or studies that focus on homogenous participant samples that are similar in race, income, and education level.

Qualitative studies exploring PA among women with children can elicit the needs of a population in the areas of PA barriers and facilitators; however, recommendations based on qualitative data lack the strength of objective data that would indicate which strategies would most likely impact PA levels (Mailey et al., 2014; McGannon & Schinke, 2013). Without objective measurement, it is unclear whether women with children meet PA recommendations or which LTPAs are most popular among women with children. Objectively measuring MVPA and using quantitative data to measure LTPA preference among this sub-population is critical in addressing the factors that are associated with physical activity, including social roles among women with children.

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Accelerometers have become an increasingly common objective approach to measure daily PA in recent years as accelerometer provides a substantial improvement over self-report methodologies (Hills et al., 2014; Umstattd Meyer et al., 2013). Self-report methodologies are more likely to have low reliability and validity through occurrences of recall bias, social desirability effects, inconsistency (Westerterp, 2009). Furthermore, when physical activity use self-report and accelerometer data, disparities in the measurement are frequent with individuals consistently reporting higher levels of physical activity than data indicates (Fukuoka et al., 2016; Ham & Ainsworth, 2010; Tucker et al., 2011). Furthermore, different self-report measures vary on how PA is measured. Different surveys will ask participants to report the PA minutes; however, those minutes can be measured in 10-minute bouts instead of single minutes (Garriguet et al., 2015). In addition, surveys differ by recall time and may ask about a typical week of PA, versus asking participants to recall PA in the previous week or year (Sirard et al., 2013).

Self-report measures used in research studies, include Kaiser Physical Activity Survey (KPAS), Godin Leisure Time Questionnaire, and 7-day recall questions (i.e. questions based on the YRBSS) (Adachi-Mejia et al., 2010; Berge et al., 2011; Dombrowski, 2011; Mailey & McAuley, 2014; Tavares et al., 2009). Studies that use self-report data for capturing PA levels capture, more accurately, perceived levels of PA. One study, using KPAS scale, found that self-efficacy predicted physical activity (Dombrowski, 2011). Although the scale included items for activity, such as housework/caregiving, active living habits, occupational, and sports exercise, this study overall lacked objective measurement of physical activity (Dombrowski, 2011). In

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addition, Hamilton (2012) and Brown (2009) captured PA levels by asking questions regarding intention of PA or frequency and duration of PA in the previous week; however, both studies did not use objective measurement. In studies that use only self-report items to understand frequency or duration, the associations between social roles, such as employment, marital status, and phase of motherhood and PA are typically unexamined. In conclusion, studies that use only self-report surveys to measure intensity and duration of PA among women with children contribute to a gap in understanding MVPA in women with children. Including objective data as well as assessing specific activities are critical as it can assist in understanding the relationship between social roles and MVPA.

Although objective measures to assess PA are recommended, many studies exclude LTPA as a complement (Dlugonski & Motl, 2014; Mailey & Hsu, 2017). This is a critical gap as LTPA independently associated with morbidity and mortality and understanding preferences can help strengthen the efficacy of interventions and policies. For example, Mailey et al (2014) measured MVPA of 94 women with at least one child under five. The primary outcome was "composite physical activity" which was derived from combining accelerometer scores with self-report scores from Godin Leisure Time Exercise Questionnaire (GLTEQ) to determine MVPA occurring throughout the day and exercise (Mailey & McAuley, 2014). Results focused on MVPA data; however, there was no measurements accounting for LTPA. Rhodes et al (2014) measured the MVPA of Canadian couples with and without children. Accelerometers were used; however, data for LTPA was not captured for this study. Not including an assessment of LTPA creates

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a gap in literature and may prevent important linkages being drawn related to health enhancement among women with children.

Another important consideration is the range of social pressures that influence physical activity participation among women with children, such as: working status, age of children, and marital status. Many studies may consider a few of these factors as independent variables as opposed to all three. For example, Gaston et al (2014) examined the impact of parenthood, number of children in the home, and age range of children on daily minutes of sedentary, light, and MVPA among Canadian parents. This study also categorized parents as single or living with a spouse/partner; however, employment status was excluded. Steeves et al (2015) examined the impact of employment status (employed versus homemaker) and age range of children (<18) on sedentary, light, and MVPA. Total minutes of activity, hour by hour analysis, and week versus weekend activity were analyzed among the groups; however, the study did not include marital status and age range of children only accounted for children younger than eighteen years of age. However, research indicates that children under 6 years of age may account for less activity among mothers (Gaston et al., 2014). Although the studies were comprehensive there are gaps that are important to include (marital status, employment status, and phase of motherhood [i.e. age range of children]) as they impact physical activity levels. It is important to address all contextual factors, as they may be interactive and simultaneously influence PA levels.

Finally, a major limitation of current research is the lack of literature including nationally representative samples of objective PA levels among mothers in the U.S. Many studies objectively measuring the physical activity levels of mothers are conducted

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with homogenous groups in terms of ethnicity and socioeconomic status. In addition, Gaston et al (2014), a nationally representative study that measured PA levels (sedentary, light, and MVPA) was conducted in Canada. However, the racial demographic criteria in Canada is being not analogous to the U.S. racial demographic (Canada uses the term "visible minority status" in lieu of "race" or "ethnicity"). In addition, Canadian study does not include employment status as an independent variable even though almost 70% of Canadian families with one child under 16 were dual employed (Statistics Canada, 2013, 2015). Studies with objective data that do not use nationally representative samples are more likely to have participants that are white, married, employed, with a higher income than the national average (Candelaria et al., 2012; Mailey & Hsu, 2017; Mailey & McAuley, 2014).

In summary, most studies of physical activity among women with children 1) use qualitative measures rather than quantitative, 2) use self-reported PA rather than objectively measured PA with accelerometers, 3) focus only on intensity and duration of physical activity among women and exclude an examination of specific LTPAs, 4) exclude examination of a range of factors that could be associated with PA such as marital status, employment status, and phase of motherhood, and 5) are not based on nationally representative or diverse samples. Conducting an analysis on a nationally representative dataset that explores objectively monitored PA and LTPA among mothers by employment, marital status, and phase of motherhood is needed to better understand this understudied population.

2.20. SIGNIFICANCE

Correlates between objectively measured MVPA, LTPA, and multiple social roles among women with children are not well established. This study is significant because it will examine a nationally representative sample with objective measurements MVPA and corresponding LTPA of sub-groups of women by marital status, employment status, and phase of motherhood. Determining MVPA and LTPA of women with children by social role(s) can assist understanding how social roles are associated with MVPA and LTPA among this population. Examining the association of MVPA and LTPA among women with children by of employment status, marital status, and phase of motherhood on a nationally representative sample of U.S. women may promote the development of effective programs and policies that could positively benefit PA levels and thus improve public health outcomes among this population.

2.21. INNOVATION

A better understanding of physical activity levels among this population of women may benefit public health through appropriately targeted, data-based PA policies for this group. This may strengthen the ability of experts to develop interventions, practices, and policies that support physical activity among women through different life transitions (i.e. employment, marriage, and having children). Through understanding MVPA and LTPA through a lens of social roles of mothers with children, realistic and positive efforts to increase activity among mothers with children can occur. In addition, data supporting increased understanding of physical activity among women with children can assist in the development of state and local physical activity plans that target this sub-population. Furthermore, data focusing on women with children can highlight the need for additional support, such as funding for physical activity initiatives, for this group.

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2.22. APPROACH

The literature reviewed in the prior chapter presents the body of knowledge on the association between MVPA, LTPA, and social roles, such as employment, marriage, and having children. Currently, there is limited literature that examines social factors related to MVPA and LTPA among women using a national sample. The majority of studies examining the association between physical activity and social factors use self-reported physical activity to measure this association leading to a gap in the literature on objectively measured MVPA. In addition, of studies that measure objectively measured MVPA among women with children, few address LTPA or social roles, such as marital status, employment status, and age of children.

This study seeks to determine if there is an association between employment status, age category of children, and marital status and objectively measured MVPA and LTPA among women with children. This study had two specific aims: Specific Aim 1) Assess the relationship between daily average minutes of MVPA and social roles (i.e. employment status, marital status, and phase of motherhood) controlling for race/ethnicity, mother's age, income, education, and BMI, and Specific Aim 2) Determine which leisure time activities emerge as most prevalent among the participant sample and determine if there are overall patterns by social role. Social role is defined as employment status, marital status, and phase of motherhood (i.e. age of youngest child [< 6 years of age, 7-13 years of age, and > 13 years of age]).

For Specific Aim 1, we hypothesize that women who are employed will have higher daily mean MVPA than unemployed women, women who are married will have lower daily mean MVPA than women who are not married, and among women with children, those with children aged 6 and under, daily mean MVPA will be lower

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compared to women whose youngest child is 6 years of age or older. For Specific Aim 2, we hypothesize that among the participant sample of women with children, the most popular types of LTPA will vary by marital status, employment status, and phase of motherhood. These specific aims are accomplished by conducting a secondary data analysis on a national dataset.

2.23. CONCEPTUAL MODEL

Multi-level social ecological models are commonly used to organize determinants that influence physical activity (Brownson et al., 2001; Dishman et al., 1985; Giles-Corti & Donovan, 2002). The ecological model that guides this study is adapted from "The Ecological Model of Four Domains of Active Living" (Sallis et al., 2006), which identifies four domains of potential influence on physical activity: 1) Recreation, 2) Transport, 3) Occupation, and Household. These domains are identified in an ecological model that identifies the domains associated with the following variables: 1) Policy and Environment, 2) Behavior Settings: Access and Characteristics, 3) Behavior: Active Living Domain, 4) Perceived Environment, and 5) Intrapersonal (Sallis et al., 2006).

This study focuses on the family situation within the "Intrapersonal" domain (i.e., motherhood status and phase of motherhood) and "Behaviors: Active Living Domain" (i.e. tasks and roles related to household and employment). The constructs of the family situation and household/occupational behavior domain pertains to the social roles involved with employment status, marital status, and motherhood (see Figure 2.2).

The interrelationships among the social roles moderate the physical activity levels among the individual. For example, the different combinations in Figure 2.3 illustrate that in addition to each social role being independent, they also, as in the case with women, overlap and form subgroups. We propose in our study that these social roles are

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independent variables and that independently and combined they moderate MVPA and

LTPA.

Table 2.1 Types of Physical Activity

Type of Activity	Examples	METs
Vigorous Physical Activity	Running, jump rope, singles tennis, aerobic dancing	> 6 METs
Moderate Physical Activity	Walking, hiking, recreational dancing, pushing a lawnmower	3-6 METs
Light Physical Activity	Casual walking, gardening, cleaning, caretaking	1.6-3 METs
Leisure Time Physical Activity	Dancing, hiking, swimming, sports, active games, walking, cycling, gardening	Varies
Occupational Physical Activity	Construction work, caregiver occupation (i.e. working at a nursing home), janitorial work, incidental movement at work (i.e. climbing stairs)	Varies
Transportation Physical Activity	Walking or cycling to and from work or to transit	Varies
Sedentary Activity or Behavior	Lying down, watching television, reading, sitting while on the computer or electronic device	≤ 1.5 METs
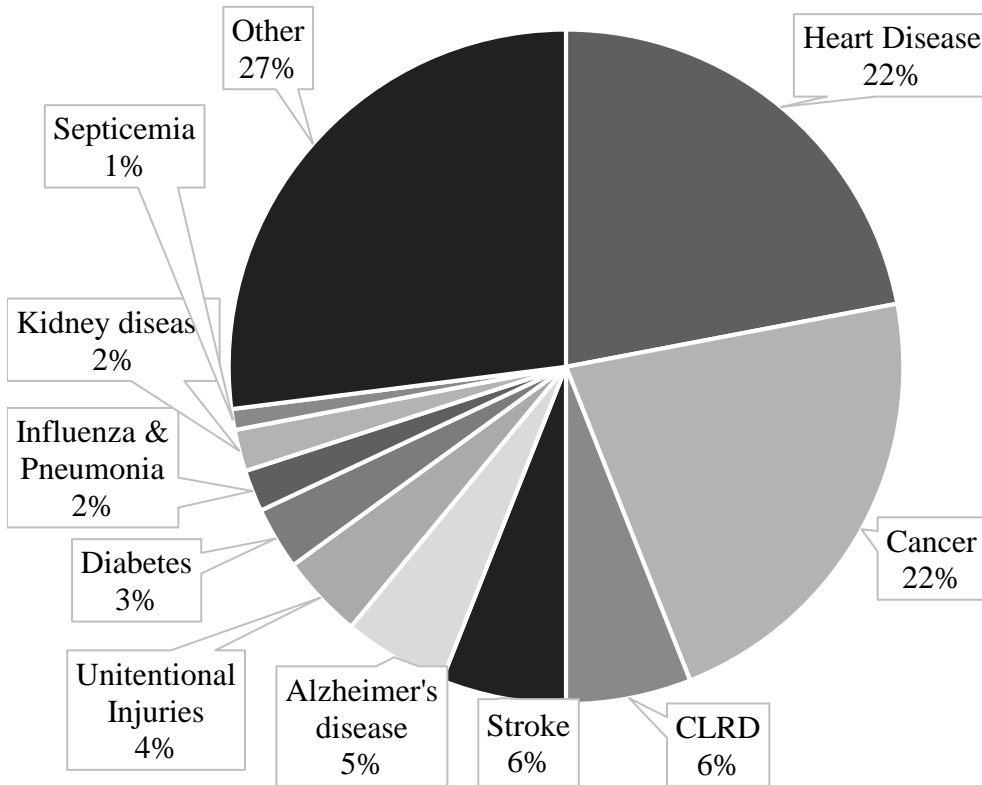
Figure 2.1 Top Causes of Death
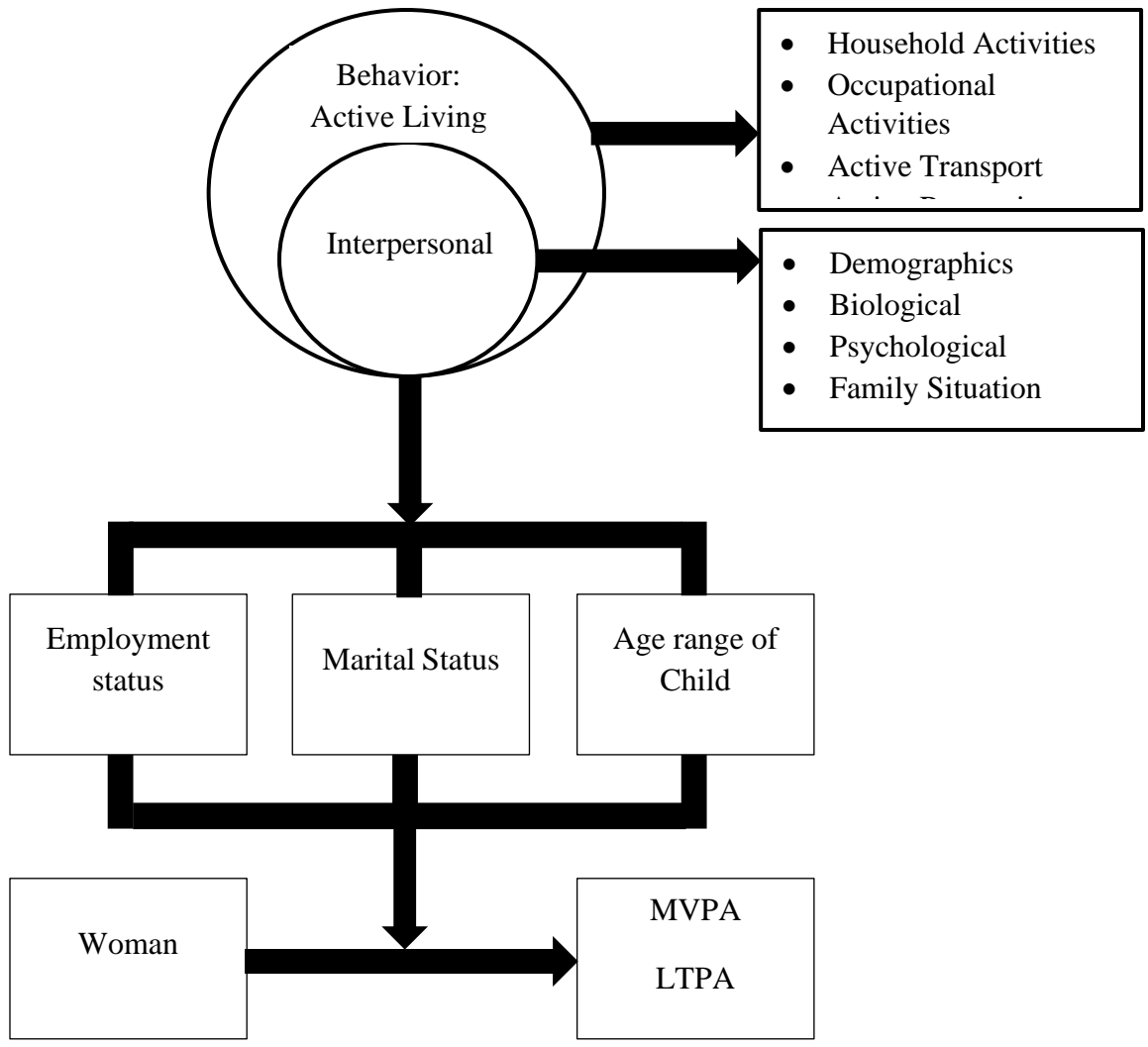
Figure 2.2 Conceptual Model
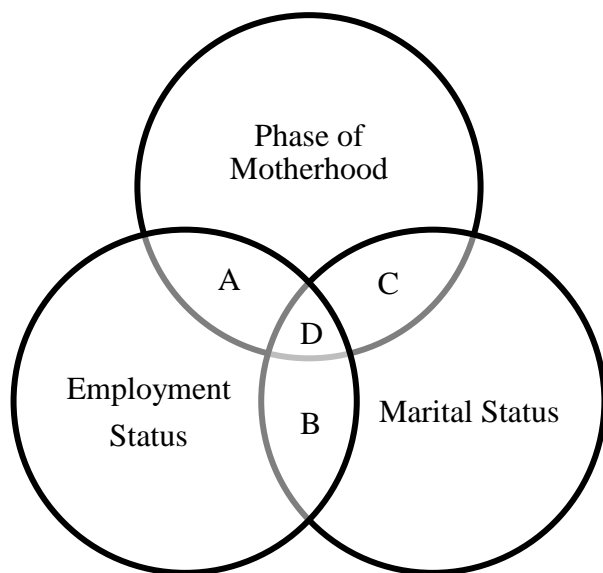
Constructs

- Employment Status
- Phase of Motherhood
- Marital Status

Interactions

A. Employment and Phase of Motherhood
B. Employment and Marital Status
C. Phase of Motherhood and Marital Status
D. Employment, Phase of Motherhood, and Marital Status

Figure 2.3 Relationship of Employment, Motherhood, Marital Status and Physical Activity

CHAPTER 3

RESEARCH DESIGN AND METHOD

3.1 SETTING DESCRIPTION

Since 1999, the continuous National Health and Nutrition Examination Survey (NHANES) study has been conducted by National Center for Health Statistics (NCHS). NHANES surveys a nationally representative sample of approximately 5,000 people per year (CDC, 2017b). NHANES uses complex, multi-stage, probability design to select participants who are representative of civilian, non-institutionalized U.S. population (CDC, 2013a). Interviews include demographic, socioeconomic, dietary, and health related questions (CDC, 2017b). NHANES collects data through interview, lab, and examination (CDC, 2017b). Data from NHANES 2003-2004 and 2005-2006 cross-sectional surveys will be used to conduct a secondary analysis for this study as NHANES 2003-2006 includes objective measurements of movement through the use of a physical activity monitor. Consent was obtained for all NHANES participants and the National Center for Health Statistics Ethics Review Board approved survey protocol (CDC, 2017c).

3.2. SAMPLING

NHANES sample 15 primary sampling units (PSUs) per survey cycle, yielding about 5,000 examined persons per year (CDC, 2013b). NHANES select participants representative of the U.S. population in four stages: 1) primary sampling units (PSU's), 2) dividing PSU's into city blocks (or equivalent), 3) randomly selecting households

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within city blocks, and 4) selecting individuals (from a list of living persons in that household) to participate in NHANES. The 2003-2004 and 2005-2006 surveys yielded similar response rates (76% and 77%, respectively) (CDC, n.d.-b)

During data collection, NHANES over-sampled low-income non-Hispanic whites, Mexican-Americans, non-Hispanic blacks, older adults (60+) and adolescents to increase sample size for high-risk populations (CDC, 2017b). To take into account complex survey design and over-sampling of high risk populations and non-response, CDC created weights were utilized (CDC, 2013c). CDC provided sample weights assist to represent the original importance of each group in population and in addition consider over-sampling, non-response, post-stratification, and sampling error. As this study appended two surveys (4 years), NHANES constructed the sampling weight as MEC4YR = 1/2 * WTMEC2YR (CDC, 2013c).

Inclusion and Exclusion Criteria

Manuscript 1 examines the association between MVPA by marital status, employment status, and phase of motherhood. For manuscript 1 participant sample, an initial sample of 20,470 participants completed the physical examination for NHANES 2003-2004 and 2005-2006 waves. Total number of women in the 2003-2006 waves were 10,420. This study focused on women ages 18-60 (n= 4,165). Participants who were pregnant (n=535) and those who did not have children (n=1,605) were excluded from the study. Those who did not identify as employed or a homemaker (n=456) were excluded. (18). Those who reported that they had physical limitations that prevented them from working, including those who had missing data for that variable, were excluded (n=50). Those who did not have at least four days of valid (at least 10 consecutive hours per day) physical activity monitor data (PAM) were excluded (n=537) as well as those who had

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missing values on demographics (n=48), leaving a final participant sample of 934 women (Figure 3.1).

Manuscript2, also uses objective physical activity data; however, SA2 examines the LTPA preferences among the participant sample. SA2 has the same inclusion and exclusion criteria as manuscript 1. The main difference between SA1 and SA2 is that those with missing LTPA data were not included in the study (n=658) leaving a final participant sample of 276 women (Chart 2).

3.3. DATA COLLECTION

Data from NHANES were collected in two steps (CDC, 2016). Participants were first interviewed in their homes (CDC, 2016). Home interview data were collected via computer through a personal interview system called CAPI (computer-assisted personal interview) (CDC, 2016). After the interview they were asked to participate in a physical examination at a local mobile examination center (MEC) (CDC, 2016). Physical examination data were recorded using automated technology (CDC, 2016).

3.4. DEPENDENT VARIABLES

MVPA minutes

NHANES collected information, during 2003-2004 and 2005-2006 waves, on the physical activity intensity and durations of sample participants (CDC, 2008). Participants were invited to wear a physical activity monitor (PAM) device if they had no walking impairments (or other limitations) and were over the age of six (CDC, 2008). The instrument used was a uni-axial accelerometer, the ActiGraph AM-7164 (CDC, 2008). This accelerometer was worn by participants on their right hip during waking hours for 7 days (CDC, 2008). Participants with physical disabilities were not given a PAM (CDC, 2008).

The ActiGraph AM-7164 records intensity of movement per minute at a specific intensity value. If no movement is recorded the value of intensity is zero. Non-wear time is defined as 60 consecutive minutes with an activity count of zero. Participants are instructed to remove the device before participating in water activities, including showering, as the device is not waterproof (CDC, 2008). Limitations of the ActiGraph AM-7164 are that it measures movement on a vertical plane, therefore there are limitations in measurement with stationary exercises (i.e. elliptical, stationary bike, strength training) (CDC, 2008).

After wearing the PAM for seven consecutive days, the participants were instructed to return the device (using a pre-paid envelope) to NCHS staff (CDC, 2008). Data was processed in collaboration with the National Cancer Institute (NCI) and a SAS program, written by NCI, was written for analyzing the raw data collected (CDC, 2008). Valid day of measurement is defined as wearing the device for 10 consecutive hours (CDC, 2008). Thresholds counts used to define intensity are based on adult accelerometer counts with metabolic equivalents (METs) (Troiano et al., 2008).

The counts derived during non-zero active times were categorized, summed in each category, and divided by the number of days the monitor was worn. The estimates were then categorized as daily minutes engaged in MVPA. In accordance with studies using adult accelerometer cut-off points, activity counts were coded using Troiano et al. (2008) in which a minute is coded as moderate-to-vigorous if activity counts were greater than or equal to 2020 counts.

LTPA

To determine LTPA, NHANES participants were required to respond to the following question: "What moderate/vigorous activity did they do in the past 30 days?"

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Participants were allowed check all leisure time physical activities that applied from a list of 48 activities (See Appendices).

Meeting MVPA guidelines

Meeting MVPA guidelines are determined using recommended guidelines for physical activity. Physical activity recommendations for adults are at least 150 minutes of Moderate Physical activity per day (American College and Sports Medicine & American Heart Association, 2007; CDC, 2015a; WHO, 2018). For this study, MVPA is recoded into a categorical variable of "meeting guidelines" or "does not meet guidelines". This variable will be derived from determining how many minutes valid participants averaged per day in MVPA during the time they wore the PAM device. MVPA guidelines (150 minutes per week) were divided by 7 (150/7=21.42) to equal an estimated 21 minutes per day. NHANES participants who averaged 21 minutes per day in MVPA activity during the time they wore the PAM device will be determined as likely to have met recommended guidelines of 150 minutes of MVPA per week.

3.5. INDEPENDENT VARIABLES

Social Role Variables

The social variables for the study were employment status, marital status, and phase of motherhood. Employment status consisted of two categories: employed or homemaker. Those who were considered "employed" were respondents who answered if that they were "working at a job or business" the previous week. Those who did not work the previous week, but responded that they were "taking care of house or family", were considered "homemakers". For marital status, women who either categorized as married or not married. Not married included women who were single, divorced, or widowed. Phase of motherhood was defined as age range of youngest child. The

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categories were under 6, 6-13, and over 13. The child's age was determined by subtracting the women's current age from age of the participant's last live birth (CDC, 2006).

Covariates

Demographic variables for this study were age category of participant, race/ethnicity, education, income, and body mass index (BMI). Age range for participants were categorized as (ages 18-44) and (ages 45-60) (CDC, 2019; Martinez et al., 2012). Race/ethnicity was categorized as: 1) Non-Hispanic White, 2) Non-Hispanic Black, 3) Hispanic, and 4) Other. Education was categorized as: 1) high school degree or less, 2) some college or less, or 3) College graduate or higher. Income (yearly household income) was categorized as: 1) under $35,000, 2) $35,000-54,999, 3) $55,000-74,999, and 4) over $75,000. BMI was categorized as: 1) normal (<24.9 kg/m2); 2) Overweight (25.0-29.9 kg/m2), and 3) Obese (> 30.0 kg/m2). In this study, there were only five participants that classified as underweight BMI (<18 kg/m2) therefore, they were included with participants with normal BMI.

Recoding

Race/ethnicity will be coded as non-Hispanic Black, non-Hispanic White, Hispanic, and other. Education level will be coded as High School, Some College, and College Graduate or Higher. Income is coded as: 1) under $35,000, 2) $35,000-54,999, 3) $55,000-74,999, and 4) over $75,000. BMI will be recoded from a continuous variable to normal, overweight, and obese. Marital status will be coded as married or not married. Employment status will be recoded to employed or homemaker. Phase of motherhood will be coded by calculating age of youngest child. Age of youngest child

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will be recoded from a continuous variable to three categorical variables: 1) under 6, 2) 6-13, 3) and over 13 years of age. See Appendix for full list of variables and recoding.

3.6. STATISTICAL ANALYSES

Data was cleaned in SAS version 9.4. Data points were consolidated into one record per person per day with recorded activity categorized as sedentary behavior, light physical activity, and moderate to vigorous physical intensity. Activity intensities were calculated by the recorded accelerometer counts for each intensity level divided by number of valid days. A valid day is defined as at least 10 hours per day of wear per day and only participants with at least four valid days of PAM wear will be used in this study. After cleaning, the data was transferred to STATA version 15 where NHANES survey cycles 2003-2004 and 2005-2006 were appended. Inclusion and exclusion criteria were then applied to the dataset. Analyses conducted in STATA version 15 accounted for NHANES's complex design and sample weights (CDC, n.d.-a).

As mentioned above, MVPA was recoded from a continuous variable to a categorical variable. The categories were divided into meeting guidelines (MVPA$\geq$ 150 minutes per week) or does not meet guidelines (MVPA < 150 minutes per week).

To estimate the sample size needed to conduct the study, the following assumptions about the main hypotheses were made:

- In the general population, an estimated 45% of women met PA guidelines (National Health Interview Survey (NHIS), 2012)

- In our study population it is hard to know the likely sample proportion meeting PA guidelines. The women in this study sample are mothers and we do know from the previous research it is likely that their activity level would be less than

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the general population. Therefore, our hypothesis is that 35% of the sample

population of this study is engaging in recommended levels of physical activity.

With an alpha = 0.05 and a power = .80, it is calculated that a sample size total of n=373

is needed to test the first hypothesis.

NHANES uses a complex multi-stage, cluster design as opposed to a simple

random sample (CDC, 2017b). Complex cluster designs may have larger standard errors,

increased sampling variance, and significance levels may be understated. For variance

estimation, this study will use sample weights provided by NHANES to analyze data in

STATA For more information see:

https://www.cdc.gov/nchs/tutorials/nhanes/stata_tips.htm

Univariate frequency distributions were produced for the independent variables,

dependent variables, and covariates. Mean is reported in this study for MVPA and

mother's age. In addition, exploratory analyses were conducted for continuous variables

to explore distributions, determine normality of data, outliers, and determine possible re-

categorization of variables. Proportions will be reported for the categorical variables:

LTPA, status of meeting MVPA guidelines, LTPA, Employment Status, Marital Status,

Phase of Motherhood, Race/Ethnicity, Income, Mother's Age category, BMI, and

Education.

3.7. SPECIFIC AIMS: METHODOLOGY

Specific Aim 1 (SA1):

Assess the relationship between daily average minutes of MVPA and social roles (i.e.

employment status, marital status, and phase of motherhood [i.e. age range of youngest

child]) controlling for race/ethnicity, mother's age, income, education, and BMI.

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Hypothesis 1

    a. Women who are employed will have higher daily mean MVPA than unemployed women

    b. Women who are married will have lower daily mean MVPA than women who are not married

    c. For phase of motherhood, those with children aged 6 and under, daily mean MVPA will be lower compared to women whose youngest child is 6 years of age or older

Analysis

For SA1, descriptive statistics, means and proportions were calculated for continuous and categorical variables. For bivariate analysis, the svy:mean and svy:regress tests were used to determine significant differences between the daily mean minutes of MVPA by demographic and social variables as MVPA levels were non-normally distributed. The two-sample Wilcoxon rank-sum was used for variables with two categorical levels (i.e. age, marital status, and employment status). Svy: regress was also used for variables with more than two categorical levels (i.e. race/ethnicity, income level, education level, BMI, and age range of youngest child) with Dunn test as a post hoc analysis for pairwise comparisons.

Multiple linear regression analysis was used to determine the statistical association between MVPA and the social roles of marital status, employment status, and phase of motherhood (i.e. age range of youngest child). Model 1 of the linear regression analysis examines the association between MVPA and all social roles: marital status, employment status, and phase of motherhood. Model 2 examines the association between

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MVPA and all three social role roles controlling for demographics: age category of mother, race/ethnicity, income level, education status, and BMI of participant.

Specific Aim 2 (SA2):

Determine which LTPA activities emerge as most prevalent in the participant sample and determine if there are overall patterns in LTPA activity by social role (marital status, employment status, and phase of motherhood [i.e. age range of youngest child]).

Hypothesis 2

    a.   Among the participant sample of women with children, the most popular types of LTPA will vary by marital status, employment status, and phase of motherhood.

Analysis

For SA2, descriptive statistics, prevalence, and proportions were calculated for LTPA, social roles (employment status, marital status, and phase of motherhood [i.e. age range of youngest child]), demographic variables (age range, race/ethnicity, education level, income, and BMI), and by meeting MVPA guidelines (having at least 21 minutes of MVPA per day). Univariate analysis determined mean minutes of daily MVPA per participant by demographic group, social role, and status of meeting MVPA guidelines. For bivariate analysis, the svy:mean and svy:regress test was used to determine significant differences between the daily mean minutes of MVPA by demographic and social variables. Svy: regress was also used for variables with two categorical levels (i.e. age, marital status, and employment status) and for post-hoc analysis pairwise comparisons.

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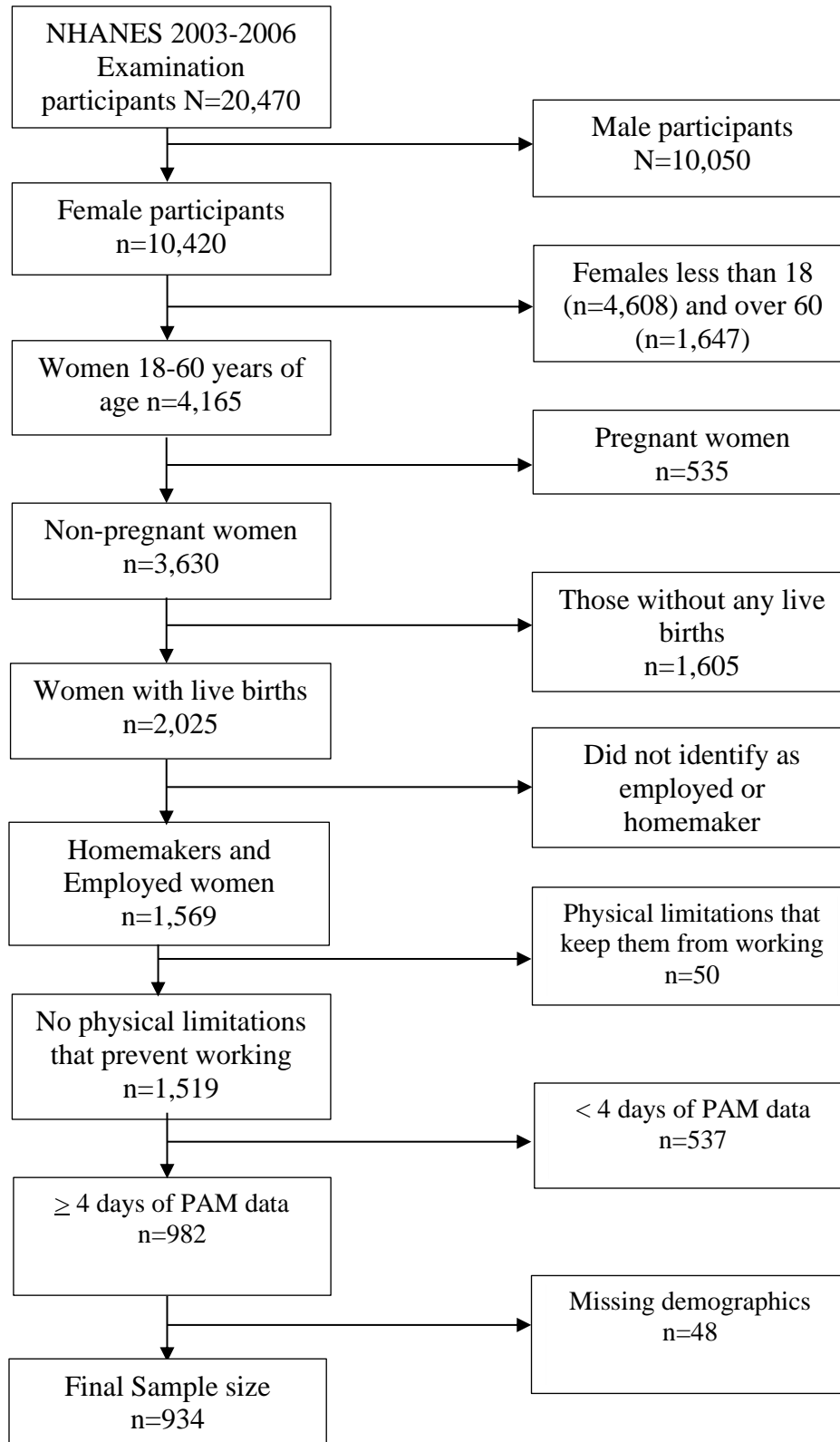
Figure 3.1: Participant Sample SA1
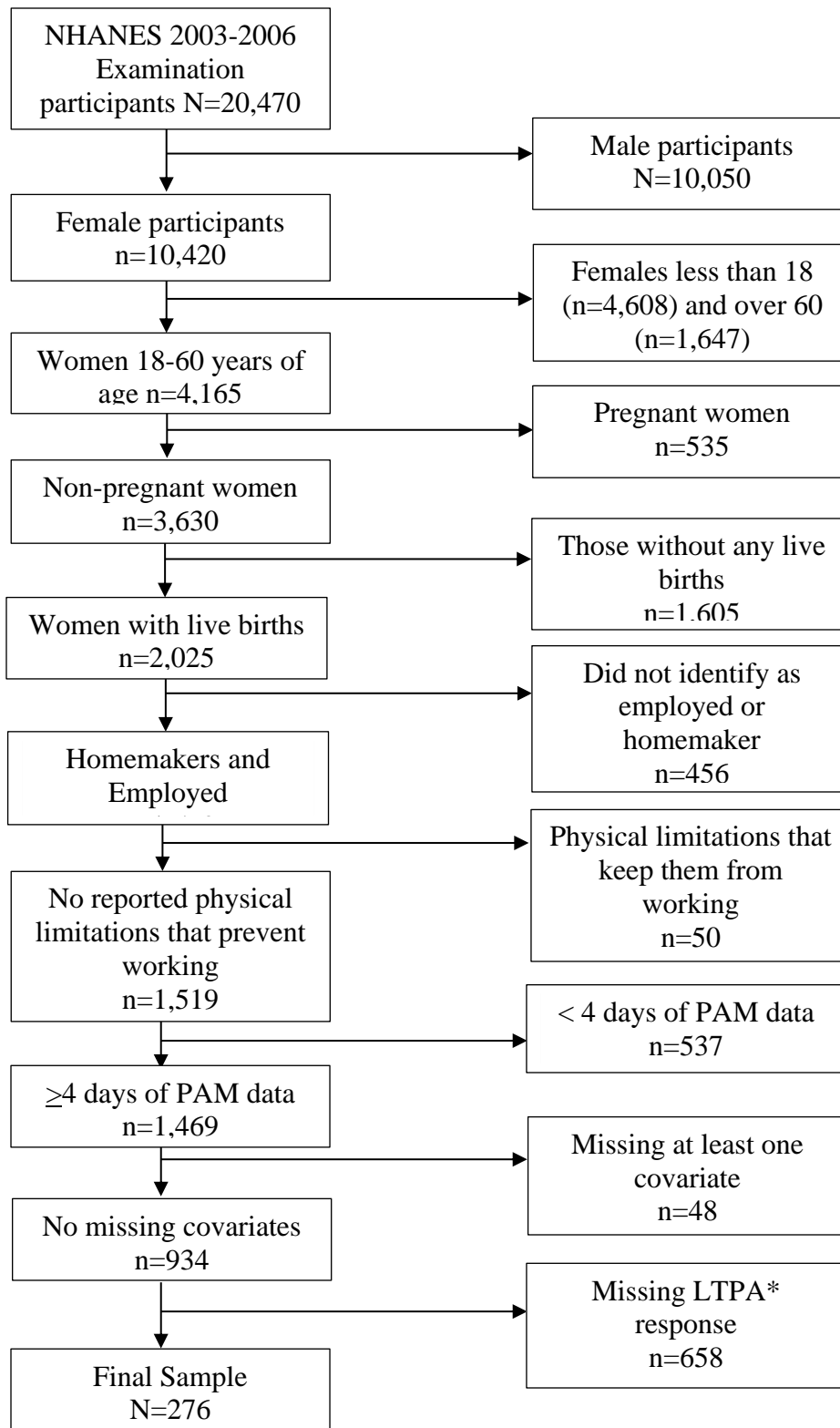
Figure 3.2: Participant Sample SA2

CHAPTER 4

MANUSCRIPT 1

THE ASSOCIATION BETWEEN MARITAL STATUS, EMPLOYOMENT

STATUS, AND PHASE OF MOTHERHOOD WITH MODERATE TO

VIGOROUS PHYSICAL ACTIVITY AMONG PAROUS WOMEN[1]

4.1 ABSTRACT

Purpose. Social roles, such as being married, employed, or having children, have been shown to have independent negative relationships with moderate to vigorous physical activity (MVPA) levels among women. However, few studies have examined the relationship between holding multiple social roles and MVPA among women with children. The purpose of this study was to understand the associations of marital status, employment status, or phase of motherhood (very young, young, and older children) with objectively measured MVPA among women.

Methods. The sample consisted of 947 women (ages 18-60) from the 2003-2006 National Health and Nutrition Examination Survey (NHANES). Each participant wore an accelerometer (ActiGraph-AM 7164) for at least four days with at least 10 hours of daily wearing. MVPA was defined as ≥ 2020 counts per minute (CPM).

Results. Employment status and phase of motherhood, but not marital status, were associated with MVPA after controlling for the mother's age, race, education, household income, and participant BMI ($p=.0000$). Homemakers compared to employed women had less daily MVPA ($p=0.036$) and women whose youngest child was under 6 ($p=0.008$) or over 13 ($p=0.006$) had less daily MVPA compared to women whose youngest child was between the ages of 6 and 13.

Conclusions. Employment status and phase of motherhood should be considered when developing policies or interventions to increase MVPA among women with children.

Key words: physical activity, mothers, MVPA, employment, marriage, accelerometry

4.2 INTRODUCTION

Women participate in less physical activity at every stage of the life course compared to men (Brown & Trost, 2003; CDC, 2014; Nader et al., 2008; Telford et al., 2016; Troiano et al., 2008). An estimated 45% of women in the United States meet the physical activity (PA) guidelines of at least 150 of MVPA per week (Blackwell et al., 2014b), as recommended by World Health Organization (WHO), Physical Activity Guidelines for Americans, American College and Sports Medicine (ACSM), and American Heart Association (AHA) (American College and Sports Medicine & American Heart Association, 2007; *American Heart Association Recommendations for Physical Activity in Adults*, 2016; U.S. Department of Health and Human Services, 2018; WHO, 2018). Consequently, a substantial proportion of US women are not realizing the benefits of regular physical activity, which include reduced risk of non-communicable diseases, such as type 2 diabetes mellitus (Bao et al., 2014) and cardiovascular disease (Chomistek et al., 2015), protection against cognitive decline (Willey et al., 2016), smaller waist circumference (Choi et al., 2012), reduced incidence of obesity (CDC, 2014), reduced incidence of breast cancer and breast cancer death (Lahart et al., 2015), and prevention of depression (Mammen & Faulkner, 2013a) .

For women, participation in social roles corresponding to employment status, marital status, and phase of motherhood may influence likelihood of meeting MVPA guidelines (Brown & Trost, 2003; Larouche et al., 2012a). Research has shown that women who are homemakers have less MVPA than their employed counterparts (Steeves et al., 2015); however, qualitative studies indicate that employed women also encounter challenges when employment is combined with motherhood (Dixon, 2009). These challenges include: limited time available to exercise due to inflexible or long work hours,

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responsibilities of driving children to and from school or daycare, extracurricular activities, and household duties (e.g., cooking, cleaning) (Dixon, 2009).

Women typically assume the role of primary caretakers for children. The age of children, especially with younger children, is associated with duties and responsibilities (e.g., caretaking, food preparation, provision of transportation) that have time and energy requirements (Gaston et al., 2014). These requirements may impact real and perceived free time among women who want to engage in MVPA (Mailey et al., 2014; Pereira et al., 2007). Finally, the influence of marital status on MVPA may be positive, negative, or neutral, depending on factors such as spousal support (Berge et al., 2011; Hull et al., 2010; Uijtdewilligen et al., 2015).

Because substantial portions of the US population of women are affected by multiple social roles simultaneously, it is necessary to examine the effects of multiple roles (married and employed with a young child) simultaneously on MVPA versus, as previous studies have done, analyze the association between one or two social roles (e.g. marital status) on MVPA among women (Bureau of Labor Statistics, Current Population Survey, 2013; Department of Labor, 2016). Also many physical activity studies among women tend to assess physical activity by self-report rather than with objective measures (Hills et al., 2014; Umstattd Meyer et al., 2013). Self-report data of MVPA has challenges as participants may have difficulty in recalling past physical activity and may over-estimate physical activity (CDC, 2007; S.-H. Liu et al., 2016; Tomaz et al., 2016). Therefore, it is important to have objective data to increase accuracy, especially when measuring activity levels among women with children to accurately predict whether this population is meeting MVPA guidelines (Bazargan-Hejazi et al., 2017; Fukuoka et al., 2016; Gorzelitz et al., 2018; Tucker et al., 2016). However,

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research of activity levels among women with children that does use objective measures of PA can also be limited. Many studies analyzing the association between MVPA and women with children have non-United States (US) participants (Gaston et al., 2014). In addition, many studies that are in the US use homogenous populations with participant samples that are similar in race/ethnicity, education, and/or geographic region (Candelaria et al., 2012; Dlugonski et al., 2017). For example, Candelaria (2012) analyzed differences between households with and without children; however, participants were majority white (>60%), majority with a college degree or more (60%), and lived in Seattle Washington or Maryland (Candelaria et al., 2012). Therefore, this study is unique from previous studies as this study analyzed objectively-measured MVPA among women with children from a U.S. national data set, and studied the association between multiple social roles (i.e. marital status, employment status, and age range of youngest child) on MVPA among women with children.

The purpose of this study was to determine the relationship between objectively measured MVPA and marital status, employment status, and phase of motherhood (having very young, young, or older children) among women from a national U.S. sample.

4.3 METHODS

Study population

Data for this study were drawn from the National Health and Nutrition Examination Survey (NHANES) which collects cross-sectional data through questionnaires and exams every two years from participants who are representative of civilian, non-institutionalized U.S. population (CDC, 2008). NHANES is conducted by the National Center for Health Statistics (NCHS) using a complex, multi-stage, probability design. Consent is obtained

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for all NHANES participants, and the NCHS Ethics Review Board approved survey protocol (CDC, 2013c, 2017b).

An initial sample of 20,470 participants completed the physical examination for NHANES 2003-2004 and 2005-2006 waves. Total number of women in the 2003-2006 waves were 10,420. This study focused on women ages 18-60 (n= 4,165). Participants who were pregnant (n=535) and those who did not have children (n=1,605) were excluded from the study. Those who did not identify as employed or a homemaker (n=456) were excluded (18). Those who reported that they had physical limitations that prevented them from working, including those who had missing data for that variable, were excluded (n=50). Those who did not have at least four days of valid (at least 10 consecutive hours per day) physical activity monitor data (PAM) were excluded (n=537) as well as those who had missing values on demographics (n=48), leaving a final participant sample of 934 women (Figure 4.1).

Dependent Variable

MVPA

The dependent variable was MVPA, defined as daily mean minutes of MVPA per sample participant, measured via accelerometry. Subjects were recruited to wear the activity monitor at a mobile examination center, as part of the NHANES data collection process (CDC, 2008). Those who were eligible and agreed to participate were given the ActiGraph-AM 7164 accelerometer (Fort Walton Beach, FL) device to wear for 7 consecutive days (CDC, 2008). Instructions were to wear the device on the right hip, and only removing the device for water activities (i.e. swimming, showering, etc.) (CDC, 2008).

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The public dataset was reviewed by National Center for Health Statistics (NCHS) and the National Cancer Institute (NCI) in terms of outliers and unreasonable values (CDC, 2008). Accelerometer data were divided into non-wear times and wear times. Period of wear times were categorized into activity level by intensities. This study focused on MVPA, which would be activities ($\geq$ 3 METs) such as running, dancing, or aerobics (B. E. Ainsworth et al., 1993; Barbara E. Ainsworth et al., 2011). A cut-point of $\geq$2020 count/min was used to classify minutes of MVPA (CDC, 2008; Troiano et al., 2008). Total minutes of MVPA/day was calculated for each participant and the sums of MVPA minutes per participant for all valid days were then divided by number of valid days the accelerometer was worn. The final result was daily mean MVPA minutes per participant.

Independent Variables

Independent variables for the study were marital status, employment status, and age range of youngest child. Marital status, from NHANES demographics Information Questionnaire (DMQ-SP), was categorized as "married" or "not married". The category "not married" included all responses other than married. Employment status was based on two questions from the NHANES Occupation Questionnaire (OCQ). Those who responded that they were "working at a job or business" were categorized as employed. For the second question, those who responded that the main reason they were not working last week were because they were "taking care of a home or family" were categorized as homemaker. Those who were categorized as employed reported "working at a job or business" the previous week. For the category phase of motherhood, this was categorized by the variable "age range of youngest child". As in a previous study, age of youngest child was determined by subtracting the participant's age at last live birth from

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participant's current age using the Demographic questionnaire and the Reproductive Health Questionnaire. The age of the youngest child was then coded into three categories: under 6, ages 6-13, and over 13.

Covariates/Demographic Variables

Additional variables included were women's age, race/ethnicity, education, household income, and participant BMI. Age ranges for participants of the study were categorized as older (45-60) and younger (18-44). Race/ethnicity was categorized as non-Hispanic Black, non-Hispanic White, Hispanic, and Other. Household income was categorized as <$35,000, $35,000-$54,999, $55,000-$74,999, and >$75,000. Education level was categorized as high school diploma or less, some college or less, and college graduate or higher. Participant BMI was classified as normal (<24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese (>30 kg/m^2). Sample size of those whose BMI classified as underweight (>18.5 kg/m^2) was low (n=5) and was included with participants with a normal BMI (18.5-24.9 kg/m^2).

Statistical Analyses

NHANES 2003-2006 accelerometer data cleaning, in which data points were consolidated and non-valid participants were identified, was performed with SAS data analysis software (version 9.4; SAS Institute, Cary, NC). Data points were consolidated to one record per person per day. Data were transferred to STATA data analysis software (version 15; College Station, TX) and merged with NHANES datasets from questionnaires. For descriptive statistics, means and proportions were calculated for continuous and categorical variables. For bivariate analysis, the svy:mean and svy:regress test was used to determine significant differences between the daily mean minutes of MVPA by demographic and social variables as MVPA levels were non-normally

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distributed. Svy:regress was used for variables with two categorical levels (i.e. age, marital status, and employment status) and for variables with more than two categorical levels (i.e. race/ethnicity, income level, education level, participant BMI, and age range of youngest child). Svy:regress was also used for post hoc analysis for pairwise comparisons.

Multiple linear regression analysis was used to determine the statistical association between MVPA and the social roles of marital status, employment status, and age range of youngest child. Model 1 of the linear regression analysis examines the association between MVPA and all social roles: marital status, employment status, and age range of youngest child. Model 2 examines the association between MVPA and all three social role roles controlling for demographics: age category of mother, race/ethnicity, income level, education status, and BMI of participant. Analyses conducted within STATA accounted for NHANES's complex design and this study used the sample weights provided by NHANES.

4.4 RESULTS

To be included in the study, the participants had to have at least one child. Compared to the participant sample (n=934), those excluded from the study due to missing data (n=575) were more likely to be younger (18-44), non-Hispanic Black or Hispanic, have a high school education or less, have an income under $35,000, be unmarried, a homemaker, and have a child under the age of 6 (Table 4.1). Those included were more likely to be older (45-60), non-Hispanic White, have a college degree or more, or more likely have a household income of $75,000 or more (Table 4.1).   In addition, those included were more likely to be married, employed, or their youngest

child was over the age of 13 (Table 4.1). There were no differences between the participant sample those excluded from the study by participant BMI (Table 4.1).

Univariate Analysis

Demographic characteristics are presented in Table 4.2. Mean age of the participant sample was 46.7 years of age. Out of 934 women, 47% were non-Hispanic White, 39% had a household income of less than $35,000 per year, 43% a high school education or less, and 39% classified as obese. The majority were married (67%, n=624), employed (83%, n=773), and had a youngest child over the age of 13 (49%, n=464). Overall, 38% of the women in the study met the MVPA guidelines of at least 150 minutes of MVPA per week (Table not shown). The mean value of time spent engaged in MVPA by the entire participant sample was 19.9 minutes per day (Table 4.2).

Bivariate Analysis

Table 4.2 describes the bivariate results. Daily MVPA minutes varied significantly by marital status and age range of youngest child. Married women (20.7 min/day) had significantly higher daily MVPA minutes than non-married women (17.9 min/day). Women whose youngest child was between the ages of 6-13 (24.4 min/day) had statistically significantly higher MVPA/day than women with children under 6 (19.7 min/day) and children over 13 (17.9 min/day). Employed women (20.2 min/day) had higher daily MVPA minutes than their homemaker counterparts (17.8 min/day); however, the results were not statistically significant.

There were also statistically significant differences in MVPA by age, race, income, education, and participant BMI (Table 4.2). Younger participants (18-43 years) had more mean minutes of MVPA (21.1 min/day) per day compared to the "older" (44-60 years of age) counterparts (18.5 min/day). For race/ethnicity, post hoc tests using the Dunn test

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revealed that Hispanic participants (23.5 min/day) had significantly higher MVPA compared to the non-Hispanic Blacks (17.7 min/day) and those categorized as Other (17.0 min/day). Non-Hispanic White participates had lower MVPA than Hispanic participants (19.7 min/day); however, the results were only statistically significant among non-Hispanic Black and participants who identified as Other. For income, post hoc tests revealed that participants with a household income of $75,000 or more (22.8 min/day) had a statistically significant higher daily mean MVPA than those with an income under $35,000 (18.5 min/day), $35,000-$54,999 (17.8 min/day), and $55,000-$74,999 (18.0 min/day). For education, post hoc tests revealed that those who had a college degree or more (23.2 min/day) had higher daily MVPA than those who had a high school degree or less (18.8 min/day) or some college (18.5 min/day). For participant BMI, post hoc tests revealed that participants who classified as normal weight (23.2 min/day) and overweight (20.5) had significantly more daily mean MVPA minutes compared to participants who classified as obese (15.7 min/day).

Multiple Linear Regression Analysis

In the multiple linear regression analyses, for Model 1, all three social roles (being married, employed, and having the youngest child between the age of 6 and 13) were positively associated with MVPA in the unadjusted regression analysis (Model 1, Table 4.3). In Model 1, social roles accounted for 3.5% of the variance in MVPA, $F(4, 429)=6.22$, p=.0001.

In Model 2, which included all three social roles controlled for covariates, only employment status and age range of youngest child, but not marital status, were significantly associated with MVPA (R^2=9.74%, $F(15,918)=5.03$, p=.0000) (Table 4.4).

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Among the participants, being a homemaker was associated with less MVPA compared to being employed (p<0.033). Also, a child under the age of 6 (p<0.010) or over the age of 13 (p<0.004) was associated with less MVPA compared to participants whose youngest child was between the ages of 6 through 13.

In Model 2, among the demographic variables, only race, income, and participant BMI had a statistically significant positive or negative association with MVPA (Table 4.4). Hispanic women had higher minutes of MVPA per day compared to non-Hispanic Whites (reference variable) (p<0.023). Those with a household income range of $55,000 and $74, 9999 had less MVPA per day compared to compared to their counterparts with an income of $75,000 or more (reference variable) (p<0.015). Participants with obesity had less MVPA per day compared to participants with normal BMI (reference variable) (p<0.0000).

4.5 DISCUSSION

The primary goal of the study was to determine if MVPA levels among women were associated with marital status, employment status, and phase of motherhood, which was defined by age range of youngest child. Key findings of this study were that employed women and women whose youngest child was between the ages of 6-13 had higher levels of MVPA compared to women who were homemakers and women with children under 6 or women with children over 13 years of age.

In this study, employed women and women those whose youngest child is between the ages of 6-13 had statistically significantly higher daily MVPA than their counterparts. These results are consistent with the findings of Steeves et al.(Steeves et al., 2015), which found that employed women have higher MVPA than homemakers and Gaston et al.

(Gaston et al., 2014) who found parents who have a child under the age of 6 have less MVPA than parents with older children. However, these previous studies focused on the MVPA association by employment status and age range of child among participants with children whereas the present study examined the associations of MVPA among women with children by marital status, employment status, and by age range of child. In this study there was no association between marital status and MVPA in the regression analysis. Previous studies have shown that the relationship between marriage and physical activity among women can be positive (Berge et al., 2011), negative (Brown & Trost, 2003; Hull et al., 2010; Ortega et al., 2011), or neutral (Hull et al., 2010). Results of this study aligns with literature that suggests that there is a neutral relationship between marriage and physical activity. This study suggests that it is important to consider multiple social roles and demographic simultaneously when assessing the relationship between PA and marital status.

The bivariate analysis with the demographic variables in this study was also consistent with previous studies reporting associations between MVPA and demographic characteristics. Results of this study's bivariate analysis found that age, race/ethnicity, income, education level, and participant BMI were associated with significant different in daily mean MVPA minutes among sample participants (Table 4.2). Choi (2017) found in a systematic review that (increasing) age is a negative determining factor for physical activity (Choi et al., 2017a). Another review found that having a higher income increased the likelihood of meeting activity guidelines among U.S. adults (Shuval et al., 2017). A systematic review on correlates associated with adult women being physically activity found 11 studies reported a positive association between education and MVPA

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(Prince et al., 2016). Uijtdewilligen (2015) found that a person's BMI was positively associated with less physical activity and Lee (2011) found that regardless of race/ethnicity, women with normal BMI did more physical activity (R. E. Lee et al., 2011; Uijtdewilligen et al., 2015). Not all of our results aligned with previous studies. In this study's bivariate analysis, Hispanic women with children had the highest MVPA compared to their counterparts (Table 4.2).

In the linear regression analysis (Model 2, Table 4.4), a statistically significant association between MVPA and demographic variables only remained among in race/ethnicity, household income, and participant BMI. Hispanic compared to non-Hispanic white participants had higher MVPA. Previous studies indicate that patterns regarding race and MVPA vary regarding the Hispanic population. Lee (2011) found that non-Hispanic Black women had higher MVPA than Hispanic women and national data collected from accelerometry indicate that Hispanics are less likely to meet PA guidelines than non-Hispanic Whites (Carlson et al., 2010). However, accelerometer data from study by Arredondo (2016) and a previous NHANES (Evenson et al., 2015) study indicate Hispanic women may have higher MVPA levels compared to their non-Hispanic Black and non-Hispanic White counterparts.

Households earning $55,000 and $74,999 annually had a statistically significant negative association compared to their counterparts earning $75,000 or more annually (Model 2, Table 4.4). This aligns with previous studies. Shuval (2017) found that among mothers having a higher income was associated with higher physical activity and an increased likelihood of being a "weekend warrior" (i.e. women who exercise on the weekend) (Shuval et al., 2017). Bennie (2019) that found that low socioeconomic status

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was negatively associated with physical activity (Bennie et al., 2019). Pabayo (2018) found that income inequality was negatively associated with physical activity among only women and not men (Pabayo et al., 2018). Finally, Okunrintemi (2019) found that compared to high-income women, low-income women were more likely to have suboptimal PA (Okunrintemi et al., 2019) .

Also, in the adjusted linear regression analysis, MVPA was negatively associated with participant BMI, with participants with and obese BMI having fewer minutes/day compared to women with a normal BMI (Model 2, Table 4.4). Britton (2012) that found that increased time in vigorous LTPA was associated with lower BMI and Droyvold (2004) that found that low levels of PA were associated with higher BMI eleven years later compared to higher PA counterparts (Britton et al., 2012; Wenche et al., 2004).

A strength of this study is that the sample population (Table 4.2) in this study is comparable to the U.S. demographic population of non-Hispanic Whites, Hispanics, non-Hispanic Blacks, and "other" (additional racial categories) (*U.S. Census Bureau QuickFacts*, 2018).

Limitations of the study were that the ActiGraph-AM 7164 accelerometers measured intensity of movement on a vertical plane so non-ambulatory movements such as weight-lifting or cyclical motion (e.g. elliptical machine or stationary cycling) is less accurate when using accelerometry. In addition, there were limitations regarding how independent variables were defined.   Employment status had two categories: employed or homemaker and this study does not account for employed-homemakers, women who work full-time and also have the duties of a homemaker (e.g. cooking, cleaning, caretaking) (Steeves et al., 2015). In addition, classification of "age range of youngest

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child" does not account for stepchildren or determine if the last live birth is living in the home or still alive.

This study expands current knowledge regarding the impact on MVPA levels among women with children who have multiple social roles. Results of this study indicate that being employed, married, and having the youngest child between the ages of 6-13 is associated with higher MVPA levels among women after controlling for covariates. These data may strengthen the ability of experts to develop studies and interventions for women. The results suggest that interventions may need to be tailored differently for women who participate in different combination of social roles.

Additional research might explore existing barriers to MVPA such as such as the unique time constraints, duties, support, and access to physical activity that may prevent women who are homemakers, women who are not married, and women who have older (>13) or young (<6) children from meeting recommended MVPA guidelines. In addition, understanding successful strategies among women who are employed and among women whose youngest child is between the ages of 6 and 13 use to meet MVPA guidelines would assist in tailoring interventions to this population.
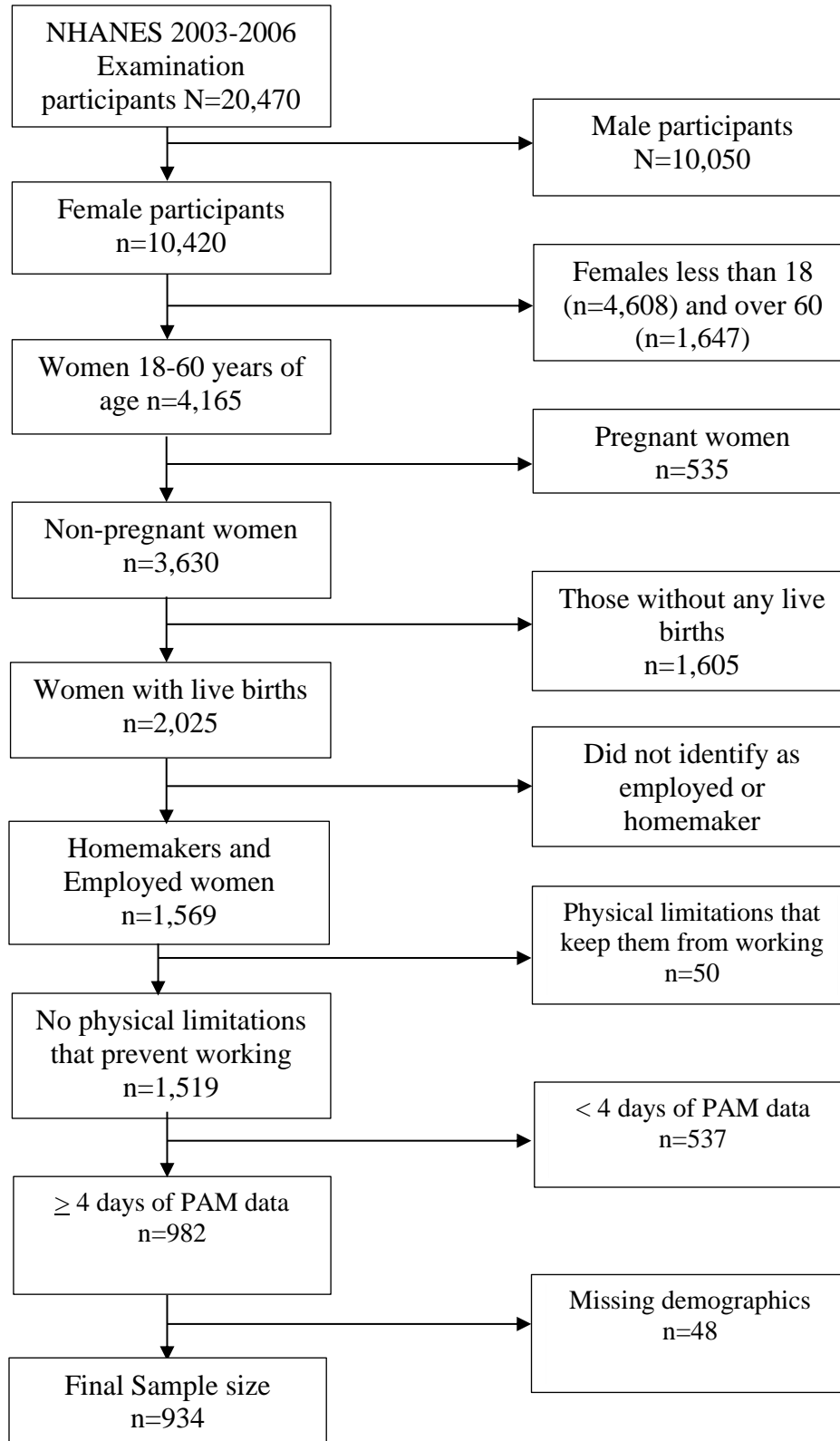
Figure 4.1: Participant Sample

Table 4.1: Comparison of differences between study population (n=934) and those excluded** from the study population (n=575) demographics among women ages 18-60, NHANES 2003-2006***

	Study Population		Excluded Population		p-value
	#	%	#	%	
Age Range					0.000*
18-44	498	54	429	46	
45-60	436	74	136	26	
Race/Ethnicity					0.000*
Non-Hispanic Black	203	56	158	44	
Non-Hispanic White	444	66	228	34	
Hispanic	241	57	184	43	
Other	46	75	15	25	
Income*					0.000*
Under $35,000	361	56	289	44	
$35,000-$54, 999	184	64	103	36	
$55,000-$74,999	127	68	59	32	
$\geq$ $75, 000	262	73	99	27	
Education Level					0.000*
High school education or less	406	58	297	42	
Some college or less	327	67	159	33	
College graduate or higher	201	74	72	26	
BMI					0.716
Normal weight (<24.9 kg/m^2)	287	61	180	39	
Overweight (25-29.9 kg/m^2)	283	63	163	37	
Obese ($\geq$30 kg/m^2)	364	61	232	39	

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Marital Status					0.000*
Married	624	67	303	33	
Not married	310	52	282	48	
Employment Status					0.000*
Employed	773	65	414	35	
Homemaker	161	48	171	52	
Age Range of Youngest Child					0.000*
<6	249	49	260	51	
6-13	221	61	140	39	
>13	464	71	185	29	

*p<0.05
** To be included in the study participants had to have at least one child. From there, participants were excluded if they were missing valid physical activity monitor (PAM) data via accelerometer, missing demographic data (i.e. mother's age, race/ethnicity, income, education level, and BMI), or social role data (i.e. marital status or employment status). ***MVPA and meeting MVPA guidelines were not included as excluded population was excluded because lack of PAM data. Only 48 participants in the excluded population had PAM data. Analysis indicated that compared to the included population and the excluded population that had PAM data there were no statistically significant differences by daily MVPA minutes or by status of meeting MVPA guidelines (table not shown).

Table 4.2: Sample characteristics of study population (n=934) and average daily minutes in moderate-vigorous physical activity among women ages 18-60**, NHANES

	Descriptive Characteristics		Daily mean MVPA Minutes	
Demographic Variables				
	#	%*	Mean*	p-value***
Age (mean age 46.7)				0.0327*
18-43	498	51	21.1	
44-60	436	49	18.5	
Race/Ethnicity				0.0184*
Non-Hispanic Black	203	11	17.7	
Non-Hispanic White	444	71	19.7	
Hispanic	241	12	23.5	
Other	46	6	17.1	
Income****				0.0138*
Under $35,000	361	30	18.5	
$35,000-$54, 999	184	18	17.8	
$55,000-$74,999	127	16	18.0	
$\geq$ $75, 000	262	36	22.8	
Education Level				0.0388*
High school education or less	406	36	18.8	
Some college or less	327	38	18.5	
College graduate or higher	201	26	23.2	
BMI				0.0000
Normal weight (<24.9 kg/m^2)	287	36	23.2	
Overweight (25-29.9 kg/m^2)	283	29	20.5	
Obese ($\geq$30 kg/m^2)	364	35	15.7	

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Independent Variables				
	#	**%**	**Mean**	**p-value*****
Marital Status				0.0412*
Married	624	73	20.7	
Unmarried	310	27	17.9	
Employment Status				0.2324
Employed	773	86	20.2	
Homemaker	161	14	17.8	
Age Range of Youngest Child				0.0293*
Under 6 years of age	249	23	19.7	
6-13 years of age	221	24	24.4	
14 years of age or older	464	53	17.9	
Dependent Variable				
Total population MVPA per day (minutes)	934	100	19.8	

*Percentage (%) and MVPA means are weighted
** In addition to being women ages 18-60, women included in the study had at least one child, at least 4 valid
days (10+ hours) of physical activity monitor (PAM) data via accelerometer, demographic data (i.e. mother's age,
race/ethnicity, income, education level, and BMI), and social role data (i.e. marital status or employment status).
 Svy: mean and svy: regress was used for bivariate analysis for variables with two categorical levels and for
variables with more than two categorical levels, respectively.
***p<0.05
****Annual household income

Table 4.3: Model 1, results from linear regression analyses for daily mean MVPA minutes among women (n=934), ages 18-60, by employment status, marital status, age range of youngest child, NHANES 2003-2006

	Model 1***			
	Coefficient	p-value*	95% Confidence Interval	
Marital Status				
Not married (vs. married)	Reference			
Married	2.93	0.019*	0.47	5.39
Employment Status				
Employed	Reference			
Homemakers (vs. employed)	-3.54	0.036*	-6.85	-0.24
Age Range of Children				
Under 6 (vs. ages 6-13)	-4.38	0.018*	-8.02	-0.75
Age 6-13	Reference			
Over 13 (vs. ages 6-13)	-6.76	0.000*	-10.07	-3.44

*p<0.05

**Annual household income

***Model 1 includes marital status, employment status, and age range of youngest child.

Table 4.4: Model 2, Results from linear regression analyses for daily mean MVPA minutes among women (n=934), ages 18-60, by employment status, marital status, age range of youngest child and adjusted for covariates, NHANES 2003-2006

	Model 2***			
	Coefficient	p-value*	95% Confidence Interval	
Age				
Age 18-44	Reference			
Age 45-60	0.18	0.927	-3.77	4.14
Race/Ethnicity				
Non-Hispanic Black	0.92	0.585	-2.37	4.21
Non-Hispanic White	Reference			
Hispanic	5.01	0.023*	0.68	9.34
Other	-4.90	0.129	-11.24	1.43
Income**				
<$35,000	-2.72	0.144	-6.37	0.93
$35,000-$54,999	-3.32	0.071	-6.94	0.29
$55,000-$74,999	-3.18	0.015*	-6.89	-0.73
≥$75,000	Reference			
Education Level				
≤High School	-1.83	0.258	-5.00	1.34
Some College	-2.71	0.073	-5.67	0.25
≥College	Reference			
BMI				
Normal	Reference			
Overweight	-2.63	0.112	-5.87	0.61
Obese	-7.72	0.000*	-10.59	-4.85
Marital Status				
Not married	Reference			
Married	1.82	0.242	-1.23	4.87

Employment Status				
Employed	Reference			
Homemakers	-4.25	0.033*	-8.16	-0.34
Age Range of Children				
Under 6 (vs. ages 6-13)	-4.95	0.010*	-8.73	-1.17
Age 6-13	Reference			
Over 13 (vs. ages 6-13)	-5.78	0.004*	-9.65	-1.90

*p<0.05

**Annual household income

*** Model two includes age, race/ethnicity, education, income, marital status, employment status, and age range of youngest child.

CHAPTER 5

MANUSCRIPT 2

LEISURE TIME PHYSICAL ACTIVITY PREVALENCE AND OBJECTIVELY

MEASURED PHYSICAL ACTIVITY AMONG WOMEN WITH CHILDREN BY

EMPLOYMENT STATUS, MARITAL STATUS, AND PHASE OF MOTHERHOOD[2]

5.1 ABSTRACT

Purpose. Increasing the number of women with children that meets physical activity guidelines is critical to reduce chronic disease and early mortality in this population.

Methods. Types of LTPA and minutes of MVPA by social role was analyzed among women with children using self-reported data and accelerometer data, respectively, from NHANES dataset (2003-2006).

Results. Walking was the most frequently reported LTPA activity overall and by social role. Percentage of respondents who reported walking in the past 30 days ranged from 26%-30% of answers across social role. Other tops activities reported by respondents were dance, aerobics, bicycling, treadmill, hiking, and stretching.

Conclusions. Walking is a popular LTPA among women with children across social roles. Strategies for promoting increased MVPA among women with children should consider the influence of employment status and phase of motherhood.

Key words: physical activity, mothers, MVPA, physical activity guidelines, employment, marriage, accelerometry.

5.2 INTRODUCTION

Among women, inadequate moderate to vigorous physical activity (MVPA) and excessive sedentary behavior has been associated with increased risk of overall mortality (1), heart disease (2,3), cancer (4,5), diabetes (6), and obesity (7). National physical activity (PA) guidelines recommend at least 150 minutes of MVPA or 75 minutes of vigorous physical activity (VPA) per week and some form of strength training at least twice a week to reduce overall risk of mortality and certain chronic diseases (4,8–10). Even performing less than the recommended levels of physical activity (PA) per week is

associated with lower mortality risk (11,12). However, despite PA benefits, only 45% of women meet MVPA guidelines and only 16% meet strength training recommendations (13).

When women fail to acquire adequate PA, they not only increase their risk of non-sex specific chronic diseases (14), but also diseases associated with being female, such as endometrial cancer (15–17), fibroids (18,19) and ovarian cancer (20). In addition, breast cancer, the second leading cause of cancer death among women (21), is inversely associated with PA (22). Consistent participation in PA is associated with reduced risk of recurrence of breast cancer for survivors (23) and reduced risk of a heart attack after having breast cancer, which is the leading cause of death among breast cancer survivors (24,25)

There are additional risks of inadequate PA as women transition across the lifespan. Osteoporosis, is a bone disease that becomes more common in women after menopause and can lead to disability (26). Onset or progression of osteoporosis can be delayed by exercise which is related to the preservation of bone mass and strength among women, as well as the and reduction of bone cell death (27,28). Furthermore, as women are going through menopause, vasomotor symptoms, such as hot flashes, may be lessened with PA (29). Finally, mental well-being, including anxiety (30–32), depression (33,34) postpartum depression (35), Alzheimer's disease risk and dementia progression (36–38) can be mitigated with adequate and continuous PA in women.

Social roles, such as employment (39,40), marriage (41,42), and motherhood (43–45), are independently correlated with reduced PA. Across the lifespan, as women engage in social roles, their likelihood of meeting PA recommendations decreases (46,47).

Understanding the relationship between social roles and participation in MVPA among women is critical as most women (18+ years of age) in the United States are currently in one or more of these social roles. Approximately 57% of U.S. women are employed (48), 50% of U.S. women over 15 are married (49), and 60% of U.S. women have a child under the age of 18 (50). In addition, many of these roles are combined as 70% of U.S. women who are working also have a child under the age of 18 (48).

Juggling multiple social roles can leave women feeling as if there is not enough time to be active. Barriers to PA can include: rigid work schedules, working long hours, sedentary jobs, multiple daily household duties, duties associated with child rearing, caring for sick children, and coordinating and taking children to school, daycare, or children's extracurricular activities (51–53). Research also indicates that parents of young children have less MVPA than their counterparts with older children or their non-parenting counterparts (54,55). Furthermore, women report that the mental toll of multiple duties, lack of motivation, lack of support, and exhaustion is a barrier to PA, even among women who considered themselves athletic before having children (51,56).

Fan et al. (58) examined NHANES 2003-2006 data to understand what physical activities women participated in at age 25 and beyond. They found major declines in LTPA participation as women aged, with the most substantial declines at ages 35-44 and ages 55-64 (57). However, they did not examine the role of motherhood, employment, and marriage (57). In another NHANES study (1999-2006) comparing women's and men's LPTA activities, women reported walking as the most common activity followed by dancing and aerobics (58). Social roles among men or women were not explored.

Many studies explore PA duration and intensity; however, just as important is describing the specific PA behaviors (54). Although women with children are less likely to meet MVPA guidelines than their counterparts with children, common LTPA preferences among women with children is not well understood (44). In addition, few, if any studies, explore specific LTPA activities among with women with children who are meeting MVPA guidelines compared to their counterparts not meeting MVPA guidelines. As participation in PA can differ by demographic and type of activity, it is important to understand specific PA preferences among women with children when it comes to developing interventions or policies that intend to increase participation in PA (58).

The purpose of this study was to examine the most common type of leisure time physical activities among women with children by social role, defined as employment status, marital status, and age category of youngest child (< 6 years, 7-13 years, and > 13 years). Our study hypothesizes that among the participant sample of women with children, the top five most common LTPAs will vary by marital status, employment status, and age range of youngest child.

5.3 METHODS

Survey Design

National Health and Nutrition Examination Study (NHANES) data from 2003-2004 and 2005-2006 were used for this study. NHANES is a complex, multi-stage, probability design that since 1999, has surveyed a nationally representative sample of the noninstitutionalized civilian population in 2-year cycles (59). Data collected includes household interviews and PA examinations in a mobile examination center (MEC) (59).

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NHANES has approval from the National Center for Health Statistical Research Ethics Review Board and participant provide written consent (60).

Participants

This study focused on 276 women participants aged 18-60 (Figure 4.2). Women were excluded if they were pregnant, did not have children, did not identify as employed or a homemaker, reported physical limitations, did not have at least four days (10 consecutive hours per day) of PA monitor data, were missing LTPA or demographic data. Participants included in the study were compared to those excluded because of missing data.

Leisure-Time Physical Activity (LTPA)

NHANES participants were required to respond to the following question: "What moderate/vigorous activity did you do in the past 30 days?" Participants were allowed check all leisure time physical activities that applied from a list of 48 activities.

Physical Activity Monitor (PAM) Data

During the waves 2003-2006, NHANES included objective measures to determine activity levels of participants. Eligible subjects (age 6+) and those who did not have walking impairments or limitations from wearing the PAM device were recruited by health technicians in the mobile examination center (61). Participants wore accelerometers ActiGraph AM-7164 on their hip for at least 7 days and were only instructed to remove the accelerometers during sleep and water activities (i.e., shower or swimming) (61).

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Moderate to Vigorous Physical Activity (MVPA) Guidelines

The variable MVPA_Guidelines was categorized as "meets guidelines" or "does not meet." Participants who accumulated 150 minutes per week, or an average of 21 minutes per day (150 minutes per week/7 days), of MVPA were categorized as "meets guidelines". Participants with less than 21 minutes per day of MVPA were categorized as "does not meet" MVPA guidelines.

Social Role Variables

The social role variables for the study were employment status, marital status, and phase of motherhood. Employment status consisted of two categories: employed or homemaker. For marital status, women who either categorized as married or not married. Not married included women who were single, divorced, or widowed. Phase of motherhood was determined by age category of youngest child. Categories of children's ages were under 6, 6-13, and over 13. Age of youngest child was determined by subtracting the woman's current age from age of the participant's last live birth (62).

Demographic Variables

Demographic variables for this study were age category of participant, race/ethnicity, education, income, and body mass index (BMI). Age category for participants were categorized as (ages 18-44) and (ages 45-60) (63,64). Race/ethnicity was categorized as: 1) Non-Hispanic White, 2) Non-Hispanic Black, 3) Hispanic, and 4) Other. Education was categorized as: 1) high school degree or less, 2) some college or less, or 3) College graduate or higher. Income (yearly household income) was categorized as: 1) under $35,000, 2) $35,000-54,999, 3) $55,000-74,999, and 4) over $75,000. BMI was categorized as: 1) normal (<24.9 kg/m2); 2) Overweight (25.0-29.9 kg/m2), and 3)

Obese (> 30.0 kg/m2). In this study, there were only five participants that classified as underweight BMI (<18 kg/m2) therefore, they were included with participants with normal BMI.

Statistical Analysis

NHANES 2003-2006 accelerometer data cleaning, in which data points were consolidated and non-valid participants were identified, was performed with SAS data analysis software (version 9.4; SAS Institute, Cary, NC). Data points were consolidated to one record per person per day. Data were transferred to STATA data analysis software (version 15; College Station, TX) and merged with questionnaires from the NHANES dataset. Analyses conducted within STATA accounted for NHANES's complex design and this study used the sample weights provided by NHANES.

Descriptive statistics were calculated for the overall population and subgroups of population by social role (marital status, employment status, and phase of motherhood [age category of youngest child]). For the study purpose, frequencies and percentages of specific LTPAs were calculated for overall participant sample and by social roles (employment status, marital status, and phase of motherhood [age category of youngest child]). Descriptive analyses were also conducted to examine MVPA minutes and status of meeting MVPA guidelines for the sample population.

5.4 RESULTS

Sample

The purpose of this study was to examine the frequency of specific leisure time physical activities, mean daily MVPA minutes and status of meeting MVPA guidelines among women with children by social role, defined as employment status, marital status,

and age category of youngest child (< 6 years of age, 7-13 years of age, and > 13 years of age). Study participants were 43.6 years of age and the majority were married (74%), employed (88%), and had children over the age of 13 (55%) (Table 5.10). Only 43% percent of the participant sample met the MVPA guidelines and overall, the participant sample did not meet MVPA guidelines (Table 5.10). The mean MVPA of the participant sample per day was 21.0 minutes (Table 5.10). Compared to the participant sample (n=276), being excluded from the study due to missing data (n=457) was associated with being Hispanic, having a high school education or less, and having a BMI that qualified as obese (data not shown). Being included was associated with being non-Hispanic White or being a college graduate or higher (Table 5.5). Walking was the most frequently reported LTPA by the overall sample and this remained consistent across social roles; other frequently reported LPTAs were dance, aerobics, bicycling, and treadmill (Table 5.6).

LTPA Patterns and MVPA by Marital Status

Walking was the most popular LTPA among married and unmarried participants. Just under one-third (29%) of married participants reported that they had walked in the past 30 days, followed by 8-9% reporting dancing and stretching (Table 5.7). Approximately the same proportion of unmarried women reported walking (30%) as the most prevalent activity. The next most common activities across both groups were bicycling, aerobics, and dance (Table 4.7). Daily mean MVPA for married women in the study was 21.7 min/day and 43% of married women met MVPA guidelines (Table 4.10). Among women not married, daily mean MVPA minutes was 19.3 min/day and 42% met MVPA guidelines (Table 4.10).

LTPA Patterns and MVPA by Employment Status

   Walking was the most popular LTPA among employed participants and participants who were categorized as homemakers. Just under one-third of employed and homemaker participants reported that they had walked in the past 30 days (30% and 27%, respectively) (Table 4.8). The next most common activities across both groups were bicycling, aerobics, and dance (Table 4.8). Employed women and women who identified as homemakers differed significantly in daily mean minutes of MVPA. Employed women participated in 21.6 MVPA minutes per day compared to 16.9 MVPA min/day of the homemaker counterparts (Table 4.10). They did not differ significantly on meeting MVPA guidelines per week (employed women, 44%; homemakers, 35%) (Table 4.10).

LTPA Patterns and MVPA by Phase of Motherhood [age category of youngest child]

   Walking was the most popular LTPA among participants by age category of youngest child. Among women whose youngest child was under the age of 6, 26% reported that they had walked in the past 30 days (Table 4.9). Among women whose child was between 6 and 13 years of age or over 13 years of age, 32% and 31%, respectively, reported that they had walked in the past 30 days (Table 4.9). The next most common activities across all three groups bicycling, aerobic, and dance (Table 4.9).

   Women whose youngest child was under the age of 6 averaged 20.6 min/day. Women whose youngest child was between the ages of 6 and 13 average 22.4 min/day (Table 4.10). Women whose youngest child was over the age of 13 average 20.6 min/day (Table 4.10). However, there was a statistically significant difference between participants who met MVPA guidelines per week by age category of youngest child (Table 4.10). Women whose child was over the age of 13 were less likely to meet MVPA

guidelines (38%) than women whose youngest child was under the age of 6 (51%) or age 6 through 13 (46%) (Table 4.10).

5.5 DISCUSSION

Overview

Key findings of this study were that walking was the most common LTPA among all women. Only 43% of women overall met MVPA guidelines, defined by having at least 150 minutes of MVPA minutes per week.

LTPAs by Social Role

Walking was the most commonly reported LTPA for the total sample and across all three social role groups, ranging from 26%-31%. Other activities consistently identified as top five LTPAs were dancing, aerobics, bicycling.

These findings are consistent with two previous NHANES studies that found walking to be the most prevalent LTPA activity among women (57,58). Fan (2013) found that walking was consistently the top activity, with 40% or more women (ages 25-74) participating in walking (ages 25-74) (57). In addition, similar to our findings, the Fan study found that after walking, dancing, treadmill, and biking were the most prevalent activities among this sample of women (57). Dai (2015) compared women's and men's LTPA activity also found that walking that among women, walking was the most commonly reported activity, followed by aerobics and dancing (58).

Activities that were most prevalent after walking across all groups by social role were similar: aerobics, dancing, bicycling, treadmill, and stretching. Future studies may want to consider the role of culture in the appeal of these activities. For example, a dance class offered may have to consider the cultural context of the audience to improve

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chances of buy-in from participants (70). Furthermore, based on culture, social role or demographics, women may be motivated differently to participate in the same exercise (71). Therefore, health promotion messages may need to be tailored to these groups of women to increase participation.

Limitations of the study were that the variable "age category of youngest child" does not account for stepchildren or determine if the last live birth documented on the questionnaire is still living or living in the home with the biological mother. In addition, there were limitations with the physical activity monitor device used to measure MVPA and determine status of meeting MVPA guidelines among the participants for this study. The ActiGraph-AM 7164 accelerometer, does not capture stationary or water activities, such as weightlifting and swimming. Therefore, MVPA activities captured are only activities that involve vertical acceleration (61). In addition, participants who were Hispanic, have a high-school education or less, or have obesity were more likely to be excluded from the study due to missing variables, and non-Hispanic white participants and those with a college education or higher were more likely to be included (Table 4.5). This may bias the results as previous studies have shown associations between race, education, and BMI and PA (41,52,67,77); respondents included in the sample compared to those excluded may be more active.

Nonetheless, this study expands current knowledge regarding LTPA among women with children. To our knowledge, the number and different types of LTPA in which US women with children engage in by social role has not been previously reported. Another strength of the study is that the sample population had objective PA data available in addition to self-reported LTPA.

These results have public health implications. Most women in this study did not meet weekly MVPA guidelines, which is consistent with the literature showing that women with children are less likely to meet MVPA than women without children (13,68,69). Future recommendations to promote MVPA in women with children may want to focus interventions on increasing the time spent in the most popular activity, walking, and investigate ways to increase the intensity of walking to complement existing promotional activities that promote walking among women (78–80).

```
┌─────────────────────────┐
│ NHANES 2003-2006         │
│ Examination              │         ┌──────────────────────┐
│ participants N=20,470    │────────▶│ Male participants     │
└─────────────────────────┘         │ N=10,050              │
              │                      └──────────────────────┘
┌─────────────────────────┐
│ Female participants      │         ┌──────────────────────┐
│ n=10,420                 │────────▶│ Females less than 18  │
└─────────────────────────┘         │ (n=4,608) and over 60 │
              │                      │ (n=1,647)             │
┌─────────────────────────┐         └──────────────────────┘
│ Women 18-60 years of     │
│ age n=4,165              │         ┌──────────────────────┐
└─────────────────────────┘────────▶│ Pregnant women        │
              │                      │ n=535                 │
┌─────────────────────────┐         └──────────────────────┘
│ Non-pregnant women       │
│ n=3,630                  │         ┌──────────────────────┐
└─────────────────────────┘────────▶│ Those without any live│
              │                      │ births                │
┌─────────────────────────┐         │ n=1,605               │
│ Women with live births   │         └──────────────────────┘
│ n=2,025                  │
└─────────────────────────┘         ┌──────────────────────┐
              │             ────────▶│ Did not identify as   │
┌─────────────────────────┐         │ employed or           │
│ Homemakers and           │         │ homemaker             │
│ Employed                 │         │ n=456                 │
└─────────────────────────┘         └──────────────────────┘
              │
┌─────────────────────────┐         ┌──────────────────────┐
│ No reported physical     │────────▶│ Physical limitations  │
│ limitations that prevent │         │ that keep them from   │
│ working                  │         │ working               │
│ n=1,519                  │         │ n=50                  │
└─────────────────────────┘         └──────────────────────┘
              │
┌─────────────────────────┐         ┌──────────────────────┐
│ ≥4 days of PAM data      │────────▶│ < 4 days of PAM data  │
│ n=1,469                  │         │ n=537                 │
└─────────────────────────┘         └──────────────────────┘
              │
┌─────────────────────────┐         ┌──────────────────────┐
│ No missing covariates    │────────▶│ Missing at least one  │
│ n=934                    │         │ covariate             │
└─────────────────────────┘         │ n=48                  │
              │                      └──────────────────────┘
┌─────────────────────────┐         ┌──────────────────────┐
│ Final Sample             │────────▶│ Missing LTPA*         │
│ N=276                    │         │ response              │
└─────────────────────────┘         │ n=658                 │
                                     └──────────────────────┘
```
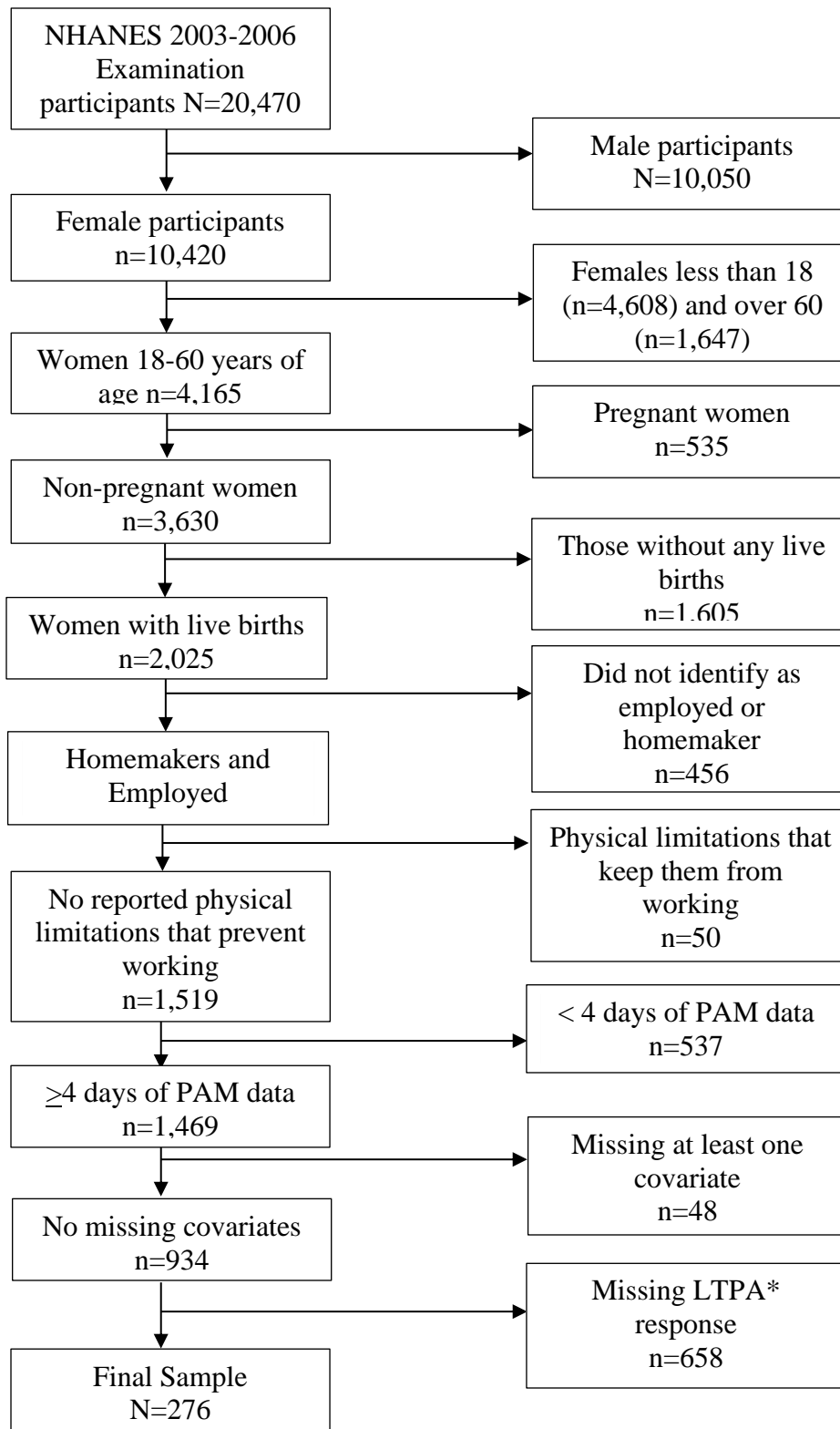
Figure 5.1: Sample Size Chart of Study Participants

Table 5.1: Demographic differences between women included (n=276) in the study and women excluded (n=658) due to missing LTPA responses, ages 18-60, NHANES 2003-2006

	Included (n=276)		Excluded (n=658)		p-value
	#	%	#	%	
Age Category					0.458
18-44	142	29	356	71	
45-60	134	31	302	69	
Race/Ethnicity					**0.000***
Non-Hispanic Black	50	25	153	75	
Non-Hispanic White	168	38	276	62	
Hispanic	45	19	196	81	
Other	13	28	33	72	
Income*					0.542
Under $35,000	99	27	262	73	
$35,000-$54, 999	54	29	130	71	
$55,000-$74,999	37	29	90	71	
$\geq$ $75, 000	86	33	176	67	
Education Level					**0.002***
High school education or less	99	24	307	76	
Some college or less	101	31	226	69	
College graduate or higher	76	38	125	62	
BMI					**0.045***
Normal weight ($\leq$24.9 kg/m^2)	96	33	191	67	
Overweight (25-29.9 kg/m^2)	89	31	194	69	
Obese ($\geq$30 kg/m^2)	91	25	273	75	
Marital Status					0.143
Married	194	31	430	69	

Not married	82	26	228	74	
Employment Status					0.497
Employed	232	30	541	70	
Homemaker	44	27	117	73	
Age Category of Youngest Child					0.184
<6	63	25	186	75	
6-13	65	29	156	71	
>13	148	32	316	68	
Status of Meeting MVPA Guidelines					0.054
Meets Guidelines	162	27	430	73	
Does Not Meet Guidelines	114	33	228	67	

*p<0.05

Table 5.2: Leisure Time Physical Activity (LTPA)
analyses* of the study sample, women ages 18-60 (n=276),
NHANES 2003-2006

Leisure Time Physical Activity	Frequency#	Percentage%
1. Walking	185	30
2. Dance	48	8
3. Aerobics	47	8
4. Bicycling	47	8
5. Treadmill	43	7
6. Stretching	36	6
7. Weightlifting	30	5
8. Hiking	25	4
9. Stairclimbing	20	3
10. Swimming	18	3
11. Jogging	13	2
12. Yoga	13	2
13. Basketball	12	2
14. Running	11	2
15. Tennis	9	1
16. Fishing	6	<1
17. Golf	6	<1
18. Bowling	5	<1
19. Softball	5	<1
20. Volleyball	5	<1

21. Kayaking	4	<1
22. Soccer	4	<1
23. Other	4	<1
24. Baseball	3	<1
25. Gardening	3	<1
26. Rowing	3	<1
27. Skiing-CC	3	<1
28. Skiing-DH	2	<1
29. Frisbee	2	<1
30. Horseback riding	2	<1
31. Wrestling	2	<1
32. Football	1	<1
33. Racquetball	1	<1
34. Rollerblading	1	<1
35. Skating	1	<1
36. Yard work	1	<1
37. Boxing	1	<1
38. Trampoline	1	<1

*Response are from NHANES Physical Activity- Individual Activities questionnaire

Table 5.3: Leisure Time Physical Activity (LTPA) analyses* of the study sample
(n=276)* by marital status, women ages 18-60 (n=276), National Health & Nutrition
Examination

Top 15 LTPAs	Married LTPA	#	%	Unmarried LTPA	#	%
1.	Walking	125	29%	Walking	60	30%
2.	Bicycling	37	9%	Dance	25	12%
3.	Aerobics	34	8%	Stretching	19	10%
4.	Treadmill	33	8%	Aerobics	13	7%
5.	Dance	23	5%	Bicycling	10	5%

*Response are from NHANES Physical Activity- Individual Activities questionnaire

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Table 5.4: Leisure Time Physical Activity (LTPA) analyses* of the study sample
(n=276)** by employment status, women ages 18-60 (n=276), NHANES (2003-2006)

Top 15 LTPAs	Employed LTPA	#	%	Homemaker LTPA	#	%
1.	Walking	159	30%	Walking	26	27%
2.	Dance	43	8%	Aerobic	8	8%
3.	Aerobics	39	7%	Biking	8	8%
4.	Bicycling	39	7%	Hiking	7	7%
5.	Treadmill	39	7%	Dance	5	5%

*Response are from NHANES Physical Activity- Individual Activities questionnaire

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Table 5.5: Leisure Time Physical Activity (LTPA) analyses* of the study sample (n=276) by age range of youngest child, women ages 18-60 (n=276), NHANES 2003-2006

Top 15 LTPAs	<6	#	%
1.	Walking	45	26%
2.	Aerobics	14	8%
3.	Dance	13	7%
4.	Stretching	13	7%
5.	Bicycling	12	7%
	6-13		
1.	Walking	48	32%
2.	Aerobics	14	9%
3.	Dance	12	8%
4.	Bicycling	9	6%
5.	Treadmill	9	6%
	≥14		
1.	Walking	92	31%
2.	Bicycling	26	9%
3.	Dance	23	8%
4.	Treadmill	23	8%
5.	Aerobics	19	6%

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Table 5.6: Characteristics of study population, women ages 18-60, (n=276, mean age 43.6 years), average daily minutes in moderate-vigorous physical activity (MVPA) and status of meeting MVPA guidelines, National Health & Nutrition Examination Surveys (NHANES 2003-2006)

Demographic Variables	#	%*	Daily MVPA Minutes*	% of Status Meeting MVPA guidelines* Meets	% of Status Meeting MVPA guidelines* Does not meet
Overall Sample	276	100	21.0	43	57
Age Range					
Younger (18-44)	142	52	21.5	46	54
Older (45-60)	134	49	20.6	39	61
Race/Ethnicity					
Non-Hispanic Black	50	9	17.5	32	68
Non-Hispanic White	168	79	21.3	44	56
Hispanic	45	7	24.0	52	48
Other	13	5	18.3	33	67
Income (annual household income)					
Under $35,000	99	29	16.8	33	67
$35,000-$54, 999	54	18	21.6	46	54
$55,000-$74,999	37	14	19.9	35	65
≥ $75, 000	86	39	24.4	52	48
Education Level					

High school education or less	99	30	20.8	44	56
Some college or less	101	38	18.4	35	65
College graduate or higher	76	32	24.4	52	48
BMI					
Normal weight (<24.9 kg/m^2)	96	40	26.0	58	42
Overweight (25-29.9 kg/m^2)	89	33	20.1	37	63
Obese ($\geq$30 kg/m^2)	91	26	14.8	27	73
Marital Status					
Married	194	74	21.7	43	57
Not Married	82	26	19.3	42	58
Employment Status					
Employed	232	88	21.6	44	56
Homemaker	44	12	16.9	35	65
Phase of Motherhood (age range of youngest child)					
<u><6 years of age</u>		21	20.6	51	49
<u>6-13 years of age</u>		25	22.4	46	54
<u>>13 years of age</u>		55	20.6	38	62

*Percentage (%), MVPA means, and status of meeting MVPA guidelines is weighted

CHAPTER 6

CONCLUSION AND IMPLICATIONS

6.1 OVERALL CONCLUSIONS

Inadequate physical activity among women with children is a public health concern that is associated with increased risk for chronic disease and early mortality (Alves et al., 2016; CDC, 2018b, 2018c, 2018a; Moore et al., 2016; WHO, 2017, 2018). Less than half (45%) of U.S. women meet MVPA guidelines and research indicates that it is even less for women with children (Blackwell et al., 2014a). Social roles, such as employment status, marital status, and phase of motherhood (i.e. having very young, young, or older children) may adversely impact physical activity (Brown & Trost, 2003; Larouche et al., 2012a). However, the association of multiple social roles with MVPA in women with children is not well understood, nor is the association between social roles and women's LTPA preferences.

The sample used for this study was from 2003-2006 National Health and Nutrition Examination Study (NHANES) dataset, which has objective physical activity measures and self-report LTPA. Women with children, ages 18-60, who identified as a homemaker or employer, were the target population. The first aim of this study (SA1, Manuscript 1) was to determine the relationship between objectively measured MVPA and marital status, employment status, and phase of motherhood (having very young, young, or older children). The second aim (SA2, Manuscript 2) was to examine the frequency of specific leisure time physical activities, mean daily MVPA minutes and

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status of meeting MVPA guidelines among women with children by social role, defined as employment status, marital status, and phase of motherhood.

Results from regression analysis for SA1, reported in manuscript 1, found that employed women had higher levels of MVPA compared to women who were homemakers. Married women had higher MVPA compared to women who were not married. In addition, women whose youngest child was between the ages of 6-13 had higher levels of MVPA compared to women whose youngest child was under 6 years of age or women whose youngest child was over 13 years of age.

Results from analyses for SA2, reported in manuscript 2, found that regardless of social role, walking was the most common LTPA among the participant sample and that by social role, mothers of younger ($\leq$6 and 6-13 years of age) compared to mothers of older children (>13 years of age) are more likely to meet guidelines, and employed women compared to homemakers had more minutes of MVPA.

Additional findings from both studies were that most women in both studies did not meet MVPA guidelines, defined by having at least 150 minutes of MVPA minutes per week (American College and Sports Medicine & American Heart Association, 2007; US Department of Health and Human Services, 2008; WHO, 2018). In Manuscript 1 (SA1, n=934) and Manuscript 2 (SA2, n=276), only 37% of women met MVPA guidelines.

6.2 PREVIOUS RESEARCH THAT ALIGNS TO FINDINGS

This study is consistent with previous studies in that our participant sample of women with children had lower MVPA than studies reporting the MVPA of the overall population of U.S. women (Blackwell et al., 2014a). Aim 1 of this study focused on the association between MVPA and the combination of social roles. Our results that women

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had higher levels of MVPA than homemakers, aligns with previous studies that indicates that reduced physical activity is associated with not being in the labor force among women with children (Bell & Lee, 2005; Estrella et al., 2018). However, previous studies, such as Steeves et al. (2015) used objective physical activity data (2003-2006 NHANES dataset) to measure if there were differences between women with children who were either employed or identified as homemakers. The study found that there was no difference between MVPA among employed women and homemakers, but during the week, employed women had more MVPA (corresponding to commute times) than their homemaker counterparts (Steeves et al., 2015). However, this study categorized women with children by either having children over 18 years of age or under 18 years of age.

In this study there was a positive association with marital status and MVPA in the regression analysis. However, when controlling for covariates, there was no association between marital status and MVPA. Previous studies have shown that the relationship between marriage and physical activity among women can be positive (Berge et al., 2011), negative (Brown & Trost, 2003; Uijtdewilligen et al., 2015; Verhoef et al., 1992), or neutral (Hull et al., 2010; Ortega et al., 2011). Results of this study aligns with literature that suggests that there is a neutral relationship between marriage and physical activity.

Regarding phase of motherhood, in Manuscript 1 (SA1) results showed that having very young (<6) children was associated with lower MVPA compared to women whose children were ages 6-13. These findings align with literature in previous studies that indicated that having very young children was associated with reduced levels of physical activity among parents (Berge et al., 2011; Gaston et al., 2014).

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Manuscript 1 (SA1) also found that having older children (>13) was associated with lower minutes of MVPA among women. The findings of lower activity among women with older children in our study are likely due to the older age of the women. Previous literature has shown that as women age, they are more likely to participate in less physical activity (Choi et al., 2017b).

Analysis for Specific Aim 2 found that walking was the most common LTPA among the participant sample. This aligns with previous literature that measured LTPA among women and found that walking was the most popular LTPA (Dai et al., 2015; Fan et al., 2013). A second focus of Aim 2 was to determine if there was a statistically significant difference between meeting MVPA status and daily MVPA minutes among women with children by social role. Our study found that mothers of younger children (<6 and 6-13 years of age) were more likely to meet MVPA guidelines ($\geq$150 minutes per week) than mother's whose children were over the age of 13. Again, this may be related to increased age, which is independently related to reduced physical activity among women (Choi et al., 2017b). However, these results align with Verhoef et al. (1992), a study that examined the interaction between physical activity with social roles (marital status, employment status, and parenthood) among women. Verhoef et al. (1992) found that parenthood affected exercise participation and the effect was dependent on age. Non-parents under 35 years of age were more likely to exercise than their counterparts with children under 35 years of age (Verhoef et al., 1992). However, for parents and non-parents over the age of 35, there was not a significant difference (Verhoef et al., 1992).

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The conceptual model guiding this study was the "Ecological Model of Four Domains of Active Living" which focused on the "Intrapersonal" and "Behaviors: Active Living" domains (Sallis et al., 2006). Results from the study were consistent with the conceptual model (Figure 2.2) in that the combination of the marital status and phase of motherhood (i.e. age range of youngest child) (Intrapersonal domain) and employment and household tasks (Behaviors: Active Living Domain) had a statistically significant association with daily MVPA minutes (Specific Aim 1). This study aligns with a previous study which found (through self-reported physical activity) that all three social roles (marital status, employment status, parenthood) need to be addressed when examining physical activity among women (Verhoef et al., 1992).

6.3 LIMITATIONS AND IMPLICATIONS OF RESEARCH AND FINDINGS

Limitations of the study were that the ActiGraph-AM 7164 accelerometers measured intensity of movement on a vertical plane so non-ambulatory movements such as weight-lifting or cyclical motion (e.g. elliptical machine or stationary cycling) is less accurate when using accelerometry. In addition, there were limitations regarding how independent variables were defined. Employment status had two categories: employed or homemaker and this study does not account for employed-homemakers (i.e. women who work full-time and also have the duties of a homemaker) (Steeves et al., 2015). Limitations of the study were that the variable "age category of youngest child" does not account for stepchildren or determine if the last live birth documented on the questionnaire is still living or living in the home with the biological mother. Finally, although there were slight differences between the characteristics of populations included in Manuscript 1 and Manuscript 2, across both studies, participants more likely to be included were non-Hispanic White, had a college education or higher, or had a

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household income at or greater than $75,000 per year. This may bias the results as previous studies have shown associations between race, education, and income and PA (CDC, 2020; R. E. Lee et al., 2011; Prince et al., 2016; Uijtdewilligen et al., 2015); therefore, respondents included in the sample compared to those excluded may be more active.

This study expands current knowledge regarding the combined associations of employment status, marital status, and phase of motherhood on MVPA levels among women with children. To our knowledge, objective levels of MVPA and different types of LTPA in which US women with children engage in by social role has not been previously reported. Results of our study found that being employed, married, and having the youngest child between the ages of 6-13 is associated with higher MVPA levels among women. In addition, results also indicated that being a homemaker and having a child over 13 was associated with decreased physical activity among women.

Most women in this study did not meet weekly MVPA guidelines, which is consistent with the literature regarding women with children (Blackwell et al., 2014b; Brown & Trost, 2003; Engberg et al., 2012b). Research should focus on data collection among this population and should include the impact of social role when tailoring activities for the purpose of increasing PA. As walking was the most popular LTPA, regardless of social role, the focus should be increasing amount of time spent walking among women.

Interventions may need to be tailored differently for women who participate in different social roles. As the results show that women who are married, have children between ages of 6-13, and who are employed have higher physical activity, previous

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studies indicate that higher physical activity is related to greater self-efficacy and a more supportive environment for physical activity. Additional research may explore if this is the case with women with children who are married, have children between the ages of 6 and 13, and who are employed. Furthermore, in the participant sample, women whose children were over 13 or who were homemakers were at greater risk for physical inactivity.

6.4 POSSIBLE AREAS FOR FUTURE RESEARCH

Possible areas for future research are examining the existing barriers to MVPA, such unique time constraints experienced by women with children. As women age and add on additional roles, time is reallocated to those roles which may decrease time spent in physical activity (Brown & Roberts, 2011). In addition, the chronic stress associated with those roles may further reduce the motivation and intention to become physically activity for women who do have access to perform LTPA (Stults-Kolehmainen & Sinha, 2014). Other barriers that may need to be considered is the psychological barriers among U.S. women who are mothers. Guilt for not spending enough time with children for women who are employed, may impact their decision making when choosing to spend time after work exercising (Cawley & Liu, 2012; Dixon, 2009). Furthermore, cultural beliefs regarding how women spend their leisure-time may influence whether women spend extra time they may have with family or practicing self-care (Freeman et al., 2006).

Future interventions may explore promoting physical activity among young women as they transition into adult roles and increasing their awareness of barriers and how to navigate barriers as they increase or transition among their social roles (Bell & Lee, 2005). For example, women may need additional support to make exercise more convenient which may encourage more frequent participation (Brown & Roberts, 2011).

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In addition, as women with children are often taking their children to the doctor for well-visits, this may be a key intervention point where women can receive tailored assistance and a key point to collect data from women on their physical activity levels (Berge et al., 2011). Also, as women with children have tasks associated with their social roles, interventions promoting reduced sedentary time in addition to promoting increased walking may work on both ends to reduce the chronic disease risk among this population (Del Pozo-Cruz et al., 2018).

Policies that enable homemakers to access childcare may be beneficial for homemakers. Homemakers may need financial support for childcare as there is only one income supporting the family. Policies that cover the cost of childcare at gyms and/or gym membership would assist in reducing barrier to PA among women with children. In addition, for women who are homemakers, policies that support the creation or subsidization of drop-in daycare would assist in creating time during the day for PA.

For employed women, policies in the workplace may be effective in increasing PA among women with children. In a qualitative study women indicated the need for flexible leave time within the day to attend exercise classes, and convenient onsite exercise facilities and programming (Dixon, 2009). Policies that support flexible breaks at work and that financially support the building and maintenance of an on-site exercise facility tailored for women would assist in reducing barriers to exercise and take away the pressure of needing childcare after work or balancing after work duties with PA.

Finally, for both employed women and homemakers, as finding time during the week for PA may be challenging, therefore, promoting "weekend warriors" (e.g. being active on the weekends) may help to increase PA among this population (O'Donovan et

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al., 2017; Steeves et al., 2015), especially if this is accompanied by childcare support policies.

Overall, it is critical to address physical inactivity among women with children. The additional social roles of this population are important to consider when developing interventions or polices that aim to increase physical activity. Understanding the positive or negative associations between social roles and MVPA and associations between social roles and LTPA can help guide the development of programs that appeal to this population.

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APPENDIX A

DEPENDENT VARIABLES

Variable Name	NHANES Mobile Examination Center	Intensity	Cut Points
allmean_mvpa1	Physical Activity Monitor Accelerometer ActiGraph AM-7164	MVPA	≥2020 CPM
Variable Name	Questionnaire	NHANES variable name	Description
LTPA	Physical activity- Individual Activities	PADACTIV	[Over the past 30 days], what {vigorous/moderate} activities did {you/SP} do?

APPENDIX B

INDEPENDENT VARIABLE

Independent Variable	NHANES Variable Name	Questionnaire	Description	Recode
Marital Status	SPQ.180	Demographic-SP	(Are you/SP) is married, divorced, separated, never married or partnered?	Married=0 Else=1
Employment Status	OCQ.150 OCQ.380	Occupation	Respondents can answer that they were working or a homemaker, respectively	If working, then=0 If homemaker, then=1
Age Range of Child	RIDAGEYR RHQ.190	DEMO Reproductive Health	RHQ.190 subtracted from RIDAGEYR	Age_youngest_child
	Age_youngest_child	DEMO Reproductive Health	Age of youngest child	6 years of age or less=0 7-13 years of age= 1 Above the age of 13=2

APPENDIX C

COVARIATES

Covariate	NHANES Variable Name	Questionnaire	Description	Recode
Mother's Age	RIDAGEYR	DEMO	Women ages 18-44 and 44-60 at age at screening	Ages 18-44=0 Ages 45-60=1
Race/Ethnicity	RIDRETH1	DEMO	Race/Hispanic Origin	Hispanic=0 Non-Hispanic White=1 Non-Hispanic Black=3 Other=4
Education	DMQ.140	Demographic-SP	Highest level of school/degree completed	High School or less=1 Some College=2 College graduate or higher=3
Income	INDFMINC	DEMO	Household income	Under $35,000=0 $35,000-54,999=1 $55,000-74,999= 2 $75,000 or more=3
BMI	BMXBMI	Body measures	Body Mass Index	(underweight and normal BMI)- <24.9 (kg/m2) $\leq$=1 Overweight- 25-29.9 (kg/m2) =2 Obese- $\geq$30 (kg/m2) =4

APPENDIX D

PHYSICAL ACTIVITY-INDIVIDUAL ACTIVITIES QUESTIONNAIRE

Code or Value	Value Description	Code or Value	Value Description
10	AEROBICS	34	SOCCER
11	BASEBALL	35	SOFTBALL
12	BASKETBALL	36	STAIR CLIMBING
13	BICYCLING	37	STRETCHING
14	BOWLING	38	SWIMMING
15	DANCE	39	TENNIS
16	FISHING	40	TREADMILL
17	FOOTBALL	41	VOLLEYBALL
18	GARDENING	42	WALKING
19	GOLF	43	WEIGHT LIFTING
20	HIKING	44	YARD WORK
21	HOCKEY	50	BOXING
22	HUNTING	51	FRISBEE
23	JOGGING	52	HORSEBACK RIDING
24	KAYAKING	53	MARTIAL ARTS
25	PUSH-UPS	54	WRESTLING
26	RACQUETBALL	55	YOGA
27	ROLLERBLADING	56	CHEERLEADING AND GYMNASTICS

28	ROWING	57	CHILDREN'S GAMES (E.G. DODGEBALL, KICKBALL)
29	RUNNING	58	ROPE JUMPING
30	SIT-UPS	59	SKATEBOARDING
31	SKATING	60	SURFING
32	SKIING - CROSS COUNTRY	61	TRAMPOLINE JUMPING
33	SKIING - DOWNHILL	71	OTHER
.	MISSING		

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