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Exploring the Relationship between Physical Activity and Acculturation in U.S. Asian Indian Women

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Exploring the Relationship between Physical Activity and Acculturation in U.S. Asian Indian Women

by

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Dissertation

Presented to the Faculty of the Graduate School of
The University of Texas Medical Branch
in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

The University of Texas Medical Branch
March, 2014

Acknowledgements

I would like to express my special appreciation and thanks to my advisor and dissertation chair, Dr. Sheryl Bishop, for her constant support, expertise, guidance and advice along the way. I would also like to thank my committee members, Dr. Pamela Watson, Dr. Yolanda Davila, Dr. Ranjita Misra and Dr. Karl Eschbach, for serving as my committee members. Thank you for all of their invaluable expertise, comments and suggestions that allowed me to complete and refine my dissertation. I appreciate the time and energy that each of them invested in my education, training and future. The UTMB Nursing PhD faculty members have consistently been supportive and encouraging as I pursued my goals, giving excellent suggestions and providing guidance with grace. I would like to extend my sincere gratitude to Dr. Pamela Watson, Dr. Alice Hill and Dr. Carolyn Phillips for not only providing mentoring but also offering me financial support through the National Jonas Scholarship Award. This study was supported by TNA District 9 Research Grant Award, and I wish to express my most sincere gratitude to Texas Nurses Association District 9 for offering me this research grant.

Many of my friends, classmates and colleagues supported and encouraged me along the way. I could not imagine doing this without them.

I am also very much grateful to all my family members for their constant inspiration and encouragement. Words cannot express how grateful I am to my great

mother, Mrs. Annamma Mathew, and my sisters, Smitha Sanu and Anu Mathew, for all of the sacrifices that you have made on my behalf. They have shaped me into who I am today and I love them deeply for that. Your prayer for me was what sustained me thus far. Unfortunately, my father is no longer with us to celebrate the completion of my PhD. I owe my deepest gratitude towards my loving husband, Joby Joseph, whose unconditional love, care, patience and continual support of my academic endeavors over the past several years enabled me to complete this dissertation. Finally, I would like express my appreciation and love to my beloved son, Jeswin Joby Joseph. Thank you, Jeswin, for being understanding, amazing, inspiring and supportive everyday with your loving words and deeds.

Exploring the Relationship between Physical Activity and Acculturation in U.S. Asian Indian Women

Publication No._____

Nitha Mathew, PhD

The University of Texas Medical Branch, 2014

Supervisor: Sheryl L. Bishop

Asian Indian immigrants are at greater risk for morbidity and mortality from coronary heart disease and diabetes compared to Caucasians and other immigrant groups in the U.S., and have been shown to have lower levels of physical activity. Acculturation has been associated with increased risk for obesity, Type 2 diabetes, metabolic syndrome and coronary artery disease among Asian Indians. The study objective was to identify relationships between acculturation and five types of activity in Asian Indian women in the U.S. The central hypothesis was that more acculturated U.S. Asian Indian women will have higher levels of leisure time physical activity and sedentary activity, and lower levels of job-related, transportation and household physical activity than less acculturated counterparts. A cross-sectional descriptive comparative design was used on a convenience sample of Asian Indian women in Houston, Texas. Data were collected by

survey method using the IPAQ, Modified SL-ASIA and PF-10. Data analysis included descriptive analysis of five types of activity and acculturation and correlations between different types of activity and acculturation. Data analysis also included differences in levels of activity across all five types of activity between high and low acculturated Asian Indian women and between immigrant status of Asian Indian women in the U.S. utilizing analyses of covariance. Multiple regression techniques were used to examine predictive power of acculturation, physical functioning, BMI, immigration status and demographic characteristics on physical activities and sedentary activity. Study results indicated higher levels of total physical activity among Asian Indian women, with higher levels of job-related physical activity and lower levels of leisure, household and transportation physical activity. The study results suggested that higher acculturation was associated with higher levels of leisure activity and time spent sitting and lower levels of job and household physical activity. The information on the association of five types of activity and acculturation can be used to design nursing interventions to promote physically active lifestyles in Asian Indian women, thus reducing health disparities in the U.S. Study findings indicate more studies are needed to explore the cultural factors affecting each types of physical activity in U.S. Asian Indian women.

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List of Abbreviations

ACSM	American College of Sports Medicine
AHA	American Heart Association
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
BMI	Body Mass Index
CAD	Coronary artery disease
CHD	Coronary Heart Disease
CVD	Cardiovascular disease
DM	Diabetes Mellitus
GSBS	Graduate School of Biomedical Science
HDL	High Density Lipoprotein
HDL-C	High Density Lipoprotein -Cholesterol
HHS	Health and Human Services
IANA	Indian American Nurses Association
IRB	Institutional Review Board
IPAQ	International Physical Activity Questionnaire
LDL	Low Density Lipoprotein
LTPA	Leisure Time Physical Activity
MET	Metabolic Equivalent of Task
MOS	Medical Outcomes Study
M-SL-ASIA	Modified Suinn-Lew Asian Identity Acculturation Scale

NHIS	National Health Interview Survey
NGO	Non-Governmental Organization
NLTPA	Non-Leisure Time Physical Activity
PI	Principal Investigator
PA	Physical Activity
PF	Physical Functioning
SAI	South Asian Indian
SD	Standard Deviation
SES	Socio Economic Status
SL-ASIA	Suinn-Lew Asian Identity Acculturation Scale
SPSS	Statistical Package for the Social Sciences
U.K	United Kingdom
U.S.	United States of America
UTMB	University of Texas Medical Branch

Chapter 1: Introduction

This chapter introduces the problem of physical inactivity and acculturation in Asian Indian women in the U.S. It also describes the significance of the problem and the purpose of the current study, its design and the research questions based on the problem.

STATEMENT OF THE PROBLEM

Asian Indian immigrants are at greater risk for morbidity and mortality from coronary heart disease and diabetes compared to Caucasians and other immigrant groups in the United States (Jonnalagadda & Diwan, 2005; Misra et al., 2005). Central obesity is a significant risk factor for cardiovascular disease, metabolic syndrome and diabetes in Asian Indian immigrants despite the fact that this population has a lower average body mass index (BMI) than Caucasians (Misra & Vikram, 2004). Many empirical studies have confirmed that an increased level of exercise is negatively related with body fat or weight (Dwyer et al., 2007; Krum et al., 2006).

Regular physical activity and exercise are essential for the health and well-being of humans. Studies conducted in the U.S. and other western countries have shown a reduced level of physical activity among immigrant Asian Indians (Misra et al., 2000, 2005; Mohan et al., 2008). Lower levels of physical activity have been associated with the development of diabetes, coronary artery disease (Kandula & Lauderdale, 2005; Williams et al., 2011) and metabolic syndrome in Asian Indians (Balasubramanyam et al., 2008; Misra et al., 2005). Thus, regular physical activity is essential for reducing risk factors for cardiovascular disease, diabetes and obesity in Asian Indians (Joshi et al., 2007; Misra & Khurana, 2009).

Acculturation to the U.S. was found to be significantly associated with a lower frequency of physical activity participation among South Asian Americans (Sharma, 2006). Acculturation is described as the process by which immigrants adopt the attitudes, values, customs, beliefs, behaviors and lifestyles of a new culture and dominant society (Abraido-Lanza et al., 2006). Acculturative stresses related to adjustment to the American lifestyle such as responsibilities towards family, long working hours, less support from extended family and time constraints were reported as concerns for the development of cardiovascular disease among the Asian Indian population living in the U.S. because these acculturative stressors negatively influence physical activity levels (Kalra et al., 2004; Mohan et al., 2008).

Within the Asian Indian community, Asian Indian women have lower rates of participation in physical activity than men and have been studied to a lesser extent than Asian Indian men (Babakus & Thompson, 2012; Eyler et al., 2002). The relationship between acculturation and physical activity in Asian Indian women remains under-explored. Research findings on the relationship between acculturation and physical activity may influence the planning and implementation of physical activity programs for Asian Indians to reduce health disparities and thereby improve their health.

BACKGROUND AND SIGNIFICANCE OF THE PROBLEM

Asian Indians are defined as U.S. citizens or residents whose origins are from the Indian subcontinent. Asian Indians comprise one of the fastest growing immigrant populations in the United States. A demographic snapshot of South Asians in the United States extracted from the 2010 U.S Census by a non-governmental organization **(**NGO**)** shows that the Asian Indian population in the U.S. grew 68% over 2000-2010 from 1.9

million to 3.19 million, representing approximately 1% of the U.S. population (Rajghatta, 2012). This surge in numbers makes Asian Indians the third largest Asian-American group in the U.S. after Chinese-Americans (3.79 million) and Filipino-Americans (3.42 million), but with a much faster growth rate, according to the 2010 U.S. census data (Rajghatta, 2012). Asian Indians in the U.S. are significantly different from other immigrant groups in that they are usually well educated, prosperous and English speaking. The 2010 U.S. Census data indicated that Asian Indians, along with other Asian Americans, have attained the highest educational levels of all ethnic groups in the U.S. Seventy-one percent of all Indians have a bachelor's degree or higher and are economically well-off, with the highest household income of all ethnic groups in the United States (U.S. Census Bureau, 2012b). Asian Indians are heterogeneous with diverse ethnicities, languages, religions, dress styles, social habits, cultural practices, festivals, diets and lifestyles. In addition, health knowledge, beliefs and behaviors vary within and between Asian Indian ethnic groups (Misra et al., 2000). The increase in the rapid growth of this significant population in the U.S. has created a need for health professionals and researchers to study and understand the relationship of acculturation and physical activity among this subpopulation.

From the literature it is evident that Asian Indians are at twice the risk for cardiovascular disease (CVD) and diabetes compared to Caucasians (Roger et al., 2011; Venkataraman et al., 2004). The physical activity (PA) objective of Healthy People 2020 emphasized that regular PA plays an important role in lowering the risk of heart disease and diabetes (U.S. Department of Health & Human Services, 2008). Unfortunately, the prevalence of physical inactivity has been reported as high as 60% among Asian Indians

in the U.S. (Misra et al., 2000). Inadequate physical activity is recognized as a significant, independent risk factor for cardiovascular diseases and other chronic diseases among Asian Indians in the U.S. (Babakus & Thompson, 2012; Balasubramanyam et al., 2008; Misra et al., 2005).

Acculturation has been defined as the merging of cultures as a result of prolonged contact between individuals and groups of different cultural backgrounds (Sam, 2006). Thus, acculturation is the process of socio-cultural and psychological adaptation of an individual following intercultural contact (Berry, 2004). The changes at the socio-cultural level depend on the characteristic of the societies or cultures in which individuals have been in contact, and this contact may result in cultural changes in psychological or individual levels. Psychological or individual acculturation may lead to behavioral changes in the areas of eating, language preferences and cultural identity. Thus, during the acculturation process adaptation occurs at the psychological or individual level and also at the socio-cultural level. The adaptation is connected to personal well-being or self-esteem at the individual level. Yet at the socio-cultural level, adaptation is linked to personal interaction with the society (Berry, 2004). Clearly, acculturation is a complex concept that no single factor can adequately describe. Therefore, researchers often use more accessible indicators such as place of birth, length of residence in the host country and language preference, either independently or in combination, as proxy measures of acculturation (Daniel & Wilbur, 2011).

Existing literature has suggested that acculturation influences the health behaviors of Asian Indians in general. Acculturation has been associated with an increase in the risk factors for obesity, Type 2 diabetes, metabolic syndrome and coronary artery disease

among Asian Indians (Dodani & Dong, 2011; Kalra et al., 2004; Mooteri et al., 2004). Studies have examined the ways in which acculturation increasingly impacts the health of Asian immigrants (Dodani & Dong, 2011). Acculturation creates health risks by impacting levels of stress, access to health resources and the knowledge and attitudes that shape and influence health behaviors (Hill et al., 2006). In many immigrant groups an inverse relationship has been demonstrated between acculturation (e.g., length of time in residence) and physical activity (i.e., an increase in time since U.S. immigration correlates with a decrease in physical activity), with an end result of poorer health outcomes (Hubert et al., 2005; Kaushal, 2009).

While historically the relationship between acculturation and physical activity has focused on activity related to compliance with specific disease management protocols (e.g., Type 2 diabetes, cardiovascular), the few studies conducted with Asian Indians to date have focused almost exclusively on leisure time physical activity, which may be very differentially accessed between male and female Asian Indians. In fact, studies have found evidence that leisure time physical activity was higher in Asian Indian men than women (Daniel et al., 2011, 2013; Kalra et al., 2004; Kolt et al., 2007; Misra et al., 2005; Ye et al., 2009). Unlike other immigrant groups, one intriguing possibility is that as the number of years of residence in the host country increases, leisure time physical activity of Asian Indians who become more acculturated to the host country may increase because newer immigrants may not have the time or the money to participate in leisure time physical activity (Daniel & Wilbur, 2011). But this pattern may not be equally evident across genders or generations.

Nonetheless, little is known about the relationship between physical activity and acculturation among Asian Indian women. Research has shown that immigrant South Asian women are more prone to acculturative stress than their male counterparts (Ahmad et al., 2004), including change in lifestyle after migration, dietary changes, loneliness and lack of support as a result of changes in family structure (Mohan et al., 2008), ethnic minority status and language barriers (Farooqi et al., 2000).

Past studies have indicated that promoting physical activities among Asian Indian women pose a particular challenge, with cultural differences being identified as the key factor in decreased leisure time activity (Sriskantharajah & Kai, 2007). It appears that South Asian Indian women participate in less physical activity and recreational exercises than other women due to the cultural barriers of religious modesty, avoidance of mixed-gender activities and fear of going outside alone (Johnson, 2000; Sriskantharajah & Kai, 2007).

In addition, Asian Indian women come from a patriarchal and collectivistic society and bear the responsibility of holding, teaching and transmitting cultural traditions, values and beliefs to their families (Bhattacharya, 2002). Findings from a study conducted among South Asian women in the U.K. showed that South Asian women were under considerable demands, including physical activity, from care-giving, housekeeping and workday activities. This, in turn, resulted in supplemental time for exercise such as aerobics classes was not seen as an acceptable part of family duties. The notion of "exercise" for oneself beyond daily work was perceived by some as a selfish activity or given little priority in the context of family and community expectations and needs (Sriskantharajah & Kai, 2007). In South Asian women, physical activity remains a

function relegated to normal daily duties rather than enjoyment or added provision of time to focus on being physically active (Lucas et al., 2013).

Therefore, the contribution of this research was expected to be an enhanced understanding of the relationship between acculturation and various forms of activity (leisure time physical activity, job-related physical activity, transportation physical activity, household physical activity and sedentary activity time spent sitting) in both immigrant and non-immigrant Asian Indian women living in the U.S. This contribution is significant as it is the first step in a continuum of research that is expected to lead to the development of effective community health nursing interventions to promote physically active lifestyles in Asian Indian women for the reduction of health disparities. It is important for nurses to understand cultural differences in the physical activity pattern of their clients and develop culturally appropriate health promotional counseling and programs for the high-risk immigrant Asian Indians. Moreover, the development of strategies for physical activity interventions is applicable to the prevention of chronic diseases associated with physical inactivity among other immigrant and native-born groups to improve quality of life as well as health outcomes.

The present study aimed to provide information that may help nurses and other health professionals to develop educational programs or implement specific strategies to improve physical activity behaviors of immigrant and non-immigrant Asian Indian women living in the U.S., and thus potentially offer Asian Indian women in the U.S. an opportunity to improve their health and quality of life. Research findings on acculturation may also influence planning and implementation of public health policies and programs for immigrants (Abramson et al., 2002). In addition, the development of culturally

sensitive, effective physical activity interventions will positively affect the U.S. healthcare system by reducing healthcare related costs, e.g., lost wages by people unable to work because of chronic diseases and disability, the value of future earnings lost by premature death (U. S. Department of Health & Human Services, 2002).

This study also sought to address several shortcomings of the existing literature which represent significant gaps in understanding critical features necessary for effective health promotion among Asian Indians. Central to this understanding was a clear grasp of the role of culture in participation in physical activities necessary to prevent chronic illness (e.g., CHD, diabetes). First, few studies have evaluated the acculturation of Asian Indians in the U.S. as a factor influencing physical activity, and those that did only used proxy measures of acculturation (e.g., time since immigration, fluency in English, language preference) to measure acculturation (Daniel & Wilbur, 2011; Kolt et al., 2007; Lawton et al., 2006; Misra et al., 2005).

Second, the physical activity studies conducted in Asian Indians have focused primarily on immigrant Asian Indians and could not differentiate the ways in which their physical activity behavior differed from U.S. born Asian Indians' lifestyles (Mohan et al., 2008). Thus, inferences attributed to acculturation changes were not discernible from those of cultural practices that may still be resident in U.S. Asian Indian populations. The issue has been further complicated by the fact that substantial Asian Indian migration to the U.S. and other developed countries is a modern phenomenon (U.S. Census Bureau, 2012a) wherein representation of native born Asian Indian Americans is almost absent in the older population. Thus, a simple comparison of immigrants versus non-immigrants has been confounded by age. Similarly, ample evidence from the acculturation literature

in general has supported the assumption that immigration during one's formative years (i.e., under 15 years of age) would have a substantially different impact than immigration as an adult. Therefore, this study examined the physical activity behavior across immigration status based on three approaches: 1) in immigrant versus non-immigrant (i.e., U.S. born), 2) across years in the U.S., and 3) across age at time of immigration.

Third, there have been several gaps related to the measurement of physical activity in studies of Asian Indians. Most of the physical activity studies failed to use physical activity measures that had been tested for reliability and validity (Daniel & Wilbur, 2011). This oversight may have been due to the focus on multiple behaviors as opposed to an in-depth focus on physical activity behavior. Also with few exceptions, studies that examined correlates of physical activity behavior in Asian Indians primarily have focused on leisure time physical activity. The measurement of a single domain of physical activity underestimates physical activity obtained in household, transportation or occupational work in Asian Indian immigrants, especially in women (Daniel & Wilbur, 2011; Daniel et al., 2013; Lawton et al., 2006; Ye et al., 2009). A focus on only leisure time activity limits the possible intervention opportunities to increase physical activity in other areas that may be more culturally accessible.

This study also explored sedentary activity as time spent sitting in addition to physical activity. The amount of time spent in sedentary behaviors has been independently associated with lower levels of physical-activity energy expenditure (Levine et al., 2005; Westerterp, 2001), increased risk of weight gain (Hu et al., 2003; Levine et al., 2005), and increased risk of metabolic syndrome, diabetes and heart disease (Bankoski et al., 2011; Ford et al., 2005). Sedentary behavior is a separate activity from

physical activity and is defined as engaging in activities at the resting level of energy expenditure, which includes time spent sitting at a desk; reading, sitting or lying down; computer time; and lying down or sitting to watch television in the daily life (IPAQ, 2005; Waidyatilaka et al., 2013).

The research study was innovative because it sought to address the entire spectrum of physical activity and acculturation by employing a culturally relevant and valid acculturation scale and physical activity assessment to determine the extent to which acculturation is associated with types of physical activity: leisure time activity, job-related physical activity, transportation physical activity and household physical activity in Asian Indian women in the U.S. The study described differential patterns and levels of physical activity that varied across acculturation and immigration status in Asian Indian women living in the U.S. The identification of levels of physical activity and acculturation may provide targets for interventions for chronic disease prevention by increasing Asian Indian women's physical activity and improving physical functioning, thus reducing health disparities in the U.S.

THEORETICAL FRAMEWORK

The socio-ecological model was used as a guide to examine physical activity and acculturation among Asian Indian women living in the U.S. Physical activity behavior and the factors influencing it are complex. Research has suggested that social, physical and organizational environments impact the ability or likelihood of individuals to participate in physical activity. Human behavior is difficult to change, especially in an environment that does not support change. Social-ecological frameworks (McLeroy et al., 1988; Sallis & Owen, 1997; Sallis et al., 1998) are considered to be appropriate for

addressing the complex, multilevel interactions related to individual behaviors such as physical activity within the contexts of specific ethnic minority populations. The social-ecological model developed out of the work of a number of researchers. Urie Bronfenbrenner's Ecological Framework for Human Development focused on the relationship between the individual and the environment, which evolved into the Ecological Systems Theory (Bronfenbrenner, 1979). Kenneth McLeroy's Ecological Model of Health Behaviors (McLeroy et al., 1988) classified five different levels of influence on health behavior, although it did not include the physical environment, an essential element of a social-ecological model of physical activity. The Social Ecology Model of Health Promotion created by Daniel Stokols (1992) identified the core assumptions that underpin the social-ecological model (Glanz et al., 2008).

From a social-ecological perspective, behaviors, including health behaviors, are acquired and maintained through a complex and interactive set of factors: intrapersonal (individual factors), interpersonal (social environmental factors), physical environmental and policy and organizational (Sallis & Owen, 1999) (see Figure 1.1). Surrounding the individual factors in the social-ecological model is the social environment. The social environment is comprised of relationships, culture and society with which individuals interact (Glanz et al., 2008). The social environment has a significant influence on physical activity behavior. For example, having a physically active peer, family member or work colleague can impact one's own physical activity behavior. Research in social ecology has recognized that individual behavior is often a function of individuals' larger social context (Breslow, 1996; Emmons, 2000). A desire to modify individual behavior may be impeded by economic, social and cultural constraints (Stokols, 1996). In this

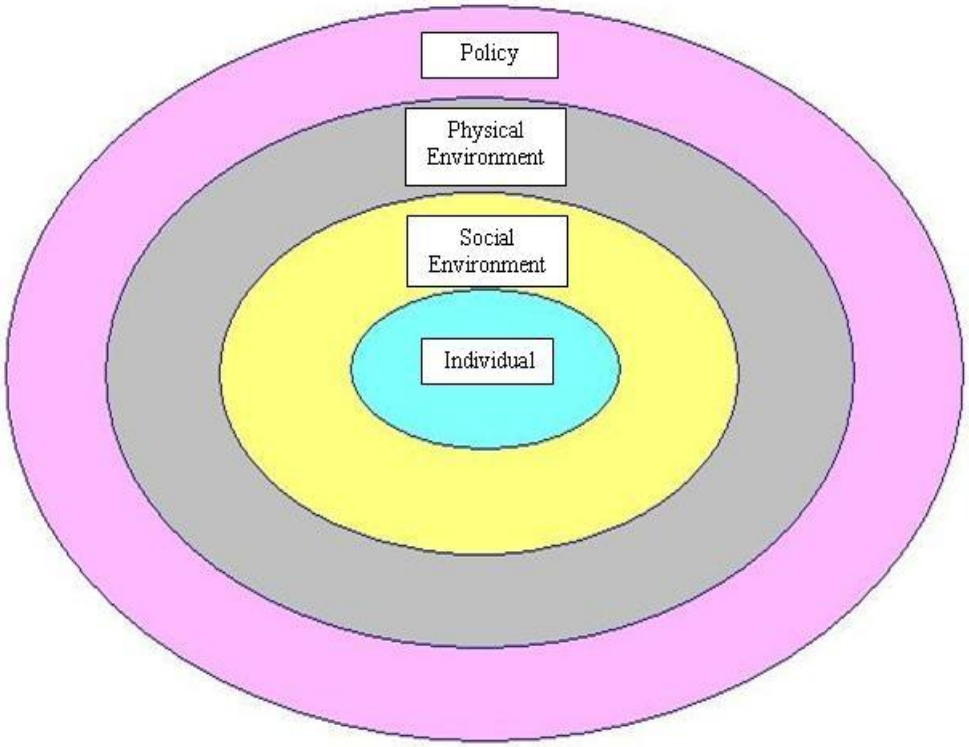
study, the socio-ecological framework (Sallis & Owen, 1999) provided a structure to examine whether acculturation may impede or promote physical activity. Acculturation has also been defined as changes in cultural patterns when groups of individuals from different cultures come into first-hand continuous contact (Berry, 2006). The process of acculturation involves the degree to which immigrants integrate and incorporate values, attitudes, beliefs and practices of the host society into their lives (Peragallo et al., 2000) as their immersion into the host culture increases over time. Taking a socio-ecological approach to health allows researchers and public health practitioners to address acculturation to design interventions to change and sustain healthy behaviors. Therefore, at the primary level, understanding the influence of acculturation on physical activity is critical to developing culturally appropriate physical activity programs.

VARIABLES AND DEFINITIONS OF RELEVANT TERMS

Four dimensions of physical activity (leisure time activity, job-related physical activity, transportation physical activity and household physical activity) and sedentary activity time spent sitting were the dependent variables. Four domains of physical activity and sedentary activity were measured using the long form of the International Physical Activity Questionnaire (IPAQ).

Physical activity included all the vigorous and moderate activities that the participants did in the seven days prior to taking the survey. Vigorous physical activities referred to activities that require substantial physical effort and cause breathing to be much harder than normal. Moderate activities referred to activities that take moderate physical effort and cause breathing to be somewhat harder than normal.

Figure 1.1. Components of the Social-Ecological Model



Adapted from Sallis, J. F., & Owen, N. (1999). *Physical activity and behavioral medicine*. Thousand Oaks, CA: Sage Publications.

Job-Related Physical Activity was related to work related activities including paid jobs, farming, volunteer work, course work and any other unpaid work outside of the home. It does not include unpaid work one might do around the home, like housework, yard work, general maintenance and caring for family.

Transportation Physical Activity was related to how the participants traveled from place to place, including to places like work, stores and movies.

Household Physical Activity was some of the physical activities participants might have done in the last seven days in and around their home, like housework, gardening, yard work, general maintenance work and caring for their family.

Leisure Time Physical Activity was all the physical activities that the participants did in the last seven days solely for recreation, sport, exercise or leisure.

Time Spent Sitting included the time participants spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. It did not include any time spent sitting in a motor vehicle for transportation.

One of the independent variables was *acculturation*. Acculturation was operationally defined and measured by items on the Modified Suinn-Lew Asian Identity Acculturation Scale (M-SL-ASIA) assessing the degree of acculturation of Asian Indian Americans.

Acculturation was defined as the process by which members of one cultural group adopted the attitudes, values, customs, beliefs and behaviors of a new culture when two or more cultures interacted together. There may be several possible outcomes of this process, including assimilation, whereby a host culture absorbs the immigrant culture, or multiculturalism, whereby both cultures exist side-by-side. On an individual level, exposure to another culture can lead people to: a) resist change in their values and behavioral competencies, b) adopt the host culture's values and behavioral skills and styles as a replacement for their parent cultures' values or behaviors, c) reject both their home culture and the host culture or d) acquire and maintain parts of both the home and the host cultures' values or behaviors.

Demographic variables were age, employment status (i.e., employed, homemaker, student, retired, disabled, other), presence of any existing medical conditions (yes/no),

marital status (partnered/unpartnered), income, education and immigration status (immigrant versus non-immigrant, years in the U.S. and age at immigration).

Two physiological covariates, physical functioning and body mass index (BMI), were assessed to refine evaluations of physical activities and their relationship with acculturation.

Physical functioning was operationally defined and measured by the physical functioning subscale (PF-10) from the RAND 36-ltem Health Survey. An assessment of physical functioning provided a way to control for factors that might affect physical activity that were not directly related to acculturation factors (e.g., limitations in the ability to walk a block with ease).

Body Mass Index (BMI) was computed using a simple measurement of weight and height, and has consistently been used as an index of obesity because it correlates with adiposity (WPRO, 2000). It is an acceptable proxy for thinness and fatness, and has been directly related to health risks and death rates in many populations. Since BMI certainly impacts physical functioning as well as the kind and intensity of physical activity one participates in, it represents a highly relevant covariate worthy of inclusion. Both the physical functioning score and BMI were treated as covariates in all correlational analyses and group comparisons, reflecting extraneous factors that can moderate physical activity scores. For regression analyses, these factors were evaluated for their independent contribution to the best set of predictors for physical activities.

SPECIFIC AIMS AND RELATED RESEARCH QUESTIONS AND HYPOTHESES

The purpose of the study was to identify the relationships between acculturation factors and five different kinds of activity of Asian Indian women in the U.S. The central

hypothesis was that more acculturated U.S. Asian Indian women will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity and household physical activity than less acculturated U.S. Asian Indian women. The long-term goal was to gain insight into the determinants of physical activity among Asian Indian women to develop culturally appropriate health interventions to reduce health disparities and thereby improve their health.

Specific Aim 1: Identify the self-reported levels of five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting), physical functioning and BMI in Asian Indian women living in the U.S.

Research Question 1.1: What are the frequencies and levels of five different types of activity, physical functioning and BMI in Asian Indian women in the U.S.?

Specific Aim 2: Describe the degrees of acculturation in Asian Indian women living in the U.S.

Research Question 2.1: What are the degrees of acculturation in Asian Indian women in the U.S.?

Specific Aim 3: Explore the relationships between the five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting), immigration status (years in the U.S. and age at immigration in immigrants), acculturation, physical functioning and BMI in Asian Indian women in the U.S.

Research Question 3.1: What are the relationships between the five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time activity and sedentary activity time spent sitting), immigration status (years in the U.S. and age at immigration in immigrants), acculturation, physical functioning and BMI in Asian Indian women in the U.S. uncontrolled and controlled for physical functioning and BMI?

Research Question 3.2: What is the best set of predictors from acculturation, moderator variables (physical functioning and BMI), immigration status (immigrant and non-immigrant [included as a dummy variable]), years in the U.S., age at immigration and demographic characteristics (age, marital status, years of education and income) for each types of activity (job-related, transportation, household, leisure time and sedentary activity time spent sitting) for Asian Indian women in the U.S.?

Specific Aim 4: Examine the differences in the levels of activity across all five types of activity between high and low acculturated Asian Indian women and between immigrant status (immigrant and non-immigrant, years in the U.S. and age at time of immigration) of Asian Indian women in the U.S. controlling for age, BMI, physical functioning and income.

Hypothesis 4.1: More acculturated U.S. Asian Indian women will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity, and household physical activity than less acculturated U.S. Asian Indian women when controlling for age, BMI, physical functioning and income.

Hypothesis 4.2: Non-immigrant U.S. Asian Indian women, those with more years in the U.S. or immigrants with younger ages at immigration will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity and household physical activity than immigrant U.S. Asian Indian women controlling for age, BMI, physical functioning and income.

OVERVIEW OF RESEARCH DESIGN

A quantitative cross-sectional descriptive comparative design was used to achieve the specific research objectives. Data were collected by survey method using the demographic questionnaire, IPAQ-long form, Modified SL-ASIA (M-SL-ASIA) and PF-10 of the RAND 36-item Health Survey. Data analysis included descriptive statistics, correlational analyses, stepwise Multiple Regression and analyses of covariance (ANCOVA).

Chapter 2: Literature Review

This chapter presents the scientific literature on the magnitude of the problem regarding physical inactivity and associated health risks in Asian Indians, the kinds of physical activity behavior of Asian Indians and the factors influencing physical activity in Asian Indians. This chapter also explores acculturation and associated health risks in Asian Indians and the association between acculturation and physical activity. The gap in the literature and implications of the study are discussed.

MAGNITUDE OF THE PROBLEM

The prevalence of diabetes and cardiovascular disease (CVD) in U.S. Asian Indians are two to three times higher than Caucasians in the U.S. and Europe (Balasubramanyam et al., 2007; Dodani, 2008; Mohanty et al., 2005; Roger et al., 2011; Venkataraman et al., 2004). One in six Asian Indians (about 18%) in the U.S. have been diagnosed with type 2 diabetes, which is higher than any other race in the U.S. (Misra et al., 2010; Venkataraman et al., 2004). Specifically, the mortality and morbidity from coronary heart disease and diabetes is higher in people of Asian Indian descent who live in the U.S. than those who reside in India (Misra et al., 2000). The prevalence, incidence, hospitalization and mortality from coronary vascular disease in Asian Indians residing in the United States and other countries is 50% to 400% greater than subjects in other ethnicities (Yusuf & Ounpuu, 2001). The prevalence of diabetes among first generation Asian Indian immigrants is estimated to be two-to three-fold higher than in the general US population (Enas et al., 1996).

Palaniappan et al. (2004) investigated the ethnic variations in coronary heart disease death among non-Hispanic white (Caucasians), Hispanic, non-Hispanic black (Black), Chinese, Japanese and Asian Indian Americans. The researchers found a significantly higher general or disease-specific mortality and morbidity in the younger Asian Indian population compared with other U.S. racial and ethnic groups, accounting for more than 40% of all deaths due to coronary heart disease.

Wu et al. (2011) conducted a cross sectional descriptive study with Asian Indians who attended the Michigan Association of Physician Origin's health fair from 2008-2009. The researchers used the self- administered Michigan Behavioural Risk Factor Survey (MBRFS) to examine the prevalence and pattern of coronary heart disease risk factors such as hypertension, prehypertension, diabetes, hyperlipidaemia and obesity. The findings of the study indicated that the prevalence of cardiovascular risk factors was relatively high among Asian Indians, particularly for diabetes (20.1%) and obesity. More than half of respondents had an elevated body mass index (BMI). The prevalence of hypertension was higher in Asian Indian males (50% for males vs. 19.3% for females) whereas, in the multivariate analysis after adjusting demographic and access to healthcare factors, the results showed that the prevalence of metabolic syndrome increases among Asian Indian women but not among Asian Indian men. The study suggested developing culturally tailored interventions to effectively to reduce multiple risk factors for coronary heart disease among Asian Indians.

NATIONAL PHYSICAL ACTIVITY GUIDELINES

The U.S. Department of Health & Human Services (2008) set the 2008 Physical Activity Guidelines for Americans to provide science-based guidance, including the types

and amounts of physical activity essential for health benefits to all Americans aged six years and older to improve their health through appropriate physical activity. The U.S. Center for Disease Control and Prevention (2013) has recommended that adults engage in at least 2 hours and 30 minutes (150 minutes) of moderate activity (i.e., 10 minutes brisk walking) every week. The CDC recommended muscle-strengthening activities on two or more days a week that work all major muscle groups or vigorous activity intensity aerobic activity (i.e., jogging, running) for 1 hour and 15 minutes (75 minutes) every week, and to conduct muscle-strengthening activities on two or more days a week that work all major muscle groups every week in order to ensure health benefits for adults. Adults should increase such activity to obtain even greater health benefits. The physical activity guidelines of U.S. Department of Health & Human Services (HHS) have been jointly published by the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) (American College of Sports Medicine, 2013). Based on the 2008 Physical Activity Guidelines for Americans, 1,000 MET-minutes/week should be devoted to walking and moderate and vigorous physical activities, with 500–1,000 MET-minutes/week being the recommended energy expenditure on physical activity for health benefits (U.S. Department of Health & Human Services, 2008). It has been indicated that 150 minutes (2 hours and 30 minutes) of moderate-intensity activity per week could be regarded as roughly equivalent to 500 MET-minutes/week. In adults, at least 75 minutes (1 hour and 15 minutes) per week of vigorous-intensity activity is suggested to generally achieve 500 to 1,000 MET-minutes/week (U.S. Department of Health & Human Services, 2008).

PHYSICAL INACTIVITY AND ASSOCIATED HEALTH RISKS IN ASIAN INDIANS

Regular physical activity and exercise are essential for the health and well-being of humans. It has been well established that regular physical activity is important to control blood glucose levels and prevent or delay type 2 diabetes (Meisinger et al., 2005). In addition, physical activity also has a positive effect on blood cholesterol and blood pressure levels, thus potentially reducing a person's chances of having a heart attack, stroke or of dying while improving quality of life (Colberg et al., 2010).

Bhalodkar et al. (2005) examined the association of leisure time exercise with HDL cholesterol concentration, size and subclass levels measured by Nuclear Magnetic Resonance spectroscopy (NMR) in 388 healthy Asian Indians. Data were collected on demographic questionnaires pertaining to personal and family history of conventional risk factors for coronary artery disease, exercise and dietary habits. The study cohort was divided into two groups on the basis of participation in activity in a non-exercise group (n=73) and an exercise group (n=123). The study found higher concentrations of HDL cholesterol in the exercise group by an average of 4.7 mg/dl (11%) compared with the non-exercise group. The findings of the study confirmed that exercise reduces coronary artery disease risk by improving HDL cholesterol levels in Asian Indians.

Several studies have identified insufficient physical activity as an independent risk factor for diabetes and CVD among Asian Indians. Misra et al. (2005) conducted a cross-sectional exploratory study to examine the physical activity patterns of Asian Indian immigrants aged 25 to 59 years living in California. The study showed a 33.9% prevalence of metabolic syndrome with average BMI of 26.1+/-3.7, further suggesting development of metabolic syndrome at a younger age. In men, moderate activity was

associated with a lower prevalence of metabolic syndrome, lower fasting glucose, two-hour glucose tolerance and lower serum triglyceride. Only heavy activity was inversely associated with waist girth for both men and women. Low levels of physical activity were associated with prevalence of low high-density lipoprotein cholesterol (HDL-C) in both sexes.

Balasubramanyam et al. (2008) examined the association between metabolic syndrome, lifestyle behaviors, perception and knowledge of health and CVD among Asian Indians in the U.S. Subjects demonstrated high levels of physical inactivity (M = 3.42, SD = 2.77) and poor knowledge of CVD risk factors. Dietary behavior, age, number of years lived in the U.S., self-rated physical and mental health and BMI were significant predictors, explaining 40.1% of the variance in metabolic syndrome scores calculated for each subject using five criteria (abdominal obesity, high blood pressure, low High Density Lipoprotein (HDL) cholesterol, high triglycerides and high fasting blood glucose). The results of this study also showed that the prevalence of both diabetes (18%) and the metabolic syndrome (32%) was much higher in Asian Indians than other ethnic groups in the U.S. The prevalence of metabolic syndrome was equivalent in both men and women and increased with age, which placed them at risk. The study demonstrated the need for early preventive efforts by encouraging more physical activity among Asian Indian immigrants in the United States.

An observational longitudinal study with follow-up mortality data from the 1999 and 2004 health survey of NHS registries for England investigated the role of physical activity in explaining excess CHD mortality observed in U.K. South Asian subjects compared with U.K. white subjects (Williams et al., 2011). The results of the study

showed that South Asian participants were more likely to be physically inactive than white participants (47.0% vs. 28.1%). Deaths from CHD were more common in U.K. South Asian participants, particularly among Pakistani and Bangladeshi groups (HR 2.87, 95% CI 1.74 to 4.73) than in U.K. white participants, and South Asian people experienced an event at an age on average 10 years younger than white people. Physical inactivity explained >20% of the excess CHD mortality in the South Asians, even after adjustment for potential confounding variables (including socioeconomic position, smoking, diabetes and existing cardiovascular disease). The findings of the study provided evidence for the contribution of physical inactivity to the excess CHD mortality risk observed in U.K. South Asian groups and encouraged a priority focus of resources towards facilitation and promotion of physical activity in South Asian Indians.

Ivey et al. (2004) assessed the cardiovascular risks in Asian Indians in California using a mixed model design with focus groups and a pilot survey using community-based participatory research (CBPR) methods. Qualitative focus group methods were utilized to obtain cardiovascular perceptions of South Asian Indians in Northern California. Eight focus groups were conducted in either English or Punjabi and 57 participants were interviewed. Participants from all eight focus groups believed that genetic and family history, diet, stress, acculturation and lack of exercise were the most common reasons for developing cardiovascular disease. Focus group information and themes were used to develop the survey instrument and conducted telephone surveys with a random sample of persons of South Asian heritage (n=304) in the U.S. The result of the self-reported survey showed hypertension (20.4%), high cholesterol (35.3%) and diabetes (10.6%) were more

prevalent in participants than the population average, while other risk factors such cigarette smoking (tobacco) was less common.

Mohanty et al. (2005) conducted a cross-sectional study related to diabetes and cardiovascular disease among Asian Indians in the U.S. The study utilized four years (1997-2000) of National Health Interview Survey (NHIS) data and analyzed 87,846 non-Hispanic Whites and 555 Asian Indians. Using regression analysis, the study examined the relationship between being Asian Indians and prevalence of diabetes, hypertension and heart diseases. The findings confirmed that Asian Indians in the U.S. have a higher prevalence of diabetes despite lower BMI and being younger in age, and they were less likely to engage in regular physical activity than non-Hispanic Whites. The authors of the study suggested immediate prevention priorities for Asian Indians should include promoting culturally appropriate exercise and dietary strategies to improve glucose tolerance.

In a cross-sectional study, Gill et al. (2013) investigated the independent contribution of waist circumference (as an index of abdominal obesity), physical activity and sedentary behavior on glycemia in South Asians living in Scotland as part of the Prevention of Type 2 Diabetes and Obesity in South Asians (PODOSA) trial. Physical activity was measured using the IPAQ-short form, venous blood samples were collected after 2 hours of the standard 75-g oral glucose tolerance test and also after an overnight fast of 10–16 hours and waist circumference was measured. Study findings indicated that time spent sitting down and waist circumference were associated with an increase in 2-hour glucose concentrations independent of age, sex and self-reported physical activity patterns in South Asians participants. The results warranted further studies on sedentary

time as an independent behavior and not just the absence of physical activity as a lifestyle variable on metabolic risk in South Asian populations.

From the above discussions it is evident that regular physical activity is imperative in the prevention and management of chronic disease conditions including coronary artery disease and diabetes in Asian Indians.

PHYSICAL ACTIVITY BEHAVIOR (PHYSICAL ACTIVITY PREVALENCE) IN ASIAN INDIANS

Many studies have explored physical activity behavior in immigrant Asian Indians. Williams et al. (2011) assessed physical activity behavior of the South Asian Indian population in the U.K. using a questionnaire containing multiple questions across three domains of activity in the last four weeks (leisure time sports/exercises, domestic activities and walking for any purposes) in comparison with the U.K. white population. This physical activity measure asked about activities of at least moderate intensity for a minimum of 30 minutes per week. The results of the study showed that the South Asian Indian population was more physically inactive than white groups (47.0% vs. 28.1%).

In a Canadian cross-sectional study, Dogra et al. (2010) compared the prevalent modes of physical activity in all ethnic groups including Whites, South Asian Indians, South-East Asians, Blacks, Latin Americans, West Asians and Aboriginal persons using a questionnaire of 21 physical activities over the past three months. Physical activity preferences over the past three months were collapsed into eight categories including walking, endurance, recreation, sports, conventional exercise and active commuting. The results of the study showed that all ethnic minorities including South Asian Indians reported no participation in the conventional forms of physical activity such as home-based exercise, aerobics and weight training, and were engaged less in walking, with the

exception of Aboriginal persons (OR: 1.25, CI: 1.16-1.34). South Asian Indians were less engaged in walking (56.7%), endurance (29.7%), recreation (38.3%) and sports (24.3%) compared to Whites [walking (68.3%), endurance (34.6%), recreation (60.0%), sports (28.8%)]. About 18.7% of South Asian Indians reported more inactivity as compared with Whites (10.5%). The results of the study suggest that physical activity interventions should be targeted towards ethnic minority groups including South Asian Indians immigrant groups as they are at high-risk for physical inactivity and chronic disease.

Kolt et al. (2007) conducted a cross-sectional exploratory study to assess body fatness, physical activity and nutritional behaviors in 112 (50 male and 62 female) Asian Indians aged 44–91 years old and living in New Zealand. Physical activity was assessed objectively using New Lifestyles NL2000 sealed pedometer. A compliance survey was also administered to verify that the participants used the pedometers. The results of the study showed that the physical activity levels for the sample were low with a large variability (mean daily steps= 5,977, SD = 3,560) and was significantly different between males (6,982 ± 4,426) and females (5,159 ± 2,401). Males (mean daily steps = 6,982 ± 4,426) were significantly more active than females (5,159 ± 2,401). The findings suggested that the perceptions of physical activity and cardiovascular risk factors in Asian Indian immigrant groups are vital for designing interventions to reduce the risk of disease.

Another cross-sectional study examined the association between ethnicity and self-reported physical activity level, energy expenditure (EE), energy intake (EI) and macronutrient intake among Guadeloupeans (a population composed of Afro-Caribbeans and a Asian Indian minority) to test the hypothesis that Asian Indians would be less

physically active than the rest of the population (Sinnapah et al., 2009). Energy expenditures (EE), energy intakes (EI) and macronutrient intakes of 122 Guadeloupian workers (60 Indians and 62 Afro-Carribean counterparts as control group) were assessed by three consecutive 24-hour recalls. Two-way analyses of variance confirmed lower EE (P=0.011), lower EE/EI ratios (P=0.001) and lower physical activity (P=0.003) in Asian Indians than their Afro-Caribbean counterparts. No sex and ethnicity interactions were significant (α=0.05) in the study. The findings of the study suggested that the determinants of the tendency toward physical inactivity in Asian Indians should be explored to rationalize the strategies for reduction of sedentary lifestyles in this group.

In a cross-sectional exploratory study, Misra et al. (2005) examined the physical activity patterns of Asian Indian immigrants in California using Minnesota Leisure Time Physical Activity (LTPA) Questionnaire. The results of the study indicated that Asian Indian men were twice as active as women (Activity Metabolic Index [AMI/week] 533 vs. 204). Nearly 12.5% of Asian Indian men reported actively commuting to work while no women reported doing so. Compared to 10% Asian Indian men, nearly 40% women reported no participation in leisure time physical activity.

Data from the National Health Interview Survey (NHIS) from 2003 to 2005 were evaluated to examine the prevalence of major cardiovascular disease (CVD) risk factors among Chinese, Asian Indian, Filipino and other Asian populations compared to non-Hispanic Whites in the United States (Ye et al., 2009). The study results confirmed that physical inactivity was highest among Asian Indians. Asian Indians had higher odds of physical inactivity than Whites even after controlling the covariates (odds ratio [OR] = 1.50, 95% confidence interval [CI] = 1.22–1.84). Asian Indians were more likely to have

diabetes (OR = 2.27, 95% CI = 1.63–3.20) compared to non-Hispanic Whites in the United States (Ye et al., 2009). The study suggested that it is important to develop effective interventions to promote physical activity adoption and maintenance of the health of the rapidly growing Asian Americans.

A cross-sectional descriptive survey study by Daniel et al. (2013) examined lifestyle physical activity behavior of midlife South Asian Indians by comparing the leisure time physical activity, household physical activity and occupational physical activity behavior between men and women in the U.S. The leisure time physical activity and household physical activity was measured using the 28-item Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire and occupational activity was measured using the 12-month Tecumseh Occupational Activity questionnaire. In addition, accelerometers were used as an objective measure of lifestyle physical activity. Only about half of the participants (51.8%) met the recommended PA guidelines through LTPA, and no significant difference between men (51.2%) and women (52.2%) was found. The average number of daily steps via accelerometer (mean = 6,904.3; men = 7,056, women = 6,813) were in the low active classification. This finding suggests that it is important to improve South Asian Indians lifestyle physical activity behavior by providing physical activity interventions appealing to gender and culture.

Waidyatilaka et al. (2013) described different types of activity and sedentary behaviors in urban South Asian women living in Sri Lanka with dysglycemia (diagnosed at recruitment) and without dysglycaemia. The study also examined the relative contribution of physical activity and sedentary behaviors to their glycemic status.

Physical activity and sedentary behaviors were measured using the IPAQ and recorded demographic data, diet and anthropometry. The results of the study indicated that for normoglycemic women the mean energy expenditure on walking was 2,648.5 ± 1023.7 MET-minutes/week and on moderate and vigorous physical activity was 4,342.3 ± 1768.1 MET-minutes/week; for dysglycaemic women mean energy expenditure on walking was 1,046.4 ± 728.4 MET-minutes/week and on moderate and vigorous physical activity it was 1,086.7 ± 1184.4 MET-minutes/week, which was above the recommended amount of physical activity per week. In addition, 94.3% of women spent 1,000 MET-minutes/week on activity. Mean sitting and TV time for normoglycemic women were 154.3 ± 62.8 and 38.4 ± 31.9 minutes per day, and for dysglycemic women those times were 154.3± 312.6 ± 116.7 and 140.2 ± 56.5 minutes per day. Physical activity and sedentary behavior contributed to dysglycemia after controlling for family history, diet, systolic blood pressure and Body Mass Index. The study suggested that urban Asian women are at risk of dysglycemia even with lower levels of sedentary behavior and greater physical activity than western populations, indicating the need for re-visiting current physical activity guidelines for South Asians.

Fischbacher et al. (2004) conducted a systematic literature review of studies describing the various levels of physical activity and fitness among the South Asian Indian population in the United Kingdom and identified 12 physical activity studies in adults for Indian, Pakistani and Bangladeshi groups (South Asians ethnic groups) performed between 1987 and 1999. Despite using various methods to assess physical activity and fitness, very low levels of physical activity were reported among South Asian groups in all 12 studies. Substantial differences on the levels of physical activity levels

were noted among women and older people. The authors concluded that lower levels of physical activity were evident among U.K. South Asian ethnic groups than the general population, which may contribute to their increased risk of diabetes and CHD.

In summary, the studies on physical activity make evident that Asian Indians, especially Asian Indian women, are less physically active. The methods and measurements used to assess physical activity behavior varied greatly between studies. Most of the studies used a subjective measure of physical activity; only three studies used a reliable and valid instrument for assessing physical activity, and even these instruments had been validated mostly on Caucasians, except one that was validated on Asian Indians (Daniel et al., 2011, 2013; Misra et al., 2005). Most of the studies were focused only on leisure time physical activity or exercise physical activity. Only two studies used an objective measure (pedometers) (Daniel et al., 2013; Kolt at al., 2007). None of the studies differentiated the physical activity of immigrant Asian Indians and non-immigrant Asian Indians. Sedentary activity or time spent sitting was only reported in two of the studies in South Asians but not specifically in Asian Indians.

FACTORS INFLUENCING PHYSICAL ACTIVITY IN ASIAN INDIANS

The factors that can influence physical activity behavior can be background characteristics such demographics, current health, social influences (e.g., acculturation, discrimination, social support), environmental influences and intrapersonal factors including motivation and knowledge to be physically active (Daniel et al., 2011). Therefore, it is important to consider these confounding covariates that can influence physical activity in Asian Indian women. In this study, acculturation was considered to be an independent variable that could influence the physical activity levels in Asian Indian

women in the U.S. The covariates addressed in this study were age, BMI, physical functioning and income.

Gender is an important factor that can also influence levels of physical activity. Worldwide data of physical activity levels for adults from 122 countries confirm that women are generally less physically active than men (Hallal et al., 2012). Speck and Harrell (2003) conducted a national survey analysis that included three ethnic classifications (i.e., Caucasian, African American, Mexican American), and the findings indicated that women had a higher percentage of inactivity (22% to 47%) than did men (14% to 32%). With advancing age, women were less likely to participate in physical activity. Physical activity is considered an important factor in preventing cardiovascular illnesses, which is the leading cause of mortality among women (Mosca et al., 2007). Similarly, lower levels of physical activity behavior was observed among Asian Indian women than among men (Daniel et al., 2011, 2013; Kalra et al., 2004; Kolt et al., 2007; Misra et al., 2005; Ye et al., 2009).

Lawton et al. (2006) conducted a qualitative exploratory study among British South Asians of Pakistani or Indian origin with Type 2 diabetes (n = 32, aged 40-70 years) using face-to-face interviews. The data analysis determined that lack of time, family obligations and cultural norms were the main barriers to activities such as walking and swimming, particularly among female respondents. Other cultural norms reflected expected behaviors of women once they got married, i.e., they were expected to stay indoors and attend to domestic chores and responsibilities, which prevented involvement in many types of physical activity. A number of other socio-cultural barriers were also reported by 17 of the female participants, whom had mostly grown up in India or

Pakistan and immigrated to the U.K. after marriage to join their spouses or to accept professional employment. Because these women had not been exposed to sports or other socializing activities at a young age, they found it very hard to improve their physical activity due to fear and shame. Some women were concerned about swimming in the public pools and going to gymnasium for exercise because of cultural taboos about exposing their bodies to other male members and the lack of availability of single-sex exercise or swimming facilities with same-sex instructors (Lawton et al., 2006). Inadequate family and peer support as well as socio-cultural variations have been reported to be barriers to physical activity among Asian Indians in the U.S. (Jonnalagadda & Diwan, 2005).

Sriskantharajah and Kai (2007) conducted an exploratory qualitative study to assess the extent to which South Asian Indian (SAI) women with coronary heart disease (CHD) and diabetes were aware of the value of exercise in improving and slowing the progression of their illnesses. The target populations of women were between the ages of 26 and 70 years and were from different ethnicities, cultures and socio-economic statuses and had been recruited from three general practice settings in the U.K. The semi-structured home interview report indicated that few SAI women recognized physical activity as a preventative health measure. Most SAI women were unaware of the benefits of the physical activity to improve or limit the progression of their disease conditions and they were also uncertain of level and type of activities appropriate and safe for them. In fact, exercise was associated with physical exertions such as chest pain, shortness of breath, dizziness, drowsiness, body pains and fatigue in women who were diagnosed with heart disease. Further, the anxiety generated when these symptoms were provoked from

exercise decreased individuals' motivations to continue physical activity. Additionally, insufficient guidance about suitable activities from health professionals was reported. The notion of "exercise" for oneself beyond daily work was perceived by some as a selfish activity or given little priority in the context of family and community expectations and needs. Other barriers included unease with exercising in public places and poor English language fluency (Sriskantharajah & Kai, 2007).

In a physical activity study of British South Asians with diabetes, investigators concluded that the risk of diabetic complications was significantly related to physical inactivity (Lawton et al., 2006). This qualitative study included both Indians (n = 23) and Pakistani (n = 9) participants and explored the attitudes and practices of physical activity in their routine diabetic care. The results of the study supported health problems related to diabetes as being one of the major barriers to physical activity.

Kalra et al. (2004) conducted focus groups as part of a 3-year community-based participatory research project to examine the cardiovascular risk factors among Asian Indians (57 men and women) in Northern California. The findings of the study suggested that factors related to acculturation, such as adjustment to life in the United States and responsibilities toward family and work, were some of the major risk factors for cardiovascular risk factors among this Asian Indian population. The study also found that men in rural communities enjoyed walking and exercised with their families whereas rural women walked and looked after their children and did housework to stay active (Kalra et al., 2004).

Kalavar et al.'s (2004) study examined barriers to and motivations for physical activity in older Asian Indians living in the U.S. The study identified the most important

motivational factors for leisure time physical activity as keeping healthy and active and for medical reasons, and also found differences in these motives based on gender and age. Identified barriers included existing health problems, risks of injury and issues associated with new lifestyles in the new country. The study suggested developing culturally specific physical activity programs for the growing population of older Asian Indians in the U.S.

Mohan et al. (2008) used a qualitative study to explore lifestyle factors (including physical activity) of Asian Indians in Australia in relation to coronary heart disease. Lack of adequate physical exercise and sedentary lifestyle were clearly understood to be a problem in Asian Indians who participated in this study. The participants explained that they concentrated on family more than exercise, and that their lifestyle was very sedentary due to availability of cars and easy access to other forms of transportation which limited walking. In addition, loneliness due to migration and lack of support as a due to changes in family structure were other factors related to low physical activity.

Daniel et al. (2011) conducted an integrative review to examine the correlates of lifestyle physical activity behavior of healthy South Asian Indian immigrants. Eleven cross-sectional studies and four qualitative studies were examined. Study results showed low physical activity levels in at least 40% of the participants regardless of the physical activity measure used. The correlates of physical activities were sociodemographic variables, current health, acculturation, female sex, poorer health and decreased time since immigration. It was also evident that physical activity was higher in men, younger persons, those with higher socioeconomic status and higher income and those with better current health including lower blood pressure and lower BMI. The study also suggested

that acculturation may play a role in the physical activity behavior of Asian Indians (Daniel et al., 2011).

Body Mass Index (BMI)

Body Mass Index (BMI) consistently has been used as an index of obesity nationally and internationally because BMI correlates with adiposity (WPRO, 2000). Obesity is a factor associated with the migration process because a change in diet, exercise and stress is often seen in populations that have migrated to new countries. Studies have shown significant BMI increases in Asian Indians following immigration to a new country (Jonnalagadda & Diwan, 2002). A cross-sectional study of 112 (50 male, 62 female) Asian Indians living in New Zealand showed that using Asian Indian specific criterion cut-offs, 69% of the sample was obese (BMI$\geq$25 kg/m^2) and 13.7% was overweight (23$\geq$BMI<25 kg/m^2). The study also identified that average BMI for females (28.0 ± 5.4 kg/m^2) was significantly higher than males (25.6 ± 5.4 kg/m^2). As expected, the study also found that higher pedometer steps (physical activity) were associated with lower BMI and lower waist circumference (Kolt et al., 2007). Misra et al. (2005) found a 33.9% prevalence of metabolic syndrome with average BMI of 26.1±3.7, indicating development of metabolic syndrome at a younger age in Asian Indians. An integrative review of correlates of physical activity in Asian Indians (Daniel et al., 2011) also supported that lower BMI was associated with increased physical activity in Asian Indians. For the Asian Pacific population, the agreement on BMI cut-off value is still being refined (Anuurad et al., 2003; Razak et al., 2007; Zhou, 2002). However, since BMI will certainly have an impact on both physical functioning as well as the kind and intensity of physical activity in which one chooses to participate; it remains a highly

relevant covariate worthy of inclusion. In considering WHO criteria for Asian-Pacific population were used: underweight (BMI<18.5 kg/m^2), normal (BMI 18.5–23 kg/m^2), overweight (BMI 23–25 kg/m^2), and obese (BMI > 25 kg/m^2) (WPRO, 2000, 2002).

In summary, lower levels of physical activity have been reported in Asian Indian women and the barriers to leisure time physical activity in Asian Indians included cold climate, altered lifestyle, acculturation, health problems, fear of injury, household responsibilities, difficulty exercising in public places, language barriers and inadequate family and social support (Kalavar et al., 2004; Lawton et al., 2006; Misra et al., 2000; Mohan et al., 2008; Sriskantharajah & Kai, 2007).

Acculturation

Usually immigration is accompanied by the process of acculturation and assimilation. Acculturation can be defined as the process of cultural change and adaptation that occurs when individuals from different cultures come into contact with each other (Gibson, 2001). Immigration to a new country is associated with two dimensions of acculturation including a) adoption of ideals, values and behaviors of the receiving culture; and b) retention of ideals, values and beliefs from the immigrant person's culture of origin (Phinney et al., 2001). According to Gorden (1964), the unidimensional process model of acculturation causes immigrants to abandon their values, attitudes and behaviors of their origin cultures while adopting the values and behaviors of host cultures. On the other hand, in the bidimensional model of acculturation, immigrants may adopt several values and behaviors of the host culture without totally giving up all aspects of their original culture. Acculturation impacts the health of the immigrant people as a result of prolonged contact with the health practices

of the dominant culture. Generally, the acculturation process presents numerous challenges that could benefit or harm immigrants' health practices (Abraido-Lanza et al., 2006; Crespo et al., 2001). Asian Indians living in the U.S. are also exposed to different risk factors or may adopt unhealthy behaviors that result in increases in morbidity and mortality associated with various chronic diseases.

ACCULTURATION AND ASSOCIATED HEALTH RISKS IN ASIAN INDIANS

Mooteri et al. (2004) conducted a cross-sectional study with a relatively homogeneous group of 527 first generation Konkani subjects (population of the west coast of South India) in the U.S. Self-reported questionnaires examined the association between duration of residency and coronary artery disease among Konkanis. The study results reported a high prevalence of coronary artery disease (CAD) despite a lack of smoking and significant obesity. In addition, duration of residency in the U.S. (acculturation factor) was significantly related to hypertension, diabetes, physical inactivity, alcohol consumption, non-vegetarian diet and total number of CAD risk factors. The study concluded that acculturation is a major risk factor for CAD in U.S. Asian Indian immigrant population.

Dodani and Dong (2011) investigated the level of acculturation and its association with coronary artery disease, sub-clinical coronary artery disease, coronary artery risk factors and type II diabetes in 159 South Asian Indians aged 35–65 years from the U.S. states of Georgia, Kansas and Missouri. Subclinical CAD was assessed by common carotid artery ultrasound using intima media thickness (CCA-IMT) as the surrogate marker for arthrosclerosis, and acculturation was measured using the Suinn-Lew Asian

Self-Identity Acculturation scale (SL-ASIA Scale) and years in the U.S. (≥10 years stay in the United States). Study findings showed that 67.7% of South Asian Indians were identified to have high acculturation based on SL-ASIA scale. Type 2 diabetes and CAD risk factors were significantly associated with high acculturation. The implication of this study was that acculturation may play a major role in predisposing immigrant populations to the development of diabetes and CAD. Further studies should be conducted to better understand how acculturation influences health behaviors of the Asian Indian immigrant population in the U.S. As noted earlier, Kalra et al. (2004) found acculturation factors such as adjustment to life in the United States, responsibilities toward family and work and the cultural value differences between Indian and American culture to be cardiovascular risk factors among Asian Indians in Northern California (Kalra et al., 2004).

Based on a National Health Interview Survey (1992-1995), Frisbie et al. (2001) examined the effect of nativity and duration of residence in the United States on the health of Asian-Pacific Islanders (including Asian Indians). Asian-Pacific Islander immigrants were found to be in better health than their U.S. counterparts upon entering the country, but their health advantages consistently decreased with duration of residence in the logistic regression models when adjusted for age, marital status, living arrangement, family size and several socioeconomic indicators.

The above acculturation study results support the notion that immigration status and acculturation strongly influence the health of Asian Indians in the U.S. and act as a major contributor to the development of CVD and diabetes. Studies in other ethnic minorities including Chinese (Wong et al., 2013) and Hispanics (Daviglus et al., 2012)

also support the fact that acculturation (as assessed by place of birth, duration of residence in the U.S., language and ethnic self-identification) is associated with high prevalence of coronary heart disease and cardiovascular risk factors.

ACCULTURATION AND PHYSICAL ACTIVITY IN IMMIGRANT POPULATIONS

Although becoming more acculturated in the U.S. is generally associated with the adoption of unhealthy behaviors and lifestyles, data for the relation with physical activity and acculturation are mixed in U.S. immigrant groups but most studies have supported a positive association.

Some studies have shown that high acculturation is positively associated with physical activity in some immigrant groups in the U.S. Gerber et al. (2012) conducted a systematic review of studies examining the relationship between acculturation and physical activity among immigrants and ethnic minority populations. Data sources incorporated original studies that were written in English, German or French and used a measure of acculturation and physical activity, exercise or sport as independent and dependent variables from the electronic databases. The resulting database contained 44 studies that were narratively synthesized. Results showed that higher acculturation was associated with a higher leisure time physical activity level in 57% of all studies even after controlling for potential confounds and independent of participants' gender, age and ethnic background. This study demonstrates the importance of planning and implementing prevention programs to increase the physical activity participation among immigrants with low acculturation levels that incorporate their culturally specific beliefs and constraints.

Song et al. (2004) examined the effects of acculturation on health behaviors

among Korean Americans in California (n=2,830) compared to Koreans in Seoul (n=500). Health risk conditions and behavior were measured based on the self-reported height, weight, selected exercise, smoking, drinking and some dietary practices and acculturation as measured using the Suinn–Lew Asian Self-Identity Acculturation scale (SL-ASIA). The results of the study showed that the odds ratios of exercise were the highest among the acculturated group, and acculturated men and women were 1.8 times and 1.7 time more likely, respectively, to exercise than their Seoul counterparts ($P<0.05$). At the same time, traditional Korean Americans were much less likely to exercise than their counterparts in Seoul.

Neighbors et al. (2008) used the National Health Interview Survey to compare leisure time physical activity among Hispanic and non-Hispanic Whites in the U.S. Leisure time physical activity was assessed based on the frequency and duration of vigorous and light-to-moderate activities during their leisure time. Acculturation was measured using three proxy measures for acculturation: 1) language, 2) birthplace and 3) resided in the United States less than 10 years. Logistic regression results indicated higher acculturated individuals (i.e., those individuals who were bilingual in both Spanish and English) reported higher mean physical activity than Spanish only (OR=0.9 versus OR=.07). Foreign born participants (OR=0.9) and those who resided in the United States less than 10 years (OR=0.8) reported high mean physical activity scores compared to more acculturated immigrants.

In the third National Health and Nutrition Examination Survey, the relationship between acculturation and leisure time physical inactivity among Mexican American adults was examined using the acculturation indictors of place of birth and language used

at home. The results of the study indicated that less-acculturated Mexican Americans (Spanish speakers and bilingual speakers and those born in Mexico and living in the United States for less than 5 years) were more likely to be inactive during leisure time than were more-acculturated Mexican Americans (Crespo et al., 2001).

In a cross-sectional survey, Wolin et al. (2006) examined the relation of language acculturation and generation in the U.S. since migration with leisure time and occupational activity in low-income, multiethnic urban groups (non-Hispanic white, non-Hispanic black, Hispanic and Asian Pacific Islander) from Massachusetts small businesses (n = 1,725) and health centers (n = 2,205). The study results showed that individuals with low acculturation reported significantly lower levels (3–5 MET-hours/week) of leisure time activity (LTPA) than those who were highly acculturated (P<0.05). In contrast, least acculturated health centers participants reported higher levels of occupational physical activity (10–12 MET-hours/week) than highly acculturated participants. Acculturation was inversely associated with occupational activity in small business men and language acculturation was positively associated with occupational activity small business women. The study concluded that individuals who were less acculturated or who were foreign born generally had lower levels of LTPA and higher levels of occupational physical activity than those who were most acculturated or who were second generation or greater. The study recommended consideration of acculturation when designing public health interventions to improve physical activity.

Kandula and Lauderdale (2005) conducted a cross-sectional study on leisure time, non-leisure time and occupational physical activity in Asian Americans in the U.S. Data from the 2001 California Health Interview Survey included a sample of 4,226 Asian

Americans (Chinese, Filipinos, South Asians, Japanese, Koreans and Vietnamese) and 29,473 U.S.-born non-Asian Americans between the ages of 18 and 59 years. The study analyzed the effects of ethnicity, nativity and years in the U.S. on LTPA, non-leisure time physical activity (NLTPA) and occupational physical activity. Multivariate regression model analysis confirmed that Asian Americans were much less likely to meet recommended levels of LTPA ($p < .01$) than U.S.-born non-Asians. There was no significant difference ($p < .01$) between men and women. The results also found that foreign-born Asians had the least participation in LTPA, and LTPA increased as years in the U.S. increased. Asian Americans were found to have significant lower weekly energy expenditure than U.S.-born non-Asians (men = 570 MET-minutes/week and women = 405 MET-minutes/week vs. men = 980 MET-minutes/week and women 660 = MET-minutes/week, respectively). Kandula and Lauderdale (2005) confirmed that recent Asian American immigrants were more at risk for low levels of recommended physical activity and high levels of physical inactivity than U.S.-born Asians or Asians who have lived in the U.S. more than 10 years. The study recommended that physical activity interventions should be tailored to each specific ethnic group in the context of income and acculturation, as these factors affect whether individuals incorporate physical activity into their lives.

The above discussion makes clear that high acculturation is positively associated with physical activity in some immigrant groups in the U.S. The importance of considering acculturation when designing public health interventions to improve physical activity in immigrant groups is evidenced by these studies.

ACCULTURATION AND PHYSICAL ACTIVITY IN ASIAN INDIANS

Acculturation studies specifically conducted in Asian Indians have only used a proxy measure of acculturation, including time since immigration and language preference (Jonnalagadda & Diwan, 2005; Kolt et al., 2007; Misra et al., 2000) and American or bicultural identity (Jonnalagadda & Diwan, 2005) to assess the relationship between acculturation and physical activity.

Some studies in Asian Indian immigrants have found that levels of physical activity increased with increased length of residence in their new country (Jonnalagadda & Diwan, 2005; Misra et al., 2000). Jonnalagadda and Diwan (2005) examined the correlates of healthy behaviors including physical activity and self-rated health in middle-aged and older Asian Indian immigrants men (n=162) and women (n=64) in metropolitan Atlanta via telephone surveys. The measures used were demographics, behavioral risk factors, acculturation, perceived control, quality of social support, depression, body mass index, chronic disease prevalence and self-rated health. Length of residence in the U.S. and American or bicultural identity were used as a proxy measures of acculturation. The results of the study showed that longer residence in the U.S. and having a more American or bicultural identity were associated with more physical activity in Asian Indian immigrants. The study concluded that as cultural attitudes and beliefs can influence the practice of healthy behaviors, these factors should be addressed while developing culturally appropriate health promotion interventions in immigrant Asian Indians.

In contrast, a cross-sectional exploratory study by Misra et al. (2000) evaluated the health-promotion behaviors of Gujurati (Gujarat is a state in India) Asian Indian immigrants living in the U.S. Health promotion behaviors were assessed using the Health

Promotion Lifestyle Profile II from 261 women with a mean age 46 years. The results showed that Asian Indian women were significantly more likely ($p < .001$) to engage in low levels of physical activity. Adults between the ages of 26 and 50 had significantly lower levels of physical activity. However, the study also found that participants who had lived more than 20 years in U.S. had higher physical activity and were also more responsible for their health. Thus, the relationship between acculturation and physical activity may be a curvilinear one in which negative trends are reversed once a certain threshold of acculturation is reached or sufficient levels of improved socioeconomic status (SES) allow for the pursuit of non-work related physical activity.

Conversely, Kolt et al. (2007) found that low levels of physical activity (fewer pedometer steps) were associated with increased length of stay in the Asian Indian immigrants in New Zealand after adjusting for age. Mooteri et al. (2004) also examined inverse relationships between physical activity and the duration of residence the U.S. in a cross-sectional study among 527 first generation Konkani subjects (population of the west coast of South India) living in the U.S.

Few studies have examined the relationship between acculturation and physical activity in Asian Indians. With the exception of one study, all the other studies showed a positive correlation between acculturation measures and leisure time physical activity in Asian Indians. The evidence for a curvilinear relationship revealed by Misra et al. (2000) suggests that a good measures of acculturation need to be incorporated into the mix of factors that are predictive of physical activity to avoid conclusions that may only be accurate for those at specific points in the acculturation process.

GAPS IN THE LITERATURE

Physical inactivity still remains an important issue in Asian Indians. Yet the relationship between acculturation and physical activity in Asian Indian women remains underexplored. Few studies have evaluated the acculturation of Asian Indians in the U.S. as a factor influencing physical activity, and those that did only used proxy measures of acculturation, e.g., time since immigration, fluency in English, language preference. The physical activity studies conducted in Asian Indians to date have focused primarily on immigrant Asian Indians and could not differentiate the ways in which their physical activity behavior differed from non-immigrant Asian Indians' lifestyle. Thus, inferences attributed to acculturation changes were not discernible from those of cultural practices that may still be resident in non-immigrant Asian Indian populations. The issue is further complicated by the fact that substantial Asian Indian migration to the U.S. and other developed countries is a modern phenomenon (U.S. Census Bureau, 2012a) wherein representation of native born Asian Indian Americans is almost absent in the older population. Thus, a simple comparison of immigrants versus non-immigrants is confounded by age. Similarly, ample evidence from the acculturation literature in general supports the assumption that immigration during one's formative years (i.e., under 15 years of age) would have a substantially different impact than immigration as an adult. Therefore, this study examined the physical activity behavior across immigration status based on three approaches: 1) in immigrant versus non-immigrant (i.e., U.S. born), 2) across years in the U.S., and 3) across age at time of immigration. Most of the physical activity studies have failed to use physical activity measures that had been tested for reliability and validity. In addition, studies which used a reliable and valid instrument for

assessing physical activity have been mostly validated on Caucasians, with only one validated on Asian Indians. Also, with few exceptions, all measures of physical activity were of leisure time physical activity, which may underestimate physical activity in immigrant populations and limit possible intervention opportunities to increase physical activity in other areas that may be more culturally accessible. Sedentary activity or time spent sitting was only reported in two of the studies in South Asians but not specifically in Asian Indians.

IMPLICATION OF THE STUDY

The contribution of the study is an enhanced understanding of the relationship between acculturation and various forms of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and time spent sitting) in both immigrant and non-immigrant Asian Indian women living in the U.S. This contribution is significant because it is the first step in a continuum of research that is expected to lead to the development of effective community health nursing interventions to promote physically active lifestyles in Asian Indian women to reduce health disparities. It is important for nurses to understand cultural differences in the physical activity pattern of their clients and develop culturally appropriate health promotional counseling and programs for high-risk immigrant Asian Indians. Moreover, the development of strategies for physical activity interventions is applicable to the prevention of chronic diseases associated with physical inactivity among other immigrant and native-born groups. This in turn will improve quality of life as well as health outcomes and, thus, reduce health disparities in the U.S. Research findings on acculturation and physical activity also may influence planning and implementation of

prevention programs to increase the physical activity participation among Asian Indian women in the context of their cultural values and beliefs. In addition, the development of culturally sensitive, effective physical activity interventions may positively affect the U.S. health care system by reducing health care costs and other related costs including lost wages by people unable to work because of chronic diseases and disability, as well as the value of future earnings lost by premature death.

Chapter 3: Research Design and Methods

This chapter reviews the research design of this study. The sampling method, setting of the study, measurements of variables and the instruments used in this study are discussed in detail. This chapter also discusses the ethical considerations for the study subjects. Additionally, data collection and the statistical procedures used to analyze the data are explained in detail.

STUDY DESIGN

A quantitative cross-sectional descriptive comparative design was used to achieve the specific research objectives. Cross-sectional research is designed to study a group of subjects or variables at a specific point in time and draw conclusion (Polit & Beck, 2010). A cross-sectional descriptive design is extremely useful to identify the health status, behavior, attitudes or other characteristics of a particular group of people at a particular point in time. This study identified the self-reported levels of activity across five types of activity (leisure time, job-related, transportation, household and time spent sitting), degree of acculturation, physical functioning and BMI in Asian Indian women living in the U.S.

The descriptive comparative design compares or explores the differences of two or more groups in a natural setting (Gliner et al., 2009). This study explored the differences in the levels of five different types of activity (leisure time, job-related, transportation, household and time spent sitting) between high and low acculturated Asian Indian women and between immigrant status (immigrant and non-immigrant, years in the U.S. and age at time of immigration) of Asian Indian women in the U.S.

SAMPLING METHOD

The Houston metropolitan area hosts approximately 5,000 Asian Indian females within a closely-knit community. According to the 2010 census data, Texas is one of the top three states in the U.S. with the largest number of Asian Indians (n=245,981, i.e., 0.9% of 25,145,561) (Springer, 2012). The majority of the Asian Indian population resides in Houston (1.21% of 2,571,090), Stafford (7.35% of 27,677), Sugar Land (7.20% of 108,607), Missouri City (3.4% of 65,701), and surrounding neighborhoods of Houston (Zip Atlas, 2013). Power analyses for survey research based on estimates of contact population (n=2,000) conducted with a 95% confidence level, a 5% margin of error and an estimated response rate of 25% indicated a recommended minimum sample size of 252 (Raosoft, 2004; Watson, 2001).

A convenience sampling method was primarily used in this study. A snowball sample approach also was employed to recruit participants through announcements and word-of-mouth.

INCLUSION/EXCLUSION CRITERIA

Participants were included in the study if they met the following criteria: a) female, b) Asian Indian (self-identified), c) between 21–60 years of age, and d) able to speak, read and write English. Participants were excluded if they were a) male, b) below 21 years of age, c) unable to speak, read, and write English, d) 60 years or older or e) had any self reported physical disability.

SETTING

The study participants were recruited from Indian community churches, Hindu

temples and the Muslim mosques located in Houston, Sugar Land, Stafford, Pearland and Missouri City, Texas, as well as the Kumon Learning Center, Indian cultural organizations and the Indian American Nurses Association of Greater Houston. The principal investigator (PI) had established strong community ties and endorsement from various community leaders. Informal leaders in churches, temples or Mosque activity groups were consulted for help in referring candidates to the study through the distribution of flyers and word of mouth. Women who wanted to know more about the study were directed to contact the researcher. The PI also handed out the recruitment flyer (Appendix E) to the female members and advertised through the organization with permission and abiding by requirements of the facility. A web link to the survey for online participation was included in the recruitment flyer and the poster so that individuals could directly participate without contacting the PI and thus preserve anonymity. In addition, regularly scheduled on-site study hours were held and advertised during peak attendance hours for the different sites to provide for face-to-face recruitment and informative presentation of the study. Email invitations were sent to the members of Indian cultural organizations, and the Indian American Nurses Association of Greater Houston (IANA). Email lists of the members of these organizations were provided to the PI by these organizational authorities. A web link of the survey was included in the email messages. The PI also utilized snowball sampling by which recruited participants were encouraged to recommend other Asian Indian women into the study.

ETHICAL CONSIDERATIONS

The ethical issues considered in this study were confidentiality, avoidance of harm to the participants and anonymity of the participants. Permission to conduct the

proposed study was obtained from the University of Texas Medical Branch Institutional Review Board (IRB) before conducting the study. All the study procedures were in compliance with standards set forth by the UTMB Institutional Review Board. The participants were not considered members of any vulnerable population. Before data collection began all participants were fully informed that the IRB approval (Appendix F) had been obtained, participation was voluntary, completion of the questionnaire was considered implied consent and no financial compensation for participating in the study would be received. This information was transmitted through an introductory paragraph in both the paper survey and the web survey. Permission letters were obtained from the recruiting facilities to recruit the participants to the study. This study was designed to reduce any risk of loss of confidentiality by giving participants the option of anonymous participation. To ensure the anonymity of the questionnaires, no identifying information was collected. A private space was also provided for the face-to-face recruited participants who filled out the paper survey immediately at the contact locations. The PI provided her contact information (phone number and email address) in the web survey, paper survey, flyer and the poster. Provision of a secure drop box to deposit the completed paper maintained the anonymity of the survey. All original paper surveys were kept in a locked file cabinet during the study and were shredded at the end of the study.

MEASUREMENT OF VARIABLES

The dependent variables for this study were five types of activity: job-related physical activity, transportation physical activity, household physical activity, leisure time activity and sedentary activity time spent sitting. All forms of activity were measured using the IPAQ-long form.

Independent variables were acculturation and demographic variables (age, employment status, comorbidity, marital status, household income, education and immigration status) (Appendix A) along with two physiological covariates: physical functioning and body mass index (BMI). Comorbidity was measured as yes or no. Marital status was categorized as either partnered or unpartnered. Employment status was classified as employed, homemaker, student, retired, disabled or other. Education was measured as both an ordinal grouping category (e.g., highest grade competed less than high school, high school, associate/technical degree) and as an interval variable by assigning a set number of years of education to each educational level (e.g., did not complete high school = enter last grade completed, high school = 12, some college = enter sum of 12 plus the number of years of college completed, associate's/technical degree = 14, bachelor's degree = 16, master's degree = 18 and doctorate degree = 20). Immigration status was measured as immigrant versus non-immigrant, years in the U.S. and age at immigration.

Acculturation was operationally defined and measured by 21 items on the Modified Suinn-Lew Asian Identity Acculturation Scale (M- SL-ASIA) assessing the degree of acculturation of Asian Indian Americans. Two physiological covariates, physical functioning and body mass index (BMI), were assessed to refine evaluations of physical activities and their relationship with acculturation. Physical functioning was measured by using the physical functioning subscale (PF-10) from the RAND 36-ltem Health Survey. For calculating BMI, self reported data of height and weight was collected from the participants and then BMI was computed using the simple formula of weight (in kilograms) divided by height (in meters) squared. For the purposes of this

study, WHO criteria for Asian-Pacific population were used: underweight (BMI<18.5 kg/m^2), normal (BMI 18.5–23 kg/m^2), overweight (BMI 23–25 kg/m^2), and obese (BMI > 25 kg/m^2) (WPRO, 2000, 2002).

INSTRUMENTS

The Physical Functioning Scale of the Rand 36-Item Health Survey (PF-10 Scale)

The RAND 36-Item Short Form Health Survey (MOS 36-Item Short Form Survey Instrument, SF-36) was developed by RAND Health as part of the Medical Outcomes Study (MOS), a multi-year, multi-site study to explain variations in patient outcomes (Ware & Sherbourne, 1992). The RAND 36-Item Health Survey was adapted from longer instruments completed by patients who participated in the MOS, an observational study of variation in physician practice styles and patient outcomes in different systems of health care delivery (Hays et al., 1995; Stewart et al., 1992). The RAND 36-Item Health Survey is a set of generic, coherent and easily administered quality-of-life measures yielding an 8-scale profile of functional health and well-being scores as well as psychometrically-based physical and mental health summary measures and a preference-based health utility index: physical functioning, bodily pain, role limitations due to physical health problems, role limitations due to personal or emotional problems, general mental health, social functioning, energy/fatigue (vitality) and general health perceptions. Extensive psychometric testing has been conducted on the SF-36 in the United States (Garratt et al., 1993; Jenkinson et al., 1993; Wagner et al., 1995; Ware et al., 1994), and in other countries (Bullinger, 1995; McCallum, 1995; Sullivan et al., 1995). Reliability estimates for physical and mental summary scores was 0.90 (Ware et al., 1994). SF-36

scales have been shown to achieve about 80-90% of their empirical validity in studies involving criteria of physical and mental health (McHorney et al., 1993).

The Physical Functioning (PF), Role Physical (RP) and Bodily Pain (BP) scales and the PC (Physical component) summary have been shown to be the most valid SF-36 scales for measuring physical health. The Physical Functioning scale (PF-10) of the RAND 36-ltem Short Form Health Survey (Item 3-Item 12) (Appendix B) was most relevant to this study as it related the ability of participants to perform different physical activities as compared with the entire instrument. The assessment of physical functioning provided a way to control for factors that might have affected physical activity that were not directly related to acculturation factors (e.g., limitations in the ability to walk a block with ease). Physical Functioning (PF-10) measured the extent to which health limits the physical activities such as self-care, walking, climbing hills and stairs, bending and lifting and moderated and vigorous activities (Hays et al., 1995). Completed items were averaged together to create a total Physical Functioning mean score. Higher scores represented better health status.

High reliability was exhibited by the Physical Functioning subscale of Rand 36-item survey (Cronbach Alpha=0.93, Mean =70.61, SD =27.92) in the Medical Outcome study (Ware & Sherbourne, 1992). The PF-10 has shown high test–retest reliability in people with rheumatic arthritis (0.93) (Ruta et al., 1998) and low back pain (0.83– 0.9) (Davidson & Keating, 2002). High internal consistency has also been reported for older adults (Cronbach's $\alpha = 0.82$) (Bohannon & DePasquale, 2010) and people with gout (Cronbach's $\alpha \geq 0.93$) (Klooster et al., 2011). Criterion validity of the PF-10 has been found to be associated with both generic and disease-specific measures of functional

outcome in a variety of rheumatologic studies (Gandhi et al., 2009; Salaffi et al., 2005). In addition, the PF-10 has been shown to be highly correlated with the Late Life Function and Disability Index in older adults (r = 0.74 – 0.88) (Dubuc et al., 2004). Construct validity of the PF-10 has been found to measure a single or unidimensional index in people with psoriatic arthritis (Taylor & McPherson, 2007), in subjects with chronic medical and psychiatric conditions from the U.S. (Haley et al., 1994) and among subjects from the general population from seven countries, including Denmark, Germany, Italy, the US, Sweden, the Netherlands, and the U.K. (Raczek et al., 1998). For the scoring of the scale, the items in the scale were averaged together to create the score for the PF-10 scale. All items were scored in a manner that high score defined a more favorable health state. Each item was scored on a 0 to 100 range so that the lowest and highest possible scores were set at 0 and 100, respectively. Scores represented the percentage of total possible score achieved.

International Physical Activity Questionnaire (IPAQ)

The long form of the IPAQ (Appendix C) was used to measure different levels of physical activity among Asian Indian women. The IPAQ was designed specifically for adults (18–65 years old) to determine what kind of physical activities people participate in as part of their everyday lives (Booth, 2000; Craig et al., 2003; IPAQ, 2005). The long version of IPAQ consists of 27 questions in four physical activity domains and one sedentary domain: occupational, transportation, housework/house maintenance, leisure time physical activity, and the time spent sitting (sedentary activity domain). The items in IPAQ have been structured to provide separate domain specific scores for walking, moderate-intensity, and vigorous-intensity activity. All questions in the IPAQ refer to the

previous seven days. The results of physical activity were presented as the estimation of energy expenditure in metabolic equivalent minutes per week or MET-hours/week (IPAQ, 2005).

To date, 94 research studies have utilized the IPAQ instrument to measure physical activity. The validity and reliability of the IPAQ was tested in 12 countries (both developed and developing countries) across six continents using standardized methods, demonstrating acceptable reliability and validity (Craig et al., 2003). The test-retest reliability (intra-class correlations range (0.7–0.8) and inter-method validity (median rho = 0.67), with criterion validity (rho = 0.3) based on comparisons with accelerometer data. According to the authors, these results are comparable to other physical activity self-report validation studies (Craig et al., 2003). Measurement properties were similar in 12 countries with the IPAQ offering broader applicability to a wide range of countries and cultures (Craig et al., 2003). The IPAQ estimates frequency (day/week) and duration (minutes or hours/week) of physical activities of different intensity (moderate and vigorous), including walking activity, during the previous seven days. It also includes the time spend sitting as sedentary activity. While both categorical and continuous measures of physical activity can be reported with the IPAQ, the categorical classification (low, moderate or high) typically produces non-normal distributions, so the use of continuous variables are recommended and have been employed in this study.

Scoring protocol of continuous variables were the total minutes/week or MET-minutes/week of moderate to vigorous physical activity plus walking for each type of physical activity. According to IPAQ scoring protocol (IPAQ, 2005), MET-hours/week of specific activity (walking or moderate intensity activity or vigorous intensity activity)

is computed by multiplying MET value of particular activity (3.3 for walking, 4.0 for moderate intensity activity, and 8.0 for vigorous intensity activity) with hours spent in that particular activity (e.g., walking MET-minutes/week at work = 3.3 × walking hours (minutes) x walking days at work). To calculate physical activity scores, only the activities lasting at least 10 minutes were considered. Algorithms (scoring protocol) for calculating the continuous physical activity scores were used to estimate physical activity based on participants' answers (Appendix G). Total physical activity scores were calculated, as well as separate scores for each of the four physical activity domains and the time spent sitting (sedentary activity domain). The IPAQ sitting question is an additional indicator variable used to measure the time spent sitting. It was not included as part of the scoring of physical activity. For the sitting question "minutes" (hours) was used to calculate time spent in sitting rather than MET-minutes. To provide for comparison with national standards and prior research, MET-minutes were transformed into MET-hours for reporting purposes.

Validity and reliability is not yet established specifically among Asian Indian women in the U.S. In order to establish the preliminary data for this study, the researcher conducted focus groups among Asian Indian women to examine content validity and cultural appropriateness of the IPAQ-long form in Asian Indian women living in the U.S. Results indicated that there was no comprehension problem or issues regarding instrument vocabulary other than the suggestion of adding more activity examples such as kick boxing, table tennis, badminton, basketball, zumba dance, traditional dance, yoga, jogging, taking child in stroller and walking, treadmill, elliptical exercise, weight bearing

exercise, strength training exercises and pilates exercises in section four (recreation, sport and leisure time physical activity of IPAQ).

Modified Suinn-Lew Asian Identity Acculturation Scale (M-SL-ASIA)

SL-ASIA was originally developed by Suinn et al. (1992) as a 21-item measure modeled on the Acculturation Rating Scale for Mexican Americans (ARSMA-I) (Cuellar et al., 1980) to assess the degree of acculturation of Asian-American clients as a reflection of cultural behaviors. The SL-ASIA measures acculturation unidimensionally, i.e., an individual's identity is measured on a continuum of Asian and Western identity. The original 21 questions query on a variety of acculturation dimensions including language (four questions), identity (four questions), friendship choice (four questions), behaviors (five questions), generation/geographic history (three questions) and attitudes (one question). Each question has five response options that are worded to measure acculturation on a continuum of low acculturation to high acculturation. A total score is computed by summing across the answers for all 21 items and then dividing by the number of items to yield a score range from 1.00 (low acculturation) to 5.00 (high acculturation). A low score reflects high Asian identity while a high score reflects high Western identity. SL-ASIA is the only scale that has been designed expressly for Asian populations, and studies have shown that it is both reliable and valid.

The SL-ASIA has been used successfully across a wide range of ages. Alpha coefficients range from .72-.91 (Kodama & Canetto, 1995; Suinn et al., 1987, 1995). The reliability and validity was established in an extensive study of the SL-ASIA involving a sample of 324 Asian American university students. Concurrent validity results showed that the SL-ASIA scores were significantly correlated with demographic information

hypothesized to reflect levels of Asian American identity. Factorial validity was determined by comparing factors obtained for the SL-ASIA with factors reported for a similar scale measuring acculturation of Hispanics—the ARSMA. Of the four interpretable factors reported for the ARSMA, three were similarly identified for the SL-ASIA (Suinn et al., 1995). Cronbach's alpha for the SL-ASIA was .79, reflecting a reasonably stable performance. The SL-ASIA Scale was further tested with a non-student, random sample (N = 124) comprised of Chinese- and Filipino-Americans aged 18 years old and older who lived in San Francisco. Resulting data confirmed results of the initial study of the SL-ASIA: the test scores resulted in acceptable reliability measures and the instrument is considered to contain items that are promising for accurate measurement of acculturation among Asian-American populations (Ownbey, 1998). Researchers also investigated the level of acculturation in South Asian Indians in the U.S. using a validated Indian-Gujarati language version of the SL-ASIA (Dodani & Dong, 2011; Menon et al., 2011). The alpha coefficients of the Indian-Gujarati language version of the SL-ASIA ranged from .69 to .95 (Dodani & Dong, 2011; Menon et al., 2011).

Validity and reliability has yet to be established specifically among Asian Indian women in the U.S. To establish the preliminary data for this proposed study, the researcher conducted focus groups among Asian Indian women to examine the content validity and cultural appropriateness of the SL-ASIA in Asian Indian women living in the U.S. Results indicated minor wording revisions to clarify requested information or to change wordings for better comprehension of the instrument. The author of the instrument, Dr. Richard M. Suinn, was contacted about the wordings changes and agreed

with the changes. An adapted version of the SL-ASIA targeted for the South Asian Indian population had been used in a dissertation examining the cultural influences on South Asian American relationships (Kapadia, 2009). In this study, no items of the SL-ASIA were substantially changed, but those minor wording clarifications plus the focus on Asian Indian women specifically indicated the use of a modified reference to the instrument. Therefore, this study used a more specific name to reflect this focus, the Modified SL-ASIA (M-SL-ASIA) (Appendix D).

DATA COLLECTION

Approval for the study was obtained from the Institutional Review Board (IRB) at the University of Texas Medical Branch at Galveston (UTMB). Once the study had been approved by the IRB, participants were approached as they visited each facility for services and offered a hand-flyer describing the study by the principal investigator (PI). The PI was available before and after services to enroll interested participants. Email invitations were sent to the members of Indian cultural organizations and the Indian American Nurses Association of Greater Houston (IANA). Flyers, posters and electronic informationals (emails) included the web link to the survey so that individuals could directly participate without contacting the PI and thus preserve anonymity. Location and times for when the PI was available at the different facilities were provided for those individuals that wished to fill out paper copies of the questionnaire or required further clarification. In addition, contact information (phone number and email address) of the PI was provided to the participants. In all cases where a paper form was preferred, the researcher validated eligibility to preclude ineligible participants from completing

surveys. The survey was composed of the demographic questionnaire (Appendix A), PF-10 (Appendix B), IPAQ (Appendix C), and Modified SL-ASIA (Appendix D) and administered in English only. Asian Indians have different mother tongues and it was not feasible to translate the questionnaires to each Indian language. English is the common language Indian women use to communicate with each other from different regions of India. The duration of participation in the study was approximately 45 minutes for the completion of demographic, PF-10, IPAQ and M-SL-ASIA questionnaire, which took into account any extra time needed for inquiries or clarifications that were directed to the PI.

DATA ANALYSIS

Data were analyzed using standard statistical methods from the Statistical Package for Social Sciences (SPSS, version 22.0). All data were examined for normality and homogeneity. Significance for all statistical analyses was set at $p \leq 0.05$. Data analyses for each research questions are described below.

Specific Aim 1

Identify the self-reported levels of five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting), physical functioning and BMI in Asian Indian women living in the U.S.

Research Question 1.1

What are the frequencies and levels of five different types of activity, physical functioning and BMI in Asian Indian women in the U.S.? Analyses included descriptive statistics (means, standard deviations and medians) that were calculated for each of the four physical activity as well as total physical activity MET scores and hours/week scores for total time spent sitting, BMI and total physical functioning score. The means, standard deviations and medians of walking, moderate and vigorous subcategories based on level of intensity for each physical activity were also calculated.

Specific Aim 2

Describe the degrees of acculturation in Asian Indian women living in the U.S.

Research Question 2.1

What are the degrees of acculturation in Asian Indian women in the U.S.? To examine this question, descriptive statistics (means, standard deviations and medians) were calculated for acculturation. The acculturation measure ranged from 1.00 (low acculturation) to 5.00 (high acculturation).

Specific Aim 3

Explore the relationships between five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting), immigration status (years in the U.S. and age at immigration in immigrants), acculturation, physical functioning and BMI in Asian Indian women in the U.S.

Research Question 3.1

What are the relationships between five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting), acculturation, immigration status (years in the U.S. and age at immigration in immigrants), physical functioning and BMI in Asian Indian women in the U.S. when uncontrolled and controlled for physical functioning and BMI. Pearson's correlation analyses were used to examine the relationship of physical activity, sedentary activity time spent sitting, acculturation, immigration status (years in the U.S. and age at immigration in immigrants), physical functioning and BMI scores. Partial correlational analyses were used to examine the relationships between acculturation score, immigration status (years in the U.S. and age at immigration in immigrants) and five different types of activity scores (job-related physical activity, transportation physical activity, household physical activity, leisure time activity and sedentary activity time spent sitting) controlling for physical functioning and BMI.

Research Question 3.2

What is the best set of predictors from the acculturation, moderator variables (physical functioning and BMI), immigration status (immigrant and non-immigrant [included as a dummy variable]), years in the U.S. and age at immigration) and demographic characteristics (age, marital status, years of education and income) for five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting) among Asian Indian women in the U.S.? Stepwise Multiple Regression

Analyses (forward and backward) were used to examine the predictive power of acculturation, physical functioning, BMI, immigration status and demographic characteristics on each of the self-reported physical activities. Each of the immigration status variables were entered into the model separately since high multicollinearity between these predictors was expected. The model solutions were then compared to evaluate the utility of each approach regarding its predictive power. Based on preliminary analyses, only those predictor variables showing a sufficient relationship with the criterion were included in the model to avoid over-fitting.

Specific Aim 4

Examine the differences in the levels of activity across all five types of activity between high and low acculturated Asian Indian women and between immigrant status (immigrant and non-immigrant, years in the U.S. and age at time of immigration) of Asian Indian women in the U.S. while controlling for age, BMI, physical functioning and income.

Hypothesis 4.1

More acculturated U.S. Asian Indian women will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity, and household physical activity than less acculturated U.S. Asian Indian women when controlling for age, BMI, physical functioning and income. The acculturation score was dichotomized (1-2.5=low; 2.51-5=high) to produce low and high acculturation groups on each dimension. Analyses of covariance (ANCOVA) were used to investigate differences between low and high

acculturated groups on the four Physical activity scores and one sedentary score controlling for age, BMI, Physical functioning, and income.

Hypothesis 4.2

Non-immigrant U.S. Asian Indian women, those with more years in the U.S. and immigrants with younger ages at immigration will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity and household physical activity than immigrant U.S. Asian Indian women when controlling for age, BMI, physical functioning and income. To examine this hypothesis, immigration status was categorized as immigrant versus non-immigrant (place of birth), high and low mean/median years in the U.S. and high and low mean/median split age for Asian Indian women in the U.S. Analyses of covariance (ANCOVA) were conducted to investigate the differences between immigrant status groups (immigrant/non-immigrant, high and low mean/median split years in the U.S. and high and low mean/median split age at immigration) of Asian Indian women on the five activity scores controlling for age, BMI, physical functioning and income.

Chapter 4: Results

This chapter presents the results of the study examining the relationship between acculturation and five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting) in Asian Indian women living in the U.S. A description of the sample demographic characteristics and the psychometric properties of the study instruments are followed by the results for each research question. The overall objective of this study was to identify the relationships between acculturation and five different types of activity in Asian Indian women in the U.S. The central hypothesis was that more acculturated Asian Indian women will have higher levels of leisure time physical activity and sedentary activity time spent sitting accompanied by lower levels of job-related physical activity, transportation physical activity and household physical activity than less acculturated U.S. Asian Indian women.

The dependent variables for this study were four dimensions of physical activity (job-related physical activity, transportation physical activity, household physical activity and leisure time physical activity) measured in MET-hours/week and sedentary activity time spent sitting measured in hours/week. The independent variables were acculturation, demographic variables (age, employment status, comorbidity, marital status, household income, education and immigration status [immigrant versus non-immigrant], years in the U.S. and age at immigration) and two physiological covariates: physical functioning and body mass index (BMI).

SAMPLE CHARACTERISTICS

The study was conducted over the course of three months beginning August 22, 2013, and ending November 30, 2013. The total number of Asian Indian women contacted via face-to-face method was 755. Sixty-five participants elected to complete paper forms of survey; two of these individuals submitted incomplete forms and were excluded from the analysis. The total number of participants who accessed the online survey link was 244, of whom 45 did not proceed with the survey. The final number of respondents who completed the survey was 199 of the 244 (81.5% completion rate of those who accessed the survey link). The combined total number of Asian Indian women who completed the both the paper and online survey was 262. Missing values were handled using the "exclude cases pairwise" option in SPSS. This option excludes the cases from the analysis only if they are missing the data required for the specific analysis.

Sample characteristics across the total sample are shown in Table 4.1. The age of the subjects ranged from 21-58 with a mean of 34.7 years (SD=8.1). Most of the participants were partnered, held bachelor's or master's degrees, were employed, had no comorbidities and were immigrants. Age when immigrated to the U.S. for immigrants was mid-20s and the average years in the U.S. for the total group was 18.8 years (SD=11.5).

Table 4.1: Total Sample Characteristics

Characteristic	*n*	*M* (*SD*) or %
Average age (± *SD*)	262	34.7 (8.1)
Marital Status	262	
Partnered	213	81.3%
Unpartnered	49	18.7%
Education	262	
High school or equivalent	1	0.4%
Associate/technical degree	25	9.5%
Bachelor's degree	146	55.7%
Master's degree	83	31.7%
Doctorate degree	7	2.7%
Employment Status	262	
Employed	213	81.3%
Home maker	16	6.1%
Student	33	12.6%
Annual Household Income	240	125,459 (88,280)
Comorbid Condition	262	
Yes	20	7.6%
No	242	92.4%
Immigration status	262	
Immigrant	164	62.6%
Non-immigrant	98	37.4%
Age when immigrated to the U.S. (For immigrant group only)	164	25.4 (9.7)
Years living in the U.S.	262	18.8 (11.5)

COMPARISON OF THE SAMPLE CHARACTERISTICS WITH A NATIONAL SAMPLE

Characteristics of the national sample of Asian Indian women from the American community survey of 2012 (U.S. Census Bureau, 2012a) are shown in Table 4.2. The age of the subjects ranged from 21-60 with a mean of 38.2 years (SD=10.5), and was slightly older than the study sample (34.7 years). The majority of participants were partnered in both the study sample and the national sample. The proportion of immigrants was higher in the national sample. The average years in the U.S. was 12.7 years (SD=10.8), which

was less than the study sample (18.8 years). The average household income ($226,247) was higher in national sample as compared with study sample ($125,459). A comparison across education indicated a higher proportion of the study sample with bachelor's degrees and lower proportion of associate's and technical degrees compared to the national sample, with an equal distribution for graduate degrees. In contrast, the study sample demonstrated a higher proportion of participants as employed when compared to the national sample. Thus, the study sample appears to more heavily represent better educated, employed but lower SES than the national sample of Asian Indian women in the United States.

Table 4.2: Characteristics of the National Sample of Asian Indian Women from the American Community Survey of U.S. Census Bureau, 2012

Characteristic	*n*	*M* (*SD*) or %
Average age (± *SD*)	8,249	38.2 (10.5)
Marital Status	8,249	
Partnered	6,582	79.8%
Unpartnered	1,667	20.2%
Education	8,249	
High school or equivalent	1,464	17.7%
Associate/technical degree	969	11.8%
Bachelor's degree	2,968	36.0%
Master's and Doctorate degree	2,848	34.5%
Employment Status	8,249	
Employed	4,963	60.2%
Unemployed and Not in labor force	3,286	39.8%
Annual Household Income	8,249	226,247 (968,341)
Immigration status	8,249	
Immigrant	7,184	87.1%
Non- immigrant	1,065	13.0%
Years living in the U.S.	8,249	12.7 (10.8)

DISTRIBUTIONS OF THE DEMOGRAPHIC VARIABLES

Nominal Variables

Chi Square analysis was used to investigate the association between the demographic nominal level variables (Tables 4.3 and 4.4). Education, as measured in the current study, was measured as both an ordinal grouping category (e.g., highest grade completed less than high school, high school, associate's/technical degree) and as an interval variable by assigning a set number of years of education to each educational level (e.g., high school=12, associate's/technical degree=12+2=14, bachelor's degree=16, master's degree=18, doctorate degree=20). Chi square analyses could not be conducted on the relationship between educational groups due to the high number of cells with too

few subjects. Therefore, a second education group categorization was created whereby those with only high school (n=1), associate's or technical degrees (n=25) and bachelor's degrees (n=146) were grouped together with undergraduate degrees. Those with graduate degrees (master's=83 and doctorate=7) composed the second group. There were no statistically significant relationships found between education groups (2) and other demographic variables.

Statistically significant associations were found between marital status and employment status (Table 4.3), with the largest proportion of partnered individuals being employed (91.1%) (Table 4.4). It was also found that a majority (61.2%) of the unpartnered participants were students.

A statistical significant association was also found between immigrant status and marital status. Almost 90.9% of immigrants were partnered; on the other hand, only 65.3% non-immigrants were partnered. There was a statistically significant relationship between immigration status and employment, with 86.6% immigrants employed compared to 72.4% non-immigrants. Almost 23.5% of the non-immigrants were students as compared with 6.1% of immigrant students.

Interval Variables

Differences between marital status, comorbidities and immigration status were assessed on interval level variables of age, household income and years in the U.S. (see Table 4.5). There were significant differences between marital status subgroups, comorbidity groups and immigrant groups on age, with those of partners, immigrants and comorbidities being older.

Table 4.3: Chi Square Analyses for Total Sample

Variables	χ^2	df	$p<$
Marital Status*Comorbidity	.024[a]	1	0.80
Marital Status*Education [c]	.893	1	0.35
Employment*Comorbidity	.865[a]	2	0.80
Employment status*Education [c]	2.006	2	0.37
Employment *Marital Status	**130.25**	2	**0.001**[b]
Comorbidity*Education [c]	.182	1	0.67
Immigration Status*Marital Status	**26.33**	1	**0.001**[b]
Immigration Status*Comorbidity	.062	1	0.80
Immigration Status*Education[c]	2.90	1	0.09
Immigration Status* Employment	**17.26**	2	**.001**[b]

[a] Fisher's exact test is used.
[b] *p* value is significant at the 0.05 level
[c] Education as a two category variable.

On household income, there was a significant difference between those with partners and those without, with partnered individuals reporting higher income reflecting a dual income household. Also significant differences on household income across education categories were found with participants with graduate level education having higher household incomes. No significant differences in household income among immigrant groups or comorbid groups were observed.

There was a significant difference between marital status subgroups on years in the U.S., with unpartnered individuals living in the U.S. being longer than partnered individuals. Unsurprisingly, there was a significant difference between immigration subgroups on years in the U.S., such that non-immigrants evidenced longer time in the U.S. than immigrants. Of note, no significant difference was found between comorbid groups on years in the U.S. There were significant differences between education subgroups on years in the U.S., with individuals with graduate level education living in the U.S. longer than those with only undergraduate degrees.

Among immigrants, there were significant differences between marital status subgroups on age when immigrated to the U.S.—partnered individuals were much older when they immigrated to the U.S. than unpartnered individuals. Also there was a significant difference between comorbidity subgroups on age when immigrated to the U.S., indicating that those with current comorbidities were older when they had immigrated.

Table 4.6 displays the assessment of differences across employment categories. Because of substantial differences in subgroup sizes, occurrences of small subgroups and issues of heterogeneity, the nonparametric Kruskal Wallis ANOVA was employed. Means and standard deviations were provided for the purposes of interpretation of results in addition to the mean ranks on which nonparametric tests of significance were based. There were significant differences between employment subgroups on age, with employed people being older than homemakers or students. Homemakers had significantly higher incomes compared to other groups. Of special interest were the demographic differences for immigrants. As seen in Table 4.6, there were significant differences between employment subgroups on age when immigrated to U.S., with those who were employed being older when immigrated to U.S. than homemakers and students.

Table 4.4: Distribution of Demographic Variables for Entire Sample

% (*n*)	Immigration status		Marital Status		Employment Status			Comorbidity	
Variable	Immigrant	Non-immigrant	Partnered	Unpartnered	Employed	Homemaker	Student	Yes	No
Education									
Undergraduate Degree	69.5% (114)	59.2% (58)	64.3% (137)	71.4% (35)	66.2% (141)	50.0% (8)	69.7% (23)	70.0% (14)	65.3% (158)
Graduate Degree	30.5% (50)	40.8% (40)	35.7% (76)	28.6% (14)	33.8% (8)	50.0% (8)	30.3% (10)	30.0% (6)	34.7% (84)
Comorbidity									
Yes	7.3% (12)	8.2% (8)	7.5% (16)	8.2% (4)	8.5% (18)	0 (0%)	6.1% (2)		
No	92.7% (152)	91.8 % (90)	92.5% (197)	91.8% (45)	91.5% (195)	100% (16)	93.9% (31)		
Marital Status									
Partnered	90.9% (149)	65.3% (64)							
Unpartnered	9.1% (15)	34.7 % (34)							
Employment									
Employed	86.6% (142)	72.4 % (71)	91.1% (194)	38.8% (19)					
Homemaker	7.3% (12)	4.1% (4)	7.5% (16)	0% (0)					
Student	6.1% (10)	23.5% (23)	1.4 % (3)	61.2% (30)					

Table 4.5: Demographic Group Differences on Interval Level Variables

Variables (n)			M (SD)	Significance
Age	Marital status	Partnered (213)	36.72 (7.03)	t=.34, *P=**.001***
		Unpartnered (49)	25.88 (6.54)	
	Comorbidity	Yes (20)	39.05 (10.09)	t=2.52, ***P=.012***
		No (242)	34.33 (7.85)	
	Immigration status	Immigrant (164)	37.27 (8.10)	t=7.29, ***P=.01***
		Non-immigrant (98)	30.37 (6.09)	
	Education	Undergraduate (171)	34.42 (8.54)	t=-.733, *P=.47*
		Graduate (90)	35.20 (7.26)	
Household Income	Marital status	Partnered (208)	131,480 (88,266)	t=2.73, ***P=.007***
		Unpartnered (32)	86,316 (78,974)	
	Comorbidity	Yes (20)	128,300 (2,651)	t=.150, *P=.88*
		No (220)	125,200 (59,39)	
	Immigration status	Immigrant (159)	124,236 (88,073)	t=-.30, *P=.76*
		Non-immigrant (81)	127,858 (98,205)	
	Education	Undergraduate (154)	110611 (71827)	t=-3.57, ***P=.002***
		Graduate (86)	152046 (107294)	
Years in the U.S.	Marital status	Partnered (213)	18.10 (12.03)	t=-2.9, ***P=.008***
		Unpartnered (49)	21.88 (7.95)	
	Comorbidity	Yes (20)	20.15 (12.0)	t=.54, *P=.58*
		No (242)	18.69 (11.43)	
	Immigration status	Immigrant (164)	11.88 (7.62)	t=-20.31, ***P=.01***
		Non- immigrant (98)	30.40 (6.30)	
	Education	Undergraduate (172)	17.04(11.44)	t=-3.51, ***P=.001***
		Graduate (90)	22.18 (10.77)	
Age at immigration (Immigrants only)	Marital status	Partnered (149)	26.66 (8.89)	t=5.62, ***P=.01***
		Unpartnered (15)	13.00 (9.62)	
	Comorbidity	Yes (12)	31.50 (12.85)	*t=2.27,* ***P=.02***
		No (152)	24.93 (9.37)	
	Education	Undergraduate (114)	26.20 (10.03)	t=1.577, *P=.18*
		Graduate (50)	23.60 (8.98)	

Table 4.6: Demographic Group Differences on Interval Level Variables

Variables (n)			Mean (SD)	Mean Rank	Significance
Age	Employment Status	Employed (n=213)	36.26 (7.38)	146.91	H(2)= 62.65, ***P<.001***
		Homemaker (n=16)	34.63 (6.12)	125.47	
		Student (n=33)	24.69 (8.12)	34.95	
Household Income	Employment Status	Employed (n=207)	128,8923 (89,829)	123.54	H(2)= 7.43, ***P<.05***
		Homemaker (n=16)	(132,688) (88,504)	127.88	
		Student (n=17)	76,471 (49,205)	76.53	
Years in the U.S.	Employment Status	Employed (n=213)	18.57 (12.03)	129.51	H(2)= 1.135, *P=.56*
		Homemaker (n=16)	18.06 (10.83)	130.94	
		Student (n=33)	20.70 (7.23)	144.59	
Age at Immigration	Employment Status	Employed (n=142)	26.58 (8.88)	87.97	H(2)= 15.81, ***P< .001***
		Homemaker (n=12)	22.08 (8.80)	59.29	
		Student (n=10)	12.80 (13.6)	32.65	

DEMOGRAPHIC GROUP DIFFERENCES ON AGE AT IMMIGRATION CONTROLLING FOR AGE IN IMMIGRANT SUBGROUPS

A one-way ANCOVA was used to determine whether there were any statistically significant differences between the age at immigration across marital groups and across comorbidity groups adjusted for age within immigrants. There was a statistically significant difference in age when immigrated to U.S. between marital groups, such that partnered individuals were much older when they immigrated to U.S. than unpartnered individuals. There was no significant difference between comorbidity subgroups on age

when immigrated to U.S., indicating that those with current comorbidities were not older when they immigrated (Table 4.7).

PSYCHOMETRICS OF INSTRUMENTS

Suinn-Lew Asian Self Identity Acculturation Scale (SL-ASIA) is a 21-item questionnaire used to assess the degree of acculturation of Asian American populations. This scale was modified for this specific Asian Indian population living in the U.S. was named as Modified SL-ASIA (M-SL-ASIA). The 21 questions query a variety of acculturation dimensions including language (four questions), identity (four questions), friendship choice (four questions), behaviors (five questions), generation/geographic history (three questions) and attitudes (one question). The administration of M-SL-ASIA yields scores that describe acculturation status on a unidimensional scale from 1-5, with 1 being least acculturated and 5 being most acculturated. M-SL-ASIA has shown good internal consistency (Cronbach alpha = .95). The alpha coefficient of at least .80 is considered to be adequate for an established (developed) instrument (Nunnally, 1978). On the other hand, very high reliabilities (0.95 or higher) are not necessarily desirable, as this indicates that some items may be redundant. The corrected item-total correlation (item 4: identification mother use and item 5: identification father use) on the scale had very low correlations (.30 and .298 respectively). If these item were deleted, then the subscale reliability would remain $\alpha = .951$. Therefore those items could be considered as uninformative and candidates for omission in future research studies.

Table 4.7: Demographic Group Differences on Age at Immigration Controlling for Age in Immigrant Subgroup

Variable/ Covariate: Age			Mean (SD)	Significance
Age at immigration (Immigrants only)	Marital status	Partnered (n=149)	26.66 (8.89)	F(df)=8.54, ***P=.004***
		Unpartnered (n=15)	13.00 (9.62)	
	Comorbidity	Yes (n=12)	31.50 (12.85)	F(df)=.017, P=.89
		No (n=152)	24.93 (9.37)	

The Physical Functioning scale (PF-10) of the RAND 36-ltem Short Form Health Survey (Item 3 – Item 12) measures the extent to which health limits physical activities such as self-care, walking, climbing hills and stairs, bending and lifting and moderated and vigorous activities (Hays et al., 1995). Completed items are averaged together to create a total Physical Functioning mean score. Higher scores represent better health status. The PF-10 has been widely used and tested across a variety of populations, and has been shown to have high reliabilities. The PF-10 showed good internal consistency (Cronbach alpha = .87).

SPECIFIC AIM 1

Identify the self-reported levels of five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting), physical functioning and BMI in Asian Indian women living in the U.S.

Research Question 1

What are the frequencies and levels of five different types of activity, physical functioning and BMI in Asian Indian women in the U.S?

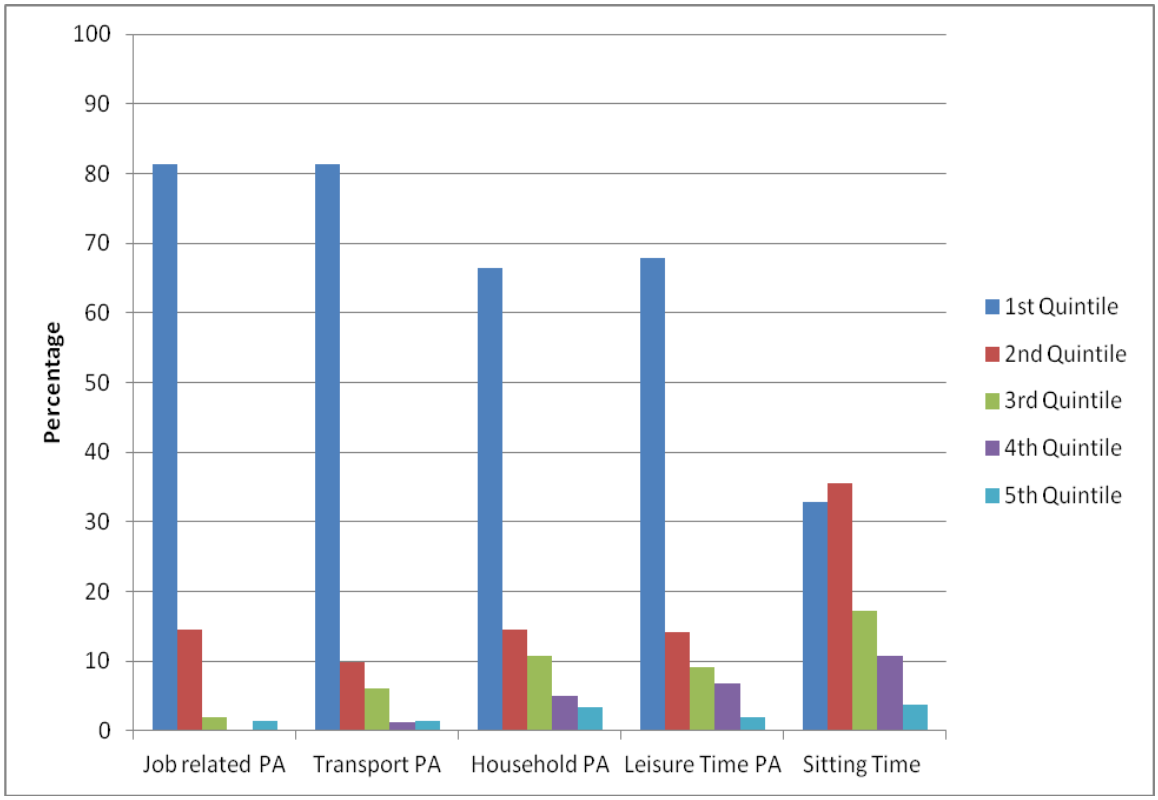
Descriptive statistics (means, standard deviations and medians) were calculated for each of the four physical activity as well as total physical activity MET scores, hours/week scores for total time spent sitting (calculated according to the IPAQ scoring protocol; Appendix G), total physical functioning scores and BMI. The sample included 262 Asian Indian women participants. As seen in Table 4.8, the means and medians were vastly different for all activity measures except for time spent sitting, with means notably higher than medians. This reflects a right skew to the data as seen in Figure 4.1 where the distribution was grouped into five ranges from lowest to highest based, indicating that job-related physical activity, transportation physical activity, household physical activity and leisure time physical activity were not normally distributed. The largest percentage of participants clearly scored in the lowest fifth of each physical activity except for sitting time, in which there was a greater representation across the higher scores (higher scores indicated more sedentary activity). The notably skewed distribution towards lower physical activity in all categories is evidence of a sample in which the greatest proportion fell in the lowest range of participation (at the lowest quintiles of activity) across all domains. The differences between median and mean values again confirmed the disproportionate influence of a small number of extremely active participants.

Table 4.8: Frequency Distribution of Each Domains of Physical Activity (MET-hours/week) and Time Spent Sitting (hours/week)

Types/Domains of physical activity (PA)	N	Mean (SD)	Median	Interquartile range
Job-related PA	262	71.27 (117.87)	12.0	104.90
Transportation PA	262	1.11(2.43)	.000	0.14
Household PA	262	15.52 (20.28)	6.00	27.00
Leisure PA	262	15.29 (19.70)	6.60	25.29
Time Spent Sitting	262	35.50 (23.44)	30.50	30.25
Total Physical Activity✶	262	103.19 (125.39)	55.96	128.61

✶Total Physical activity = Job-related PA + Transportation PA + Household PA+ Leisure Time PA

Figure 4.1: Frequency Distribution of Each Domains of Physical Activity (MET-hours/week) and Time Spent Sitting (hours/week)



Physical activities can be also evaluated by assessing their levels of intensity. MET scores can be aggregated across walking, moderate and vigorous categories in addition to types (domains), i.e., job, transportation, household, leisure. As seen in Table 4.9, all levels of job-related activities represent the largest expenditures of effort. Vigorous leisure activity was the second most frequent category, with both moderate household activities following behind. Mean total physical activity was highest for moderate activities followed by walking then vigorous physical activity, with the same pattern seen for median values. The large differences between mean and median total values reflect the skewness of the distribution, with a number of individuals in each of these categories at the extreme high end.

Table 4.10 portrays the descriptive statistics for the PF10 items (total physical functioning score) and BMI of Asian Indian women. The high PF10 total score indicates a more favorable health outcome for the participants. The highest levels of physical ability involved bathing or dressing, walking one block and climbing one flight of stairs. The lowest areas of physical functioning were seen in participation in vigorous activities, such as running, lifting heavy objects, participating in strenuous sports and climbing several flights of stairs. Figure 4.2 represents the quartile distribution of physical functioning scores and clearly shows the left skew to the data and non-normal distribution. The largest number of participants scored in the 4th quartile (i.e., highest) of physical functioning.

Table 4.9: Physical Activities Based on Levels of Intensity by MET-hours/week Scores

Physical Activities Defined by Level of Intensity (N=262)	Mean (SD)	Median
Job-related Physical Activity		
Job-related Walking	25.10 (45.10)	
Job-related Moderate Activity	26.61 (51.68)	
Job-related Vigorous Activity	18.66 (56.00)	
Transportation Physical Activity		
Walking	1.1(2.41)	
Bicycling (Moderate Activity)	.01 (.19)	
Household Physical Activity		
Moderate Activity in Garden or yard	6.72 (10.86)	
Moderate Activity inside house	6.89 (10.11)	
Vigorous Activity in Garden or yard	1.90 (5.63)	
Leisure time Physical Activity		
Leisure Time Walking	3.42 (5.10)	
Leisure Time Moderate Activity	3.76 (6.07)	
Leisure Time Vigorous Activity	8.11(13.58)	
Total Walking	30.51 (45.69)	9.90
Total Moderate Physical Activity	45.90 (60.47)	22.54
Total Vigorous Physical Activity	26.78 (57.88)	8.0
Total Physical Activity✶	103.19 (125.39)	55.96

✶Total Physical activity = Job-related PA + Transportation PA + Household PA+ Leisure Time PA

The mean BMI score was 24.58 (SD=3.48) (Table 4.10). The most recent BMI criteria for Asians defined by WHO were as follows: underweight (BMI<18.5 kg/m^2), normal (BMI 18.5–23 kg/m^2), overweight (BMI 23–25 kg/m^2) and obese (BMI > 25 kg/m^2) (WPRO, 2000, 2002). Figure 4.3 represents the distribution of BMI based on the above criteria, indicating that 36% of participants were within normal weight (n=94), whereas 26% (n=68) of participants were overweight. None of the participants were underweight. Most importantly, 38% of participants (n=100) met the criteria for being obese.

Table 4.10 Frequency Distribution of Physical Functioning and BMI

Physical Functioning	N	Mean (SD)	Median
Do vigorous activities	262	80.53 (29.08)	100.00
Do moderate activities	262	92.18 (20.20)	100.00
Lifting or carrying groceries	262	93.32 (19.65)	100.00
Climbing several flights of stairs	262	87.79 (23.64)	100.00
Climbing one flight of stairs	262	95.04 (17.35)	100.00
Bending, kneeling, or stooping	262	91.41 (22.59)	100.00
Walking more than a mile	262	92.37 (21.42)	100.00
Walking several blocks	262	90.08 (22.68)	100.00
Walking one block	262	96.76 (15.13)	100.00
Bathing or dressing myself	262	97.90 (13.33)	100.00
Total Physical Functioning	262	91.73 (14.09)	100.00
Body Mass Index (BMI)	262	24.58 (3.48)	24.14

Figure 4.2: Quartile Distribution of Physical Functioning

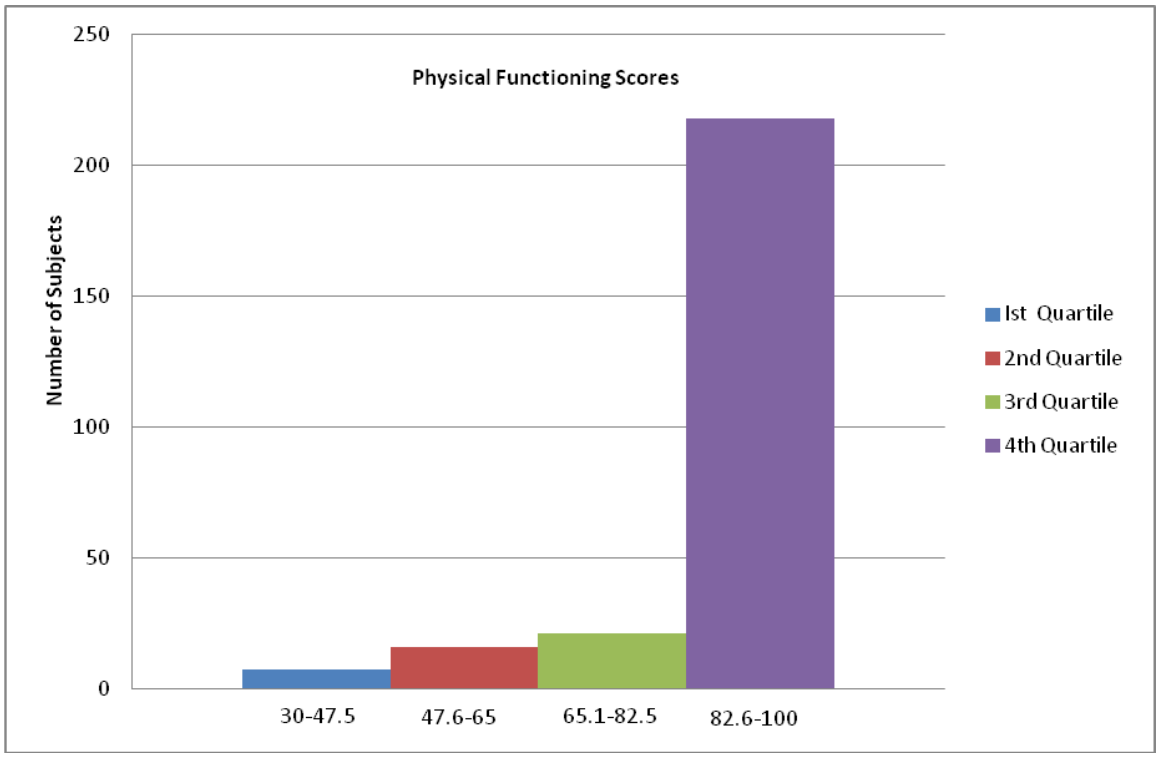
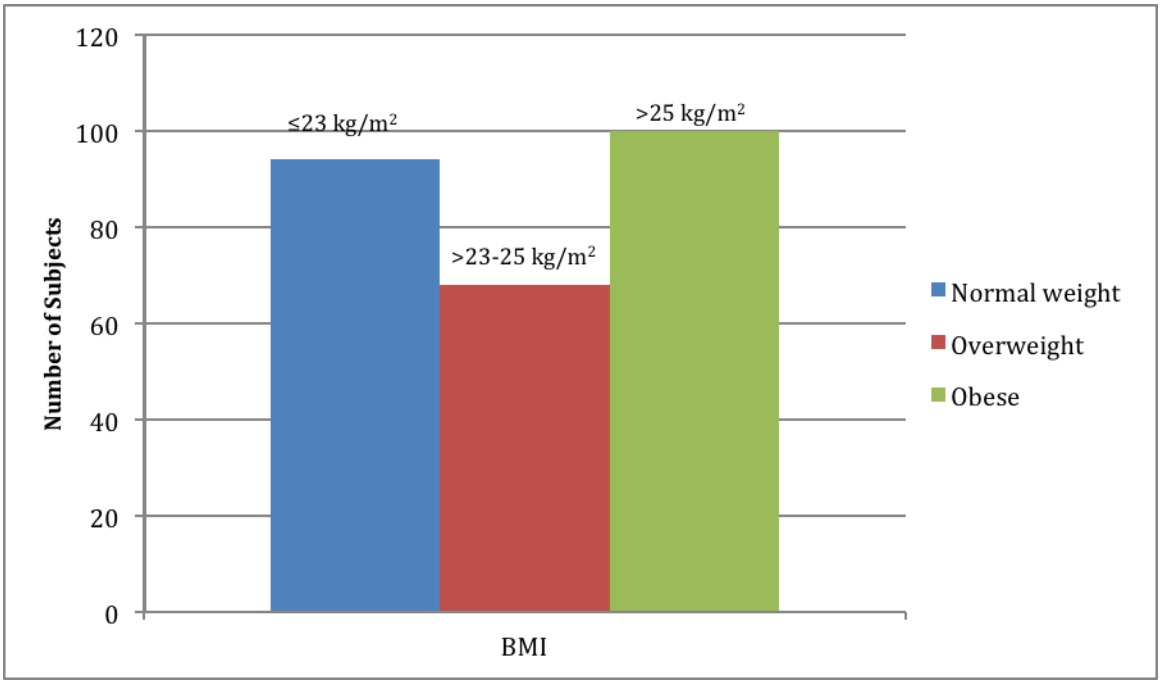


Figure 4.3: Frequency Distribution of BMI Based on WHO Criteria for Asians



SPECIFIC AIM 2

Describe the degrees of acculturation in Asian Indian women living in the U.S.

Research Question 1

What are the degrees of acculturation in Asian Indian women in the U.S.? To examine this question, descriptive statistics (means, standard deviations and medians) were calculated for acculturation.

Each item in the acculturation scale had five response options that were worded most commonly to measure acculturation on a continuum of low acculturation (1.00) to high acculturation (5.00). A total mean score was computed by summing across the answers for all 21 items and dividing by the number of items, which yielded a mean score ranging from 1.00 (low acculturation) to 5.00 (high acculturation). Alternatively, a low score can be interpreted as reflecting high Asian identity whereas a high score reflects

high Western identity. The mean acculturation score was 2.80 (SD=.78) and 17 of the 21 items were above 2.5, reflecting a slightly higher predisposition towards Western identity than Asian identity for this sample (Table 4.11).

SPECIFIC AIM 3

Explore the relationships between the five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting), physical functioning, BMI, immigration status (years in the U.S. and age at immigration in immigrants) and acculturation in Asian Indian women in the U.S.

Specific Aim 3: Research Question 1

What are the relationships between the five different types of activity (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting), acculturation, physical functioning, immigration (years in the use and age at immigration) and BMI in Asian Indian women in the U.S. uncontrolled and controlled for physical functioning and BMI?

Table 4.11: Frequency Distribution of Acculturation Score

Acculturation (21 items)	N	Mean (SD)	Median	Interquartile range
Language speak	262	3.36 (.85)	3.00	1.00
Language prefer	262	3.60 (.89)	3.50	1.00
Identify self	262	3.40 (1.00)	3.00	1.00
Identification mother use	262	3.00 (.97)	3.00	2.00
Identification father use	262	3.00 (.98)	3.00	2.00
Ethnic origin of the friends and peers as a child up to age 6	262	2.09 (1.24)	2.00	2.00
Ethnic origin of the friends and peers as a child from 6 to 18	262	2.22 (1.27)	2.00	2.00
Associate with in the community	262	2.60 (1.14)	3.00	1.00
Prefer to associate with in the community	262	2.60 (1.03)	3.00	1.00
Music preference	262	3.00 (1.27)	3.00	2.00
Movie preference	262	3.16(1.20)	3.00	2.00
Generation	262	1.37 (.48)	1.00	1.00
Place raised	262	2.76 (1.86)	2.00	4.00
Primary contact with India	262	1.96 (1.08)	1.00	2.00
Food preference at home	262	2.57 (.96)	2.00	1.00
Food preference in restaurants	262	2.93 (.89)	3.00	2.00
Languages read	262	3.82 (1.06)	3.00	2.00
Languages write	262	3,87 (1.01)	3.00	2.00
Pride to associate with the Asian group	262	1.86 (1.11)	1.00	1.00
Self rating of culture	262	2.73 (1.26)	3.00	2.00
Participation in Asian occasions, holidays, and traditions	262	2.80 (1.29)	3.00	2.00
Total Acculturation Score	262	2.80 (.78)	2.54	1.38

Pearson correlations were computed between study variables, including five different types of activity, acculturation, interval measures of immigration (years in the use and age at immigration), physical functioning and BMI in Asian Indian women in the U.S. (Table. 4.12). Acculturation showed a small significant positive correlation with physical functioning, leisure time physical activity and total time spent sitting, which indicated higher acculturation was related to higher levels of physical functioning, leisure time physical activity and time spent sitting. Acculturation displayed a small negative

correlation with job-related physical activity, household physical activity and total physical activity, suggesting that higher scores for these three physical activities were related to lower acculturation levels. Leisure time physical activity was positively correlated with physical functioning and acculturation, indicating an association between leisure activity and better physical functioning as well as greater acculturation. Leisure time physical activity was also negatively correlated with job-related physical activity (lower job-related physical activity was related to higher leisure time physical activity). Total time spent sitting was understandably negatively correlated with job-related physical activity, household physical activity and total physical activity but moderately positively correlated with acculturation. While transportation physical activity was correlated with BMI, the effect size was miniscule (3% of the variance). Total physical activity was negatively correlated with acculturation, i.e., higher acculturation was linked to less physical activity. It should be noted that the positive correlations between total physical activity, household physical activity and job-related physical activity reflected the relative contribution of each of these components to the total physical activity variable.

Small positive relationships were noticed among years in the U.S. and physical functioning, leisure time physical activity and total time spent sitting. Small negative relationships were noticed among years in the U.S. and job-related physical activity, household physical activity. Understandably, acculturation showed a high positive correlation with years in the U.S., i.e., the level of acculturation increased with increasing years in the U.S. Age when immigrated to U.S. in immigrants was significantly positively correlated with job-related physical activity and total physical activity. Furthermore,

among immigrants, age when immigrated to U.S. was moderately significantly negatively correlated with acculturation, i.e., the older the age at immigration was associated with less acculturation and had a small negative relationship with the time spent sitting (older age was associated with less time spent sitting).

Partial correlational analyses were used to examine the relationships between acculturation score, immigration status (years in the U.S. and age at immigration in immigrants) and five different types of activity scores (job-related physical activity, transportation physical activity, household physical activity, leisure time physical activity and sedentary activity time spent sitting) controlling for physical functioning and BMI. From the analysis (Table 4.13) it can be seen that neither BMI nor physical functioning had much influence on study variables when controlled.

Specific Aim 3: Research Question 2

What is the best set of predictors from the acculturation, moderator variables (physical functioning and BMI), immigration status (immigrant and non-immigrant [included as a dummy variable]), years in the U.S. and age at immigration and demographic characteristics (age, marital status, education and income) for each types of activity (job-related, transportation, household, leisure time and sedentary activity time spent sitting) among Asian Indian women in the U.S.?

Stepwise multiple regression analyses (forward and backward) were used to examine the predictive power of acculturation, physical functioning, BMI, immigration status and demographic characteristics on each of the self-reported physical activities and sedentary activity time spent sitting. Each of the immigration status variables was entered

into the model separately since high multicollinearity between these predictors was expected.

JOB-RELATED PHYSICAL ACTIVITY

Forward regression results with two of the immigration status variables (immigrant and non-immigrant; years in the U.S.) indicated that acculturation, education and comorbidities significantly predicted job-related physical activity, ($F(3, 236) = 13.62$, $p < .001$) (Table 4.14 and Table 4.15), although the regression was a poor fit ($R^2 = 15\%$ of the variance for job-related physical activity). In both models, acculturation accounted for the larger contribution (31% of the explained variance when controlling for all other variables) followed by comorbidities (17%) and education (13%). Acculturation and education were negatively associated with job-related physical activity, indicating that those who were less acculturated and less educated have engaged in higher job-related activities, whereas the positive association for comorbidities indicated that those with comorbidities had higher job-related activity scores relative to those with no comorbidities.

Table 4.12: Correlations between Different Types of Physical Activity (MET-hours/week), Time Spent Sitting (Hours/Week), Acculturation, Immigration Status, Physical Functioning and BMI

Variable	Physical Functioning	BMI	Acculturation	Job-related PA	Transportation PA	Household PA	Leisure PA	Total Physical Activity ✶	Time Spent Sitting
BMI (*n*=262)	-.10								
Acculturation (*n*=262)	**.23****	-.08							
Job-related PA (*n*=262)	.006	.033	**-.30****						
Transportation PA (*n*=262)	.08	**.13***	-.001	.01					
Household PA (*n*=262)	-.04	.011	**-.35****	**.33****	.01				
Leisure PA (*n*=262)	**.17****	-.02	**.39****	**-.12***	.06	-.02			
Total Physical Activity✶ (*n*=262)	.03	.03	**-.28 ****	**.98****[a]	.04	**.47****	.04		
Time Spent Sitting (*n*=262)	.08	-.03	**.42****	**-.31***	-.04	**-.30****	.08	**-.33****	
Years in the in the U.S. (*n*=262)	**.19****	.02	**.79**** [a]	**-.28****	-.02	**-.26****	**.38****	**-.24****	**.32*****
Age at Immigration (*n*=164)	-.14	.005	**-.59 ****	**.29****	.03	.14	-.15	**.29****	**-.25*****

*p<.05, **p<.01,*** p<.001, [a] notable effect sizes

✶Total Physical activity = Job-related PA+ Transportation PA+ Household PA+ Leisure Time PA

Table 4.13: Partial Correlational Analyses of Different Types Of Physical Activity (MET-hours/week), Time Spent Sitting (hours/week), Acculturation, and Immigration Status Controlling for Physical Functioning and BMI.

Variable	Acculturation	Job-related PA	Transportation PA	Household PA	Leisure PA	Total Physical Activity✶	Time Spent Sitting
Acculturation (*n*=262)							
Job-related PA (*n*=262)	**-.31****						
Transportation PA (*n*=262)	-.03	.06					
Household PA (*n*=262)	**-.35****	**.36** **	.02				
Leisure PA (*n*=262)	**.37****	**-.13** *	.04	-.01			
Total Physical Activity✶ (*n*=262)	**-.29****	**.98** **[a]	.04	**.48****	.04		
Time Spent Sitting (*n*=262)	**.40** **	**-.32****	-.04	**-.30****	.07	**-.33****	
Years in the in the U.S. (*n*=262)	**.77**[a]**	**-.29** **	-.03	**-.25** **	**.37****	**-.26****	**.30*****
Age at Immigration (*n*==164)	**-.56****	**.30****	.05	.14	-.13	**.30****	**-.25*****

*p<.05, **p<.01,*** p<.001, [a] notable effect sizes

✶Total Physical activity = Job-related PA+ Transportation PA+ Household PA+ Leisure Time PA

Interestingly, backward regression results produced model solutions that differed from the forward regressions for both immigration status variables. When immigration status measured as immigrant and non-immigrant was included, a larger set of predictors was retained. This allowed physical functioning to be added to the model in addition to acculturation, education and comorbidity, with an increase to 16% of variance accounted for although it remained a poor fit ($F(4,235)=11.005$, $p<.001$) (Table 4.14). Of the four predictors, acculturation still accounted for the greatest proportion of explained variance when controlling all other variables with comorbidity, education and physical functioning followed by acculturation (34%). The same negative relationships were evident for acculturation and education as well as positive relationships with comorbidities and physical functioning as seen with the forward regression. The positive relationship between physical functioning and job-related physical activity was not surprising. Similarly, the negative correlation between education (years) and job-related physical activity reflected a decrease in job-related physical activity with increased education.

On the other hand, backward regression with immigration status measured as years in the U.S. not only produced a larger set of predictors with an explained variance of 17% (still a poor fit but significant: ($F(5, 234)=9.49$, $p<.001$) (Table 4.15), but it also differed in the predictor set from forward regression results as well as from the model derived with the immigrant/non-immigrant predictor. In this model, acculturation was dropped and replaced by years in the U.S. and physical functioning. Since years in the U.S. has commonly been used as a proxy measure for acculturation, the fact that acculturation remained in the model in the immediate step prior to the final solution ($F(6, 233)=8.30$, $p<.001$), accounted for 16% of the variance and was more heavily weighted in

the forward regression ($F(3, 236)=13.62$, $p<.001$) where it accounted for 31% of the explained variance when all other variables are held constant (as evidenced by its inclusion when years in the U.S. was not), suggested that the two measures, while sharing a good deal of common variance, also differed in important ways. Both education and years in the U.S. were negatively associated with job-related physical activity, indicating a decrease in job-related physical activity with increased number of years in the U.S. and an increase in educational levels.

When exploring predictors for those that immigrated to the U.S., both backward and forward regression results for job-related PA with immigration status measured as age at immigration indicated that age at immigration, comorbidity and education significantly predicted, albeit poorly, job-related physical activity (Table 4.16). Education was negatively associated with job-related physical activity, indicating a decrease in job-related physical activity with an increase in educational levels. In forward regression, age at immigration accounted for the greatest proportion of variance (21%) when holding all other variables constant, followed by comorbidity (17%) and education (15%), together representing 13% of explained variance for the total model ($F(3,155)=7.39$, $p<.001$). In backward regression, physical functioning (14%) was also included as a significant predictor in addition to age at immigration (23%), comorbidity (17%), education (15%), and physical functioning (14%)—representing 15% explained variance for the total model ($F(4,154)=6.52$, $p<.001$). The positive relationship between physical functioning and job-related physical activity was not surprising, as an increase in physical functioning would increase job-related physical activity.

Table 4.14: Multiple Regression Analyses of Job-related PA with Immigration Status: Immigrant/Non-immigrant

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.15	.001
Job-related PA	Acculturation	**-.31**		
	Comorbidity	**.17**		
	Education	**-.13**		
Backward:	Retained:		.16	.001
Job-related PA	Comorbidity	**.17**		
	Physical Functioning	**.10**		
	Acculturation	**-.34**		
	Education	**-.13**		

Table 4.15: Multiple Regression Analyses of Job-related PA with Immigration Status: Years in U.S.

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.15	.001
Job-related PA	Acculturation	**-.31**		
	Comorbidity	**.17**		
	Education	**-.13**		
Backward:	Retained:		.17	.001
Job-related PA	Age	**.19**		
	Comorbidity	**.14**		
	Physical Functioning	**.11**		
	Education	**-.11**		
	Years in the U.S.	**-.29**		

Table 4.16: Multiple Regression Analyses of Job-related PA with Immigration Status: Age at Immigration

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.13	.001
Job-related PA	Age at Immigration	**.21**		
	Comorbidity	**.17**		
	Education	**-.15**		
Backward:	Retained:		.15	.001
Job-related PA	Physical Functioning	**.14**		
	Comorbidity	**.17**		
	Education	**-.15**		
	Age at Immigration	**.23**		

TRANSPORTATION PHYSICAL ACTIVITY

Forward regression results on transportation physical activity were the same for immigration measured as immigrant and non-immigrant and as years in the U.S. (Table 4.17). Education (years) was the only variable that significantly predicted transportation-related physical activity ($F(1,238)=4.55$, $p = .03$), which explained only 2% of the variance and was negatively associated. This indicated that those who had low education engaged in more transportation related physical activities than those with higher education. On the other hand, the backward regression analyses produced a larger and different set of predictors—i.e., household income, employment, BMI were included in the model with an small increase to 4% of explained variance of transportation physical activity ($F(3,236)=3.28$, $P=.02$). Employment and household income equally accounted for the same proportion of variance when holding all other variables constant (12%), followed by BMI (11%). A positive correlation with household income indicated that those who had higher incomes engaged in more transportation physical activities than those with lower incomes. Unsurprisingly, a negative relationship with employment indicating that those who were employed were associated with lower transportation physical activity compared to those who were not employed.

Both forward and backward regression results for transportation physical activity with immigration status measured as age at immigration (immigrant participants only) indicated that only employment significantly predicted transportation-related physical activity ($F(1,157)=6.79$, $p=.01$), explaining 4% of the variance (Table 4.18). The negative relationship of employment with transportation indicated that those who were employed were associated with lower transportation physical activity; this result was consistent

with previous findings regarding other immigration status variables and transportation physical activity.

HOUSEHOLD PHYSICAL ACTIVITY

Forward regression results for household physical activity with both immigrant groups and years in U.S. indicated only acculturation significantly predicted household physical activity ($F(1, 238) = 30.85$, $p < .001$), explaining 12 % of the variance for household physical activity (Table 4.20). The negative relationship indicated that higher levels of acculturation were associated with lower household physical activity. Conversely, backward regression indicated that acculturation and comorbidity significantly predicted household physical activity ($F(2, 237) = 17.46$, $p < .001$), with 13% of variance explained for household physical activity (Table 4.19). Acculturation contributed the greatest proportion of the explained variance when holding all other variables constant (30%), with a negative relationship consistent with the forward regression analyses. But comorbidity also accounted for 30% of the explained variance with acculturation held constant and was positively associated with the model, which indicated that lower levels of household physical activity was associated with comorbidity.

Both in the forward and backward regression for household physical activity with immigration status measured as age at immigration indicated that acculturation significantly predicted household physical activity ($F(1, 157) = 4.43$, $p < .001$), explaining 3% of the variance (Table 4.20). A negative relationship with acculturation was consistent with the previous regression findings with immigration status variables and household physical activity.

Table 4.17: Multiple Regression Analyses of Transportation PA with Immigration Status: Immigrant/Non-Immigrant and Years in U.S.

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.02	.03
Transportation PA	Education	**-.14***		
Backward:	Retained:		.04	.02
Transportation PA	Household Income	**.12**		
	BMI	**-.11**		
	Employment	**-.12**		

*Beta weights squared and totaled= R^2. For models with only a single predictor, the Beta weights do not contribute additional information

Table 4.18: Multiple Regression Analyses of Transportation PA with Immigration Status: Age at Immigration

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.04	.01
Transportation PA	Employment	**-.20***		
Backward:	Retained:		.04	.01
Transportation PA	Employment	**-.20***		

*Beta weights squared and totaled= R^2. For models with only a single predictor, the Beta weights do not contribute additional information

Table 4.19: Multiple Regression Analyses of Household PA with Immigration Status: Immigrant/Non-Immigrant and Years in the U.S.

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.12	.001
Household PA	Acculturation	**-.34***		
Backward:	Retained:		.04	.001
Household PA	Acculturation	**.12**		
	Comorbidity	**-.30**		
	Employment	**-.12**		

*Beta weights squared and totaled= R^2. For models with only a single predictor, the Beta weights do not contribute additional information

Table 4.20: Multiple Regression Analyses of Household PA with Immigration Status: Age at Immigration

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.03	.04
Household PA	Acculturation	**-.17***		
Backward:	Retained:		.03	.04
Household PA	Acculturation	**-.17***		

*Beta weights squared and totaled= R^2. For models with only a single predictor, the Beta weights do not contribute additional information

LEISURE TIME PHYSICAL ACTIVITY

Both forward and backward regression for leisure time physical activity with immigrant status indicated that immigration status, household income employment and acculturation resulted in a fairly fitted model that significantly predicted leisure physical activity, explaining 26% of the variance ($F(4, 235) = 20.19$, $p < .001$) (Table 4.21). Immigration status (immigrant/non-immigrant) contributed 21% of variance when all other variables were held constant, with lower levels of leisure time physical activity being associated with immigrants. Unsurprisingly, the same positive relationship was evident with acculturation (20% of the explained variance when all other variables were held constant) as immigration is a proxy measure of acculturation. Those employed engaged in lower levels of leisure time physical activity. Household income was positively associated with leisure physical activity, indicating that participants with high household incomes tended to engage in more leisure physical activity.

Forward regression for leisure physical activity with immigration status measured as years in the U.S. results indicated that acculturation, household income, years in the U.S. and employment significantly predicted leisure time physical activity ($F(4, 235)=20.08$, $p<.001$), a fair model that explained 26% of the variance (Table 4.22). Participants with high household incomes and those living more years in the U.S. demonstrated increased levels of leisure time physical activity, while employed participants displayed lower levels of leisure physical activity. In backward regression marital status was also associated with leisure time physical activity (partnered participants engaged in less leisure activity) in addition to acculturation (18%), household

income (20%), employment (21%) and years in the U.S. (21%). Even after the addition of marital status in the backward regression, the variance of the model remained at 26%.

In the forward regression for leisure time physical activity with immigration status measured as age at immigration (immigrants only) indicated that acculturation and education were significant predictors for leisure physical activity ($F(2, 156)=8.03$, $p < .001$), explaining 9% of the variance for leisure time physical activity (Table 4.23). Acculturation contributed a greater proportion of variance when education was held constant (23%) compared to education with acculturation held constant (17%). The backward regression produced a larger set of predictors with an increase in explained variance of 15% ($F(5, 153)=5.36$, $p<.001$) and also differed in the predictor set from forward regression results. The resulting predictor variables were marital status (20%), acculturation (27%), age (18%), comorbidity (16%) and household income (19%). Acculturation, employment, age and household income were positively associated with leisure time physical activity. The negative association for comorbidities and marital status indicated that those with no comorbidities had higher leisure time physical activity related scores relative to those with comorbidities, and partnered participants were associated with lower leisure time physical activity.

Table 4.21: Multiple Regression Analyses of Leisure Time PA with Immigration Status: Immigrant/Non-Immigrant

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.26	.001
Leisure PA	Immigration Status	**-.21**		
	Household Income	**.21**		
	Employment	**-.23**		
	Acculturation	**.20**		
Backward:	Retained:		.26	.001
Leisure PA	Immigration Status	**-.21**		
	Household Income	**.21**		
	Employment	**-.23**		
	Acculturation	**.20**		

Table 4.22: Multiple Regression Analyses of Leisure Time PA with Immigration Status: Years in U.S.

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.26	.001
Leisure PA	Acculturation	**.21**		
	Household Income	**.19**		
	Employment	**-.24**		
	Years in the U.S.	**.21**		
Backward:	Retained:		.26	.001
Leisure PA	Marital Status	**-.10**		
	Household Income	**.18**		
	Employment	**.20**		
	Years in the U.S.	**-.21**		

Table 4.23: Multiple Regression Analyses of Leisure Time PA with Immigration Status: Age at Immigration

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.09	.001
Leisure PA	Acculturation	**.23**		
	Education	**.17**		
Backward:	Retained:		.15	.001
Leisure PA	Marital Status	**-.20**		
	Acculturation	**.27**		
	Age	**.18**		
	Comorbidity	**-.16**		
	Household Income	**.19**		

TOTAL PHYSICAL ACTIVITY

Forward regression results for total physical activity with both immigrant status and years in U.S. indicated acculturation and comorbidity significantly predicted total physical activity ($F(2, 237) = 15.35$, $p < .00$), explaining 12% of the variance (Table 4.24). Although the model was a poor fit, acculturation was the strongest predictor of the two. However, backward regression results for total physical activity with both immigrant status and years in U.S. indicated that acculturation, comorbidity, physical functioning and age significantly predicted total physical activity ($F(4,235)=9.40$, $p < .001$), explaining 14% of the variance for total physical activity. Acculturation was the strongest predictor in both regressions. An unexpected positive association of comorbidity with total physical activity was seen in both regressions, indicating that those with comorbidities had *higher* total physical activity relative to those with no comorbidities—a finding contrary to results from individual activity scales. This strongly suggests that this association is an artifact stemming from the contribution of job-related physical activity in the total physical activity scores. The positive association with physical functioning reflected that high physical function was associated with higher levels of total physical activity. Also positive association with age indicated that total physical activity increased with increased ages.

Forward regression for total physical activity with immigration status measured as age at immigration indicated age at immigration and comorbidity were significant predictors, explaining 9% of the variance for total physical activity ($F(2,156)=8.00$, $p < .001$) (Table 4.25). However, in backward regression ($F(3,155)=8.61$, $p < .001$) physical functioning was also included as significant predictor in addition to age at immigration

and comorbidity, with age at immigration the strongest predictor of the set (Table 4.25). Higher physical functioning was associated with higher levels of total physical activity, and those with comorbid conditions again demonstrated higher levels of total physical activity. The positive association with age at immigration indicated that people who immigrated at older ages had higher levels of total physical activity. This result may be due to that fact that older age groups engaged more in job-related physical activity than younger groups, who were more likely to be students in this sample.

TIME SPENT SITTING

The results of both forward and backward regression analyses with two of the immigration status variables (immigrant and non-immigrant and years in the U.S.) showed that acculturation and age significantly predicted job-related physical activity ($F(2, 237) = 26.53$, $p < .001$) (Table 4.26), explaining 18% of the variance for total time sitting. Acculturation accounted for the larger contribution (36% of the variance with age held constant). Acculturation was positively associated with sedentary activity, indicating that those who were more acculturated engaged in more sedentary activities and spent more time sitting. In addition, the negative association for age reflected that younger participants had higher sedentary activity/total time sitting than older participants.

The results of both forward and backward regression analyses for total time sitting with immigration status measured as age at immigration found similar results—i.e., acculturation and age as significant predictors with slight differences in the contribution of predictors as compared with previous analyses with the other two immigration status variables. The explained variance for total time sitting was only 7% ($F(2,156)=6.01$, $p < .001$), a very poor fit, with acculturation again the strongest predictor (Table 4.27).

Table 4.24: Multiple Regression Analyses of Total PA with Immigration Status: Immigrant/Non-Immigrants and Years in U.S.

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.12	.001
Total PA	Acculturation	**-.31**		
	Comorbidity	**.16**		
Backward:	Retained:		.14	.001
Total PA	Acculturation	**-.31**		
	Comorbidity	**.16**		
	Physical Functioning	**.12**		
	Age	**.11**		

Table 4.25: Multiple Regression Analyses of Total PA with Immigration Status: Age at Immigration

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.09	.001
Total PA	Age at Immigration	**23**		
	Comorbidity	**.16**		
Backward:	Retained:		.12	.001
Total PA	Physical Functioning	**.15**		
	Comorbidity	**.17**		
	Age at Immigration	**.25**		

Table 4.26: Multiple Regression Analyses of Time Spent Sitting with Immigration Status: Immigrant/Non-Immigrant, and Years in the U.S.

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.18	.001
Total PA	Acculturation	**36**		
	Age	**-.17**		
Backward:	Retained:		.18	.001
Total PA	Age	**-.17**		
	Acculturation	**.36**		

Table 4.27: Multiple Regression Analyses of Time Spent Sitting with Immigration Status: Age at Immigration

Method/Variable	Predictor(s)	Standardized Beta	R^2	Model p
Forward:	Retained:		.07	.001
Total PA	Acculturation	**19**		
	Age	**-.16**		
Backward:	Retained:		.07	.001
Total PA	Age	**-.16**		
	Acculturation	**.19**		

SUMMARY OF RESEARCH QUESTION 3.2

The best set of predictors from the set explored—i.e., acculturation, moderator variables (physical functioning and BMI), demographic characteristics (age, marital status, employment, comorbidity, education and income) and immigrations status (immigrant and non-immigrant, years in the U.S. and age at immigration)—for each type of activity (leisure time, job-related, transportation, household and sedentary activity/time spent sitting) among Asian Indian women in the U.S. resulted from the backward regression analyses (more predictors were obtained by backward regression compared to forwarded regression) (Table 4.28). Comorbidity, physical functioning, acculturation and education were persistently significant predictors across multiple physical activity components. In multiple cases, immigration as a proxy measure of acculturation, years in the U.S. and age at immigration displaced acculturation as a predictor, which reflected their high degree of shared variance. In addition, age repeatedly appeared to be an important moderator as well. Most models were poor fits indicating that the set of variables considered accounted for only a small proportion of the variance in physical activity. This was a strong indication that other relevant factors more strongly affecting engagement in physical activity have not yet been identified. Only leisure activity showed a somewhat better fit between this particular set of predictors but there is still a great deal of improvement to be made.

Table 4.28: Summary (Backward Regression Analyses)

Variables	Immigration Status Variables	Predictors
Job-related PA	Immigrant/Non-immigrant	Comorbidity Physical Functioning Acculturation Education Age
	Years in U.S.	Comorbidity Physical Functioning Education Years in the U.S.
	Age at Immigration	Physical Functioning Comorbidity Education Age at Immigration
Transportation PA	Immigrant/Non-immigrant/ Years in U.S.	Household Income BMI Employment
	Age at Immigration	Employment
Household PA	Immigrant/Non-immigrant/Years in U.S.	Acculturation Comorbidity Employment
	Age at Immigration	Acculturation
Leisure PA	Immigrant/Non-immigrant	Immigration Status Household Income Employment Acculturation
	Years in U.S.	Marital status Household Income Employment Years in the U.S.
	Age at Immigration	Marital status Acculturation Age Comorbidity Household Income
Total PA	Immigrant/Non-immigrant/ Years in U.S.	Acculturation Comorbidity Physical Functioning
	Age at Immigration	Physical functioning Comorbidity Age at immigration
Time Spent Sitting	Immigrant/Non-immigrant/ Years in U.S./Age at Immigration	Age Acculturation

SPECIFIC AIM 4

Examine the differences in the levels of activity across all five types of activity between high and low acculturated Asian Indian women and between immigrant status (immigrant and non-immigrant, years in the U.S. and age at time of immigration) of Asian Indian women in the U.S. while controlling for age, BMI, physical functioning and income.

Specific Aim 4: Hypothesis 1

More acculturated U.S. Asian Indian women will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity and household physical activity than less acculturated U.S. Asian Indian women when controlling for age, BMI, physical functioning and income. The acculturation score was dichotomized (1-2.5=low; 2.51-5=high) to produce low and high acculturation groups. Analyses of covariance (ANCOVA) were used to investigate differences between the low and high acculturated group on the five activity scores controlling for age, BMI, physical functioning and income.

Preliminary analyses, i.e., correlations between demographic variables and study variables, indicated that several variables could be evaluated as covariates: BMI for transportation related physical activity; physical functioning and household income for leisure time physical activity; age for job-related physical activity; household physical activity; leisure time physical activity; total physical activity; and time spent sitting. Table 4.29 displays the assessment of differences between low acculturation and high acculturation groups on the five activities controlling for appropriate covariates where

possible. Significant heterogeneity was found on all study variables identified with covariates except when controlling for BMI on transportation activity. This violation of ANCOVA assumptions necessitated the use of nonparametric Mann Whitney U test of differences, which precluded an assessment of the impact of covariates for those variables. Means and standard deviations are provided for the purposes of interpretation of results in addition to the mean ranks on which nonparametric tests of significance are based.

Results indicated significantly lower activity scores in job-related, household and total physical activity for high acculturated groups compared to low acculturated groups providing support for the hypothesis. Although BMI was a significant covariate, no significant differences were detected between acculturation groups on transportation activity, which did not support the hypothesis. In contrast, high acculturation groups displayed higher scores on leisure time physical activity and sedentary (time spent sitting) activity compared to low acculturated groups as hypothesized. Thus, the hypothesis was largely supported, with only transportation activity failing to demonstrate the proposed difference.

Specific Aim 4: Hypothesis 2

Non-immigrant U.S. Asian Indian women, those with more years in the U.S. or immigrants with younger ages at immigration, will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity and household physical activity than immigrant U.S. Asian Indian women when controlling for age, BMI, physical functioning and income.

Table 4.29: Differences between Acculturation Groups on Physical Activity and Sedentary Activity

Dependent Variable	Acculturation Groups	M (SD)	Mean Rank	Significance
Job-related PA	Low (n=124)	110.77 (144.64)	157.42	*U*= 5342.50, ***p*< .001**
	High (n=138)	35.78 (70.74)	108.21	
Household PA	Low (n=124)	21.98 (23.67)	151.78	*U* = 6041.50, ***p*< .001**
	High (n=138)	9.70 (14.44)	113.28	
Leisure PA	Low (n=123)	7.24 (14.20)	95.31	*U* =4068.00, ***p*< .001**
	High (n=117)	21.89 (20.27)	164.02	
Transportation PA	Low (n=124)	1.09 (2.59)	n/a	*F(1,259)=.02, p=.88 BMI: ***p*=.03**
	High (n=138)	1.11 (2.28)	n/a	
Total PA	Low (n=124)	141.23 (151.3)	152.64	*U* = 5934.50, ***p*< .001**
	High (n=138)	69.01 (83.15)	112.50	
Time Spent Sitting	Low (n=124)	26.80 (18.78)	103.75	*U* = 5114.50, ***p*< .001**
	High (n=138)	43.33 (24.50)	156.44	

*No significant heterogeneity, ANCOVA employed.

To examine this hypothesis, immigration status was categorized as immigrant versus non-immigrant (place of birth), high and low mean/median split years in the U.S. and high and low mean/median split age at immigration for Asian Indian women in the U.S. Analyses of covariance (ANCOVA) were used to investigate differences between immigrant status groups (immigrant/non-immigrant, high and low mean/median split years in the U.S. and high and low mean/median split age at immigration) of Asian Indian women on the five activity scores controlling for age, BMI, physical functioning and income. Since there was no *a priori* evidence that a mean split was more appropriate than a median split to create high and low groups on years in the U.S. or age at immigration, the decision was made to conduct analyses using both grouping schema.

Where this approach resulted in differences in membership, separate results were presented. Where the membership was identical, only one set of results was shown.

Table 4.30 represents the assessment of differences between *immigrant groups* (immigrant/non-immigrant) on the five activities controlling for appropriate covariates. Significant heterogeneity was found on all study variables with covariates except when controlling for BMI on transportation activity. This violation of ANCOVA assumptions resulted in the use of nonparametric Mann Whitney U test of differences and thus an assessment of the impact of covariates was not possible.

Results indicated significantly lower activity scores in job-related, household and total physical activity for non-immigrant groups compared to immigrant groups as hypothesized. No significant differences were detected between immigrant and non-immigrant groups on transportation activity, which did not support the hypothesis. However, non-immigrant groups showed higher scores on leisure time physical activity and sedentary activity (time spent sitting) compared to immigrant groups as proposed. The hypothesis was supported for all variables except transportation physical activity when comparing immigrant versus non-immigrant groups.

Table 4.30: Differences between Immigrant Groups on Physical Activity and Sedentary Activity

Dependent Variable	Immigrant Groups	M (SD)	Mean Rank	Significance
Job-related PA	Non-Immigrant (n=98)	34.14 (74.67)	105.24	*U*= 5463.00, ***p< .001***
	Immigrant (n=164)	93.46 (132.68)	147.19	
Household PA	Non-Immigrant (n=98)	7.33 (12.35)	103.08	*U* = 5250.50, ***p< .001***
	Immigrant (n=164)	20.41 (22.44)	148.48	
Leisure PA	Non-Immigrant (n=81)	24.94 (20.47)	176.32	*U* =3644.00, ***p< .001***
	Immigrant (n=159)	9.00 (16.06)	104.72	
Transportation PA	Non-Immigrant (n=98)	1.31 (2.47)	n/a	*F(1,259)=.80, p=.37 BMI: *p*=.04
	Immigrant (n=164)	.99 (2.40)	n/a	
Total PA	Non-Immigrant (n=98)	68.64 (86.87)	113.00	*U* =6223.00, ***p<.002***
	Immigrant (n=164)	123.84 (139.78)	142.55	
Time Spent Sitting	Non-Immigrant (n=98)	46.97 (25.04)	167.45	*U* =4513.00, ***p< .001***
	Immigrant (n=164)	28.66 (19.51)	110.02	

*No significant heterogeneity, ANCOVA employed.

Table 4.31 presents the differences between immigrant groups determined by high and low, mean/median splits on *years in the U.S.* for Asian Indian women on the five activities when controlling for appropriate covariates where possible. Mean years in U.S. was 18.81 and the median was 18.00; therefore, these two groups were identical in group membership. The results replicated the pattern of findings of the analysis across immigrant and non-immigrant groups, showing significantly lower activity scores in job-related, household and total physical activity and higher levels of leisure time activity and time spent sitting for high mean/median years in the U.S. group compared to low mean/median years in the U.S. group as hypothesized. Similarly, no significant differences were detected between groups on transportation activity. The results again supported the hypothesis that Asian Indian women with more years in the U.S had lower levels of job-related and household-related physical activity but higher levels of leisure

time physical activity and time spent sitting as compared with Asian Indian women with fewer years in the U.S.

The mean and median splits on *age when immigrated* produced different membership groupings, so both approaches are presented. The samples for these analyses only include those that have immigrated to the U.S. The data presented in Table 4.32 show the differences between mean split groups on age at immigration across physical and sedentary activity while controlling for appropriate covariates where possible. An analysis of covariance on both household physical activity and transportation physical activity showed no significant differences between low and high mean age at immigration groups, which contradicted prior results for household activity. Similarly, non-parametric analysis for low and high mean age at immigration groups did not detect a significant difference on leisure activity in contrast to previous findings. There were significant differences found for sedentary activity time spent sitting, with the low mean split group (younger) displaying higher scores as hypothesized. As proposed, the low mean age at immigration group (younger) showed significantly lower scores on the job-related and total physical activity (the latter being the result of the former). Thus, the hypothesis was supported for mean split groups on age at immigration for job-related physical activity, total physical activity and time spent sitting. However, the pattern of differences for the other variables was consistent across the activities.

Table 4.31: Differences between Mean/Median Splits Years in the U.S. Groups on Physical Activity and Sedentary Activity

Dependent Variable	Groups	M (SD)	Mean Rank	Significance
Job-Related PA	Low (n=134)	101.76 (138.47)	152.53	*U*=5757.50, ***p< .001***
	High (n=128)	39.36 (80.41)	109.48	
Household PA	Low (n=134)	21.04 (23.19)	150.09	*U* =6085.00, ***p< .001***
	High (n=128)	9.73 (14.69)	112.04	
Leisure PA	Low (n=131)	6.94 (13.42)	96.52	*U* =3889.00, ***p< .001***
	High (n=109)	23.32 (21.21)	168.12	
Transportation PA	Low (n=134)	1.11 (2.56)	n/a	*F(1,259)=.02, *p*=.90 BMI: *p*=.03
	High (n=128)	1.11 (2.29)	n/a	
Total PA	Low (n=134)	130.93 (146.00)	146.40	*U* =6580.00, ***p< .001***
	High (n=128)	74.16 (91.25)	115.91	
Time Spent Sitting	Low (n=134)	28.631 (19.80)	109.49	*U* =5626.00, ***p< .001***
	High (n=128)	42.70 (24.83)	154.55	

*No significant heterogeneity, ANCOVA employed.

Table 4.32: Differences between Mean Splits Age at Immigration Groups on Physical and Sedentary Activity

Variable	Groups	M (SD)	Mean Rank	Significance
Job-related PA	Low (n=76)	61.22 (85.53)	71.66	*U*=2520.00, ***p=.006***
	High (n=88)	121.30 (158.07)	91.86	
Household PA	Low (n=76)	17.99 (21.16)	n/a	*F(1,161)=.21, *p*=.65 Age*: p=.11*
	High (n=88)	22.49 (23.41)	n/a	
Leisure PA	Low (n=71)	11.48 (18.56)	88.42	*U* =2894.00, *p*=.11
	High (n=88)	6.98 (13.50)	77.39	
Transportation PA	Low (n=76)	1.16 (2.56)	n/a	*F(1,161)=.77, *p*=.38 BMI *: p=.13*
	High (n=88)	.84 (2.26)	n/a	
Total PA	Low (n=76)	91.66 (89.51)	74.03	*U* =2700.00, ***p= .03***
	High (n=88)	151.63 (167.36)	89.82	
Time Spent Sitting	Low (n=76)	31.88 (20.85)	90.28	*U* =2753.00, ***p= .05***
	High (n=88)	25.87(17.93)	75.78	

*No significant heterogeneity, ANCOVA employed.

Contrary to the hypothesis, analysis showed no significant differences between high and low median age at immigration for groups on leisure physical activity, household physical activity, transportation physical activity, and time spent sitting when controlling for covariates where possible (Table 4.33). Younger age at immigration (low median age group) participants showed significantly lower MET scores on job-related and total physical activity as compared to older age at immigration participants (high median age at immigration group) as hypothesized.

SUMMARY FOR SPECIFIC AIM 4 FINDINGS

Hypothesis 1

More acculturated U.S. Asian Indian women will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity and household physical activity than less acculturated U.S. Asian Indian women when controlling for age, BMI, physical functioning and income.

1. Lower levels of job-related, household and total physical activity scores were found for high acculturated groups compared to low acculturated groups.
2. Even though BMI was a significant covariate, no significant differences were detected between acculturation groups on transportation activity.
3. More acculturated groups displayed higher scores on leisure time physical activity and sedentary (sitting) activity compared to low acculturated groups.

Table 4.33: Differences between Median Splits Age at Immigration Groups on Physical Activity and Sedentary Activity

Variable	Groups	M (SD)	Mean Rank	Significance
Job-related PA	Low (n=88)	59.31 (83.08)	71.04	*U*=2335.50, ***p< .001***
	High (n=76)	132.99 (165.23)	95.77	
Household PA	Low (n=88)	16.94 (20.34)	76.48	*U*=2814.500, *p*=.08
	High (n=76)	24.42 (24.17)	89.47	
Leisure PA	Low (n=83)	11.14 (18.34)	87.38	*U* =2915.00, *p*=.13
	High (n=76)	6.66 (12.85)	76.86	
Transportation PA	Low (n=88)	1.06 (2.44)	n/a	*F(1,161)=1.29, *p*=.25 BMI *: p=.14*
	High (n=76)	.91 (2.37)	n/a	
Total PA	Low (n=88)	88.31 (87.58)	72.26	*U* =2443.00, ***p= .003***
	High (n=76)	164.98 (174.26)	94.36	
Time Spent Sitting	Low (n=88)	31.98 (20.26)	n/a	*F(1,161)=.21, *p*=.65 Age*: p=.60*
	High (n=76)	24.80 (17.97)	n/a	

*No significant heterogeneity, ANCOVA employed.

Hypothesis 2

Non-immigrant Asian Indian women, those with more years in the U.S. and immigrants with younger ages at immigration will have higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, transportation physical activity and household physical activity compared to immigrant U.S. Asian Indian women controlling for age, BMI, physical functioning and income.

1. Immigrant versus Non-immigrant
    a. Lower job-related household and total physical activity scores were found for non-immigrant groups compared to immigrant groups.
    b. No significant differences were detected between immigrant groups and non-immigrant groups on transportation activity.
    c. Non-immigrant groups showed higher scores on leisure time physical

activity and sedentary activity (time spent sitting) compared to immigrant groups.

2. Years in the U.S.
    a. The differences between immigrant groups defined by high and low, mean/median splits on years in the U.S. for Asian Indian women on the four physical activities and sedentary activity controlling for appropriate covariates replicated the pattern of findings of the analysis across immigrant and non-immigrant groups. These differences showed significantly lower activity scores in job-related, household and total physical activity for high mean/median years in the U.S. group compared to low mean/median years in the U.S. groups.
3. Age at Immigration
    a. The mean split groups on age at immigration showed significantly lower job-related physical activity and total physical activity and greater time spent sitting for the group with younger ages at immigration.
    b. No significant differences between high and low, median or mean age at immigration groups on leisure physical activity, household physical activity, transportation physical activity and time spent sitting.
    c. Younger age at immigration participants displayed lower job-related and total physical activity as compared to older age at immigration participants (high median age at immigration group) as hypothesized.

Chapter 5: Conclusions, Discussion and Recommendations

This chapter presents major findings of this study. Study results are related to the theoretical framework and existing literature. Study limitations and recommendations for future research are also discussed. The chapter concludes with implications for nursing.

SAMPLE

Asian Indian women who completed the study were 21-58 years with an average age of 34.7 years, which was slightly younger than the national data of Asian Indian women from the American community survey of U.S. Census Bureau (2012a). The majority of the Asian Indian women were partnered, had no comorbidities and were immigrants. Among immigrant Asian Indian women, the age at which most immigrated to the U.S. was in their mid-20s, and the average years in the U.S. was 18.8 years. Participants were better educated, employed but had lower SES (socioeconomic status) when compared with the Asian Indian women from the American community survey of 2012 (U.S. Census Bureau, 2012a).

PHYSICAL ACTIVITY, SEDENTARY ACTIVITY AND ACCULTURATION

The means and medians were vastly different for all activity types except for time spent sitting, with means notably higher than medians indicating that job-related physical activity, transportation physical activity, household physical activity and leisure physical activity were not normally distributed. The large differences between mean and median total values reflected the skewness of the distribution, with a number of individuals in each of these categories at the extreme high end. Mean total physical activity for the

whole study sample was 103.19 ± 125.39 MET-hours/week, which was substantially higher than most previous findings. However, such skewness is a known factor when using mean values, and the IPAQ scoring protocol suggests that when using total physical activity as a continuous indicator the use of the median rather than mean may be a more accurate reflection of central tendency and sufficient to offset skewed distributions of the scores (IPAQ, 2005). Therefore, when we consider the median of the physical activity in the present study, the resulting 55.96 MET-hours/week is similar to results reported in prior studies (Jurakic et al., 2009; Rutten et al., 2002).

Comparing to the national physical activity guidelines, the median caloric expenditure for study participants was approximately 3,000 MET-minutes/week (55.96 MET-hours/week). This is roughly equivalent to approximately 13 hours of moderate or 9 hours of vigorous physical activity per week. Physical activity guidelines for Americans advise that 150 minutes (2 hours and 30 minutes) of moderate-intensity activity per week could be regarded as (roughly) equivalent to 500 MET-minutes/week. In adults, at least 75 minutes (1 hour and 15 minutes) per week of vigorous-intensity activity would generally achieve 500 to 1,000 MET-minutes/week (U.S. Department of Health & Human Services, 2008). By these standards, most of the study participants would already meet these recommendations.

Table 5.1: Comparison of Physical Activity and Total Sitting Scores of Different European Countries with U.S. Asian Indian Women

	Belgium	Finland	France	Germany	Italy	Netherlands	Spain	United Kingdom	Croatia	U.S. Asian Indian Women
Total PA	67.01[a]	70.20[a]	63.7[a]	84.50[a]	19.55[a]	56.41[a]	39.32[a]	27.55[a]	58.20[b]	55.96[c]
Total Sitting	29.02[a]	30.87[a]	31.3[a]	35.45[a]	29.39[a]	37. 29[a]	42.32[a]	34.95[a]	-	35.50[c]

*PA: Physical Activity (MET-hours/week)
*Total Time Spent Sitting (hours/week)
[a] Rutten et al., 2002, [b] Jurakic et al., 2009, [c] Current study

Table 5.1 displays IPAQ median scores from eight European Union countries from the European Activity Surveillance System (EUPASS) project (Rutten et al., 2002), Croatia (Jurakic et al., 2009) and the current study. The wide variability of the IPAQ scores across countries raised substantial concerns over the concepts of PA behind the measurements. For instance, walking and use of bicycles is a common form of transportation in Europe where cities are not optimized for vehicular transportation, the availability of mass transportation is high and neighborhoods are configured for localized shopping and resources. In American cities, with the few exceptions, reliance on automotive transportation is dominant and neighborhoods are distant from work, shopping and resources. Thus, transportation as configured by the IPAQ assessing walking and use of bicycles is completely inappropriate for U.S. populations. A median physical activity score for all the countries together was 58.20 MET-hours/week, which is only slightly higher (3.1 MET-hours/week) than the median physical activity score of the present study.

One limitation of most of the previous physical activity studies in Asian Indians (Dogra et al. 2010; Williams et al., 2011; Ye et al., 2009) was the specific focus on leisure activity, resulting in physical activity scores that were lower than the standard PA recommendations. In contrast, Waidyatilaka et al. (2013) used IPAQ with all the domains of activity in urban South Asian women living in Sri Lanka both with and without dysglycemia (diagnosed at recruitment); the researchers found 94.3% of women met 1,000 MET-minutes/week on activity (standard recommendation of PA). A strength of the present study was that it included all the domains of activities using the IPAQ. This is of importance because prior studies have provided evidence that both the amount and level of PA as well as the kind of PA makes a difference. For instance, the pattern and levels of physical activity in Asian Indian women having low levels of leisure and transportation physical activity may be due to living conditions and lifestyle. This is equally true for those exemplifying higher scores in job-related physical activity and lower scores in the transportation physical activity, both which would be vastly affected by the standard of living. Increased physical activity at work has not been found to correlate to improvement in physical fitness because it typically does not have adequate intensity and duration to affect positive changes (Ruzic et al., 2003). However, Tuero et al. (2001) and many others have found a positive correlation between leisure time physical activity and physical fitness. Burton and Turrell (2000) demonstrated positive relationships between leisure time and transportation activity and health. The indications from the current study and others are that as income, education and SES improve, leisure physical activity increases and all other forms of physical activity decrease. Thus, a focus

on improving use of sufficient leisure physical activity to make a difference in health outcomes would seem to be a desirable approach.

The average total sitting time (sedentary activity) for U.S. Asian Indian women for this present study was 35.50 hours/week. Mean total sitting time score for all the eight European countries (Rutten et al., 2002) together was 33.83 hours/week, which is slightly lower (1.7) than the Asian Indian women total sitting score (sedentary activity score) of the present study. In another study, South Asians of Sri Lanka had a very low sedentary activity score of 22.48 hours/week, which is a lower level of sedentary behavior than western populations (Waidyatilaka et al., 2013). In contrast, the average sitting time in South Asians living in Scotland, U.K. was 40.25 hours/week, which was associated with an increase in 2-hour glucose concentrations independent of age, sex and self-reported physical activity patterns in that population (Gill et al., 2011). Future studies should explore the effects of sitting time on metabolic and cardiovascular risk in Asian Indian women.

In this study, acculturation was positively associated with sedentary activity, indicating that those who were more acculturated engaged in more sedentary activities and spent more time sitting. In addition, the negative association for age reflected that younger participants had higher sedentary activity/total time sitting than older participants; this may have been seen because most of the younger participants were students.

In addition, the current study demonstrated a persistent pattern of significant relationships (albeit small) between acculturation and physical activity (positive for leisure and negative for job and household physical activity). This finding strongly

supports the premise that various *cultural* factors play an important role in the choice, availability and endorsement of different kinds of physical activity. Yet the small effect sizes in the current study and other studies (e.g., Jurakic et al., 2009) for those demographic and socioeconomic variables typically assessed suggest that the 'right' factors have yet to be identified. The findings from the current study suggest that it is not acculturation *per se* that is important but that cultural factors, yet to be identified, may play a more important role in planning effective interventions for U.S. Asian Indian women than those variables studied to date.

LIMITATIONS AND FUTURE STUDY RECOMMENDATIONS

There are many limitations to the study design. The use of a convenience sampling method produced unequal representation of individuals across the distribution of immigration variables, most notably across immigrant and nonimmigrant participants, which limits the generalization of the study. Also, the setting of the study was limited the Houston, Texas metropolitan area instead of a national sample of Asian Indian women. A comparison with national sample indicated that the study sample appears to more heavily represent better educated, employed but lower SES (socioeconomic status) women with a higher average years in the U.S. for immigrants than the national sample of Asian Indian women in the United States. Thus the study results should be generalized cautiously. An improved plan for future research would involve conducting the same study on a national sample of Asian Indian women living in the U.S.

In addition, the use of self-reported anthropometric measurements (weight and height) for the calculation of BMI posed a limitation to this study because respondents

may not be accurate in their self-reports. Future studies can be conducted by including measurement of anthropometrics by researchers.

One of the advantages of the study is the use of the long version of the IPAQ instrument allowed the researcher to determine the level of physical activity in each of four physical activity domains and sedentary behavior to gather a more comprehensive insight of patterns of physical activity in Asian Indian women in the U.S. In addition, the IPAQ is an international standardized measurement of physical activity used in different independent studies around the world; therefore, the results of the present study are comparable with other physical activity studies. One limitation is that the IPAQ is used to explore the complex nature of physical activity with the use of self-report questionnaire, which may have led to overreporting of physical activity by study participants.

Also the pattern of physical activity may be different based on lifestyles, standard of living and living conditions, especially in the present study in which high levels of physical activity in the work domain and low levels of physical activity in the transportation related physical activity. Therefore there is a need for internationally comparable PA indicators or national guidelines to identify the level of physical activity needed for each domain in relation to PA-related categories provided by the IPAQ. Further studies are needed to explore and compare the amount of calories expenditure of physical activity at the workplace and determine whether leisure time physical activity has significantly different health effects. In addition, relevant categories of transportation activity need to be developed that are equivalent to those currently assessed because these categories are not appropriate for automotive dominant cultures. Furthermore, it is evidenced from the preset study that acculturation plays an important role in physical

activity; thus, it is important to explore cultural factors that specifically affect each type of physical activity—especially leisure time physical activity.

CONCLUSIONS AND NURSING IMPLICATIONS

The overall objective of this study was to identify the relationships between acculturation and five different types of activity in Asian Indian women in the U.S. The central hypothesis was that more acculturated U.S. Asian Indian women will have higher levels of leisure time physical activity and sedentary activity time spent sitting, and lower levels of job-related physical activity, transportation physical activity and household physical activity compared to less acculturated U.S. Asian Indian women. The study results suggested that higher acculturation was associated with higher levels of leisure activity and time spent sitting. A small negative correlation between job-related physical activity, household physical activity and total physical activity with lower acculturation levels was found to exist. No relationship was seen with transportation related physical activity and acculturation. The proxy measures of acculturation, immigration status variables (younger age at immigration) were associated with higher levels of leisure time physical activity and time spent sitting, and lower levels of job-related physical activity, household physical activity and total physical activity. Another proxy measure of acculturation, more years in the U.S., was only associated with higher levels of job-related physical activity and time spent sitting.

This study comes under the broad domain of public health nursing. The results of the study help to enhance the understanding of the relationship between acculturation and various forms of activity (leisure time physical activity, job-related physical activity, transportation physical activity, household physical activity and time spent sitting) in

both immigrant and non-immigrant Asian Indian women living in the U.S. This contribution is a significant first step in a continuum of research that is expected to lead to the development of effective community health nursing interventions to promote physically active lifestyles in Asian Indian women and help reduce health disparities. It also helps nurses to understand cultural differences in the physical activity pattern of their clients and develop culturally appropriate health promotional counseling and programs for high-risk immigrant Asian Indian women. Ultimately, the development of strategies for physical activity interventions help the prevention of chronic diseases associated with physical inactivity among other immigrant and native-born Asian Indian women and to improve quality of life as well as health outcomes.

Appendix A: Demographic Questionnaire

I would like to find out more about the people who take part in the study. I would be very grateful if you could answer the questions below

1. Age

Years old ☐

2. Marital Status : Partnered ☐
Unpartnered ☐

3. Employment Status

Employed ☐
Home maker ☐
Student ☐
Retired ☐
Disabled ☐
Other, please specify _____

4. Presence of any existing medical conditions, such as Diabetes, Heart Disease etc?

Yes ☐
No ☐

5. What is your Annual Household Income? (Includes both spouse and self)? ☐

6. How many years of education have you completed?

Please use the following guidelines to answer:

If you did not complete High School= please enter the last grade completed.
If you finished High School or equivalent =12
Some college=enter sum of 12 plus the number of years of college COMPLETED, NOT years attended (Freshman=1, Sophomore=2, Junior=3, Senior=4)
Associate/Technical degree=14
Bachelor's degree= 16

Master's degree=18
Doctorate degree=20

Years completed

7. What is your Height?

Please answer in total Inches (For example: 5'6"=5x12=60+6=66)

8. What is your Weight?

Please answer in total Pounds

9. Are you Immigrant (NOT born in the U.S.)?

Yes
No

10. How long have you been living in the USA?

Number of years

11. How old were you when you came to the USA?

Age in years (Please put "0" if you If you were born in the U.S.)

Appendix B: The Physical Functioning Scale of the RAND 36-Item Health Survey

The following items are about activities you might do during a typical day. Does **your health now limit you** in these activities? If so, how much?

(Circle One Number on Each Line)

	Yes, Limited a Lot	Yes, Limited a Little	No, Not limited at All
1. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	[1]	[2]	[3]
2. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	[1]	[2]	[3]
3. Lifting or carrying groceries	[1]	[2]	[3]
4. Climbing **several** flights of stairs	[1]	[2]	[3]
5. Climbing **one** flight of stairs	[1]	[2]	[3]
6. Bending, kneeling, or stooping	[1]	[2]	[3]
7. Walking **more than a mile**	[1]	[2]	[3]
8. Walking **several blocks**	[1]	[2]	[3]
9. Walking **one block**	[1]	[2]	[3]
10. Bathing or dressing yourself	[1]	[2]	[3]

Appendix C: International Physical Activity Questionnaire (IPAQ-Long Form)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

☐ **Yes**

☐ No → ***Skip to PART 2: TRANSPORTATION***

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

_____ **days per week**

☐ No vigorous job-related physical activity → ***Skip to question 4***

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

_____ **hours per day**

_____ **minutes per day**

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

_____ **days per week**

☐ No moderate job-related physical activity → ***Skip to question 6***

5. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

_____ **hours per day**

_____ **minutes per day**

6. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

_____ **days per week**

☐ No job-related walking → ***Skip to PART 2: TRANSPORTATION***

7. How much time did you usually spend on one of those days **walking** as part of your work?

_____ **hours per day**

_____ **minutes per day**

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

_____ **days per week**

☐ No traveling in a motor vehicle → ***Skip to question 10***

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

_____ **hours per day**

_____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No bicycling from place to place → ***Skip to question 12***

11. How much time did you usually spend on one of those days to **bicycle** from place to place?

_____ **hours per day**

_____ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY***

13. How much time did you usually spend on one of those days walking from place to place?

_____ **hours per day**

_____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

_____ **days per week**

☐ No vigorous activity in garden or yard → ***Skip to question 16***

15. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

_____ **hours per day**

_____ **minutes per day**

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**

☐ No moderate activity in garden or yard → ***Skip to question 18***

17. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

_____ **hours per day**

_____ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

_____ **days per week**

☐ No moderate activity inside home → ***Skip to PART 4: RECREATION, SPORT AND LEISURE TIME PHYSICAL ACTIVITY***

19. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

_____ **hours per day**

_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

_____ **days per week**

☐ No walking in leisure time → ***Skip to question 22***

21. How much time did you usually spend on one of those days **walking** in your leisure time?

_____ **hours per day**

_____ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, jogging at 6 mph, basketball game, soccer game tennis singles, basketball game, circuit weight training, ***vigorous*** weight bearing exercises, ***vigorous aerobic exercises, vigorous kick-boxing exercise*** fast dancing or fast swimming **in your leisure time**?

_____ **days per week**

☐ No vigorous activity in leisure time → ***Skip to question 24***

23. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

_____ **hours per day**

_____ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, doubles tennis, badminton, moderate paced zumba, moderate paced yoga, moderate dancing, basketball drill such as layups, weight training, gymnastics, martial arts, moderate weight bearing exercises, moderate kickboxing, or moderate ***aerobic exercises*** **in your leisure time**?

_____ **days per week**

☐ No moderate activity in leisure time → ***Skip to PART 5: TIME SPENT SITTING***

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?

_____ **hours per day**

_____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

_____ **hours per day**

_____ **minutes per day**

27. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?

_____ **hours per day**

_____ **minutes per day**

Appendix D: Modified Suinn-Lew Asian Self-Identity Acculturation Scale (M-SL-ASIA)

INSTRUCTIONS: The questions which follow are for the purpose of collecting information about your historical background as well as more recent behaviors which may be related to your cultural identity. Choose the one answer which best describes you.

1. What language can you speak?
    1. Asian only (for example, Indian, Chinese, Japanese, Korean, Vietnamese, etc.)
    2. Mostly Asian, some English
    3. Asian and English about equally well (bilingual)
    4. Mostly English, some Asian
    5. Only English

2. What language do you prefer?
    1. Asian only (for example, Indian, Chinese, Japanese, Korean, Vietnamese, etc.)
    2. Mostly Asian, some English
    3. Asian and English about equally well (bilingual)
    4. Mostly English, some Asian
    5. Only English

3. How do you identify yourself?
    1. Oriental
    2. Asian
    3. Asian-American
    4. Asian Indian, Chinese-American, Japanese-American, Korean-American, etc.
    5. American

4. Which identification does (did) your mother use?
    1. Oriental
    2. Asian
    3. Asian-American
    4. Asian-Indian, Chinese-American, Japanese-American, Korean-American, etc.
    5. American

5. Which identification does (did) your father use?
    1. Oriental
    2. Asian
    3. Asian-American
    4. Asian-Indian, Chinese-American, Japanese-American, Korean-American, etc.

5. American

6. What was the ethnic origin of the friends and peers you had, as a child up to age 6?
   1. Almost exclusively Asians, and/or Asian-Americans, and/or Orientals
   2. Mostly Asians, and/or Asian-Americans, and/or Orientals
   3. About equally Asian groups and Anglo groups
   4. Mostly Anglos (Caucasians), Blacks, Hispanics, and/or other non-Asian ethnic groups
   5. Almost exclusively Anglos (Caucasians), Blacks, Hispanics, and/or other non-Asian ethnic groups

7. What was the ethnic origin of the friends and peers you had, as a child from 6 to 18?
   1. Almost exclusively Asians, and/or Asian-Americans, and/or Orientals
   2. Mostly Asians, and/or Asian-Americans, and/or Orientals
   3. About equally Asian groups and Anglo groups
   4. Mostly Anglos(Caucasians), Blacks, Hispanics, and/or other non-Asian ethnic groups
   5. Almost exclusively Anglos, Blacks, Hispanics, and/or other non-Asian ethnic groups

8. Whom do you now associate with in the community?
   1. Almost exclusively Asians, and/or Asian-Americans, and/or Orientals
   2. Mostly Asians, and/or Asian-Americans, and/or Orientals
   3. About equally Asian groups and Anglo groups
   4. Mostly Anglos(Caucasians), Blacks, Hispanics, and/or other non-Asian ethnic groups
   5. Almost exclusively Anglos, Blacks, Hispanics, and/or other non-Asian ethnic groups

9. If you could pick, whom would you prefer to associate with in the community?
   1. Almost exclusively Asians, Asian-Americans, Orientals
   2. Mostly Asians, Asian-Americans, Orientals
   3. About equally Asian groups and Anglo groups
   4. Mostly Anglos (Caucasians), Blacks, Hispanics, or other non-Asian ethnic groups
   5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

10. What is your music preference?
    1. Only Asian music (for example, Indian, Chinese, Japanese, Korean, Vietnamese, etc.)
    2. Mostly Asian
    3. Equally Asian and English
    4. Mostly English
    5. English only

11. What is your movie preference?

1. Asian-language movies only
2. Asian-language movies mostly
3. Equally Asian/English English-language movies
4. Mostly English-language movies only
5. English-language movies only

12. What generation are you? (circle the generation that best applies to you:)
    1. 1st Generation = I was born in Asia or country other than U.S.
    2. 2nd Generation = I was born in U.S., either parent was born in Asia or country other than U.S.
    3. 3rd Generation = I was born in U.S., both parents were born in U.S, and all grandparents born in Asia or country other than U.S.
    4. 4th Generation = I was born in U.S., both parents were born in U.S, and at least one grandparent born in Asia or country other than U.S. and one grandparent born in U.S.
    5. 5th Generation = I was born in U.S., both parents were born in U.S., and all grandparents also born in U.S.
    6. Don't know what generation best fits since I lack some information.

13. Where were you raised?
    1. In Asia only
    2. Mostly in Asia, some in U.S.
    3. Equally in Asia and U.S.
    4. Mostly in U.S., some in Asia
    5. In U.S. only

14. What is the primary kind of contact have you had with Asia? (Choose the one that represents the level of your contact)

    1. I was raised one year or more in Asia
    2. I have only lived for less than one year in Asia
    3. I have only had occasional visits to Asia
    4. I have only had occasional communications (letters, phone calls, etc.) with people in Asia
    5. I have had no exposure or communications with people in Asia

15. What is your food preference at home?
    1. Exclusively Asian food
    2. Mostly Asian food, some American
    3. About equally Asian and American
    4. Mostly American food
    5. Exclusively American food

16. What is your food preference in restaurants?
    1. Exclusively Asian food
    2. Mostly Asian food, some American

3. About equally Asian and American
4. Mostly American food
5. Exclusively American food

17. Do you
    1. Read only an Asian language?
    2. Read an Asian language better than English?
    3. Read both Asian and English equally well?
    4. Read English better than an Asian language?
    5. Read only English?

18. Do you
    1. Write only an Asian language?
    2. Write an Asian language better than English?
    3. Write both Asian and English equally well?
    4. Write English better than an Asian language?
    5. Write only English?

19. If you consider yourself a member of the Asian group (Asian, Asian-American, Asian-Indian, Chinese-American, etc., whatever term you prefer), how much pride do you have in this group?
    1. Extremely proud
    2. Moderately proud
    3. Little pride
    4. No pride but do not feel negative toward group
    5. No pride but do feel negative toward group

20. How would you rate yourself?
    1. Very Asian
    2. Mostly Asian
    3. Bicultural
    4. Mostly Westernized
    5. Very Westernized

21. Do you participate in Asian occasions, holidays, traditions, etc.?
    1. Nearly all
    2. Most of them
    3. Some of them
    4. A few of them
    5. None at all

Appendix E: Recruitment Flyer

PHYSICAL ACTIVITY AND ACCULTURATION IN U.S. ASIAN INDIAN WOMEN.

Be part of an important research study

- Are you an Asian Indian woman between 21 and 60 years of age?
- Can you speak, read, and write English?

*If you answered **YES** to these questions, you may be eligible to participate in this research study.*

The purpose of this research study is to *identify the relationships between acculturation factors and different kinds of physical activity of Asian Indian women in the U.S.* Acculturation is a process in which members of one cultural group adopt the beliefs and behaviors of another group. The results from this research will be a significant first step in the development of culturally appropriate health interventions to promote physically active lifestyles in Asian Indian women to reduce health disparities.

Participation is by anonymous survey through the internet or by a paper questionnaire as you prefer. Simply access the web survey at the following web address or contact the researcher to obtain your paper survey. Participation is completely anonymous and will only take approximately 30 minutes.

Tell your friends, family and neighbors!

Web link for survey: https://www.surveymonkey.com/s/women_PA

For more information, please contact the Researcher:
Nitha Mathew, BSN, RN
Doctoral Nursing Student
Graduate School of Biomedical Sciences,
University of Texas Medical Branch
Galveston, Texas.
Email: nimathew@utmb.edu
Phone: 832-603-7590
Study overseen by Sheryl L. Bishop, PhD
Approved by the UTMB Institutional Review Board (IRB)

Appendix F: UTMB IRB Approval

UTMB
The University of Texas Medical Branch

OFFICE OF RESEARCH SUBJECT PROTECTIONS
Institutional Review Board

21-Aug-2013

MEMORANDUM

TO: Nitha Mathew, RN/Sheryl Bishop, PhD
Grad School Biomedical Science

Andrea Mtiaz

FROM: Janak Patel, MD
Vice-Chairman, IRB #2
Institutional Review Board 0158

SUBJECT: IRB #13-0373 - **Final Approval** of Expedited Protocol.
Exploring the Relationship Between Physical Activity and Acculturation in U.S. Asian Indian Women

Having met the requirements set forth by the Institutional Review Board by an expedited review process on **August 15, 2013,** your research project is now approved, effective **August 21, 2013.**

This project will require **annual** review and will expire on August 15, 2014. **Research that has not received approval for continuation by this date may not continue past midnight of the expiration date.**

Waiver of the requirement for obtaining written documentation of informed consent was approved after determining that either 1) the consent form would be the only record linking the subject and the research and the principal risk would be loss of confidentiality, or 2) the research presents no more than minimal risk to the subjects and involves no procedures for which written consent is normally required outside the research context. It was also determined that continuing review of this protocol did not have to be accomplished more often than annually.

This project is approved for completion of an anonymous survey. All data will be coded to protect confidentiality.

JP/ak

Appendix G: IPAQ Scoring Protocol

Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ)

– Short and Long Forms

November 2005

Contents

1. Introduction

This document describes recommended methods of scoring the data derived from the telephone / interview administered and self-administered IPAQ short and long form instruments. The methods outlined provide a revision to earlier scoring protocols for the IPAQ short form and provide for the first time a comparable scoring method for IPAQ long form. Latest versions of IPAQ instruments are available from www.ipaq.ki.se.

Although there are many different ways to analyse physical activity data, to date there is no formal consensus on a 'correct' method for defining or describing levels of physical activity based on self–report population surveys. The use of different scoring protocols makes it very difficult to compare within and between countries, even when the same instrument has been used. Use of these scoring methods will enhance the comparability between surveys, provided identical sampling and survey methods have been used.

2. Uses of IPAQ Instruments

IPAQ short form is an instrument designed primarily for population surveillance of physical activity among adults. It has been developed and tested for use in adults (age range of 15-69 years) and until further development and testing is undertaken the use of IPAQ with older and younger age groups is not recommended.

IPAQ short and long forms are sometimes being used as an evaluation tool in intervention studies, but this was not the intended purpose of IPAQ. Users should carefully note the range of domains and types of activities included in IPAQ before using it in this context. Use as an outcome measure in small scale intervention studies is not recommended.

3. Summary Characteristics of IPAQ Short and Long Forms

1. IPAQ assesses physical activity undertaken across a comprehensive set of domains including:
    a. leisure time physical activity
    b. domestic and gardening (yard) activities
    c. work-related physical activity
    d. transport-related physical activity;

2. The IPAQ **short** form asks about three specific types of activity undertaken in the four domains introduced above. The specific types of activity that are assessed are walking, moderate-intensity activities and vigorous-intensity activities.

3. The items in the **short** IPAQ form were structured to provide separate scores on walking, moderate-intensity and vigorous-intensity activity. Computation of the total score for the short form requires summation of the duration (in minutes) and frequency (days) of walking, moderate-intensity and vigorous-intensity activities. Domain specific estimates cannot be estimated.

4. The IPAQ **long** form asks details about the specific types of activities undertaken within each of the four domains. Examples include walking for transportation and moderate-intensity leisure-time activity.

5. The items in the **long** IPAQ form were structured to provide separate domain specific scores for walking, moderate-intensity and vigorous-intensity activity within each of the work, transportation, domestic chores and gardening (yard) and leisure-time domains. Computation of the total scores for the long form requires summation of the duration (in minutes) and frequency (days) for all the types of activities in all domains. Domain specific scores or activity specific sub-scores may be calculated. Domain specific scores require summation of the scores for walking, moderate-intensity and vigorous-intensity activities within the specific domain, whereas activity-specific scores require summation of the scores for the specific type of activity across domains.

4. Overview of Continuous and Categorical Analyses of IPAQ

Both categorical and continuous indicators of physical activity are possible from both IPAQ forms. However, given the non-normal distribution of energy expenditure in many populations, it is suggested that the continuous indicator be presented as median minutes/week or median MET–minutes/week rather than means (such as mean minutes/week or mean MET-minutes/week).

4.1 Continuous Variables

Data collected with IPAQ can be reported as a continuous measure. One measure of the volume of activity can be computed by weighting each type of activity by its energy requirements defined in METs to yield a score in MET–minutes. METs are multiples of the resting metabolic rate and a MET-minute is computed by multiplying the MET score of an activity by the minutes performed. MET-minute scores are equivalent to kilocalories for a 60 kilogram person. Kilocalories may be computed from MET-minutes using the following equation: MET-min x (weight in kilograms/60 kilograms). MET-minutes/day or MET-minutes/week can be presented although the latter is more frequently used and is thus suggested.

Details for the computation for summary variables from IPAQ short and long forms are detailed below. As there are no established thresholds for presenting MET-minutes, the IPAQ Research Committee propose that these data are reported as comparisons of median values and interquartile ranges for different populations.

4.2 Categorical Variable: Rationale for Cut Point Values

There are three levels of physical activity proposed to classify populations:

1. Low
2. Moderate
3. High

The algorithms for the short and long forms are defined in more detail in Sections 5.3 and 6.3, respectively. Rules for data cleaning and processing prior to computing the algorithms appear in Section 7.

Regular participation is a key concept included in current public health guidelines for physical activity.[1] Therefore, both the total volume and the number of days/sessions are included in the IPAQ analysis algorithms.

The criteria for these levels have been set taking into account that IPAQ asks questions in all domains of daily life, resulting in higher median MET-minutes estimates than would have been estimated from leisure-time participation alone. The criteria for these three levels are shown below.

Given that measures such as IPAQ assess total physical activity in all domains, the "leisure time physical activity" based public health recommendation of 30 minutes on most days will be achieved by most adults in a population. Although widely accepted as a goal, in absolute terms 30 minutes of moderate-intensity activity is low and broadly equivalent to the background or basal levels of activity adult individuals would accumulate in a day. Therefore a new, higher cutpoint is needed to describe the levels of physical activity associated with health benefits for measures such as IPAQ, which report on a broad range of domains of physical activity.

'High'

This category was developed to describe higher levels of participation. Although it is known that greater health benefits are associated with increased levels of activity there is no consensus on the exact amount of activity for maximal benefit. In the absence of any established criteria, the IPAQ Research Committee proposes a measure which equates to approximately at least one hour per day or more, of at least moderate-intensity activity above the basal level of physical activity Considering that basal activity may be considered to be equivalent to approximately 5000 steps per day, it is proposed that "high active" category be considered as those who move at least 12,500 steps per day, or the equivalent in moderate and vigorous activities. This represents at least an hour more moderate-intensity activity over and above the basal level of activity, or half an hour of vigorous-intensity activity over and above basal levels daily. These calculations were based on emerging results of pedometers studies.[2]

This category provides a higher threshold of measures of total physical activity and is a useful mechanism to distinguish variation in population groups. Also it could be used to set population targets for health-enhancing physical activity when multi-domain instruments, such as IPAQ are used.

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[1] Pate RR, Pratt M, Blair SN, Haskell WL , Macera CA, Bouchard C et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American Medical Association* 1995; 273(5):402-7. and U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The Presidents' Council on Physical Fitness and Sports: Atlanta, GA:USA. 1996.

[2] Tudor-Locke C, Bassett DR Jr. How many steps/day are enough? Preliminary pedometer indices for public health. Sports Med. 2004;34(1):1-8.

'Moderate'

This category is defined as doing some activity, more than the low active category. It is proposed that it is a level of activity equivalent to "half an hour of at least moderate-intensity PA on most days", the former leisure time-based physical activity population health recommendation.

'Low'

This category is simply defined as not meeting any of the criteria for either of the previous categories.

5. Protocol for IPAQ Short Form

5.1 Continuous Scores

Median values and interquartile ranges can be computed for walking (W), moderate-intensity activities (M), vigorous-intensity activities (V) and a combined total physical activity score. All continuous scores are expressed in MET-minutes/week as defined below.

5.2 MET Values and Formula for Computation of MET-minutes/week

The selected MET values were derived from work undertaken during the IPAQ Reliability Study undertaken in 2000-2001[3]. Using the Ainsworth et al. Compendium (*Med Sci Sports Med* 2000) an average MET score was derived for each type of activity. For example; all types of walking were included and an average MET value for walking was created. The same procedure was undertaken for moderate-intensity activities and vigorous-intensity activities. The following values continue to be used for the analysis of IPAQ data: Walking = 3.3 METs, Moderate PA = 4.0 METs and Vigorous PA = 8.0 METs. Using these values, four continuous scores are defined:

Walking MET-minutes/week = 3.3 * walking minutes * walking days
Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days
Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days
Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores.

5.3 Categorical Score

Category 1 Low

This is the lowest level of physical activity. Those individuals who not meet criteria for Categories 2 or 3 are considered to have a 'low' physical activity level.

[3] Craig CL,Marshall A , Sjostrom M et al. International Physical Activity Questionnaire: 12 country reliability and validity *Med Sci Sports Exerc* 2003;August

Category 2 Moderate

The pattern of activity to be classified as 'moderate' is either of the following criteria:

a) 3 or more days of vigorous-intensity activity of at least 20 minutes per day
OR
b) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day
OR
c) 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum Total physical activity of at least 600 MET-minutes/week.

Individuals meeting at least one of the above criteria would be defined as accumulating a minimum level of activity and therefore be classified as 'moderate'. See Section 7.5 for information about combining days across categories.

Category 3 High

A separate category labelled 'high' can be computed to describe higher levels of participation.
The two criteria for classification as 'high' are:

a) vigorous-intensity activity on at least 3 days achieving a minimum Total physical activity of at least 1500 MET-minutes/week
OR
b) 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 3000 MET-minutes/week.

See Section 7.5 for information about combining days across categories.

5.4 Sitting Question in IPAQ Short Form

The IPAQ sitting question is an additional indicator variable of time spent in sedentary activity and is not included as part of any summary score of physical activity. Data on sitting should be reported as median values and interquartile ranges. To-date there are few data on sedentary (sitting) behaviours and no well-accepted thresholds for data presented as categorical levels.

6. Protocol for IPAQ Long Form

The long form of IPAQ asks in detail about walking, moderate-intensity and vigorous-intensity physical activity in each of the four domains. Note: asking more detailed questions regarding physical activity within domains is likely to produce higher prevalence estimates than the more generic IPAQ short form.

6.1 Continuous Score

Data collected with the IPAQ long form can be reported as a continuous measure and reported as median MET-minutes. Median values and interquartile ranges can be computed for walking (W), moderate-intensity activities (M), and vigorous-intensity activities (V) within each domain using the formulas below. Total scores may also be calculated for walking (W), moderate-intensity activities (M), and vigorous-intensity activities (V); for each domain (work, transport, domestic and garden, and leisure) and for an overall grand total.

6.2 MET Values and Formula for Computation of MET-minutes

Work Domain

Walking MET-minutes/week at work = 3.3 * walking minutes * walking days at work

Moderate MET-minutes/week at work= 4.0 * moderate-intensity activity minutes * moderate-intensity days at work

Vigorous MET-minutes/week at work= 8.0 * vigorous-intensity activity minutes * vigorous-intensity days at work

Total Work MET-minutes/week =sum of Walking + Moderate + Vigorous MET-minutes/week scores at work.

Active Transportation Domain

Walking MET-minutes/week for transport = 3.3 * walking minutes * walking days for transportation

Cycle MET-minutes/week for transport= 6.0 * cycling minutes * cycle days for transportation

Total Transport MET-minutes/week = sum of Walking + Cycling MET-minutes/week scores for transportation.

Domestic and Garden [Yard Work] Domain

Vigorous MET-minutes/week yard chores= 5.5 * vigorous-intensity activity minutes * vigorous-intensity days doing yard work (**Note**: the MET value of 5.5 indicates that vigorous garden/yard work should be considered a moderate-intensity activity for scoring and computing total moderate intensity activities.)

Moderate MET-minutes/week yard chores= 4.0 * moderate-intensity activity minutes * moderate-intensity days doing yard work

Moderate MET-minutes/week inside chores= 3.0* moderate-intensity activity minutes * moderate-intensity days doing inside chores.

Total Domestic and Garden MET-minutes/week =sum of Vigorous yard + Moderate yard + Moderate inside chores MET-minutes/week scores.

Leisure-Time Domain

Walking MET-minutes/week leisure = 3.3 * walking minutes * walking days in leisure

Moderate MET-minutes/week leisure = 4.0 * moderate-intensity activity minutes * moderate-intensity days in leisure

Vigorous MET-minutes/week leisure = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days in leisure

Total Leisure-Time MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores in leisure.

Total Scores for all Walking, Moderate and Vigorous Physical Activities

Total Walking MET-minutes/week = Walking MET-minutes/week (at Work + for Transport + in Leisure)

Total Moderate MET-minutes/week total = Moderate MET-minutes/week (at Work + Yard chores + inside chores + in Leisure time) + Cycling Met-minutes/week for Transport + Vigorous Yard chores MET-minutes/week

Total Vigorous MET-minutes/week = Vigorous MET-minutes/week (at Work + in Leisure)

Note: Cycling MET value and Vigorous garden/yard work MET value fall within the coding range of moderate-intensity activities.

Total Physical Activity Scores

An overall total physical activity MET-minutes/week score can be computed as:

Total physical activity MET-minutes/week = sum of Total (Walking + Moderate + Vigorous) MET-minutes/week scores.

This is equivalent to computing:

Total physical activity MET-minutes/week = sum of Total Work + Total Transport + Total Domestic and Garden + Total Leisure-Time MET-minutes/week scores.

As there are no established thresholds for presenting MET-minutes, the IPAQ Research Committee proposes that these data are reported as comparisons of median values and interquartile ranges for different populations.

6.3 Categorical Score

As noted earlier, regular participation is a key concept included in current public health guidelines for physical activity.[4] Therefore, both the total volume and the number of day/sessions are included in the IPAQ analysis algorithms. There are three levels of physical activity proposed to classify populations – 'low', 'moderate', and 'high'. The criteria for these levels are the same as for the IPAQ short [described earlier in Section 4.2]

Category 1 Low

This is the lowest level of physical activity. Those individuals who not meet criteria for Categories 2 or 3 are considered 'low'.

Category 2 Moderate

The pattern of activity to be classified as 'moderate' is either of the following criteria:

d) 3 or more days of vigorous-intensity activity of at least 20 minutes per day
OR
e) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day
OR

[4] Pate RR, Pratt M, Blair SN, Haskell WL , Macera CA, Bouchard C et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American Medical Association* 1995; 273(5):402-7. and U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The Presidents' Council on Physical Fitness and Sports: Atlanta, GA:USA. 1996.

f) 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 600 MET-minutes/week.

Individuals meeting at least one of the above criteria would be defined as accumulating a moderate level of activity. See Section 7.5 for information about combining days across categories.

Category 3 High

A separate category labelled 'high' can be computed to describe higher levels of participation.
The two criteria for classification as 'high' are:

a) vigorous-intensity activity on at least 3 days achieving a minimum Total physical activity of at least 1500 MET-minutes/week

OR

b) 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 3000 MET-minutes/week.

See Section 7.5 for information about combining days across categories.

6.4 IPAQ Sitting Question IPAQ Long Form

The IPAQ sitting question is an additional indicator variable and is not included as part of any summary score of physical activity. To-date there are few data on sedentary (sitting) behaviours and no well-accepted thresholds for data presented as categorical levels. For the sitting question 'Minutes' is used as the indicator to reflect time spent in sitting rather than MET-minutes which would suggest an estimate of energy expenditure.

IPAQ long assesses an estimate of sitting on a typical weekday, weekend day and time spent sitting during travel (see transport domain questions).

Summary sitting variables include

Sitting Total Minutes/week = weekday sitting minutes* 5 weekdays + weekend day sitting minutes* 2 weekend days

Average Sitting Total Minutes/day = (weekday sitting minutes* 5 weekdays + weekend day sitting minutes* 2 weekend days) / 7

Note: The above calculation of 'Sitting Total' excludes time spent sitting during travel because the introduction in IPAQ long directs the responder to NOT include this component as it would have already been captured under the Transport section. If a summary sitting variable including time spent sitting for transport is required, it should be calculated by adding the time reported (travelling in a motor vehicle) under transport to the above formula. Care should be taken in reporting these alternate data to clearly distinguish the 'total sitting' variable from a 'total sitting – including transport' variable.

7. Data Processing Rules

In addition to a standardized approach to computing categorical and continuous measures of physical activity, it is necessary to undertake standard methods for the cleaning and treatment of IPAQ datasets. The use of different approaches and rules would introduce variability and reduce the comparability of data.

There are no established rules for data cleaning and processing on physical activity. Thus, to allow more accurate comparisons across studies IPAQ Research Committee has established and recommends the following guidelines:

7.1 Data Cleaning

I. Any responses to duration (time) provided in the hours and minutes response option should be converted from hours and minutes into minutes.
II. To ensure that responses in 'minutes' were not entered in the 'hours' column by mistake during self-completion or during data entry process, values of '15', '30', '45', '60' and '90' in the 'hours' column should be converted to '15', '30', '45', '60' and '90' minutes, respectively, in the minutes column.
III. In some cases duration (time) will be reported as weekly (not daily) e.g., VWHRS, VWMINS. These data should be converted into an average daily time by dividing by 7.
IV. If 'don't know' or 'refused ' or data are missing for time or days then that case is removed from analysis.

Note: Both the number of days *and* daily time are required for the creation of categorical and continuous summary variables

7.2 Maximum Values for Excluding Outliers

This rule is to exclude data which are unreasonably high; these data are to be considered outliers and thus are excluded from analysis. All cases in which the sum total of all Walking, Moderate and Vigorous time variables is greater than 960 minutes (16 hours) should be excluded from the analysis. This assumes that on average an individual of 8 hours per day is spent sleeping.

The 'days' variables can take the range 0-7 days, or 8, 9 (don't know or refused); values greater than 9 should not be allowed and those cases excluded from analysis.

7.3 Minimum Values for Duration of Activity

Only values of 10 or more minutes of activity should be included in the calculation of summary scores. The rationale being that the scientific evidence indicates that episodes or bouts of at least 10 minutes are required to achieve health benefits. Responses of less than 10 minutes [and their associated days] should be re-coded to 'zero'.

7.4 Truncation of Data Rules

This rule attempts to normalize the distribution of levels of activity which are usually skewed in national or large population data sets.

In IPAQ short - it is recommended that all Walking, Moderate and Vigorous time variables exceeding ' 3 hours' or '180 minutes' are truncated (that is re-coded) to be equal to '180 minutes' in a new variable. This rule permits a maximum of 21 hours of activity in a week to be reported for each category (3 hours * 7 days).

In IPAQ long – the truncation process is more complicated, but to be consistent with the approach for IPAQ short requires that the variables total Walking, total Moderate-intensity and total Vigorous-intensity activity are calculated and then, for each of these summed behaviours, the total value should be truncated to 3 hours (180 minutes).

When analysing the data as categorical variable or presenting median and interquartile ranges of the MET-minute scores, the application of the truncation rule will not affect the results. This rule does have the important effect of preventing misclassification in the 'high' category. For example, an individual who reports walking for 10 minutes on 6 days and 12 hours of moderate activity on one day could be coded as 'high' because this pattern meets the '7 day" and "3000 MET-min" criteria for 'high'. However, this uncommon pattern of activity is unlikely to yield the health benefits that the 'high' category is intended to represent.

Although using median is recommended due to the skewed distribution of scores, if IPAQ data are analysed and presented as a continuous variable using mean values, the application of the truncation rule will produce slightly lower mean values than would otherwise be obtained.

7.5 Calculating MET-minute/week Scores

Data processing rules 7.2, 7.3, and 7.4 deals first with excluding outlier data, then secondly, with recoding minimum values and then finally dealing with high values. These rules will ensure that highly active people remain classified as 'high', while decreasing the chances that less active individuals are misclassified and coded as 'high'.

Using the resulting variables, convert time and days to MET-minute/week scores [see above Sections 5.2 and 6.2; METS x days x daily time].

7.6 Calculating Total Days for Presenting Categorical Data on Moderate and High Levels

Presenting IPAQ data using categorical variables requires the total number of 'days' on which all physical activity was undertaken to be assessed. This is difficult because frequency in 'days' is asked separately for walking, moderate-intensity and vigorous-intensity activities, thus allowing the total number of 'days' to range from a minimum

of 0 to a maximum of 21'days' per week in IPAQ short and higher in IPAQ long. The IPAQ instrument does not record if different types of activity are undertaken on the same day.

In calculating 'moderately active', the primary requirement is to identify those individuals who undertake activity on at least '5 days'/week [see Sections 4.2 and 5.3]. Individuals who meet this criterion should be coded in a new variable called "*at least five days*" and this variable should be used to identify those meeting criterion b) at least 30 minutes of moderate-intensity activity and/or walking; and those meeting criterion c) any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of 600 MET-minutes/week.

Below are two examples showing this coding in practice:

i) an individual who reports '2 days of moderate-intensity' and '3 days of walking' should be coded as a value indicating "*at least five days*";

ii) an individual reporting '2 days of vigorous-intensity', '2 days of moderate-intensity' and '2 days of walking should be coded as a value to indicate "*at least five days*" [even though the actual total is 6].

The original frequency of 'days' for each type of activity should remain in the data file for use in the other calculations.

The same approach as described above is used to calculate total days for computing the 'high' category. The primary requirement according to the stated criteria is to identify those individuals who undertake a combination of walking, moderate-intensity and or vigorous-intensity activity on at least 7 days/week [See section 4.2]. Individuals who meet this criterion should be coded as a value in a new variable to reflect "*at least 7 days*".

Below are two examples showing this coding in practice:

i) an individual who reports '4 days of moderate-intensity' and '3 days of walking' should be coded as the new variable "*at least 7 days*".

ii) an individual reporting '3 days of vigorous-intensity', '3 days moderate-intensity' and '3 days walking' should be coded as "*at least 7 days*" [even though the total adds to 9] .

8. Summary algorithms

The algorithms in Appendix 1 and Appendix 2 to this document show how these rules work in an analysis plan, to develop the categories 1 [Low], 2 [Moderate], and 3 [High] levels of activity.

IPAQ Research Committee
November 2005

APPENDIX 1

At A Glance
IPAQ Scoring Protocol (Short Forms)

Continuous Score

Expressed as MET-min per week: MET level x minutes of activity/day x days per week

	Sample Calculation
MET levels	**MET-minutes/week for 30 min/day, 5 days**
Walking = 3.3 METs	3.3*30*5 = 495 MET-minutes/week
Moderate Intensity = 4.0 METs	4.0*30*5 = 600 MET-minutes/week
Vigorous Intensity = 8.0 METs	8.0*30*5 = 1,200 MET-minutes/week
	TOTAL = 2,295 MET-minutes/week

Total MET-minutes/week = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days)

Categorical Score- three levels of physical activity are proposed

1. **Low**

   - No activity is reported **OR**
   - Some activity is reported but not enough to meet Categories 2 or 3.

2. **Moderate**

   Either of the following 3 criteria
   - 3 or more days of vigorous activity of at least 20 minutes per day **OR**
   - 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day **OR**
   - 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes/week.

3. **High**

   Any one of the following 2 criteria
   - Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week **OR**
   - 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week

Please review the full document "Guidelines for the data processing and analysis of the International Physical Activity Questionnaire" for more detailed description of IPAQ analysis and recommendations for data cleaning and processing [www.ipaq.ki.se].

APPENDIX 2

At A Glance
IPAQ Scoring Protocol (Long Forms)

Continuous Score

Expressed as MET-minutes per week: MET level x minutes of activity/day x days per week

Sample Calculation

MET levels	**MET-minutes/week for 30 min/day, 5 days**
Walking at work= 3.3 METs	3.3*30*5 = 495 MET-minutes/week
Cycling for transportation= 6.0 METs	6.0*30*5 = 900 MET-minutes/week
Moderate yard work= 4.0 METs	4.0*30*5 = 600 MET-minutes/week
Vigorous intensity in leisure= 8.0 METs	8.0*30*5 = 1,200 MET-minutes/week
	TOTAL = 3,195 MET-minutes/week

Domain Sub Scores
Total MET-minutes/week at **work** = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days) at work

Total MET-minutes/week for **transportation** = Walk (METs*min*days) + Cycle (METs*min*days) for transportation

Total MET-minutes/week from **domestic and garden** = Vig (METs*min*days) yard work + Mod (METs*min*days) yard work + Mod (METs*min*days) inside chores

Total MET-minutes/week in **leisure-time** = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days) in leisure-time

Walking, Moderate-Intensity and Vigorous-Intensity Sub Scores

Total **Walking** MET-minutes/week = Walk MET-minutes/week (at Work + for Transport + in Leisure)

Total **Moderate** MET-minutes/week = Cycle MET-minutes/week for Transport + Mod MET-minutes/week (Work + Yard chores + Inside chores + Leisure) + Vigorous Yard chores MET-minutes

Note: The above is a total moderate activities only score. If you require a total of all moderate-intensity physical activities you would sum Total Walking and Total Moderate

Total **Vigorous** MET-minutes/week = Vig MET-minutes/week (at Work + in Leisure)

Total Physical Activity Score
Total Physical Activity MET-minutes/week = **Walking** MET-minutes/week + **Moderate** MET-minutes/week + Total **Vigorous** MET-minutes/week

Continued……..

Also

Total Physical Activity MET-minutes/week = Total MET-minutes/week (at Work + for Transport + in Chores + in Leisure)

Categorical Score- three levels of physical activity are proposed

1. **Low**

   No activity is reported **OR**
   a. Some activity is reported but not enough to meet Categories 2 or 3.

2. **Moderate**

   Either of the following 3 criteria
   a. 3 or more days of vigorous-intensity activity of at least 20 minutes per day **OR**
   b. 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day **OR**
   c. 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-min/week.

3. **High**

   Any one of the following 2 criteria
   - Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week **OR**
   - 7 or more days of any combination of walking, moderate- or vigorous- intensity activities accumulating at least 3000 MET-minutes/week

Please review the full document "Guidelines for the data processing and analysis of the International Physical Activity Questionnaire" for more detailed description of IPAQ analysis and recommendations for data cleaning and processing [www.ipaq.ki.se].

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Vita

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