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Physical Activity and Breast Cancer Prevention Among Asian American Women

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PHYSICAL ACTIVITY AND BREAST CANCER PREVENTION AMONG ASIAN AMERICAN WOMEN

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DEDICATION

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ABSTRACT

Asian Americans (AsAm) comprise about 7% of the United States population and are the only racial group for whom cancer is the leading cause of death. Breast Cancer (BrCa) is the most commonly diagnosed cancer in this population, with the highest incidence in the age of 45-49 years, which is 30 years younger than for non-Hispanic Whites. The incidence of BrCa has been increasing for over three decades in AsAm.

Physical activity (PA) is a modifiable protective factor for BrCa. Unfortunately, AsAm women have a low PA prevalence of meeting PA recommendations. The increased BrCa risk, younger age at diagnosis, and low PA levels among AsAm highlight the urgency of developing PA-promoting interventions. Therefore, the purpose of this dissertation is to examine PA predictors and understand PA experiences in AsAm women to provide knowledge for establishing health promotion programs to increase PA and lowering BrCa risk in this population.

Two data-based studies were conducted for this dissertation. In the first study, a quantitative approach used data from the 2011-2018 National Health and Nutrition Examination Survey to assess PA and identify predictors related to PA in AsAm women (n=1605, age≥18). PA was self-reported as minutes of weekly PA by domains (work PA [WPA], transportation PA [TPA], and leisure PA [LPA]). Multivariable logistic regression was performed to build separate models for meeting the recommendations of ≥150 minutes of weekly moderate-intensity PA for each PA domain and total PA. The prevalence of meeting PA guidelines through any combination of WPA, TPA, or LPA

was 47.8%. For total PA, odds of meeting aerobic PA recommendations were higher for those who were younger (p<.001), had higher education (p<.001), or were English-speaking (p<.001). For the work domain, odds of meeting the aerobic PA guideline were lower for those who were older (p<.001), had lower body mass index (p =.011), or were non-English speaking (p<.001). For the transportation domain, odds of meeting the aerobic PA guideline were higher in those that were older (p=.008), were single (p=.017), had lower systolic blood pressure (p =.009), or were living in the US for <15 years (p=.034). For the leisure domain, odds of meeting the aerobic PA guideline were higher in those with higher education (p <.001), were single (p=.016), had better perceived health status (p-value<.001), or were US-born (p<.001).

The second study was a descriptive qualitative study of 21 Chinese American women (CAW) aged 24-60 to explore the PA experiences and self-perceived PA knowledge of BrCa prevention. Using Braun and Clark's thematic analysis approach to analyze the data, this study identified 12 themes: two on knowledge, five on motivations and barriers, and five on culture/acculturation. The findings suggest a lack of understanding of PA benefits in BrCa prevention among CAW. The process of acculturation influenced their PA experiences. Except for LPA, other domains of PA were substantially reduced when those women immigrated. Although acculturation facilitated leisure-time PA, CAW's PA preference was continuously impacted by cultural heritage.

Overall, the findings from the two studies are congruent regarding the changes in PA domains that AsAms gradually converted their PA behaviors towards the dominant society as they acculturated to the US. The qualitative findings provide further

explanations for how this PA change occurred. Based on the continuous increase in BrCa incidence and low PA in AsAm women, findings from this dissertation emphasize the importance of promoting PA and enhancing PA knowledge in BrCa prevention. Future research is needed to understand whether other Asian American subgroups have experienced similar PA changes and the impact of the development of culture-specific interventions. Strategies to improve PA and reduce breast cancer risk in this population should take this population's cultural background into account.

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CHAPTER 1

INTRODUCTION

Asian Americans (AsAm) are the fastest-growing population in the United States (US) (U.S. Census Bureau, 2021), and are the only US population suffering from cancer as the leading cause of death (Torre et al., 2016). Breast cancer (BrCa) is the most common cancer among AsAm women (Siegel et al., 2021). Despite decreasing female BrCa incidence in the US, there has been a steady increase in BrCa incidence among non-Japanese AsAm women for the past 30 years (Deapen et al., 2002; Gomez et al., 2013; Gomez et al., 2017). AsAm women living in the US have 2.6 times higher BrCa incidence than those who reside in their native countries (95.6 vs. 36.8 per 100,000 population) (Global Cancer Observatory: Cancer Today, 2020; Siegel et al., 2021). Immigrant AsAm women living in the US for more than half their life had three times higher BrCa risk than US-born AsAm women; those who lived in the US for less than half their life had 2.6 times higher BrCa risk than their US-born counterparts (Morey et al., 2019). Therefore, elevated BrCa risk among AsAm women seems to be associated with immigration status and longer residence in the US (Gomez et al., 2010; Morey et al., 2019). However, mechanisms of this phenomenon remain unclear.

Current scientific evidence shows that physical activity (PA) reduces BrCa risk in various ways, such as preventing overweight and obesity, decreasing inflammation, improving immune function, and decreasing sex hormones (Loprinzi et al., 2012). One preventive mechanism is maintaining a healthy weight (Swift et al., 2014). Being

overweight or obese confers a higher BrCa risk than normal weight, particularly in postmenopausal women (Brown & Simpson, 2010). A population-based, case-control study of BrCa risk in AsAm women found that height, adiposity, and weight change between current and weight during the previous decades were important predictors of BrCa risk (Ziegler et al., 1996). Although AsAms are considered to have a lower prevalence of overweight and obesity than other racial groups (Ogden et al., 2014), their prevalence of overweight and obesity has increased substantially. From 1992 to 2011, the prevalence of obesity has tripled, whereas the prevalence of overweight doubled in AsAms (Singh & Lin, 2013). Another mechanism in which PA protects against BrCa risk is the anti-inflammatory effects. Chronic inflammation is a risk factor for cancer (Singh et al., 2019). Regular PA exerts anti-inflammatory effects by reducing interleukin-6 basal level (Gomez-Rubio & Trapero, 2019). Acute PA releases interleukin-6 into circulation from contracting muscle fibers, which subsequently increase numbers of interleukin-10 secretion, which may reduce cancer risk (Allen et al., 2015; Gleeson et al., 2011). Interleukin-10 act as a defense mechanism in chronic inflammation (Iyer & Cheng, 2012). Meanwhile, Further, regularly PA affects sex hormones that could mediate BrCa risk. Prolonged exposure to high endogenous sex hormones is a significant risk factor for BrCa. Studies found that higher leisure-time PA reduced estradiol levels in premenopausal women (Emaus et al., 2008; Verkasalo et al., 2001). For postmenopausal women, increasing PA is associated with a decrease in estrogen and an increase in sex hormone-binding globulin (Friedenreich et al., 2010; McTiernan et al., 2004). Estrogen is mainly stored in the adipose tissue in postmenopausal women. PA also reduces BrCa risk by decreasing estrogen production, which may be mediated by decreasing body adiposity

(Kendall et al., 2007). The practice of regular PA has been proposed in the literature as a non-pharmacological, low-cost, and accessible intervention that can reduce BrCa risk (Friedenreich, 2010; Loprinzi et al., 2012; Lynch et al., 2011).

PA wields a positive effect on reducing BrCa risk in all ethnic groups (Lynch et al., 2011) and has an even more substantial impact on Asians, in which BrCa risk is reduced by an average of 41% reduces compared to 20% in Whites (Friedenreich, 2010). However, despite the substantial benefits of PA, AsAm, especially women, are less likely to be physically active than all racial groups in the US (Centers for Disease Control and Prevention [CDC], 2004; Kandula & Lauderdale, 2005; Kao et al., 2016; Yi et al., 2015). A population-based study found that the prevalence of meeting PA recommendations was lowest in AsAms (38.6%) compared to Whites, African Americans, and Hispanics (49.9% vs. 45.5% vs. 45.4%, respectively) (Kao et al., 2016). Similarly, in New York City, 42.7% of AsAms met PA recommendations, which was lower than all other racial groups [61.3% in White, 59.4% in African Americans, 60.2% in Hispanics, and 62.7% in others] (Yi et al., 2015). In Los Angeles County, 55.8% of AsAms met PA recommendations compared to 64.3% in Whites, 59.8% in African Americans, 62.4% in Hispanics, and 66.2% in others (Yi et al., 2015). In general, both studies showed that the prevalence of meeting PA recommendations was lower in women than men.

There were 22.9 million AsAms in the US, with six out of ten being immigrants (U.S. Census Bureau, 2021). Culture is a critical element that shapes an individual self-identity and influences behaviors. Migration to the U.S. can represent a significant change in a person's lifestyle that initiates the process of acculturation. Although the concept of acculturation has been widely used in research, there is no universal or

standard definition of acculturation in literature. The definition of acculturation was first presented by Redfield et al. (1936, p.136): “acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original cultural patterns of either or both groups.” The acculturation process involves behavioral changes and psychological adaptation (Graves, 1967). During acculturation, individuals could experience additional stresses and difficulties that could introduce potential psychological problems (Gong et al., 2011; Tseng et al., 2011). Later-generation immigrants may also experience acculturation, especially for those who reside in areas where most residents are from the same ethnic minority group because they live in or exposure to more heritage culture than American culture (Schwartz et al., 2010). Acculturation stress can be passed on to later AsAms generations because their race/ethnicity can be identified by appearance (Schwartz et al., 2010). For example, US-born AsAms may be complimented on English fluency or asked, “Where are you really from?”

In general, there is substantial research on acculturation and health behaviors, including PA (Chen et al., 2019; Choi et al., 2011; Gadgil et al., 2020; W. Mao et al., 2020; Tseng et al., 2015; Vu et al., 2020). However, existing evidence in AsAms is limited, inconsistent, and has failed to explain the underlying mechanism on whether acculturation has a direct, moderating, or mediating effect on PA. One study in Indian American women showed that high acculturated women had a higher level of leisure-time PA and a higher level of sedentary time than low acculturated women, but low acculturated women had a higher level of total PA and occupational PA (Joseph et al., 2019) This study used the modified Suinn-Lew Asian Identity Acculturation Scale to

assess acculturation. Another study examining the relationship between immigrant generation and PA among Chinese- and Filipino-Americans found that PA was significantly associated with the immigrant generation, which is highly correlated with language preference (Afable-Munsuz et al., 2010). In Chinese Americans, non-leisure time PA was negatively associated with generation, but leisure-time PA has a positive relationship. In Filipino-Americans, non-leisure time PA decreased from the first- to second-generation, then increased in third-generation (Afable-Munsuz et al., 2010). For immigrant AsAms, there may be positive features in American culture that facilitate their PA as their length of residence in the US increases (Yan & Cardinal, 2019). With the rising AsAm population in the US and the limited research on acculturation and PA of AsAms, there is a need for information about this population to understand the role of acculturation as they adjust or adapt to US culture and how it affects their PA.

While a greater number of studies focused on PA, less information is available on AsAm women. Therefore, the purpose of this dissertation was to better understand AsAm women's PA and to provide foundational knowledge for developing health promotion initiatives designed to increase PA and reduce BrCa risk in this population.

CHAPTER 2

LITERATURE REVIEW:

FACTORS INFLUENCING PHYSICAL ACTIVITY AMONG ASIAN AMERICAN WOMEN

In 2019, there were about 23 million AsAms in the US, accounting for 7% of the total population (U.S. Census Bureau, 2021). According to the US Census Bureau, AsAms are the most rapidly increasing population, with an 82% increase from 2000 to 2019. With the rapid growth in AsAms, significant health challenges for AsAm women became more noticeable, including inactivity (Im, 2017; Im et al., 2012). PA plays a substantial role in lowering cardiovascular disease, diabetes, and BrCa risk; there is a high prevalence of adults who are either sedentary or engage in low PA levels (Piercy et al., 2018).

Research on PA in AsAms is limited, and AsAms are often underrepresented or omitted from health research regarding PA. Limited research has highlighted that AsAms participate in even less PA than the general US population, and women are commonly lower than men (Kandula & Lauderdale, 2005; Kao et al., 2016; Suminski et al., 2002; Yi et al., 2015). Low PA levels in AsAms can be tracked back to 2000. About 38% of AsAms met recommended levels of PA compared to the US average of 45.8% (CDC, 2004). A population-based study using data from the 2001 California Health Interview Survey found that AsAm men (18-39 years, 36.4%; 40-59 years, 21.2%) and women (18-

39 years, 20%; 40-59 years, 20.6%) of all ages were less likely to meet PA recommendations in leisure time than US-born non-Asian (men: 18-39 years, 50.7%; 40-59 years, 38.8%; women: 18-39 years, 35.8%; 40-59 years, 31%) (Kandula & Lauderdale, 2005). According to a study using the 2010 and 2012 New York City Community Health Survey, only 42.7% of AsAms followed PA recommendations compared to 61.3% for Whites, 59.4% for African Americans, 60.2% for Hispanics, and 55.8% for others (Yi et al., 2015). Using the data from the 2011 Los Angeles County Health Survey, this study also examined PA among AsAms and discovered that the prevalence of meeting PA recommendations is lower among AsAms (55.8%) compared to other racial groups (64.3% in Whites, 59.8% in African Americans, 62.4% in Hispanics, and 66.2% in others). Another study using the 2010 Health of Houston Survey to examine the PA showed that AsAms (38.6%) were the least likely to follow PA recommendations than Whites, African Americans, and Hispanics (49.5%, 45.5%, 45.4%; respectively) (Kao et al., 2016).

PA can be defined and quantified in different ways. Caspersen and colleagues define PA as "any bodily movement produced by skeletal muscles that result in energy expenditure" (Caspersen et al., 1985). Exercise is considered a subtype of PA, which is "planned, structured, and repetitive" (Caspersen et al., 1985). PA is a health behavior that can be categorized according to type (i.e., flexibility, aerobic, muscle-strengthening PA), frequency (i.e., number of movements per day/week), duration (i.e., length of actual movement), and intensity (i.e., light, moderate, and vigorous). Further, PA is divided into four major domains based on the purpose of PA, including leisure PA, occupation PA, transportation PA, and household PA. Leisure PA may also be called recreational PA. In

the literature, many researchers refer to leisure-time PA as exercise. The American Cancer Society endorses the US Department of Health and Human Services PA recommendations of engaging in at least 150 minutes of moderate or 75 minutes of vigorous-intensity activity per week or an equivalent combination (Rock et al., 2020). The terms exercise and PA are used interchangeably in nursing and medicine literature. Therefore, we use both terms in the literature search strategy for this review.

Engaging in regular PA is essential for women's health, but there is a significant and longstanding gap in the literature regarding PA among AsAm women. Limited knowledge of factors associated with PA among AsAm women is a barrier to developing PA interventions for this population. Thus, in order to build a foundation for promoting PA, this literature review will describe the current state of scientific evidence on factors influencing PA among AsAm women.

Methods

This systematic review is guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021). The review focuses on PA and factors associated with daily PA among AsAm adult women. Five electronic databases: PubMed, CINAHL, PsycINFO, SPORTDiscus, and Web of Science were systematically searched for English language, peer-reviewed papers published between January 2010 and April 2022. The PubMed search strategy (Table 2.1) was guided by Population Intervention Comparison and Outcome Model in collaboration with a librarian (Amy Edwards) familiar with nursing literature. The PubMed strategy was then adapted for CINAHL, PsycINFO, SPORTDiscuss, and Web of Science.

Inclusion and Exclusion Criteria

Studies included in this review met the following criteria: 1) PA is an outcome variable in quantitative studies or primary focus in qualitative studies or mixed methods, 2) reported factors associated with PA, 3) population included AsAm women, and 4) published in English. The exclusion criteria were 1) abstract or conference report only; 2) review paper; 3) findings focusing on flexibility activities only; 4) findings including multiple racial/ethnic groups but did not report findings separately from AsAm groups; 5) findings not reporting factors by gender; and 6) participants were Pacific Islanders rather than Asians. Pacific Islanders were excluded because of a 1997 Office of Management and Budget directive dividing Asian or Pacific Islanders' racial category into two categories in the US census.

All the identified articles were initially imported into Endnote X9 software, and duplicate records were removed. Two reviewers (JS and another Ph.D. nursing student) independently assessed study eligibility. Further discussion was conducted until reaching an agreement if any disagreements were encountered.

Results

Study selection

The systematic search of five electronic databases identified 4317 records. The 2537 non-duplicate records were then screened using the title and abstracts, which further excluded 2463 records. Full texts of the remaining 74 articles were retrieved and assessed in detail using inclusion/exclusion criteria, and an additional 59 records were excluded at this stage. Figure 2.1 presents the study selection process using the PRISMA flow chart.

There were 15 studies included in the narrative synthesis, including eight quantitative and seven qualitative studies (Table 2.2).

Quantitative synthesis

Study Characteristics. In this review, almost all quantitative studies were cross-sectional with one pilot, randomized control trial (RCT). Sample sizes ranged from 40 to 419, representing 1457 AsAm women. Four studies were limited to women (Choi, Shin, et al., 2021; Joseph et al., 2019; Lee & Im, 2010; Nelson-Peterman et al., 2015), while the remaining studies included both men and women with analyses by gender (Thanawala et al., 2020; Yi et al., 2021; Zhou & Oh, 2012). For the quantitative studies, the average age of women ranged from 35 to 61 years. Three studies investigated South AsAms, with two only on Asian Indian (Joseph et al., 2019; Thanawala et al., 2020; Yi et al., 2021). Two studies reported AsAms as a whole racial group (Lee & Im, 2010; Zhou & Oh, 2012). Two investigated single AsAm subgroups, Cambodian (Nelson-Peterman et al., 2015)and Korean (Choi, Shin, et al., 2021).

PA Measurement. All studies assessed PA through self-reported surveys except for the pilot randomized control trial that used self-report and Fitbit (Table 2.3). Measurements of PA were differed across studies. Two studies used PA guidelines (150 min/week) to assess the factors associated with PA participation (Yi et al., 2021; Zhou & Oh, 2012); one study investigated whether the participants had less than 2 days/week of walking (Nelson-Peterman et al., 2015); two studies reported PA hour/week or min/week (Choi, Shin, et al., 2021; Lee & Im, 2010); the remaining studies reported the factors related to the 1-unit metabolic equivalent of task (MET) changes (Joseph et al., 2019; Thanawala et al., 2020). Regarding PA domains, two studies only measured leisure PA

(Lee & Im, 2010; Thanawala et al., 2020), one study only measured walking days without specifying domains (Nelson-Peterman et al., 2015), and the remaining studies assessed all PA domains. However, only two studies separately reported PA by domains (Choi, Shin, et al., 2021; Joseph et al., 2019).

Factors associated with PA. Research focuses varied across studies (Table 2.4). One study examined the association between social networks and PA (Thanawala et al., 2020); one assessed the relationship between neighborhood factors and PA (Yi et al., 2021); Two investigated acculturation, immigration status, and PA (Joseph et al., 2019; Nelson-Peterman et al., 2015); two examined broad potential covariates for participating in PA (Lee & Im, 2010; Zhou & Oh, 2012). The pilot RCT examined whether an online community via a social media app can more efficiently promote PA among Korean American women (Choi, Shin, et al., 2021). Most factors were not associated with PA. The relationship between age and PA varied across studies. Age was positively associated with the number of walking days/week, not associated with leisure PA, and contradicted with total PA. Education, marital status, and income were not associated with PA. Lower PA were found among AsAm women who were employed, perceived their health as poor, and had more children. High cholesterol concentration, living more years in a neighborhood, or having a spouse as an exercise partner was positively associated with PA. In Asian Indian Americans, higher acculturation was associated with a higher level of leisure-time PA. In contrast, lower acculturation was associated with higher occupational, household, and total PA levels. In Cambodian Americans, higher acculturation was associated with a higher odds of walking at least 2 days/week.

Qualitative synthesis

Study Characteristics. Eight qualitative studies included in this review investigated PA (Table 2.2). Three conducted individual interviews (Choi, Cho, et al., 2021; Kim et al., 2014; W. Y. Mao et al., 2020), four conducted focus groups (Daniel et al., 2018; Dave et al., 2015; Katigbak et al., 2019; Riley et al., 2016), and one used an online forum (Im et al., 2012). Two studies explored PA in South Asian Americans (Daniel et al., 2018; Dave et al., 2015), two in elderly Chinese Americans (Katigbak et al., 2019; W. Y. Mao et al., 2020), two in Korean Americans (Choi, Cho, et al., 2021; Kim et al., 2014), and one each in AsAms (Im et al., 2012) and Bangladeshis Americans (Riley et al., 2016). The sample size ranged from 5 to 67. Four studies were restricted to females only. The mean ages of participants ranged from 42-77, except one did not include participants' mean age. Three studies identified the theoretical framework underpinning the themes or interview questions (Daniel et al., 2018; Dave et al., 2015; Im et al., 2012). A broad range of themes emerged, including PA perception, changes through life stages, attitudes towards PA, barriers and facilitators to PA participation, and cultural effects on PA (Table 2.3).

PA had been defined differently across AsAm ethnic groups. Bangladesh women expressed that household PA is the same as exercise (Riley et al., 2016); some South Asian Indian women described PA as leisure-time PA only (Daniel et al., 2018); Elderly Chinese women viewed PA as an integration of physical and mental activities (Katigbak et al., 2019). Knowledge of PA is low among South AsAms such that they have little knowledge about PA recommendations and PA benefits for chronic illness prevention (Dave et al., 2015).

Barriers to PA. Eight studies reported barriers to PA participation among AsAm women (Table 2.3). Major barriers were 1) family-related responsibilities, 2) lack of encouragement, and 3) cultural norms.

Family-Related Responsibilities. Women in five studies reported that family members' needs, and household responsibilities are more important, leaving them with no time or energy for PA (Choi, Cho, et al., 2021; Daniel et al., 2018; Dave et al., 2015; Im et al., 2012; Katigbak et al., 2019). AsAm women viewed the importance of their family's needs and wellbeing over their own and would make sacrifices for it (Daniel et al., 2018; Im et al., 2012). Women considered housekeeping or daily chores as a type of PA, so they did not need to engage other types of PA (Daniel et al., 2018; Riley et al., 2016). Some elderly Chinese American women reported that caregiving to grandchildren was a PA barrier because it disrupted their PA plan (Katigbak et al., 2019).

Lack of Encouragement. The other significant barriers were lack of encouragement in childhood and midlife (Choi, Cho, et al., 2021; Daniel et al., 2018; Dave et al., 2015; Im et al., 2012). Women described that when they were young, their families told them that they were thin enough, did not need to work out, or they should spend time on cooking, household work, or academic pursuits rather than PA (Dave et al., 2015; Im et al., 2012). Midlife women also report feeling a lack of encouragement or support. For example, spouses did not want to participate in PA with them, resulting in a loss of motivation to engage in PA (Daniel et al., 2018). A woman reported that her spouse would make fun of her posture when she was exercising at home (Choi, Cho, et al., 2021).

Cultural Norm. South AsAm women, especially Muslims, believed that cultural norm was a barrier to PA. Leisure-time PA was not a norm in South Asian culture and was further restricted by a lack of culturally appropriate facilities (Dave et al., 2015; Riley et al., 2016). Examples included mixed-sex indoor or outdoor facilities and the use of male instructors that are unacceptable for their religion (Dave et al., 2015; Riley et al., 2016). Chinese Americans were more likely to participate in traditional PA types, such as Tai Chi, Yuanji dance, and Kung Fu (W. Y. Mao et al., 2020).

Other barriers. Other barriers were reported, such as physical illness (Dave et al., 2015), too busy, soreness after exercise, and bad weather were reported (Choi, Cho, et al., 2021). Structural barriers such as safety concerns and lack of an exercise-friendly environment were mentioned in two studies (Choi, Cho, et al., 2021; Daniel et al., 2018). For example, women reported feeling unsafe when walking alone or uncomfortable walking in the neighborhood because of unleashed dogs. Immigrant women reported that the environmental change from their country of origin to the US was a barrier because it was hard to pursue a physically active lifestyle such to the lack of infrastructure to support walking or public transportation (Choi, Cho, et al., 2021; Im et al., 2012).

Facilitators of PA. Several facilitators were indentified across studies. Social support and social interaction were highlighted as important facilitators to initiate or maintain PA (Daniel et al., 2018; Dave et al., 2015; Kim et al., 2014; W. Y. Mao et al., 2020).

Social Support. Social support includes informational, emotional, and instrumental support facilitating PA. Women reported they felt motivated to do PA if they received encouragement from a family member or if they had someone with whom

they could do PA. Three studies found that having a workout partner or working out with people with similar cultural backgrounds would positively influence PA (Choi, Cho, et al., 2021; Daniel et al., 2018; Im et al., 2012). Further, immigrant women described adaptation challenges, including language barriers, loneliness, and limited social networks (Kim et al., 2014; W. Y. Mao et al., 2020). Because of such adaptation challenges, participating in PA expanded their social networks and allowed them to meet people from the same ethnic background, improved their psychological well-being, and motivated them to maintain regular PA (Kim et al., 2014; W. Y. Mao et al., 2020).

Other Facilitators. Physician recommendations to participate in PA and awareness of PA benefits can motivate women to engage in PA (Dave et al., 2015). These women were more willing to engage in PA when they believed that PA was the way to maintain physically and mentally healthy (Choi, Cho, et al., 2021; Daniel et al., 2018), and reported they were willing to do PA to become healthier or reduce the risk of health problems (Choi, Cho, et al., 2021; Daniel et al., 2018; Riley et al., 2016). Finally, staying in shape (Daniel et al., 2018), trying small changes in daily life (Choi, Cho, et al., 2021), and gaining confidence from small achievements (Choi, Cho, et al., 2021) were additional facilitators.

Discussion

The quantitative studies included in this review varied by research focus. The relationship between PA and neighborhood environment, acculturation, social network, and other lifestyle behaviors were examined. This review only identified one pilot RCT despite low PA levels in AsAm women (CDC, 2004; Kandula & Lauderdale, 2005; Kao et al., 2016; Yi et al., 2015). One of the challenges AsAm women face is the lack of

recent or reliable data for PA levels and the inconsistency of PA measurement that prevent the development of effective PA programs. All cross-sectional studies used self-report surveys to measure PA participation, which limits reliability such as social desirability bias. PA outcomes used in examining barriers and facilitators were different across studies making it challenging to compare factors associated with PA. Therefore, more quantitative research using objective PA measurement with the standard PA guidelines is needed on PA in this population.

The qualitative studies reviewed for this paper varied by methods, population ethnicity, sample size, and research focus. Lack of social support and competing family responsibility are the most common themes in most studies. The different cultural backgrounds and religions of Asians have other influences on their PA. For example, religion seems to be a more relevant factor to PA in Muslim AsAms but is not seen in Koreans and Asian Indians. Findings suggest that religion is a barrier and facilitator in South AsAm women. Culturally inappropriate facilities were a barrier to PA participation in South AsAms; Meanwhile, participating in the religious activity itself is an essential type of PA among South AsAms.

Acculturation's influence on PA was described or investigated in qualitative and quantitative studies (Choi, Cho, et al., 2021; Im et al., 2012; Joseph et al., 2019; Kim et al., 2014; W. Y. Mao et al., 2020). In qualitative studies, lifestyle changes because of the acculturation process were mentioned as a barrier to transportation PA (Choi, Cho, et al., 2021; Im et al., 2012). For example, walking was one of Koreans' main types of daily PA. After immigrating, women changed to driving more than walking because walking was not as common or safe in the US. Another quantitative study reported that higher

acculturated women had the highest level of leisure-time PA, but lower acculturated women had the highest level of total, occupational, and household PA (Joseph et al., 2019). Due to substantial differences in culture and lifestyles between Asian and American, the impact of acculturation on these women's PA needs further investigation.

Overall, with the synthesis of qualitative and quantitative findings, this review demonstrated that many AsAm women view PA as part of daily life activity and do not need structured time for PA. With the adaptation to American culture, this view is gradually changing to participation in more leisure-time PA. Because heavy reliance on automobiles for transportation in the US reduced AsAm women's daily PA; meanwhile, their lack of awareness of the need to adopt leisure PA may make them the most vulnerable group. Therefore, those in the early acculturation process may need more attention.

Limitations of this review arise from limited research focusing on AsAm women's PA, despite the low PA level in this population. Further, the discrepancies and inconsistencies in PA instrumentation, PA type measured, guidelines or recommendations adopted by different researchers, samples, and other confounding factors increased the challenges for finding comparison. These made it difficult to fully use the extracted data and impossible to compare the PA prevalence between different subgroups or assess PA factors with certainty.

Conclusion

This systematic review provides some insights on factors associated with PA among AsAm women based on quantitative and qualitative studies conducted to date. Current evidence showed a longstanding knowledge gap on PA in this population, which

can hinder PA interventions. Efforts to increase PA have been reported intensively in other minority groups. However, AsAm women's PA has received less attention than the general US population and other minority groups; therefore, there is little information on factors associated with PA in this population and the percentage of AsAm women whose PA complies with PA recommendations. To better understand PA in AsAm women, robust studies that include representative samples and that use consistent or objective PA measurements are required. More information about PA levels and factors among AsAm women is warranted to guide PA intervention in this population that attains health equity for all Americans.

Table 2.1 PubMed Searching Strategy

Concept 1 – Asian Americans
Part 1
#1 Asian Americans [MeSH]
#2 Asian American* [TIAB]
#3 #1 OR #2
Part 2
#4 Asia, Southeastern [MeSH]
#5 Asian Continental Ancestry Group [MeSH]
#6 Far East [MeSH]
#7 Asian Indian* [TIAB]
#8 Bangladesh* [TIAB]
#9 Burma [TIAB]
#10 Burmese [TIAB]
#11 China [TIAB]
#12 Chinese [TIAB]
#13 Cambodia* [TIAB]
#14 Filipina* [TIAB]
#15 Filipino* [TIAB]
#16 Hmong* [TIAB]
#17 Indochin* [TIAB]
#18 Japan* [TIAB]
#19 Korea* [TIAB]
#20 Lao people* [TIAB]
#21 Laos [TIAB]
#22 Laotian* [TIAB]
#23 Malaysia* [TIAB]
#24 Mongol* [TIAB]
#25 Myanmar [TIAB]
#26 Nepal* [TIAB]
#27 Pakistan* [TIAB]
#28 Philippines [TIAB]
#29 Singapore* [TIAB]
#30 Taiwan* [TIAB]
#31 Tibet* [TIAB]
#32 Thai* [TIAB]
#33 Vietnam* [TIAB]
#34 Combine #4 - #33 with OR
Part 3
#35 Emigration and Immigration [MeSH]
#36 Refugees [MeSH]
#37 United States [MeSH]
#38 America* [TIAB]
#39 immigrant* [TIAB]
#40 immigration [TIAB]
#41 refugee* [TIAB]
#42 United States [TIAB]
#43 USA [TIAB]
#44 U.S.A. [TIAB]
#45 Combine #35 -44 with OR
#46 #34 AND #45 Combining Parts 2 and 3 (Countries and American)
#47 #3 OR #46 (Including Asian Americans and Combo from above)
Concept 2 – Exercise
#48 Exercise [MeSH]
#49 Physical Fitness [MeSH]

#50	Sports [MeSH]
#51	aerobic* [TIAB]
#52	bicycl* [TIAB]
#53	cardio [TIAB]
#54	dancing [TIAB]
#55	exercis* [TIAB]
#56	hiking [TIAB]
#57	jogging [TIAB]
#58	physical activit* [TIAB]
#59	physical fitness [TIAB]
#62	runner* [TIAB]
#63	sport* [TIAB]
#64	swim*[TIAB]
#65	walk* [TIAB]
#66	#48 - #65 Combine with OR
#67	#66 AND #47 (Added combined exercise terms AND Asian American terms)
Removed child only	
#68	infant [MeSH]
#69	child [MeSH]
#70	adolescent [MeSH]
#71	#68 -#70 with OR
#72	#71 adult [MeSH]
#73	NOT (#71 NOT #72)
#74	#67 AND #73
#75	Limit to 2010 forward
#76	English only

Table 2.2 Studies and participant characteristics (N = 15)

Quantitative study (n = 7)						
First author (Year)	Study region	Sample size[a]	Ethnicity, mean age in years/ age range	Study design	Theoretical Framework	PA measures
Lee (2010) (Lee & Im, 2010)	National	91	Asian American, 49	Cross-sectional (secondary data analysis)	Feminist	Self-reported, assessed sport and LTPA hours over the past week
Zhou (2012) (Zhou & Oh, 2012)	National	187 (62% F)	Asian American, 61	Cross-sectional (BRFSS)	No	Self-reported, assessed MVPA min per week.
Nelson-Peterman (2015) (Nelson-Peterman et al., 2015)	Lowell, Massachusetts	154	Cambodian, 47	Cross-sectional	No	Self-reported, assessed at least 10 min walking day/week
Joseph (2019) (Joseph et al., 2019)	Texas	261	Asian Indian, 35	Cross-sectional	Social-ecological framework	Self-reported, International Physical Activity Questionnaire
Thanawala (2020) (Thanawala et al., 2020)	California, 2014-2017	305 (44% F)	Asian Indian, 58	Cross-sectional	No	Self-reported, Cross-Cultural Activity Participation Study
Choi (2021) (Choi, Shin, et al., 2021)	San Francisco, California	40	Korean, 48	Pilot, Randomized control trial (online social community)	Social Cognitive Theory and the Stages of Change Model	Self-reported, International Physical Activity Questionnaire short form; with time spent in aerobic activities and number of days spent in muscle-strengthening activities Fitbit
Yi (2021) (Yi et al., 2021)	California	419 (46% F)	South Asian, 54	Cross-sectional	No	Self-reported, Cross-Cultural Activity Participation Study
Qualitative study (n = 8)						
Im (2012) (Im et al., 2012)	n/a (internet recruitment)	17	Asian American, 49	Online forum	Feminist	Attitudes and beliefs of PA

Kim (2014) (Kim et al., 2014)	n/a	5 (38% F)	Korean, ranged 34-60	Individual interview	n/a	Meanings given to PA involvement through interactions with member of the same ethnic group
Dave (2015) (Dave et al., 2015)	Chicago	42	South Asian,18-71	Focus group	Socio-ecological model	Life stage influences on PA
Riley (2016) (Riley et al., 2016)	New York City	25 (37% F)	Bangladeshis, 42	Focus group	No	understand factors that affect physical activity and weight management
Daniel (2018) (Daniel et al., 2018)	Not applied	67	South Asian Indian, 50	Mixed-method, focus group	PA Framework for SAI Immigrants	Barriers and motives to PA
Katigbak (2019) (Katigbak et al., 2019)	Boston, Massachusetts	38 (64%F)	Chinese, 76	Mixed-method, focus group	No	Understand the culturally bound attitudes, behaviors, and beliefs related to PA
Mao (2020) (W. Y. Mao et al., 2020)	Los Angeles, California	13 (54%F)	Chinese, 77	Individual interview	No	Identify acculturation experiences and describe their influences on health behaviors of older Chinese immigrants
Choi (2021) (Choi, Cho, et al., 2021)	California	37	Korean, 48	Individual interview	No	Barriers and facilitators of PA after participating in a PA program

[a]Sample size reports Asian American women only
Abbreviation: F, female; PA, physical activity

Table 2.3 Physical activity measurements and major themes in Asian American women

Quantitative Study			
Author (year)	PA measured in the study	PA outcome used in examination of barriers and facilitators	PA rates
Lee (2010)	Sport and LTPA hours/week (leisure)	Hour/week	Sport: 4.06 (4.17) LTPA: 5.92 (4.95) Mean with SD, hour/week
Zhou (2012)	MVPA (all domains, but did not separately report)	Meeting PA guideline (≥150 min/week)	42.5% (both sex) meet PA guidelines.
Nelson-Peterman (2015)	Number of walking day (not specifically report which domains)	< 2 days/week and ≥ 2 days/week	49% had ≥ 2 days/week of at least 10 min walking.
Joseph (2019)	MVPA (occupational, household, and leisure)	MET scores	Total PA: 153, 108, 113. Occupational: 157, 113, 105. Household PA: 152, 135, 103. LTPA: 95, 131, 177. Above mean MET showed as low acculturation-immigrant, high acculturation-immigrant, and high acculturation-nonimmigrant, respectively.
Thanawala (2020)	MVPA (leisure)	MET scores	Median MET for female: 1267 min/week
Choi (2021)	MVPA (occupational, household, and leisure)	Min/week	Pre / Post IPAQ (min/week) Intervention: 115 / 363 Control: 139 / 312 Aerobic (min/week) Intervention: 42 / 215 Control: 43 / 192 Muscle (day/week) Intervention: .4 / 3.2 Control: .3 / 1.7
Yi (2021)	Light, moderate, and heavy PA (household, transportation, occupational,	Meeting PA guidelines (> 500 MET min/week)	Median MET for female: 9720 min/week 64.4% (female only) meet PA guidelines

	leisure, and exercise but did not separately report)		
Qualitative study			
Author (year)	Major themes	Facilitators	Barriers
Im (2012) (Im et al., 2012)	Attitudes toward PA: Keeping traditions, not a priority, and not for Asian girl	▪ Having people from the similar cultural background would be a positive influence on PA	▪ PA is part of daily life. ▪ Watching TV programs. ▪ Acculturation process. ▪ Children's need, intellectual activity and life events are more important than PA. ▪ Lack of encouragement in childhood.
Kim (2014)	The experience of psychological well-being. The creation of a unique cultural work. The facilitation of PA involvement.	▪ Having social interaction. ▪ Establishing new social network ▪ Seeing psychological benefit	▪ Limited social networks ▪ Discrimination experience ▪ English proficiency ▪ PA was not among their leisure preference
Dave (2015) (Dave et al., 2015)	PA changes through life stages. PA decreased after marriage and having children. Health condition impacts older women PA ability.	▪ Social support. ▪ Recognizing benefits of PA ▪ Receiving physical advice from physician	▪ Family responsibility. ▪ Cultural and social norms. ▪ Lack of awareness, personal perception and beliefs. ▪ Physically limited.
Riley (2016) (Riley et al., 2016)	Women and men views PA and exercise differently. Religious activity is views as a type of PA.	▪ Religious activity itself is an important type of PA.	▪ Male and female exercising in the same indoor place is unacceptable. ▪ Limited outdoor facilities because of religious beliefs. ▪ PA is equal as exercise. ▪ Housekeeping is a type of PA.
Daniel (2018) (Daniel et al., 2018)	Role expectation is a core theme for barriers and self-motivation is core theme for motivations	▪ Maintain optimal physical and psychological health. ▪ Obtain beauty appearance ▪ Having strong social support	▪ Lack of time because of housework. ▪ Family's needs are more important. ▪ Lack of encouragement from spouse or children. ▪ Lack of accessibility (no places, unsafe). ▪ Bad weather

Katigbak (2019)	Physical activity integrates the mind and body. Traditional Chinese culture influences perceptions and preferences for PA. PA presents opportunities for social engagement. PA facilitate family harmony.	▪ Social engagement ▪ Belief of PA promote longevity	▪ Family responsibilities ▪ Caregiving to grandchildren
Mao (2020)	High dependence on intraethnic networks influences health behaviors. Value-informed preference in types of exercise.	▪ Senior Centers ▪ Traditional PA: Pingpong, Tai Chi, and Yuanji dance ▪ Group activity	▪ n/a
Choi (2021) (Choi, Cho, et al., 2021)	The individual, interpersonal, and neighborhood/community-level barriers to and facilitators of PA	▪ Trying small changes from their daily activity. ▪ Gain confidence from small achievement. ▪ Feel under pressure when wearing Fitbit. ▪ Health problem concerns/willing to become healthier.	▪ Too busy/tired/stressed from work or family responsibility. ▪ Lack of interest/ willpower. ▪ illness/discomfort/body ache after exercise. ▪ Workout alone. ▪ Lack of social support ▪ Bad weather ▪ Lack of accessibility (no places, unsafe).

Abbreviations: MET, metabolic equivalent of task; PA, physical activity; MVPA, moderate-to-vigorous PA; LTPA, leisure time PA.

Table 2.4 Factors and association/non-association with physical activity in Asian American women

Category	Factors	A positive association (p<.05)	A negative association (p<.05)	No association (p>0.05)
Demographic factors	Older age	Nelson-Peterman (2015)	Yi (2021)	Lee (2010), Zhou (2012)
	Being married			Nelson-Peterman (2015), Lee (2010), Zhou (2012), Yi (2021)
	Higher education			Lee (2010), Yi (2021)
	Being employed		Lee (2010)	
	Higher income			Zhou (2012), Yi (2021)
Health related factors	Being overweight/obesity			Lee (2010), Zhou (2012)
	Being a current smoker			Zhou (2012)
	Adequate intake of fruits/vegetables			Zhou (2012)
	Perceived poor health status		Zhou (2012)	Lee (2010)
	Being physically illness			Zhou (2012)
	High blood pressure			Zhou (2012)
	High cholesterol concentration	Zhou (2012)		
	Having sever menopausal symptoms			Lee (2010)
Others	Higher number of children		Lee (2020)	
Environment Factors	Living longer years in neighborhood	Yi (2021)		
	Higher neighborhood social cohesion			Yi (2021)
	Feeling safe in neighborhood	Daniel (2017)*, Choi (2021)*		Yi (2021)
	Shorter distance from park/playground	Daniel (2017)*		Yi (2021)
	Lacking culturally appropriate facilities		Daniel (2017)*, Riley (2016)*	
	Bad weather		Choi (2021)*, Daniel (2017)*	
Acculturation factors	Higher acculturation	Nelson-Peterman (2015), Joseph (2019)[a]	Joseph (2019)[a]	
	Longer Tine in the US			Yi (2021)

PA Knowledge and beliefs	Recognizing benefits of PA	Dave (2015)*		
	Having religious activity	Riley (2016)*		
	Traditional beliefs		Dave (2015)*, Riley (2016)*, Kim (2014)*	
	Self-motivation: optimal physical and psychological health, Obtaining beauty appearance	Riley (2016)*, Daniel (2017)*, Kim (2014)*		
	Lack of interests		Daniel (2017)*	
Social factors	Stronger social support	Daniel (2017)*, Dave (2015)*		Yi (2021)
	Having social interaction	Kim (2014)* Mao (2020)*		Choi (2021)
	Lack of encouragement		Im (2012)*, Dave (2015)*, Daniel (2017)*	
	Spouse was an exercise partner	Thanawala (2020)		
	Too many family responsibility		Im (2012)*, Dave (2015)*, Riley (2016)*, Daniel (2017)*,	

[a]Joseph (2019) reported low acculturation-immigrant women have highest occupational, household, and total PA; high-acculturation-nonimmigrant had highest LTPA.

*qualitative studies. The qualitative studies contain rich information on factors associated with PA. We put major themes results in the qualitative studies as an association factor.

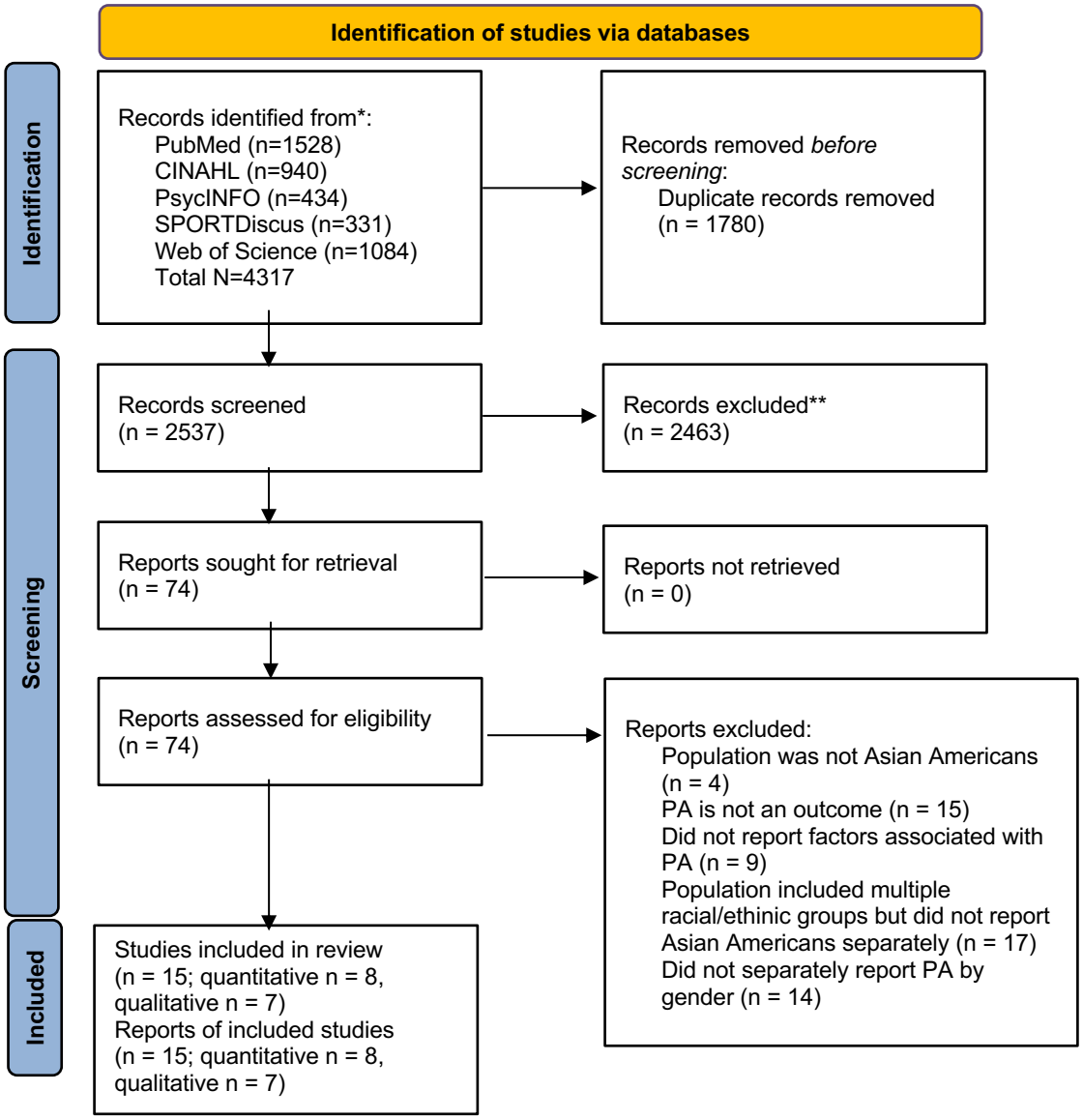

Figure 2.1 PRISMA Flow Chat

CHAPTER 3

STUDY ONE: SOCIODEMOGRAPHIC, HEALTH-RELATED, AND ACCULTURATION DETERMINANTS OF PHYSICAL ACTIVITY AMONG ASIAN AMERICAN WOMEN

The AsAm population increased by about 82% between 2000 and 2019, which doubled the population to 23 million by 2019. AsAms now account for approximately 7% of the US population (U.S. Census Bureau, 2021), and the AsAm population is expected to triple by 2050 (Budiman & Ruiz, 2021). Despite the AsAm population being the fastest-growing racial group in the US, few studies have included AsAms when investigating PA or those that include them tend to be outdated (Afable-Munsuz et al., 2010; CDC, 2004; Kandula & Lauderdale, 2005; Kao et al., 2016; Li & Wen, 2013; Maxwell et al., 2012; Yi et al., 2015).

Current PA Guidelines for Americans recommend at least 150 minutes of moderate-intensity (or vigorous-intensity equivalent) aerobic PA per week (Singh et al., 2020). However, from limited findings, lack of PA has been shown to be a persistent phenomenon in AsAms, particularly among women (Afable-Munsuz et al., 2010; CDC, 2004; Kandula & Lauderdale, 2005; Kao et al., 2016; Li & Wen, 2013; Maxwell et al., 2012; Yi et al., 2015). In 2001, the California Health Interview Survey indicated that the prevalence of meeting the aerobic PA recommendations was lower in AsAm women (20.0% among those 18-39 years of age, and 20.6% in those 40-59 years of age) than in

US-born non-Asian women (35.8% among those 18-39 years of age, and 31% in those 40-59 years of age) (Kandula & Lauderdale, 2005). The CDC (2004) reported that about 36% AsAm women met the aerobic PA recommendations compared to 43% of general US women in 2003. The 2010 Health of Houston Survey showed that AsAms had the lowest prevalence of meeting the aerobic PA recommendations (38.6%) compared to other racial groups (49.9%, 45.5%, 45.4%, 54.1% among Whites, African Americans, Hispanics, and others, respectively); overall, men (44.4%) had a higher prevalence than women (30.2%). Using data from the 2010 and 2011 New York City Community Health Survey, researchers similarly found that 42.7% of AsAms met the aerobic PA recommendations, which was lower than all other racial groups (61.3% in White, 59.4% in African Americans, 60.2% in Hispanics, and 62.7% in others); the prevalence of meeting the aerobic PA recommendations was higher among men (62.6%) than women (53.8%) (Yi et al., 2015). This study also analyzed the 2011 Los Angeles County Health Survey data. Consistent with previous findings, AsAms (55.8%) had a lower prevalence of meeting the aerobic PA recommendations compared to 64.3% in Whites, 59.8% in African Americans, 62.4% in Hispanics, and 66.2% in others; women (56.9%) were less active than men (67%) (Yi et al., 2015).

PA is critical for maintaining a healthy lifestyle and preventing the onset of various chronic diseases, including type II diabetes, cardiovascular diseases, and cancer (Papadimitriou et al., 2020; Posadzki et al., 2020; Sampath Kumar et al., 2019; Wewege et al., 2018). Despite efforts to improve the PA of all Americans, current strategies focused on increasing PA may not be reaching minority populations (Hasson et al., 2017). A critical gap is the lack of understanding of predictors of PA among AsAm

women. To address the gap and improve the effectiveness of PA promotion efforts, an important area of inquiry is to determine what factors influence PA in this minority population.

Various sociodemographic factors have been associated with PA in various racial/ethnic populations (Becerra et al., 2015; Ferrari et al., 2020; Jaeschke et al., 2020; Mitas et al., 2019; Sabia et al., 2014; Whitfield et al., 2019). Across studies, women were consistently less active than men (Becerra et al., 2015; CDC, 2019; Ferrari et al., 2020; Kao et al., 2016; Mitas et al., 2019). Associations between age and PA are complex. There is some evidence for a curvilinear relationship between age and leisure PA, with higher PA among the youngest and oldest groups (Mitas et al., 2019). Younger age was associated with higher leisure aerobic PA (CDC, 2019). Some findings from these studies indicate that adults with higher education levels were more likely to meet PA recommendations or engage in higher PA levels (Mitas et al., 2019; Whitfield et al., 2019; X. Zhu et al., 2021). However, most studies do not provide insight into how sociodemographic factors affect different PA domains. A greater understanding of relationships between sociodemographic factors and domain-specific PA is needed to inform strategies to increase PA.

Multiple health-related factors such as body mass index (BMI), smoking status, perceived health status, sleep status, and depression are also related to PA, but findings vary across studies (Brailovskaia & Margraf, 2020; Jaeschke et al., 2020; McClain et al., 2014; Pengpid & Peltzer, 2019). For example, higher BMI has been negatively associated with low-intensity PA, but not associated with moderate-to-vigorous PA (Jaeschke et al., 2020). Current smokers had higher low-intensity and vigorous-intensity PA than those

who never smoked (Jaeschke et al., 2020), and physical inactivity has been positively associated with depression (Cho et al., 2018). Findings on associations between health-related factors and PA are often based on data from the general population, and findings specific to AsAm women are lacking.

According to the Pew Research Center, about 71% of AsAm adults are foreign-born (Budiman & Ruiz, 2021). As a racial minority with a large number of immigrants, the pattern of AsAms' PA may have unique variations with immigration and acculturation (Joseph et al., 2019; X. Zhu et al., 2021). Acculturation has been defined as the process of social, psychological, and cultural changes by which immigrants adjust to the host country's norms (Bornstein, 2017). Acculturation is linked to PA and health outcomes in ethnic minorities, but the relationship between acculturation and domain-specific PA is unclear (Abraido-Lanza et al., 2016; Benitez et al., 2016; Fox et al., 2017). PA is defined in various contexts or domains related to work, household, transportation, and leisure (Strath et al., 2013). A positive relationship has been found between acculturation and leisure PA (Gerber et al., 2011; Yan & Cardinal, 2019; X. Zhu et al., 2021). In contrast, other researchers have found negative associations between acculturation and transportation PA (Berrigan et al., 2006; Dogra et al., 2010; Murillo et al., 2015), whereas others showed no association (Kandula & Lauderdale, 2005; Mathew, 2014; Pichon et al., 2007). Work PA has been negatively associated with acculturation (Camplain et al., 2020; Joseph et al., 2019), but one study observed no association (Murillo et al., 2015).

Although several studies have provided insight into factors associated with PA, there is a significant gap in understanding PA in AsAm women. Moreover, most research

and national reports regarding PA often focused only on leisure PA. However, work, transportation, household, and leisure PA can all contribute toward meeting PA recommendations (Singh et al., 2020). To understand and promote PA for AsAm women, it is essential to consider factors influencing PA behavior across the different domains. Therefore, the purpose of this study is to 1) describe AsAm women's PA and 2) investigate the sociodemographic, health-related, and acculturation factors linked to each PA domain (i.e., work, transportation, and leisure) and total PA to inform future interventions for increasing PA among AsAm women.

Methods

Study Design

This is a secondary data analysis using cross-sectional data from the 2011-2018 National Health and Nutrition Examination Survey (NHANES). The NHANES is an ongoing health-related study that uses a multistage stratified probability cluster design to measure health and nutrition in a nationally representative sample of non-institutionalized civilians in the US every two years. Since 2011, the NHANES has oversampled AsAms to provide a more accurate health status estimation for this group because they have been historically underrepresented in health research. Survey questionnaires and a standardized health examination are used in the assessments. The NHANES was approved by the National Hospital Care Survey Research Ethics Review Board.

Participants and Settings

The study population included 1605 non-Hispanic AsAm women (age ≥ 18) surveyed in the 2011-2018 (weighted sample size equated to 7,129,653 women). Participants first completed professionally administered survey questionnaires at their

residences. Afterwards, participants were invited to a mobile examination center (MEC) for a standardized health assessment.

Measurements

Physical Activity. NHANES measured PA using the Global Physical Activity Questionnaire (GPAQ) developed by the World Health Organization (Bull et al., 2009). The GPAQ consists of 19 items to assess PA in three behavioral domains: work (WPA), transportation (TPA), and leisure (LPA). WPA includes both occupation and household PA. Questions assess the frequency and duration of vigorous- or moderate-intensity activity within the work and leisure domains. The frequency and duration of all walking and cycling for transportation are captured in the transport domain, but no attempt is made to discriminate between intensity levels for these activities; therefore, TPA was classified as moderate-intensity PA in accordance with existing research (Ainsworth et al., 2011). Current PA guidelines recommend either 150 minutes per week of moderate-intensity or 75 minutes per week of vigorous-intensity, or an equivalent combination of moderate and vigorous PA (Singh et al., 2020). Given that vigorous-intensity PA has a metabolic equivalent of task (MET) score roughly double moderate-intensity PA, minutes of vigorous-intensity PA were multiplied by two and added to moderate-intensity PA minutes (Kim et al., 2022). In order to examine the predictors within each PA domain, all minutes of PA reported were summed by domain. The total PA was summed transportation, work, and leisure PA. The participants were categorized into groups according to whether they completed the recommended 150 minutes of moderate-to-vigorous PA in a typical week, as recommended by the 2018 PA guidelines for Americans (Piercy et al., 2018).

Potential Predictors. Figure 3.1 illustrates the variables included in this study based on the availability of NHANES data and previous empirical evidence (Kepper et al., 2019; Kim et al., 2020; Perez et al., 2018; X. Zhu et al., 2021). Potential predictors included sociodemographic variables, health-related variables, and acculturation variables.

Sociodemographic Factors. Sociodemographic included age, education, marital status, income, health insurance, and having a routine place for healthcare. NHANES classified adults aged 80 years and up as 80-years-old to protect their privacy. Education was categorized as high school or less, some college, or college graduate or above. Marital status was categorized as single never married, widow/divorced/separated, and married/living with a partner. Income was categorized less than $20,000, $20,000-$34,999, $35,000-$65,000, and over $65,000. Having insurance and having a routine place for healthcare were categorized as yes or no.

Health-related Factors. Health related variables included body mass index (BMI), asthma, arthritis, blood pressure, depression score, smoking status, sleep duration, perceived health status, and perceived weight status. Asthma and arthritis were self-reported and categorized as yes or no. BMI was calculated based on clinically measured weight and height. Blood pressure was measured after participants rested in a seated position for 5 minutes. Three consecutive BP readings were obtained by a certified BP examiner and the average of the three was used. Depression score was a continuous score measured by the nine-item Patient Health Questionnaire (Kroenke et al., 2001). Smoking status was self-reported and categorized as never smoker, current smoker, or former smoker. Sleep duration was measured as the self-reported hours of sleep duration per

night. Perceived health status included excellent, very good, good, and fair or poor. Perceived weight status was categorized as normal or underweight and overweight or obese.

Acculturation. We utilized three proxies to assess acculturation: nativity, length of residency in the US, and language use at home (X. Zhu et al., 2021). We integrated nativity and length of residency in the US as one variable. The distinction between US-born and non-US-born nativity was made. Only AsAms who were not born in the US recorded their length of residency in the country. Thus, length of residency and nativity are divided into three categories: <15 years in the US, ≥15 years in the US, and US-born. Non-English, some English and some non-English, and English only are categorized as the language spoken at home.

Data Analyses

We used SAS 9.4 Software (SAS Institute, Cary, NC) for data analyses. To accurately represent the AsAm population, we used weighted data. Because eight years of NHANES data were collected in four waves, we created 8-year weights by multiplying the 2-year weights by one-fourth (National Center for Health Statistics, 2018). Descriptive analyses were used for sample characteristics. PA behaviors were presented in medians with interquartile range because PA distributions were skewed (Habibzadeh, 2017). Given that the linearity assumption was violated for PA, logistic regression was used to build separate models for each PA domain (work, transportation, and leisure) and for total PA. The cut-off point was based on the PA guidelines recommendations of 150 moderate-to-vigorous minutes/week (Echeverria et al., 2019). Variable selection was backward elimination procedure. We started with all possible predictors and then used

the p-value to compute the model. Variables with the highest p-value were removed until all the remaining variables were statistically significant.

Results

Characteristics of participants

Table 3.1 shows the sample characteristics of AsAm women aged 18 years old or older (n = 1605, unweighted). The majority were middle age (45.15 ± .57), had college or above education (51%), were married or living with a partner (71%), had an income above $65,000 (51%), were insured (87%), and had a routine place to go for healthcare (83%). About 87% of the participants was non-US born with 46% being non-English speaking at home.

Description of PA

Overall, 47.8% of women met the aerobic PA recommendations through any combination of WPA, TPA, or LPA (Table 3.1). The prevalence of meeting the aerobic PA recommendations was highest through LPA (33.5%), followed by WPA (15.7%) and TPA (15.1%). Approximately 5.6% of participants engaged in ≥150 min/week of TPA and ≥150 min/week of LPA; 6.8% engaged in ≥150 min/week of WPA and ≥150 min/week of LPA; and 2.3% engaged in ≥150 min/week of WPA and ≥150 min/week of TPA. The average total PA across all domains was 371 ± 22 min/week. The proportion of time spent on each domain of PA was 38.9% through LPA (144 ± 8 min/week), 38.9% through WPA (144 ± 12 min/week), and 21.8% through TPA (81 ± 11min/week).

The median (interquartile range) of total PA was 158 (420) minutes, with median LPA at 25 (210) minutes (Table 3.2). At least 75% of participants did not have any WPA, and 50% did not have any TPA. At least 25% of participants did not have any moderate

PA, and 50% did not have any vigorous PA. The highest medians of total and leisure PA mins/week were observed in those aged 18-39, college and above education, single, income over $65,000, having insurance, and having a routine place for healthcare.

Factors Associated with Meeting aerobic PA Recommendations

Table 3.3 presents the results of multivariable logistic regression analyses of factors associated with participants having a weekly PA ≥ 150 minutes for total PA and through each PA domain. In the total PA model, total PA was negatively associated with age (OR=.99, 95%CI [.98-.99]). Higher education (college and above) was associated with having higher odds of meeting aerobic PA recommendations than those were high school and below (OR=1.60, 95%CI [1.27-2.02]). Compared to the non-English speaking group, English-speaking AsAms had higher odds of meeting aerobic PA recommendations by 72% (OR=1.72, 95%CI [1.32-2.24]).

In the WPA model, WPA was negatively associated with age (OR=.98 95%CI [.97-.99]) but was positively associated with BMI (OR=1.04 95%CI [1.01-1.07]). Compared to non-English speaking women, those who spoke English and spoke both English and non-English had higher odds of having WPA≥150 min/week by 129% (OR=2.29 95%CI [1.53-3.42]) and 64% (OR=1.64 95%CI [1.14-2.34]).

In the TPA model, TPA was positively associated with age (OR=1.02 95%CI [1.00-1.04]) but was negatively associated with systolic BP (OR=.99 95%CI [.98-.996]). Those who were married or living with a partner were 48% less likely to meet the aerobic PA recommendations through TPA compared to being single (OR=.52 95%CI [.33-.81]). The odds of meeting the aerobic PA recommendations through active transportation

decreased by 40% among AsAm women living in the US ≥ 15 years compared to those residing in the US < 15 years (OR=.41, 95%CI [.41-.88]).

In the LPA model, compared to the high school and below group, having at least a college education increased was associated with higher odds of meeting the aerobic PA recommendations through LPA by 126% (OR=2.26, 95%CI [1.66-3.08]), followed by an increase of 52% for those who had some college (OR=1.52, 95%CI [1.06-1.69]). Compared to those residing in the US < 15 years, US-born AsAms had the highest odds of meeting the aerobic PA recommendations through LPA (OR=2.17, 95 %CI [1.53-3.08]), followed by women living in the US ≥ 15 years (OR=1.34, 95%CI [1.06-1.69]). Compared to those self-reporting fair or poor perceived health status, those who perceived their health status as excellent or very good had higher odds of meeting the aerobic PA recommendations through LPA by 168% (OR=2.68, 95%CI 1.67-4.29) and 105% (OR=2.05, 95%CI 1.27-3.31).

Discussion

Using a large nationally representative sample of AsAm women, the current study found that the prevalence of AsAm women who met the aerobic PA recommendations through any combination of work, transportation, or leisure was 47.8%. The prevalence of AsAm women meeting the aerobic PA recommendations is lower compared to the 50.6% of US women in general who meet the recommendations (CDC, 2019). This finding is also consistent with prior studies that found AsAms had a lower prevalence of meeting the aerobic PA recommendations than other racial groups (Kao et al., 2016; Yi et al., 2015). Given that PA plays a significant role in disease prevention and control

(Anderson & Durstine, 2019; Luan et al., 2019), our findings highlight the need for PA promotion among AsAm women.

Evidence from this study indicates that most AsAm women did not engage in WPA and TPA, and most of their PA came from moderate-intensity leisure activity. Since work PA is highly related to occupational types, strategies for increasing work PA are complex; therefore, interventions targeting leisure and transportation PA may be more feasible and effective for increasing PA among AsAm women. Active transportation allows people to engage in PA throughout daily life and potentially improve their health, especially for those struggling to find the time for LPA. A meta-analysis found that for people who met the PA guidelines through TPA, the risk of mortality for all causes was reduced by approximately 10% (Kelly et al., 2014). Several studies have found that public transportation use can increase daily PA, decrease sedentary time, and ultimately improve health (Brown et al., 2019; Patterson et al., 2019; Rissel et al., 2012; Saelens et al., 2014). Because safety is an essential consideration for promoting active transportation, infrastructure enhancements such as sidewalks, bicycle lanes, or paths may be warranted to increase active transportation. Thus, promoting active transportation through policy, system, and environmental change with consideration of safe infrastructures is a potential strategy to increase daily PA (Young et al., 2020).

The current study demonstrated that associations between sociodemographic factors and PA varied by domain. Education was only related to LPA such that AsAm women with a college degree and above were 1.26 times more likely to meet the aerobic PA recommendations through LPA than those with a high school degree and below, which is consistent with previous findings (Piirtola et al., 2016). Women with higher

education may have higher health literacy and self-efficacy, leading to higher LPA. Compared to single women, married women were less likely to meet the aerobic PA recommendations through TPA and LPA by 48% and 38%, respectively. Married women could have more family and social responsibilities, which may leave them with less time to engage in PA other than work. The differences across education and marital status could be important to consider in the development of PA interventions targeting AsAm women.

Compared to AsAm women living in the US< 15 years, US-born AsAm women had higher odds of meeting the aerobic PA recommendations through LPA by 117%, followed by those living in the US ≥ 15 years by 34%. This finding was consistent with previous studies among Chinese and Asian Indian Americans in which LPA increased with greater acculturation to the US (Joseph et al., 2019; Yi et al., 2016). LPA is a societal norm in the US but not in Asian countries (Ranasinghe et al., 2013; Zou et al., 2020); therefore, LPA shifts towards the immigrated country due to cultural assimilation. Also, our study demonstrated that longer residency time in the US was significantly associated with lower TPA. While walking isone of the primary forms of daily PA in Asian countries (Im et al., 2012; Ranasinghe et al., 2013), AsAms who immigrate to the US may engage in less walking because automobiles are more commonly used for transportation in the US compared to other countries (U.S. Department of Energy, 2017). In addition, public transportation usage is relatively low in the US compared to Asian countries (Benfield, n/a). Therefore, AsAm women may gradually convert their PA behaviors towards the dominant society as they acculturate to the US.

As the fastest increasing group in the US, the high growth rate of AsAm adults is mainly driven by immigration with 71% being foreign-born (Budiman & Ruiz, 2021). Our findings suggest that new AsAm immigrant women would be the group that needs the most help with LPA education during the cultural adaptation process. For AsAm women who had a longer residency length, PA promotion strategies should consider emphasizing daily active commuting. Future interventions should consider their PA behavior needs with the acculturation process to develop effective PA programs.

Interestingly, even though our findings demonstrates that 75% of this population has no work-related moderate-to-vigorous PA, English speaking AsAm women were 1.29 times likely to have higher odds of meeting the aerobic PA recommendations via work than non-English speaking AsAm women. Given that the intensity of WPA is closely related to occupation, this finding may be related to education level and occupation types. According to the US Bureau of Labor Statistics, AsAms were the highest educated racial group, with 65% having a bachelor's degree or above, compared to 41% Whites, 32% Black, and 22% Hispanics (U.S. Bureau of Labor Statistics, 2020). Evidence also suggests that 53% of AsAm women work in management, professional, and related occupations (U.S. Bureau of Labor Statistics, 2020). Therefore, we surmise that English proficient women may have more access to broader types of employment opportunities including physically active occupations.

The current study found that self-perceived health status was only related to LPA. AsAm women's better self-perceived health status (excellent or very good) was more likely to be physically active in their leisure time than fair or poor groups, consistent with prior studies. One previous study found exercise was associated with better self-reported

health status among midlife women, including Whites, Hispanics, African Americans, and AsAms (Lee & Im, 2010). Another study found that LPA but not WPA was associated with perceived health status; women, regardless of race, who expend 1000 kcal/week or more on LPA had a significantly lower risk for poor perceived health status (Kaleta et al., 2006). Similar results were found in female adolescents (aged 14-19) in which insufficient participation in PA was linked to negative health self-perception (Silva et al., 2019). AsAm women who purposely engage in regular LPA may be more knowledgeable about the health benefits of regular PA and motivated to engage in PA to improve their health compared to those in physically active occupations or those who actively commute for non-health related reasons. Additional research on AsAm women's motivations for engaging in LPA and TPA is needed to understand why better self-reported health status was only associated with LPA in the current study.

Strength and Limitations

The present study used a large, nationally representative sample of AsAm women in the US to describe PA and examine potential predictors associated with their PA by domains; therefore, findings can be generalized to the current AsAm women. NHANES includes a rigorous data collection process for many variables that are relevant to understanding PA among AsAm women. To our knowledge, this is the first study to examine predictors of domain-specific PA in AsAm women, resulting in a more comprehensive understanding of PA in this population that will inform future research and guide interventions to increase PA. Limitations of this study include using self-reported PA data to examine PA behaviors, which may be susceptible social desirability biases. Further, acculturation was measured by acculturation proxies, commonly used in

minority health-related research (Wong et al., 2013; X. Zhu et al., 2021). However, those acculturation proxies might not reflect on actual acculturation levels. For example, language use at home might not reflect language acculturation. Future research should consider using culturally appropriate acculturation questionnaires when measuring acculturation. Last, the current study reported AsAms as a single racial group, which may have obscured differences across AsAm subgroups. Because AsAms have a diverse cultural background, future research may focus on specific subgroups to avoid overgeneralizing research findings.

Conclusion

Less than half of AsAm women meet the aerobic PA recommendations, which underscores the need for strategies to enhance PA in this population. The effect of sociodemographic, health-related, and acculturation factors varies by PA domain. Lower educated, married, or perceived lower health status AsAm women might need the most help in PA promotion. There is a need for strategies that target enhanced leisure PA in new Asian immigrants. PA promotion efforts for AsAm women with higher acculturation may emphasize active transportation. Health professionals and organizations should consider how sociodemographic, health-related, and acculturation factors influence PA in each PA domain and the PA infrastructure when developing PA outreach programs for AsAm women to achieve targeted and effective results.

Table 3.1 Sample characteristics (N=1605)

	Unweighted No. (weighted %)
Sociodemographic	
Age in years, mean ± SD	45.15 ± .57
Education	
High school and below	465 (29)
Some college	308 (21)
College and above	766 (51)
Marital status	
Married/living with a partner	1088 (71)
Widow, divorced, separated	219 (13)
Single	230 (16)
Income	
<$20,000	254 (16)
$20,000-$34,999	140 (9)
$35,000-$65,000	351 (24)
>$65,000	720 (51)
Insurance	
Yes	1384 (87)
Have routine place to go for healthcare	
Yes	1339 (83)
Health related factors	
Body mass index (kg/m^2), mean ± SD	24.72 ± .14
Depression score, mean ± SD	2.36 ± .09
Systolic BP (mmHg), mean ± SD	118.66 ± .53
Diastolic BP (mmHg), mean ± SD	70.50 ± .33
Sleep duration (hours), mean ± SD	7.34 ± .04
Asthma	
No	1452 (91)
Arthritis	
No	1299 (86)
Perceived Health Status	
Excellent	269 (17)
Very good	502 (32)
Good	608 (38)
Fair or poor	225 (13)
Perceived weight status	
Normal or underweight	980 (61)
Overweight	622 (39)
Smoke Status	
Never	1436 (91)
Former	99 (6)
Current	52 (4)
Acculturation	
Language spoken at home	
Only English	403 (26)
Both non-English and English	440 (28)
Only non-English	759 (46)
Nativity with length of residency	
<15 years	611 (39)
≥15 years	764 (48)
US born	218 (13)
Met physical activity recommendations	
Through WPA	
Yes	245 (15.7)

Through TPA	
Yes	261 (15.1)
Through LPA	
Yes	514 (33.5)
Through any combination of WPA, TPA, or LPA[a]	
Yes	763 (47.8)

BP, blood pressure; SD, standard deviation; US, United States; WPA, work physical activity; TPA, transportation physical activity; LPA, leisure physical activity.

[a]The proportions of respondents meeting PA guidelines through the three distinct domains of PA will not add up to this combined measure since a respondent may meet PA guidelines through a single mode of PA or a mix of modes of PA.

Table 3.2 Physical activity in Asian American women (N=1605, unweighted)

	Median physical activity time (IQR), min/week					
	Total[a]	By domain			By intensity	
		Work	Transportation	Leisure	Moderate	Vigorous[b]
Overall	158 (420)	0 (0)	0 (52)	25 (210)	102 (284)	0 (30)
Sociodemographic						
Age (years)						
18-39	230 (510)	0 (19)	0 (57)	58 (262)	115 (310)	0 (110)
40-64	136 (368)	0 (0)	0 (29)	0 (180)	88 (1269)	0 (0)
≥65	82 (291)	0 (0)	0 (53)	0 (173)	75 (239)	0 (0)
Education						
High school and below	64 (301)	0 (0)	0 (59)	0 (84)	58 (242)	0 (0)
Some college	147 (484)	0 (16)	0 (16)	0 (209)	99 (287)	0 (52)
College and above	206 (473)	0 (0)	0 (49)	91 (265)	118 (288)	0 (86)
Marital status						
Married/living with a partner	145 (416)	0 (0)	0 (27)	3 (179)	110 (285)	0 (0)
Widow, divorced, separated	79 (342)	0 (0)	0 (34)	0 (204)	57 (250)	0 (0)
Single never married	262 (538)	0 (0)	0 (92)	120 (341)	113 (296)	0 (159)
Income						
<$20,000	146 (408)	0 (0)	0 (57)	0 (173)	61 (296)	0 (0)
$20,000-$34,999	116 (362)	0 (0)	0 (80)	0 (139)	87 (257)	0 (0)
$35,000-$65,000	139 (466)	0 (0)	0 (57)	0 (178)	84 (343)	0 (0)
>$65,000	176 (445)	0 (0)	0 (16)	80 (240)	113 (271)	0 (80)
Insurance						
Yes	176 (445)	0 (0)	0 (50)	36 (231)	109 (283)	0 (51)
No	107 (357)	0 (0)	0 (64)	0 (134)	74 (281)	0 (0)
Have routine place to go for healthcare						
Yes	175 (442)	0 (0)	0 (45)	30 (229)	109 (289)	0 (31)
No	144 (359)	0 (0)	0 (63)	0 (174)	80 (253)	0 (29)
Health related factors						
Body Mass Index (kg/m^2)						
<23	177 (414)	0 (0)	0 (66)	54 (232)	104 (269)	0 (56)
23-27.49	120 (437)	0 (0)	0 (20)	0 (231)	88 (291)	0 (0)
≥ 27.5	149 (441)	0 (0)	0 (35)	10 (178)	115 (311)	0 (0)
Depression (score)						
Yes (5-27)	165 (443)	0 (0)	0 (50)	0(232)	83 (280)	0 (78)
No (0-4)	177 (440)	0 (0)	0 (43)	58 (234)	116 (293)	0 (52)
Systolic BP (mmHg)						
<120	205 (495)	0 (10)	0 (51)	57 (237)	117 (316)	0 (72)
≥120	109 (357)	0 (0)	0 (45)	0 (200)	83 (247)	0 (0)

Diastolic BP (mmHg)						
<80	176 (443)	0 (0)	0 (47)	46 (232)	111 (288)	0 (50)
≥80	137 (411)	0 (0)	0 (60)	0 (184)	90 (295)	0 (0)
Sleep duration (hours)						
<7	175 (476)	0 (0)	0 (44)	0 (226)	108 (321)	0 (54)
7-9	171 (418)	0 (0)	0 (53)	43 (214)	110 (277)	0 (28)
>9	92 (420)	0 (0)	0 (52)	0 (163)	48 (255)	0 (0)
Asthma						
Yes	219 (512)	0 (100)	0 (0)	46 (321)	80 (270)	0 (129)
No	149 (417)	0 (0)	0 (54)	23 (205)	104 (284)	0 (25)
Arthritis						
Yes	125 (385)	0 (0)	0 (15)	0 (176)	91 (292)	0 (0)
No	170 (440)	0 (0)	0 (51)	38 (232)	107 (282)	0 (52)
Perceived Health Status						
Excellent	203 (487)	0 (0)	0 (54)	110 (273)	120 (296)	0 (109)
Very good	207 (508)	0 (0)	0 (53)	82 (258)	117 (284)	0 (76)
Good	117 (357)	0 (0)	0 (35)	0 (160)	81 (283)	0 (0)
Fair or poor	93 (338)	0 (0)	0 (56)	0 (80)	82 (239)	0 (0)
Perceived weight status						
Normal or underweight	149 (414)	0 (0)	0 (60)	0 (209)	88 (259)	0 (50)
Overweight	176 (471)	0 (0)	0 (16)	46 (218)	112 (317)	0 (0)
Smoke Status						
Current	274 (935)	0 (80)	0 (5)	17 (297)	108 (429)	0 (132)
Former	202 (627)	0 (90)	0 (0)	97 (315)	79 (422)	0 (112)
Never	149 (417)	0 (0)	0 (53)	20 (205)	101 (277)	0 (17)
Acculturation						
Language spoken at home						
Only non-English	110 (351)	0 (0)	0 (56)	0 (163)	65 (234)	0 (0)
Both non-English and English	172 (458)	0 (0)	0 (56)	48 (216)	117 (298)	0 (54)
Only English	237 (591)	0 (75)	0 (0)	97 (295)	137 (368)	0 (118)
Nativity with length of residency						
<15 years	173 (711)	0 (137)	0 (89)	0 (116)	133 (506)	0 (52)
≥15 years	118 (599)	0 (92)	0 (39)	0 (138)	89 (418)	0 (11)
US born	180 (795)	0 (355)	0 (0)	0 (177)	131 (448)	0 (161)

[a]Total PA = WPA+TPA+LPA. Mins of the vigorous-intensity of PA were doubled and added to minutes of the moderate-intensity of PA.
[b]Mins of vigorous intensity of PA, did not multiplied by two.
BP, blood pressure; IQR, interquartile range; SD, standard deviation; US, United States.

Table 3.3 Multivariate logistic regression: variables associated with physical activity (N=1605, unweighted)

Predictors	Meeting physical activity guideline (150min/week)							
	Total MVPA		Work PA		Transportation PA		Leisure PA	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sociodemographic								
Age[a]	.99	(.98, .99)***	.98	(.97, .99)***	1.02	(1.01, 1.03)**		
Education								
(Ref: High school and below)								
Some college	1.21	(.94, 1.56)					1.52	(1.06, 1.69)*
College and above	1.60	(1.27, 2.02)***					2.26	(1.66, 3.08)***
Marital status								
(Ref: Single)								
Married or living with partner					.52	(.33, .81)**	.62	(.45, .86)*
Widowed/divorces/separated					.56	(.29, 1.06)	.74	(.47, 1.16)
Health related								
Systolic BP[a]					.99	(.98, .996)**		
BMI[a]			1.04	(1.01, 1.07)*				
Perceived health status								
(Ref: Fair or poor)								
Excellent							2.68	(1.67, 4.29)***
Very good							2.05	(1.27, 3.31)*
good							1.40	(.86, 2.28)
Acculturation								
Nativity with residency length								
(Ref: <15 years)								
≥15 years					.60	(.41, .88)**	1.34	(1.06, 1.69)*
US-born					.83	(.50, 1.39)	2.17	(1.53, 3.08)***
Language use at home								
(Ref: Non-English)								
English and Non-English	1.19	(.93, 1.53)	1.64	(1.14, 2.34)**				
English	1.72	(1.32, 2.24)***	2.29	(1.53, 3.42)***				

CI, Confidence interval; OR, odds ratio; PA, physical activity, US, United States.
All displayed variables had a p-value<.05
[a]Continuous variable reported on point estimate.
*p<.05, **p<.01, ***p<.001, compared to indicated reference group.

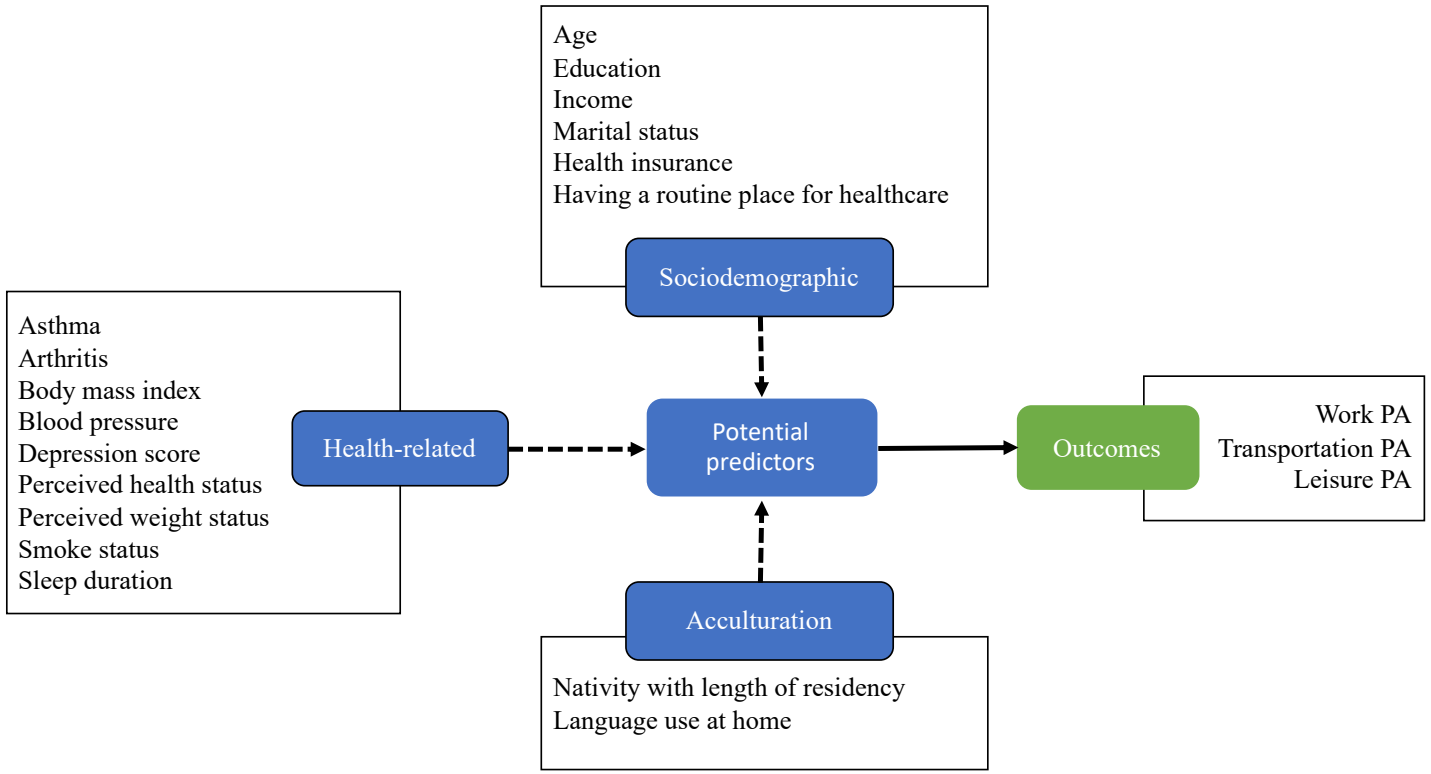

Figure 3.1 Included Variables

CHAPTER 4

STUDY TWO: CHINESE AMERICAN WOMEN'S PHYSICAL ACTIVITY EXPERIENCE AND KNOWLEDGE OF BREAST CANCER PREVENTION: A QUALITATIVE STUDY

Regular PA has been demonstrated to reduce the risk of a variety of chronic illnesses and cancers (Myers et al., 2019; Rock et al., 2020). The Physical Activity Guideline for US adults recommends 150 to 300 minutes of moderate-to-vigorous aerobic PA weekly (Singh et al., 2020). According to the CDC, 53.3% of US adults met this recommendations, and women (50.6%) in all age groups were less likely than men (58.2%) to do so (CDC, 2019). Women, on the other hand, appear to be more likely than men to adapt to healthy diet behaviors, such as low sodium and low fat, but less likely to increase PA (Vynckier et al., 2022).

AsAms were the fastest growing racial group in the US, increasing by 82.2% from 2000 to 2019 (U.S. Census Bureau, 2021). However, research on PA among Chinese Americans is often limited or outdated. Data and studies on PA and other health outcomes across races often excluded AsAms in their reports (Armstrong et al., 2018; CDC, 2021; Vina et al., 2019). A population-based study indicated that the prevalence of meeting PA guidelines was 38.6% among AsAms which was lower compared to Whites, African Americans, and Hispanics (49.9%, 45.5 percent, and 45.4 percent, respectively) (Kao et al., 2016). Similar findings revealed that 42.7% of AsAms living in New York

City reached PA recommendations, compared to 61.3% for Whites, 59.4% for African Americans, and 60.2% for Hispanics (Yi et al., 2015).

Chinese Americans are the largest AsAm subgroup, with 5.4 million people living in the US. From previous limited findings, Chinese Americans seem to have a low prevalence of meeting US-based PA guidelines. For example, Afable-Munsuz et al (2010) used data from California Health Interview Survey and found that the prevalence of meeting PA guidelines was low among Chinese American (34%) compared to Mexican (52.4%) and Filipino (52.1%) Americans. Although ample research on PA exists across multiple populations, little is known about how Chinese American women (CAW) view PA and what motivates them to engage in PA. Without data on their knowledge, perceived motivation, and cultural beliefs, researchers and clinicians are challenged to design and implement effective PA promotion programs among this group.

In the US, AsAms are the only racial group for which cancer is the primary cause of death, which has been the case for more than 20 years (Torre et al., 2016). Despite declining or stable BrCa incident rates in other racial groups, AsAms' rates have risen by 1.5% per year from 2012 to 2016 (DeSantis et al., 2019). BrCa is the most common cancer diagnosis, is diagnosed at an earlier age in AsAms compared to Whites and is the second leading cancer death for CAW (Thompson et al., 2014). The peak age of BrCa diagnosis in AsAms is 45 to 49 years old compared to 75-79 in Whites. A worldwide statistical estimation found that physical inactivity contributed to 10% of new BrCa cases (Lee et al., 2012). PA wields a positive effect of reducing BrCa risk on all ethnic groups (Lynch et al., 2011), and has an even more substantial impact on Asians in which PA reduces BrCa risk by an average of 41% compared to 20% in Whites (Friedenreich,

2010). However, despite the substantial benefits of PA, AsAms, especially women, are less likely to meet PA recommendations than other racial groups in the US (Kao et al., 2016; Yi et al., 2015).

The increased cancer risk, the younger diagnosis age, and the low PA levels among CAW underscore the importance of developing interventions to promote PA for this population. However, information on CAW regarding behavioral strategies that could effectively increase and maintain PA is limited. PA interventions may be more acceptable and provide better PA outcomes in minorities if those interventions are culturally relevant to address the specific cultural beliefs, values, and practices of these minorities (Conn et al., 2013). Therefore, the purpose of this study was to 1) understand PA practice and knowledge, 2) identify motivations and barriers of PA, and 3) explore culture/acculturation influence on PA engagement among CAW.

Conceptual Framework

A theoretical framework (Figure 4.1) based on the Information, Motivation, and Behavioral Skills Model (IMB) was used to guide this study. The original IMB model asserts that behavioral change requires health-related information, motivation, and behavioral skills. “Information” includes relevant knowledge on PA, such as appropriate PA duration and intensity. Information might be correct or incorrect and can facilitate or impede PA participation. Information can also include broader PA maintenance information such as arranging PA into a busy schedule. “Motivation” includes both personal and social motivations and barriers. Positive or negative attitudes toward regular PA, perceived advantages of PA, and perceived negative repercussions of physical inactivity are examples of personal motivation. Social motivation includes the

individuals' perceptions of social support for PA engagement and their desire to comply with others. “Behavioral skills” are the individual's objective ability to participate regular PA and her perceived self-efficacy for regular PA participation. The model was adapted to include culture/acculturation to emphasize culture's significant effects on AsAms’ PA. Additionally, because empirical research demonstrated that sociodemographic and environmental factors are associated with PA, they were incorporated into the model to address additional crucial elements related to PA (Gidlow et al., 2019; Kaushal & Rhodes, 2014; Kepper et al., 2019; Perez et al., 2018).

Method

Design

This is a descriptive qualitative study design (Sandelowski, 2010), using semi-structural individual interviews to explore the knowledge of PA, motivation and barriers, and cultural/acculturation perspectives related to PA. A descriptive qualitative design is appropriate as limited knowledge exists on this topic (Bradshaw et al., 2017). This method is descriptive in nature that provide a broad insight into particular phenomena, particularly in nursing and healthcare research. The qualitative descriptive approaches yield abundant information by identifying multiple essential knowledge and motivation related to PA and strengthening conceptual validity to guide future research (Doyle et al., 2020). This methodology provides for investigation of ethnic factors and individual experiences in PA to facilitate a richer understanding of CAW’s PA behaviors.

Recruitment

Participants were recruited from social media (i.e., Facebook, Instagram, Linked-in, WeChat, and Twitter). Social media as a method of participant recruitment has been

successful, especially for minority populations (Topolovec-Vranic & Natarajan, 2016). Also, a respective member of the Chinese American community helped share the study information within her community. Snowballing was also used by having participants who completed the interview after others to the principal investigator. The advertisements (Figure A.1 and Figure A.2) were provided in simplified Chinese and English, including a brief study introduction, eligible criteria, and the principal investigator's contact information. The inclusion criteria were CAW born in the US or who immigrated to the US more than one year prior to the study date, who were 18 to 65 years old, who either spoke English or Mandarin, and who had no cognitive deficiency. The study was exempted by the institutional review board of the University of South Carolina.

Data Collection

Due to the Coronavirus Disease 2019 (COVID-19) pandemic, we collected data through a virtual meeting (i.e., Teams or Zoom). Data were collected between December 2021 and February 2022. Data collection was discontinued when saturation had been achieved. The principal investigator screened potential participants for eligibility and conducted all interviews in either English or Mandarin based on participants' choice. Prior the interview, the first author orally reviewed the invitation letter with each participant and completed demographic survey (Appendix A). Interviews were audio recorded lasting 25-60 minutes with an average time of 43 minutes. The interview questions (Table 4.2) were developed based on the PA-IMB framework. The open-ended, semi-structured questions with probes addressed knowledge, motivation, behavior skills, and a cultural perspective on PA. We did not use a standard definition for "physical activity" (身体活动). Participants defined how they think out and act toward PA.

Data Analysis

The study was analyzed with NVivo using thematic analysis (Braun & Clarke, 2008). The interviews were recorded, transcribed verbatim, and deidentified before analysis. We followed the six steps of thematic analysis: familiarization, coding, generating themes, reviewing themes, defining and naming themes, and producing the report (Javadi & Zarea, 2016). This method is an analytic approach to data organization and analysis that involves exploring the rich intricacies of the data. This method is employed in health research projects, particularly those descriptive in nature or seek to highlight main issues affecting certain groups or individuals (Sundler et al., 2019).

Our multidisciplinary team with the racially concordant interviewer and coders had previous experience with qualitative research and cultural sensitivity toward our participants, which aligned with best practices in research engaging racial and ethnic minorities (Table 4.1) (Fryer et al., 2016). Two bilingual (i.e., English and Chinese) researchers (JS and a Exercise Science master-prepared PhD student) coded the data from each of the transcripts. The interviews conducted in Chinese were coded in Chinese and then translated to English (Ho et al., 2019). Two coders reviewed and discussed the themes and subthemes until reaching a final consensus. Once the themes were established, we shared the themes with other team members. The final report was produced, in which all significant themes and elements were included from the discussions with other researchers. Participants have been given pseudonyms. Additionally, the demographic data were examined using descriptive statistic to characterize the sample.

Results

Sample Characteristics

As shown in Table 4.3, the 21 CAW ranged in age from 24 to 60 years (mean = 45.19, SD = 12.44). The majority of participants (95.24%) had a bachelor's degree or above, were married or in committed a relationship (61.90%) and were foreign-born (85.71%). Non-US born participants immigrated at a mean age of 27.28 (SD = 7.47), with a length of US residency average of 21.65 years (SD= 6.14). The participants resided across eight states, including California (5%), Florida (10%), Georgia (5%), Illinois (5%), Mississippi (5%), North Carolina (33%), South Carolina (5%), and Virginia (29%).

Knowledge of PA

Theme I: Perception of PA in Daily Life. CAW's descriptions of PA fall into three subthemes. Subtheme 1: PA and exercise mean the same thing. For example, Zhen, a 55-year-old immigrant software engineer said, "there is not much difference between physical activity and exercise. They are the same." Subtheme 2: intensity determined the difference between PA and exercise. Low-intensity movement is PA (e.g., walking or yoga), and moderate-to-high intensity movement is exercise (e.g., jogging):

> There are definitely exercises where my body is moving, but I don't necessarily feel like I am getting a workout. So, I do yoga sometimes, which I really love, but I think of that more like a stretch, giving my mind and body space. But when I'm running or when I'm like lifting weights, that's totally different. So, I think of that as a workout. Yoga is a way for me to connect with my body, if that makes sense. (Grace, age 25, US-born

second-generation clinical researcher)

Subtheme 3: PA includes all body movement, and exercise is an intentional and conscious movement requiring more preparation with a specific purpose. For example, Xiaotong, a 33-year-old immigrant civil engineer, described: “PA is just moving around. For exercise, you need to take time off and focus on it with a purpose. You need to arrange it, such as changing clothes.”

When asked about what PA meant to CAW, participants described that PA signifies being healthy and happy, staying energetic, reducing stress, and maintaining social ties. For example, Wanlin, a 47-years-old immigrant financial analysis, said, “I think [PA] is wanting to be a better myself. I want to be healthy for my loved ones. I can walk better and feely happy.” Another participant described her feeling of PA:

> I think PA is very important to my daily life. I think it helps me to maintain my routine activity. Keep my work going, and also keep my mental health. I think more and more that PA is very important in my life, or even more important than taking all the nutrition, supplements, or going to a doctor. (Qianlin, age 48 immigrant, software developer)

Regarding PA domains, there was not much work and transportation PA. Zhen stated, “I don’t have any PA at work. Work is sitting in front of the computer; that is why I need to do exercise.” Participants also noted that there were not many heavy household chores. For example, Ting, a 58-year-old immigrant software engineer described, “Doing housework is also considered PA, but there really is no heavy housework nowadays. There is a washing machine that washes clothes, and a dishwasher cleans dishes. Cooking

is also easy now. There are not many chores left." Therefore, most of their PA came from leisure-time PA (LTPA). The most common types of LTPA are reported as walking, yoga, Pilates, traditional dancing, swimming, jogging, and hiking. Many participants reported that they tend to engage in light, flexible types of PA rather than cardiovascular activities or high-intensity PA and weightlifting. When there was no time to exercise, household chores could be compensated as activities; as Zhen stated, "Of course, we should find a fixed time to go to gym or group classes, but if you don't have time, you can also [do], for example, gardening and housework. Those can be counted as PA."

Theme II: PA in Breast Cancer Prevention. When referring to PA and BrCa prevention knowledge, a common statement was, "I never think about [PA and breast cancer prevention] that way." However, CAW believed that PA could promote overall health, boost the immune system, and improve psychological health; as Sihai, 49-year-old immigrant housewife, stated, "I think if you're healthy, the chance of inducing cancer will be lower, including being physically healthy and mentally healthy." Therefore, they were not surprised by the role of PA in BrCa prevention. When talking about BrCa, they think more of genetic risks, life stress, or bad mood; as Wanlin said, "I think breast cancer is more related to genes. I know somebody, their entire family, including sisters and mothers, all got breast cancer." Besides genetic risk, CAW believed that BrCa was more related to stress. Professional women working under pressure or women with unhappy families were more likely to be diagnosed with BrCa. Also, this group of women felt that depressed mood or prolonged unhappiness was a significant cause of BrCa:

> People around me diagnosed with breast cancer are either professional women believing they must do everything perfectly… or women with a lot of mental stress, such as unhappy marriage, or her partner would not be able to relieve her stress. Those external stress could affect their mood, and then she got breast cancer. (Manni, 47-year-old, immigrant, housewife)

Motivations and Barriers to PA

Theme III: Stay Healthy. Almost all the participants described promoting or maintaining health as one of the greatest motivations to engage in regular PA. Particularly, changes in health conditions or sudden weight gain were the main reasons for starting PA regularly in midlife women. Health is not only about their physical well-being but also about their responsibilities to their families:

> I think definitely for my health benefits…I started to run last May because I didn't feel very well about myself. It's kind of like a warning, and I tell myself I need to be healthy. I have kids. I have parents. I need to be healthy. (Qiaolin, age 48, immigrant, software developer)
>
> A few years ago, I was diagnosed with diabetes and started taking medicine. Last year when I went for the annual check, my doctor told me to increase PA and get my body active to see any changes. So, I started walking 10,000 steps daily if weather and schedule allowed. Then, my subsequent examination revealed that my diabetic indicator became prediabetic…I didn't expect this big change. I definitely feel the benefits of exercise. If I had done this before, I might be at prediabetes and not

have developed to diabetes. (Qian, age 53, immigrant, research manager)

Theme IV: Having Social Networks That Are Physically Active. Most CAW described how they gain motivation around physically active people. Women explained that when they observed friends' physical and psychological improvement after regular exercise or how energetic and positive physically active people are, that motivated them to be willing to try exercising or being more active. For example, Xinyi, a 35-year-old immigrant software engineer, described, "Seeing them [who exercise] makes me think this is why they are often more positive."

Combining social activities with exercise promoted PA in this group. Several participants participated in a virtual exercise group using a mini-program (Fitnow) plugging to guide and record their workouts on the social media platform (WeChat). They could maintain their PA because they also shared their lives with the same group of friends, such as cooking, make-up, and skincare. They also could track their changes and achievement together, in which they share photos to compare difference before and after exercise, that was a facilitator as well. Those women stated that they could build and maintain new networks, stimulate new ideas, and stay motivated and engaged by participating in these activities. Some participants described how they integrated their social and exercise networks:

> The social component is essential here because exercise needs time. If you want to exercise and you have a different social group, you may not have enough time. If you combine your social activities with the exercising group, you could yield twice the results with half the effort. (Ting, age 58, immigrant, software engineer)

> It just kind of built into my schedule, and I tend to spend time around people that will be more likely to exercise, like my dad or my boyfriend. Currently, he goes to the gym all the time. So, most of my physical exercises are at the gym. (Grace)

Having friends exercising together keep those women accountable, which facilitates them to be persistent with their workout plan; as Qiaolin, described her experience as follow:

> I do have a small group. My friends close by are all my age group that have a busy life, but we still have group activities. We may schedule once a week. Or a small group to have a walk. Sometimes, even walking to climb a mountain… So, I think that helps. If you do exercise all by yourself, it is a boring thing and hard to continue doing or persist doing. Suppose I have friends, like a small group, even a small group at work. It definitely helps keep doing that way because it encourages others. When you look at other people, they are in good shape. Then we know that's the way we should go. (Qiaolin, age 48, immigrant, software developer)

In contrast, Jenny, a 26-year-old US-born second-generation, graduate research assistant, felt demotivated: "Just going [to the gym], your circle, your social network, they also don't go to [the gym] a lot or don't utilize that resource, it's just makes you less motivated."

Theme V: COVID-19. COVID-19 pandemic served as both a facilitator and barrier for engaging in PA. Interestingly, COVID-19 pandemic motivated women to participate in more PA. First, working from home gave women more flexibility in their schedules and more time to exercise. For example, Qian described, "For me, traveling

from work and home takes about two hours. I can use this time to take a walk. So, working from home is good for my PA." Second, home quarantine at the beginning of the pandemic led to a significant reduction in daily activity that forced many women to start to exercise:

> I actually feel like I've exercised more since COVID. That is probably because we've been so isolated, and it's one of the few times, and I'm working from home, so one of the few times when getting out of the house, and kind of have more space to myself. (Grace)

Lastly, some CAW started exercising regularly because of the fear of getting COVID-19 or having severe symptoms if infected with COVID-19. Those women believed that exercise could boost the immune system and promote overall health:

> Like this epidemic, the general population knows that you must be more vulnerable if you have underlying diseases. So, people with underlying diseases, such as pre-diabetes, should definitely be more active. This way, even if you are infected, your symptom may be lighter because your body is good. (Qian)

Accessibility was not a problem for the CAW in this study. Almost all women lived in a walking-friendly community or had a recreation center or nearby gyms. Even though COVID had hindered them from going to the gym, physically active participants had built a small gym at home or found alternative ways to keep active. However, environmental safety was a significant obstacle. Because of the increased rate of hate crime toward the Asian population during the COVID-19 pandemic, CAW reported that they were more careful about walking in the neighborhood, choosing only to do so before

sunset or when accompanied by friends. Women, who live in areas with a high incidence of hate crimes (e.g., Chicago or San Jose), had more concerns about safety. For example, Grace said, “Especially with hate crimes and violence against Asian women, ... It doesn't feel very safe for me to do as much like exploring or exercising outdoors as I normally want to.”

> Last year, there were some attacks against AsAms happened. So, I used to take a walk no matter how late it was, but now, I won’t go out if it is late. Perhaps take a walk at front of my house. I won’t go too far. (Juan, 58 age, immigrant, clinical researcher)

Theme VI: Family Needs. The priority in almost all middle-aged women’s lives was family needs, particularly children’s needs, which became the most significant barrier to PA. Those women prioritized their children’s schedules over their own needs:

> I work 8 hours, and I have two kids at home, right? So, in the morning, kind of chaos because they’re on different schedules. One is in elementary school; another one is in high school. Even if I cook breakfast for them, they won’t eat at some time. So, I may have to cook twice. It was a little challenging…If kids have other activities, I have given up my activity. then take them to do what they want to do. (Qiaolin)

Those middle-aged women described that as their children went to college and did not require as much assistance, they would have less stress on childcare and focus on their own needs; Manni described, “I am looking forward to that day. It is about my limit. Luckily, my daughters will go to college two years later. When they’re gone, that is when I can manage my life.”

Theme VII: Less Likely Being Obese. Some participants describe lacking motivation to exercise because they did not have pressure to lose weight through exercise. For instance, Caihua, a 56-year-old woman said, “In my generation, very few people were obese in China. We were very thin. At that time, I felt like I didn't have the pressure to exercise to maintain my health.” Another participant, Hanqin, a 49 immigrant teacher, described how her feeling regarding to the relationship between exercise and her weight status: “Not like them [whose be overweight or obese], they exercise because they feel that they need to keep fit or have to burn some calories, or what else. But I don’t have weight concerns, and I eat relatively healthy. I feel that I don’t have to exercise. I won't feel guilty for not exercising.” Even if they wanted to maintain weight, they would pay more attention to diet than exercise. For example, Zhiqing, a 25-year-old immigrant accountant described her observation comparing American with Chinese American women, ““I found that Chinese exercise less than Americans. My American colleagues would go to gyms at least once a week… My Chinese friends are very thin, but they eat less to maintain weight not through exercising.”

Cultural Heritage and Acculturation

Theme VIII: Walking. Walking is the most prevalent leisure time PA among CAW. They considered walking not just PA but also a type of social engagement in which they could communicate with friends and families:

> Taking a walk after dinner is very common in China. Here [in the US], everyone treats PA at the exercise level. But in China, your life includes some sort of PA. A couple or a whole family taking a walk together is very common. It seems to be embedded in our culture, and we may bring

> it with us; it is part of our lifestyle that we feel walking is good and we should do it. (Lan, age 51, immigrant, information technology project manager)
>
> Chinese may not spend a lot of time in the gym like Americans, like spending an hour in the gym. I think Chinese people are less likely to do that. But we walk a lot, like walking for an hour or two hours…We all have these social needs or may destress throughout social activities. If you just sit there [talk], it is unhealthy. So, you can take a walk, and you also have the social component during the walking. (Manni)

Theme IX: Leisure Time Exercise Was Not Part of Traditional Chinese Culture and Lifestyle. Lack of awareness of leisure-time exercise is very common among immigrant CAW, as their daily lives involved PA in other domains. Almost all immigrant CAW reported not having much awareness of exercising in their leisure time because their daily life used to involve constant movement. They thought the amount of PA they got at work or during their commute was sufficient:

> I was a financial report for the TV station. Actually, I visited many places, interviewed people, and was very busy. I think working is PA for me. No specific time to do whatever kind of PA or exercise. I work hard. (Wanlin)

Traditional leisure time activities were not physically active. Many leisure time activities were sharing food, playing board games, or chatting:

> I think the [Chinese] cultural parts are mixed with food and activities you do as a group. In my experiences outside the Chinese church, people are more than willing to do things that are more physically active oriented

than [Chinese] gathering is about eating or sitting together [chat] or playing majiang. Those kinds of things. It's just different. (Amy, age 29, US-born second-generation, academic researcher)

Additionally, PA is not a priority compared to academia and work. Many participants reported that education was more important when they were growing up. For example, Amy said, "I think growing up. It was very much a focus on like doing well in school and focusing on studying. Like sports and activities, not really like a big in a real part of my life growing up." Parents would not particularly cultivate exercise or sports:

> Parents love to see their children doing homework when they get home after work. If there is a little bit of free time, you should be reading extracurricular books. They won't say you should go out or go playing with your friends. Parents seem not particularly encourage you to exercise. They seem to be prouder about kids participating in academic competitions or getting full marks on SAT. (Hanqin)

One second-generation Chinese American recounted the different feelings and expectations when going to a non-Asian friend's house versus visiting an Asian friend's house.

> There's also a difference. If I went to my friends' house and their parents were Chinese or Asian Americans, or their parents are Asian, their expectation is for you to stay still and not create chaos in their house, right? If you go to American friends' house or a white friend's house, they're very rambunctious; they like run around... Growing up, it felt very differently... I think the same could be set up like my parents' house that

> expectation is you don't run around, you respect your space and take care of it. (Amy)

Theme X: Traditional Chinese Medicine Health Promotion Practices (Yang Sheng) Influenced PA Preference. The Yang means nurturing, caring for, and nourishing, while Sheng denotes life, birth, and vitality. The concept of Yang Sheng refers to the act of nurturing or nourishing life to promote health and wellness through nurturing the body, mind, and spirit under natural rhythms and universal principles (Dear, 2012). The concept of Yang Sheng profoundly influenced Chinese women's lifestyle and health behaviors. Those women described that Chinese culture pays more attention to diet than exercise; Lan stated, "Every Chinese pays attention to Yang Sheng. However, Yang Sheng focuses on what to eat. So, we are a little more negligent on exercise than diet."

Further, this culturally oriented health promotion practice also shaped CAW's PA preference. Some Chinese women believed that exercise should be in moderation and not in excess. Those high-intensity, hardcore workouts in mainstream American culture were unnecessary or unnatural.

> I think we should be Yang Sheng. To nourish your body, you need to do the right amount of exercise but do not over. Your life and environment make you very tired already. Although the daily workload is very fragmented, you are in movement consistently…I think many people are overdoing it, especially for women of our age. (Manni)

Theme XI: "A Kind of Ingrained Feeling That Those Financial Costs [on PA] Are Unnecessary". Many CAW believed that exercise should not cost money. For example, Jenny, a 26-year-old second-generation graduate student,

said, “Why would I ever pay $70 to go to a random cycling class or those things? So, I think it relates to my background and those where I just I wasn't exposed to certain things.” Even though they did not have financial restrictions, they still did not want to spend too much on exercise:

> The tendency of spending money, where are the Chinese people willing to spend money? I think exercise may be a relatively low priority for Chinese compared to people from other cultural backgrounds. It is an extra expense…It took me a while to change. I didn’t want to spend money on the gym. I can exercise by myself, why I need to spend so much money on a gym membership. (Ting, age 58 immigrant, software engineer)

Theme XII: Acculturation Facilitates LTPA. Traditional Chinese culture and lifestyle influence continue to play a role in Chinese Americans’ PA. The second generation grew up in the US under their family social environment could hold more cultural heritage. For example, Jenny described her feeling about specific types of exercise.

> I think oftentimes, it is a cultural thing, like finding things that fit your values and interests. For example, I feel like [some exercise belongs to] certain dominant white culture, like they really love Zumba classes or barre classes or things like that. And I just feel like those aren’t things that Asian people do. I don't have an interest in that, so I think there's sometimes it feels like there's not many things that I would be willing to try because I don't know, it doesn't interest me, or I wouldn't even be willing to try essentially.

However, acculturation positively impact on Chinese American women's leisure PA. Being exposed to the US culture and acculturate to US society, some women described how their PA changed over time. For example, Lan explained, "The [work and transportation] activities you used to do was reduced, and then replaced with those purposeful type of exercise… you would be more likely to go to a recreation center or gym." Because fitness culture was prevalent in the US, accompanied by easy access to exercise resources (e.g., gyms), some women became adopting leisure time exercise as a part of their lifestyle: "A lot of American love exercise, so you must be edified by what you see (Hanqin)." Ting described the shift of her leisure PA:

> Because people are affected by their environment, you see their changes if you have more active people around you; this is the most significant impact. In China, I am very outgoing and always passionate about many things, but no one around me goes to the gym. I didn't even know this was an option. So, I think this is a significant change because people here attach great importance to exercise and there are many gyms. Suppose you go out, no matter where, even in your neighborhood, people are running or talking about going to sports. All of these make you willing to exercise more.

Discussion

Knowledge of PA

This study identified that CAW hold a unique PA perception and limited knowledge on PA in BrCa prevention. Our findings regarding CAW's perspectives of PA are different from other AsAm subgroups (Im et al., 2015; Daniel et al., 2018; Riley et

al., 2016) that CAW's PA definition fall into three categories. Two of these categories were similar to previous findings; 1) PA does not differ from exercise; 2) exercise is part of PA but is planned, purposefully PA; and 3) the difference between exercise and PA is defined by activity intensity. For example, South Asian Indians defined PA as either leisure time exercise or as part of everyday household chores and daily commute (Daniel et al., 2018). However, a subset of CAW differentiated PA and exercise by activity intensity, which was not found in previous studies. Leisure-time walking or yoga was described as PA but not exercise because they considered those to be light-intensity activities. Future PA intervention for CAW may need to consider grouping participants based on their PA perception, then provide the individualized design guidance.

Further, our findings indicated a lack of knowledge about the role of PA in BrCa prevention among CAW. Some participants believed there is no link between PA and BrCa; and some reported they did not think of the link before the interview. Due to the increased risk of BrCa in this group coupled with the young diagnosis age, education on prevention should be enhanced. Because most cancer risk factors such as sex and genetics are non-modifiable targeting preventable risk factors such as physical inactivity is crucial (Momenimovahed & Salehiniya, 2019). Moreover, the younger age of diagnosis means that this group of BrCa survivors will have a longer time to live after a cancer diagnosis. These underscore the importance of PA because PA also reduces the risk of BrCa recurrence and mortality (Xu & Rogers, 2020). Therefore, future research could examine whether other AsAm subgroups experience a similar knowledge deficit. Meanwhile, existing cancer prevention programs should include education on the benefits of PA and take CAW's unique PA perspective into consideration.

Motivations and Barriers

The current study found that staying healthy was a key facilitator that motivates CAW to participate in PA. This finding is consistent with previous studies among other AsAm subgroups, including Cambodian, Filipino, and Korean Americans (Ceria-Ulep et al., 2011; Choi, Cho, et al., 2021; Coronado et al., 2011), which suggested that internal motivation and perceived benefits play a significant role in PA participation.

Additionally, our findings suggested that having a physically active social network can effectively motivate CAW to participate in PA in multiple ways. First, seeing benefits in others within a close social network can motivate those women to try and potentially engage in PA regularly, which is consistent with another study among older Chinese who temporarily lived in the US (Wang & King, 2022). This might be related to social norms about PA in a person's social network. A previous study on Latina women found that positive social norms about PA were associated with increased leisure PA and resistance training. Women with positive social norms on exercise had 3.6 times more intense LTPA per week, 2.29 times more moderate LTPA per week, and 2.21 more weight training sessions per week on average than those without (Abraido-Lanza et al., 2017). Second, having active social network provides social support, including emotional, instrumental, and informational support. Consistent with previous research (Choi, Cho, et al., 2021; Daniel et al., 2018; Davis et al., 2021; Smith et al., 2017; Ren et al., 2020), our findings suggest that social support positively influences PA by increasing motivation and adherence. For example, our result showed that wellness accountability partners help each other for reaching their goals in exercise and overall wellbeing. The last dimension is social interaction. The social interaction is a significant facilitator in

keeping CAW active. They would initiate exercise or be more willing to participate in PA regularly when they have a group of people who exercise together and share other life activities, such as food, skincare, or children. Interestingly, this group may not necessarily be close geographically or in person. Several participants in our study were actively on a social media platform (WeChat) where they have an exercise group to help them maintain a regular PA. Those women used a device, mobile fitness app, or wearable sensor to record their PA and post in the group. Women in the group were from different places and countries (e.g., America, Canada, Australia, and Singapore). With the growth in social media flatforms and health-tracking technology, PA interventions should integrate social features to increase cohesiveness and sustainability within the group to promote PA engagement in CAW. Based on our findings, a group-based intervention might be preferred and more effective than an individua-based intervention, especially for CAW who are developing PA habits.

This study identified three main barriers among CAW, including safety concerns, family needs, and lack of motivation because of being thin. First, besides the influences of COVID-19 on all populations, CAW have faced discrimination in the US as a result of the COVID pandemic (Gover et al., 2020). The New York Police Department has reported a 365% increase in anti-Asian hate crime since 2020, and San Francisco police data show a 567% increase (Anguiano, 2022; Yam, 2021). Due to the increasing hate crime rate toward East Asians, many CAW in this study described that they were concerned about the safety of their surroundings; thus, they chose to decrease their outdoor PA. This effect was more evident in young CAW who live in high hate crime areas than some middle-aged CAW who live in relatively safer neighborhoods. However,

those middle-aged women also reported that they started carrying pepper spray and would not go out for walks after sunset. Because the long-term effects of anti-Asian hate crime is unknown, future research may need to investigate whether the negative impact on PA persists. Secondly, family responsibilities are a significant barrier to regular exercise among middle-aged women. This finding is consistent with previous findings with other AsAm ethnicities (Daniel et al., 2018; Dave et al., 2015; Im et al., 2012). Most Asian women emphasized that family responsibilities and the need to care for children prevented them from scheduling their own time and thus from participating in the exercise. In order to increase CAW's PA, intervention programs could include their significant others as part of the program and address strategies to allocate family responsibilities. Finally, our findings suggest that CAW perceive being less likely to be overweight or obese, which leads to a lack of motivation to engage in PA in this group of women. Given that AsAms are more likely to develop adverse health outcomes with a lower body mass index than other racial groups (Fang et al., 2019; Harvard T.H. Chan School of Public Health, 2022; L. Zhu et al., 2021), educational programs should address the unique need for exercise and deliver accurate information that the benefits of exercise lie in disease prevention, not just weight loss.

Cultural Heritage and Acculturation

This study found that Chinese culture, lifestyle, and acculturation are closely related to CAW's physical activity. This study identified that walking is the most common PA in CAW, but some may not consider walking a type of exercise depending on the purpose of walking. If walking is for transportation or work, many CAW do not see it as exercise, but they also believe that it provides the amount of exercise their bodies

need; therefore, they do not consider exercising in their leisure time, which explains why exercise is not emphasized in the leisure time of the Chinese lifestyle. On the other hand, walking after dinner seems to be a widespread activity for the Chinese, which is considered an exercise. This activity is generally a group activity with friends or families that provide them the needed exercise and social interactions. The prevalence of walking in Chinese culture might be associated with their health promotion practice – Yang Sheng (Ng et al., 2014). Yang Sheng refers to the act of nurturing or nourishing life in order to promote health and wellness through nurturing the body, mind, and spirit that achieve a longer longevity (Ng et al., 2014). Our study found that Yang Sheng significantly impacts CAW's lifestyle. There is a proverb in China saying, "walk a hundred steps after each meal, and you will live a long life (饭后百步走，活到九十九)."

Our study showed that exercise in their spare time does not seem to be a major emphasis in Chinese culture. In the Chinese lifestyle, leisure time activities focus on relaxing and socializing. Many immigrated CAW described how their PA domain shifted when they moved to the US. A significant decline in work and transportation PA has been noticed in our study; meanwhile, some CAW had gradually adapted to American exercise culture, but some were continuously not engaging in leisure-time PA. Changes in PA domains are founded in other AsAm subgroups (Choi, Cho, et al., 2021; Im et al., 2012). Overall, acculturation was found to contribute to leisure-time PA. Many participants described that after immigrating to the U.S., the popularity of exercise (gyms and recreation center) and observing surrounding people participating in exercise, led them to gradually try to participate in more PA in their leisure time. In some quantitative studies, acculturation was associated with greater leisure PA among AsAms (Yan &

Cardinal, 2019; X. Zhu et al., 2021). According to one study, compared to those who had been in the country for less than a year, as the number of years AsAms living in the US increased, the odds of participating in leisure MVPA have also gradually risen (Yan & Cardinal, 2019). Another study among AsAms found that the longer their stay in the US, the more likely they were to meet PA guidelines; US-born had 1.54 times the risk of meeting the PA guideline (X. Zhu et al., 2021). Therefore, future research needs to focus on these less acculturated CAW who have not adapted PA in their leisure time, as they are likely to lack adequate PA.

Interestingly, the current study found that CAW had a different view of spending money on exercise compared to the general western culture. Many CAW believed that physical activity should be low cost or no cost. This belief may be related to their past lifestyle. Most of CAW's PA came from commuting and working; therefore, the primary purpose of the activity was not fitness. This habitual thinking continuously impacts CAW's perception of PA after moving to the US. Since their PA was more passive and at no cost in the past, the need to spend money to achieve the amount of PA they used to do is hard to understand. Our findings suggest that this phenomenon seems to have impacted their offspring. Since we did not have any third-generation CAW in our study, we cannot know if this effect decreases from generation to generation. Future studies could further investigate their expenses attitude across generations. In the meantime, existing programs could improve PA in this group by educating the changes in PA domain and lifestyle.

Limitations

There are several limitations to this study. Because all interviews were conducted online, findings from this study may not be generalizable to those who do not have access

to the Internet and do not own smartphones or computers. Further, most participants were from North Carolina and Virginia, but a large percentage of Chinese Americans live in Califonia and New York. Therefore, future research is needed to determine whether the PA for those who live in a social environment with higher Chinese and Chinese culture would be consistent with our findings. Lastly, participants were first- and second-generation Chinese American women. Thus, our results may not be generalizable to those who were third-generation or above. Future research could investigate whether later generations' PA would be continuously influenced by Chinese culture.

Conclusion

Our findings indicate that CAW have a complex PA perspective and lack knowledge of PA benefits in reducing BrCa risk in CAW. The process of acculturation influenced their PA experiences. Although acculturation facilitated leisure-time PA, CAW's PA preferences were continuously impacted by cultural heritage. Future PA promotion programs need to be adapted according to CAW's PA perspective and encourage and support their social interactions. Significantly, nationally recognized structural interventions are warranted to address the discrimination and violence toward East AsAms. Our results pointout the need to educate Chinese Americans to improve cancer literacy and the importance of BrCa risks. BrCa prevention programs should include Chinese American women's unique perspective on PA as well as their cultural background. Future research is needed to understand whether other AsAm subgroups have experienced similar changes and will need individualized interventions. A culturally appropriate intervention integrating traditional Chinese practices with education and behavioral change strategies to increase PA is needed to reduce BrCa risk in CAW.

Table 4.1 Personal and professional characteristics of the research team

Member Initials	Race/Ethnicity & Sex	Occupation	Credentials (Disciplines)	Experience & Training	Study Role
JS	Asian Female	PhD Candidate	PhD(c), RN (Nursing)	Previous experience conducting qualitative interview and focus groups; previous qualitative coding experience	Principal Investigator; Interviewer, data coding, data analysis and interpretation
HL	Asian Female	Master student	MS (Exercise Science)	Intensive training in qualitative research methods	Data coding, data analysis and interpretation
HSW	Asian Female	Associate professor	PhD, RN (Nursing)	Previous experience in conducting qualitative research; extensive training in qualitative research methods	Data analysis and interpretation
SH	Caucasian Female	Assistant professor	PhD, RN, FAAN (Nursing)	Experience performing qualitative research, substantial communication training, knowledge of psycho-oncology, and knowledge of breast cancer among African Americans	Data analysis and interpretation
DA	Caucasian Male	Assistant professor	PhD, RN (Nursing)	Has conducted qualitative research and studies in which physical activity is a variable of interest. Research focuses on health disparities in various populations.	Critical review and editing of manuscript.
MW	Caucasian Male	Assistant professor	PhD, MSPH (Epidemiology and Biostatistics)	Previous experience collaborated with nursing researcher who conducted qualitative research	Critical review and editing of manuscript.

Table 4.2 Interview questions

Knowledge
What does physical activity mean to you?
Probes: What kind of activities do you see as PA or exercise?
Tell me more about different ways women of your age could be physically active.
Tell me about what you do during your leisure-time, tell me about what you do at work, how do you get to work, or housekeeping.
What do you know about physical activity?
Probes: physical activity recommendations for US adults
places to engage in physical activity
Benefits of physical activity
What role do you think physical activity or exercise play in breast cancer prevention?
Motivation
Tell me about what motivates you or could motivate you to engage in physical activity?
Probes: What are some personal factors or social factors? What about cultural, environmental factors? Any other factors?
Tell me about what hinders you or could hinders you from being physically active?
Probes: What are some personal factors or social factors? What about cultural, environmental factors? Any other factors?
What, if any, physical activity impacts did you experience from COVID-19?
Culture/acculturation
How do you see Chinese American women valuing PA in their daily lifestyle?
Probes: What image comes to mind when you think of a physically active Chinese American woman either at home, at work, or some other places?
For non-US born Chinese Americans or those who did not grow up in the US: You have been lived in China and then immigrated to the US, how does your immigration transition affect your physical activity? If yes, in what ways?
For US-born Chinese Americans or those who grew up in the US: how does your cultural background influence your physical activity?

Table 4.3. Participants characteristics (n =21)

Demographics	N (%)
Age in years, mean ± SD (range)	45.19 ± 12.44 (24 – 60)
Age in years when immigrated, mean ± SD (range)	27.28 ± 7.47 (11 – 45)
Length of US residency in years, mean ± SD (range)	21.65 ± 6.14 (13 – 27)
Marital Status	
Single	4 (19.05)
Married/committed to a relationship	15 (71.43)
Divorced/Widow/Separated	2 (9.52)
Education	
Some College/associated degree	1 (4.76)
Bachelor's degree	8 (38.10)
Graduate degree	12 (57.14)
Income	
<$10,000	2 (9.52)
$10,000 - $ 19,999	2 (9.52)
$20,000 - $ 29,999	1(4.76)
$40,000 - $49,999	2 (9.52)
≥ $50,000	14 (66.67)
Occupation	
Academic/Clinical researcher	6 (28.57)
Accounting/Financial analysis	2 (9.52)
Civil engineer	1 (4.76)
Software developer/engineer	7 (33.33)
Teacher	1 (4.76)
Housewife	4 (19.05)
Birthplace	
US	3 (14.29)
Non-US	18 (85.71)
Language use at home	
Chinese	8 (38.10)
English	1 (4.76)
Both	12 (57.14)
Self-identification	
Chinese	7 (33.33)
Chinese American	8 (38.10)
Chinese and Chinese American	4 (19.05)
Chinese American and American	1 (4.76)
Chinese, Chinese American, & American	1 (4.76)
Body mass index	
Underweight and normal	16 (76.19)
Overweight	4 (19.05)
Obese	1 (4.76)

Note: body mass index was calculated by self-report weight and height.

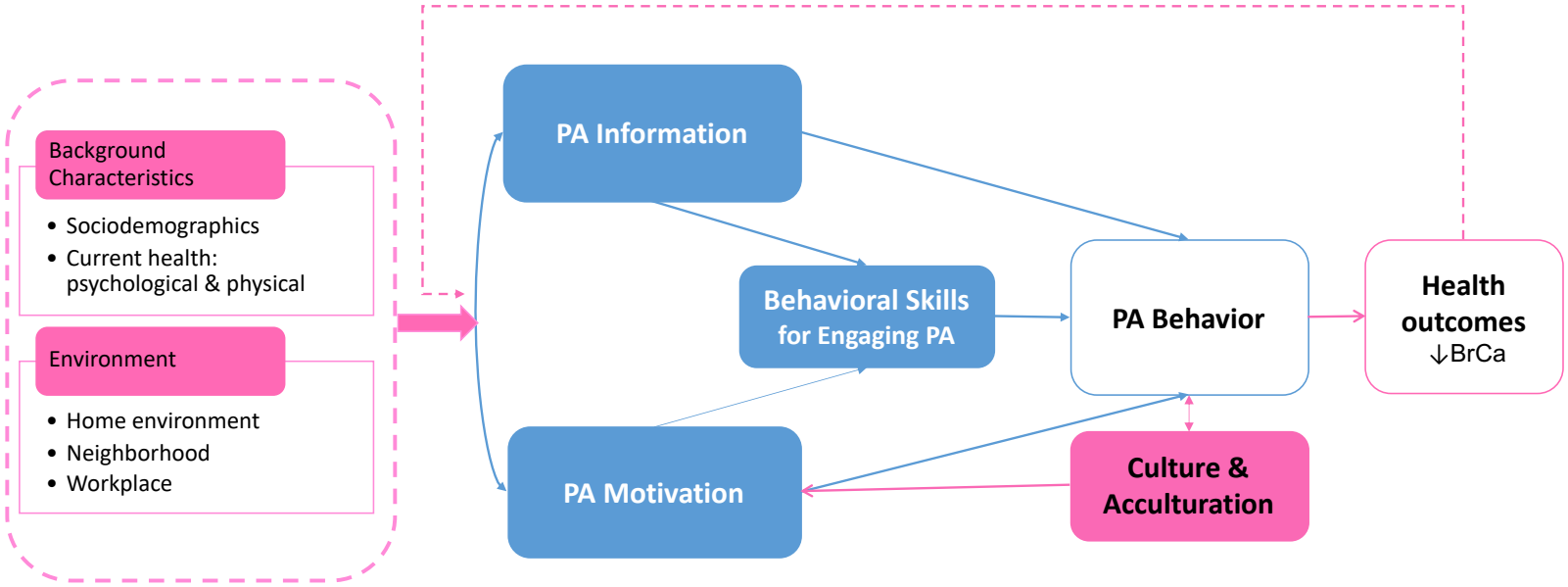

Figure 4.1 Theoretical Framework: Physical Activity – the Information, Motivation, and Behavioral Skills Model

CHAPTER 5

CONCLUSION

The purpose of this dissertation was to better understand PA among AsAm women to provide guidance for future interventions to promote PA and reduce BrCa risk in this population. Through a quantitative approach, study one used nationally representative data to describe and analyze the PA of AsAm women. This study found that approximately 48% of AsAm females met the PA guidelines when all PA domains were included. Factors associated with PA varied by domain. The influence of acculturation plays a vital role in PA practice among AsAm women. The findings from this dissertation showed that the trend of PA in this group gradually aligns with the dominant culture, decreasing in WPA and TPA but gradually increasing in LPA. Understanding acculturation in AsAm could pinpoint target groups and guide future PA interventions to achieve desired outcomes. Due to the heterogeneousness between AsAm subgroups, the second study focused on the largest Asian subgroup, Chinese Americans, through qualitative analysis using individual interviews with CAW from eight states. This study provides insight into the knowledge level of PA in BrCa prevention, PA experiences (perception, practice, and adaptation), facilitators, and barriers. The findings suggest that CAW have a low perception of the benefits of exercise for BrCa. The study also provides a more detailed understanding of the influence of traditional culture and acculturation on their PA perception and practice.

This dissertation demonstrates that PA prevalence among AsAms women remains low and that acculturation influences their daily PA practices. Based on the findings of this dissertation, PA promotion is warranted, and strategies need to consider AsAm women's cultural background and acculturation level. A structural community-based approach to facilitating bicycles, pedestrians, and public transportation might be more potent benefits for higher acculturated AsAm women. Group exercise programs, including online programs, would be more beneficial for lower acculturated AsAm women to improve PA while also helping to decrease loneliness and gaining social support so they can assimilate more quickly into mainstream culture.

BrCa prevention requires not only a focus on secondary prevention (screening) but also enhanced primary prevention. This dissertation found that CAW were unaware of the benefits of PA in cancer prevention and the increasing rate of BrCa diagnosis in this population. Findings from this dissertation underscore the importance of increasing education about the benefits of PA in BrCa prevention programs. Future research is required to investigate AsAm subgroups to provide more details that can develop effective interventions to decrease cancer risk through increasing PA.

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APPENDIX A

QUALITATIVE STUDY DEMOGRAPHIC QUESTIONNAIRE

We want to know about your physical activity or exercise in your daily life. We will ask questions about your life. This survey will take less than 10 minutes to complete.

1. How old are you?
   age: _____

2. What is your marital status?
   - ☐ Single
   - ☐ Married
   - ☐ Committed relationship
   - ☐ Separated
   - ☐ Divorced

3. If you work, what kind of job do you do?
   _____

4. What is the highest grade or level of school that you completed, or the highest degree received?
   - ☐ Never attended school
   - ☐ Complete grade school (grades 1-8)
   - ☐ Some high school
   - ☐ Graduated from high school
   - ☐ Some college, no degree
   - ☐ Associated degree: academic, occupational, technical, or vocational program
   - ☐ Bachelor's degree
   - ☐ Master's degree
   - ☐ Doctorate degree (example: PhD, EdD, MD, DDS, DVM, JD)

5. What is your total income in the last year?
   - ☐ < $10,000
   - ☐ $10,000 - $19,999
   - ☐ $20,000 - $29,999

- ☐ $30,000 - $39,999
- ☐ $40,000 - $49,999
- ☐ $50,000 or above
- ☐ Prefer not to answer

1. What language do you usually speak at home?
   - ☐ Chinese (Mandarin/Cantonese)
   - ☐ English
   - ☐ Both Chinese (Mandarin/Cantonese) and English
   - ☐ Others

6. Were you born in the US? (1st generation)
   - ☐ Yes (complete question 7)
   - ☐ No -> (complete question 13, 14, 15)

7. Were your parents born in the US? (2nd generation)
   - ☐ Yes (complete question 8)
   - ☐ No

8. Were your grandparents born in the US? (3rd generation)
   - ☐ Yes (complete question 9)
   - ☐ No

9. Were your great grandparents born in the US? (4th generation)
   - ☐ Yes
   - ☐ No

10. If you were born in the US, did you grow up in the US?
    - ☐ Yes
    - ☐ No (complete question 11 and 12)

11. How old are you when you left the US?
    - ☐ _____

12. How old are you when you moved back to the US?
    - ☐ _____

13. In what country were you born?

    _____

14. If you were born outside the US, how long have been in the US?
(_____) years

15. If you were born outside the US, how old are you when you moved to the US?
(_____) years old

16. How do you self-identify yourself? (Select all applied)
- ☐ Chinese
- ☐ Chinese American
- ☐ American

17. What is your height?
_____ ft. _____ in **OR** _____ cm

18. What is your weight?
_____ lbs **OR** _____kg

19. Which of the following do you think describes your weight?
- ☐ underweight
- ☐ normal
- ☐ overweight
- ☐ Obesity
- ☐ Morbid obesity
- ☐ Not sure

20. Have your mother, grandmother, or siblings been diagnosed with breast cancer?
- ☐ Yes
- ☐ No
- ☐ Do not know

21. Have you been diagnosed with breast cancer?
- ☐ Yes
- ☐ No

22. Did you know physical activity reduces the risk of getting breast cancer?
- ☐ Yes
- ☐ No

APPENDEX B

QUALITATIVE STUDY ADVERTISEMENT FLYER

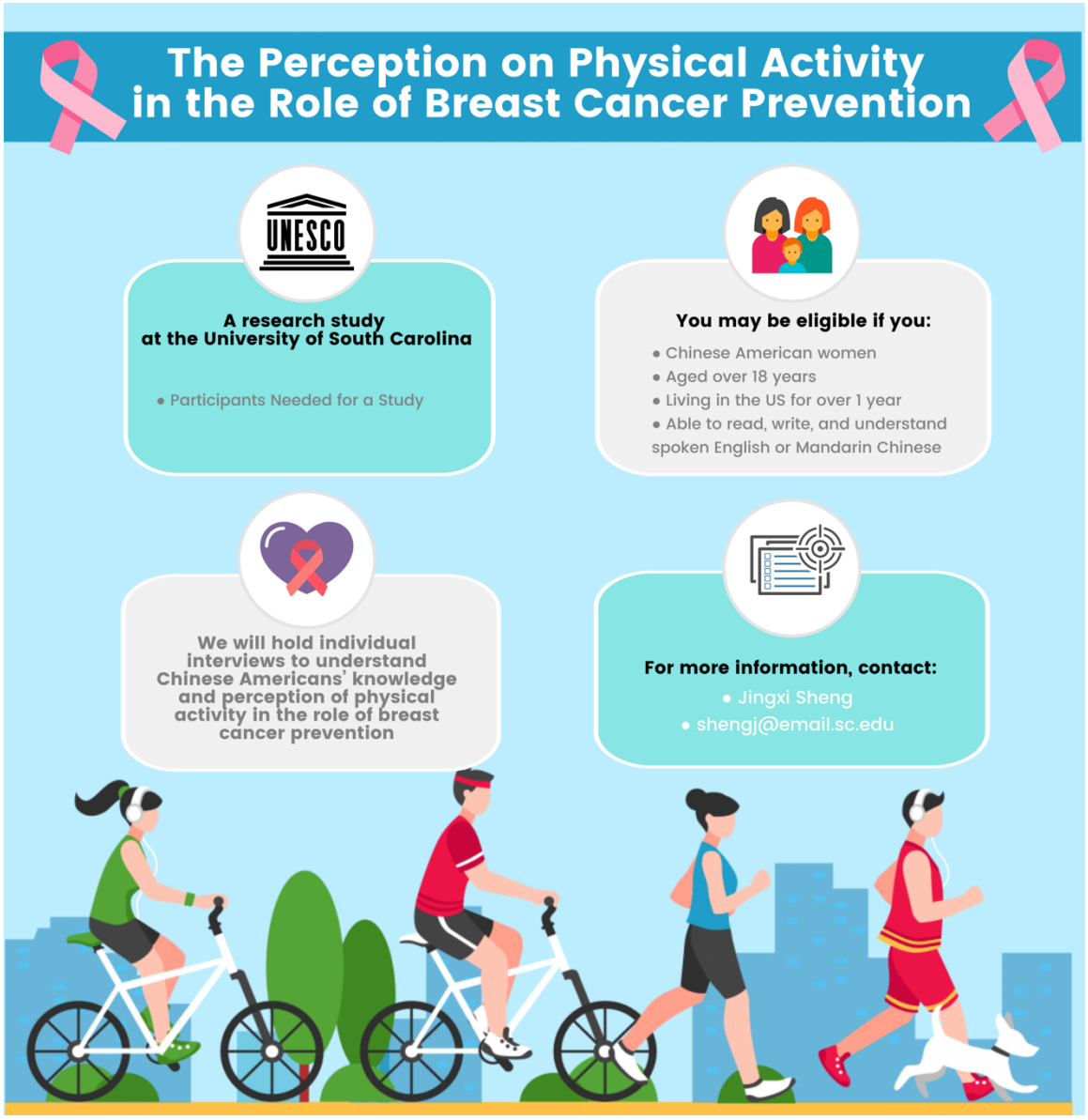

Figure B.1 Advertisement Flyer (English)

Figure B.2 Advertisement Flyer (Chinese)