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Correlates of Lifestyle Physical Activity Among South Asian Indian Immigrants

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Abstract

South Asian immigrants are at increased risk for cardiovascular disease and diabetes, but little is known about their physical activity patterns. In this cross-sectional study, 110 participants were recruited to describe lifestyle physical activity behavior of this at-risk population. Education ($p = .042$), global health ($p = .045$), and self-efficacy ($p = .000$) had significant positive independent effects on leisure-time physical activity. Depression ($p = .035$) and waist circumference ($p = .012$) had significant negative independent effects, and frequency of experiencing discrimination a significant positive independent effect ($p = .007$) on daily step counts. Culture-sensitive physical activity interventions need to target South Asian Indian immigrants who are less educated, in poor health, concerned about racial discrimination, and have low self-efficacy.

The mortality rate for cardiovascular disease (CVD) among South Asian Indian immigrants (SAIs) is twice that of Whites (2.86 v 1.32 events/100 patient-years, respectively; $p = 0.002$; Khattar, Swales, Senior, and Lahiri, 2000). The prevalence rate for diabetes for SAIs in Atlanta was substantially higher (18.3%; Venkataraman, Nanda, Baweja, Parikh, and Bhatia, 2004) than the NHANES 2005–2008 data for Whites, Blacks, and Hispanics (6.8–12.7%; Roger et al., 2011). Regular physical activity (PA) including lifestyle PA (leisure-time, household, and occupational PA) is important for reducing risks for chronic illnesses such as CVD and diabetes (Nelson et al., 2007). Many SAIs adopt a sedentary lifestyle following immigration to Western countries (Jonnalagadda and Diwan, 2002). U.S. epidemiological evidence is limited, but a Canadian study showed the prevalence of moderate PA as lower in SAIs (34%) than in Whites (49%; Bryan, Tremblay, Perez, Ardern, and Katzmarzyk, 2006). This is consistent with a smaller U.S. study in which 35% of SAIs reported participating in regular PA (R. Misra, Patel, Davies, and Russo, 2000) vs. 40% for White males and 30.2% for White females (Roger et al., 2011).

Based on the U.S. census, SAIs rose from the third largest immigrant group in 2000 to the second largest in 2010. About three million people (2,843,391) in the USA are SAIs (United States Census Bureau, 2010). A number of factors may influence the health behavior of SAIs, including: acculturative changes in values, attitudes, and customs (Jonnalagadda and

Diwan, 2002); racial discrimination resulting in psychological health problems; limited sense of community due to varying languages, religious observances, cultural practices, and the caste system (R. Misra et al., 2000); and limited availability of family for social support (Kalavar, Kolt, Giles, and Driver, 2004). With the rise in the SAI population in the United States, it is imperative that we address their high levels of CVD and diabetes by identifying factors related to their lifestyle PA behavior. This is an essential first step in developing targeted interventions to increase lifestyle PA in SAIs.

Conceptual Framework and Background

The PA framework for SAIs developed for this study is based on the Interaction Model of Client Health Behavior (IMCHB; Cox et al., 2008). This framework was used to specify static (unchangeable) background and dynamic (modifiable) intrapersonal (within individual's self or mind that influence motivation) characteristics that potentially predict health behavior. The background characteristics influence intrapersonal characteristics, and both influence health behavior (Cox et al., 2008). The background characteristics included demographics, current health, and social influences (acculturation, discrimination, social support from family and friends, and sense of community). To explain motivation for more PA, the intrapersonal characteristic of self-efficacy (confidence in ability to perform a behavior) from the social cognitive theory was used (Bandura, 2004). According to this theory, the concept of self-efficacy is important to motivate a person for behavior modification necessary to achieve a desired outcome. The health behavior outcome refers to engaging in lifestyle PA. This model has been used in PA studies with diverse age and ethnic groups (Wilbur, Miller, Chandler, and McDevitt, 2003; Plonczynski, Wilbur, Larson, and Thiede, 2008; Choi, Wilbur, Miller, Szalacha, and McAuley, 2008).

Literature Review

Background characteristics associated with higher levels of self-reported leisure-time PA (LTPA) in SAIs include being male, younger, and of higher income (Jonnalagadda and Diwan, 2005; K. Misra et al., 2005). Further, better health parameters (including lower blood pressure and lower body mass index [BMI]) were associated with higher levels of LTPA (Jonnalagadda and Diwan, 2005; R. Misra et al., 2000) and self-reported lifestyle PA (Hayes et al., 2002). The only study identified that used pedometers found that men had higher steps counts than women (Kolt, Schofield, Rush, Oliver, and Chadha, 2007).

Findings from studies that examined the relationship between acculturation using proxy measures and PA in SAIs were conflicting. One study showed that higher English proficiency was associated with increased LTPA (Hine, Fenton, Hughes, and Velleman, 1995) and three studies showed that increased length of residence in the host country was associated with increased LTPA (Jonnalagadda and Diwan, 2005; K. Misra et al., 2005; R. Misra et al., 2000). Another study, however, found that step counts decreased with SAIs' length of stay in the country (Kolt et al., 2007). The one known study to include a measure of acculturation found that having more American or bicultural identity was associated with higher levels of LTPA (Jonnalagadda and Diwan, 2005). Although no study was found that specifically looked at discrimination and either LTPA or lifestyle PA, Williams et al. (1994)

found a higher reported incidence of discrimination on the job and in housing, as well as attacks on person, among SAIs in England than in the general population.

Interestingly, the two studies that examined social support and PA yielded inconsistent findings. Kalavar et al. (2004) found a positive association of LTPA with social support from family, whereas Jonnalagadda and Diwan (2005) found that social support did not significantly influence LTPA of SAIs. None of the studies reviewed examined the influence of the community or feelings of a sense of community on either LTPA or lifestyle PA of SAIs. Prior cross-sectional (Choi et al., 2008; Marquez and McAuley, 2006a) and intervention studies (Jerome and McAuley, 2012) representing diverse ethnic groups including Koreans, Latinos, and Caucasians showed increased self-efficacy was associated with higher LTPA levels. Despite these findings, none of the SAI studies reviewed included a measure of self-efficacy. Thus, it is imperative to examine the influence of self-efficacy on the PA behavior of SAIs.

A number of gaps were identified in the studies of PA of SAIs (Daniel and Wilbur, 2011). We identified only four studies with SAIs that used measures translated into one of the predominant SAI languages (Hayes et al., 2002; Hine et al., 1995; Lip, Luscombe, McCarry, Malik, and Beevers, 1996; Williams et al., 1994). All but one study (Hayes et al., 2002) that used a self-reported PA measure looked at lifestyle PA. Overall, self-report measures are limited by problems with recall and ability to capture unstructured or unplanned PA. Further, only one study (Kolt et al., 2007) used an objective measure that captures lifestyle PA that is unstructured or unplanned. The measurement of acculturation was restricted primarily to proxy measures. Importantly, they failed to look at the association between lifestyle PA and discrimination, sense of community, and self-efficacy.

The purposes of this study were to: (1) describe lifestyle PA (leisure-time, household, and occupational PA) behaviors of SAIs; and (2) examine the relationship between background (acculturation, discrimination, social support) and intrapersonal (self-efficacy) characteristics, and lifestyle PA (combined moderate/vigorous LTPA and daily step counts per accelerometers).

Methods

Design

A cross-sectional descriptive face-to-face survey design was used.

Sample and Setting

Inclusion criteria.—The inclusion criteria were: SAI between the ages of 40–65; immigrated to the United States directly from India; born in India (first generation); resided in the Chicago metropolitan area; spoke Hindi (the national language in India) or English; and had no disability that interfered with walking.

Sample size.—Sample size was primarily determined based on a regression model. Empirical studies have found a .41 correlation between self-efficacy for walking and pedometer steps in a study that included SAIs in the UK (Yates et al., 2008) and a .21

correlation between self-efficacy for overcoming barriers and self-reported LTPA in a sample of Korean immigrants in the United States (Choi et al., 2008). By assuming a median regression coefficient of .31, one-tailed alpha of .05, and sample size of 100, we obtained a power of .92 (Cohen, 1988). Approximately 10% incomplete accelerometer data were expected, so 110 persons were recruited.

Setting and recruitment.—The study took place in Illinois, which ranks fifth in SAIs ($n = 186,955$; U.S. Census Bureau, 2010). The primary recruitment sites were seven religious institutions serving SAIs, including one Sikh gurudwara (serving over 2500 people), five Christian churches (serving 75–125 people), and one Hindu temple (serving over 10,000 people). Recruitment included distribution of flyers, announcements, and presentations at the religious institutions. Also, social networking occurred among church members and their outside friends.

The flyers in English and Hindi included brief information regarding the study purpose, eligibility criteria, and telephone number to call to obtain additional information. At all institutions, flyers were posted on the bulletin boards in the lobby, given to the office personnel to hand out to people of the congregation, and handed out to the people after the services by the bilingual investigator. A mass e-mail with attached flyers in English and Hindi was sent out by the Hindu *Dharma* (religion) and Philosophy committee chairperson to the members of the Hindu temple. Six presentations informing the congregants about the study were held, including two at the gurudwara, two at one church, and two at the temple to inform the congregation about the study. Interested persons signed their name on a sheet to be screened at a later time. In addition, weekly announcements were made at the gurudwara and one Christian church for three consecutive weeks during worship hours.

A total of 122 persons were screened in person: 51 from the gurudwara, 42 from the temple, and 24 from a Christian church. An additional five persons were referred by a member of one of the Christian churches; although Christian, they did not attend any of the contact religious institutions. Twelve persons were ineligible due to the following reasons: (1) 6 were nonimmigrant and (2) 6 did not meet the age criteria. The recruitment period lasted six weeks (June 19–July 31, 2011). A total of 110 SAIs were eligible and participated in the study.

Measures

Instrument translation.—All measures were translated from English into Hindi, with sequential use of multiple translation techniques (Daniel, Miller, and Wilbur, 2011). These techniques included: (1) the committee method (three bilingual SAI translators), which focused on clarity of translated words while preserving the meaning of words by reaching consensus on an integrated version; (2) a focus group (five bilingual SAIs) that resolved minor discrepancies in translation that remained from the committee method; and (3) think-aloud interviews with cognitive probing that enhanced understanding of translation while the concepts represented the same meaning and function as in the original version. Focus group and think-aloud participants were represented by SAIs from diverse educational, professional, and Indian regional background. The sequential use of these multiple

translation techniques improved translation with culturally acceptable language, thereby maintaining equivalence with original versions.

Demographics.—The demographic items were age, gender, education, marital status, number of children, employment, income, religion, and preferred Indian language.

Current health.—Self-report and physical measures were used to assess current health. Global health was measured with a single item from the Behavioral Risk Factor Surveillance System (BRFSS, 2010), asking participants to rate their overall health status on a 5-point scale (1 = *excellent*, 2 = *very good*, 3 = *good*, 4 = *fair*, 5 = *poor*). The BRFSS previously has been administered to Hindi-speaking SAIs using an interpreter (Link, Osborn, Induni, Battaglia, and Frankel, 2010). The 12-item Center for Epidemiologic Studies Depression Scale (CES-D) for SAIs was used to measure current depressed mood (Gupta, Punetha, and Diwan, 2006). The responses range from 1 (*rarely or none of the time*) to 4 (*most or all of the time*). The scores are summed. The Cronbach's alpha in the present study was .85.

Blood pressure was measured following National Heart, Lung, and Blood Institute (NHLBI) recommendations (NHLBI, 2011). Using a HEM-907 XL monitor, three blood pressure readings were taken 2 minutes apart and averaged. Participants were identified as having hypertension if the systolic blood pressure was ≥ 140 mm Hg or diastolic blood pressure was ≥ 90 mm Hg. Height was measured to the nearest 1/16 inch using the Seca Portable Stadiometer Model 213. Weight was measured to the nearest 1/4 pound using a balance beam digital scale (Seca Brand SE 803 scale), with participants standing in light clothing and without shoes. BMI was calculated by dividing weight (converted to kilograms) by height (converted to meters) squared (wt/ht^2). Waist circumference was measured by placing a measuring tape in a horizontal plane around the abdomen at the uppermost lateral border of the iliac crest, measuring to the nearest centimeter while participants stood straight. Waist circumference was categorized into ≤ 40 inches or > 40 inches for men and ≤ 35 inches or > 35 inches for women. These cutoff points indicate disease risk for type 2 diabetes, hypertension, and CVD (NHLBI, 2011).

Social influences.—Social influences measures included acculturation, discrimination, and social support. Acculturation is a cross-cultural adaptation process that maintains and reflects the host and traditional cultural values and beliefs (Ryder, Alden, and Paulhus, 2000). The Vancouver Index of Acculturation is a 20-item self-report measure with two subscales, including SAI heritage (10 items) and mainstream American (10 items) culture orientation (Ryder et al., 2000). Responses range from 1 (*strongly disagree*) to 9 (*strongly agree*). The acculturation scores are summed and mean calculated for each subscale (SAI and American). Higher scores for each subscale indicate stronger SAI acculturation or American acculturation, respectively. In the present study, Cronbach's alphas were .92 for the SAI acculturation subscale and .93 for the American acculturation subscale.

Discrimination refers to differential actions toward others because of their race/ethnicity (Kressin, Raymond, and Manze, 2008). For this study, discrimination was measured using the Experiences of Discrimination (EOD) measure (Krieger, Smith, Naishadham, Hartman, and Barbeau, 2005). The measure includes ever experiencing discrimination in nine

situations, frequency of occurrence, and response to unfair treatment. The numbers of situations in which respondents experienced discrimination were summed for a situation score. The frequency of discrimination was measured on a 4-item scale: 0 for *never*, 1 for *once*, 2.5 for *2–3 times*, and 5 for *4 or more times*. Frequency was summed across items for a possible frequency score of 0 to 45. Response to unfair treatment was scored as 2 for engaged (*do something about it or talk to someone about it*), 1 for moderate (*act/keep it to self or accept/talk to someone about it*), or 0 for passive (*accept/keep it to self*). In the present study, the Cronbach's alpha was .86.

The measures of social support included social support provided by family and friends and sense of community. The PA Social Support Survey is a 5-item measure of family and friend support for PA (Eyler et al., 1999). Responses range from 1 (*strongly agree*) to 4 (*strongly disagree*). The items are summed and mean obtained. A higher final score indicates higher social support from family and friends. In the present study, the Cronbach's alpha was .87. The 12-item Sense of Community Index is a measure of membership, influence, fulfillment of needs, and emotional connection (Chipuer and Pretty, 1999). Responses range from 1 (*strongly agree*) to 5 (*strongly disagree*). The items are summed and mean obtained. A higher score indicates higher sense of community. In the present study, the Cronbach's alpha was .70.

Self-efficacy.—Self-efficacy was measured with McAuley's 17-item Self-Efficacy Scale for Confidence in Overcoming Barriers to PA (McAuley, 1992). The scale is scored from 0% = *not confident* to 100% = *completely confident* in overcoming each barrier to being physically active. The items are summed and mean calculated. One item was added to reflect the barrier due to SAI traditional clothing. In the present study, the Cronbach's alpha was .96.

Physical activity behavior.—The 17 LTPA items from the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire were used to estimate the typical weekly minutes of combined moderate and vigorous LTPA in the past two weeks (Stewart et al., 2001). CHAMPS has been used with middle aged adults from diverse ethnic backgrounds (Ju, Wilbur, Lee, and Miller, 2011; Resnicow et al., 2003). The 17 items had an assigned MET (metabolic equivalent) that was moderate intensity or above. Eleven items were moderate-intensity (3–5) LTPA, and six were high-intensity (>5 MET). Frequency of activity was assessed in times per week, and duration was classified into six categories ranging from < 1 hour/week (coded 0.5 hour) to 9 hours/week (coded 9.75 hours). Minutes spent in moderate- and vigorous-intensity activity per week were obtained by summing the duration per week for all items with a moderate- and vigorous-intensity code, respectively. The scores for weekly minutes of combined moderate/vigorous activities were summed. Validity of the CHAMPS for older and middle-aged adults was shown by significant but small correlations ($p = .16-.32$) with estimated VO_2 max (Resnicow et al., 2003). Validity for the newly translated Hindi version of the CHAMPS was shown by a significant but small correlation with step counts ($p = .201$).

Participants wore a blocked (no data displayed) Lifecorder EX (NL2200) accelerometer that counted their steps per day for seven days. Accelerometers have proven useful for accurately

measuring accumulated lifestyle PA under controlled and free-living conditions through daily steps. The Lifecorder EX is capable of storing 200 days' worth of steps, distance, and PA minutes and automatically resets to 0 steps at midnight (Crouter, Schneider, and Bassett, 2005). The accelerometer recorded a time, date, and total steps and had an embedded USB port. Data outputs were exported from Lifecorder EX software for analysis. The Lifecorder EX is based on solid-state electronic technology, which uses a piezoelectric strain gauge (a technology with no moving parts) to accurately record each step taken. The piezoelectric gauge was shown not to be affected by increasing BMI or circumference of the waist and hip. No significant difference was found between Lifecorder EX and ActiGraph accelerometers output of steps (McClain, Craig, Sisson, and Tudor-Locke, 2007).

The accelerometer was pre-programmed with the person's gender, height, weight, and age. Participants were instructed to wear the accelerometer at all times for seven days except when sleeping, showering, or swimming, and to wear it at the waist midline with their thigh. Daily steps were averaged over the seven days. The accelerometer was taped (blocked) so the participant could not be influenced by seeing their step count. All participants had at least three days of data per week—the minimum considered sufficient to provide an estimate of weekly PA (Tudor-Locke et al., 2005). The number of days the participants wore the pedometers was: 3 days ($n = 6$), 4 days ($n = 2$), 5 days ($n = 1$), 6 days ($n = 10$), and 7 days ($n = 91$).

Data Collection Procedure

The study was approved by the host university's Institutional Review Board. Based on participants' preference, the interviews were conducted either at a private location in the religious institution ($n = 83$, 75%) or at their homes ($n = 27$, 25%). Further, the participants were seen individually ($n = 85$) or in small groups of three to five ($n = 25$). At the first meeting, the bilingual researcher further explained the study purpose and obtained informed consent; participants were given the option to read the questionnaires themselves (55%) or have them read to them (45%) in the language of the participants' choosing. This was followed by physical measures, including blood pressure, height, weight, and waist circumference. A light snack was offered, and breaks were given as needed.

After completing questionnaires and physical measures, the results of the physical measures were given to the participants, and written instructions were provided in Hindi or English on wearing the blocked accelerometers for the following seven days. A time and location were identified for retrieving the accelerometer. At the second visit, the accelerometer was downloaded, and participants were given the results of their step-count information, recommended PA guidelines, and step recommendations. Participants were also given \$10 in appreciation of their time and effort.

Data Analysis

All analyses were conducted using SPSS version 17.0 for Windows. Descriptive statistics (frequencies, means, and standard deviations) were calculated for background and intrapersonal characteristics, and lifestyle PA. Chi-square and *t* tests were used to examine differences between gender on background characteristics (demographics, current health,

and social influences), intrapersonal characteristics (self-efficacy), and PA. Bivariate Pearson correlation coefficients were computed among background, intrapersonal, and PA measures. The combined self-reported moderate/vigorous LTPA and accelerometer step count PA dimensions were regressed on the background and self-efficacy. Based on our theoretical model of PA, independent variables were entered into the regression analysis in four blocks: (1) demographics characteristics, (2) current health, (3) social influences, and (4) self-efficacy. Within each block, independent variables were entered into the models using the stepwise approach. Only significant predictors from each block were retained and carried into the next block and were retained even if they became insignificant in subsequent models. This method of model building is described in Pedhazur (1997).

Results

Demographic Characteristics and Current Health

The mean age of the participants was 53 years (Range = 40–65). Most were women (62.7%), college graduates (69.1%), married (92.7%), and had children (97.2%). Over 70% of the participants were currently employed, and 67.2% had an annual household income of \$50,000. Participants were almost equally divided into three religions: Christians (30.9%), Hindus (34.5%), and Sikhs (34.5%). The most common preferred Indian languages were Hindi (29.1%) and Punjabi (39.1%), but 31.8% preferred one of seven other Indian languages. Slightly more than half of the participants answered the questionnaires in English.

The mean score for global health ($M = 3.19$) indicated moderately good physical health (Table 1). Fifty percent of the participants had a CES-D score above the cutoff point of 10 for depressive symptoms. Approximately one-fourth (27.3%) of participants had hypertension. The mean BMI for the participants was 28.6 (Range = 19–40), which is in the overweight range. The only significant difference between men and women was for waist circumference, with 75.4% of women and 39.0% of men measuring above the cutoff point for disease risk.

Social Influences, Self-Efficacy, and Physical Activity

Acculturation scores were higher for the SAI culture than the American culture (Table 1). Over one-third ($n = 49$, 44.5%) of participants reported that they experienced some discrimination. Of those who reported discrimination, the most frequent situation was at work ($n = 30$, 61.2%). On average, discrimination was experienced three times, and it was significantly higher for men than women (4.7 vs. 2.1 times). Participants expressed a moderate response towards discrimination ($M = 1.09$). Social support from family and friends for PA and the sense of community were both reported to be moderately high. On average, participants were 61.86% confident in their ability to overcome barriers to PA. On average, participants reported spending 197.3 minutes in moderate-intensity (3–5 MET), 80.5 minutes in high-intensity (> 5 MET), and 277.7 minutes in combined moderate/vigorous-intensity LTPA/week. On average, the daily number of steps was 6904.3. There was no significant difference between men and women for acculturation, social support, and self-efficacy.

Correlations among Background, Intrapersonal Characteristics, and Physical Activity

Self-efficacy for overcoming barriers to PA was significantly negatively correlated with BMI, waist circumference, and depression, and significantly positively correlated with global health (Table 1). Lower BMI, waist circumference and depression scores, and higher global health, were associated with higher self-efficacy. Education and global health were significantly positively correlated with self-reported combined moderate/vigorous LTPA. Depression and waist circumference were significantly negatively correlated with both combined moderate/vigorous LTPA and step counts. Higher American acculturation had a significant positive correlation with combined moderate/vigorous LTPA, while greater frequency of experiencing discrimination had a significant positive correlation with daily step counts. Self-efficacy was significantly positively correlated with both self-reported combined moderate/vigorous LTPA and step counts.

Regression of Physical Activity on Background and Intrapersonal Characteristics

The assumption of normality of the outcome variables was not met. As a consequence, the data were square root transformed, after which the assumption was met. Self-reported combined moderate/vigorous LTPA and step count dimensions were regressed on the background and self-efficacy (Table 2). For the self-reported combined moderate/vigorous LTPA, education was retained from the first block, and global health and depression were retained from the second block; no variables were retained from the third block. For the final model, education, global health, depression, and self-efficacy were retained. The regression was significant $F(4, 105) = 6.061, p = .000$. Education ($p = .042$), global health ($p = .045$), and self-efficacy ($p < .001$) had significant positive independent effects. Depression had a significant negative independent effect ($p = .018$). The final model explained 18% of the variance.

For daily step count, no variables were retained in the first or fourth blocks (Table 3). Depression and waist circumference were retained from the second block, and frequency of discrimination from the third block. Depression, waist circumference, and frequency of discrimination were retained for the final model. The regression was significant $F(3, 106) = 7.350, p = .001$. Depression ($p = .035$) and waist circumference ($p = .012$) had significant negative independent effects. Frequency of experiencing discrimination had a significant positive independent effect ($p = .007$). The final model explained 17% of the variance.

Discussion

We examined the PA behavior and the relationship of PA with the background and intrapersonal characteristics of midlife SAIs. The average number of steps taken by these SAIs was 6904 (men = 7056 steps, women = 6813 steps), which is in the low active classification (5000–7499; Tudor-Locke & Bassett, 2004) and did not differ by gender. This is consistent with a prior study of SAIs residing in New Zealand (men = 6982 steps, women = 5159 steps); however, in that study, step count was significantly higher in men than women (Kolt et al., 2007). In the current study, the average number of weekly minutes of self-reported combined moderate/vigorous-intensity LTPA was moderately active: 277.7. This overall mean was similar in a study of midlife/older Latino immigrants ($M = 221.7$;

Marquez et al., 2011). The discrepancy in our study between self-reported LTPA and steps may be related to a tendency to over-report PA (Adams et al., 2005).

Other studies that include Latinos (Marquez et al., 2011), Koreans (Ju et al., 2011), and Caucasians (Pettee et al., 2006; Tudor-Locke et al., 2004), all found that men were more active than women in both self-reported LTPA and objectively measured PA. We found no difference between SAI men and women in their self-reported or objectively measured PA. This finding might be due to the fact that women in this sample were slightly better educated than men. Self-reported LTPA was higher in those SAIs with higher education. This is consistent with a prior study of Latino adults (Marquez and McAuley, 2006b).

Lower levels of depressive symptoms were related to both higher levels of self-reported LTPA and higher step counts. Lower waist circumference was only related to step counts. Perception of better general overall health was related to self-reported LTPA but not to step counts. These findings are similar to those of Choi et al. (2008), who found that Koreans with better mental health had more LTPA, and an earlier study of U.S. SAIs that found better body composition was associated with higher levels of LTPA (Jonnalagadda & Diwan, 2005). The association between better health parameters and PA measures in our study suggests that participants may reap the benefits of both LTPA and general lifestyle walking. However, we do not know the direction of this relationship. It may be, for example, that higher waist circumference, depressive symptoms, or poor perception of health may restrict people from participating in PA. In order to address this question in a more systematic manner, a longitudinal study would be required.

SAIs who were more acculturated to American culture reported spending more time in moderate/vigorous LTPA. This is consistent with the only other known study of SAIs in the U.S. that also examined the acculturation relationship with LTPA (Jonnalagadda & Diwan, 2005). We speculate that, similar to Latinos (Marquez & McAuley, 2006b), SAIs who are more acculturated to American culture may have access to non-manual labor employment opportunities. Therefore, they may consider participation in LTPA to be more important for their physical fitness.

Frequency of experiencing discrimination was significantly related with step count, but not with self-reported LTPA. Interestingly, consistent with a study of SAIs in the UK (Williams et al., 1994), discrimination was experienced most frequently at work. One possible explanation for the discrimination and PA relationship is that SAIs who work and are out in public get more steps in and may have more exposure to discrimination. This bears further exploration.

Similar to prior studies with Korean immigrants (Choi et al., 2008), Latinos (Marquez & McAuley, 2006a), and other diverse ethnic groups including Caucasians (Jerome & McAuley, 2012) self-efficacy was positively associated with increased reported LTPA. Thus, self-efficacy is as important for LTPA in SAIs as it is with other groups.

Implications

Several strategies can be used to target cultural-sensitive physical activity interventions, such as involvement of South Asian Indian religious institutions to recruit and implement physical activity interventions. Recruitment from diverse SAI religious institutions could provide an opportunity to reach a broad spectrum of participants. Use of translated material into one of the most commonly used South Asian Indian language at the selected religious institution such as Hindi (the national language in India) would allow to reach participants who are not bilingual. Use of both a self-report and objective measure of PA would allow measurement of different dimensions of PA in order to capture the overall lifestyle physical activity. A major strength of the study was the inclusion of measures of acculturation, discrimination, and self-efficacy which have had limited examination in relationship to PA in this immigrant population. Designing interventions that focus on aspects of acculturation, discrimination, and self-efficacy would be helpful in overcoming barriers to increasing lifestyle physical activity in this at-risk population.

Limitations

Limitations include the cross-sectional design, which does not allow for causal inferences between the predictor and the outcome variables. Also the self-report for LTPA was based on a typical week in the two weeks prior to wearing the pedometer. Participants were not randomly selected, so results cannot be generalized beyond these participants. In addition, participants who preferred questionnaires to be read to them may have given what they felt were socially acceptable responses. We should be cautious about administering this questionnaire to people who have less than high school education. These translated questionnaires may not be generalizable to all regions of India, and we recommend testing reliability if used in regions outside the urban areas where Hindi is not most commonly used.

Conclusion

In summary, a high risk for cardiovascular disease and diabetes among SAIs and their low lifestyle PA raise a significant public health concern. Our study supports the importance of targeting and tailoring physical activity interventions on SAIs who are less educated, in poor physical and mental state of health, less acculturated to the American culture, concerned with racial discrimination, and have low self-efficacy. In addition, interventions should focus on cultural sensitivity toward SAIs.

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Table 1
Correlations among Background Characteristics, Intrapersonal Characteristics, and Physical Activity (N = 110)

Background characteristics	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Demographics																
1. Age																
2. Gender ^a		-.073														
3. Education ^b		-.327**	.054													
Current health																
4. Global health	3.19 (.92)	.134	-.044	.182												
5. CES-D	12.5 (4.6)	.065	.127	-.038	-.212*											
6. Hypertension ^c		.078	-.161	-.032	-.127	.085										
7. BMI	28.6 (3.8)	-.109	.014	-.149	-.219*	.193*	.147									
8. Waist circumference ^d		-.039	.362**	-.040	-.142	.182	-.065	.457**								
Social influences																
9. SAI acculturation	8.19 (1.17)	.057	-.016	-.215*	-.094	-.268**	.020	.022	-.013							
10. American acculturation	5.5 (2.05)	-.090	-.088	.176	.325**	-.062	.015	-.228*	-.145	-.029						
11. Discrimination situations	1.2 (1.99)	-.043	-.171	.123	-.192*	.365**	-.047	.143	-.008	-.088	-.118					
12. Discrimination frequency	3.1 (7.0)	-.057	-.183	-.013	-.153	.238*	-.059	-.113	-.050	.062	-.182	.868**				
13. Social support	3.1 (.68)	-.149	.060	-.252**	-.097	.016	.023	.169	.048	.195*	-.271**	-.050	.064			
14. Sense of community	3.4 (.48)	-.125	-.055	.184	.190*	-.252**	-.055	-.105	-.016	-.233*	.152	-.075	-.091	.044		
Intrapersonal characteristics																
15. Self-efficacy	61.86 (27.63)	-.018	-.154	.172	.226*	-.318**	.097	-.272**	-.238*	.070	.102	.055	.090	.034	.002	
Physical Activity																
16. Combined moderate and vigorous LTPA	277.7 (337.1)	.024	.058	.225*	.306**	-.246**	-.093	-.120	-.199*	-.037	.190*	-.099	-.131	-.054	.066	.293**
17. Step count	6904.3 (3388.1)	.105	-.035	.039	.128	-.244*	-.103	-.151	-.274**	.053	-.084	.118	.213*	-.050	.031	.254**

Note.

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g 1 = men, 2 = women.
 h 0 = no college degree, 1 = college degree.
 c 0 = no hypertension, 1 = hypertension.
 d 0 = waist below the cutoff point, 1 = waist above the cutoff point.
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Regression of Combined Moderate and Vigorous Leisure-Time Physical Activity on Background Correlates and Intrapersonal Correlates (N = 110)

	<i>F</i>	<i>df</i>	<i>p</i>	Variable	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
Final model	6.061 *	4, 105	.000	Education	4.376	2.122	.195	2.063	.042
				Global health	2.141	1.057	.190	2.025	.045
				Depression	-.509	.211	-.225	-2.409	.018
				Self-efficacy	.136	.034	.359	4.002	.000
$R^2 = .188$									

Model	<i>F</i>	<i>df</i>	<i>p</i>	Variables Included	Variables Retained
Intervening model 1	4.255 *	1, 108	.042	Age, gender, education	Education
Intervening model 2	5.219 *	3, 106	.002	Education, global health, depression, BMI, waist circumference, HTN	Education, global health, depression
Intervening model 3	5.219 *	3, 106	.002	Education, global health, depression, SAI acculturation, American acculturation, discrimination situations, frequency of experiencing discrimination, social support, sense of community	Education, global health, depression
Intervening model 4	6.061 *	4, 105	.000	Education, global health, depression, self-efficacy	Education, global health, depression, self-efficacy

Table 3
Regression of Average Steps on Background Correlates and Intrapersonal Correlates (N = 81)

	F	df	p	Variable	B	SE	β	t	P
Final model	7.350*	3,106	.001	Depression	-.867	.405	-.198	-2.139	.035
				Waist circumference	-9.870	3.840	-.238	-2.570	.012
				Frequency of experiencing discrimination	.722	.262	.252	2.753	.007
$R^2=.172$									
Model	F	df	p	Variables Included	Variables Retained				
Intervening model 1	.753	3,106	.523	Age, gender, education	-				
Intervening model 2	6.814*	2,107	.002	Global health, depression, BMI, waist circumference, HTN	Depression, waist circumference				
Intervening model 3	7.350*	3,106	.000	Depression, waist circumference, SAI acculturation, American acculturation, discrimination situations, frequency of experiencing discrimination, social support, sense of community	Depression, waist circumference, frequency of experiencing discrimination				
Intervening model 4	7.350*	3,106	.001	Depression, waist circumference, frequency of experiencing discrimination, self-efficacy	Depression, waist circumference, frequency of experiencing discrimination				