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The Relationship of Education and Acculturation with Vigorous Intensity Leisure Time Physical
Activity by Gender in Latinos

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Abstract

Objectives: Latinos have poorer health outcomes among certain conditions (e.g., diabetes, obesity, mental health) compared to non-Latino Whites in the U.S., in part due to difference in the amount of physical activity, which are heavily influenced by sociocultural factors such as educational attainment and acculturation. Vigorous-intensity leisure time physical activity (VLTPA) may provide health benefits with a shorter amount of time than moderate-to-light physical activity. However, VLTPA has been significantly understudied compared to LTPA in general. The purpose of this study is to examine the associations between educational attainment, acculturation, and VLTPA by gender among Latino adults in the U.S.

Design: Nationally representative samples of Latino adults aged 25 years and older ($n = 4,393$) from the 2010 National Health Interview Survey were analyzed. VLTPA was measured as the number of hours per week of VLTPA consisting of heavy sweating or large increases in breathing and heart rate. Acculturation was measured as the degree to which the English language versus the Spanish language was spoken most often. The zero-inflated Poisson regression model was constructed using the full information maximum likelihood estimation and controlling for a series of sociodemographic characteristics and relevant health behaviors.

Results: Educational attainment was positively associated with VLTPA among Latino adults [$\exp(b) = 1.09$, $p < 0.05$]. Similarly, greater acculturation was associated with greater hours/week of VLTPA [$\exp(b) = 1.10$, $p < 0.05$]. Lastly, the effect of educational attainment on VLTPA significantly varied by gender.

Conclusions: Education had a positive association and acculturation had negative association with the hours/week of VLTPA among Latinos. Also, the association between education and VLTPA was significantly stronger among women than men. These findings inform culturally

and socially sensitive approaches to improve the health of Latinos, in hopes to address health disparities by race/ethnicity the U.S.

Key Words: Hispanic; women; immigrants; exercise; health behavior

Word Count: 7,061

Introduction

Health disadvantages in Latinos

Latinos (Latino or Hispanic; Latino hereafter) are one of the largest and fastest growing ethnic minority and immigrant group in the U.S. (Ennis, Rios-Vargas, and Albert 2011). The Latino population has increased from 6.5% in 1980 to 17.3% of the total U.S. population in 2014 (Stepler and Brown 2016). However, Latinos face health disadvantages (e.g., higher diabetes, obesity, depression rates) compared to non-Latino Whites, which in turn, result in racial/ethnic health disparities (Wang and Beydoun 2007; Wassertheil-Smoller et al. 2014). Additionally, among Latinos, women have higher rates of obesity and depression than men (Wassertheil-Smoller et al. 2014; Wang and Beydoun 2007). As evidenced above, health disparities by race/ethnicity are prevalent and inclusive of numerous ill-health outcomes. Also, among Latinos, health disparities by gender are of serious concern. It is necessary to better understand underlying mechanisms in order to reduce health disadvantages among Latinos (Health and Services 2008).

Social determinants of health

In the context of health disparities by race and ethnicity, social determinants of health have been considered a particularly important area of research because they are the fundamental

causes of ill-health (Link and Phelan 1995; Marmot 2005). Since health disparities consist of numerous health outcomes, which are highly correlated with each other, addressing one health outcome at a time is ineffective and inefficient for achieving the national health goals. Instead, alleviating the fundamental causes, like social determinants of health, can simultaneously improve multiple health outcomes at the population level (Hatzenbuehler, Phelan, and Link 2013). Educational attainment and income are the most common social determinants of health (Braveman, Egerter, and Williams 2011). Notably, previous research suggests that education is a better predictor of health outcomes than income over the life course (Herd, Goesling, and House 2007; Mirowsky and Ross 2003). Although the associations between education and health have been well-established (Adler and Newman 2002; Ross and Wu 1995), more sound explanations on the pathways between education and health are needed, especially among Latinos (Zimmerman and Woolf 2014).

Braveman and colleagues (2011) suggest that social determinants of health seem to differentiate health outcomes through downstream factors such as health behaviors, beliefs, and knowledge. In this respect, social determinants of health are distal, upstream factors that affect health. For example, educational attainment shapes one's health behaviors (e.g., physical activity), which are more proximate health determinants (Mirowsky and Ross 2003, 2015). It is well-established that physical activity is a health promoting behavior, and directly influential of both physical and mental health (Penedo and Dahn 2005; Health and Services 1996). Moreover, physical activity is a complex yet modifiable behavior. Indeed, previous clinical trials and research have reported the benefits of physical activity-based interventions on health (Penedo and Dahn 2005; Buchner et al. 1992).

Vigorous-intensity leisure time physical activity

One of the major downstream health determinants is physical activity. Leisure time physical activity (LTPA) is known not only to promote health, but also to protect individuals from health risk factors (e.g., stress) at large (Mammen and Faulkner 2013; Hassmen, Koivula, and Uutela 2000). LTPA excludes both work-related and transportation-related physical activities. Although different types of LTPA have been examined in previous studies, the current study focuses on the vigorous-intensity leisure time physical activity (VLTPA) due to their health benefits and time efficiency. The Centers for Disease Control and Prevention (CDC) recommend either 75 minutes of vigorous physical activity per week or 150 minutes of moderate physical activity per week for adults as well as an equivalent combination of moderate and vigorous physical activity (Centers for Disease Control Prevention 2011b).

Previous research has highlighted the importance of studying LTPA in general and VLTPA in particular. First, a few rigorous longitudinal studies report that only vigorous physical activity reduced the mortality rates by an appreciable rate while light and moderate physical activity had a little or no significant effects on health, although this finding is yet to be confirmed with other populations (Haskell et al. 2007; Lee and Paffenbarger 2000). Similarly, Chomistek et al. (2012) found that a greater amount of vigorous intensity physical activity was associated with lower risk of major chronic disease above and beyond moderate intensity physical activity. Second, the positive effects of VLTPA on mental health (e.g., lower rates of depression) are often greater than light to moderate physical activity (Teychenne, Ball, and Salmon 2008). Also, a national study of U.S. adults showed that vigorous intensity physical activity was positively linked to sleep quality and day time productivity, whereas about twice as much moderate physical activity time was required for similar health benefits (Loprinzi and Cardinal 2011). Third, VLTPA has been understudied among racial and ethnic minorities compared to overall

physical activity. Particularly, Latinos as a rapidly increasing segment of the U.S. population should receive more attention because several studies identified cultural and/or Latino-specific barriers to physical activity (e.g., greater emphasis on familial obligations, negative attitudes toward leisure among families) (Im et al. 2010; Heesch, Brown, and Blanton 2000). Last but not least, the primary barrier to LTPA is time constraint mainly due to daily obligations (e.g., childcare, house work; Parra-Medina and Messias 2011). Indeed, time constraint due to familial obligations among Latinas is of a particular concern (discussed in more detail in the next sections). Therefore, VLTPA has a greater potential to enhance the health of Latinos while addressing the issue of time constraint.

Acculturation and leisure time physical activity

In order to better understand social determinants of health and health disparities, unique characteristics of specific sub-populations should be taken into account. Given that Latinos are the focus of this current study, one critical factor – acculturation – must be considered in addition to social determinants of health. Acculturation is the process through which an immigrant group adopts the attitudes, beliefs, and behaviors of the host culture (Gordon 1964). Although a single, consistent measurement of acculturation has not yet established, previous studies employed a variety of measures including language spoken, length of time in the U.S., age of arrival, nativity, country of origin, and cultural orientation (Gerber, Barker, and Pühse 2012). Nevertheless, acculturation is fairly consistently associated with a wide range of poor health behaviors including unhealthful diet, smoking, and excessive alcohol intake among Latino adults in the U.S. (Abraído-Lanza, Chao, and Flórez 2005; López and Yamashita 2015). At the same time, acculturation is positively associated with LTPA (Gerber, Barker, and Pühse 2012).

In comparison to non-Latino Whites, Latinos are less likely to engage in LTPA and to meet the CDC Physical Activity Guidelines (US Department of Health Human Services 2008; He and Baker 2005; Schoenborn et al. 2004). Possible mechanisms that underlie this association are still unclear. Both social determinants of health and acculturation seem to partially explain the lower amount of LTPA among Latinos. For example, previous research found that education and income are closely associated with levels of LTPA (Tovar, Walker, and Rew 2016; Crespo et al. 2000). Among racial and ethnic groups in the U.S., Latinos have the lowest level of educational attainment and the second lowest median household income (e.g., \$42,491 among Latinos vs. \$60,256 among non-Latino Whites) (Ryan and Bauman 2016; DeNavas-Walt and Proctor 2015). Furthermore, Latinos consistently have the lowest levels of LTPA across all educational and income levels (Crespo et al. 2001).

Another explanation for the lower level of LTPA among Latinos is the degree of acculturation, although, to date, the findings are mixed. On one hand, Abraído-Lanza and colleagues (2005) analyzed nationally representative data and found that nativity and greater length of time in the U.S. were associated with greater LTPA. Similarly, Murillo et al. (2015) used nationally representative data and found that foreign-born was associated lower LTPA compared to U.S.-born among Mexican-Americans. On the other hand, Perez et al. (2016), Abraído-Lanza et al. (2016), and Evenson et al. (2004) found no significant relationship between length of time in the U.S. and LTPA among Latinas (women) in California, New York, and North Carolina, respectively. However, Perez and colleagues (2016) found that greater length of time in the U.S. was associated with not meeting moderate to vigorous physical activity recommendations. Furthermore, greater degree of English language use, which indicates greater linguistic acculturation, was positively associated with LTPA among Latino immigrants

(Berrigan et al. 2006; Evenson, Sarmiento, and Ayala 2004; Crespo et al. 2001). Presumably, linguistic acculturation facilitates the resources and motivations for LTPA, such as sensitivity to public health messages, awareness of physical activity spaces (e.g., parks, sport facilities), health knowledge, and attitudes towards health (Abraído-Lanza, Chao, and Flórez 2005; Evenson, Sarmiento, and Ayala 2004; Stern et al. 1991).

Gender and physical activity

In the context of acculturation and health behaviors among Latinos, gender is a critical factor. Across racial and ethnic categories, women tend to report low levels of VLTPA compared to men (He and Baker 2005). Among Latinas, low levels of acculturation are associated with low levels of LTPA (Tovar, Walker, and Rew 2016). However, Perez and colleagues (2016) found that greater acculturation was associated with not meeting moderate to vigorous physical activity guidelines. Latinas in general, and those with low levels of acculturation in particular, tend to spend large amounts of time on housework compared to Latinos (men) (Berrigan et al. 2006; Abraído-Lanza et al. 2016). Latina immigrants often perceive leisure time in a negative context, as a luxury for elite, younger, and wealthier people (Keller and Fleury 2006; D'Alonzo and Sharma 2010; Gonzalez and Jirovec 2001). Clearly, education and income-level play a significant role in Latinas' attitudes toward LTPA. Additionally, women with low acculturation levels, are more likely to perceive physical activity as unfeminine than their counterpart (D'Alonzo 2012; Evenson et al. 2002). Most likely, religious and cultural backgrounds shape Latinas' attitudes toward LTPA, and acculturation may mediate this relationship (Jurkowski, Mosquera, and Ramos 2010; D'Alonzo 2012; Evenson, Sarmiento, and Ayala 2004). Less acculturated Latinas generally perceive and experience greater obligations toward familial and

household responsibilities, and resultantly, have less available time for self-care and/or leisure activities compared to more acculturated Latinas (Evenson et al. 2002; D’Alonzo 2012).

Taken together, the overarching objective of this study is to examine the effective and efficient health promoting behavior —VLTPA—in view of social determinants of health, and acculturation among Latinos, in order to contribute to the reduction of health disparities by race/ethnicity in the U.S. As Latinos continue to become an increasingly larger segment of the U.S. populations, the health disadvantages of Latinos directly translate into the health disparities of the nation. Such complex and prevalent public health issues require a fundamental cause perspective (i.e., social determinants of health) and consideration of population-specific factors (i.e., acculturation). Additionally, given lower LTPA among Latinas, this study also seeks to identify possible mechanisms of gender differences in VLTPA. To complement the existing research that mainly adapted broad definitions of LTPA in the general population and various sub-populations, this study focuses on the key social determinant (i.e., education) of VLTPA using nationally representative samples of Latino adults, in consideration of gender differences.

Specifically, this study addresses the following three research questions.

- (1) Is education associated with vigorous-intensity leisure time physical activity among Latino adults in the U.S?
- (2) Is acculturation associated with vigorous-intensity leisure time physical activity among Latino adults in the U.S.?
- (3) Does gender moderate the associations between acculturation, education and vigorous-intensity leisure time physical activity?

Methods

Data

Nationally representative data from the 2010 National Health Interview Survey (NHIS) were examined (Centers for Disease Control Prevention 2010). The 2010 NHIS data were the most current wave of data that incorporated the Cancer Control Supplement, a special module which includes acculturation items (e.g., language spoken). NHIS data are collected by the National Center for Health Statistics (NCHS), which is part of the Centers for Disease Control and Prevention (CDC). Participants were selected using a multistage area probability design, which includes oversampling of Blacks, Asians, and Latinos (Centers for Disease Control Prevention 2011a). NHIS provides sampling weights to adjust for non-response and post-stratification in statistical analysis (Centers for Disease Control Prevention 2011a). More details about NHIS have been published elsewhere (Murillo, Echeverria, and Vasquez 2016). The IRB has determined that this research does not meet the definition of human subjects research and therefore is excluded from the need for additional review (protocol 998398-1). In this study, Latino adults aged 24 and younger were excluded in order to assess working age (non-student) Latino adults considering the focuses (i.e., acculturation and educational attainment). This 25 years and older age range is common in the national studies which involve education, acculturation, and physical activity in North America (Bureau of Labor Statistics 2015; Kruger, Heath, and Moeti 2007; Lantz et al. 2010; Orpana et al. 2010). Respondents with missing information for gender ($n = 50$) and VLTPA were excluded from the analysis. A total of 4,393 Latino respondents aged 25 years and older [women ($n = 2,449$); men ($n = 1,944$)] were included in the analysis of this study.

Measures

Dependent Variables

Hours of VLTPA per week was computed based on a series of survey items on the frequency and duration of VLTPA per week in the NHIS. Specifically, the VLTPA hours per week was derived with the responses to two survey items including “How often do you do VIGOROUS leisure-time physical activities for at least 10 minutes that cause HEAVY sweating or LARGE increases in breathing or heart rate?” and “About how long do you do these vigorous leisure-time physical activities each time?” in the NHIS. Although physical activity research often uses meeting the CDC Physical Activity Guidelines as the outcome measure, this study did not adopt it because the preliminary analysis showed that there was a wide range of VLTPA hours/week, nearly one in three samples reported zero VLTPA hours/week, and the majority of samples did not meet the guideline.

Independent Variables

Acculturation was assessed with the degree of English language spoken, which was based on the following question, ‘In general, what language do you speak?’ Responses included: (1) Only Spanish, (2) Mostly Spanish, (3) Spanish and English about the same, (4) Mostly English, and (5) Only English. Greater English use represented greater level of acculturation to the U.S. (Gordon 1964).

Covariates

Covariates included age in years (25 – 85+ years old), Mexican (Mexican vs. other Latino), gender (women vs. men), nativity status (US-born vs. foreign born), marital status (married with spouse in household vs. others), number of family members in household under 18 years old, smoking status (smoker vs. non-smoker), obesity [BMI ≥ 30 (kg/m²) vs. BMI < 30], health status (1-5: poor, fair, good, very good, excellent), and employment status (employed for last 12 months vs. unemployed). Education was recorded in the 7-point Likert scale as follows:

(0) never attended/kindergarten only, (1) less than high school, (2) high school, (3) some college, (4) associates degree, (5) bachelor's degree, and (6) graduate/professional degree. Household income was recorded in the 5-point Likert scale as follows: (1) \$0-\$34,999, (2) \$35,000-\$49,999, (3) \$50,000 - \$74,999, (4) \$75,000-\$99,000, (5) \$100,000 and over.

Statistical analysis

In order to address the research questions, the zero-inflated Poisson regression model was constructed using the full information maximum likelihood estimation (FIML) (DeMaris 2004; Arbuckle, Marcoulides, and Schumacker 1996). Specifically, the VLTPA was modeled as a function of educational attainment, degree of acculturation, gender, and covariates. Considering that VLTPA was recorded in the count variable, the Poisson distribution was assumed. Preliminary analysis showed the violation of the equi-dispersion assumption presumably due to the large percentage of zero values in the VLTPA (about 30%) (Allison 2012). Subsequently, the zero-inflated Poisson regression model returned no violation of the equi-dispersion assumption based on the ratio of log-likelihood statistic and degrees of freedom. The zero-inflated model requires a specification of the binary logistic regression model predicting the zero or non-zero value in VLTPA. The same model specification as the main model was adapted in the zero-model because all predictor variables and covariates are selected based on the theoretical relevance to VLTPA. The gender difference in the context of VLTPA, education, and acculturation was examined using the moderator functions (a.k.a., interaction terms; Muthén, Muthén, and Asparouhov 2016). The moderator functions were derived from the products of gender and education; gender and acculturation; and gender, education, and acculturation. These moderator functions were tested in the main part of the zero-inflated Poisson regression (not included in the zero-model).

A series of sensitivity analyses was conducted. To being, all statistically significant variables in the fully conditional model were tested in unconditional models to rule out the artefactual statistical significance. The results were consistent both in the unconditional and conditional models. Also, potential multicollinearity was assessed using the variation inflation factor (VIF; Allison 1999), and was found to be adequate ($VIF < 4$). Moreover, several possible alternative models were tested including models without education, acculturation, or gender, as well as models with between-predictor variables and between-covariates correlations. Results did not dramatically change in the alternative models. Finally, besides the moderator functions tested for the research questions, other interaction terms between all statistically significant variables in the preliminary analyses were assessed. None of them were significant, and therefore, they were not included in the final model. The final model was chosen based on the inclusion of theoretically relevant variables, parsimony, regression assumptions, and model fit indicator (i.e., Akaike Information Criterion) (DeMaris 2004). The survey weights including the final sample (WTFA), cluster (PSU_P), and stratification (STRAT_P) weights in the 2010 NHIS were applied for all descriptive statistics and regression analyses. The statistical package, Mplus version 7 was used in this study (Muthén and Muthén 2010).

Results

Table 1 presents weighted descriptive summaries of variables of interest. All descriptive statistics and bivariate tests were estimated using the survey weights in the 2010 NHIS. Men had higher average weekly hours of VLTPA (0.58) than women (0.33; $p < 0.05$). Also, on average, women were older (46.6 vs. 44.3 years old; $p < 0.05$) than men in this study. Women were less likely to be Mexican (57.1% vs. 58.2%; $p < 0.05$), U.S. born (28.9% vs. 32.9%; $p < 0.05$), a

smoker (9.9% vs. 16.8%; $p < 0.05$), and employed (57.4% vs. 80.4%; $p < 0.05$) than men. Yet, the average number of children was higher for women (1.16) than men (0.96; $p < 0.05$).

Table 2 presents the exponentiated estimated coefficients (the proportional increase in the count of VLTPA hours per one-unit increase in the predictor variable or covariate) from the zero-inflated Poisson regression models. With regard to the first research question, education [$\exp(b) = 1.09$, $p < 0.05$] was statistically significantly associated with VLTPA. Every one level increase in educational attainment was related to about a 9% increase in the average weekly VLTPA hours. For the second research question, acculturation was also statistically significant [$\exp(b) = 1.10$, $p < 0.05$], and one level of greater acculturation was associated with about a 10% increase in the average weekly VLTPA hours. Other significant predictors of the VLTPA included age, gender, marital status, household income, and self-rated health. Among these, age and gender (women) had negative effects on VLTPA hours.

With regard to the third research question about the gender difference, three moderator functions (gender * education), (gender * acculturation), and (gender * education * acculturation) were included in the zero-inflated Poisson regression model. Only the gender and education moderation function was statistically significant [$\exp(b) = 1.07$, $p < 0.05$]. That is to say, the effect of education on hours of VLTPA is greater among women than men. Specifically, on average, one-unit increase in educational attainment was associated with 9% greater hours per week of VLTPA among men and 16% (9% + 7%) greater VLTPA among women. No significant gender difference in the effect of acculturation on VLTPA was observed. On a related note, non-significant moderator functions were not included in the final model.

Discussion

This study examined a major social determinant of health (education) and a Latino population-specific factor (acculturation) in relation to VLTPA. Gender differences were also examined in the same context. Results showed that education was positively associated with VLTPA among Latinos. The significant effect of education on health behaviors has been consistently reported (Braveman, Egerter, and Williams 2011). The findings from this study provide empirical support for the relationship between education and a specific health behavior—VLTPA—, although these relationships were not explicitly reported in previous studies. Despite the fact that the pathways between education and physical activity are complex, several known explanations including types of occupation, economic condition, and social network and their association to VLTPA should be verified among adult Latinos in the U.S. (Ross and Wu 1995). Also, as Trost et al. (2002) indicated, physical environments such as geographic access to sport facilities, availability of public parks, and neighborhood safety are important areas of future inquiry in order to develop policy-level VLTPA promotion programs. Considering ongoing racial/ethnic residential segregation and its impact on minority health (Williams and Collins 2001), the living environment and community characteristics may be associated with VLTPA among Latino adults. Nonetheless, given the health benefits and shorter time requirement, VLTPA has potential to promote health, particularly, among Latinos with lower levels of education.

With regard to acculturation and VLTPA, the results showed a significant relationship. Specifically, Latino adults with a greater degree of linguistic acculturation were more likely to engage in VLTPA than those who were less acculturated. This is consistent with the previous studies using nationally representative data (Abraído-Lanza, Chao, and Flórez 2005; Crespo et al. 2001). Several possible explanations have been suggested to date. For example, linguistic

acculturation may result in sensitivity to and an increased understanding of public health messages disseminated through work, school and everyday settings (Evenson, Sarmiento, and Ayala 2004). Also, acculturation status (e.g., one's country of origin) may represent the baseline difference between foreign-born and U.S.-born Latinos. Barcenas et al. (2007) analyzed a large sample and found significantly lower physical activity levels among Mexican-American adults who were born in Mexico compared to those who were born in the U.S. As such, assuming that Latino immigrants' home countries have generally lower levels of leisure time physical activity than the U.S. (Hernández et al. 2003), acculturation may indicate a shift to a greater engagement in leisure time physical activity among the average U.S. populations.

Notably, the roles of acculturation with respect to specific health behaviors are diverse. For example, unlike the findings from this study indicating that the greater acculturation is linked to positive health behaviors (i.e., VLTPA), López and Yamashita (2015) reported that linguistic acculturation is associated with negative health behaviors — lower vegetable consumption. By the same token, previous research tends to support the associations between acculturation and negative health behaviors such as excessive alcohol intake, smoking, and higher calorie intake (Abraído-Lanza, Chao, and Flórez 2005). Indeed, Lara et al. (2005) emphasize the urgent need for further research to formulate systematic explanations about acculturation resulting both in positive (e.g., preventive health care service use) and negative health behaviors among Latinos in the U.S. Since a variety of acculturation measurement strategies and health-related outcomes were analyzed in the past, future research needs to consolidate the measures and outcomes while investigating specific pathways between them.

Another important finding from this study was the gender difference. Overall, women had significantly lower levels of engagement in VLTPA than men. This finding was consistent

with the previous studies among Latinos (Abraído-Lanza, Chao, and Flórez 2005; Marquez and McAuley 2006). As stated earlier, traditional gender roles emphasize that women are expected to take care of household and familial responsibilities before their own health needs (Gonzalez and Jirovec 2001; Segar et al. 2002); resultantly physical activity in general and VLTPA in particular, might have been a lower priority. Widespread value systems such as traditional machismo and marianismo may have worked in conjunction to shape women's negative perceptions toward LTPA and to define LTPA as unfeminine, ultimately resulting in lower LTPA participation among Latinas (Evenson et al. 2002; D'Alonzo 2012; Panitz et al. 1983). One may argue that the time constraint due to gender roles and cultural perceptions are commonly accepted explanations about Latinas' lower physical activity levels. However, the detailed mechanisms of gender difference in VLTPA among Latinos are certainly understudied. Additionally, given the central role of the family, intervention to increase VLTPA among Latinas should involve family members (Keller et al. 2014). Furthermore, intervention designed specifically toward Latinos should include facilitators who are culturally competent (e.g., bilingual and bicultural), and should incorporate certain vigorous physical activities (e.g., Zumba and Salsa dancing) that are familiar to Latinos (Whitehorse et al. 1999).

In this respect, the finding about the moderation effect of gender on the relationship between education and VLTPA is a valuable insight. That is, women benefited more from higher educational attainment than men in terms of engagement in VLTPA. In light of the cultural expectation of gender roles discussed earlier, greater education might have altered the gendered view of LTPA and promoted the realization of health benefits from physical activity (Abraído-Lanza, Chao, and Flórez 2005). Also, Latinas with lower educational attainment tend to have low English proficiency, which may discourage outdoor physical activity since linguistic barriers

make it challenging to navigate the English-dominant environment and may augment safety concerns (Juarbe, Turok, and Pérez-Stable 2002; Krogstad, Stepler, and Lopez 2015). Indeed, similar to other race and ethnic groups, Latinas with greater educational attainment are more likely to work outside the home than their counterpart with less education (U.S. Department of Labor 2012). Among Latinas education may alleviate negative attitudes toward physical activity that are often shaped by traditional cultural norms and may increase one's ability to navigate the local neighborhood environment. Notably, Latinas with lower levels of education may simultaneously face linguistic and cultural barriers to leisure time physical activity.

Limitations

Several limitations in this study should be noted. This study employed cross-sectional data and therefore, any causal inference is not feasible. Findings are interpreted based on previous research and theoretical propositions, the causal direction of each finding needs to be verified with longitudinal data. Also, the VLTPA measure was self-reported. Although the unit and observation period were standardized to hours per week, a possible variability on the accuracy of measurement due to the different ways respondents reported their VLTPA (e.g., per week, per month or per year) cannot be ruled out. Sub-groups of Latino population other than Mexicans were not examined in this study due to the limited sample sizes. Considering potential effects of origin of countries and relevant cultural orientations, the findings from this study may not be applicable to sub-groups of Latinos.

Contributions

This study made four contributions to the literature. First, this study identified the associations between a specific type of acculturation and physical activity — linguistic acculturation and vigorous-intensity leisure time physical activity among a nationally

representative sample of Latinos. Second, results from this study provided empirical evidence on education as a social determinant of VLTPA. Although education is widely known to be linked to positive health behaviors, VLTPA has not been systematically examined in nationally representative Latino samples in recent years. Third, the association between acculturation and a specific type of physical activity, VLTPA has been documented. Given the existing health disparities by race and ethnicity, and major barriers (e.g., time constraint) to health promoting physical activity, VLTPA could be incorporated into development of evidence-based intervention programs for Latinos. Fourth, this study also added a possible explanation for the lower levels of physical activity, and extended it to VLTPA among Latinas. Namely, the effect of education on physical activity differs by gender among Latinos. Collectively, these findings are useful not only to guide future research but also to develop intervention programs that are sensitive to the diversity and culture of Latinos.

Conclusion

Despite the limitations, this study provided new insights about the associations between acculturation and VLTPA, and a possible educational attainment-based explanation for the gender difference in the level of VLTPA among Latinos. Prevalent health disparities by race/ethnicity put Latinos in a disadvantaged position in the U.S. Such public health problems require greater attention to fundamental causes like social determinants of health, as well as the culture and unique characteristics of the target populations. VLTPA has great potential to promote Latinos' health given the currently low level of participation among Latinos in general and women in particular, the documented health benefits, and its time efficiency. Disentangling the complex associations between acculturation and education, and their possible effects on VLTPA by gender will guide future intervention and public health policy changes in order to

alleviate health disadvantages among Latinos in the U.S. This study provided the foundation for culturally sensitive and time-efficient VLTPA-based public health promotion, specifically for Latinos in the U.S.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Key messages

- (1) Greater linguistic acculturation is associated with greater VLTPA among Latino adults in the U.S.
- (2) Greater educational attainment is associated with greater VLTPA activity among Latino adults in the U.S.
- (3) The positive relationship between education and VLTPA was greater among women than among men.

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Table 1: Weighted Descriptive Summary by Gender of Latino Respondents Aged 25 Years and Older

Variables	All (n = 4,443)	Women (n = 2,449)	Men (n = 1,944)
	Estimated mean (standard error), or estimated percentage	Estimated mean (standard error), or estimated percentage	Estimated mean (standard error), or estimated percentage
Vigorous-intensity leisure time physical activity (hours per week)	0.43 (0.01)	0.33 (0.01) *	0.58 (0.02)
Language spoken (5 levels)	2.90 (0.03)	2.92 (0.03)	2.89 (0.04)
Age (years)	45.53 (0.31)	46.60 (0.42) *	44.34 (0.38)
Gender (women)	52.60%		
Mexican or Mexican-American	57.60%	57.10%	58.20%
Marital status (married)	49.50%	46.10% *	53.40%
U.S. Born	36.10%	28.90% *	32.90%
Number of children	1.07 (0.03)	1.16 (0.03) *	0.96 (0.04)
Education (7 levels)	2.44 (0.03)	2.45 (0.04)	2.43 (0.04)
Household income (5 levels)	2.06 (0.03)	1.99 (0.03)	2.13 (0.04)
Employment (employed)	68.30%	57.4% *	80.40%
Smoker	13.10%	9.90% *	16.80%
Obesity	32.40%	33.80%	30.90%
Self-rated health (5 levels)	3.58 (0.02)	3.48 (0.03) *	3.69 (0.03)

* $p < 0.05$; weighted t-test or chi-square test was used.

Note: The total numbers do not match due to the missing values (n – 50) in gender

Final sample, cluster and stratification weights in the 2010 National Health Interview Survey were applied

Table 2: Estimated Coefficients in the Zero-inflated Poisson Regression on Vigorous-Intensity Leisure Time Physical activity

Variables	Estimated Coefficients Exp(b)	Standard Errors	p-values
Language spoken (5 levels)	1.10***	0.03	< 0.001
Age (years)	0.98***	0.01	< 0.001
Gender (women)	0.54***	0.12	< 0.001
Mexican	1.07	0.07	0.313
Marital status (married)	0.84**	0.07	0.008
Number of children in the household	0.98	0.03	0.324
U.S. born	1.04	0.07	0.547
Educational attainment (7 levels)	1.09***	0.02	<0.001
Household income level (5 levels)	1.08***	0.02	< 0.001
Employment status (employed)	1.13	0.09	0.172
Obesity	0.88*	0.06	0.038
Smoker	0.97	0.08	0.732
Self-rated health (5 levels)	1.11***	0.03	0.001
Gender * Educational attainment	1.07*	0.03	0.027

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Final sample, cluster and stratification weights in the 2010 National Health Interview Survey were applied
The same model specification except for the moderator function (Gender * Educational attainment) was
used for the binary logistic regression part of the zero-inflated Poisson Regression model.