The association of acculturation with accelerometer-assessed and self-reported physical activity and sedentary behavior: The Hispanic Community Health Study/Study of Latinos

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ARTICLE INFO

ABSTRACT

The adoption of US culture among immigrants has been associated with higher leisure-time physical activity and sedentary behavior. However, most research to date assesses this association using single measures of acculturation and physical activity. Our objective was to describe the cross-sectional association between acculturation and both physical activity and sedentary behavior among US Hispanic/Latino adults. Participants included Hispanic/Latinos 18–74 years living in four US locations enrolled in the Hispanic Community Health Study/Study of Latinos from 2008 to 2011. Acculturation was measured using acculturation scales (language and social), years in the US, language preference, and age at immigration. Physical activity and sedentary behavior were measured using the Global Physical Activity Questionnaire (N = 15,355) and Actical accelerometer (N = 11,954). Poisson, logistic, and linear regression were used, accounting for complex design and sampling weights. English-language preference was positively associated with self-reported leisure-time and transportation physical activity and accelerometer-assessed moderate-to-vigorous physical activity (MVPA). Social acculturation was positively associated with self-reported leisure-time and transportation physical activity and MVPA. Years in the US and age at immigration were positively associated with accelerometer-assessed MVPA. Language acculturation, years in the US, and age at immigration were associated with occupational physical activity among those who reported employment. Most acculturation measures were associated with self-reported sitting but not with accelerometer-assessed sedentary behavior. Different measures of acculturation, capturing various domains acculturation, were associated with physical activity and sedentary behavior. However, the direction of the association was dependent on the measures of acculturation physical activity/sedentary behavior, highlighting the complexity of these relationships.

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1. Introduction

The Hispanic/Latino population is the fastest growing racial/ethnic group in the United States (US) and constitutes almost 18% of the US population in 2017 (Bureau, 2017). (Therrien and Ramirez, 2001; Suro and Passel, 2003; Thomson and Hoffman-Goetz, 2009) Immigration to the US can result in changes of behaviors stemming from the adoption of the US cultural values and beliefs and adherence to US norms influencing health behaviors. (Evenson et al., 2004; Crespo et al., 2001; Berrigan et al., 2006; Ham et al., 2007; Banna et al., 2012; O'Donoghue et al., 2016; Singh and Siahpush, 2002) Specifically among Hispanic/Latino adults, greater acculturation to the US mainstream culture has been associated with higher self-reported leisure-time physical activity (Crespo et al., 2001; Berrigan et al., 2006; Ham et al., 2007; Daviglus et al., 2012) and sedentary behavior (Banna et al., 2012; O'Donoghue et al., 2016) and lower self-reported walking for transportation and occupational physical activity. (Berrigan et al., 2006; Martinez et al., 2011; Slattery et al., 2006)

However, existing research has explored the relationship between acculturation with physical activity and sedentary behavior using incomplete measures of both, thus contributing to heterogeneous findings. (Benitez et al., 2016) Although a common approach, the use of a single measure of acculturation (e.g., duration of time in the US) may inadequately characterize the multi-dimensional process of acculturation. Similarly, most prior research used self-reported physical activity, predominately focused only on leisure-time physical activity. (Benitez et al., 2016) Accelerometer assessment can provide more precision to measures, particularly for sedentary behavior, and consideration of alternate modes of physical activity (e.g., transportation, occupational) is understudied.

The Hispanic/Latino population in the US is comprised of different Hispanic/Latino backgrounds (countries of origin) with diverse cultures and norms that may influence health behaviors. (Arredondo et al., 2016; Marquez et al., 2010; Marquez and McAuley, 2006; Zsembik and Fennell, 2005) Additionally, Hispanic/Latino men engaged in different modes of physical activity and more MVPA compared to women. (Arredondo et al., 2016) Due to the cultural diversity of the Hispanic/Latino population and gender-specific physical activities and sedentary behaviors, Hispanic/Latino background and gender may affect individuals' physical activity and acculturation processes and their associations. As a result, associations between acculturation and physical activity may differ by Hispanic/Latino background and gender. Thus, using the rich acculturation, physical activity, and Hispanic/Latino background information from Hispanic Community Health Study/Study of Latinos (HCHS/SOL), the objective of this study was to describe the cross-sectional associations between multiple measures of acculturation and accelerometer-assessed and self-reported physical activity and sedentary behavior. Additionally, as an exploratory aim, we assessed modification of this association by Hispanic/Latino background and gender.

2. Methods

2.1. Study population

The HCHS/SOL is a US population-based cohort study designed to examine chronic disease risk and protective factors among Hispanic/Latinos. (Lavange et al., 2010; Sorlie et al., 2010) From March 2008 to June 2011, 16,415 self-identified Hispanic/Latino adults aged 18–74 were recruited and enrolled from randomly selected households in four urban communities (Bronx, New York; Chicago, Illinois; Miami, Florida; San Diego, California). The study was approved by institutional review boards at each participating institution and the Coordinating Center, written informed consent was obtained from all participants. All questionnaires (Biologic Specimen and Data Repository Information Coordinating Center. Hispanic Community Health Study/Study of Latinos (HCHS-SOL), 2014) were staff-administered in participant's preferred language (English or Spanish).

2.2. Physical activity and sedentary behavior

2.2.1. Global physical activity Questionnaire (GPAQ)

Self-reported physical activity and sedentary behavior in a typical week were assessed using the interviewer-administered GPAQ. (Arredondo et al., 2016; Bull et al., 2009) The GPAQ captured self-reported frequency (days per week) and duration (10 min or longer) of occupational, transportation, and leisure-time physical activity. Additionally, time spent sitting or reclining was assessed with one question on duration on a typical day. The GPAQ was previously validated in Hispanic/Latino populations (Hoos et al., 2012) and is reliable. (Bull et al., 2009) We estimated daily minutes of MVPA, leisure-time, occupational, and transportation physical activity, sedentary behavior, and if a participant met the aerobic Physical Activity Guidelines for Americans ("Guidelines", ≥150 min/week of MVPA, ≥75 min/week of vigorous physical activity, or an equivalent combination of the two counting vigorous as double the time of moderate). (Committee, 2008)

2.2.2. Accelerometry

HCHS/SOL participants wore an Actical accelerometer (version B-1; model 198-0200-03) for 6 days. A complete description of this device is available elsewhere. (John and Freedson, 2012) If participants consented, they were fitted with a belt and left the visit wearing the accelerometer above the right iliac crest. Participants were told to wear the accelerometer for one week during usual activities and to remove it only while in the water or sleeping. Non-wear was defined as consecutive zero counts for ≥ 90 min, allowing for up to two-minute time intervals with nonzero counts if no counts were detected during both the 30 min upstream and downstream from that interval. Any nonzero counts except the allowed short intervals were considered as wear time. (Arredondo et al., 2016; Choi et al., 2011; Merchant et al., 2015)

Adherence was defined as ≥ 10 h per day of wear time for at least three of the six possible days of wear. (Evenson et al., 2015) Average counts/minute was explored as an indicator of total volume of physical activity. Intensity of physical activity was defined as sedentary (< 100 counts/minute), light (100–1,534 counts/minute), moderate (1535–3961 counts/minute), or vigorous (≥3962 counts/minute). (Colley and Tremblay, 2011; Wong et al., 2011) Average daily light, moderate, and vigorous activity and sedentary behavior was estimated as follows:

[(average weekday time in minutes/day*5) + (average weekend time in minutes/day*2)]/7

If individuals did not contribute a weekend day of wear, average wear time was calculated as the average daily activity or sedentary behavior based on number of weekdays the Actical was worn. We estimated average counts per minutes and daily minutes of MVPA.

2.3. Acculturation

Acculturation was assessed using two subscales from Marin's Short Acculturation Scale for Hispanics (SASH). (Marin et al., 1987) SASH language subscale included three items related to language use patterns (Spanish versus English use in various contexts, $\alpha = 0.92$) and SASH social subscale included three items related to social relations (degree to which prefers social relationships with individuals of Hispanic/Latino ethnicity or non-Hispanic/Latino ethnicity, $\alpha = 0.73$). (Isasi et al., 2015) Higher scores indicated higher acculturation to US mainstream culture (range 1 to 5). Subscales were analyzed separately. Other acculturation measures included language preference (English, Spanish), age at immigration (0–12, 13–19, 20–44, ≥ 45 years), and years lived in the US 50 states or DC (US born, foreign born in the US ≥ 10 years, foreign born in the US < 10 years). (Perreira et al., 2015; Cook et al., 2009; Lopez-Gonzalez et al., 2005)

2.4. Covariates

Standardized procedures were used by centrally trained and certified HCHC/SOL personnel. (Hispanic Community Health Study / Study of Latinos. About the Study / Public Manuals and Docs, Manual 2 Field Center Procedures. http://www.cscc.unc.edu/hchs. Accessed Jun 1, 2019) Age (18–24, 25–34, 35–44, 45–54, 55–64, and 65–74 years), gender, education (< high school diploma or GED, high school or GED, > high school), total household income (< $10,000; $10,000-$20,000; $20,001-$40,000; $40,001-$75,000; > 75,000; missing), marital status (single; married/living with a partner; separated, divorced, widowed), employment status (retired, not retired nor currently employed, employed part-time, employed full time), and occupation (non-skilled worker, service worker, skilled worker) were obtained by self-report. In addition, height was directly measured to the nearest centimeter and body weight to the nearest 0.1 kg. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2).

2.5. Exclusions

Among 16,415 participants, we included 15,355 participants in the GPAQ analyses. We excluded participants missing any item from the GPAQ (N = 538) or covariate (n = 522). Analyses for GPAQ occupational physical activity were further restricted to participants with full- or part-time employment (N = 7,935). We included 11,954 participants in the Actical analyses. We excluded participants that were not adherent (i.e., < 3 days with ≥ 10 h of wear time each; n = 3,665), wear time > 23 h (n = 116), GPAQ variables missing (n = 333), and missing any covariate (n = 347).

2.6. Statistical analyses

We separately examined the association of five measures of acculturation (SASH language and social subscales, years in the US, age at immigration, and language preference) with five measures of self-reported physical activity (MVPA, leisure, occupational, and transportation physical activity, and meeting Guidelines), two measures of accelerometer-assessed physical activity (average counts per minute and MVPA), and two measures of sedentary behavior (min/day; self-report and accelerometer-assessed).

All analyses account for HCHS/SOL complex survey design and were weighted to adjust for the sampling selection probabilities and nonresponse. Analyses were performed using SAS version 9.3 software (SAS Institute, Cary, NC) and SUDAAN software release 11 (RTI International, Research Triangle Park, NC). Acculturation was assessed independently without multiple constructs in the same model. We used Poisson regression with robust standard errors to examine cross-sectional associations of acculturation and physical activity, because the number of min/day was not normally distributed (spike of zero minutes and skewed distribution). Linear regression was used for sedentary behavior. Logistic regression was used for meeting Guidelines. Models were adjusted for age, gender, BMI, education, income, marital status, employment status, Hispanic/Latino background, and HCHS/SOL site. Accelerometer–assessed MVPA was further adjusted for sedentary behavior and total wear time. Accelerometer–assessed sedentary behavior was further adjusted for wear time.

We hypothesized that the association between acculturation and physical activity would differ by Hispanic/Latino background. Thus, as an exploratory aim, we assessed modification by Hispanic/Latino background and gender with acculturation, separately. To account for multiple testing, for each response variable separately we used a conservative Bonferroni correction using an alpha level of 0.01 given five measures of acculturation. If an interaction term was significant, we reported stratified results; otherwise, we reported overall results.

Due to missing data related to accelerometry, analyses were

Table 1
Socio-demographic characteristics; Hispanic Community Health Study/Study of Latinos (HCHS/SOL), 2008–2011 (N = 15,355).

Socio-demographic characteristics	N	Weighted %
Age (years)		
18–24	1550	16.8
25–34	1937	21.8
35–44	2797	21.4
45–54	4626	19.0
55–64	3220	12.8
65–74	1225	8.3
Female	9208	52.1
Body Mass Index (kg/m^2)		
Normal or underweight (< 25)	3087	23.0
Overweight (25–29.9)	5781	37.3
Obese (≥ 30)	6487	39.7
Education		
< High school diploma or GED	5799	32.1
High school diploma or GED	3932	28.1
> High school diploma or GED	5624	39.9
Annual Household Income		
< $10,000	2177	13.2
$10,000-$20,000	4585	28.8
$20,001-$40,000	4801	30.6
$40,001-$75,000	1930	13.4
> $75,000	620	5.5
Missing	1242	8.6
Current Occupation		
Non-skilled worker	2430	14.4
Service worker	1508	9.5
Skilled worker	1811	11.9
Professional/technical, administrator, executive	938	6.9
Other occupation	1263	9.2
Not employed or retired	7405	48.1
Marital Status		
Single	4198	34.3
Married or living with partner	7993	49.3
Separated, divorced, widowed	3164	16.4
Employment Status		
Retired (not currently employed)	1456	8.2
Not retired nor currently employed	5964	40.1
Employed part-time	2658	17.4
Employed full-time	5277	34.3

adjusted for missing data using inverse probability weighting (Seaman and White, 2013) based on predicting Actical adherence from associated variables as described elsewhere. (Evenson et al., 2015) Data displayed in tables for means, proportions, and other summary metrics represented the characteristics of the underlying population rather than the cohort members studied. The socio-demographic characteristics in the final analytic samples (self-reported (n = 15,355) and accelerometer-assessed physical activity (n = 11,954)) were similar because of the use of the inverse probability weights for the latter.

3. Results

Overall, the sample was 52% female, 77% overweight or obese, 60% with a ≤ high school education, 73% with an annual household income of ≤ $40,000, 49% were married or living with a partner, 48% not employed or retired, and 14% were non-skilled workers (Table 1). Socio-demographic characteristics varied by Hispanic/Latino background (Supplement Table 1). Mexicans were younger and Cubans older compared to other Hispanic/Latino backgrounds. A higher percentage of Puerto Ricans were obese (47%) compared to other Hispanic/Latino backgrounds. Cubans and South Americans were more likely to have a high school diploma (49%, 51%) compared to other Hispanic/Latino backgrounds. A higher proportion of Mexicans and Central Americans were non-skilled workers (21%, 18%) compared to other Hispanic/Latino backgrounds.

Table 2
Adjusted means of self-reported and accelerometer-assessed physical activity and sedentary behavior (min/day) by years in the United States and language of interview; Hispanic Community Health Study/Study of Latinos, 2008–2011

Physical Activity Response Variable	N	Overall		Years in the US						Language of Preference			
				US Born	≥10 years	<10 years	P-value [a]	English	Spanish	P-value [a]
		Mean or %	95% CI	Mean or % / 95% CI	Mean or % / 95% CI	Mean or % / 95% CI		Mean or % / 95% CI	Mean or % / 95% CI	
		N = 15,355		N = 2,680	N = 9,092	N = 3,583		N = 9,092	N = 2,680	
Self-Report										
Leisure-time physical activity (min/day)	15,355	24.5	22.8 26.2	24.4 20.9 27.9	25.5 23.4 27.7	22.7 19.8 25.7	0.18	25.9 22.2 29.7	24.0 21.7 26.3	0.45
Occupational physical activity (min/day) [b]	7,935	121.6	114.4 128.7	116.4 100.9 131.9	113.6 104.8 122.5	138.6 123.6 153.7	>0.01*	110.0 94.4 125.7	125.3 116.3 134.3	0.12
Transportation physical activity (min/day)	15,355	32.6	30.2 34.9	35.7 31.0 40.4	32.2 28.5 35.9	30.6 27.2 34.0	0.26	37.1 32.5 41.7	31.0 28.5 33.6	0.02
MVPA (min/day)	15,355	137.2	131.7 142.7	140.6 127.4 153.8	132.2 125.2 139.1	143.5 133.5 153.5	0.09	137.2 124.6 149.7	137.2 130.6 143.9	0.99
Meets Physical Activity Guidelines (%) [c]	9,870	67.4	66.2 68.7	70.3 67.6 72.9	66.8 65.1 68.5	66.5 64.4 68.5	0.06	67.8 64.7 70.6	67.4 65.9 68.8	0.82
Accelerometer		N = 11,954		N = 2,680	N = 9,092	N = 3,583		N = 3,074	N = 12,281	
Average total counts/minute	11,954	177.7	173.4 182.2	183.2 174.1 192.7	172.3 166.7 178.0	182.2 173.9 190.9	0.04	181.2 173.3 189.5	177.4 172.3 182.6	0.42
MVPA (min/day)	11,954	24.8	23.7 25.9	26.9 25.3 28.7	23.8 22.6 25.1	24.4 22.8 26.0	0.002*	26.6 25.0 28.4	24.0 22.9 25.1	0.002*
Sedentary behavior (min/day)	11,954	704.1	696.0 712.2	701.2 693.1 709.2	705.7 697.6 713.8	703.6 695.3 712.0	0.0001*	702.3 694.0 710.6	704.7 696.6 712.8	0.02

Abbreviations: Moderate to vigorous physical activity (MVPA).

Adjusted for age group, gender, center, education, income, marital status, employment status, background, and body mass index.

[a] P-value for overall group effect.

[b] Restricted to participants with full or part time employment (N = 7,935).

[c] ≥ 150 min/week of MVPA, ≥75 min/week of vigorous physical activity, or an equivalent combination of the two counting vigorous as double the time of moderate.

Table 3
Adjusted means of self-reported and accelerometer-assessed physical activity and sedentary behavior by age at immigration; Hispanic Community Health Study/Study of Latinos, 2008–2011

Response variable	Age at Immigration												P-value [a]
	0–12 years			13–19 years			20–44 years			≥45 years			
	Mean or %	Lower 95%	Upper 95%	Mean or %	Lower 95%	Upper 95%	Mean or %	Lower 95%	Upper 95%	Mean or %	Lower 95%	Upper 95%	
Self-Report	N = 1364			N = 2044			N = 7558			N = 1709			
Leisure-time (min/day)	23.8	19.3	28.4	19.8	16.9	22.7	19.6	17.4	21.8	19.2	15.8	22.6	0.50
Occupational (min/day), N = 7,935	97.5	78.2	116.8	107.4	93.2	121.6	130.0	120.2	139.8	147.6	115.8	179.4	**0.0100**
Transportation (min/day)	33.4	25.7	41.1	29.1	22.8	35.5	29.8	26.3	33.2	34.6	28.5	40.6	0.20
MVPA (min/day)	121.2	106.5	135.8	121.0	109.5	132.5	130.9	123.7	138.1	147.1	131.1	163.1	0.08
Meets Physical Activity Guidelines (%) [b]	67.2	62.8	71.3	64.1	60.8	67.3	64.4	62.5	66.3	64.1	60.6	67.4	0.70
Accelerometer	N = 1364			N = 2044			N = 7558			N = 1709			
Average total counts/minute	176.1	164.7	188.4	169.9	159.3	181.1	173.1	167.3	179.0	168.6	151.8	187.3	0.80
MVPA (min/day)	25.6	23.6	27.8	21.6	19.9	23.5	22.9	21.6	24.3	22.0	19.3	25.1	**0.0050**
Sedentary behavior (min/day)	703.0	689.5	716.4	694.8	683.0	706.7	694.8	685.9	703.6	700.0	688.6	711.3	0.30

3.1. Acculturation and self-reported physical activity and sedentary behavior

SASH language scores were higher among individuals who had spent more time in the US (Supplemental Table 2). SASH social mean score was 0.4 points lower among those who had lived < 10 years in the US compared to those US born (mean score = 2.5). Similar associations were seen between SASH subscales and language preference.

We tested for modification between self- reported physical activity and sedentary behavior with all acculturation measures by Hispanic/Latino background and gender, separately. Because few interactions between acculturation measures and Hispanic/Latino background were significant for self-reported physical activity and sedentary behavior (Supplement Table 3), results were presented overall (Table 2). Similarly, few interactions between acculturation and gender were significant for self-reported physical activity (Supplement Table 4). Since consistent evidence was observed for modification of sedentary behavior by gender for four of the five acculturation measures, we presented stratified results, as described next (Fig. 1).

3.2. SASH language and SASH social subscales

Among adults, a one unit higher SASH language score (higher language-based acculturation to the US mainstream culture) was associated with more leisure-time ($\beta = 0.07$, 95% CI: 0.01, 0.14 min/day) and less occupational physical activity ($\beta = -0.11$, 95% CI: -0.17, -0.05 min/day, Supplement Table 5). There were no associations between SASH language and self-reported MVPA, transportation physical activity or meeting Guidelines. The association between SASH language and self-reported sedentary behavior was different by gender (Supplement Table 4). For a one-unit increase in SASH language, sedentary behavior was 26.4 min/day higher among women but only 15.3 min/day among men (Supplement Table 5). Among adults, a one unit increase in SASH social score was associated with more leisure-time ($\beta = 0.22$, 95% CI: 0.13, 0.32 min/day), transportation physical activity ($\beta = 0.20$, 95% CI: 0.07, 0.33 min/day), MVPA ($\beta = 0.13$, 95% CI: 0.06, 0.19 min/day), and meeting Guidelines ($\beta = 0.24$, 95% CI: 0.14, 0.34 min/day). SASH social was not associated with occupational physical activity or sedentary behavior.

3.3. Language preference

Language preference was not associated with self-reported physical activity (Table 2), but was associated with sedentary behavior and differed by gender (Supplement Table 4). Men and women who preferred English reported higher sedentary behavior compared to those who preferred Spanish. Women English speakers spent 50.7 min/day more in sedentary behavior compared to Spanish speakers (307.8 and 257.1 min/day, respectively, Fig. 1). Whereas men English speakers spent 21.2 min/day more in sedentary behavior compared to Spanish speakers (296.9 and 275.7 min/day, respectively, Fig. 1).

3.4. Years in the US

US born adults and those who lived in the US ≥ 10 years reported 22 and 25 min/day less in occupational physical activity, respectively, compared to those who lived in the US < 10 years (adjusted mean = 138.6 min/day, 95% CI: 123.6, 153.7, Table 2). However, years in the US was not associated with other physical activity measures. The association between years in the US with sedentary behavior differed by gender (Supplemental Table 4). US born men had 14.5 and 26.9 more sedentary min/day compared to those who resided in the US ≥ 10 and < 10 years respectively (Fig. 1). In contrast, US born women had approximately 46 more sedentary min/day and there was no difference between those who lived ≥10 or < 10 years.

Table 4

Summary of results for the association between acculturation with self-reported and accelerometer-assessed physical activity and sedentary behavior, Hispanic Community Health Study/Study of Latinos, 2008–2011

Acculturation (Exposure)		Self-report						Accelerometer		
Variable	Referent Group	Leisure-time	Transportation	Occupational	MVPA	Meeting the Guidelines	Sedentary Behavior [a]	Average counts per minute	MVPA	Sedentary Behavior
SASH Social	*	+	+		+	+				
SASH Language	*	+		−			Men + Women +		+	
Language Preference	Spanish						Men + Women +		+	
Years in the US	Foreign born in the US < 10 years			−			Men + Women +		+	−
Age at Immigration	≥ 45 years			−			Men - Women +		+	

All acculturation measures were examined using separate models; all models were adjusted for age group, gender, center, education, income, marital status, employment status, Hispanic/Latino background, and body mass index.

+ indicates that as acculturation increases, the outcome increases (positive association).

− indicates that as acculturation increases, the outcome decreases (negative association).

Blank cells indicate the association was not significant

Abbreviations: Short Acculturation Scale for Hispanics (SASH); moderate to vigorous physical activity (MVPA.

*Indicates the variable is continuous and there is no reference group.

[a] Interaction terms for gender were statistically significant; thus, results for sedentary behavior were presented by gender (male and female).

3.5. Age at immigration

Age at immigration was only associated with occupational physical activity and sedentary behavior. This association differed by gender (Tables 3 and Supplement Table 4). The younger individuals were when they migrated to the US, the lower occupational physical activity they reported (Table 3). Women and men who immigrated at younger ages reported more sedentary behavior compared to men and women who immigrated at older ages (Fig. 1). However, among women there was a trend of less sedentary behavior at older ages of immigration, whereas among men, there was no such trend and those who immigrated between 20 and 44 and 45+ years reported similar sedentary behavior.

3.6. Acculturation and accelerometer-assessed physical activity and sedentary behavior

There was no modification between accelerometer-assessed physical activity and sedentary behavior with all acculturation measures by Hispanic/Latino background and gender, separately (Supplements Tables 6 and 7). Thus, we present aggregate associations between acculturation and accelerometer-assessed physical activity.

3.7. SASH language and SASH social

Higher SASH language (higher acculturation to the US mainstream culture) was associated with higher accelerometer-assessed MVPA ($\beta = 0.06$, 95% CI: 0.03, 0.09 min/day for a one-unit increase, Supplement Table 5). There were no other observed association between the SASH language and social subscales and physical activity.

3.8. Language preference

Individuals who preferred English engaged in three minutes more of MVPA compared to those who preferred Spanish who had an adjusted mean of 24.0 min/day (95% CI: 22.9, 25.1, Table 2).

3.9. Years in the US

Although statistically significant, differences in years in the US were small for accelerometer-assessed MVPA and sedentary behavior (Table 2). US born individuals engaged in three more min/day of MVPA compared to those who migrated, and four and two less minutes of sedentary behavior compared to those that were in the US for ≥ 10 years or < 10 years, respectively.

3.10. Age at immigration

Individuals who immigrated to the US at 13–19 years, 20–44 years, and ≥ 45 years engaged in four, three, and four minutes less, respectively, of accelerometer-assessed MVPA compared to those who immigrated at 0–12 years that had an adjusted mean of 25.6 min/day (95% CI: 23.6, 27.8, Table 3). Age at immigration was not associated with total counts/minute and sedentary behavior.

4. Discussion

Among our diverse sample of Hispanic/Latino adults, the association between acculturation with physical activity and sedentary behavior varied across assessments of both the exposure and outcome. Leisure-time and occupational physical activity were associated with language acculturation but not language preference. Social acculturation was positively associated with self-reported leisure-time, transportation, and MVPA and meeting Guidelines but not associated with accelerometer-assessed physical activity. Years in the US and age at immigration were negatively associated with occupational physical activity and positively associated with accelerometer-assessed MVPA. Our results highlight the complexity of the relationship between acculturation and physical activity, and emphasized the importance of using multiple measures of acculturation and physical activity when assessing this association.

4.1. Language acculturation

Language preference and the SASH language scale capture a participant's comfort level with and use of the English language. Language is important in many contexts, and our findings regarding higher leisure-time physical activity among adults that preferred English were similar to other studies. (Evenson et al., 2004; Berrigan et al., 2006; Ham et al., 2007; Vermeesch and Stommel, 2014; Li and Wen, 2013; van Rompay et al., 2012; Lee et al., 2012; Bungum et al., 2011; Ghaddar et al., 2010; Jurkowski et al., 2010; Afable-Munsuz et al., 2013; Eamranond et al., 2009; Liu et al., 2009; Martinez et al., 2008; Mainous et al., 2008;
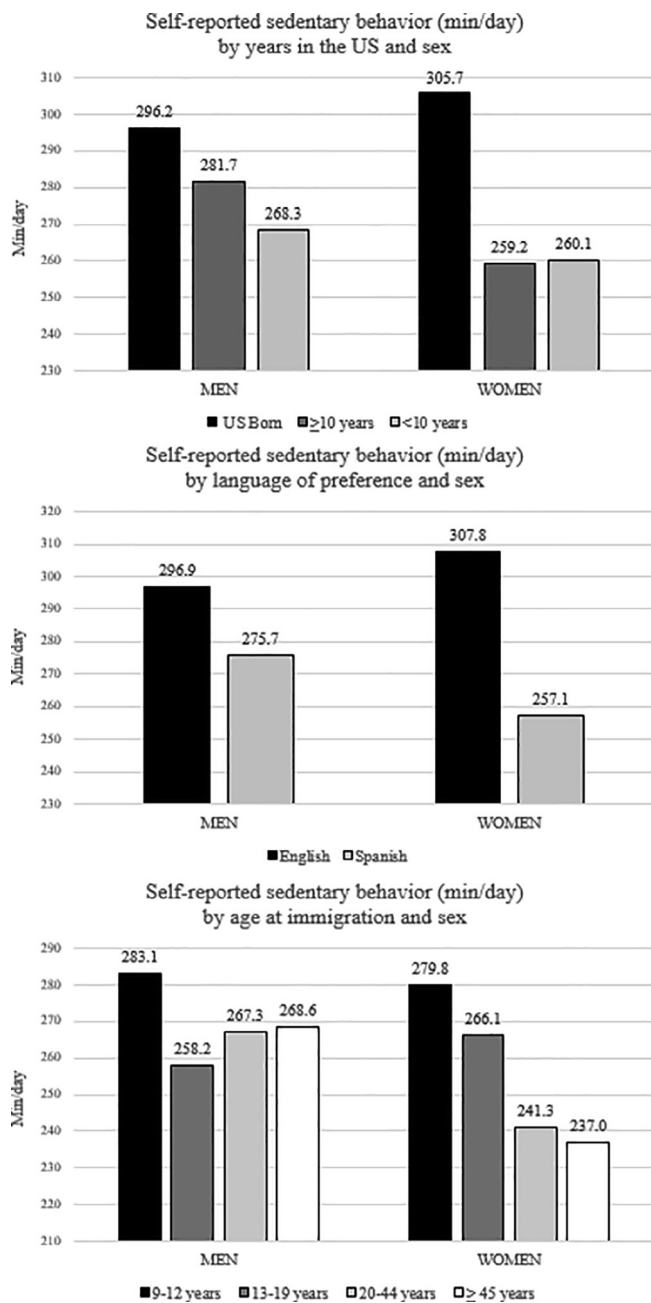
Fig. 1. Adjusted mean of self-reported sedentary behavior (min/day) by acculturation and gender; Hispanic Community Health Study/Study of Latinos, N = 15,355 Footnote: Stratified modes by gender adjusted for age, income, marital status, employment status, Hispanic/Latino background, and body mass index.

Neighbors et al., 2008; Pichon et al., 2007; Perez-Escamilla and Putnik, 2007) US cultural and social effects may influence Hispanic/Latinos to be more active in their leisure-time. However, other modes, such as occupational physical activity are important to assess in relation to acculturation and have been previously associated with English language preference. (Evenson et al., 2004; Marquez and McAuley, 2006) Our results suggest that higher SASH language scores and not language preference were associated with lower occupational physical activity. Acculturation measured by the SASH language subscale may suggest that, as one becomes more English proficient, access to non-manual labor employment opportunities increase. However, the lack of an association with occupational physical activity may indicate that language preference may not discern English proficiency.

4.2. Residency in the US

Years in the US represents a cumulative exposure to the US. More time in the US was associated with lower occupational physical activity and more accelerometer-assessed MVPA. More years in the US may present increased access to non-manual labor employment. To account for self-report bias, accelerometers have been used to assess physical activity and sedentary behavior. The few studies that have used accelerometry to assess the association between acculturation and physical activity have presented mixed results. (Lee et al., 2012; Marquez and McAuley, 2006; Vella et al., 2011; Perez et al., 2017) Although one study found women born in Mexico acquired more steps/day than those born in the US, there was no association between acculturation and accelerometer-assessed physical activity. (Vella et al., 2011) Among Latino adults, less acculturated participants, according to the SASH, engaged in less overall activity. (Marquez and McAuley, 2006) Our findings suggest adults that lived in the US longer participate in more MVPA. However, accelerometers do not consider context and physical activity may be accumulated differently by acculturation level. Similar to years in the US, age at immigration, which represents developmental or life stages at which someone moves to the US, was also associated with higher occupational physical activity and accelerometer-assessed MVPA. Although capturing slightly different contextual areas of acculturation, age at immigration and years in the US are highly correlated.

4.3. Social acculturation

The SASH Social subscale measures the degree to which a participant prefers social relationships with individuals of Hispanic/Latino ethnicity or non-Hispanic/Latino white ethnicity. Higher SASH Social scores (higher acculturation) were associated with more leisure-time and transportation physical activity, MVPA, and meeting Guidelines. More socially acculturated HCHS/SOL participants, in the four urban sites, may be influenced by peers who rely on motorized transportation due to distances of resources and potential perception of neighborhood safety, there is greater reliance on motorized transportation. (Benitez et al., 2016; D'Alonzo, 2012) Social changes that accompany immigration may be important mechanisms by which acculturation influences health behaviors such as physical activity. (Allen et al., 2014)

4.4. Sedentary behavior

There were small differences in accelerometer-assessed sedentary behavior by acculturation level. In contrast, we found multiple measures of acculturation was positively associated with higher self-reported sedentary behavior. Americans are world leaders in sedentary behavior,(Ng and Popkin, 2012) and when exposed to new social norms, such as repeated face-to-face interactions with sedentary individuals, (Madan et al., 2010) Hispanic/Latino immigrants may increase sedentary behavior. In addition, Hispanic/Latinos may watch increasing amounts of television as they acculturate because of television's central role in individuals' lives in the US. (Brownson et al., 2005) Acculturating to life in the US may also influence an increase in occupational and transportation sedentary behavior. As stated previously, acculturation is associated with less occupational activity. (Wolin et al., 2006) Thus, occupational sedentary behavior may displace occupational activity. Holding sedentary-based employment can significantly decrease one's weekly activity levels. (Parry and Straker, 2013) Additionally, we found modification for gender with acculturation for the association between self-reported sedentary behavior. There were larger differences in sedentary behavior by acculturation among women. Hispanic/Latino men engaged in more occupational and overall physical activity than Hispanic/Latino women, which may influence overall sedentary behavior. (Arredondo et al., 2016; Marquez and McAuley, 2006)

5. Limitations

Surveys, such as the SASH subscales, have been measured as valid ways to approximate acculturation and language is a powerful symbol of ethnic identity. (Giles, 1987; Tong et al., 1999) However, SASH and proxy variables may fall short of explaining the complex nature of acculturation. (Kang, 2006) Specifically, multidimensional measures of acculturation that capture the idea that individuals can adopt the beliefs and behaviors of mainstream US culture while still maintaining their ethnic identity. (Marin and Gamba, 1996) Measures that provide two scores, one for the Hispanic/Latino domain, and one for the non-Hispanic domain may perform better to assess acculturation as a continuum between two cultural identities. However, including multiple acculturation variables that may capture varying aspects of acculturation strengthens the overall ability to identify points of intervention on the acculturation continuum to promote more physical activity and less sedentary behavior.

Although we have rich information on acculturation, physical activity, and sedentary behavior, our study is cross-sectional in nature. Future studies should evaluate changes in acculturation and physical activity and sedentary patterns over time and follow participants from when they immigrate to the US to assess important transition points in acculturation status, physical activity, and sedentary behavior. Additionally, because barriers to physical activity are cultural in nature, (Larsen et al., 2015) cultural adaptation of interventions and awareness of unique facilitators and barriers to physical activity may be important along the spectrum of acculturation levels. A more detailed understanding of the influence of acculturation on relation to physical activity and sedentary behavior could increase specificity in research and interventions to target to higher risk groups.

6. Conclusions

Higher acculturation was associated with self-reported and accelerometer-assessed physical activity and self-reported sedentary behavior among a large, diverse Hispanic/Latino cohort in the US. However, the direction of the association was dependent on the measure of acculturation and the type of physical activity, highlighting the complexity of these relationships. Future research is warranted to understand the role of the multi-dimensional process of acculturation, how existing measures of acculturation can be interpreted, and how acculturation changes over time in contributing to different physical activity outcomes.

CRediT authorship contribution statement

Ricky Camplain: Conceptualization, Methodology, Software, Writing - original draft, Writing - review & editing. **Daniela Sotres-Alvarez:** Methodology, Software, Formal analysis, Data curation, Supervision, Writing - review & editing, Funding acquisition. **Carolina Alvarez:** Software, Formal analysis, Writing - review & editing. **Rebbecca Wilson:** Software, Formal analysis, Writing - review & editing. **Krista M. Perreira:** Writing - review & editing. **Sheila F. Castañeda:** Writing - review & editing. **Gina Merchant:** Conceptualization, Writing - review & editing. **Marc D. Gellman:** Writing - review & editing, Funding acquisition. **Earle C. Chambers:** Writing - review & editing, Funding acquisition. **Linda C. Gallo:** Conceptualization, Supervision, Writing - review & editing, Funding acquisition. **Kelly R. Evenson:** Conceptualization, Supervision, Writing - review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2020.101050.

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