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Brief Original Report

Self-reported and accelerometer-measured physical activity by body mass index in US Hispanic/Latino adults: HCHS/SOL☆

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ABSTRACT

The association between obesity and physical activity has not been widely examined in an ethnically diverse sample of Hispanic/Latino adults in the US. A cross-sectional analysis of 16,094 Hispanic/Latino adults 18–74 years was conducted from the multi-site Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Body mass index (BMI) was measured and categorized into normal, overweight, and obese; underweight participants were excluded from analyses. Physical activity was measured using the 16-item Global Physical Activity Questionnaire and by an Actical accelerometer. Minutes/day of physical activity and prevalence of engaging in ≥150 moderate–vigorous physical activity (MVPA) minutes/week were estimated by BMI group and sex adjusting for covariates. No adjusted differences were observed in self-reported moderate (MPA), vigorous (VPA), or MVPA across BMI groups. Accelerometry-measured MPA, VPA, and MVPA were significantly higher for the normal weight (females: 18.9, 3.8, 22.6 min/day; males: 28.2, 6.1, 34.3 min/day, respectively) compared to the obese group (females: 15.3, 1.5, 16.8 min/day; males: 23.5, 3.6, 27.1 min/day, respectively). The prevalence of engaging in ≥150 MVPA minutes/week using accelerometers was lower compared to the self-reported measures. Efforts are needed to reach the Hispanic/Latino population to increase opportunities for an active lifestyle that could reduce obesity in this population at high risk for metabolic disorders.

Introduction

According to the National Health and Nutrition Examination Survey (NHANES, 2009–2010), the prevalence of obesity is higher among Mexican-Americans compared with Non-Hispanic Whites (Flegal et al., 2012). The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) has reported a similarly high prevalence of obesity among Hispanic/Latinos of diverse background, with the highest prevalence among Puerto Ricans (Isasi et al., 2015). Obesity has been shown to be inversely associated with physical activity; (Kwon et al., 2013) however, studies across different ethnic populations are limited. Data from the Behavioral Risk Factor Surveillance System found an inverse association between self-reported leisure-time physical activity and obesity among Hispanics of primarily Mexican-American descent (Kwon et al., 2013). The association between obesity and physical activity has not been examined in an ethnically diverse community-based cohort of Hispanic/Latinos, using accelerometer measures less prone to measurement error and respondent bias compared to more commonly used self-reported questionnaires. The objective of this study was to examine and compare the relationship between body mass index (BMI) and (1) self-reported and (2) accelerometer-measured physical activity using data from HCHS/SOL, and to estimate the prevalence of Hispanic/Latino adults that engaged in at least 150 moderate–vigorous physical activity (MVPA) minutes/week (Department of Health and HUman Services, 2008), by BMI group.

Methods

Study population

HCHS/SOL is a cohort study of 16,415 adults of Hispanic/Latino background, 39% Mexican Americans, 19% Cuban American, 15.9% Puerto

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Rican Americans, 10.3% Dominican, 7.2% Central Americans, 5.0% South American and 3.7% other, from four US communities: Bronx, NY; Chicago, IL; Miami, FL; and San Diego, CA. Participants were selected using a stratified two-stage area probability sampling design within these areas to provide a representative sample of the target population (Lavange et al., 2010) (all non-institutionalized Hispanic/Latino adults aged 18–74 years and residing in these defined geographical areas). The census block groups chosen were designed to provide diversity among participants with regard to socioeconomic status and national origin or background. The first sampling stage randomly selected census block groups and the second sampling stage randomly selected households. Both stages stratified and oversampled certain strata to increase the likelihood that a selected address yielded a Hispanic/Latino household. After households were sampled, in-person or telephone contacts were made to screen eligible households and to roster its members. Lastly, the study oversampled the 45–74 age group (n = 9714, 59.2%) to facilitate examination of target endpoints. Over-sampling at both stages of sample selection was used to increase the likelihood that a selected address yielded an eligible household.

Baseline data were collected from 2008 to 2011 and included behavioral and sociodemographic assessments, and accelerometer-measured and self-reported physical activity. All study related questionnaires were available in both English and Spanish versions and administered in the language of participant's preference (80% preferred Spanish). Additional study details are described elsewhere (Sorlie et al., 2010). Written informed consent was obtained from participants and all institutional review boards approved the study.

Physical activity

Physical activity was assessed using Actical accelerometers (version B-1, model 198-0200-03; Philips Respironics; Bend, Oregon). Participants were instructed to wear the accelerometer on their right hip during awake hours for 7 days. In a review of how researchers categorized NHANES accelerometry data (Tudor-Locke et al., 2012), collected for 7 days, the most common approach was ≥4 days, although a number of authors have used less than this. In HCHS/SOL, a minimum of 3 days with ≥10 h/day of wear-time was required for data to be included. A sensitivity analysis using HCHS/SOL data of ≥3 vs. ≥4 days showed similar results in terms of number of minutes in light, moderate, and vigorous physical activity (Evenson et al., 2015). Non-wear time was defined using a validated algorithm (Choi et al., 2011). The Actical recorded counts per one-minute epochs. Physical activity was defined as vigorous (VPA): ≥3962 cpm; moderate (MPA): 1535–3961 cpm; MVPA: ≥1535 cpm; and light: 100–1534 cpm; minutes per category were summed within a day, and then averaged across days (Colley et al., 2011; Colley and Tremblay, 2011).

Physical activity was also measured using the Global Physical Activity Questionnaire (GPAQ), which has been validated in Hispanic/Latinos (Hoos et al., 2012). A 16-item questionnaire, the GPAQ assesses the self-reported frequency and duration of work, transport, leisure, and time spent sitting or reclining to estimate daily minutes of MPA, VPA, and MVPA (Trinh et al., 2009).

The operationalization of engaging in ≥150 MVPA minutes/week based on self-report and in ≥10-minute bouts measured by accelerometry are described elsewhere (Evenson et al., 2015). While weekly duration requirements were similarly derived between accelerometery and self-reported physical activity, they were not equivalent measures, in part due to differences in recall periods and how intensity was assessed (relative vs. absolute), as well as the social desirability bias associated with self-report measures (Troiano et al., 2012a; Prince et al., 2008). In HCHS/SOL, sedentary behavior in relation to cardiometabolic risk factors, was explored separately by Qi and colleagues (Qi et al., 2015).

Body mass index (BMI)

Height was measured with a wall stadiometer (SECA 222, Germany) and weight was obtained with a digital scale (Tanita Body Composition Analyzer, TBF 300, Japan). BMI was calculated as weight in kilograms divided by height in meters squared and categorized as underweight (<18.5 kg/m^2), normal (18.5–24.99 kg/m^2), overweight (25.0–29.99 kg/m^2), and obese (≥30.0 kg/m^2).

Statistical analysis

Estimates were weighted to adjust for sampling probability and standard errors account for the complex survey design. Sampling weights were adjusted for non-response, calibrated to the 2010 US census data according to age, sex, and Hispanic background, and normalized to the overall HCHS/SOL cohort. Since the number of minutes of physical activity was not normally distributed, we chose Poisson models to examine our associations. Histograms illustrating the data distribution are provided in Supplemental Fig. 1. Estimates of average minutes/day of physical activity across BMI groups were computed as predicted marginal means using Poisson models (Long et al., 2014) and estimated proportions of adults who engaged in ≥150 MVPA minutes/week were computed as predicted marginal proportions using logistic regression. All models were stratified by sex and adjusted for age (18–29, 30–44, 45–64, and 65–74 years), the 17-level site-by-Hispanic/Latino background variable, and general health measured by a single item from the SF-12 (Ware et al., 1996). The fact that individuals from specific Hispanic/Latino backgrounds tend to concentrate in specific geographic areas meant that not all backgrounds were represented at each site, creating confounding between Hispanic/Latino background and site. In particular, Cubans were predominantly in Miami, Dominicans were predominantly in the Bronx, and participants from San Diego were predominantly Mexican. Therefore, a 17-level site-by-Hispanic/Latino background variable was created for cells greater than 100 from the cross-classification of Hispanic/Latino background and site, and all other cells were combined into the "Other/Mixed" category by site (Isasi et al., 2015) (see Supplemental Table B). Interactions between Hispanic/Latino background and BMI were assessed by fitting a model with the interaction term for the above 17-level variable, constructing contrasts between background within each site, and adjusting for multiple comparisons using the Bonferroni correction. All analyses of accelerometer data adjusted for wear time, and inverse probability weighting was used to account for a high percentage of incomplete/missing accelerometer data (Seaman and White, 2013). Analyses were performed using SAS 9.3 (SAS Institute, Cary, NC) and SUDAAN release 11 (RTI International, Research Triangle Park, NC).

Results

Participant characteristics

Among the 16,415 participants, 16,094 and 12,474 were included in the GPAQ and Actical analyses, respectively. Participants were excluded from the GPAQ analysis if they had a missing GPAQ (n = 140) or BMI (n = 52), or were underweight due to the small sample size (n = 129). Participants were excluded from the Actical analysis if they had incomplete/missing Actical data (n = 3665), GPAQ (n = 45), or BMI (n = 23), were underweight (n = 92) or had ≥ 23 h/day of Actical wear due to suspected spurious data (n = 116). Baseline characteristics by BMI group are provided in Supplemental Table A.

Physical activity and BMI group

No differences were observed in the GPAQ according to self-reported minutes of MPA, VPA, or MVPA between BMI groups in males and females (Table 1). For the accelerometer-measured data,

Table 1
Population estimated adjusted means (standard error) of self-reported and accelerometer-measured physical activity levels, by BMI group and stratified by sex, the HCHS/SOL Study.

Characteristic	Females			Males		
Self-report (min/day)	Normal (n = 1854)	Overweight (n = 3361)	Obese (n = 4452)	Normal (n = 1310)	Overweight (n = 2712)	Obese (n = 2405)
Moderate activity	78.4 (4.3)	76.0 (3.2)	75.0 (3.0)	122.9 (6.1)	111.0 (4.1)	112.3 (5.4)
Vigorous activity	19.1 (1.7)	15.6 (1.4)	19.7 (2.4)	71.9 (4.8)	69.6 (3.5)	65.8 (3.4)
Moderate or vigorous activity	97.5 (5.0)	91.7 (3.7)	94.7 (4.6)	194.8 (9.1)	180.5 (6.3)	178.2 (6.7)
Recreational						
Moderate activity	11.2 (1.0)	10.5 (0.8)	10.5 (0.9)	14.3 (1.3)	15.2 (1.1)	14.8 (1.0)
Vigorous activity	8.3 (0.8)*	5.2 (0.7)	4.4 (0.8)	19.1 (1.4)	19.4 (1.3)	17.6 (1.3)
Work						
Moderate activity	38.6 (3.3)	37.6 (2.4)	37.1 (2.2)	65.8 (4.8)	62.7 (3.4)	63.3 (3.5)
Vigorous activity	10.3 (1.4)	10.6 (1.2)	15.4 (2.3)	53.3 (4.6)	50.9 (3.2)	49.3 (3.0)
Transportation	29.4 (2.2)	28.7 (1.8)	28.2 (1.5)	43.6 (3.4)*	34.0 (2.1)	35.6 (4.0)
Accelerometer-measured (min/day)	Normal (n = 1461)	Overweight (n = 2670)	Obese (n = 3377)	Normal (n = 1004)	Overweight (n = 2152)	Obese (n = 1810)
Light activity	214.0 (2.9)	213.2 (2.6)	215.0 (2.5)	229.1 (4.5)*	242.6 (3.1)	229.0 (3.7)
Moderate activity	18.9 (0.7)*	17.3 (0.7)	15.3 (0.5)	28.2 (1.0)*	27.0 (0.8)	23.5 (0.8)
Vigorous activity	3.8 (0.4)*	2.2 (0.3)	1.5 (0.2)	6.1 (0.7)*	4.7 (0.3)	3.6 (0.5)
Moderate or vigorous activity	22.6 (1.0)*	19.5 (0.9)	16.8 (0.6)	34.3 (1.5)*	31.7 (1.0)	27.1 (1.2)
Moderate or vigorous activity (in bouts)	10.0 (0.6)*	8.8 (0.6)	6.8 (0.4)	14.6 (1.0)*	13.9 (0.7)	11.7 (0.9)

Adjusted for categorized age, Hispanic/Latino background by site interaction, and SF-12 general physical health. Models using accelerometer data are additionally adjusted for accelerometer average wear time. Hispanic/Latino background by site interaction is a 17-level variable created for cells greater than 100 from the cross-classification of Hispanic/Latino background and site, and all other cells combined into the "Other/Mixed" category by site (Seaman and White, 2013) (see Supplemental Table B). These are: Dominican-Bronx, Central American-Bronx, Mexican-Bronx, Puerto Rican-Bronx, South American-Bronx, Other-Bronx, Central American-Chicago, Mexican-Chicago, Puerto Rican-Chicago, South American-Chicago, Other-Chicago, Central American-Miami, Cuban-Miami, South American-Miami, Other-Miami, Mexicans-San Diego, Other-San Diego.
Normal (18.5 kg/m^2–24.9 kg/m^2), overweight (25 kg/m^2–29.9 kg/m^2), obese (≥30 kg/m^2).
10-minute bouts, allowing only 1–2 min to drop below the threshold, with details provided elsewhere (Choi et al., 201)1.
* $p < 0.05$ for overall BMI group effect (2df) Chi Square.

adjusted means of MPA, VPA, MVPA, and MVPA bouts were higher for the normal compared to the overweight group, and for the overweight compared to the obese group in both males and females ($p < 0.05$ for overall BMI group effect). All groups have a low amount of physical activity, yet based on the accelerometer; the obese group had an average of 6 to 7 min less MVPA per day than normal weight group. For the two primary outcomes of minutes spent in MVPA per day measured by the GPAQ and Actical respectively, we found some variations in the relationship across background and sites, but no consistent trends and no statistically significant pairwise differences in this association by Hispanic/Latino background for either sex.

Fig. 1 shows the prevalence of engaging in ≥150 MVPA minutes/week of activity by BMI group and sex. According to self-report, the prevalence was higher among the normal weight (males: 79.0%, females: 61.9%) compared to the overweight (males: 76.8%, females: 59.5%) and obese groups (males: 73.3%, females: 57.1%; $p < 0.05$ for overall BMI group effect). Overall, the prevalence of engaging in ≥150 MVPA minutes/week of activity using accelerometers was lower compared to the self-reported measures (16.1%, 15.7%, and 11.0% of normal, overweight, and obese, respectively); however, the results showed similar trends across BMI groups. The association between BMI group and the prevalence of engaging in ≥150 MVPA minutes/week of activity is no different across Hispanic/Latino backgrounds for neither sex nor physical activity instrument.

Discussion

The trends in the prevalence of Hispanic/Latino adults engaging in ≥150 MVPA minutes/week were similar across BMI groups for both the GPAQ and accelerometer-measured data; however, the absolute percentage is different, as expected (Troiano et al., 2012b). Self-reported physical activity in minutes/day was not significantly different between the BMI groups. However, the use of accelerometry resulted in significant differences between BMI groups, with the obese and

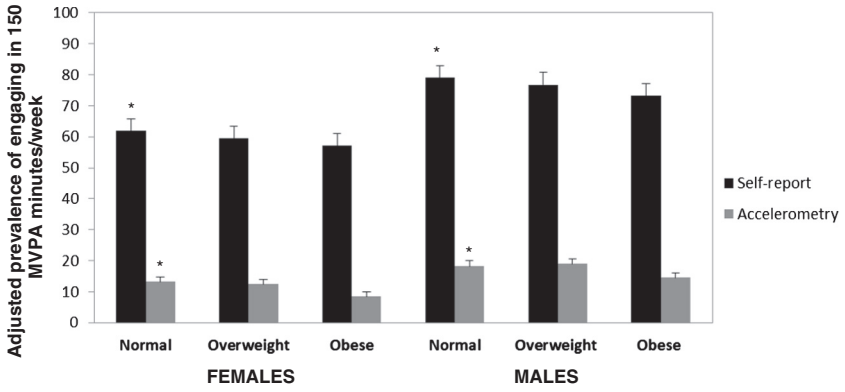

Fig. 1. Population estimate adjusted-prevalence (standard error) of adults engaging in 150 MVPA minutes/week of activity based on self-report and accelerometer-measured physical activity, by BMI group and stratified by sex, the HCHS/SOL Study (self-reported: n = 16,094; accelerometer-measured: n = 12,474). *$p < 0.05$ for overall BMI group effect (2df) Chi Square. Normal (18.5 kg/m^2–24.9 kg/m^2), overweight (25 kg/m^2–29.9 kg/m^2), obese (≥30 kg/m^2). Adjusted for categorized age, Hispanic/Latino background by site interaction, and SF-12 general health. Models using accelerometer data are additionally adjusted for accelerometer wear time. Self-reported prevalence estimates reflect engaging in 150 MVPA minutes/week which were derived from self-reported physical activity data. Prevalence estimates for accelerometery are based on bouts.

overweight groups having fewer MVPA compared to the normal weight group. Similar results have been reported in other studies (Carlson et al., 2010; Spees et al., 2012; Warner et al., 2012). Differences were also observed when comparing self-reported versus accelerometer-measured prevalence estimates of engaging in ≥150 MVPA minutes/week. Similar patterns were observed for both men and women. The results confirm prior reports of a large proportion engaging in this criteria when using self-report (Carlson et al., 2010; Adabonyan et al., 2010), compared to a lower proportion when using accelerometry (Tudor-Locke et al., 2010), although the trends across BMI groups for the two measures are similar.

Several factors may explain this finding. Social desirability biases may lead participants to overestimate their self-reported physical activity. Second, accelerometers are not designed to capture some types of physical activity (e.g. weightlifting or biking). Lastly, differences may be related to the GPAQ measuring habitual physical activity, whereas accelerometry measures one week of activity. Accelerometer-measured physical activity in any one week may not be representative of typical physical activity. For example, weather-related issues, such as a snowstorm, may impact recreation, work and/or transportation-related activity.

Strengths and weaknesses should be noted. The GPAQ required recall of a typical week, whereas the accelerometer represented the week following the GPAQ. Therefore, the recall periods did not match. Second, the protocol to define accelerometer non-wear was developed for a different accelerometer; (Choi et al., 2011) the accuracy for the Actical is unknown.

Despite these limitations, this is the largest observational study of U.S. Hispanic/Latino adults with measured weight and height and two types of physical activity measurements. Furthermore, we are able to generalize our results to those ethnic groups within the 4 HCHS/SOL communities, and although our findings may not be generalizable to all Hispanic/Latinos living in the U.S. these sites are among the cities with highest Hispanic/Latino population in the United States (New York #1, Chicago #5, San Diego #9, and Miami #11) or with the highest percent of a particular Hispanic/Latino background (e.g. Cubans in Miami).

These results suggest that among Hispanic/Latinos, physical activity differed by BMI group. Specifically, accelerometry data showed that obese adults are less active and fewer engaged in at least 150 MVPA minutes/week compared to normal weight adults. In conclusion, our results showed that compared to normal weight Hispanic/Latinos, obese adults are less active and most are not engaging in at least 150 MVPA minutes/week, especially with regard to leisure time activities. Therefore, efforts are needed to reach the Hispanic/Latino population to increase opportunities for an active lifestyle that could reduce obesity in this population at high risk for metabolic disorders.

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Conflicts of interest statement

Conflict of interest statements have been provided by each author and submitted electronically.

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Investigators website — http://www.cscc.unc.edu/hchs/

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.pmedr.2015.09.006.

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