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Article

Associations between neighborhood socioeconomic environment and physical activity in Cuban immigrants

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ABSTRACT

Physical inactivity is a major public health concern because it is a determinant of obesity and obesity-related chronic diseases. Few longitudinal studies have examined the association between neighborhood socioeconomic (SES) environment and change in physical activity behaviors. Additionally, few studies have examined this association in immigrant groups or Hispanic subgroups such as Cubans. This research aimed to determine if neighborhood SES is associated with longitudinal change in moderate-to-vigorous physical activity (MVPA) among Cuban immigrants who participate in the Cuban Health Study in Miami, Florida. Data on 280 participants [mean age: 37.4 ($\pm$4.6), 48.9% women, mean body mass index: 25.0 ($\pm$2.5)] collected at baseline, 12 months and 24 months were analyzed. Minutes of MVPA were objectively measured during each data collection period using accelerometers. A neighborhood SES score was calculated for each participant's residential census tract from American Community Survey data on median household income, median housing value, educational attainment and occupation. The neighborhood SES score was grouped into tertiles, reflecting low, moderate and high neighborhood SES environment. Multilevel linear models were used to examine the relationship between neighborhood SES and change in MVPA over 24 months. At baseline, 94 (33.6%), 108 (38.6%) and 78 (27.9%) participants resided in low, moderate, and high SES neighborhoods, respectively. After adjusting for age, sex, and body mass index, no difference in average change in MVPA over time was observed between participants residing in low and moderate SES neighborhoods ($p=0.48$) or low and high SES neighborhoods ($p=0.62$). In Cuban immigrants, longitudinal change in MVPA may not vary by neighborhood socioeconomic environment.

Introduction

Insufficient physical activity is a major health issue in the US due to its association with weight gain and chronic diseases such as cardiovascular disease (CVD) and Type 2 diabetes (Borrell, 2014; Mathieu, Powell-Wiley, & Ayers, 2012; Lee, Djousse, Sesso, Wang, & Buring, 2010; Haskell, Lee, & Pate, 2007; Lee & Paffenbarger, 2000). According to the Centers for Disease Control and Prevention (CDC), less than half of US adults over age 18 meet CDC minimal recommendations for 150 min of moderate intensity physical activity per week (Centers for Disease Control and Prevention: Facts about Physical Activity, 2014). There are also ethnic disparities in physical inactivity that exist. Hispanic subgroups (e.g. Puerto Rican, Mexican, Dominican, Cuban, or South American) have higher rates of physical inactivity compared to Non-Hispanic whites (Neighbors, Marquez, & Marcus, 2008; Daviglus, Talavera, & Aviles-Santa, 2012). Additionally, factors such as acculturation may be associated with physical activity behaviors, as some evidence suggests that that duration of time spent in the US after immigration is negatively associated with time spent physically active (Ghaddar, Brown, Pagan, & Diaz, 2010; Brewer & Kimbro, 2014; Echeverria, Ohri-Vachaspati, & Yedidia, 2015). Growing concern for current and future implications of physical inactivity

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has led to increased interests in studying the socio-cultural and environmental predictors of physical inactivity in minority populations such as Hispanic Americans and recent Hispanic immigrants (Brewer & Kimbro, 2014; Echeverria et al., 2015; Jurkowski, Mosquera, & Ramos, 2010).

Neighborhood-level socioeconomic (SES) characteristics (e.g. median household income, housing value, percentage of residents living in poverty) have been examined as risk factors for several adverse health outcomes including depression, substance abuse, and obesity (Powell-Wiley, Ayers, & Agyemang, 2014; Leventhal & Brooks-Gunn, 2003; Fauth, Leventhal, & Brooks-Gunn, 2004; Rundle, Field, & Park, 2008). Neighborhood SES is also hypothesized to influence individual-level physical activity behaviors because previous research has observed that neighborhood SES measures, such as median income, are correlated with factors such as neighborhood walkability and recreational facility availability (Moore, Diez Roux, & Evenson, 2008; Abercrombie, Sallis, & Conway, 2008). Research studies that previously examined associations between neighborhood SES and individual-level physical activity have been mostly cross-sectional, and findings have been largely inconsistent (Alves, Silva, & Severo, 2013; Molnar, Gortmaker, & Bull, 2004; Pascual, Regidor, & Astasio, 2007; Sallis, Saelens, & Frank, 2009; Carson, Rosu, & Janssesn, 2014). Among the few longitudinal studies conducted, some significant findings have been reported although study subjects examined have been mostly Non-Hispanic white and black (Shishehbor, Gordon-Larson, & Kiefe, 2008; Boone-Heinonen, Evenson, & Gordon-Larson, 2010; Boone-Heinonen, Diez Roux, & Kiefe, 2011; Voorhees, Catellier, & Ashwood, 2009). For example, Boone-Heinonen et al. (2011) observed that neighborhood deprivation was longitudinally associated with lower levels of physical activity among Non-Hispanic black adults (age 18–30 years old at baseline), but not whites (Boone-Heinonen et al., 2011).

To our knowledge, no study has examined the association between neighborhood SES and physical activity behaviors among adults of a specific Hispanic subgroup such as Cubans. Previous research has found that Cuban adults in the US have a higher prevalence of obesity and a lower prevalence of leisure-time physical activity compared to Non-Hispanic white adults (Neighbors et al., 2008; Daviglus et al., 2012). The aim of this study is to contribute to the scientific knowledge of this subject by examining the longitudinal association between neighborhood SES and physical activity behaviors in Cuban immigrants who recently relocated to the US. Focusing on this study population permits us to explore the effect of time spent in the US on the association between neighborhood SES and physical activity among individuals from the unique environment of Cuba where walking and cycling are the primary modes of transportation (Franco, Ordunez, & Caballero, 2007). We hypothesize that individuals who move to low SES neighborhoods after relocating to the US will experience greater declines in physical activity over time compared to those individuals who move to neighborhoods of higher SES.

Materials and methods

Data source

Data from the Cuban Health Study, a population based prospective cohort study conducted at the University of Miami in Miami, Florida, were used for this analysis (Brown, Patin, & Lombard, 2013; Brown, Lombard, & Toro, 2014). The overarching goal of the Cuban Health study is to investigate how environmental factors influence behavioral and biological outcomes (i.e. adiposity, inflammation and insulin resistance) and the progression of metabolic syndrome indicators (Grundy, Cleeman, & Daniels, 2005). The study population consists of 391 new Cuban immigrants who relocated from Cuba to Miami, Florida, in 2008–2010. Participants were recruited from the Miami-Dade County Refugee Health Assessment Program where incoming immigrants are eligible for free health services during their first 90 days in the US. To be eligible for participation, individuals must have relocated to the US within 90 days of their initial interview and be sufficiently healthy to perform physical activity. Individuals with pre-existing conditions that affect inflammation or diagnosed with metabolic syndrome were not eligible for participation. Participants were compensated for each assessment completed in the study. All participants were between the ages of 30 and 45 at the time of enrollment and were screened for eligibility by a research assistant prior to providing informed consent.

Quantitative data assessment methods (i.e. questionnaires, interviews, and assays) were used to collect information on demographics, environment, behavior (i.e. physical activity; dietary intake) and biological factors at baseline, 12 months and 24 months post-baseline. Geographic information on current place of residence (i.e. addresses and zip codes) was also collected. ActiCal® accelerometers (Philips Respironics Inc.; Bend, Oregon) were used to objectively measure participants' physical activity for a selected 3-day period proximal to each yearly assessment (2 weekdays and 1 weekend day). Research staff delivered the accelerometers to participants who were asked to wear the activity monitor continuously for 3 days even while sleeping and showering. At the end of the data collection period, research staff retrieved the accelerometers from study participants.

Measures

The primary outcome measure in this analysis was average minutes spent in moderate-to-vigorous physical activity (MVPA) per day over the 3 day assessment period. The ActiCal® software set on double regression analysis function was used to derive MVPA from valid days (minimum of 720 min of wear time per day) (Heil, 2006). Age was measured in years and gender was classified as male or female. Current smoker status was classified as smoker or non-smoker. General health status was self-reported as poor, fair, good or excellent (Block, Wakimoto, & Jensen, 2006). Body mass index (BMI) was calculated from measured height (cm) and weight (kg) while participants were not wearing shoes. Neighborhood SES was determined by creating a summary score using methods previously presented by Diez Roux et al. and Cohen et al. which incorporated neighborhood-level indicators such as income, education, and occupation in population-based epidemiological studies (Diez-Roux, Jacobs, & Haan, 2001; Cohen, Sonderman, & Mumma, 2011). Addresses collected from study participants at each assessment period were used to identify their Miami-Dade county census tract code. Five year estimates of the following 6 neighborhood SES indicators were extracted from the 2010 American Community Survey for all Miami-Dade county census tracts: median household income, median value of homes, percentage of neighborhood residents that completed high school, percentage of neighborhood residents that completed college, percentage of persons that hold an executive/professional occupation, add percentage of neighborhood units receiving interest, dividend, or net rental income. The census tract data extracted from the American Community Survey permitted the calculation of neighborhood SES scores for each Miami-Dade county census tract by summing the log-transformed z-scores calculated for the 6 neighborhood socioeconomic indicators of interest. The neighborhood SES score for each study participant's residential census tract was examined at each assessment period considering that 37 participants relocated during the 24 month time period. Summed z-scores ranged from -10.31 to 11.95 with the mean being 0.33.

Increasing z-score reflects higher neighborhood SES. Neighborhood scores were grouped based on the tertiles of the empirical distribution of the z-scores. These tertiles represent low neighborhood SES (z-score range: −10.31 to −2.10; mean=−4.86), moderate neighborhood SES (z-score range: −2.00 to 2.93; mean=0.59) and high neighborhood SES (z-score range: 3.01–11.95; mean=6.22).

Statistical analysis

Descriptive statistics (i.e. means and frequencies) were calculated for variables of interest among all Cuban Health Study participants and stratified by sex. There were 83 participants lost to follow-up between baseline and the 24 month assessment period. Furthermore, 27 participants were excluded due to missing census tract code information. The missing census tract codes resulted in us not being able to calculate their neighborhood SES score. The final analysis included a sample size of 280 participants. Multilevel linear models were used to explore change in MVPA over time among all participants. The PROC MIXED procedure in SAS was used along with a VC covariance structure. Analyses performed were stratified by sex as previous research has indicated sex differences in the association between weight-related outcomes (e.g. obesity) and SES status (Do, Dubowitz, & Bird, 2007; Robert & Reither, 2004). Baseline age and baseline BMI were centered by subtracting the sample mean so that the parameter coefficients calculated would represent the average rate of change for the average study participant. Model A is the unconditional growth model that includes only the linear effect of time (i.e. years) with time modeled as a random effect. Model B is the crude model that only includes time, moderate neighborhood SES, and high neighborhood SES. Low neighborhood SES served as the referent category. Model C is the multivariate adjusted model that includes the following covariates: time, baseline age, male sex, baseline general health status, smoking status, baseline BMI, moderate neighborhood SES, high neighborhood SES, and each variable's interaction with time. Model D is the multivariate adjusted model among only male participants and Model E is the multivariate adjusted model among only female participants. Goodness-of-Fit statistics were recorded in order to compare the fit of the models. Lower values for AIC and BIC suggest better model fit. A p-value less than 0.05 was considered statistically significant. All analyses were performed using SAS version 9.3 for Microsoft Windows (SAS Institute Inc. Cary, NC).

Results

Baseline demographic, health and neighborhood characteristics of the study population are presented in Table 1. Mean age at baseline was 37.4 (±4.6) and 49.0% of participants are female. Mean BMI at baseline was 25.0 and 21.4% of participants indicated they were current smokers. At baseline, there were 78 (27.9%), 108 (38.9%) and 94 (33.6%) participants living in high, moderate and low SES neighborhoods respectively. The average amount of time participants spent in MVPA at baseline was 86.7 (±55.1) min per day. Approximately 181 (64.6%) study participants had a mean time spent in MVPA that was ≥60 min and 261 (93.2%) had a mean time spent in MVPA that was ≥30 min. The proportion of men that engaged in an average of ≥60 min of MVPA was significantly greater than women ($p<0.0001$). At baseline, men were more likely to be a smoker compared to women ($p=0.01$). Men also had a higher BMI ($p<0.0001$) and engaged in more minutes of MVPA ($p=0.02$) on average compared to women. Male participants, on average, engaged in about 15 more minutes of MVPA per day compared to female participants at baseline.

Table 1
Baseline demographic, health, and neighborhood characteristics of Cuban Health Study participants (N=280).

Characteristic	All participants	Male 143 (51.07%)	Female 137 (48.93%)	p-Value
Age (years)	37.42 (±4.61)[a]	37.56 (±4.74)	37.26 (±4.50)	0.59
Smoking status				
Smoker	60 (21.43)	39 (27.27)	21 (15.33)	0.01
Non-smoker	220 (78.57)	104 (72.73)	116 (84.67)	
BMI (kg/m^2)	24.96 (±2.45)	25.60 (±2.35)	24.29 (±2.40)	<0.0001
MVPA (min)	86.74 (±55.12)	94.04 (±47.33)	79.12 (±61.60)	0.02
≥60 min of MVPA				
Yes	181 (64.6)	109 (76.2)	72 (52.6)	<0.0001
No	99 (35.4)	34 (23.8)	65 (47.5)	
General health status				0.32
Excellent	43 (15.36)	24 (16.78)	19 (13.87)	
Good	87 (31.07)	49 (34.27)	38 (27.74)	
Fair	133 (47.50)	64 (44.76)	69 (50.36)	
Poor	17 (6.07)	6 (4.20)	11 (8.03)	
Neighborhood SES				0.72
High	78 (27.86)	42 (29.37)	36 (26.28)	
Moderate	108 (38.57)	56 (39.16)	52 (37.96)	
Low	94(33.57)	45 (31.47)	49 (35.77)	

n (%).
BMI: Body Mass Index; MVPA: moderate-to-vigorous physical activity.
[a] Mean (±standard deviation) for continuous variables.

Multilevel models fitted to examine change in MVPA over time are displayed in Table 2. Results from Model A suggested that the linear effect of time was statistically significant. On average, time spent in MVPA increased 14 min each year among study participants ($p<0.0001$). Crude analyses (i.e. Model B) indicated that compared to individuals in low SES neighborhoods, no significant differences in average change in MVPA occurred among participants residing in moderate SES neighborhoods (0.38) and high SES neighborhoods (0.75). The multivariate adjusted model, Model C, suggested that male sex was positively associated with average initial level of MVPA ($p=0.002$), but not average change in MVPA over time ($p=0.15$). No other covariates and interactions were statistically significant. There were no significant differences in average initial level of MVPA ($p=0.55$) or average change in MVPA ($p=0.48$) between participants residing in low SES neighborhoods and moderate SES neighborhoods. Additionally, there were no significant differences in average initial level of MVPA ($p=0.40$) or average change in MVPA ($p=0.62$) between participants residing in low SES neighborhoods and high SES neighborhoods. Goodness-of-fit statistics showed that Model C, the adjusted model, had the best fit. Model D and Model E in Table 2 are stratified multilevel models fitted to examine differences in change in MVPA over time between males and females respectively. Among males only, a significant increase in MVPA over the 24 month assessment period was observed ($p<0.0001$). Among males and females, the multivariable adjusted model showed that no covariates or interaction terms were statistically significant. Therefore, no difference in average initial level of MVPA or change in MVPA over time was detected between the neighborhood SES groups.

Table 2
Results from multilevel models fitted to examine longitudinal associations between neighborhood SES and MVPA.

	β (SE)[a]	β (SE)[b]	β (SE)[c]	β (SE)[d]	β (SE)[e]
Fixed effects					
Initial status					
Intercept	93.14 (3.76)***	93.10 (6.39)***	76.62 (9.69)***	92.53 (14.18)***	82.36 (12.60)***
Age			−1.53 (0.82)	−0.83 (1.19)	−2.06 (1.15)
Male sex			24.13 (7.83)*	–	–
Health status			4.07 (4.44)	12.00 (6.62)	−2.90 (6.07)
Current smoker			−9.69 (9.24)	−11.30 (12.67)	−7.45 (14.36)
BMI			0.37 (1.59)	1.00 (2.38)	−0.17 (2.15)
Low SES		REF	REF	REF	REF
Moderate SES		−4.06 (8.73)	−5.11 (8.61)	−11.20 (12.72)	2.07 (11.70)
High SES		6.03 (9.52)	8.12 (9.60)	−0.68 (14.17)	12.42 (13.18)
Rate of change					
Intercept (time)	14.11 (2.87)***	16.90 (4.85)**	20.97 (7.55)*	40.45 (10.44)**	11.51 (10.03)
Age			0.86 (0.64)	0.15 (0.86)	1.15 (0.93)
Male sex			8.83 (6.11)	–	–
Health status			−4.70 (3.41)	−8.86 (4.87)	−1.15 (4.77)
Current smoker			−5.79 (7.21)	−8.22 (9.19)	−2.89 (11.46)
BMI			0.51 (1.24)	−0.29 (1.74)	1.20 (1.73)
Low SES		REF	REF	REF	REF
Moderate SES		−6.07 (6.87)	−4.87 (6.91)	−7.54 (9.63)	−2.00 (9.67)
High SES		−2.40 (7.46)	−3.72 (7.55)	−11.56 (10.50)	7.65 (10.65)
Goodness-of-fit Statistics					
Deviance	9535.6	9530.4	9290.2	4759.7	4517.0
AIC	9545.6	9548.4	9328.2	4793.7	4555.0
BIC	9563.8	9581.1	9396.9	4843.7	4600.3

β: parameter estimate; BMI: body mass index; SE: standard error; SES: socioeconomic status.

* $p < 0.05$.
** $p < 0.001$.
*** $p < 0.0001$.
[a] Model A: the unconditional growth model that only includes the linear effect of time.
[b] Model B: includes the linear effect of time and the neighborhood SES variables.
[c] Model C: the multivariate adjusted model that includes neighborhood SES and all covariates.
[d] Model D: the multivariate adjusted model among male study participants only.
[e] Model E: the multivariate adjusted model among female study participants only.

Discussion

Results from this research revealed no association between neighborhood SES and change in MVPA over time in new Cuban immigrants. Multilevel models fitted to explore change in MVPA among participants in the current study indicated that, on average, participants were highly active. Mean amount of time spent in MVPA at baseline was calculated to be 86.7 min, on average, over the 3 consecutive days of assessment. Over 90% of the study participants averaged at least 30 min of MVPA per day. Furthermore, physical activity increased approximately 14.1 min among individuals regardless of neighborhood SES. NHANES data suggest that less than less than 5% of general population of US adults engage in MVPA for at least 30 min a day (Trojano, Berrigan, & Dodd, 2008). Considering the CDC recommends 150 min of moderate activity per week, this study population was very active compared to the US adult population (Centers for Disease Control and Prevention, 2015). Results indicated that neighborhood SES was not associated with change in MVPA in males and females. Both men and women, on average, appeared to experience an increase in time spent in MVPA per week over the 24 month assessment period; however, this increase was not statistically significant in women.

We previously hypothesized that physical activity would decrease over time in new Cuban immigrants after reviewing previous research on the effects of acculturation on health behaviors such as physical activity. Acculturation, as defined as increasing number of years residing in the US, is linked to reduced physical activity and increased risk of chronic disease and among some immigrant populations (Ghaddar et al., 2010; Brewer & Kimbro, 2014). While 24 month data from the current study showed an average increase in BMI from baseline (mean = 0.47; $p < 0.0001$), an increase in MVPA was also observed. We suspect that the number of data assessment periods needed to observe statistically significant changes in physical activity behaviors by neighborhood SES level in the current study population is longer than the number of data collection periods included in the current study.

As stated before, research studies previously conducted on associations between neighborhood SES environment and physical activity behaviors have not focused on middle-aged Hispanic adults (Alves et al., 2013; Molnar et al., 2004; Pascual et al., 2007; Sallis et al., 2009; Carson et al., 2014; Shishehbor et al., 2008; Boone-Heinonen et al., 2010; Boone-Heinonen et al., 2011; Voorhees et al., 2009). Nevertheless, these studies provide some insight into how neighborhood SES and physical activity may be associated in Hispanics. Several cross-sectional studies did not report statistically significant findings. Carson et al. (2014) observed that neighborhood SES measures were not associated with self-reported physical activity in children or their parents (Carson et al., 2014). Voorhees et al. (2009) found that neighborhood SES was not associated with time spent in MVPA or BMI in a multiethnic population of adolescent girls (Voorhees et al., 2009). Some of the longitudinal studies conducted have observed significant findings. In addition to the study by Boon-Heinonen and colleagues that examined Non-Hispanic black and white adults, Shishehbor et al. (2008) reported that the odds of impaired physical activity was higher among young adults living in low SES neighborhoods compared to high SES neighborhoods (Shishehbor et al., 2008; Boone-Heinonen et al., 2011). More prospective studies are needed in order to delineate whether neighborhood SES influences physical activity behaviors in minority populations such as Hispanics.

A myriad of assessment methods (e.g. environmental scans, indices, GIS-derived measures, self-report) have been employed to characterize built and SES environment (Brownson, Hoehner, & Day, 2009). Built environment studies often employ measures of proximity to certain environmental features (e.g. recreation centers), walkability, street connectivity, or the availability of various structural of components such as sidewalks, trails and green space. Several of these studies of observed significant associations between built environment measures and individual-level physical activity behaviors (Hirsch, Diez Roux, Moore, Evenson, & Rodriguez, 2014; Kelly et al., 2014; Lovasi, Neckerman, Quinn, Weiss, & Rundle, 2009; Saelens, Sallis, Black, & Chen, 2003; Wells & Yang, 2008). Saelens et al. (2003) and Kelly et al. (2014) both found that walkability, mixed land use and street connectivity were associated with higher levels of physical activity (Kelly et al., 2014; Saelens et al., 2003). Hirsch et al. (2014) observed that study subjects who recently relocated to neighborhoods with a higher walkability score engaged in a significantly higher amount of physical activity per week (Hirsch et al., 2014). In 2010, Boone-Heinonen and colleagues examined the inter-relationships between GIS-derived built environment measures and SES environment characteristics using principal factor analysis and found that the built and SES environment constructs are significantly associated (Boone-Heinonen et al., 2010). These results suggest that future examinations of the role of neighborhood environment should be cognizant of how built environment and neighborhood SES measures are inter-related in the context of the outcome variable being studied.

There are several strengths and limitations of this research that should be noted. Strengths of this research include objective measurement of physical activity and the unique study population. Physical activity was objectively collected using accelerometry, a validated method of assessing time spent active (Watson, Carlson, Carroll, & Fulton, 2014; Hooker, Feeney, & Hutto, 2011). Study participants were new Cuban immigrants that relocated to the Miami area within 90 days of study enrollment and reported having little choice in where they lived upon initial arrival in the US. This permitted the examination of the early effects of acculturation on physical activity in a Hispanic subgroup whose physical activity behaviors are not often observed. Most study participants reported choosing to living with or near relative or being provided housing by nonprofit organizations (Brown et al. 2013). Given less than 2% of the study participants had a choice in residential location, this study addresses, in part, the selection bias that characterizes much of the literature on neighborhood characteristics and health (Brown et al. 2013; James, Hart, & Arcaya, 2015). There remains the possibility that the overall sample selected for participation includes individuals with the social and material resources necessary to migrate to Miami from Cuba. This may explain, in part, the high levels of physical activity observed among participants.

Limitations to this research include the loss to follow-up, the amount of missing data on current residence, the limited number of data assessment periods, and the potential effect of neighborhood self-selection. Observational epidemiological studies that have examined neighborhood environment as a predictor of health are often unable to control for neighborhood self-selection (i.e. freedom to select area of residence) (Arcaya, Subramanian, Rhodes, & Waters, 2014; McCormack, & Shiell, 2011). A systematic review conducted by McCormack et al. in (2010) found that neighborhood self-selection attenuated associations between built environment and physical activity in many of the studies included in the review (McCormack and Shiell, 2011). The fact that participants in the current study received assistance from non-profit organizations to relocate to the Miami area or moved in with family members might may have reduced the effect of self-selection bias on point estimates (Brown et al., 2013). Furthermore, neighborhood SES was categorized into tertiles for ease of interpretation, which might have influenced our ability to observe a statistically significant effect. Sensitivity analyses performed indicated that neighborhood SES was not associated with MVPA in models where neighborhood SES score was modeled as a continuous time-varying variable.

Conclusions

This research examined longitudinal associations between neighborhood SES and individual-level physical activity in new Cuban immigrants – a Hispanic subgroup whose health behaviors are not well documented in the US. Results from analyses performed indicated that neighborhood SES was not associated with time spent in MVPA. Overall, study participants had a high level of activity during the 24 month assessment period. Future studies on this topic should consider additional Hispanic subgroups, other measures of neighborhood quality, and more data collection points so that the potential effects of acculturation can be assessed.

Authors' contributions

JS, TP and SH participated in designing and implementing the Cuban Health Study. OA, CS and JS conceived this research project and participated in its coordination. OA and CS participated in drafting the manuscript. CS performed the statistical analysis. SB assisted in performing the statistical analysis and interpreting the results. All authors read, edited and approved the final manuscript.

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