



ELSEVIER

Contents lists available at ScienceDirect

SSM -Population Health

journal homepage: www.elsevier.com/locate/ssmph

Article

Differences in neighborhood social cohesion and aerobic physical activity by Latino subgroup

Rosenda Murillo^{a,*}, Sandra Echeverria^b, Elizabeth Vasquez^c^a University of Houston, Department of Psychological, Health, and Learning Sciences, 3657 Cullen Boulevard, Room 491, Houston, TX 77204-5029, USA^b City University of New York (CUNY), Graduate School of Public Health and Health Policy, Department of Community Health and Social Sciences, 55W. 125th Street, 5th Floor, New York, New York 10027, USA^c University of Albany State University of New York, Department of Epidemiology and Biostatistics, One University Place, GEC 121, Rensselaer, NY 12144, USA

ARTICLE INFO

Article history:

Received 24 April 2016

Received in revised form

2 August 2016

Accepted 3 August 2016

Keywords:

Neighborhood social cohesion

Physical activity

Latinos

subgroups

ABSTRACT

Previous research has examined the role of neighborhood social cohesion in physical activity outcomes; however, less is known about this relationship across Latino subgroups. The purpose of our study was to examine the association between neighborhood social cohesion and aerobic leisure-time physical activity (LTPA) among Latino adults and to determine whether these associations differ by Latino subgroup. We used cross-sectional 2013–2014 National Health Interview Survey (NHIS) data on Latinos originating from 5 countries/regions (i.e., Latinos of Puerto Rican, Mexican/Mexican-American, Cuban/Cuban-American, Dominican and Central or South American origin) aged ≥ 18 years ($n = 11,126$). Multivariable logistic regression models were used to estimate associations between self-reported neighborhood social cohesion and meeting aerobic LTPA guidelines. Models were adjusted for age, sex, education, and acculturation. We also investigated whether associations varied by Latino subgroup. In adjusted models for all Latino adults, compared with those reporting low social cohesion, individuals who reported high social cohesion (Odds Ratio [OR]: 1.33; 95% Confidence Interval [CI]: 1.17–1.52) were significantly more likely to meet the aerobic physical activity guideline. When stratified by Latino subgroups, among Mexican/Mexicans-Americans (OR: 1.39; 95% CI: 1.16, 1.66) and Cuban/Cuban Americans (OR: 1.73; 95% CI: 1.00, 2.97) high social cohesion was associated with meeting the aerobic activity guideline. Among Dominicans, those who reported medium social cohesion (OR: 0.52, 95% CI: 0.29, 0.93) were less likely to meet the aerobic activity guideline. When examining aerobic physical activity outcomes in the Latino population, the role of neighborhood social cohesion and the variability among Latino subgroups should be considered.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Latino adults are less likely to engage in leisure-time aerobic activity and to meet current aerobic activity guidelines compared with non-Latino adults (Carlson, Fulton, & Schoenborn, 2010; USDHHS, 2008). Although several studies have examined all Latinos within one category, previous research suggests that there is heterogeneity in the prevalence of aerobic activity among Latino subpopulations (Daviglius, Talavera, & Avilés-Santa, 2012; Marquez, Neighbors, & Bustamante, 2010; Neighbors, Marquez, & Marcus, 2008). For example, aerobic activity has been shown to be highest among Mexican/Mexican-Americans and lowest among Dominicans, when compared with other Latino subgroups (Daviglius et al.,

2012; Neighbors et al., 2008; Arredondo, Sotres-Alvarez, & Stoutenberg, 2015). Thus, understanding factors that contribute to the variability in physical activity patterns across Latino subgroups may help inform the development of physical activity interventions among the Latino population.

Previous research has shown that neighborhood factors have an impact on various health outcomes and health behaviors (Ellen, Mijanovich, & Dillman, 2001; Feldman & Steptoe, 2004). Specifically, perceived neighborhood social cohesion, which is generally defined as the solidarity and connectedness within a group of individuals (Sampson, Raudenbush, & Earls, 1997; Kandula, Wen, & Jacobs, 2009), at high levels has been shown to be protective against adverse health outcomes such as hypertension, myocardial infarction, stroke mortality (Clark, Guo, & Lunos, 2011; Kim, Hawes, & Smith, 2014; Kim, Park, & Peterson, 2013; Mujahid, Roux, & Morenoff, 2008) and to be related to positive health behaviors such as greater physical activity (Echeverría, Diez-Roux, & Shea, 2008; Samuel, Himmelfarb, & Szklo, 2015; Cleland, Ball, & Hume,

* Corresponding author.

E-mail addresses: rmurillo3@uh.edu (R. Murillo), sandra.echeverria@SPH.CUNY.edu (S. Echeverria), evasquez2@albany.edu (E. Vasquez).

2010; Shelton, McNeill, & Puleo, 2011). Further, prior research has shown that neighborhoods with low social cohesion are related to an increase in adverse health outcomes and behaviors, such as depression and smoking (Echeverría et al., 2008).

Among racially/ ethnically diverse populations, aspects of social cohesion such as a sense of belonging and having a shared cultural identity have been cited as protective characteristics that promote health in these communities (Angel & Angel, 2006). There is also some evidence to suggest that residing in an ethnic enclave may have a positive influence on health due to strong social networks, socioeconomic structure, and neighborhood social cohesion (Cagney, Browning, & Wallace, 2007; Peak & Weeks, 2002). Specifically within the Latino population, social connections, including neighborhood social cohesion, have been shown to be important for mental and physical health (Mulvaney-Day, Alegria, & Sribney, 2007; Rios, Aiken, & Zautra, 2012). Although some of these studies have examined the role of neighborhood social cohesion in physical activity outcomes in diverse populations that include Latinos, no studies to the authors' knowledge have examined this relationship across Latino subgroups. A consistent body of evidence has demonstrated that health patterns vary by Latino subgroup likely due to the distinct cultural, socioeconomic, and political histories as well as settlement patterns of each group, all of which are known to influence health (Zsembik & Fennell, 2005; Rodriguez, Allison, & Daviglus, 2014; Motel & Patten, 2012). Therefore, examining whether the association between neighborhood social cohesion and aerobic physical activity varies by Latino subgroup could help identify subgroups for which neighborhood social cohesion has a more deleterious or beneficial effect.

Using data from a nationally representative sample of US Latino adults we examined 1) associations of neighborhood social cohesion with meeting the guideline for aerobic leisure-time physical activity (LTPA) among all Latino adults; and 2) whether there are differences in the association of neighborhood social cohesion and meeting the aerobic activity guideline by Latino subgroup (i.e., Latinos of Puerto Rican, Mexican/Mexican-American, Cuban/Cuban American, Dominican, and Central or South American origin). We hypothesized a priori that high neighborhood social cohesion would be associated with higher odds of meeting the guideline for aerobic activity, versus not meeting the aerobic activity guideline, among all Latino adults. Further, we also hypothesized that there would be variation in this association by Latino subgroup, tested by including an interaction term between Latino subgroup and neighborhood social cohesion in fully adjusted models. For example, we hypothesized that medium or high levels of neighborhood social cohesion, compared with low levels, would be associated with meeting the aerobic activity guideline for some subgroups, but not all.

Methods

Data

We used data from the 2013–2014 National Health Interview Survey (NHIS), a cross-sectional survey conducted annually that employs a multistage probability sample survey design to obtain a nationally representative sample of the non-institutionalized US civilian population. The NHIS gathers information related to health and demographics from all family members. An adult (age ≥ 18 years old) within each family is randomly selected and interviewed to collect additional information, such as information regarding physical activity. Additional NHIS survey details can be found elsewhere (National Center for Health Statistics, 2015a, 2015b). Participants who self-reported being Hispanic or Latino were asked to indicate which Latino group they identified as their

Hispanic origin. Only participants who identified a single country for their Hispanic origin were included in our sample.

Of the 11,389 Latino participants who were 18 years of age and older, and identified a single country for their Latino origin, participants with missing data on education, nativity, neighborhood social cohesion or physical activity were excluded ($n=99$). Therefore, analyses included data from 11,290 Latino adults with complete data on the variables of interest.

Measures

Neighborhood social cohesion

NHIS Participants were asked questions related to their neighborhood. Four items specifically asked individuals whether they agreed or disagreed with the following statements: 1) "People in this neighborhood help each other out"; 2) "There are people I can count on in this neighborhood"; 3) "People in this neighborhood can be trusted"; and 4) "This is a close-knit neighborhood". The original response scales for all neighborhood social cohesion items were reverse coded and a neighborhood social cohesion sum score of the four items was created with a higher score indicating higher levels of neighborhood social cohesion. Using the sum score, approximate tertiles of neighborhood social cohesion were used to create categories of low, medium, and high neighborhood social cohesion. Previous research has used these four items assessing neighborhood social cohesion (Sampson et al., 1997), but has typically included an additional fifth item not measured in the NHIS study. However, we assessed the reliability of the four items and they demonstrated high internal consistency (Cronbach's $\alpha=0.93$).

Aerobic physical activity

Participants were asked how frequently during their leisure-time they engaged in 1) vigorous activity that caused heavy sweating or large increases in their breathing or heart rate; and 2) light or moderate activity that caused light sweating or a slight to moderate increase in their breathing or heart rate for ≥ 10 min at a time. Participants were asked to report the frequency of their activity (in days, weeks, months or year) and duration of each activity session (in minutes or hours).

Aerobic activity was categorized based on criteria from the 2008 Physical Activity Guidelines for Americans (USDHHS, 2008). Participants were classified as meeting the aerobic activity guideline if they engaged in ≥ 150 min of moderate-intensity activity per week, ≥ 75 min of vigorous-intensity activity per week, or ≥ 150 min of an equivalent combination of moderate- and vigorous-intensity activity per week. Individuals were classified as not meeting the aerobic activity guideline if they engaged in < 150 min of moderate- and vigorous-intensity aerobic activity per week. Using guidelines suggested by the 2008 Physical Activity Guidelines for Americans (USDHHS, 2008), reported minutes of vigorous-intensity activity were assigned twice the credit of reported moderate-intensity activity minutes to calculate an equivalent combination when moderate and vigorous-intensity activity were combined.

Covariates. Multivariable models included age, sex, education, and acculturation. Age was modeled continuously and educational attainment was categorized into four education levels (i.e., less than high school, high school graduate, some college or college graduate). To measure acculturation, we used self-reported nativity (foreign-born, US-born) and length of residence in the US to create proxy measures of acculturation. Based on a combination of these variables, we categorized participants as foreign-born with < 10 years of residence in the US, foreign-born with ≥ 10 years in the US, and US-born.

Statistical analysis

Unadjusted means or frequencies and standard errors of participant characteristics (i.e., demographics, acculturation, and neighborhood social cohesion) and prevalence of aerobic activity were computed by Latino subgroup. Logistic regression models were used to estimate the adjusted odds ratios (OR) for the likelihood of meeting the aerobic physical activity guideline relative to not meeting the aerobic physical activity guideline. Model 1 estimates were unadjusted, and in Model 2 we adjusted for age, sex, education, acculturation, and Latino subgroup. Additionally, given prior evidence on health differences by Latino groups and the role of neighborhood environments in shaping physical activity, we stratified our analyses by Latino groups to assess if significant interactions or trends were present. We formally tested for this by including a Latino subgroup and neighborhood social cohesion interaction term in the fully adjusted model.

SAS 9.4 survey procedures (SAS Institute Inc., Cary, NC) were used in all analyses to account for the survey weights and the complex sampling design of NHIS.

Results

Table 1 displays the distribution of aerobic activity, neighborhood social cohesion, and demographics by Latino subgroup. Puerto Rican individuals had the highest proportion of individuals who self-reported being US-born (57.1%). Among those who reported being foreign-born, a greater proportion of Puerto Ricans reported living in the US \geq 10 years (85.5%), whereas Dominicans had the highest proportion of recent immigrants who reported living in the US < 10 years (26.2%). Cuban/Cuban Americans had the highest proportion of high neighborhood social cohesion (41.8%), whereas Dominicans had the lowest proportion of high

neighborhood social cohesion (22.8%). Across all Latino subgroups, less than 50% reported meeting the aerobic activity guideline. Dominicans had the highest proportion of individuals reporting not meeting the aerobic activity guideline (71.8%), while Mexican/Mexican-Americans (56.5%) and Central or South Americans (55.6%) had the lowest proportion of individuals not meeting the aerobic guideline.

Table 2 presents the results from the logistic regression analyses used to examine the associations between neighborhood social cohesion and aerobic activity among Latino adults. Those with high neighborhood social cohesion were more likely to report meeting the aerobic activity guideline (OR: 1.28; 95% CI: 1.13, 1.45). After adjustment for demographics, acculturation, and Latino subgroup, high neighborhood social cohesion remained significantly associated with engaging in the recommended amount of aerobic activity (OR: 1.33; 95% CI: 1.17, 1.52).

We examined if the association between neighborhood social cohesion and physical activity differed by Latino subgroup (Table 3). Although formal tests for interaction were not statistically significant (p for interaction = 0.06), results suggest varying patterns in physical activity across Latino subgroups and levels of neighborhood social cohesion. In Cuban/Cuban Americans individuals with high neighborhood social cohesion were more likely to engage in recommended levels of aerobic activity (OR: 1.73; 95% CI: 1.00–2.97). Among Mexican/Mexican-Americans, those who reported high neighborhood social cohesion were also significantly more likely to meet the aerobic activity guideline (OR: 1.39; 95% CI: 1.16, 1.66). In contrast, among Dominicans, medium neighborhood social cohesion was associated with lower odds of LTPA. Dominicans who reported medium (OR: 0.52; 95% CI: 0.29, 0.93) levels of neighborhood social cohesion had lower odds of meeting the aerobic activity guideline, compared with those living in low social cohesion neighborhoods. Among Puerto Ricans and Central or South Americans, there was no significant association

Table 1
Participant characteristics by Latino Subgroup: National Health Interview Survey 2013–2014.

| | Mexican/Mexican-American (n = 7159) Mean or % (SE) | Puerto Rican (n = 1164) Mean or % (SE) | Cuban/Cuban American (n = 622) Mean or % (SE) | Dominican (n = 421) Mean or % (SE) | Central or South American (n = 1924) Mean or % (SE) |
|--|--|--|---|--|---|
| Demographics | | | | | |
| Male | 50.13 (0.70) | 48.94 (1.85) | 50.73 (2.54) | 50.88 (2.55) | 50.66 (1.25) |
| Age, years (mean) | 39.42 (0.26) | 43.34 (0.74) | 47.13 (1.17) | 42.90 (1.14) | 40.98 (0.48) |
| Education | | | | | |
| Less than high school | 40.12 (0.89) | 23.23 (1.60) | 19.09 (2.56) | 33.77 (2.56) | 30.54 (1.38) |
| High School Graduate | 26.06 (0.68) | 32.26 (1.72) | 29.76 (2.33) | 25.29 (2.66) | 23.50 (1.21) |
| Some college | 24.91 (0.75) | 32.20 (1.80) | 28.32 (2.21) | 27.40 (2.58) | 27.11 (1.44) |
| College Graduate | 8.9 (0.42) | 12.31 (1.26) | 22.83 (2.33) | 13.54 (2.10) | 18.85 (1.09) |
| Acculturation | | | | | |
| US-born | 46.45 (0.99) | 57.10 (2.38) | 25.84 (2.64) | 21.18 (2.67) | 16.64 (1.11) |
| Foreign-born | 53.52 (0.99) | 42.90 (2.38) | 74.16 (2.64) | 78.82 (2.67) | 83.36 (1.11) |
| Living in the US \geq 10 years | 85.50 (0.75) | 85.53 (1.39) | 75.66 (1.72) | 73.83 (2.65) | 79.35 (1.22) |
| Living in the US < 10 years | 14.50 (0.75) | 14.47 (1.39) | 24.34 (1.72) | 26.17 (2.65) | 20.65 (1.22) |
| Neighborhood Social Cohesion | | | | | |
| Low | 31.20 (0.67) | 35.78 (1.88) | 26.88 (2.85) | 42.35 (3.70) | 36.71 (1.49) |
| Medium | 34.29 (0.76) | 31.45 (1.67) | 31.37 (2.27) | 34.91 (3.75) | 34.47 (1.31) |
| High | 34.51 (0.89) | 32.77 (1.87) | 41.75 (3.74) | 22.75 (2.84) | 28.81 (1.29) |
| Aerobic Activity^a | | | | | |
| Did not Meet Aerobic Physical Activity Guideline | 56.53 (0.82) | 58.76 (2.09) | 65.17 (2.99) | 71.76 (2.37) | 55.58 (1.46) |
| Met Aerobic Physical Activity Guideline | 43.47 (0.82) | 41.24 (2.09) | 34.83 (2.99) | 28.24 (2.37) | 44.42 (1.46) |

SE = standard error

^a Does Not Meet Aerobic Physical Activity Guideline = < 150 min of moderate- and vigorous-intensity aerobic activity per week. Meets Aerobic Physical Activity Guideline = \geq 150 min of moderate-intensity aerobic activity, \geq 75 min of vigorous-intensity aerobic activity, or \geq 150 min of an equivalent combination of moderate- and vigorous-intensity aerobic activity per week.

Table 2
Associations of Neighborhood Social Cohesion with Meeting Aerobic Activity Guideline among Latino Adults: National Health Interview Survey 2013–2014^a.

| | Model 1 ^b OR (95% CI) | Model 2 ^c OR (95% CI) |
|-------------------------------------|-------------------------------------|-------------------------------------|
| Neighborhood Social Cohesion | | |
| Low | 1.00 | 1.00 |
| Medium | 1.05 (0.93–1.19) | 1.06 (0.94–1.21) |
| High | 1.28 (1.13–1.45) | 1.33 (1.17–1.52) |
| Age | – | 0.98 (0.98–0.98) |
| Male | – | 1.24 (1.13–1.36) |
| Education | | |
| Less than high school | – | 1.00 |
| High school graduate | – | 1.21 (1.06–1.39) |
| Some college | – | 1.78 (1.54–2.05) |
| College graduate | – | 2.53 (2.14–2.99) |
| Latino Subgroup | | |
| Mexican/Mexican-American | – | 1.00 |
| Puerto Rican | – | 0.88 (0.73–1.07) |
| Cuban/Cuban American | – | 0.70 (0.51–0.97) |
| Dominican | – | 0.55 (0.43–0.70) |
| Central or South American | – | 1.06 (0.92–1.23) |
| Acculturation | | |
| US born | – | 1.00 |
| Foreign born | – | |
| ≥ 10 years in US ^d | – | 0.65 (0.54–0.77) |
| < 10 years in US ^e | – | 0.86 (0.77–0.96) |

OR=Odds Ratio.

^a Does Not Meet Aerobic Physical Activity Guideline= < 150 min of moderate- and vigorous-intensity aerobic activity per week. Meets Aerobic Physical Activity Guideline: = ≥ 150 min of moderate-intensity aerobic activity, ≥ 75 min of vigorous-intensity aerobic activity, or ≥ 150 minutes of an equivalent combination of moderate- and vigorous-intensity aerobic activity per week.

^b Model 1 is crude unadjusted model.

^c Model 2 adjusted for age, sex, education, acculturation and Latino subgroup.

^d Living in the US ≥ 10 years.

^e Living in the US < 10 years.

between neighborhood social cohesion and meeting the aerobic activity guideline.

Discussion

Our study examined the association between neighborhood social cohesion and aerobic physical activity among Latino adults, and whether there were differences in this association by Latino subgroup. Findings from our study indicate that there is an association between neighborhood social cohesion and aerobic physical activity in Latinos, and that this relationship may vary by Latino subgroup. Specifically, high neighborhood social cohesion was associated with meeting the aerobic activity guideline. When we examined this association by Latino subgroup, we found that high neighborhood social cohesion was significantly associated with meeting the aerobic activity guideline in Mexicans/Mexican-Americans and Cuban/Cuban Americans, whereas among Dominicans the odds of engaging in the recommended level of aerobic physical activity were lower if living in a medium social cohesion neighborhood.

The findings from our study were generally consistent with previous research that showed a significant association between neighborhood social cohesion and physical activity. Specifically, several studies have shown that high neighborhood social cohesion is associated with greater physical activity (Echeverría et al., 2008; Samuel et al., 2015; Cleland et al., 2010; Shelton et al., 2011). The mechanisms underlying these associations may involve both

Table 3
Associations of Neighborhood Social Cohesion with Meeting Aerobic Activity Guidelines by Latino Subgroup: National Health Interview Survey 2013–2014^a.

| Neighborhood Social Cohesion | Model 1 ^b OR (95% CI) | Model 2 ^c OR (95% CI) |
|----------------------------------|-------------------------------------|-------------------------------------|
| Mexican/Mexican-American | | |
| Low | 1.00 | 1.00 |
| Medium | 1.07 (0.91–1.26) | 1.12 (0.95–1.33) |
| High | 1.31 (1.10–1.55) | 1.39 (1.16–1.66) |
| Puerto Rican | | |
| Low | 1.00 | 1.00 |
| Medium | 0.86 (0.62–1.18) | 0.87 (0.61–1.23) |
| High | 1.29 (0.90–1.85) | 1.43 (0.95–2.15) |
| Cuban/Cuban American | | |
| Low | 1.00 | 1.00 |
| Medium | 2.03 (1.02–4.03) | 1.72 (0.81–3.63) |
| High | 1.72 (0.99–2.99) | 1.73 (1.00–2.97) |
| Dominican | | |
| Low | 1.00 | 1.00 |
| Medium | 0.47 (0.26–0.83) | 0.52 (0.29–0.93) |
| High | 0.74 (0.45–1.20) | 0.76 (0.41–1.43) |
| Central or South American | | |
| Low | 1.00 | 1.00 |
| Medium | 1.09 (0.82–1.45) | 1.03 (0.77–1.38) |
| High | 1.23 (0.92–1.65) | 1.22 (0.91–1.64) |

OR=Odds Ratio

^a Does Not Meet Aerobic Physical Activity Guideline= < 150 min of moderate- and vigorous-intensity aerobic activity per week. Meets Aerobic Physical Activity Guideline: = ≥ 150 min of moderate-intensity aerobic activity, ≥ 75 min of vigorous-intensity aerobic activity, or ≥ 150 min of an equivalent combination of moderate- and vigorous-intensity aerobic activity per week.

^b Model 1 is crude unadjusted model.

^c Model 2 adjusted for age, sex, education and acculturation.

direct and indirect processes that promote more active living. For example, neighborhoods with high social cohesion may also have built environment factors such as access to parks and more walkable spaces that are known to promote physical activity (Bauman, Reis, & Sallis, 2012; McNeill, Kreuter, & Subramanian, 2006; Sallis, Floyd, & Rodríguez, 2012). Similarly, individuals who report a sense of trust and connection with their neighbors may be more physically active due to indirect processes related to psychological and emotional well-being that can promote health-enhancing behaviors (House, Landis, & Umberson, 1988; Inoue et al., 2013; Kawachi & Berkman, 2001; Seeman, 1996). Social norms may also play a role such that neighborhoods with high levels of neighborhood social cohesion promote social norms related to physical activity that may be more easily transmitted through group-shared values that are not present in neighborhoods with low levels of neighborhood social cohesion. Obtaining a further understanding of neighborhood predictors of physical activity is critical to inform the development of effective public health strategies that can lead to population-level increases in the prevalence of physical activity among Latinos, the largest growing minority population in the US.

Our study also contributes to the emerging literature on factors related to physical activity outcomes across Latinos subgroups. We found that associations of neighborhood social cohesion and aerobic activity varied by Latino subgroup. Among Mexicans/Mexican-Americans and Cuban-Americans, our findings showed that high neighborhood social cohesion was associated with meeting the aerobic activity guideline. However, the results for Cuban/Cuban-Americans suggest a stronger relationship between neighborhood social cohesion and physical activity compared with other subgroups. A similar pattern of increased physical activity

with increasing neighborhood social cohesion was observed for Puerto Ricans and Central/ South Americans, although associations were not statistically significant. A recent large-scale epidemiologic cohort study of Latinos (Hispanic Community Health Study/ Study of Latinos) also showed differences in objectively measured physical activity data across Latino groups (Arredondo et al., 2015) but did not examine the contribution of neighborhood-level factor to physical activity.

In contrast to our findings for all other Latino groups, in Dominicans medium levels of neighborhood social cohesion were associated with lower odds of meeting the aerobic activity guideline. One potential explanation for the differences observed in Dominicans may be due to where they were sampled. For example, it is possible that individuals in NHIS were sampled from areas where there is a high concentration of Dominicans, such as New York City where approximately 47% of Dominicans resided in 2013 (Lopez, 2013). Arredondo and colleagues (Arredondo et al., 2015) showed that Dominicans had the lowest level of overall levels of leisure-time physical activity of all Latino groups, but had higher levels of transportation-related activity, attributing this finding to the fact that the study population was largely recruited from New York City. Thus, lower levels of LTPA may miss other forms of physical activity individuals engage in depending on where they live.

Our findings for Dominicans and to some extent Cuban Americans, suggest that immigrant-related factors may also influence associations between neighborhood-level determinants and physical activity in Latino groups. For example, given that more than half of the Dominican population is foreign born (Lopez, 2013), residing in Dominican immigrant enclaves may play a role in their physical activity outcomes. Previous research has shown that Latinos living in neighborhoods with a higher proportion of immigrants are less likely to be physically active (Osypuk, Roux, & Hadley, 2009). Another possible explanation is the role of both individual and neighborhood-level socioeconomic condition shaping physical activity behaviors. For instance, a recent study that examined the association between neighborhood socioeconomic status environment and changes in physical activity over time in a sample of Cuban individuals found that physical activity was not associated with neighborhood socioeconomic environment (Affuso, Singleton, & Brown, 2016). However, this association may have been driven by the select group of Cuban Americans sampled in the study, which only included recent immigrants who generally have lower levels of income and education than prior immigrants. As a national sample, we may have captured an older cohort of Cuban Americans with a wider socioeconomic range and thus possibly allowing us to detect neighborhood-physical activity associations. Additionally, we note that our p-value for interaction was 0.06, although likely due to the increased power needed to detect differences across groups. Lastly, the unexpected association observed in Dominicans may be due to the lack of variation in both neighborhood social cohesion and physical activity, as Dominicans reported the lowest levels of neighborhood social cohesion and aerobic physical activity. Additional research is warranted to obtain further insight into the various neighborhood factors that independently and jointly with prior immigration history and time in the U.S. influence aerobic activity levels in Latino subgroups.

The strengths of our study should be considered in light of the limitations. NHIS data is cross-sectional, limiting the examination of changes that occur in aerobic activity in the same individual over time. Given the cross-sectional nature of NHIS, we were not able to more definitively establish a causal link between neighborhood social cohesion and physical activity, such as ruling out reverse causation as a plausible explanation (e.g., individuals who are more physically active help build more socially cohesive neighborhoods), or the related notion of endogeneity where

healthier (i.e. more physically active individuals) select neighborhoods that are more socially cohesive. Also, the activity estimates were based on self-reported measures rather than 'objective' device measures of activity. Previous research has indicated that the overestimation of the amount of physical activity performed can occur as a result of reporting bias from self-reported physical activity, compared with activity assessed through device measured methods (Troiano, Berrigan, & Dodd, 2008). For example, a recent study of Latinos that examined both self-reported and accelerometer measured physical activity showed that there was an overestimation of physical activity when using self-report versus an objective measure (Arredondo et al., 2015). However, it must be noted that accelerometer-based assessments also induces, to some extent, measurement error as they are based on pre-specified bouts of activity and also do not provide information on domain-specific activity, which was the goal of our study. Further, physical activity recommendations in the *2008 Physical Activity Guidelines for Americans* are based on self-reported measures of physical activity (USDHHS, 2008). Also, the measure of aerobic physical activity in our study only focused on LTPA, not accounting for other types of activity such as transportation activity, which may be impacted by neighborhood characteristics such as neighborhood social cohesion. Although Latinos engage in low levels of LTPA, occupational physical activity has been shown to be substantially higher in Latinos compared with other racial/ethnic groups (Marquez et al., 2010), which contributes to overall activity. For example, previous research has shown that based on accelerometer data, Latinos of Mexican origin engage in higher levels of overall activity compared with non-Latino whites and blacks (Troiano et al., 2008). Lastly, another limitation of our study was the use of four neighborhood social cohesion items, rather than the five items typically used to measure neighborhood social cohesion (Sampson et al., 1997). However, we assessed the reliability of the four items as a measure of neighborhood social cohesion and they demonstrated high internal consistency.

Our study adds to current knowledge on how neighborhood factors, specifically neighborhood social cohesion, contribute to physical activity outcomes by investigating whether the relationship between neighborhood social cohesion and aerobic activity varies by Latino subgroup. Our findings highlight the importance of considering the heterogeneity that exists within the Latino population. Thus, when developing physical activity interventions for Latino subpopulations, it will be important to understand the role of neighborhood factors as they relate to physical activity disparities within the Latino population. Given the low prevalence of Latino adults meeting the current physical activity guidelines, it is critical to obtain a better understanding of the factors that contribute to physical activity to improve the development of effective health promotion efforts in the Latino population.

References

- Affuso, O., Singleton, C. R., Brown, S. C., et al. (2016). Associations between neighborhood socioeconomic environment and physical activity in Cuban immigrants. *SSM-Population Health*, 2, 130–135.
- Angel, J. L., & Angel, R. J. (2006). Minority group status and healthful aging: Social structure still matters. *American Journal of Public Health*, 96(7), 1152–1159.
- Arredondo, E. M., Sotres-Alvarez, D., Stoutenberg, M., et al. (2015). Physical activity levels in US Latino/Hispanic Adults: Results From the Hispanic Community Health Study/Study of Latinos. *American Journal of Preventive Medicine*.
- Bauman, A. E., Reis, R. S., Sallis, J. F., et al. (2012). Correlates of physical activity: why are some people physically active and others not? *The Lancet*, 380(9838), 258–271.
- Cagney, K. A., Browning, C. R., & Wallace, D. M. (2007). The Latino paradox in neighborhood context: the case of asthma and other respiratory conditions. *American Journal of Public Health*, 97(5), 919–925.
- Carlson, S. A., Fulton, J. E., Schoenborn, C. A., et al. (2010). Trend and prevalence estimates based on the 2008 Physical Activity Guidelines for Americans.

- American Journal of Preventive Medicine*, 39(4), 305–313.
- Clark, C. J., Guo, H., Lunos, S., et al. (2011). Neighborhood cohesion is associated with reduced risk of stroke mortality. *Stroke*, 42(5), 1212–1217.
- Cleland, V., Ball, K., Hume, C., et al. (2010). Individual, social and environmental correlates of physical activity among women living in socioeconomically disadvantaged neighbourhoods. *Social Science Medicine*, 70(12), 2011–2018.
- Daviglus, M. L., Talavera, G. A., Avilés-Santa, M. L., et al. (2012). Prevalence of major cardiovascular risk factors and cardiovascular diseases among Hispanic/Latino individuals of diverse backgrounds in the United States. *JAMA*, 308(17), 1775–1784.
- Echeverría, S., Diez-Roux, A. V., Shea, S., et al. (2008). Associations of neighborhood problems and neighborhood social cohesion with mental health and health behaviors: the Multi-Ethnic Study of Atherosclerosis. *Health Place*, 14(4), 853–865.
- Ellen, I. G., Mijanovich, T., & Dillman, K. N. (2001). Neighborhood effects on health: exploring the links and assessing the evidence. *Journal of Urban Affairs*, 23(3–4), 391–408.
- Feldman, P. J., & Steptoe, A. (2004). How neighborhoods and physical functioning are related: the roles of neighborhood socioeconomic status, perceived neighborhood strain, and individual health risk factors. *Annals of Behavioral Medicine*, 27(2), 91–99.
- House, J. S., Landis, K. R., & Umberson, D. (1988). Social relationships and health. *Science*, 241(4865), 540–545.
- Inoue, S., Yorifuji, T., Takao, S., et al. (2013). Social cohesion and mortality: a survival analysis of older adults in Japan. *American Journal of Public Health*, 103(12), e60–e66.
- Kandula, N. R., Wen, M., Jacobs, E. A., et al. (2009). Association between neighborhood context and smoking prevalence among Asian Americans. *American Journal of Public Health*, 99(5), 885–892.
- Kawachi, I., & Berkman, L. F. (2001). Social ties and mental health. *Journal of Urban Health*, 78(3), 458–467.
- Kim, E. S., Hawes, A. M., & Smith, J. (2014). Perceived neighbourhood social cohesion and myocardial infarction. *Journal of Epidemiology and Community Health*. jech-2014-204009
- Kim, E. S., Park, N., & Peterson, C. (2013). Perceived neighborhood social cohesion and stroke. *Social Science Medicine*, 97, 49–55.
- Lopez, G. (2013). *Hispanics of Dominican Origin in the United States*. Washington, DC: Pew Research Center 2015.
- Marquez, D. X., Neighbors, C. J., & Bustamante, E. E. (2010). Leisure time and occupational physical activity among racial or ethnic minorities. *Medicine and Science in Sports and Exercise*, 42(6), 1086–1093.
- McNeill, L. H., Kreuter, M. W., & Subramanian, S. (2006). Social environment and physical activity: a review of concepts and evidence. *Social Science Medicine*, 63(4), 1011–1022.
- Motel, S., & Patten, E. (2012). *The 10 largest Hispanic origin groups: characteristics, rankings, top counties*. Washington, DC: Pew Hispanic Center.
- Mujahid, M. S., Roux, A. V. D., Morenoff, J. D., et al. (2008). Neighborhood characteristics and hypertension. *Epidemiology*, 19(4), 590–598.
- Mulvaney-Day, N. E., Alegria, M., & Sribney, W. (2007). Social cohesion, social support, and health among Latinos in the United States. *Social Science Medicine*, 64(2), 477–495.
- National Center for Health Statistics, Centers for Disease Control and Prevention. Adult physical activity information in the National Health Interview Survey. Available at: www.cdc.gov/nchs/nhis/physical_activity.htm. Accessed September 15, 2015a.
- National Center for Health Statistics, Centers for Disease Control and Prevention. National Health Interview Survey. Available at: www.cdc.gov/nchs/nhis.htm. Accessed September 15, 2015b.
- Neighbors, C. J., Marquez, D. X., & Marcus, B. H. (2008). Leisure-time physical activity disparities among Hispanic subgroups in the United States. *American Journal of Public Health*, 98(8), 1460–1464.
- Ospuyk, T. L., Roux, A. V. D., Hadley, C., et al. (2009). Are immigrant enclaves healthy places to live? The Multi-ethnic Study of Atherosclerosis. *Social Science Medicine*, 69(1), 110–120.
- Peak, C., & Weeks, J. R. (2002). Does community context influence reproductive outcomes of Mexican origin women in San Diego, California? *Journal of Immigrant Health*, 4(3), 125–136.
- Rios, R., Aiken, L. S., & Zautra, A. J. (2012). Neighborhood contexts and the mediating role of neighborhood social cohesion on health and psychological distress among Hispanic and non-Hispanic residents. *Annals of Behavioral Medicine*, 43(1), 50–61.
- Rodriguez, C. J., Allison, M., Daviglus, M. L., et al. (2014). Status of cardiovascular disease and stroke in Hispanics/Latinos in the United States: a science advisory from the American Heart Association. *Circulation*, 130(7), 593–625.
- Sallis, J. F., Floyd, M. F., Rodríguez, D. A., et al. (2012). Role of built environments in physical activity, obesity, and cardiovascular disease. *Circulation*, 125(5), 729–737.
- Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science*, 277(5328), 918–924.
- Samuel, L. J., Himmelfarb, C. R. D., Szklo, M., et al. (2015). Social engagement and chronic disease risk behaviors: The Multi-Ethnic Study of Atherosclerosis. *Preventive Medicine*, 71, 61–66.
- Seeman, T. E. (1996). Social ties and health: the benefits of social integration. *Annals of Epidemiology*, 6(5), 442–451.
- Shelton, R. C., McNeill, L. H., Puleo, E., et al. (2011). The association between social factors and physical activity among low-income adults living in public housing. *American Journal of Public Health*, 101(11), 2102–2110.
- Troiano, R. P., Berrigan, D., Dodd, K. W., et al. (2008). Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise*, 40(1), 181.
- USDHHS (2008). *physical activity guidelines for Americans* (p. 2008) Washington DC: USDHHS.
- Zsembik, B. A., & Fennell, D. (2005). Ethnic variation in health and the determinants of health among Latinos. *Social Science Medicine*, 61(1), 53–63.