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# Does the social environment moderate associations of the built environment with Latinas' objectively-measured neighborhood outdoor physical activity?

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ABSTRACT

Favorable perceptions of the built and social neighborhood environment may promote outdoor physical activity (PA). However, little is known about their independent and interactive effects on neighborhood-specific outdoor PA. We examined associations of perceived built and social neighborhood environment factors, and their interactions, with objectively-measured neighborhood outdoor moderate-to-vigorous physical activity (MVPA) among a sample of Latina women in San Diego, CA. Analyses included baseline data collected in 2011-2013 from 86 Latinas with ≥2 days of combined accelerometer and global positioning system data and complete survey measures. We examined objective neighborhood outdoor MVPA within 500-meter home buffers. Generalized linear mixed models examined associations of 3 perceived built (e.g., sidewalk maintenance) and 3 social environmental (e.g., safety from crime) factors with engaging in any daily neighborhood outdoor MVPA. Models tested interactions between the built and social environmental factors. Although the perceived neighborhood environmental factors were not significantly related to daily neighborhood outdoor MVPA, we found 2 significant interactions: perceived sidewalk maintenance x safety from crime ($p = 0.05$) and neighborhood aesthetics x neighborhood social cohesion ($p = 0.03$). Sidewalk maintenance was positively related to daily neighborhood outdoor MVPA only among Latinas that reported low levels of safety from crime. Neighborhood aesthetics was positively related to daily neighborhood outdoor MVPA only among Latinas with high neighborhood social cohesion. Findings suggest several built and social environmental factors interact to influence Latinas' neighborhood outdoor MVPA. Interventions are needed targeting both built and social neighborhood environmental factors favorable to outdoor PA in the neighborhood.



## 1. Introduction

Latinos are less likely than non-Latinos to engage in recommended levels of physical activity (PA) (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion; U.S. Department of Health and Human Services, 2008). In addition, compared to Latino men, Latina women report less leisure-time PA (15 vs. 30 min/day) and transportation-related PA (28 vs. 37 min/day) (Arredondo et al., 2016). One possible explanation for Latinas' low PA levels may be linked to perceptions that their neighborhood environment is not conducive to PA. Compared to residents of predominantly White neighborhoods, those living in neighborhoods with a higher racial/ethnic minority composition are more likely to evaluate their environments as being less safe, less comfortable (e.g., worse sidewalk conditions), and less pleasurable for outdoor PA (Franzini et al., 2010). Nevertheless, there is also evidence that Latinos tend to live in areas with high access to destinations near their homes (Franzini et al., 2010). Understanding the built and social environmental factors associated with outdoor PA in the neighborhood may help inform interventions to promote Latinas' PA (Hallal et al., 2005; Bedimo-Rung et al., 2005).

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Favorable perceived environmental factors are positively associated with PA (Ding and Gebel, 2012; Owen et al., 2000; Mama et al., 2015). Among Latinas, positive associations have been reported between perceived neighborhood aesthetics and leisure-time PA, as well as having access to destinations near the home and transportation PA (e.g., walking/cycling) (Perez et al., 2016a). Perceived neighborhood environmental factors are also positively related to objective PA (Mama et al., 2015; Saelens et al., 2003). However, one study involving Latinas in San Diego reported no associations between perceived environmental factors and objective PA (Perez et al., 2016a). Authors noted that the lack of association could have been because accelerometry is not specific to the home neighborhood. A more explicit link between PA and the neighborhood environment can be examined using simultaneous accelerometer-global positioning system (GPS) monitoring (Troped et al., 2010; Jankowska et al., 2015).

Furthermore, examining the interactive effects of built and social environmental factors may help us understand important nuances. Some studies suggest neighborhoods with higher proportions of Latino residents may be more walkable but have worse social environments, including lower perceptions of safety and less collective efficacy (i.e., social cohesion among neighbors and their willingness to intervene for the common good) (Franzini et al., 2010; Sampson et al., 1997; Lovasi et al., 2009; Foster and Giles-Corti, 2008). Residents of less socially-cohesive neighborhoods are less likely to walk for exercise than those living in more cohesive neighborhoods (Echeverría et al., 2008). Thus, despite living in neighborhoods with walkable urban form, adverse social environmental factors may inhibit Latinos' PA. Studies are needed that evaluate the interactions between built and social environmental factors in relation to neighborhood-specific PA (Ding and Gebel, 2012; Giles-Corti and Donovan, 2003).

This study aimed to test interactions among perceived built and social environmental factors in relation to Latinas' objectively-measured neighborhood outdoor PA. We hypothesized that perceived social environmental factors moderate associations of perceived built environmental factors with objectively-measured neighborhood outdoor PA, with positive associations expected only among those with favorable perceived social environments.

## 2. Methods

### 2.1. Participants and procedures

Participants were churchgoing Latinas (18-65 years) participating in *Fe en Acción* [Faith in Action], a two-group cluster randomized controlled trial to promote PA in San Diego, California. Participants completed anthropometric measurements and a survey in Spanish or English, and were asked to wear an accelerometer for 7 days. This study used baseline data only, which were collected between May 2011 and September 2013. In addition, from June 2012 through January 2013, global positioning systems (GPS) devices were distributed along with the accelerometer to integrate both sources of objective data for use in the geospatial research tool called the Personal Activity and Location Measurement System (PALMS) (Center for Wireless and Population Health Systems, University of California San Diego) and to evaluate these data in specific contexts (e.g., neighborhood). The Institutional Review Boards of San Diego State University and the University of California, San Diego approved this study.

The sampling and recruitment procedures for the sub-study involving the GPS are the same as for the main trial (Arredondo et al., 2015). In brief, research staff recruited 16 Catholic churches from two Major Statistical Areas (MSA) with large concentrations of Latino residents (San Diego Association of Governments (SANDAG) Data Warehouse, 2010). MSA's are aggregations of census tracts. Participant eligibility criteria were: 18 to 65 years of age, attended church at least 4 times/month, and reported no barriers to attending intervention activities or any health condition that could impede PA. Furthermore, women were eligible if they reported low activity on two screeners (Taylor-Piliae et al., 2006; Smith et al., 2005) (e.g., no PA or mostly light PA during leisure-time and work) and engaged in < 250 min/wk of accelerometer-based MVPA to allow for inclusion of participants most in need of a PA intervention.

Due to challenges in recruiting participants willing to wear both the accelerometer and GPS devices, researchers terminated the sub-study after recruitment of 4 churches. From these 4 churches, 203 women met the inclusion criteria and were invited to participate in the main trial. Participation was voluntary and participants could withdraw from the study at any time. Research assistants (RA) contacted the 132 women that signed an informed consent form. The GPS was optional and participants that agreed to wear the accelerometer but not the GPS were still invited to participate in the main trial. For the present study, we only analyzed data from participants that had complete survey, accelerometer, and GPS data. Reasons for dropping participants from analysis are depicted in Fig. 1. Because early in the data-cleaning phase, study staff noted that several participants had fewer days of GPS data compared to the accelerometer, possibly due to missing GPS signal or noncompliance with wearing or charging the GPS, we decided to reduce the wear time criteria for the analytical sample (≥2 valid days with ≥8 valid hours/day). The final analytical sample was 86 participants (range: 15-28 participants/church).

### 2.2. PA and spatial measures

Participants were asked to wear a GT3X accelerometer (Actigraph, Pensacola, FL) and a QStarz BT-Q1000XT GPS device (Qstarz International Co., Taipei, Taiwan, ROC) attached to an elastic belt worn over the hip on opposite sides for 7 days. Participants were instructed to charge the GPS each night, wear the devices during waking hours, and remove them only for sleep and water activities (e.g., bathing). ActiLife software version 6 (Actigraph, Pensacola, FL) was used to initialize accelerometers at 1-second epochs and Qstarz software (Qstarz International Co., Taipei, Taiwan, ROC) was used to initialize the GPS devices at 15-second epochs. We collected data at the maximum resolution (1 second epoch) that still allowed for 7 days of data collection. Using ActiLife, we reintegrated the data from 1-second to 15-second epochs to match the GPS epoch length. We used 15-second epochs to reduce misclassification error of PA estimates (e.g., minutes classified as light vs. MVPA) (Gabriel et al., 2010) and allow for greater precision in location detection and collection of data over the number of days required (Kerr et al., 2011) for the main trail (≥5 days, with ≥1 weekend day, and ≥10 hrs/day). Up to 2 re-wears were allowed if non-compliance was noted. Non-wear time was defined as ≥60 consecutive minutes of zero count values.

#### 2.2.1. Data processing

The accelerometer and GPS 15-second epoch files were uploaded into PALMS, a web-based tool that integrates data from both devices. Details of the data processing steps can be found in the PALMS User Guide (Center for Wireless and Population Health Systems, 2011). PALMS synchronized the time-stamped files from both devices and merged them into one file for calculations and analysis. PALMS functions used for this study include indoor/outdoor detection (based on signal-to-noise ratio - SNR), location detection, and activity intensity. We defined MVPA as ≥2020 counts/min (Troiano et al., 2008). The SNR, which represents the strength of the signal from the satellites, was used to classify epochs as occurring indoors or outdoors, with outdoor time defined as SNR >225 (Lam et al., 2013).

#### 2.2.2. Minutes of MVPA in the neighborhood buffer

Using ArcGIS (Esri, Redlands, CA), participants' home addresses were geocoded and plotted on a shapefile of San Diego County (San Diego Association of Governments (SANDAG) Data Warehouse, 2010). A 50-meter radial buffer was created around the geocoded address.