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Why neighborhood park proximity is not associated with total physical activity

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ABSTRACT

This study explored how parks within the home neighborhood contribute to total physical activity (PA) by isolating park-related PA. Seattle-area adults (n = 634) were observed using time-matched accelerometer, Global Positioning System (GPS), and travel diary instruments. Of the average 42.3 min of daily total PA, only 11% was related to parks. Both home neighborhood park count and area were associated with park-based PA, but not with PA that occurred elsewhere, which comprised 89% of total PA. This study demonstrates clear benefits of neighborhood parks for contributing to park-based PA while helping explain why proximity to parks is rarely associated with overall PA.

1. Introduction

Physical activity (PA) is associated with reduced risks of cardiovascular disease, obesity, diabetes, osteoporosis, and some cancers (Physical Activity Guidelines Advisory Committee, 2008). Yet more than 90% of adults in the U.S. do not meet the recommended 30 min/day of PA on most days of the week (Troiano et al., 2008). Parks are places that could support PA among adults, both as settings for activities and destinations for active travel (Evenson et al., 2013; Stewart et al., 2016b). A greater number of parks and area of parkland in close proximity to home could potentially result in higher levels of PA and reduced risk of negative health outcomes. However, a recent systematic review of the association between park proximity and objectively measured PA (Bancroft et al., 2015) found mostly null associations for adults (Carlson et al., 2012; Jilcott et al., 2007; King et al., 2005; McConville, 2009; Saelens et al., 2012; Strath et al., 2012). The one study that reported a positive association was conducted among older women and observed an unadjusted 27% greater median daily pedometer steps among those who reported living within walking distance of a park compared to those who reported not living within walking distance (King et al., 2003). This body of literature proves frustrating to urban planners, public park managers, and health professionals who know that parks provide a PA setting for nearby residents based on interviews of park visitors (Cohen et al., 2007), but lack strong evidence that increased proximity to parks contributes to increased PA.

Mostly null findings on the association between park proximity and objective PA could be due to several study design and analysis differences, including how home park exposure is operationalized, measures of PA outcomes, sample populations, and covariates included in analyses. An individuals' use of a specific park appears strongly related to the distance from that individual's home (Cohen et al., 2007), and thus park-PA associations tend to be stronger using smaller home neighborhood buffer sizes to measure park exposure (Bancroft et al., 2015). Parks support a variety of PA, but are most commonly used for lighter-intensity activities like walking (Godbey and Mowen, 2010), so stronger associations may be observed for lighter intensity PA. Activity levels during park use vary by race/ethnicity, gender, and other socio-demographic characteristics (Carlson et al., 2010; Cohen et al., 2016; Kaczynski et al., 2011). In addition, household composition (e.g., presence of children and/or dogs) may also influence park visitation and activity levels. Parks also comprise just one aspect of neighborhood environments and their presence may be correlated with other urban

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built environment (BE) characteristics that encourage active living (Zhang et al., 2011). Additionally, the distribution and quality of parks varies with neighborhood poverty and other aspects of the social environment (Abercrombie et al., 2008; Chaix et al., 2016), which also may influence PA, both in neighborhood parks and in the neighborhood generally. And finally, associations that are observed between park proximity and PA could be biased by residential self-selection, in which observed relationships between the home neighborhood BE and PA are influenced in part by the propensity for more active individuals to choose to live in neighborhoods supportive of PA (Cao et al., 2009). To our knowledge, no study examining the link between home neighborhood parks and PA has fully accounted for these complexities while using objective, geospatial park exposure and PA outcome measures.

In this paper we aim to not only test *if* neighborhood parks are associated with PA, but *how* neighborhood parks are associated with PA. To do this, we start by using data from a population-based study of urban-living adults whose activity was tracked using Global Positioning System (GPS), accelerometer, and travel diary instruments. These instruments provide contextual data on where PA occurs, and allow for much greater specificity for examining the link between the BE and health-related behaviors (Hurvitz et al., 2014). We divide total PA into three mutually exclusive categories: PA that is related to home neighborhood park visits, PA that is related to park visits elsewhere, and PA that is not related to park visits. These three distinct PA contexts and locations are then tested for an association with home neighborhood park proximity (count and area of parks in the home neighborhood) to explore the mechanism through which home neighborhood parks may differentially contribute to the three PA contexts/locations to affect total PA.

In addition to analyzing detailed contextual measures of PA in relation to home neighborhood parks, we also isolate the effect of parks on PA by progressively controlling for several socio-demographic and home neighborhood BE characteristics that could influence park access and use. We explore whether residential self-selection bias is present, whether household composition modifies the effect of parks on PA, and whether the association changes using smaller versus larger definitions of the home neighborhood. Combined, these analyses are intended to provide a more complete understanding of the nuanced ways in which home neighborhood parks may contribute to PA and in turn reduce the risk of diseases associated with insufficient PA.

2. Methods

2.1. Study design and sample

We used data from the Travel Assessment and Community (TRAC) project, a longitudinal study of travel and activity in relation to light rail implementation in King County, Washington. The sample frame included King County residents in areas proximal (< 1 mile) or distal (> 1 mile) from planned light rail stations, but with otherwise similar BE's and transit service (Moudon et al., 2009). Parcel-based sampling was used to identify households located in the sample frame (Lee et al., 2006). Households were contacted by telephone and one participant per household was recruited if they were aged 18 or older, able to complete a travel diary and survey in English, and able to walk unassisted for ≥ 10 min. In about 6% of the households contacted by phone, an individual agreed to participate. Another 53% of households contacted resulted in refusal and the remainder (41%) had no eligible residents (Moudon et al., 2009). A total of 699 enrolled participants completed baseline data collection, 584 and 532 of whom also completed first and second follow-up data collection, respectively. Baseline data collection occurred from July 2008 to July 2009, follow-up data collection occurred 2 and 4 years later. At each follow-up, participants completed a survey and provided data on their activities for a one-week period. Follow-up data collection was planned for the same time of year for each participant.

2.2. Data collection and measures

2.2.1. Activity

A detailed description of the activity data collection and processing is available elsewhere (Kang et al., 2013). Briefly, participants were instructed to wear an accelerometer (GT1M; ActiGraph LLC, Fort Walton Beach, FL, at baseline and GT3X, ActiGraph LLC, Fort Walton Beach, FL, at first and second follow-up), carry a GPS device (DG-100, GlobalSat, Taipei, Taiwan, at baseline and first follow-up and BT-1000XT GPS data logger, Qstarz, Taipei, Taiwan, at second follow-up), and complete a place-based paper travel diary for a one-week period. Accelerometers were set to record movement in the form of counts at 30-second time intervals, or epochs, and GPS devices were set to record locations every 30 s. Data from the three instruments for each participant were integrated by time matching GPS and travel diary locations to each 30-second accelerometer epoch (Hurvitz et al., 2014). Observation days were considered valid if they had ≥ 1 place recorded in the travel diary, ≥ 3 min of GPS data, ≥ 50% of all GPS point locations inside of King County, and an accelerometer wear time of ≥ 8 h (Kang et al., 2013; Stewart et al., 2016b). Accelerometer periods of ≥ 20 min with continuous zeroes were considered non-wear times (Masse et al., 2005).

2.2.2. Parks

In spring 2008, park locations were obtained from King County government and the 39 municipalities located within it. Parks were defined as publicly owned, freely accessible, outdoor spaces intended for leisure or recreation that were distinct from street easements. Thus, aquariums, boulevards, golf courses, community centers, boat launches, cemeteries and similar places not located entirely within other public parks were excluded. Data not already stored in a Geographic Information System (GIS) format were digitized in ArcGIS 9.2 (ESRI, Redlands, CA) with the aid of tax parcel data and aerial imagery. GIS park polygons were aggregated by unique park name for a final dataset of 1440 discrete parks.

2.2.3. Park visits

Park visits were comprehensively measured using two sources: travel diaries and the integration of GPS and GIS data (Stewart et al., 2016b). For each place visited, participants recorded in the travel diary the place name, address or nearest cross-streets, travel mode, and time of arrival and departure. Travel diary places were reviewed for names matching those of parks. Each travel diary park visit was linked to a park in the GIS database based on the park name. If the participant failed to record the specific name of a park in the travel diary (e.g., recorded "the park"), then the nearest cross-streets were used to identify the park name. Linked names were considered park visits if the duration between the arrival and departure time was ≥ 3 min. Park visits were also sensed from the GPS/GIS data using a method similar to that pioneered by Evenson et al. (2013). Sensed visits consisted of ≥ 3 min of consecutive GPS points in the same GIS park polygon, with a speed < 30 km/h (travel ≥ 30 km/h was assumed to be in a car) and a distance of > 50 m from the participant's home and work, while allowing for gaps of ≤ 45 min. Sensed visits were presumed to capture park visits that participants failed to record in their travel diary. If a sensed visit temporally overlapped with a visit recorded in the travel diary, the presumably more precise duration from the GPS data was used.

2.2.4. Exposure to parks

Two exposures of home neighborhood parks were measured using an 833 m home neighborhood sausage buffer: park count and park area. The sausage buffer was created by identifying all pedestrian-accessible segments of the King County transportation network within 833 m of the participant's home, buffering the segments by 50 m, then filling in any gaps inside the buffer (Forsyth et al., 2012). Park count was a