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The association between park visitation and physical activity measured with accelerometer, GPS, and travel diary

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ABSTRACT

Public parks are promoted as places that support physical activity (PA), but evidence of how park visitation contributes to overall PA is limited. This study observed adults living in the Seattle metropolitan area ($n=671$) for one week using accelerometer, GPS, and travel diary. Park visits, measured both objectively (GPS) and subjectively (travel diary), were temporally linked to accelerometer-measured PA. Park visits occurred at 1.4 per person-week. Participants who visited parks at least once ($n=308$) had an adjusted average of 14.3 (95% CI: 8.9, 19.6) min more daily PA than participants who did not visit a park. Even when park-related activity was excluded, park visitors still obtained more minutes of daily PA than non-visitors. Park visitation contributes to a more active lifestyle, but is not solely responsible for it. Parks may best serve to complement broader public health efforts to encourage PA.

1. Introduction

Public park systems are promoted as providing places that support physical activity (PA) (Sherer, 2006; US National Physical Activity Plan Coordinating Committee, 2010), which is associated with reduced risks of several chronic diseases including cardiovascular disease, diabetes, and some cancers (US Department of Health and Human Services, 2008). As the world's population becomes more urban (United Nations Department of Economic and Social Affairs/Population Division, 2012), more obese (Ng et al., 2014), and more at risk for chronic disease (Yach et al., 2004), park systems have the potential to play an increasingly important role in health promotion. Yet the current understanding of how park visitation contributes to PA among adults is limited.

Adults who visit parks obtain more PA (Coombes et al., 2010; Veitch et al., 2013). This evidence, however, is based on self-report measures that do not distinguish between park-related PA and PA that occurred elsewhere. Park visitation itself may therefore not be the mechanism for higher PA, as park visitors may be more active elsewhere too. Furthermore, self-report measures have poor validity for physical activity time estimates due to recall and social desirability biases (Sallis and Saelens, 2000).

Time-matched GPS and accelerometer data can overcome these limitations by enabling PA to be located in space, then overlaid with GIS environmental data to identify the places where PA occurs (Hurvitz et al., 2014a). This approach has been used in studies of children and adolescents to learn that even though a small portion of time is spent in parks, that time is more likely to be spent in higher levels of PA (Coombes et al., 2013; Rodriguez et al., 2012), often while accompanied by an adult who is also engaged in PA (Dunton et al., 2012). To our knowledge, however, only Evenson et al. (2013) have published research using accelerometer and GPS/GIS data to explore how park visitation contributes to PA specifically among adults. In their sample, recruited from intercept surveys inside parks or from households living within 1 mile of select parks, adults were more active during park visits than at other times of the day and spent more time in PA on days when park visits occurred. Evenson et al.'s findings using objective measures of park visits and PA suggest that park visitation contributes to higher levels of PA among adults who visit parks. However, it remains unclear if park visitors achieve higher levels of overall PA compared to those who do not visit parks. Park visitors may obtain PA in parks, while non-visitors may obtain the same or more PA in athletic clubs, neighborhood streets, the workplace, or any number of other environments that support PA (Sallis et al., 2012).

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Furthermore, the degree to which park-related PA contributes to greater amounts of PA on days when parks are visited is still unclear – PA obtained during park visitations could account for only a small portion of any differences in overall daily PA. Finally, higher PA levels on days that parks are visited may be driven by day-level characteristics, such as weather or work schedules. Park visits may occur more often on weekends or during fair weather, when adults have more leisure time and enjoy being outdoors.

The present study advances current research by providing a comprehensive estimate of the extent to which park-based PA contributes to overall PA. To identify park visits, we use both objective (GPS/GIS) and subjective (travel diary) data taken from a population-based sample of adults in a large metropolitan area. First we compare overall PA *and* PA unrelated to park visits between urban adults who visited a park and those who did not. These comparisons allow us to determine the magnitude of observed differences in PA between park visitors and non-visitors that is attributable to park visitation. We then examine whether park visitors differ in overall PA *and* PA unrelated to park visits on days that parks were visited versus days parks were not visited. Similarly, these comparisons allow us to assess the magnitude of any observed difference in PA that is attributable to park visitation, among park visitors. Finally, we examine how park visitation is associated with daily PA while controlling for factors that could be related to both park visitation and PA at the individual level and the day level (e.g., weather or work schedule).

2. Methods

2.1. Study design and participants

This study presents cross-sectional analyses of baseline data from the Travel Assessment and Community (TRAC) project being conducted 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 built environments (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 between July 2008 and July 2009 and participants were 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.

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), carry a GPS device (DG-100; GlobalSat, Taipei, Taiwan), and complete a place-based paper travel diary for a one week period. Data from the three instruments for each participant were integrated by time matching GPS and travel diary locations to each 30-s accelerometer epoch (Hurvitz et al., 2014b). Valid days had ≥ 1 place recorded in the travel diary and an accelerometer wear time of ≥ 8 h. 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 and the 39 municipalities located within it. Parks were defined as publically owned, freely accessible, outdoor spaces intended for leisure or recreation that were distinct from street right-of-ways. Thus, aquariums, boulevards, golf courses, community centers, boat launches, cemeteries and similar places not located entirely within public parks were excluded. Data not already stored in a GIS format were digitized in ArcGIS 9.2 (ESRI, Redlands, CA) with the aid of tax parcel data and aerial imagery. Jurisdiction GIS park polygons were aggregated by unique park name for a final dataset of 1,440 discrete parks.

2.2.3. Park visits

Park visits were identified from two sources: travel diaries and GPS/GIS data. Travel diary places were reviewed for names matching those of public parks. Matching names were considered park visits if corresponding activity codes (which participants recorded in the diary for each location visited) did not include “drop off/pick up,” “preparing for day,” “shopping/errands,” “waiting for transportation,” or “working at employer site.” An attempt was made to link each travel diary park visit to a park in the GIS database, with a 96.6% match rate. GPS/GIS data were used to sense park visits based on the method described 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 kmh and a distance of >50 m from the participant’s home and work, while allowing for gaps of ≤ 45 min.

Park visits from both travel diary and GPS/GIS data sources were used in the analysis to comprehensively measure park visitation. 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. In addition to duration, park visits were characterized by percent of visit duration with GPS coverage, mean speeds during visits calculated from GPS data, park size, and Euclidean distances from participants’ homes and workplaces to the nearest point along the perimeter of the park visited. Distances were measured using PostGIS 2.0 (The PostGIS Development Group). These park characteristics were not available for 12 travel diary park visits that were not matched to a park in the GIS database.

2.2.4. Overall and park-related PA

Our main PA outcome was time spent in PA bouts. We used a low accelerometer activity count threshold to capture light PA obtained during walking, the most commonly reported form of park-based PA (Godbey and Mowen, 2010). Thus PA bouts were defined as time intervals with vertical axis accelerometer counts >500 per 30-second epoch for at least 5 min, allowing for counts to drop below that threshold for up to 2 min during any 7-min interval (Kang et al., 2013).

Park-related PA bouts were PA bouts that temporally overlapped any portion of park visits. The duration of park-related PA was measured in three ways: total, and then total separated into inside or outside the park. *Total* park-related PA included all minutes in a park-related PA bout. *Inside* park-related PA was the portion of PA bout time that occurred inside the park boundary; *outside* park-related PA was the portion of PA bout time that occurred immediately before or after the park visit, but that was still part of a bout that consisted of at least some time inside the park (Fig. 1). Outside park-related PA bout minutes were used to capture active travel, such as walking or jogging, to or from the park. The proportion of park visit time spent in PA was calculated as inside park-related PA bout minutes divided by park visit duration.

Because parks also support activities that involve short bursts of PA, such as tennis or basketball, as well as leisure activities, such as picnics or sitting, we included secondary PA outcomes of minutes in moderate to vigorous PA (MVPA) and sedentary activity, regardless of whether they occurred during bouts. MVPA time was defined as 30-second epochs with accelerometer counts ≥ 976 to