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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) minutes 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.

Keywords

Recreation; Leisure; Built Environment; GIS; Substitution

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2 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). 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).

3 Methods

3.1 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 minutes.

3.2 Data Collection and Measures

3.2.1 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-second accelerometer epoch (Hurvitz et al., 2014b). Valid days had ≥1 place recorded in the travel diary and an accelerometer wear time of ≥8 hours. Accelerometer periods of ≥20 minutes with continuous zeroes were considered non-wear times (Masse et al., 2005).

3.2.2 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.

3.2.3 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 minutes of consecutive GPS points in the same GIS park polygon, with a speed <30kmh and a distance of >50 meters from the participant's home and work, while allowing for gaps of ≤45 minutes.

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.

3.2.4 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 minutes, allowing for counts to drop below that threshold for up to 2 minutes during any 7-minute 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 (Figure 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 correspond with the commonly used ActiGraph adult threshold of 1952 counts per minute and sedentary activity was defined as 30-second epochs with accelerometer counts <50 to correspond with the adult threshold of 100 counts per minute (Gorman et al., 2014). We also differentiated between MVPA and sedentary time that occurred during park visits and all other times.

3.2.5 Observation period characteristics—Participants were observed under varying conditions. At the day level, we measured quarter of year, day of the week, precipitation (cm), the mean temperature (°Celsius), and whether the participant worked. Climatic measures were taken from those reported at Seattle-Tacoma International Airport by the National Oceanic and Atmospheric Administration (National Oceanic and Atmospheric Administration). Participant workdays were identified from the travel diary as days when "working from home," "working at employer site," or "work-related business" activity codes were recorded for one or more places.

3.2.6 Socio-demographics—Participants received a survey that queried age, gender, annual household income, race and ethnicity, highest level of education, presence of children under age 18 in the household, and body mass index (BMI) calculated from self-reported height and weight.

3.2.7 Built environment—The built environment was measured within the home neighborhood, defined as an 833-meter Euclidean buffer around each participant's home. Residential density was measured as housing units per acre. Neighborhood wealth was measured as the mean appraised property (land and improvement) value per residential unit (Moudon et al., 2011). Park proximity was measured in three ways: the count of discrete parks and the total area of parks that intersected the home neighborhood, as well as the as the Euclidean distance to the closest park, regardless of whether it was in the home neighborhood or not.

The home neighborhood buffer size was chosen to represent the area in which parks could easily be reached by foot. The distance of 833 meters corresponds to about a 10-minute walk and Euclidean distances were used over network distances because parks, which often have porous boundaries, can be accessed via informal pathways as well as the formal street network (Hewko et al., 2002). Residential density and neighborhood wealth were measured using ArcGIS 10.0 (ESRI, Redlands, CA). Physical park access measures were taken using PostGIS 2.0 (The PostGIS Development Group).

3.3 Statistical Analysis

We restricted the current analysis to participants who completed the survey, accumulated at least one valid day of observation with ≥3 minutes of GPS data, and did not have a workplace within a park.

We assessed the concordance between travel diary and GPS/GIS methods for identifying park visits (online appendix). Briefly, park visits that were reported in the travel diary were longer in duration than those that were only sensed via GPS/GIS data. The two visit types were associated with very similar levels of total park-related PA bout time, but reported visits had greater durations of park-related PA bout time inside the park whereas sensed visits had greater durations of park-related PA bout time outside the park. Reported visits were also associated with greater durations of MVPA and sedentary time. Both types of park visits were combined for analysis in order to capture all park visitation. We used descriptive statistics to characterize park visits among this sample in terms of duration, activity level, and other features.

We defined park visitors as participants with ≥1 park visit during observation, and compared them to those with no park visits (non-visitors) on socio-demographics, home neighborhood built environment, and observation day characteristics. For individual-level variables, differences among park visitors and non-visitors were tested using independent two-sample t-tests for continuous variables and chi-square tests for categorical variables. For day-level characteristics, differences were tested using univariate logistic regression models with robust standard errors that accounted for clustering within individuals.

For our main analysis, we applied linear mixed effects models to examine the association between park visitation status and daily PA (overall and park-related). Mixed effects models enabled us to account for correlation among outcomes within participants over multiple days of observation while controlling for both individual- and day-level covariates (Gardiner et al., 2009). Model covariates were selected *a priori* and included age, gender, race/ethnicity, education, household income, children in household, BMI, home neighborhood residential density and wealth, count and area of parks in the home neighborhood, quarter of year, day of week, workday, daily precipitation, and daily mean temperature. Models where sedentary time was the outcome were also adjusted for daily total accelerometer wear time as a covariate, as non-wear time could be largely sedentary.

Finally, we compared PA outcomes between park visit days and non-park visit days among park visitors. Linear fixed effects models with robust standard errors were used to estimate the within-individual difference in daily PA bout, sedentary, and MVPA minutes on park days and non-park days. Because fixed effect models control for non-time varying characteristics (Gardiner et al., 2009; Setodji and Shwartz, 2013), these models only included the day-to-day varying covariates of day of week, workday, precipitation, and temperature. For all analyses, we set the statistical significance threshold at $p < 0.05$ and used Stata 13.1 (StataCorp, College Station, TX). Analyses were performed in 2014 and 2015.

4 Results

A completed survey and ≥1 valid observation day with ≥3 minutes of GPS data was available for 681 participants; 10 were excluded because their workplace was located within a park. The remaining 671 participants contributed 4469 valid person-days of observation. A total of 868 park visits occurred for an incidence rate of 1.4 park visits per person-week.

4.1 Park visits

Of 868 park visits, 241 were both reported in the travel diary and sensed from the GPS/GIS data, 127 were reported only, and 500 were sensed only. Concordance between the two methods for measuring park visitation can be found in the online appendix. Overall, park visits averaged 40.6 minutes in duration and 66% temporally overlapped with one or more PA bout. Total park-related PA bout time averaged 26.6 minutes, with a little more than half occurring inside the park (14.2 minutes) and a little less than half occurring outside the park (12.4 minutes). Table 1 describes park visit characteristics.

4.2 Park visitors

Those who visited parks (n=308) were similar to non-visitors (n=363) in age, gender, and race/ethnicity (Table 2). Park visitors had higher educational attainment and household income, were more likely to have children, and were less likely to be overweight or obese than non-visitors. Park visitors and non-visitors lived in neighborhoods with similar residential densities and distances to the closest park, but visitors lived in wealthier residential neighborhoods with both greater counts of discrete parks and acres of park land. At the day level, park visitors were more likely to have been observed from April to September and on days with no precipitation. Park visitors were less likely to have been observed from October to March. Park visitors and non-visitors' observation days were similar in terms of day of the week, working days, and the mean temperature.

Park visitors achieved more PA bout minutes per day than non-visitors, even when total park-related PA bout time was excluded. Park visitors also had more minutes in MVPA and fewer sedentary minutes per day, both overall and when excluding time spent in park visits. These associations held in adjusted analyses that controlled for socio-demographics, home neighborhood environment, and day-level factors (Table 3). Compared to non-visitors, park visitors obtained an adjusted average of 14.3 more PA bout minutes per day than non-visitors, of which 8.4 minutes occurred outside the park and 5.2 of which were not-related to the park visit (i.e., not obtained inside the park nor during active travel to or from the park). Similarly, park visitors obtained an adjusted average of 12.2 more MVPA minutes per day than non-visitors, of which 7.3 minutes occurred outside the park. Park visitors spent an adjusted average of 18.4 fewer minutes in sedentary time per day than non-visitors. Even when comparing only time spent outside of park visits, park visitors spend 12.3 fewer minutes per day in sedentary time than park visitors.

4.3 Park visit days

On days that a park was visited (park days), park visitors spent 68.3 (SD 57.6) minutes in PA bouts. On these park days, about half of park visitors' PA bout minutes were park related; and PA bout minutes not related to park visitation were similar to that of non-visitors (Figure 2). When comparing park visitors' park days to days that a park was not visited (non-park days) using fixed effects models that adjusted for day-level characteristics, an average of 20.9 additional minutes of total PA bout time occurred on park days (Table 4). PA bout minutes on park days versus non-park days among park visitors did not differ when PA bout minutes that occurred inside parks were excluded. When total park-related PA bout time was excluded, an average of 12.9 additional minutes of PA bout time occurred on non-park days compared to park days. Similar results were obtained for MVPA and sedentary time outcomes: park visitors spent more time in MVPA and less time in sedentary activity on park days, but when time inside a park visit was excluded, no differences were observed between park days and non-park days.

5 Discussion

Using travel diary, GPS, GIS, and accelerometer data, we comprehensively measured park visitation and related activity among a U.S. metropolitan sample of adults. The present study improved on past research through integrating self-report (travel diary) and device-based (GPS/GIS) measures to identify park visits. A surprising 58% of all park visits were only sensed with GPS/GIS data and not reported in the travel diary. These sensed park visits were on average less than half the duration of reported visits (29.1 versus 67.2 minutes) but had strikingly similar total durations of park-related PA (26.6 minutes). Sensed park visits seemed to capture activities incidental to the park itself that participants may not register as a park visit–a walk *through* a park rather than a walk *in* a park. Another 17% of park visits were reported but not sensed with GPS/GIS data, possibly due to device failure (e.g., dead battery, lack of satellite reception due to tree canopy or buildings) or participant non-compliance (e.g., failure to wear the GPS device). Both GPS and travel diary instruments appear to be necessary to comprehensively measure park visits.

Use of both travel diary and GPS/GIS data to identify park visitation was made possible using Evenson et al.'s (2013) method to process GPS/GIS data into temporally discrete park visits that were comparable to those reported in the travel diary. This approach differed from most prior research on park-based PA using GPS instruments, which analyzed momentary PA levels from individual GPS points with no regard for the continuity of activity (Coombes et al., 2013; Dunton et al., 2012; Quigg et al., 2010; Rodriguez et al., 2012). This process of identifying park visits likely better represents how parks are experienced by the visitor and allowed us to capture PA bout time that extended beyond the duration of the park visit. This PA likely represents active travel to or from a park and is crucial for understanding the full contribution of parks to PA. Indeed, in this study, park-based PA bout time that occurred beyond the park visit was on average almost equal to the PA bout time that occurred within the park (12.4 versus 14.2 minutes).

The 26.6 minutes of park-related PA bout time associated with an average park visit approached the recommended 30 minutes of daily PA for adults (Pate et al., 1995). However, parks were visited at a rate of 1.4 times per person-week and less than half our sample visited a park at all during the observation period. We observed similar amounts of PA time associated with each park visit as Evenson et al. (2013), who also used GPS, GIS, and accelerometer data to quantify PA during GPS/GIS sensed park visits only. Expectedly, however, our general urban-living adult population visited parks less frequently than Evenson at al.'s adult population sampled in or near specific parks.

Similar to past studies using self-report park visitation and activity (Coombes et al., 2010; Veitch et al., 2013), we found that park visitors were more active and less sedentary than those who did not visit a park. This association held even when excluding time spent in parks and controlling for socio-demographics, home neighborhood environment, and observation day characteristics. We estimated that park visitors obtained an additional 14.3 minutes in overall PA bout time per day compared to non-visitors, of which 8.4 minutes did not occur inside a park and 5.2 minutes neither occurred inside a park nor on the way to or from a park. Thus we estimate that activity inside parks contributes to only 5.9 minutes

(14.3 less 8.4 minutes) of the difference in daily PA bout time between park visitors and non-visitors, and active travel to or from parks contributes to only 3.2 minutes (8.4 less 5.2 minutes) of this difference. Since 5.2 minutes of the difference in PA bout time between park visitors and non-visitors is unaccounted for by park-related activity, park visitation among users appears to be just one component of an overall more active lifestyle.

Park visitors were more active on days they visited parks. When time inside a park was excluded, however, activity levels were similar for their park days and non-park days. Furthermore, when active travel to or from the park was also excluded, PA levels were lower on park days. Park-related PA may therefore substitute for PA that occurs elsewhere on days that parks are not visited. This is in contrast to transit-related PA, which was not found to reduce other types of PA in this sample (Saelens et al., 2014). Because overall PA was still greater on park days, park visitation may extend the duration of activities that result in PA. For example, a neighborhood jog may be lengthened when the jogger chooses to make a few laps around a park (Figure 1).

We used hierarchical models to control for day-level factors such as weather and day of week. Point estimates from fixed effects models comparing park days and non-park days within individuals changed very little when day-level covariates were added (Table 4). This suggests that the additional PA obtained on park days was not driven by the tendency for both park visits and PA to occur during fair weather and when leisure time is available.

This study found an unadjusted association between greater counts and area of parks near home and park visitation. Park visitation may mediate the association that some studies have observed between home neighborhood park proximity and PA (Bancroft et al., 2015). Yet making parks easily accessible is only a first step to supporting PA. Because park-related PA partially substitutes for PA that would otherwise occur elsewhere, parks may contribute to PA primarily among those who already have interest, resources, and leisure time to engage in PA. This is further evidenced in the associations we observed between park visitation and higher socioeconomic status (measured in education, income, and residential wealth) and lower weight status. As a result, additional efforts, such as park programming and outreach, may be necessary to encourage lower income and less active residents to visit and engage in PA at parks (Cohen et al., 2013). Interventions may also need to address household characteristics that could moderate the amount of PA adults obtain during park visits, such as the presence of children or dogs. Specific park features (Cohen et al., 2012; Kaczynski et al., 2008); the surrounding neighborhood (Kaczynski et al., 2010); and other aspects, such as safety and cleanliness (Bedimo-Rung et al., 2005), are also likely to influence the amount of PA that occurs within (or while traveling to or from) individual parks. Indeed in our sample, the mean distance from home to visited parks was twenty times the mean distance from home to the closest park (4.7 versus 0.2 km). Further research using detailed activity and park data will elucidate which park and host neighborhood characteristics will help achieve public health goals for specific target populations.

6 Limitations

Self-report travel diary data were used to identify 127 park visits that were not sensed by the GPS/GIS data and are likely subject to recall and social desirability bias. Yet relying solely on GPS/GIS sensed visits has limitations as well (Kang et al., 2013). Inclusion of both GPS and travel diary visits enabled us to more completely ascertain park visits. Our GIS park dataset is the full catalog of parks identified by all of the local jurisdictions, but still may not capture places people consider parks, such as privately owned but publically accessible green spaces, while including some places that people may not consider parks, such as inaccessible natural areas. Park visitation outside the study area (county) was not measured, resulting in a potential underestimate of park visitation and misclassification of participants who only visited a park outside of the county. However, only 3.5% of person-days registered >4 hours of GPS coverage outside of the county. Finally, an observation period that averaged one week may be insufficient to capture usual park visitation behavior (Ortúzar et al., 2011).

7 Conclusion

This study assessed the contribution of comprehensively measured park visitation to objectively measured PA among a large sample of free living adults in an urban U.S. metropolitan area. Park visitors achieved more overall physical activity than non-visitors, particularly on park visit days. However, greater PA time among park visitors was not solely attributable to park visitation. These findings provide detailed evidence that parks support active lifestyles.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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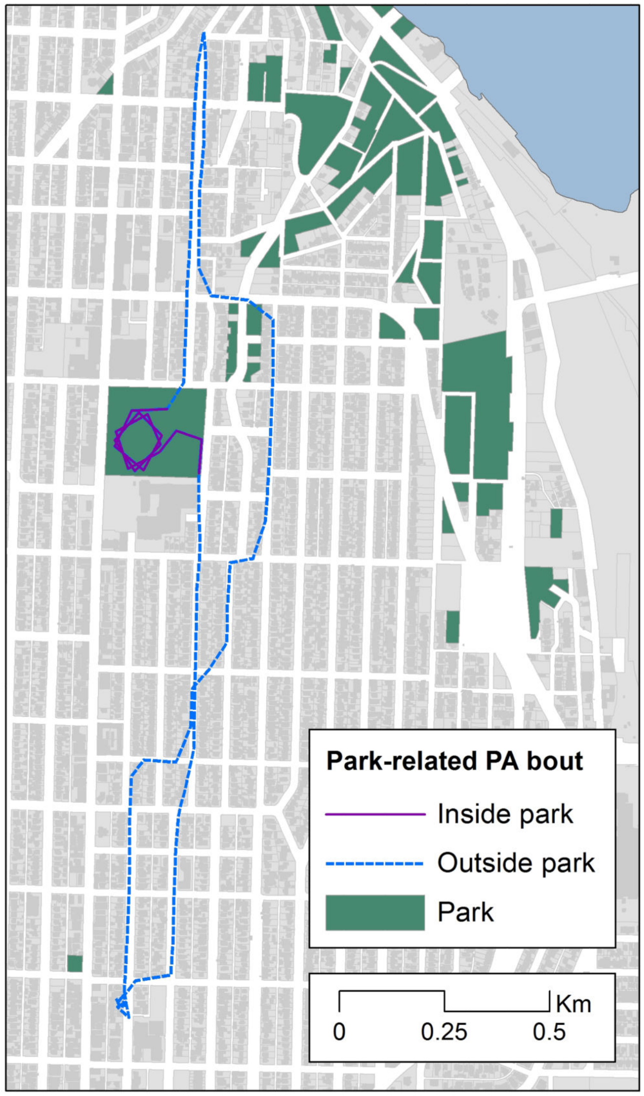

Figure 1.

GPS trace of a park-related physical activity (PA) bout. The solid line represents bout time that occurred inside the park. The dashed line represents bout time that occurred outside the park and was intended to capture active travel (i.e., walking or jogging) to or from the park.

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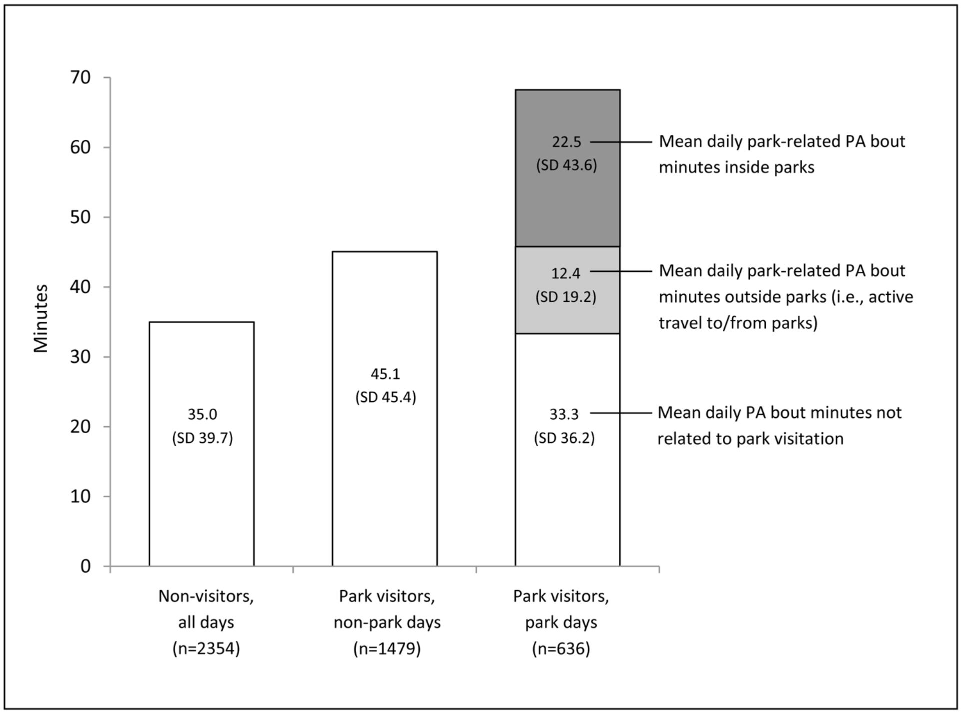

Figure 2.

Daily physical activity (PA) bout minutes by park visitor status and park day classification.

Table 1

Park visit characteristics

	n	mean	(SD)	median	Interquartile range
Duration (minutes)	868	40.6	(52.0)	20.5	6.0 – 56.5
Minutes in park-related PA bout(s), total	868	26.6	(29.5)	17.5	0.0 – 45.0
Minutes in park-related PA bout(s), inside park	868	14.2	(21.8)	4.8	0.0 – 19.3
Minutes in park-related PA bout(s), outside park	868	12.4	(21.0)	0.0	0.0 – 17.5
Minutes in MVPA	868	11.9	(18.4)	4	1.0 – 15.0
Minutes in sedentary activity	868	16.8	(32.9)	3	0 – 16.5
Proportion of park visit in PA bout(s) (%)	868	46.7	(44.0)	39.4	0 – 100.0
Proportion of park visit in MVPA (%)	868	38.9	(38.6)	20.8	2.6 – 79.6
Proportion of park visit in sedentary activity (%)	868	29.9	(31.4)	18.4	0 – 53.1
Proportion of park visit w/GPS coverage (%)	868	88.1	(27.1)	100.0	96.7 – 100.0
Mean speed during visit (kmh)	828	4.4	(5.9)	2.9	1.4 – 4.6
Distance from home to visited park (Euclidean km)	856	4.7	(6.9)	2.0	0.6 – 5.8
Distance from work to visited park (Euclidean km)	572	7.8	(8.7)	5.3	2.7 – 9.9
Park area (acres)	856	519.7	(6666.7)	33.3	11.0 – 189.9

Table 2

Participant individual- and day-level characteristics by park visitor status

	Park visitor (n=308)		Non-visitor (n=363)		
	n	mean (SD) or %	n	mean (SD) or %	p-value**
Individual characteristics					
Age, years	299	50.2 (12.9)	353	51.7 (13.4)	0.144
Male	108	35.1	138	38.0	0.429
Non-Hispanic White	253	82.7	278	77.0	0.070
College degree	238	79.6	217	62.0	<0.001
Annual household income					<0.001
<$50K	90	30.7	156	45.6	
$50–100K	121	41.3	134	39.2	
>$100K	82	28.0	52	15.2	
Children in household	87	29.1	63	18.2	<0.001
Weight status					<0.001
Underweight or normal (BMI<25 kg/m^2)	173	59.5	138	40.6	
Overweight (25≤BMI<30 kg/m^2)	75	25.8	111	32.6	
Obese (BMI≥30 kg/m^2)	43	14.8	91	26.8	
Residential density, units/acre	308	19.5 (13.7)	363	20.7 (14.8)	0.297
Residential wealth, mean value/unit, $1000	308	265.5 (87.1)	363	232.0 (74.2)	<0.001
Parks in neighborhood, count	308	7.0 (3.9)	363	6.3 (3.7)	0.014
Parks in neighborhood, acres	308	91.6 (98.1)	363	71.2 (105.8)	0.010
Distance from home to closest park, m	308	225 (161)	363	243 (178)	0.167
Day-level characteristics*					
Time of year					0.009
First quarter (January through March)	630	29.8	770	32.7	
Second quarter (April through June)	675	31.9	602	25.6	
Third quarter (July through September)	581	27.5	534	22.7	
Fourth quarter (October through December)	229	10.8	448	19.0	
Day of week					0.196

	Park visitor (n=308)		Non-visitor (n=363)		
	n	mean (SD) or %	n	mean (SD) or %	p-value**
Sunday	274	13.0	301	12.8	
Monday	299	14.1	319	13.6	
Tuesday	306	14.5	334	14.2	
Wednesday	321	15.2	352	15.0	
Thursday	316	14.9	364	15.5	
Friday	308	14.6	365	15.5	
Saturday	291	13.8	319	13.6	
Workday	1,031	50.4	1,133	49.6	0.752
Any precipitation	759	36.5	979	43.5	0.008
Mean temperature (°Celsius)	2115	11.5 (6.2)	2354	10.8 (6.0)	0.094

* Each individual contributed multiple days of observation.

** Individual-level p-values based on two-sample t-test allowing for unequal variance for continuous variables and chi-square test for categorical variables; day-level p-values based on univariate logistic regression models with robust standard errors accounting for clustering of days within individuals.

Table 3

Association between park visitor status and day-level physical activity (PA) outcomes from linear mixed effects models.

	Unadjusted (n=4469 days within 671 individuals)		Adjusted* (n=4087 days within 608 individuals)	
	Coefficient (95% CI)	**p value**	**Coefficient (95% CI)**	**p value**
PA bout minutes	17.4 (12.5, 22.2)	<0.001	14.3 (8.9, 19.6)	<0.001
PA bout minutes, not inside park	10.6 (6.0, 15.2)	<0.001	8.4 (3.1, 13.7)	0.002
PA bout minutes, not park-related	6.9 (2.4, 11.4)	0.003	5.2 (0.2, 10.4)	0.049
MVPA minutes	15.3 (11.3, 19.3)	<0.001	12.2 (8.0, 16.5)	<0.001
MVPA minutes, not inside park	9.7 (5.9, 13.4)	<0.001	7.3 (3.2, 11.5)	0.001
Sedentary minutes**	−22.8 (−32.9, −12.6)	<0.001	−18.4 (−29.7, −7.1)	0.001
Sedentary minutes, not inside park**	−16.0 (−26.0, −6.0)	0.002	−12.3 (−23.5, −1.1)	0.031

*Adjusted for age, gender, race/ethnicity, education, household income, children in household, BMI, home neighborhood residential density, home neighborhood residential wealth, home neighborhood park count, home neighborhood park area, quarter of year, day of week, workday, daily precipitation, and mean daily temperature

**Models of sedentary minutes are also adjusted for daily wear time

Table 4

Within-individual association between park day and physical activity (PA) outcomes among park visitors based on linear fixed effects models.

	Unadjusted (n=2115 days within 308 individuals)		Adjusted* (n=2115 days within 308 individuals)	
	Coefficient (95% CI)	p value	Coefficient (95% CI)	p value
PA bout minutes	21.7 (15.6, 27.7)	<0.001	20.9 (14.9, 26.9)	<0.001
PA bout minutes, not inside park	−0.5 (−4.4, 3.4)	0.807	−0.9 (−4.9, 3.1)	0.647
PA bout minutes, not park-related	−12.5 (−16.2, −8.7)	<0.001	−12.9 (−16.7, −9.0)	<0.001
MVPA minutes	16.9 (11.7, 22.1)	<0.001	17.0 (11.8, 22.2)	<0.001
MVPA minutes, not inside park	−1.8 (−4.7, 1.1)	0.218	−1.5 (−4.4, 1.56)	0.320
Sedentary minutes**	−27.7 (−35.3, −20.0)	<0.001	−24.1 (−31.2, −16.9)	<0.001
Sedentary minutes, not inside park**	−4.7 (−11.3, 1.9)	0.165	−3.9 (−10.4, 2.5)	0.229

*Adjusted for quarter of year, day of week, workday, daily precipitation, and mean daily temperature

**Models of sedentary minutes are also adjusted for daily wear time