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Objectively measured active travel and uses of activity-friendly neighborhood resources: Does change in use relate to change in physical activity and BMI?

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ABSTRACT

Few studies examine how objectively measured use of local physical activity resources contributes to objectively-measured healthy physical activity and weight changes over time. We utilized objective measures to test whether changes in active travel and uses of three physical activity (PA) resources–parks, recreation centers, and transit–related to changes in PA and BMI. Adults ($n = 536$) in Salt Lake City, UT, wore accelerometer and GPS units in 2012 and 2013, before and after neighborhood rail completion. Regression outcomes included accelerometer counts per minute (cpm), MVPA (moderate-to-vigorous activity minutes/10 h accelerometer wear) and measured BMI; key predictors were changes in active travel and PA resource uses (former and new uses). Significant results (all $p < 0.05$) showed that increased active travel related to increased total PA (59.86 cpm and 8.50 MVPA); decreased active travel related to decreased MVPA (−3.01 MVPA). Poorer outcomes were seen after discontinuing use of parks (−36.29 cpm, −5.73 MVPA, and +0.44 BMI points), recreation centers (−6.18 MVPA), and transit (−48.14 cpm, −5.43 MVPA, and +0.66 BMI). Healthier outcomes were seen after commencing use of parks (29.83 cpm, 5.25 MVPA), recreation centers (44.63 cpm) and transit (38.44 cpm, 4.17 MVPA, and −0.56 BMI). Transit and park/recreational center uses were unrelated, although park users were more likely to be recreation center users. Active travel and use of three neighborhood PA resources relate to healthy activity and could be fostered by policy and design.

1. Introduction

Increasingly, policymakers recognize that activity-friendly community designs can create opportunities for active travel, other forms of physical activity (PA), and healthy weight (Heath et al., 2006). Research on PA associated with using community facilities such as parks, recreation centers, and transit is accumulating (Moody et al., 2004; Owen et al., 2004), although often limited to cross-sectional self-reported uses of one type of PA facility (Evenson et al., 2013). We use GPS/GIS and accelerometry to pinpoint whether changes in active travel and uses of three particular modifiable neighborhood PA resources—public transit (bus, light rail, or commuter rail), parks, and recreation centers—relate to PA and weight changes.

Changes in active travel are seldom studied as a source of PA, although one UK study found changes in active travel corresponded to changes in total PA, but not to changes in recreational PA (Sahlqvist et al., 2013). The authors argued these results supported more development of active travel policies, although it is unknown whether such findings would replicate in the U.S., where active travel is less frequent (Bassett et al., 2008), or for objectively measured PA, which is often much lower than self-reported PA (Troiano et al., 2008).

Parks near home are a common venue for activity, especially among males (Cohen et al., 2007) and walking groups (Schoffman et al., 2015). However, residents living close to parks have been found to walk less than residents living far from parks (King et al., 2012), perhaps due to a dearth of other walkable destinations near parks (King et al., 2015). Furthermore, few park user studies measure objective MVPA attained in parks; one study that showed park visits entailed 2.3 MVPA minutes (Evenson et al., 2013) and another found they involved approximately 4.9 MVPA minutes (Stewart et al., 2016). No studies were found that examined objective PA associated with recreation center use or change in use, although proximity to recreation centers has been related to more self-reported PA (Hirsch et al., 2013; Humpel et al., 2002).

Transit use typically requires active travel to/from the stations, although few studies measure changes in transit use over time. In the current study a new light rail transit line was extended as part of a Salt

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Lake City "complete street" intervention, in which a street is renovated to be more supportive of active travel by pedestrians, cyclists, and transit riders (Smart Growth America, 2016). This renovation included five new rail stops, improved sidewalks, bike lanes, and landscaping. Generally, transit riders show more total objectively measured PA (Chaix et al., 2014; Saelens et al., 2014; Wener and Evans, 2007), although in one case only for those who were less active initially (Hong et al., 2016). In our past research, residents who started using the complete street transit post-construction were found to have increased their cpm and MVPA (Brown et al., 2015), especially for days riding transit (Miller et al., 2015), and reduced their BMI (Brown et al., 2015), with similar findings for PA bouts among Seattle transit riders (Saelens et al., 2014). We anticipate similar results for transit ridership in the current study, where transit ridership involves any transit ride, not limiting riders to those within the complete street corridor. One concern is whether using time-consuming transit might reduce one's leisure PA (Lachapelle et al., 2016). Positive (Gordon-Larsen et al., 2009; Sugiyama et al., 2010), negative (Collins and Agarwal, 2015) and null (Kwasniewska et al., 2010; Sahlqvist et al., 2012) relationships between active travel and recreational PA have been found, using cross-sectional data and self-reported PA. Thus, we examine whether transit ridership, park, and recreation center uses are interrelated.

For a cohort of adults in 2012–2013, we test whether objectively measured a) active travel changes relate to changes in accelerometer cpm, MVPA, and BMI; b) uses of neighborhood parks, recreation centers, and transit are interrelated; and c) changes in neighborhood facility use relate to changes in cpm, MVPA, and BMI.

2. Methods

2.1. Participants

Adults were recruited in an area up to 2 km north and south of the complete street renovation area (approximately a 4 × 4.2 km area, between 200 West and 1950 West on North Temple). They wore accelerometers (Actigraph GT3 +, Actigraph, Pensacola, FL) and GPS data loggers (GlobalSat DG-100, New Taipei City, Taiwan) for approximately 1 week in 2012 and 2013, pre- and post-renovation (see details in Brown et al., 2014). Eligible adults from randomly sampled blocks included those who could walk a few blocks, spoke English or Spanish, were not pregnant, anticipated remaining in the neighborhood for a year, gave informed consent as approved by the authors' institution, and provided at least 3 days of ≥ 10 h/day accelerometer wear along with GPS data. Accelerometer non-wear time was defined as 60 min of 0 cpm, allowing for two interruptions of up to 100 cpm (Troiano et al., 2008); one re-wear was allowed if participants did not meet eligibility.

Due to these screening requirements and a recruitment area that did not match census boundaries, the representativeness of the sample cannot be definitive. As might be expected from screening out participants who did not expect to live there for one year, there were fewer renters in the sample (48%) than in the census neighborhood (59%). The sample was more representative of area gender (51% female sample, 48% area), Hispanic ethnicity (24% and 26%), and age (42 & 44 years old) (Brown et al., 2016).

This study includes 536 adults with valid data who remained in the study in 2012 and 2013. There were 939 participants at time 1 (March–December 2012). By time 2 (May–November 2013), 403 participants were lost to follow-up: 283 participants moved, 77 did not have valid GPS data, 34 refused, and 9 became ineligible. Incomplete GPS data are common, in part because the devices needed to be charged daily and do not reliably record inside buildings (Krenn et al., 2011) (see additional description of this sample in Brown et al., 2014).

2.2. Procedures

Researchers met with participants, typically in their homes, to secure informed consent, administer surveys and provide equipment wearing instructions. Researchers returned after a week to administer final surveys, measure weight and height, and download data from the devices to a secure website, designed by GeoStats (now Westat) to merge the time-stamped accelerometer minutes to GPS/GIS data and assign travel modes.

2.3. Variables

2.3.1. Dependent variables: cpm, MVPA, and BMI

Outcome variables were difference scores calculated as 2013 minus 2012 values of average cpm per approximately one week of accelerometer wear (Strath et al., 2012), MVPA minutes/10 h accelerometer wear, and measured BMI. Accelerometer cpm can provide useful comparison data to studies using similar accelerometer units but different PA intensity cut-points (Strath et al., 2012) as well as providing an overall PA measure. To interpret cpm, it is useful to know that obese adults have about 45 fewer cpm than overweight adults and overweight individuals have about 12 fewer cpm than healthy weight adults (Tudor-Locke et al., 2010). A 2020 cpm threshold for MVPA was adopted (Troiano et al., 2008). Heights and weights were measured following NHANES protocols (Centers for Disease Control and Prevention, 2005), using calibrated scales and portable stadiometers, with BMI defined as $kg/m.^2$

2.3.2. Active travel

Following Sahlqvist et al. (2013) we examine how change in active travel durations relates to total PA change. GeoStats combined accelerometry and GPS/GIS data to identify minutes of active travel, based on speed, location, and acceleration data (see details of identification of trip ends, trip modes, and identification of travel mode transitions in Miller et al., 2015). Active travel is any non-automotive travel. It is typically walking, which averaged 2.83 mph across the full sample (SD = 1.22), but could include biking and jogging. Active travel designations require ≥ 1 min of active travel and can include MVPA. Active travel change scores (years 2013 minus 2012) were divided into thirds to represent increased (top third, cutpoint ≥ 4.39 min active travel change per 10 h GPS wear), decreased (bottom third, ≤−1.44 min change), and unchanged (middle third reference group) active transportation.

2.3.3. Park use

The 25 parks (omitting small "tot" lots of ≤ 1 block, see map in Appendix) within 4 km of neighborhood boundaries were included, a distance comparable to average travel to parks (Stewart et al., 2016). Accelerometer minutes of activity were merged to the first GPS point within each minute. Park users were defined as those with ≥ 1 MVPA (2020 cpm) minute of activity that had ≥ 1 GPS points within GIS-defined park boundaries, excluding any sidewalks bounding the park. Participants were effect-coded into four groups based accelerometer/GPS evidence of use during the one-week measurement periods each year. For park users this included: never users (did not use park in 2012 or 2013; coded − 1 for never, 0 otherwise), continuing users (in 2012 and 2013), former users (in 2012 but not 2013), and new users (in 2013, but not 2012; the latter three groups are coded 1 for use, 0 otherwise). We recognize that these group labels derive from approximately one week of data for each of the two time periods and should not be considered enduring categories; a "never user" might have used a park, but during our measurement periods.

2.3.4. Recreation center use

The two government-owned multipurpose recreation centers within 4 km of neighborhood boundaries were included. The centers offer