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Transit use and physical activity: Findings from the Houston travel-related activity in neighborhoods (TRAIN) study

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ABSTRACT

Transportation-related physical activity can significantly increase daily total physical activity through active transportation or walking/biking to transit stops. The purpose of this study was to assess the relations between transit-use and self-reported and monitor-based physical activity levels in a predominantly minority population from the Houston Travel-Related Activity in Neighborhoods (TRAIN) Study. This was a cross-sectional analysis of 865 adults living in Houston, Texas between 2013 and 2015. The exposure variable was transit-use (non-users, occasional users, and primary users). Self-reported and accelerometer-determined physical activity were the outcomes of interest. Regression models adjusting for age, sex, race/ethnicity, and other covariates of interest were built to test the hypothesis that transit user status was directly associated with 1) minutes of moderate-intensity physical activity and 2) the prevalence of achieving the physical activity guidelines. The majority of participants were female, non-Hispanic black, and almost one-third had a high school education or less. After adjustment, primary transit-use was associated with 134.2 ($p < 0.01$) additional mean minutes per week of self-reported moderate-intensity transportation-related physical activity compared to non-users. Further, primary users had 7.3 (95% CI: 2.6–20.1) times the relative adjusted odds of meeting physical activity recommendations than non-users based on self-reported transportation-related physical activity. There were no statistically significant associations of transit-use with self-reported leisure-time or accelerometer-derived physical activity. Transit-use has the potential for a large public health impact due to its sustainability and scalability. Therefore, encouraging the use of transit as a means to promote physical activity should be examined in future studies.

1. Introduction

Among the four domains of physical activity (Gabriel et al., 2012), the transportation and leisure-time domains offer the greatest opportunity for sustainably increasing total daily physical activity (Reis et al., 2016). In particular, transportation-related physical activity can increase daily activity through physically active travel (walking or biking to/from destinations) and through transit related physical activity (walking or biking to/from mass transit stations/stops).

Previous findings on the relation between transit-use and physical activity should be reviewed based on the instrument used to assess physical activity (self-report or device-based measures), and the study design. In a cross-sectional analysis of a representative sample of US adults, Besser and Dannenberg found that transit users self-reported a median 19-minutes per day of transit-related physical activity (Besser and Dannenberg, 2005). Lachapelle and colleagues further contextualized the transit-use–physical activity relation by demonstrating that public transit users reported engaging in more physically active

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travel than those who use automobiles for transportation and concluded that transit related activity does not displace leisure-time physical activity (Lachapelle et al., 2016; Lachapelle and Noland, 2012). In another cross-sectional study, Lachapelle et al. used accelerometry to find that frequent transit users accumulate an additional 8-minutes of physical activity over non-users (Lachapelle et al., 2011). Using a quasi-experimental design, Miller et al. found that on transit days, transit users accumulate almost 12 more minutes of accelerometer-derived physical activity, than those who do not use transit (transit non-users) (Miller et al., 2015). The body of literature, to this point, indicates that transportation-related physical activity, independent of leisure-time activity, may significantly contribute to weekly physical activity volume that is reflected in guidelines for aerobic activity (Saelens et al., 2014), that is, at least 150 min per week of moderate-intensity aerobic activity or 75 min per week of vigorous-intensity aerobic activity or an equivalent combination of both (United States Department of Health and Human Services, 2008). However, the magnitude of this effect appears to depend upon the physical activity measurement device used and may differ for understudied populations.

The transit-use–physical activity relation is not as well understood among more diverse populations (e.g., older age, race/ethnicity minority, low income groups). This area of inquiry has important public health implications as people of lower socioeconomic status and older populations are at highest risk for many preventable chronic health conditions related to physical inactivity (Smedley et al., 2002). Additionally, transit-use and physical activity has not been fully explored in the context of the transportation and leisure-time domains of physical activity, coupled with device based assessments of total physical activity accumulated throughout the day (Saelens et al., 2014). A combination of self-report and device based assessments is necessary to attribute differences in total physical activity to domain specific estimates of physical activity (Troiano et al., 2012). Device based assessments of physical activity alone are not able to provide any contextual information on the physical activity behavior (the type of physical activity, where it was performed, etc.). Alternatively, self-reports of domain specific physical activity do not provide estimates of total physical activity and often times do not capture physical activity that is less than moderate in intensity.

Therefore, the purpose of this study is threefold. First, is to evaluate the differences in occasional transit users (occasional users) and primarily transit users (primary users) and transit non-users (non-users) estimates of: a) self-reported transportation-related physical activity, b) self-reported leisure-time physical activity, and c) accelerometer-derived total physical activity. Second, is to estimate the relation between transit-use and physical activity, when accounting for participant characteristics that may be influencing the relations. Third, is to estimate the odds of being sufficiently active (meeting physical activity aerobic guidelines) among occasional users and primary users compared to transit non-users based on domain specific estimates of physical activity and accelerometer-derived total physical activity.

2. Methods

2.1. Study design, setting, and participants

Data for this cross-sectional analysis came from baseline assessments of transit-use and physical activity in the Houston Travel-Related Activity in Neighborhoods (TRAIN) Study. The TRAIN Study is a prospective natural experiment aimed at determining if the extension of a public light rail transit system in Houston, Texas affects both transit-use and physical activity over a five year period (2013–2018). There were 3 new light rail extensions, which added 15 miles of line and 24 stations primarily serving residential and light industrial areas. The new light rail extensions opened in two phases in December 2013 and May 2015. A rolling recruitment and enrollment strategy, involving telephone/email/and targeted community outreach efforts, was employed from November 2013 to October 2015, at which time the desired baseline cohort size was achieved. To be eligible to participate, an individual must have met the following criteria: 1) at least 18 years of age, 2) reside within the defined study buffer area (within 3 mile Euclidean buffer around the new light rail extensions), and 3) not residing with a current TRAIN participant (only one participant per household). A 3-mile buffer, which extends over the existing light rail lines, was chosen to maximize the pool of eligible participants and to provide variability in distances between participants' homes and the light rail lines – the parent study's primary predictor of transit-use. As Durand et al. points out, it is currently not well understood how far individuals are willing to travel, and in particular, walk, to reach public transit (Durand et al., 2016). Therefore, in the interest of capturing a range of probabilities among participants in the parent study, a much larger buffer than the traditional quarter-mile distance, was used. Study materials were offered to participants in English or Spanish, and participants were compensated for their participation. See Durand et al. (2016) for a complete description of the TRAIN Study methodology (Durand et al., 2016).

The analytic sample in the current study included participants that completed a baseline questionnaire (n = 865). At enrollment, all participants were invited to participate in the accelerometer protocol (wear an accelerometer during waking hours for seven consecutive days) in addition to completing the questionnaire. Approximately 77% (688/865) of participants opted-in and were included in the analysis as a sub-sample.

2.2. Data collection

Two data collection instruments were used – a self-administered questionnaire, and a hip-worn tri-axial accelerometer (ActiGraph wGT3X-BT). The questionnaire was sent to/from participants by mail and took approximately 90 min to complete. After returning the questionnaire, the subsample of participants opting to participate in the accelerometer protocol were sent and returned an accelerometer in the mail.

2.3. Variables

The primary independent variable of interest was transit-use. Items pertaining to frequency of transit-use were included in the questionnaire. These were presented as an initial yes/no question: "*Do you ever use Houston's METRO bus and/or light rail systems at all* (*even just occasionally*)?", and a follow-up question conditional on a < *YES* > response, "*Is the METRO your main source of transportation*?" Participants were categorized as transit non-users (do not use transit), occasional transit user (use transit but not as main source of transportation), and primary transit user (use transit as main source of transportation), dependent upon the response[*s*].

The primary dependent variable of interest for self-reported physical activity was total minutes per week of moderate-, and vigorous-intensity physical activity. These estimates were derived from The Self-Administered Modifiable Activity Questionnaire (S-MAQ), which was administered in the questionnaire. The S-MAQ assessed leisure-time and transportation-related (physically active travel and transit related) physical activity over the past seven (7) days. First, participants were asked if "In the past 7-days, did [s/he] do any of the following activities during … leisure-time" and "for transportation". The participant is presented a list of 38 leisure-time physical activities (e.g., bicycling for exercise, walking for exercise, strength or weight training, swimming, etc.), and three activities for transportation (i.e., walking, bicycling, other [e.g., skateboarding]). A "yes" response then directed the participant to enter the "total number of minutes [s/he] did the activity on each day" for the past 7-days. Activities were categorized by intensity level (moderate or vigorous) based on corresponding metabolic equivalent of task (MET) values, where 3–6 METs were moderate-