Transit Use, Physical Activity, and Body Mass Index Changes: Objective Measures Associated With Complete Street Light-Rail Construction

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Objectives. We assessed effects on physical activity (PA) and weight among participants in a complete street intervention that extended a light-rail line in Salt Lake City, Utah.

Methods. Participants in the Moving Across Places Study resided within 2 kilometers of the new line. They wore accelerometers and global positioning system (GPS) loggers for 1 week before and after rail construction. Regression analyses compared change scores of participants who never rode transit with continuing, former, and new riders, after adjustment for control variables (total n = 537).

Results. New riders had significantly more accelerometer-measured counts per minute than never-riders ($P < .01$), and former riders had significantly fewer ($P < .01$). New riders lost ($P < .05$) and former riders gained ($P < .01$) weight. Former riders lost 6.4 minutes of moderate-to-vigorous PA (MVPA) per 10 hours of accelerometer wear ($P < .01$) and gained 16.4 minutes of sedentary time ($P < .01$). New riders gained 4.2 MVPA minutes ($P < .05$) and lost 12.8 ($P < .05$) sedentary minutes per 10 hours accelerometer wear.

Conclusions. In light of the health benefits of transit ridership in the complete street area, research should address how to encourage more sustained ridership. (*Am J Public Health.* 2015;105:1468–1474. doi:10.2105/AJPH.2015.302561)

Historically, many streets have been engineered to support speedy car travel, with designs that manifest little concern for other users, such as pedestrians or transit riders.[1] Reflecting a cultural shift in priorities, public health advocates in the United States[2] and other countries[3] are supporting transportation policies and built environment interventions that enhance opportunities for physical activity (PA). Complete street policies support roadways designed or altered to accommodate active transport by pedestrians, cyclists, or transit users. Physical environment modifications created by such policies vary substantially in scale, from the addition of painted bike lanes to the installation of new rail lines. Complete street policies were the most frequently sought policies by 59 active-living collaborative groups,[4] have been endorsed by the Centers for Disease Control and Prevention,[5] and have been adopted by more than 600 jurisdictions.[6] However, research on complete streets often focuses on the notable challenges of implementation,[7,8] rather than on assessment of potential health effects.[9]

Past research showed that transit riders self-report more PA and healthier body mass indexes (BMIs). A round trip on transit typically involves 4 walks or bike rides to get to and from the transit stop,[10] making transit use a form of active transportation. A review of mostly cross-sectional studies worldwide found 9 studies that showed that transit use was associated with between 8 and 33 minutes of PA per day of transit use[11]; 4 of these were limited to self-reported PA.[12–15] In the United States, according to the 2001 National Household Travel Survey, the 3312 transit riders reported walking 19 minutes daily to and from transit[12]; similar results emerged from more recent waves of this survey.[16]

Important advances in research are the use of objective measures of PA and BMI in longitudinal designs. Indeed, objective measures of PA have yielded weaker associations with built environment features than were found by studies relying on self-reports, according to a recent review.[17] Still, in cross-sectional studies, transit use was correlated with more pedometer-measured PA.[18,19] Transit commuters in Seattle, Washington, and Baltimore, Maryland, achieved 4 to 8 more moderate minutes (with a threshold of 1952 counts per minute [cpm]) of accelerometer-measured activity daily than noncommuters.[20] A more recent Seattle study used travel diaries and accelerometers to relate reported transit use to moderate PA (defined as ≥ 5-minute bouts of ≥ 1000 cpm).[21] Participants who recorded occasional to frequent diary-logged transit trips accrued 2.3 to 15 more daily minutes of walking (defined as traveling 2–6 km/hour, according to global positioning system [GPS] measures) than did nontransit users.[22]

Longitudinal studies show that an increase in transit use correlates with better health measures. Phone surveys before and after a Charlotte, North Carolina, rail opening revealed that those who became daily rail riders (n = 26) reported their BMI as 1.18 points lower than that of nonrail commuters (n = 275) and were 81% less likely to become obese, although they did not report a greater likelihood of attaining 150 minutes of walking per week.[15] Residents who started using a new Salt Lake City, Utah, rail stop had more accelerometer-measured occurrences of moderate-to-vigorous PA (MVPA) than nonusers, and fewer were obese.[23] The addition of the new stop was associated with an 18.75% increase in the number of residents who reported using light rail, and new riders increased their MVPA.[10] Yet no study has verified ridership by using GPS data to confirm transit location, verified

PA with accelerometry data, and provided clinically obtained BMI measures. We aimed to fill this gap.

Tracking PA before and after complete street "natural interventions" can provide quasi-experimental evidence of behavior changes.[9] Although not all the intended consequences of a complete street makeover, such as residential and commercial development, will be evident immediately, changes to active travel patterns may be detectible early. We examined objective PA, verified by accelerometry data, and clinically measured BMI changes that accompanied transit ridership changes along a complete street implementation in Salt Lake City that provided 5 new TRAX light-rail neighborhood stops.

GPS measures to confirm transit ridership are needed because studies have found more walking[24,25] or lower weight[26] associated with residential proximity to transit stops, which may reflect the location of some transit stops in pedestrian-friendly, transit-oriented developments.[27] Generally, pedestrian-friendly designs provide at least moderate population densities and a variety of desirable destinations, supported by well-connected street designs.[28,29] We therefore used GPS data to ensure that residents were in fact using transit in the complete street corridor. We hypothesized that residents who started to use the new complete street intervention area for transit would engage in more PA and have less BMI increase than other residents and that conversely, any residents who stopped using the corridor for transit should accrue less PA and gain weight.

METHODS

For the Moving Across Places Study, we surveyed 614 adults who resided within 2 kilometers of a planned light-rail extension (map in Figure A, Appendix A, available as a supplement to the online version of this article at http://www.ajph.org) and wore accelerometers (Actigraph GT3×+, Actigraph, Pensacola, FL) and GPS loggers (GlobalSat DG-100 data loggers, GlobalSat, New Taipei City, Taiwan) for approximately 1-week periods before and after rail construction (sample size determined by power calculations). Light-rail service opened in April 2013; we collected time 1 data between March and December of 2012 and time 2 data between May and November of 2013. The complete street intervention evaluation focused on 5 new residential TRAX stops along a new line extension (excluding a nonresidential sixth stop at the airport), a bike lane, and improved sidewalks. Participants completed surveys, and we measured their height and weight and fitted them with the measurement devices in their homes.

Sample

We recruited participants mainly door to door; selection criteria were age 18 years or older, ability to walk a few blocks, intention to stay in the neighborhood at least 1 year, not being pregnant, ability to speak Spanish or English, and ability to wear the devices and fill out the surveys (details are published elsewhere[30]). Of residents participating before construction (n = 939), 614 completed the postconstruction data collection. Residents who were unavailable for follow-up had moved (n = 283 verified as movers or did not respond to ≥ 8 phone and in-person contact attempts), refused (n = 34), or became ineligible (n = 8).

We analyzed a subsample of 537 residents who had valid GPS data at both times. The reasons for not having GPS data, a common challenge in the field,[31] included mechanical malfunction or participant failure to wear, recharge, or turn on the equipment; participants could also have spent their time indoors, where GPS signal reception was not reliable. The 77 residents we excluded from these analyses were more likely than the 537 who provided GPS data both times to be female (0.70 vs 0.51 female; $t(103.47) = 3.39$; $P < .01$) and to have more household members (3.64 vs 3.00; $t(91.01) = 2.55$; $P < .01$). The groups did not differ on age, Hispanic ethnicity, White race, student status, employment, presence of children in the home, household income, access to a car, marital status, or years of residence in the current home.

To be included, participants needed at least 3 days of valid accelerometer wear in 2012, defined as at least 10 valid hours of wear time per day.[32] We defined not worn as 60 minutes of 0 counts on the accelerometer, allowing for 1 to 2 minutes of up to 100 accelerometer cpm.[32] GeoStats (Atlanta, GA) provided a custom Web site for upload and temporal integration of device data. It also assigned modes to trip segments, according to accelerometer counts, GPS tracks, and acceleration patterns. We counted any trip that crossed into or through an area defined by a 40-meter buffer from the complete street centerline, encompassing all 5 new residential TRAX stops, as a trip that involved the new complete street renovation of North Temple Street. We considered residents who had a trip that used the complete street in which part of the trip included transit (TRAX light rail, bus, or commuter rail) to be complete street transit users. The complete street TRAX line supplemented and displaced some of the existing bus line service.

We combined all transit users into 1 group to ensure that those who rode a bus in 2012 but rode TRAX in 2013 would not be considered new transit riders. Four participants only used commuter rail, not light rail; we included them in the transit rider group because the easternmost light-rail stop provided a transfer stop for commuter rail. The use of transit typically is considered to be active transportation; indeed, GPS–accelerometer data confirmed that 95% of the transit trips in our study detected walking as part of the transit trip.

Variables

Transit ridership status was a 4-category independent variable derived from patterns of transit ridership on trips in the complete street corridor before and after construction of the complete street, in accordance with past research.[23] The 4 groups were never-riders (i.e., residents who never used transit; who used transit, but on trips outside the complete street buffer; or who biked or walked only in any part of the neighborhood), continuing riders, former riders (i.e., residents who had complete street transit trips in 2012 but not 2013), and new riders (i.e., residents who had complete street transit trips only in 2013). Tests revealed that accelerometer wear time was equivalent across the 4 groups in 2012 but not in 2013. Post hoc Tukey tests showed that in 2013 new riders had more wear time than never-riders (94 hours vs 85 hours of wear; $P = .02$); we assumed both groups had sufficient wear time to detect transit ridership.

Outcome variables were changes in accelerometer cpm,[33] in MVPA and light and sedentary PA (per 10 hours of accelerometer wear, according to intensity thresholds from Troiano et al., which include 2020 cpm for MVPA[32]), and in measured BMI (defined as weight in kilograms divided by the square of height in meters). Control variables were age and dummy variables for female gender, Hispanic ethnicity, college degree, and married status. Additional control variables were changes in employment and in health status (in addition to screening for ability to walk a few blocks, we chose a single-item health variable: "In general, how has your health been lately?" with response options 1–4, poor, fair, good, and excellent). Finally, we controlled for the number of days between the 2012 and 2013 participation weeks and for temperature differences across the 2 beginning time points for each resident's participation times in 2012 and 2013.

Statistical Analysis

We assessed control variables across the 4 groups with 1-way analysis of variance and ordinary least squares regressions (SPSS version 21, IBM, Armonk, NY, and SAS version 9.3, SAS Institute Inc, Cary, NC) to estimate change in PA from time 1 to time 2 as a function of sociodemographic control variables.[34] We conducted a similar analysis of BMI change.

Effect code contrasts compared participants who never registered a transit trip that intersected the North Temple buffer with the other 3 groups: continuing riders, former riders, and new riders. Because our never-ride group combined residents with various usage patterns, we conducted a second set of analyses on a less heterogeneous group of never-riders as a sensitivity test. This additional analysis substituted car riders in the complete street corridor for the never-ride transit group and contrasted them with the 3 types of transit riders (continuing, former, and new).

RESULTS

After the complete street construction, 52 of the 537 participants became new transit users, who took trips involving transit in the complete street corridor in 2013 but not 2012, an increase of 9.68%. Continuing transit users had GPS- and accelerometer-identified trips in both years (n = 51). Most participants never had complete street transit trips in the 2 years (n = 393). In addition, 41 former transit users had trips recorded in 2012 but not in 2013.

Averages for variables for the whole group and for transit ridership groups of interest (never-riders, continuing riders, new riders, and former riders) are shown in Table 1. The control variables differed somewhat across the groups in univariate analyses. Those who never rode were more likely than continuing riders to be married (52% vs 16%; $F[3,532] = 10.39$; $P < .001$; post hoc Games–Howell $P = .001$). New riders were more likely than continuing riders to have gained employment from 2012 to 2013 (13% job gain vs 8% job loss; $F[3,527] = 3.50$; $P = .015$; Tukey $P = .027$). Former riders experienced warmer temperatures from the 2012 to the 2013 participation times (62°F vs 76°F) than continuing riders (69°F vs 70°F; $F[3,533] = 3.84$; $P = .01$; Tukey $P = .007$).

TABLE 1—Descriptive Statistics of Sample of Residents Near an Extended Light-Rail Line: Moving Across Places Study; Salt Lake City, UT; 2012–2013

Characteristic	All (n = 537), Proportion or Mean ±SE	Never-Riders (n = 393), Proportion or Mean ±SE	Continuing Riders (n = 51), Proportion or Mean ±SE	Former Riders (n = 41), Proportion or Mean ±SE	New Riders, (n = 52), Proportion or Mean ±SE
Female	0.51 ±0.02	0.53 ±0.03	0.43 ±0.07	0.51 ±0.08	0.42 ±0.07
Age, y	41.72 ±0.64	42.28 ±0.75	43.86 ±1.92	37.78 ±2.43	38.50 ±1.95
Hispanic	0.25 ±0.02	0.25 ±0.02	0.18 ±0.05	0.22 ±0.07	0.29 ±0.06
College graduate	0.37 ±0.02	0.39 ±0.02	0.24 ±0.06	0.34 ±0.07	0.33 ±0.07
Married	0.46 ±0.02	0.52 ±0.03	0.16 ±0.05	0.34 ±0.07	0.35 ±0.07
Employment change	0.03 ±0.02	0.02 ±0.02	-0.08 ±0.06	0.12 ±0.06	0.13 ±0.05
Health change	-0.02 ±0.03	-0.02 ±0.03	-0.14 ±0.10	-0.02 ±0.11	0.13 ±0.12
Temperature change	7.45 ±0.84	7.26 ±0.97	1.00 ±2.82	14.10 ±3.05	9.96 ±2.62
Participation day change	346.47 ±2.79	350.09 ±3.31	341.82 ±9.78	335.54 ±9.45	332.29 ±7.34
Activity					
2012, cpm	322.64 ±6.30	308.36 ±6.63	391.05 ±27.15	361.08 ±27.63	333.23 ±20.75
2013, cpm	331.40 ±6.46	320.33 ±7.11	376.93 ±23.18	317.96 ±25.73	381.04 ±23.73
Change	8.76 ±5.20	11.97 ±5.50	-14.13 ±18.87	-43.12 ±20.44	47.81 ±22.33
BMI					
2012	29.01 ±0.30	29.18 ±0.35	28.79 ±1.13	29.15 ±0.95	27.88 ±0.99
2013	29.25 ±0.30	29.38 ±0.35	29.32 ±1.12	30.07 ±1.02	27.59 ±0.99
Change	0.23 ±0.08	0.19 ±0.09	0.53 ±0.37	0.92 ±0.24	-0.29 ±0.30

Note. BMI = body mass index; cpm = counts per minute. All changes are 2013 – 2012.

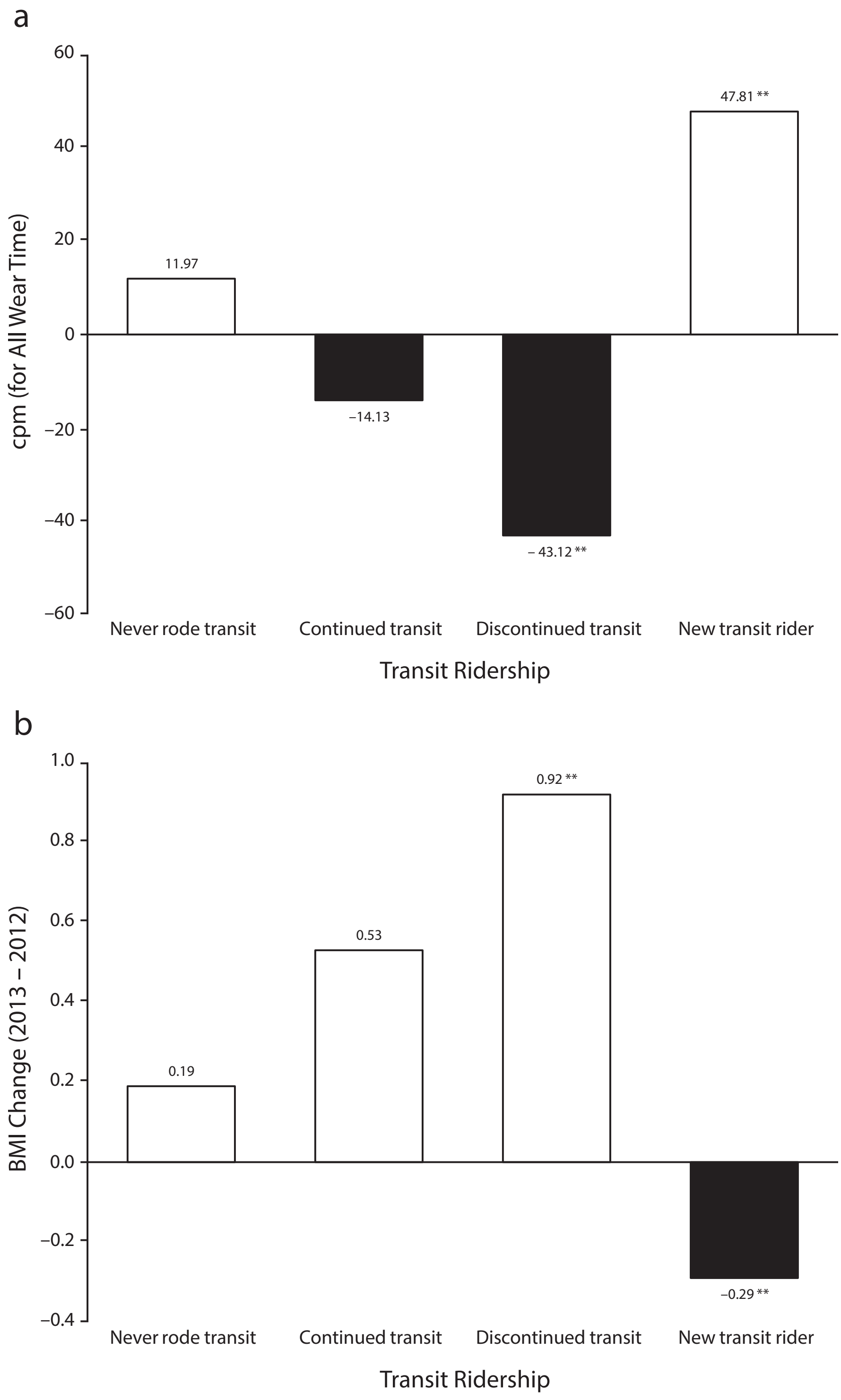
Figure 1 shows, for PA (accelerometer cpm) and BMI, how each group changed over time. The activity counts changed the most for those who changed transit patterns, with new riders gaining activity and former riders losing activity. BMI increases were greatest among former riders; the new rider group experienced a small BMI decrease.

Multivariate Results

We tested change scores of the 4 transit ridership groups with 3 planned comparisons that compared never-riders with former, continuing, and new riders, respectively (Table 2), after adjustment for control variables. Results of the full model showed significant changes in activity cpm ($F[12,506]=3.96$; $P<.001$). Former riders experienced a decline in PA—a change significantly different than the never-riders, who slightly increased their PA ($t=-3.30$; $P=.001$). New transit users accrued more PA than never-riders ($t=2.72$; $P=.007$). Continuing riders experienced little change in activity, and their 2013 – 2102 change scores were not significantly different from those who never used transit.

Results for PA changes were consistent with BMI changes for the 3 groups relative to the never-riders (2013 BMI – 2012 BMI; $F[12,505]=2.46$; $P=.004$). Former transit users experienced an increase in BMI ($t=2.72$; $P=.007$), and new riders had a slight loss in BMI ($t=-2.32$; $P<.022$); both changes were significantly different from our comparison group of never-riders, who experienced a slight gain in BMI.

These results were consistent with results from an analysis of 3 commonly used PA intensity categories: MVPA, with 2020 cpm as a cutpoint[32] ($F[12,506]=2.71$; $P<.001$); light PA ($F[12,506]=3.65$; $P<.001$); and sedentary PA ($F[12,506]=4.38$; $P<.001$). Former riders achieved 6.37 fewer MVPA minutes per 10 hours of accelerometer wear than never-riders (SE=2.01; $t=-3.17$; $P<.01$); new riders gained 4.16 MVPA minutes per 10 hours of wear (SE=1.84; $t=2.26$; $P<.05$). For light PA, former riders accrued 9.99 fewer minutes (SE=5.60; $t=-1.78$; $P=.075$), and new riders accrued 8.67 more minutes per 10 hours of wear (SE=5.14; $t=1.69$; $P=.092$), both nonsignificant trends compared to the



Note. The control group was never rode transit.
**$P<.01$.

FIGURE 1—Transit ridership change groups and changes in (a) accelerometer counts per minute (cpm) and (b) body mass index: Moving Across Places Study; Salt Lake City, UT; 2012–2013.

TABLE 2—Regression Analyses of Transit Rider Change Categories and Physical Activity and Body Mass Index Changes: Moving Across Places Study; Salt Lake City, UT; 2012–2013

Change Measurement[a]	B ±SE (95% CI)
Activity, cpm	
Former riders	-49.35** ±14.97 (-78.75, -19.94)
Continuing riders	-6.25 ±14.44 (-34.62, 22.12)
New riders	37.40** ±13.74 (10.41, 64.39)
BMI, kg/m^2	
Former riders	0.64** ±0.24 (0.18, 1.11)
Continuing riders	0.03 ±0.23 (-0.42, 0.48)
New riders	-0.50* ±0.22 (-0.93, -0.08)
MVPA	
Former riders	-6.37** ±2.01 (-10.32, -2.43)
Continuing riders	-0.81 ±1.94 (-4.62, 3.00)
New riders	4.16* ±1.84 (0.54, 7.78)
Light PA	
Former riders	-9.99 ±5.60 (-21, 1.01)
Continuing riders	3.64 ±5.41 (-6.98, 14.26)
New riders	8.67 ±5.14 (-1.43, 18.77)
Sedentary PA	
Former riders	16.38** ±6.09 (4.41, 28.35)
Continuing riders	-2.84 ±5.88 (-14.39, 8.71)
New riders	-12.83* ±5.59 (-23.82, -1.85)

Note. BMI = body mass index; CI = confidence interval; cpm = counts per minute; MVPA = moderate-to-vigorous physical activity. All change scores were comparisons with never-riders. Analyses controlled for gender, age, Hispanic ethnicity, college graduation, marital status, employment change, health change, temperature change, and days between data collection.
*P < .05; **P < .01.

changes of the never-riders (who gained 3.46 absolute minutes of light activity/10 hours of accelerometer wear). Finally, former riders accrued 16.38 more minutes of sedentary activity than never-riders (SE = 6.09; t = 2.69; P < .01); new riders accrued 12.83 fewer minutes of sedentary activity per 10 hours of wear than never-riders (SE = 5.59; t = –2.30; P < .05).

TABLE 3—Regression Analyses of Physical Activity and Body Mass Index Among Transit Riders and Car Users: Moving Across Places Study; Salt Lake City, UT; 2012–2013

Change Measurement	B ±SE (95% CI)
Activity, cpm	
Former riders	-52.95** ±16.41 (-85.26, -20.65)
Continuing riders	-3.98 ±16.11 (-35.69, 27.74)
New riders	34.82** ±15.06 (5.17, 64.48)
BMI, kg/m^2	
Former riders	0.66** ±0.25 (0.16, 1.15)
Continuing riders	0.11 ±0.25 (-0.38, 0.59)
New riders	-0.50* ±0.23 (-0.95, -0.04)

Note. BMI = body mass index; CI = confidence interval; cpm = counts per minute. All change scores were comparisons with car users. Analyses controlled for gender, age, Hispanic ethnicity, college graduation, marital status, employment change, health change, temperature change, and days between data collection.
*P < .05; **P < .01.

Sensitivity Tests

Exploratory analyses showed no significant interactions between sociodemographic control variables and the transit change groups. As a further sensitivity test, we redid all analyses to include the 2012 baseline variable for the dependent variable as a predictor.[35] All significant effects for the transit groups were sustained (and 1 new significant effect emerged: former riders had 11.34 fewer minutes of light PA than did never-riders; P = .03).

We assessed whether allowing recruitment of individuals with 3 or 4 days of accelerometer wear time related to transit ridership group. Cross-tabulations indicated that ridership groups had similar percentages of less than 5 days of wear (both χ^2 P > .15; overall, 21.4% of participants had < 5 days of wear and 15.1% had 4 days in 2012; 22.7% had < 5 days of wear and 19% had 4 days in 2013).

A final analysis used the subset of automobile-only participants to focus on the relations of PA and BMI with automobile use. We compared this group, which logged only car travel through the complete street corridor in either year, with the same 3 groups of new, continuing, and former transit users (Table 3). Again, both sets of change scores, for 2013 – 2012 accelerometer cpm and BMI, were significant (for cpm, F[12, 278] = 3.36; P < .001; for BMI F[12, 277] = 2.26; P = .01). Former transit riders had a decline in activity (–52.95 cpm/10 hours of accelerometer wear; SE = 16.41; t = –3.623; P < .01), and new transit riders had more activity (34.82 cpm; SE = 15.06; t = 2.31; P < .05); these changes were significantly different from the changes of those who used only car travel through the corridor, who had an absolute increase of 11.98 cpm per 10 hours of wear.

The results were similar with BMI change as the outcome. BMI change scores were 0.66 points higher among former riders than car users (SE = 0.25; t = 2.63; P < .01) and 0.50 points lower among new riders (SE = 0.23; t = –2.16; P < .05).

DISCUSSION

Objective GPS and accelerometer data allowed participants' travel to be identified as involving bus, light rail, or commuter rail. Such objective measures are important to confirm that accelerometer-measured PA is associated with transit travel. Results show that use of transit associated with a complete street intervention yields beneficial PA and BMI outcomes for those who begin to use transit. Similarly, individuals who stopped using transit gained sedentary activity and BMI and lost MVPA minutes. These findings were robust for variations in PA measures (cpm or activity intensity categories) and complete street nonrider comparison group membership (transit rider groups compared with all nontransit riders or just to car-only riders in the complete street corridor). BMI changes were also significant and in the expected direction, despite the 2013 measures being collected up to 7 months after the new transit opportunities were provided.

Limitations

The new rail line lacked land-use patterns typical of mature transit-oriented design, reducing opportunities for additional PA around transit stops. The entire complete street area was rezoned to support transit-oriented development: a walkable street design, with sufficient density to support multiple attractive destinations and street forms designed for convenient walking, such as interconnected grid streets. Walkable street forms have been associated with the use of transit[36] and light rail in particular.[37] However, mature transit-oriented development designs take years to accomplish. They have land-use patterns that may invite other forms of healthy behaviors, such as additional walks to businesses that develop around transit or social capital from having neighborhood gathering places.[3] Currently, the complete street is dominated by businesses oriented to drivers, such as drive-through fast-food establishments or businesses with dedicated parking out front. Although the street form in much of the neighborhood involves a walkable grid, some neighborhood residents have circuitous routes to the TRAX stops that must circle around large plots of fenced-off land. Like other studies of community-wide design supports for walking, gradual land-use transformations around these stops may make the area even more attractive for active transportation in the future.

Another limitation of our study was that the reasons individuals stopped using transit were unknown and may represent an unintended consequence; research is needed to see whether changes in transit service or personal circumstances triggered riders to discontinue transit use. Data in Table 1 suggest that change in transit accompanies change in employment, an effect that was significant in a post hoc comparison of new riders with continuing riders.

We based our categorization of our transit rider groups on approximately 1 week's worth of observation; our analyses were not sensitive to the variations of ridership frequencies within rider groups or variations beyond our 2 measured points in time (e.g., former riders may have commenced riding again the week after our measurements; never-riders might have been occasional riders). This measurement schema may have made our results conservative. The loss of activity and gain in weight associated with former transit ridership indicate that programs that can anticipate and overcome the reasons for transit discontinuation offer potential health benefits. In addition, the results of the test for sedentary behavior are suggestive, because about 22% of participants did not wear the accelerometers for 5 days; past research has found either 5[38] or more[39] days of wear may be needed for reliable estimation of sedentary behavior.

Conclusions

From a public health perspective, adding infrastructure such as light rail defines an intervention as a structural change that is scalable for population benefits and relatively sustainable.[40] Walking to transit is increasingly popular, with a 28% increase from 2001 to 2009, according to results from the National Household Transportation Survey. Transit walking is especially likely in cities with rail systems,[16] and rail riders have been found to walk more than either car drivers or bus riders.[41]

Many endorse complete streets for their potential to support PA, obesity prevention, social equity, youth and elderly mobility, pollution prevention, less automobile dependence and sprawl, open space preservation, and transit-oriented development.[42–46] Our findings underscore the benefits to health conferred by transit use. ■

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This article was accepted January 6, 2015.

Contributors

B. B. Brown designed the study and led the writing and data analyses. C. M. Werner helped conceptualize the study. C. P. Tribby provided the GIS support. K. R. Smith helped conceptualize the study and provided statistical advice. All authors edited drafts of the article and approved the final article.

Acknowledgments

This research was supported in part by a grant from the National Cancer Institute (CA157509) and the Robert Wood Johnson Foundation.

We thank Kristi Flick and Doug Tharp for their valuable assistance in this study. We thank the reviewers for their constructive suggestions.

Human Participant Protection

The institutional review board at the University of Utah approved this study.

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