Moving Toward Physical Activity Targets by Walking to Transit: National Household Transportation Survey, 2001—2017

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Introduction: Public transportation systems can help people engage in physical activity. This study assesses sociodemographic correlates and trends in the daily time spent walking to and from transit in the U.S. from 2001 to 2017.

Methods: This cross-sectional study used data from the 2001, 2009, and 2017 National Household Transportation Survey. Data were analyzed in 2019 to assess the daily level of physical activity attained solely by walking to and from transit. Regression models were used to examine predictors of daily transit−associated walking.

Results: Compared with the full National Household Transportation Survey sample, transit users who walked to and from transit tended to be younger, from households earning <$25,000 per year, in areas with rail infrastructure, and did not have a household-owned car. Transit walkers spent a median of 20 minutes per day (95% CI=18.5, 21.5) walking to and from transit in 2017, compared with a median of 19 minutes (95% CI=17.5, 20.5) in 2001. Among transit walkers, daily transit-associated physical activity was 27% higher for those residing in areas with rail infrastructure (adjusted coefficient=1.27, 95% CI=1.11, 1.46) and 34% higher for those from households earning <$25,000 per year than those earning >$99,999 per year (adjusted coefficient=1.34, 95% CI=1.15, 1.56).

Conclusions: As documented in a growing literature, most public transit trips include at least some walking; thus, efforts to encourage transit use are favorable to public health. Continued monitoring by transportation surveys is important as new forms of mobility and changing demographics may impact future transit use and associated physical activity.
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INTRODUCTION

Despite the well-recognized benefits of physical activity, only half of Americans reported meeting guidelines for aerobic activity in 2017.[1,2] Inadequate physical activity is associated with significant health burden and economic costs, accounting for 10% of premature mortality and $117 billion in annual medical expenditures in the U.S.[1,3] To promote and maintain health, the 2018 Physical Activity Guidelines for Americans recommend that adults engage in at least 150 minutes per week of moderate-intensity aerobic physical activity (such as brisk walking).[1] Physical aerobic activity should ideally be spread throughout the week,[1] with

many health organizations (e.g., the American Heart Association,[4] American College of Sports Medicine,[5] and Centers for Disease Control and Prevention)[6]

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recommending that individuals engage in at least 30 minutes of daily activity, 5 days per week, which accumulates to an amount sufficient for current weekly guidelines. Incorporating physical activity into daily living can help people meet key recommendations and improve individual and population health.

Policymakers have increasingly emphasized the role of public transportation systems in improving health.[1,7−9] In addition to reduced pollution and motor vehicle crashes,[10] transit systems can help individuals engage in physical activity as most transit journeys begin or end with walking.[2,8,9,11−13] Meta-analyses have shown that extending public transit is associated with higher levels of transportation-related walking and light-to-moderate physical activity,[10,14] although one study reported a decline in total physical activity.[10] A systematic review found that transit users spend 8−33 minutes per day walking to and from transit,[13] and research has suggested that transit users can meet physical activity recommendations by transit walking.[11,12,15,16] Public transit systems can integrate physical activity into daily routines, thereby lowering risk factors such as adiposity, especially among less active populations who may be more likely to use transit.[17,18] In the past 2 decades, policy movements such as the Surgeon General's Call to Action,[8] the Community Preventive Services Task Force recommendations,[9] and Healthy People 2020[2] have encouraged investments in public transit. With growing investments, examining how much physical activity is done solely by walking to and from public transit allows decision makers to consider health impacts as part of the decision process for transportation policies and projects.[11]

Continued surveillance of physical activity attained by walking to and from transit is important, as demographic and technological trends (i.e., shared mobility through ride hailing, telecommuting, online shopping) may contribute to changes in travel behavior and transit-associated physical activity.[19−22] Previous analysis reported that transit walking increased by 28% from 2001 to 2009, with 2.1 million more people walking ≥30 minutes per day to and from transit in 2009.[11] However, transit ridership has declined in most major U.S. metropolitan regions in recent years.[19,23] An analysis showed that the prevalence of walking for transportation increased 2.2% from 2010 to 2015, with the average time spent walking for transportation decreasing from 73 to 53 minutes per week from 2005 to 2015.[24] However, the study was conducted on those who reported walking in bouts of more than 10 minutes, and the role of public transportation-related physical activity remains unclear. This study expands on previous analyses[11,12] by estimating the daily level of physical activity attained solely by walking to and from transit, the sociodemographic predictors of transit-associated walking, and changes in transit-associated walking from 2001 to 2017.

METHODS

Study Sample

The National Household Transportation Survey (NHTS) is a nationally representative survey of travel behaviors administered by the U.S. Department of Transportation approximately every 8 years. Travel data are collected from the civilian, non-institutionalized population; people living in medical institutions and military bases are excluded. Sampled households must have at least 1 person aged ≥18 years to be eligible. NHTS uses a 2-stage data collection design that includes a household recruitment survey and a person-level survey of travel day information.

In the 2001 and 2009 cycles, list-assisted random-digit dialing was used to ensure an equal probability of sampling of households with landlines.[25,26] Selected households participated in a telephone-based recruitment interview and were assigned to a 24-hour travel day in which travel data such as trip times, purposes, and modes were recorded in a travel diary. Within 7 days of the travel day, travel details were collected through a telephone-based survey. Households were included in the final data sets if ≥50% of the household adults provided travel data.

Owing to the growth of cell phone−only households, an address-based sample survey was used in the 2017 NHTS cycle that included cell phone−only households.[27] Addresses were assigned to sampling strata on the basis of geographic characteristics and then randomly selected from each stratum. Selected households were invited to participate through the mail. Recruited households were assigned to a 24-hour travel day, and travel data were collected by a web-based questionnaire or computer-assisted telephone interview within 7 days of the travel day. Post-travel day reminders were sent through every form of contact, starting from the day after assigned travel to the seventh day. Households were included in the final 2017 data set if all household members aged ≥5 years provided travel details; adult household members served as a proxy for members aged <16 years. In this study, demographic and travel-related information for individuals aged ≥18 years from the 2001, 2009, and 2017 NHTS were analyzed.

Measures

A transit walker was defined as a person who walked to or from public transit on their assigned travel day. For each transit walker, the total daily walk time was calculated by summing all walk segments to and from transit. A walk segment was defined as a trip between a place (e.g., home and work) and a transit station or bus stop to which a person walked. Improbable walk segments, defined as those that lasted >60 minutes, were excluded. Owing to limitations in the NHTS, trips to and from public transit involving a mode other than walking (e.g., driving and biking) were excluded. Transit walkers were excluded if they had missing walk times (*n*=31 from 2001, *n*=41 from 2009, and *n*=34 from 2017).

Demographic information included age (18−24, 25−34, 35−44, 45−54, 55−64, >64 years), education level (less than high school, high school degree, some college, college graduate), race/ethnicity, sex, and employment status (employed and not employed). Race/ethnicity was defined as white, non-Hispanic;

black, non-Hispanic; Asian, non-Hispanic, Native Hawaiian, or Pacific Islander; Hispanic; and other (e.g., American Indian, Alaska Native, multiracial, or other races). Household characteristics included annual household income (<$25,000; $25,000−$49,999; $50,000−$74,999; $75,000−$99,999; >$99,999), presence of rail infrastructure in the metropolitan statistical area, household urban status (urban and rural), and household car ownership (none and at least 1 car). The use of ride-hailing services (e.g., Uber and Lyft) and online shopping in the past 30 days were also analyzed, as previous research has documented the importance of these services on transit use.[19−21]

Statistical Analysis

The median total walk time was calculated because the distribution of walk time was right skewed.[11] Using the 2017 NHTS sample, descriptive statistics were calculated for transit walkers and the full NHTS sample, which included transit walkers. As transit walkers constitute only a small proportion of the full NHTS sample,[11,12] including transit walkers in the full NHTS sample would make little difference in calculations.

Among transit walkers in the 2017 NHTS, linear and logistic regression models were used to determine the predictors of transit-associated walk time and of attaining ≥30 minutes per day of physical activity solely by walking to and from public transit, respectively. Walk time was log-transformed because it approximated a log-normal distribution. The exponentiated regression coefficients are presented, which represent the expected percentage change in minutes per day of transit walking between predictor variables.[28] Model selection was intended to obtain predictors interpretable and generalizable for multidisciplinary work by health, transportation, and policy researchers. Starting from a model with a priori expected predictors (i.e., sex, age, race/ethnicity, and household income), additional covariates significant at $p<0.05$ in univariate analyses were included in a preliminary model. These additional covariates were retained in the final multivariable model if they were independently significant at the $p<0.01$ level.

Among transit walkers in the 2001, 2009, and 2017 NHTS, linear trends in the proportion engaging in ≥30 minutes per day of transit walking were evaluated using logistic regression models across survey years. Trends are presented by household income, age, education, race/ethnicity, sex, car ownership, employment status, presence of rail infrastructure, and urban/rural classification. The p-values for trends were estimated using survey year as a continuous variable and were considered significant at 0.01 level. Survey analysis procedures used jackknife replicate weights provided by NHTS to obtain unbiased variance estimates. Analyses were conducted in 2019 using R, version 3.6.1.

RESULTS

The analysis included 120,332 adults in 2001, a total of 263,572 adults in 2009, and a total of 230,592 adults in 2017. After excluding people who did not use public transit on their assigned travel day and those who used more than 1 mode of transportation to get to public transit, there were 3,435 transit walkers in 2001, a total of 4,115 in 2009, and a total of 4,601 in 2017. Among

these participants, 150 (4.4%) participants in 2001, 69 (1.7%) in 2009, and 39 (0.84%) in 2017 were excluded for having improbable walk segments.

Compared with the full NHTS sample, transit walkers tended to be younger, from households earning < $25,000 per year (32.6%, 95% CI=29.2, 36.1 vs 19.6%, 95% CI=19.0, 20.3), from households in metropolitan statistical area with rail infrastructure (66.3%, 95% CI=63.4, 69.2 vs 28.9%, 95% CI=28.5, 29.2), from households in urban areas (98.9%, 95% CI=98.3, 99.4 vs 82.2%, 95% CI=81.6, 82.8), and from households without a car (44.7%, 95% CI=41.7, 47.7 vs 6.7%, 95% CI=6.5, 6.9) (Table 1). A smaller proportion of transit walkers was white, non-Hispanic (42.1%, 95% CI=40.0, 44.3 versus 64.2%, 95% CI=63.6, 64.8), while a greater proportion was black, non-Hispanic, Asian/Pacific Islander, or Hispanic. A higher proportion of transit walkers reported using ride-hailing services (30.4%, 95% CI=27.6, 33.1 vs 10.0%, 95% CI=9.5, 10.0).

Transit walkers in the 2017 NHTS spent a median of 20 (95% CI=18.5, 21.5) minutes per day walking to and from public transit compared to a median of 19 minutes (95% CI=17.5, 20.5) in 2001. In 2017, 77.6% of transit walkers attained ≥10 minutes of physical activity solely by walking to and from transit (Figure 1). Trip purposes for transit walkers included work-related commuting (40.7%); school, religious, or family/personal business (22.5%); social/recreational activities (17.9%); and shopping (14.9%).

The percentage of transit walkers in the full NHTS sample increased from 3.6% (95% CI=3.4, 3.8) in 2001 to 4.3% (95% CI=4.1, 4.5) in 2017, with an estimated 3.5 million more people walking to and from public transit in 2017 than in 2001 (linear trend, $p<0.001$). The proportion engaging in ≥30 minutes per day of transit walking did not change significantly from 29.0% (95% CI=26.5, 31.5) in 2001 to 30.4% (95% CI=28.2, 32.5) in 2017. When stratified by sociodemographic characteristics, the proportion of transit walkers engaging in ≥30 minutes per day of transit walking among white, non-Hispanics increased from 17.9% (95% CI=14.8, 20.9) in 2001 to 28.4% (95% CI=26.9, 29.9) in 2017 (linear trend, $p<0.001$) (Table 2). The proportion of transit walkers in rural areas walking ≥30 minutes per day to and from transit increased from 6.5% (95% CI=2.0, 10.9) in 2001 to 32.8% (95% CI=18.8, 46.8) in 2017 (linear trend, $p<0.001$).

Adjusting for sex, age, race/ethnicity, and household income, the daily minutes of transit-associated walking were 27.0% higher for participants in metropolitan statistical areas with rail infrastructure (adjusted coefficient=1.27, 95% CI=1.11, 1.46). The daily minutes of transit walking were 34.0% higher

Table 1. Demographic Comparison of Transit Walkers and Full NHTS Sample, 2017

Characteristic	Transit walkers[a] n=4,562		Full NHTS sample n=230,592	
	N	Weighted, % (95% CI)	n	Weighted, % (95% CI)
Age, years				
18–24	456	15.8 (13.6, 18.0)	13,303	12.6 (12.6, 12.7)
25–34	954	23.8 (21.6, 26.1)	27,789	17.1 (16.7, 17.6)
35–44	728	16.6 (13.9, 19.4)	28,702	17.1 (16.6, 17.5)
45–54	788	15.4 (12.9, 17.9)	36,100	16.3 (15.9, 16.8)
55–64	932	16.5 (14.3, 18.6)	51,272	17.6 (17.2, 18.0)
>64	704	11.9 (10.1, 13.8)	73,426	19.2 (19.2, 19.3)
Household income/year, $				
<25,000	1,373	32.6 (29.2, 36.1)	35,227	19.6 (19.0, 20.3)
25,000−49,999	668	16.0 (14.0, 18.0)	45,815	21.1 (20.5, 21.7)
50,000−74,999	529	12.3 (10.1, 14.5)	40,223	16.8 (16.1, 17.5)
75,000−99,999	440	9.80 (8.30, 11.3)	32,105	13.2 (12.8, 13.6)
>99,999	1,448	29.2 (26.8, 31.6)	69,874	29.4 (28.6, 30.1)
Education				
Less than high school diploma	324	7.7 (6.50, 8.90)	9,556	6.3 (6.00, 6.58)
High school degree	746	19.8 (17.4, 22.1)	47,148	22.8 (22.3, 23.2)
Some college	987	23.5 (20.8, 26.3)	69,165	30.5 (29.9, 31.1)
College graduate	2,503	49.0 (47.0, 51.1)	104,513	40.5 (39.9, 41.0)
Race/ethnicity				
White, non-Hispanic	2,512	42.1 (40.0, 44.3)	179,647	64.2 (63.6, 64.8)
Black, non-Hispanic	795	24.7 (22.0, 27.4)	15,535	11.5 (11.2, 11.9)
Asian/Pacific Islander	458	9.7 (8.20, 11.2)	9,858	5.2 (4.70, 5.6)
Hispanic	575	19.1 (15.8, 22.4)	17,465	15.6 (15.3, 15.9)
Other[b]	206	4.3 (3.20, 5.40)	7,300	3.4 (3.20, 3.7)
Sex				
Female	2,403	52.1 (49.2, 55.1)	122,905	51.4 (51.4, 51.4)
Male	2,158	47.9 (44.9, 50.8)	107,567	48.6 (48.6, 48.6)
Presence of rail in the MSA				
Yes	2,336	66.3 (63.4, 69.2)	36,424	28.9 (28.5, 29.2)
No or household not in MSA	2,226	33.7 (30.8, 36.6)	194,168	71.1 (70.8, 71.4)
Household urban status				
Urban	4,395	98.9 (98.3, 99.4)	176,446	82.2 (81.6, 82.8)
Rural	167	1.1 (0.6, 1.7)	54,146	17.8 (17.2, 18.4)
Household-owned car				
At least 1 car	2,860	55.3 (52.3, 58.3)	222,705	93.3 (93.1, 93.5)
No car	1,702	44.7 (41.7, 47.7)	7,887	6.7 (6.5, 6.9)
Employment status				
Employed	3,050	68.1 (63.7, 72.4)	126,825	62.6 (62.1, 63.0)
Not employed	1,512	31.9 (27.6, 36.3)	103,752	37.4 (37.0, 37.9)
Purchased online in past 30 days				
Yes	2,713	58.4 (55.4, 61.3)	132,790	55.7 (55.1, 56.4)
No	1,845	41.6 (38.7, 44.6)	97,328	44.3 (43.6, 44.9)
Used ride-hailing services in past 30 days				
Yes	1,221	30.4 (27.6, 33.1)	17,281	10.0 (9.5, 10.0)
No	3,334	69.6 (66.9, 72.4)	213,113	90.0 (89.5, 90.0)

Note: Percentages are by columns.
[a]A transit walker is defined as someone who walked to and from transit on their assigned travel day.
[b]Other includes American Indian, Alaska Native, multiracial, or other races.
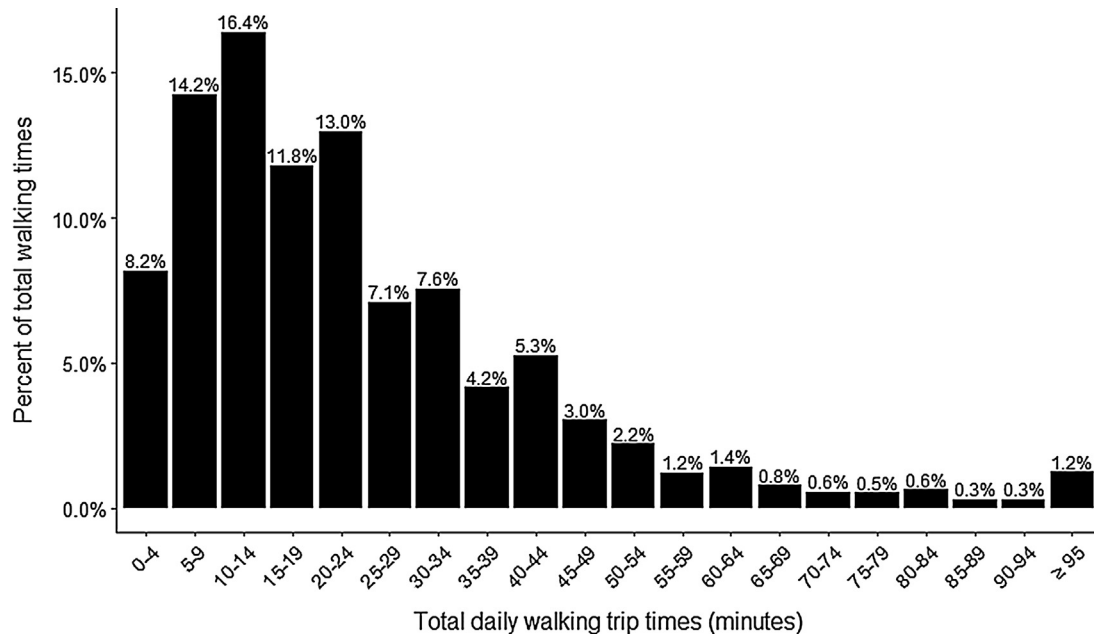MSA, metropolitan statistical area; NHTS, National Household Transportation Survey.

Figure 1. Distribution of total daily walking time to and from transit, 2017 NHTS (*n*=4,562).
Note: Numbers and percentages shown are unweighted.
NHTS, National Household Transportation Survey.

(adjusted coefficient=1.34, 95% CI=1.15, 1.56) for participants with a household income <$25,000 than those with >$99,999 per year (Table 3). Similarly, odds of transit walking ≥30 minutes per day were 51% higher for those in areas with a rail infrastructure (AOR=1.51, 95% CI=1.21, 1.89, *p*<0.01).

DISCUSSION

This analysis showed that the proportion of transit walkers increased from 2001 to 2017, with 3.5 million more adults walking to and from transit in 2017 than in 2001. Transit walkers added a median of 20 minutes per day of physical activity by transit walking, and approximately 30% of transit walkers attained ≥30 minutes per day of walking. These findings are consistent with a study conducted in England showing that public transit users engage in an average of 21 minutes per day of physical activity.[16] This analysis also found higher levels of daily transit-associated physical activity for those in areas with rail infrastructure and those with lower household incomes. These findings are consistent with research reporting that people are willing to walk longer distances to reach a rail system[29,30] and socioeconomic variations in transit use.[11,12,31]

Transit-associated walking increased over time among transit walkers residing in rural areas. Estimates from this analysis are imprecise owing to the decreased

representation of rural areas in the 2017 NHTS,[32] and the removal of walk segments lasting >60 minutes may have underestimated walk time for rural residents who live farther away from transit. A national study has reported that the prevalence of meeting physical activity guidelines increased between 2008 and 2017 in rural communities.[33] Implementation of culturally appropriate strategies and a better understanding of the barriers surrounding public transit in rural communities might improve physical activity levels further and reduce health disparities.[33]

Consistent with previous research, transit walkers tended to be from lower-income households,[11,12,31] and transit-associated walk times were significantly higher for those in households earning <$25,000 per year than those earning >$99,999 per year. Lower-income populations are less likely to own an automobile, which increases the necessity of transit use,[34] and they may live in urban cores where transit is more accessible.[12] It should be noted that the proportion of transit walkers walking ≥30 minutes per day tended to increase for those in higher-income households between 2001 and 2017, whereas these proportions remained steady for lower-income households. Results may be consistent with shifts in demographics over this time period, such as increases in automobile ownership among lower-income populations[35,36] and higher transit use among higher-income populations, potentially driven by the

Table 2. Proportion of Transit Walkers With ≥30 Minutes/Day of Walking by Characteristic and Year of NHTS Survey

Characteristic	2001 (n=3,285) Weighted, % (95% CI)	2009 (n=4,046) Weighted, % (95% CI)	2017 (n=4,562) Weighted, % (95% CI)	p-value
Household income/year, $				
<25,000	37.6 (33.0, 42.3)	37.4 (31.5, 43.2)	37.8 (33.0, 42.6)	0.954
25,000−49,999	25.8 (20.4, 31.1)	32.9 (24.2, 41.6)	24.5 (18.2, 30.7)	0.746
50,000−74,999	26.2 (17.7, 34.8)	31.3 (21.5, 41.2)	29.0 (21.3, 36.8)	0.712
75,000−99,999	18.8 (11.9, 25.6)	24.4 (16.7, 32.0)	28.6 (18.7, 38.4)	0.124
>99,999	19.4 (13.6, 25.2)	24.6 (19.1, 30.0)	26.2 (21.2, 31.1)	0.134
Age, years				
18–24	30.3 (24.9, 35.7)	30.5 (22.3, 38.7)	32.1 (24.6, 39.6)	0.710
25–34	25.2 (20.0, 30.4)	30.6 (20.8, 40.4)	26.1 (21.2, 31.0)	0.861
35–44	28.2 (22.6, 33.9)	33.1 (27.5, 38.8)	27.4 (24.6, 30.2)	0.701
45–54	32.3 (25.7, 39.0)	36.5 (30.3, 42.8)	30.8 (25.1, 36.6)	0.588
55–64	30.0 (21.6, 38.4)	29.1 (22.9, 35.3)	35.6 (28.3, 42.9)	0.224
>64	34.5 (25.3, 43.8)	29.4 (19.6, 39.1)	33.0 (26.1, 39.9)	0.946
Education				
Less than high school degree	40.7 (33.3, 48.0)	36.9 (29.0, 44.8)	32.8 (23.6, 41.9)	0.185
High school degree	29.7 (24.8, 34.6)	36.7 (30.0, 43.4)	36.9 (31.9, 41.9)	0.054
Some college	26.0 (18.9, 33.0)	27.1 (20.5, 33.7)	31.8 (28.7, 35.0)	0.097
College graduate	24.4 (20.1, 28.8)	29.5 (23.1, 35.8)	26.7 (24.6, 28.8)	0.525
Race/ethnicity				
White, non-Hispanic	**17.9 (14.8, 20.9)**	**25.2 (21.2, 29.3)**	**28.4 (26.9, 29.9)**	**<0.001**
Black, non-Hispanic	33.5 (29.1, 38.0)	38.5 (31.1, 45.9)	33.9 (26.3, 41.5)	0.991
Asian/Pacific Islander	40.8 (29.5, 52.1)	41.9 (32.1, 51.7)	33.3 (26.9, 39.7)	0.173
Hispanic	37.3 (31.2, 43.3)	31.5 (25.4, 37.7)	29.5 (22.9, 36.0)	0.095
Other[a]	47.8 (25.3, 70.4)	32.9 (17.8, 48.0)	26.4 (13.7, 39.2)	0.110
Sex				
Female	30.7 (27.2, 34.2)	32.3 (27.8, 36.8)	31.9 (29.1, 34.7)	0.616
Male	27.0 (23.6, 30.3)	31.5 (26.4, 36.6)	28.6 (24.9, 32.4)	0.692
Household-owned car				
At least 1 car	23.2 (19.9, 26.5)	29.2 (25.2, 33.2)	27.8 (25.3, 30.2)	0.060
No car	36.3 (32.0, 40.6)	35.6 (29.1, 42.0)	33.6 (30.6, 36.6)	0.296
Employment status				
Employed	28.4 (25.6, 31.3)	29.9 (26.1, 33.6)	27.6 (24.8, 30.5)	0.628
Not employed	30.8 (25.5, 36.1)	36.1 (29.8, 42.5)	36.3 (31.1, 41.4)	0.222
Presence of rail in the MSA				
Yes	31.4 (28.3, 34.5)	34.2 (29.6, 38.8)	31.9 (29.3, 34.5)	0.899
No or household not in MSA	22.6 (18.1, 27.2)	26.3 (21.2, 31.4)	27.3 (23.7, 31.0)	0.144
Household urban status				
Urban	29.5 (27.0, 32.1)	32.1 (28.5, 35.7)	30.3 (28.3, 32.4)	0.769
Rural	**6.5 (2.0, 10.9)**	**26.8 (13.9, 39.7)**	**32.8 (18.8, 46.8)**	**<0.001**

Note: Boldfaces indicate a statistically significant (*p*<0.01) linear trend in the proportion of transit walkers gaining ≥30 minutes of walk time from 2001 to 2017, which was tested using logistic regression. Analysis was restricted to transit walkers, defined as those who walked to and from transit on their assigned travel day.
[a]Other includes American Indian, Alaska Native, multiracial, or other races.
MSA, metropolitan statistical area; NHTS, National Household Transportation Survey.

gentrification and displacement of transit-dependent populations in urban areas.[36,37]

This analysis found that a lower proportion of transit walkers are white, non-Hispanics, consistent with other national surveys suggesting that transit riders largely are composed of minority populations.[38] Although adherence to physical activity guidelines has improved over time, sociodemographic disparities still exist, with the lowest adherence rates among older and minority populations.[39] Among transit walkers, 34% of black, non-

Table 3. Multivariable Linear Regression Model Predicting Minutes/Day of Transit Walking, 2017 NHTS

Characteristic	Adjusted coefficient (95% CI)[a]	p-value
Male	0.99 (0.90, 1.08)	0.61
Age, years		0.09
18–24	ref	
25–34	0.89 (0.70, 1.13)	
35–44	0.96 (0.78, 1.19)	
45–54	0.92 (0.70, 1.21)	
55–64	1.05 (0.86, 1.28)	
>64	0.95 (0.72, 1.24)	
Race/ethnicity		0.14
White, non-Hispanic	ref	
Black, non-Hispanic	1.05 (0.98, 1.14)	
Asian/Pacific Islander	1.04 (0.88, 1.23)	
Hispanic	0.95 (0.83, 1.09)	
Other[b]	1.13 (0.90, 1.42)	
Household income/year, $		**<0.01**
<25,000	**1.34 (1.15, 1.56)**	
25,000−49,999	1.10 (0.95, 1.27)	
50,000−74,999	1.19 (0.99, 1.44)	
75,000−99,999	1.18 (1.00, 1.39)	
>99,999	ref	
Presence of rail in MSA	**1.27 (1.11, 1.46)**	**<0.01**

Note: Boldface indicates statistical significance (*p*<0.01).
[a]Coefficients represent the adjusted association between a demographic characteristic and the geometric mean of minutes per day of transit walking, controlling for all other variables.
[b]Other includes American Indian, Alaska Native, multiracial, or other races.
MSA, metropolitan statistical area; NHTS, National Household Transportation Survey.

Hispanics; 30% of Hispanics; and 33% of those aged >64 years walked ≥30 minutes per day to and from transit in 2017. Improving access and addressing age- and race/ethnicity-specific barriers to transit may mitigate disparities in physical activity and promote healthy aging.

Increases in the proportion of transit walkers in this analysis differs from other national statistics on transit ridership. The American Public Transportation Association reported an 8% increase in transit trips from 9.5 billion in 2001 to 10.3 billion in 2009 and a 6% decrease from its peak in 2014 (10.7 billion trips) to 2017 (10.1 billion trips).[40,41] Reporting may differ because of the differences in sampling and reporting of trips.[32] Several explanations have been proposed for the recent decline in transit ridership.[35−37] Ride-hailing services have been linked to reductions in transit use, although findings are conflicting and region-dependent.[23,42,43] This analysis found that a higher proportion of transit walkers used ride-hailing services than that the full NHTS sample, although the use of ride-hailing services was not significantly predictive of the minutes per day of transit walking. Findings may be consistent with studies suggesting that ride-hailing services and public transit are seen as part of a multimodal lifestyle.[42,44] Further studies are needed to examine the impact of ride-hailing services on transit ridership and associated physical activity, especially as autonomous vehicles continue to develop.[45]

Limitations

The NHTS collects data during a 24-hour travel day that may not be representative of typical routine. However, the use of large, national data allowed for generalizable estimates of transit walking among U.S. adults. The increasing use of cell phones may have impacted response rates and representativeness of the 2001 and 2009 NHTS samples, which only included landlines. Trip activities are self-reported and may be inaccurate. This bias may have been mitigated as participants were given a travel diary, and travel data were collected within 7 days from the assigned travel day. This analysis could not account for secular trends that may impact travel behavior during the study period, such as changes in transit or pedestrian infrastructure, travel-related costs, employment growth, or emerging travel modes (e.g., car or bike sharing).[23]

The NHTS does not collect information about leisure-time physical activity that is unrelated to travel. Individuals may change activity patterns owing to active commuting, and more research examining activity substitution is needed.[10] It is unclear whether reported transit walking qualifies as moderate-to-vigorous activity. NHTS data do not include information on muscle-strengthening activities and the amount of time spent walking for nontransit users. Though some exercise is better than none,[1] the 30 minutes per day of aerobic activity target has been used in other peer-reviewed articles[11,12,15,16] and is a daily target recommended by some organizations.[4−6] In addition, studies have suggested that replacing 30 minutes per day of sedentary time with an equal amount of light-intensity activity is associated with an 11%−20% risk reduction in all-cause mortality.[46−48]

Finally, this analysis excluded those who commute to and from public transit using other active transportation modes instead of walking (e.g., biking) or using nonactive transportation (e.g., personal vehicles). Walking is the most common form of physical activity among U.S. adults.[8] In the 2017 NHTS, transit walkers comprised 89.6% transit users, and they were demographically similar to transit users who commute to and from transit using other modes in terms of age, education, sex, employment status, and geography. Future studies could

examine physical activity attained through other modes to get to and from transit and assess differences in physical activity levels by mode of transit.[49]

CONCLUSIONS

Inadequate physical activity is associated with significant morbidity and mortality. Community-level interventions such as expansion of public transit are increasingly considered as strategies that can integrate physical activity into daily lives. This study corroborates previous findings that walking to public transit is a source of physical activity. Although modifying and enhancing transit may contribute further to physical activity levels, continued surveillance will be valuable as new forms of technology and shifting demographics may impact transit-associated physical activity.

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