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(Citation)
Health Psychology,37(4):355-363

(Issue Date)
2018-04

(Resource Type)
journal article

(Version)
Accepted Manuscript

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Acknowledgments

This work was supported by Strategic Basic Research Programs (RISTEX Redesigning Communities for Aged Society), Japan Science and Technology Agency; and Grant-in-Aid for Young Scientists B (26750329), Japan Society for the Promotion of Science.

Abstract

Objective: Although previous studies have shown that good access to public transportation is positively related with physical activity, the moderators of this relationship have not been explored sufficiently in older adults. It is possible that driving status could moderate this relationship. The present study examined whether the objectively measured distance between public transportation and the home was associated with physical activity levels, and whether this association was moderated by driving status among Japanese older adults. **Methods:** In this cross-sectional study, participants (n = 2878) completed questionnaires and wore accelerometers for at least seven days, to measure their average daily step counts and minutes spent engaging in moderate-to-vigorous physical activity. Road network distances (m) between the home and the nearest bus stop or train station were measured using geographic information systems. Driving status was assessed using questionnaires. **Results:** Multiple regression analyses stratified by driving status revealed that, among non-drivers, living further away from public transportation was associated with higher step counts ($\beta=0.08$, $p<0.001$) and moderate-to-vigorous physical activity ($\beta=0.06$, $p=0.029$). Among drivers, living closer to public transportation was significantly associated with higher moderate-to-vigorous physical activity levels ($\beta=-0.05$, $p=0.042$). **Conclusions:** Despite the small effect sizes, the direction of the association between distance from public transportation and physical activity was different for current drivers and non-drivers. These findings imply that good access to public transportation does not positively relate with greater engagement in physical activity among non-driving older adults. Shorter distances to public transportation might reduce opportunities for engaging in physical activity for them.

Key words: active living, aged, automobile driving, effect modifier, environment design, geographic information systems, physical activity, public transportation, residence characteristics, walking

Distance from Public Transportation and Physical Activity in Japanese Older Adults: The Moderating Role of Driving Status

The health benefits of physical activity among older adults have been established by substantial research evidence. Current physical activity guidelines recommend that older adults should engage in physical activity to promote healthy living (Nelson et al., 2007; World Health Organization, 2010). However, the level of physical activity is lower in older adults as compared to that in younger adults (e.g., Inoue, Ohya, Tudor-Locke, et al., 2011). Therefore, it is a public health priority to developing effective strategies to promote physical activity among older adults. In order to develop effective promotional strategies, it is necessary to identify modifiable factors associated with physical activity (Sallis, Owen, & Fotheringham, 2000). In particular, the ecological model (Sallis et al., 2006) proposes the importance of environmental influences on physical activity, because environmental factors can have longer-term effects on larger populations than individual factors can. Environmental attributes represent an emerging area of physical activity research, and numerous previous studies have identified environmental correlates of physical activity among adults, such as access to outdoor physical activity facilities, diversity of land use mix, and residential density (e.g., Saelens & Handy, 2008). Because environmental correlates of physical activity among older adults are different from those among younger adults (e.g., Shigematsu et al., 2009), it is necessary to conduct research focusing on older adults to develop effective strategies to promote physical activity among them.

Among various environmental factors, good access to public transportation (e.g., access to a bus stop and train station) is commonly examined as an environmental factor in physical activity studies. The Physical Activity Neighborhood Environment Scale (Sallis et al., 2010), which is one of the commonly used measure of perceived environment, includes an item assessing public transportation. The International Physical Activity and Environment

Network study (Adams et al., 2014) also measured public transportation objectively as a component of the physical activity environment. Across various countries, people with good access to public transportation are more physically active than those without good access are (Sallis et al., 2009). Longitudinal studies have revealed that good access to public transportation is positively associated with physical activity level (e.g., Cleland, Timperio, & Crawford, 2008; Knuiman et al., 2014). A meta-analysis also showed that good access to public transportation is positively associated with physical activity among older adults (Cerin et al., 2017).

To derive a better understanding of the environmental influences (e.g., influences of access to public transportation) on physical activity among older adults, it is necessary to examine moderators (effect modifier) (Cerin et al., 2017). Driving status could be a moderator (effect modifier) in the relationship between public transportation and physical activity among older adults. It can be expected that drivers are less likely to use public transportation than non-drivers are; therefore, it is possible that access to public transportation is more closely associated with physical activity level among non-drivers than among drivers. However, only a few previous studies have shown that the relationship between access to public transportation and physical activity was moderated by driving status (Kamada et al., 2009; Cerin et al., 2016). One study from the United States failed to find evidence for the moderating role of driving status (Ding et al., 2004). Thus, further examinations are necessary to determine the moderating role of driving status on the relationship between access to public transportation and physical activity.

Furthermore, in some cases, such as in areas with sufficiently developed public transportation systems, good access to public transportation might not necessarily be associated with higher physical activity levels in older adults. Previous studies have argued that the use of public transportation can help increase physical activity because people have to walk to and from the bus stop/train stations and their destinations (Besser & Dannenberg, 2005; Rissel, Curac, Greenaway, & Bauman, 2012). Thus, it could be assumed that extremely good access to public transportation would not be helpful to increase transportation-related physical activity, as the distance individuals have to walk would be shorter. Indeed, contrary to the findings of the meta-analysis, previous studies from Japan, where the public transportation network is adequately matured and its utilization is much higher than it is in Western countries (Japan Ministry of Land, Infrastructure, Transport and Tourism, 2012), have not found positive relationships between access to public transportation and physical activity among older adults (Inoue, Ohya, Odagiri et al., 2011; Saito, Oguma, Inoue, Tanaka, & Kobori, 2013; Tsunoda et al., 2012). Instead, Tsunoda et al. (2012) revealed that Japanese older adults who perceive their public transportation favorably are actually less likely to walk ≥150 minutes in a week than are those who do not. However, while these Japanese studies have assessed access to public transport and physical activity level only through self-reports of participants (Inoue, Ohya, Odagiri et al., 2011; Saito et al., 2013; Tsunoda et al., 2012), a Hong Kong study (Cerin et al., 2016) measured them using objective methods. Cerin et al. (2016) found that good access to public transportation was negatively associated with the physical activity level among older adults who did not own cars. These Asian studies (Cerin et al., 2016; Tsunoda et al., 2012) imply that adequate access, rather than good access, to public transportation might be more desirable in promoting physical activity among older adults, especially among non-drivers. However, except for these two studies, no previous studies have supported this indication.

Therefore, the purpose of the present study was to examine whether objectively measured distance from public transportation was associated with physical activity level, and whether this association was moderated by driving status among Japanese older adults.

Methods

Participants and Procedures

The present study analyzed the data of a sub-cohort of the National Center for Geriatrics and Gerontology-Study of Geriatric Syndromes: NCGG-SGS (Shimada et al., 2016), conducted in 2013, at Midori ward, Nagoya city, Japan. Nagoya city consists of 16 Wards, and it is the capital of the Aichi prefecture, with a population of approximately 2.3 million residents. The NCGG-SGS received prior approval from the ethic committee of the National Center for Geriatrics and Gerontology. Informed consent was obtained from all participants. All procedures were conducted in accordance with the Helsinki Declaration. Among the NCGG-SGS sub-cohort data, the present study utilized the data from a questionnaire and an accelerometer.

The questionnaire survey was conducted from July to December 2013 as a part of a screening for decline in cognitive and physical function. Three public facilities were utilized as screening sites. An invitation document for the screening was sent to all people (n=24271) aged 70 years or more on January 1, 2013, who lived in Midori ward and were without long-term care needs or support. Among all invited people, 5257 (21.7%) actually participated in the screening and answered a questionnaire. Trained staff supported participants in answering the questionnaire when required.

Triaxial accelerometers were distributed to all participants. They were asked to wear the accelerometer every day, for one month, after which they were asked to visit one of the nine Midori ward pharmacies with data-readers capable of downloading the accelerometer data (the authors had collaborative relationships with the pharmacies and had asked them to place the data-readers). The display of the accelerometer was hidden. From 5257 initial participants, 79 refused to wear the accelerometer, 1627 did not visit any of the nine pharmacies within two months, and 18 experienced technical errors with the data-reader. Of the remaining 3533 participants, 335 participants who did not wear the accelerometer for ≥ 10 hours each day, at least for seven days, as well as seven outliers for the average number of steps per day (less than 300 steps per day or more than 30000 steps per day) were excluded. Furthermore, 2878 individuals met the following criteria: 1) did not report a decline in engaging in basic activities of daily living; 2) did not have a history of dementia, stroke, or Parkinson’s disease; 3) scored 20 points or higher on the Mini Mental State Examination; and 4) did not have any missing data on the variables used in the present study. Finally, data of 2878 participants were analyzed in the present study.

Measures

Physical activity. A triaxial accelerometer (modified GT40-020: ACOS Corporation, Limited: Nagano, Japan: size 75 × 33.5 × 10.8 mm, weight 26 g) was used to measure step counts and time spent engaging in moderate-to-vigorous physical activity (activities involving ≥3 metabolic equivalents, which is the expression of the energy cost of physical activity). Current physical activity guidelines recommend that both younger and older adults engage in physical activity with moderate to vigorous intensity levels (Nelson et al., 2007; World Health Organization, 2010). The intensity level of activity was measured by the same algorithm as the Kenz Lifecorder (Suzuken Corporation, Limited: Aichi, Japan (Kumahara et al., 2004)). The accelerometer estimates the intensity of physical activity across 10 levels, with Level 4 or higher corresponding to ≥3 metabolic equivalents. The epoch length of the accelerometer was set as 4 seconds. The participants were asked to wear the accelerometer on either the left or right side of their waist when they were awake, except for during swimming or bathing, and to lead life as usual. The time engaged in moderate-to-vigorous physical activity in a day was calculated by adding up all epochs in which the intensity level was estimated at Level 4 (≥3 metabolic equivalents) or higher.

Because previous studies have commonly required participants to wear the accelerometer for ≥10 hours per day (Gorman et al., 2014), the present study included participants' data only from days on which they had worn the device for ten hours or more. Wearing time was calculated by subtracting non-wearing time from 24 hours. A period of at least 35 minutes in which the accelerometer data was not recorded was designated as non-wearing time. Furthermore, because a previous study (Hart et al., 2011) proposed that at least four days of data would be necessary to estimate physical activity levels across 21 days, individuals were excluded if the total eligible days (wearing time ≥10 hours) were less than seven.

Distance from public transportation. Road network distances (m) from each home address to the nearest bus stop or exit of the train station were measured using geographic information systems [ArcGIS for Desktop 10.2.2 Network Analyst software (ESRI Japan Corporation: Tokyo, Japan)]. The bus stop data were downloaded from the *Kokudo-Suchi-Joho* download service (translated as "National Land Numerical Information"). Data on the exit of the train station were obtained from a common map service website [MapFan Web (Increment P Corporation) https://mapfan.com/]. There were totally 443 bus stops and 19 train stations in Midori ward and in other adjoining communities. The average operation frequency was 52.1 buses/day for each bus stop and 241.1 trains/day for each train station.

Driving status. The participants were asked whether they usually drove a car and/or motorbike by themselves (yes or no), and were accordingly categorized into current drivers and current non-drivers.

Demographic and health-related factors. Gender (men or women), age (years), education level (years spent in education), engagement in paid work (yes or no), living alone (yes or no), current alcohol drinking habits (yes or no), current smoking habits (yes or no), history of hypertension (yes or no), history of diabetes (yes or no), history of hyperlipidemia (yes or no), and history of heart disease (yes or no) were included as demographic and health-rated factors in the present study.

Analyses

Binary associations of current driving status with physical activity, distance from public transportation, and demographic and health-related factors were examined by chi-squared tests for categorical variables and t-tests for continuous variables.

Multiple regression analyses were performed with physical activity as the dependent variable (average daily step count, average minutes in moderate-to-vigorous physical activity per day). For the multiple regression analyses, the present study constructed two models. In Model 1, the independent variables were distance from public transportation, driving status, and demographic and health-related factors. All independent variables in Model 1 were entered using the force-entry method. In Model 2, 23 interaction terms were examined by the stepwise method: 11 interaction terms of current driving status with demographic and health-related factors; 11 interaction terms of distance from public transportation with demographic and health-related factors; and one interaction term of current driving status with distance from public transportation. Each interaction term was created by multiplying the standardized scores of each variable. Standardized scores were calculated using the means and standard deviations of each variable.

If the interaction terms were significant, stratified multiple regression analyses were conducted. In the stratified analyses, the independent variables included distance from public transportation and demographic and health-related factors for which any significant main and/or interactive results were observed in the regression analyses for the whole sample. The dependent variable was the physical activity level. Figures were also created to show the plot of physical activity variables by current driving status and distance from public transportation. Similar to previous studies that visually showed the interactive effects of neighborhood environments with individual factors on physical activities using figures (Carlson et al., 2012;

Ding Ding et al., 2012), the distance from public transportation was categorized into a near group (<-1SD group) and distant group (>+1SD group).

Statistical significance was set at $p<.05$. The Statistical Package for the Social Sciences (SPSS) for Windows 21.0 was used to perform all the analyses.

Results

Characteristics of Participants

Characteristics of the participants have been shown in Table 1. Mean steps per day was 5043.6, and the mean time engaged in moderate-to-vigorous physical activity was 23.2 minutes. Mean distance from the nearest public transportation was 292.6 m. Compared with non-drivers, current drivers were likely to be men, employed, living with others, alcohol drinkers, smokers, have diabetes, did not have hyperlipidemia, younger, and highly-educated.

Association of Distance from Public Transportation with Physical Activity, by Driving Status

Table 2 represents the results of the multiple regression analyses for the whole sample. In Model 1, the main effect of distance from public transportation was not significant on both physical activity variables. However, the effect of the interaction term of current driving status and distance from public transportation was significant on both variables. Among the demographic and health-related factors, the main effects of gender, living alone, current smoking status, history of heart disease, and current driving status on physical-activity levels (both steps and moderate-to-vigorous physical-activity level per day) were significant. None of the interaction terms for demographic and health-related factors with distance from public transportation and with current driving status were significant and therefore not selected in Model 2 by the stepwise method. Thus, further analyses stratified by current driving status were conducted.

The mean steps per day was 4923.7 in non-drivers and 5122.1 in drivers, the mean time engaged in moderate-to-vigorous physical activity was 22.9 minutes in non-drivers and 23.4 minutes in drivers, and the mean distance from the nearest public transportation mode (bus stop/train station) was 292.3 m in non-drivers and 292.9 m in drivers. A t-test revealed no significant differences between these variables [steps per day, $t(2876)=1.95$, $p=0.052$; moderate-to-vigorous physical activity, $t(2876)=0.78$, $p=0.436$; distance from nearest public transportation, $t(2876)=0.10$, $p=0.919$]. Table 3 (current non-driver) and Table 4 (current driver) show the results of the multiple regression analyses stratified by current driving status. Because both the main and interactive effects of employment in paid work, current drinking habits, hypertension, diabetes, hyperlipidemia, and education on physical activity were not significant in the analyses for the whole sample, these variables were excluded from the stratified analyses. In the stratified multiple regression analyses, Model 1 included demographic and health-related factors and Model 2 added distance from public transportation. These variables were entered by the force-entry method. The increases of adjusted R^2 from Model 1 to Model 2 were small among both non-drivers and drivers. However, among non-drivers, living at a greater distance from public transportation was significantly associated with higher step counts and moderate-to-vigorous physical activity levels. In contrast, among current drivers, living at a shorter distance from public transportation was associated with significantly higher moderate-to-vigorous physical activity levels. Although it was only marginally significant ($p=0.097$), shorter distances from public transportation were associated with higher step counts.

Figure 1 (steps per day) and Figure 2 (moderate-to-vigorous physical activity) show the average step counts and minutes in moderate-to-vigorous physical activity per day by using current driving status and distance from public transportation. Among current non-drivers, the differences of steps and moderate-to-vigorous physical activity per day between near group and distant group were 1124.3 step counts and 5.8 minutes, respectively. Among current drivers, the differences between near group and distant group were 575.4 step counts and 3.9 minutes, respectively.

Discussion

This present study found that the direction of the association between distance from public transportation and physical activity is different for current drivers and non-drivers though the effect sizes were small. To the best of our knowledge, only one previous study from Hong Kong (Cerin et al., 2016) reported similar findings. Together, these findings indicate that good access to public transportation does not always relate with physical activity levels among older adults. A meta-analysis showed that good access to public transportation positively relates with physical activity for older adults (Cerin et al., 2017). However, as evident from the findings of other Japanese studies (Inoue, Ohya, Odagiri et al., 2011; Saito et al., 2013; Tsunoda et al., 2012), this finding may not be generalizable to areas with more developed public transportation systems. Furthermore, the moderating role of driving status on the relationship between access to public transportation and physical activity were not sufficiently examined by previous studies.

Similarly, as compared to a Hong Kong study (Cerin et al., 2016), the present Japanese study showed that living at a greater distance from public transportation was associated with a higher physical activity level among current non-drivers. This finding indicates that walking to and from public transportation might represent an important opportunity for non-drivers to engage in transportation-related physical activity, and that living at a shorter distance from public transportation could reduce these opportunities. Previous studies (Besser & Dannenberg, 2005; Rissel et al., 2012) have reported that walking to public transportation contributes to an increase in physical activity levels, and have suggested that good access to public transportation promotes transportation-related physical activity. In the present study, living at a shorter distance from public transportation was associated with higher physical activity level among drivers, and with lower physical activity level among non-drivers. The different directions for this association between non-drivers and drivers could be explained by their choice of transportation. A previous study (Buehler, 2011) revealed that people who live further away from public transportation are more likely to choose to travel by car as their primary mode of transportation. For drivers, living closer to public transportation would lead them to choose the same over traveling by car, which would contribute to an increase in physical activity. However, most non-drivers do not have the choice but to rely on public systems for transportation. Therefore, they would choose public transportation regardless of the distance they had to walk from their home in order to travel by bus or rail. The necessity of public transportation for non-drivers might promote an increase in their physical activity.

While a meta-analysis (Cerin et al., 2017) reported that there was a positive relationship between access to public transportation and physical activity for older adults, other Japanese studies on older adults (Inoue, Ohya, Odagiri et al., 2011; Saito et al., 2013; Tsunoda et al., 2012) did not reveal positive and significant relationships. These inconsistent findings might be partly explained by the ratio of drivers and non-drivers. People tend to stop driving as they age (Shimada et al., 2016), and the utilization of public transportation is much higher in Japan than it is in most other countries (Japan Ministry of Land, Infrastructure, Transport and Tourism, 2012). Consequently, the ratio of non-drivers is higher in the older population than that in the younger population, particularly in Japan. This higher proportion of non-drivers might confound the relationship between access to public transportation and physical activity level.

Although significant associations were found, the effects of the distance from public transportation on physical activity were smaller than demographic and health-related factors regardless of driving status. Similar to our study, previous studies have consistently shown that environmental factors have slightly smaller impacts on physical activity than individual factors among both younger (Burton, Turnell, Oldenburg, & Sallis, 2005; Giles-Corti, & Donova, 2002) and older populations (Satariano et al., 2010; Wilcox, Bopp, Oberrecht, Kammermann, & McElmurray, 2003). Despite the smaller impact, an advantage of environmental factors is their long-term impact on larger populations compared with individual factors (Sallis et al., 2006). Smaller effects of the distance from public transportation are comparable to previous studies, and be a relevant result. However, as shown in Figure 2, the absolute differences in the duration of moderate-to-vigorous physical activity were lower than 10 minutes, while current guidelines recommend that physical activity should be performed in bouts of at least 10 minutes (Nelson et al., 2007; World Health Organization, 2010). The present study does not confirm whether the impact of the distance from public transportations is meaningful in the practical context of physical activity promotions.

The present study utilized the data from Japanese urban/suburban areas. The mean distance from the participants' home to the nearest form of public transportation was 292.6 m. As mentioned in the Methods section, the average operation frequencies of buses and trains were adequately high (52.1 buses/day for each bus stop and 241.1 trains/day for each station). As the availability of public transportation in the research area was considered good, this finding cannot be generalized to areas where public transportation systems are not sufficiently developed, such as in rural areas. There is the possibility that living at an extremely long distance from public transportation (e.g., a few of kilometers) would inhibit physical activity among non-drivers. However, the data of the present study cannot examine this possibility. Further studies exploring optimal distance from public transportation to promote physical activity among drivers and non-drivers would be expected.

The strengths of the present study include its adequate sample size and employment of objective assessments for measuring both distance from public transportation and physical activity levels. However, the present study includes some limitations. First, the study design was cross-sectional. Second, the present study did not investigate the mechanism on how distances from public transportation would influence physical activity among older adults. Potential mediating factors, such as the actual use of public transportation and walking time by purposes (i.e., walking for utilitarian/transportation and leisure/recreational purposes) were not measured in this study. Frequent uses of public transportation and longer walking time for utilitarian/transportation might explain the relationship between distances from public transportation and physical activity. Further examination will be necessary to clarify its mechanisms. Absence of measuring potential mediating factors might also explain why a clear, significant, relationship between distance from public transportation and steps per days was not found among current drivers. Third, the present study would include sampling bias. The average steps per day in the present study (5043.6 step counts) was similar to Japanese national data (4898 step counts in those aged ≥ 70 years or more: Japan Ministry of Health, Labour and Welfare, 2015). However, the rate of participants of the present study was 21.3%, and 38.2% of participants were excluded from the analysis due to the inadequacies in wearing the accelerometers. Previous Japanese studies for older adults (Chen et al., 2015; Izawa, Shibata, Ishii, Miyawaki, & Oka, 2017; Saito, Sakita, & Kumagai, 2015) have shown higher participation rates in the studies (27.9% to 43.0%) and lower exclusion rates due to the accelerometer problems (14.7% to 23.4%) than the present study. Thus, sampling bias of the present study should be noted. In spite of these limitations, the present study contributes to the better understanding of the association between public transportation and physical activity among older adults.

In conclusion, the present study found that living further away from public transportation was associated with lower physical activity levels among drivers, but with higher physical activity levels among non-drivers in Japanese older adults. These findings indicate that good access to public transportation would not positively relate to physical activity among older adults. However, the present study should note that the effect sizes of impact of distance from public transportation on physical activity were small, and that the mechanisms of the effects were not shown. To clarify the mechanisms and to indicate the practical impact and the optimal level of the accessibility of public transportation, it is necessary to reveal the relationships among access to public transportations, frequency of use of each transportation mode, walking time by purposes, and total physical activity levels. Nonetheless, the present study provides evidence contrary to the previous findings about the importance of good access to public transportation. The present study can have policy implications different from those in previous studies. According to the present study, improving access to public transportation might increase physical activity in older adults at the population level if the majority of the population were drivers. In contrast, if there are considerable numbers of non-driving older adults, improving access to public transport might not be helpful in increasing physical activity at the population level. Furthermore, it can be speculated that making public transportation extremely convenient would be unprofitable; although it would demand greater amount of costs, it could lead to the increase of healthcare costs through the decrease of physical activity among older adults. Based on our findings, effective environmental interventions could be investigated as a way to promote physical activity in older adults.

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Figure Legends

Figure 1. Associations of distance from public transportation and driving status with steps per day. Steps per day were adjusted by gender, age, living alone, current smoking habits, and history of heart disease. The distance from public transportation was categorized into near group (<-1SD group) and distant group (>+1SD group). F value and p value for the interaction term of distance from public transportation and driving status in analysis of covariance were $F=18.3$ and $p<0.001$.

Figure 2. Associations of distance from public transportation and driving status with moderate-to-vigorous physical activity per day. Moderate-to-vigorous physical activity per day was adjusted by gender, age, living alone, current smoking habits, and history of heart disease. The distance from public transportation were categorized into near group (<-1SD group) and distant group (>+1SD group). F value and p value for the interaction term of distance from public transportation and driving status in analysis of covariance were $F=13.4$ and $p<0.001$.

MVPA, moderate-to-vigorous physical activity

Table 1

Characteristics of Participants

	Total, n or mean (N=2738)		Driving status, n or mean				
			Current non driver (n=1139)		Current driver (n=1739)		p-value
Gender, n (%)							<0.001[a]
Women	1494	(51.9)	949	(83.3)	545	(31.3)	
Men	1384	(48.1)	190	(16.7)	1194	(68.7)	
Employment in paid work, n (%)							<0.001[a]
No	2375	(82.5)	1009	(88.6)	1366	(78.6)	
Yes	503	(17.5)	130	(11.4)	373	(21.4)	
Living alone, n (%)							<0.001[a]
No	2449	(85.1)	897	(78.8)	1552	(89.2)	
Yes	429	(14.9)	242	(21.2)	187	(10.8)	
Current alcohol drinker, n (%)							<0.001[a]
No	1664	(57.8)	819	(71.9)	845	(48.6)	
Yes	1214	(42.2)	320	(28.1)	894	(51.4)	
Current smoker, n (%)							<0.001[a]
No	2712	(94.2)	1112	(97.6)	1600	(92.0)	
Yes	166	(5.8)	27	(2.4)	139	(8.0)	
Hypertension, n (%)							0.465[a]
No	1515	(52.6)	590	(51.8)	925	(53.2)	
Yes	1363	(47.4)	549	(48.2)	814	(46.8)	
Diabetes, n (%)							0.012[a]
No	2536	(88.1)	1025	(90.0)	1511	(86.9)	
Yes	342	(11.9)	114	(10.0)	228	(13.1)	
Hyperlipidemia, n (%)							<0.001[a]
No	1660	(57.7)	594	(52.2)	1066	(61.3)	
Yes	1218	(42.3)	545	(47.8)	673	(38.7)	
Heart disease, n (%)							0.094[a]
No	2342	(81.4)	944	(82.9)	1398	(80.4)	
Yes	536	(18.6)	195	(17.1)	341	(19.6)	
Current driving status, n (%)							—
No	1139	(39.6)	—	—	—	—	
Yes	1739	(60.4)	—	—	—	—	
Age (years), mean (SD)	75.6	(4.1)	76.6	(4.4)	75.0	(3.7)	<0.001[b]
Education level (years), mean (SD)	12.0	(2.6)	11.4	(2.4)	12.4	(2.7)	<0.001[b]
Distance from public transportation (m), mean (SD)	292.6	(146.5)	292.3	(141.9)	292.9	(149.5)	0.919[b]
Steps per day, mean (SD)	5043.6	(2673.7)	4923.7	(2590.8)	5122.1	(2724.5)	0.052[b]
Moderate-to-vigorous physical activity (minutes) per day, mean (SD)	23.2	(17.4)	22.9	(16.2)	23.4	(18.1)	0.436[b]

[A]chi-squared test, [b]t-test

Table 2

Multiple Regression Analysis for the Association of Distance from Public Transportation and Driving Status with Physical Activity

	Steps per day				MVPA per day			
	Model 1[a]		Model 2[b]		Model 1[c]		Model 2[d]	
	Standardized β	p value	Standardized β	p value	Standardized β	p value	Standardized β	p value
Gender (male)	0.18	<0.001	0.17	<0.001	0.20	<0.001	0.20	<0.001
Employment in paid work (yes)	0.02	0.207	0.02	0.223	-0.01	0.583	-0.01	0.552
Living alone (yes)	0.06	0.002	0.06	0.001	0.08	<0.001	0.08	<0.001
Current alcohol drinker (yes)	0.03	0.097	0.03	0.112	0.02	0.267	0.02	0.299
Current smoker(yes)	-0.06	0.001	-0.06	0.001	-0.06	0.003	-0.06	0.003
Hypertension (yes)	-0.03	0.167	-0.02	0.200	-0.01	0.708	-0.01	0.782
Diabetes (yes)	0.01	0.481	0.01	0.484	0.02	0.281	0.02	0.283
Hyperlipidemia (yes)	0.01	0.725	0.01	0.709	0.03	0.129	0.03	0.124
Heart disease (yes)	-0.06	0.001	-0.06	0.001	-0.07	<0.001	-0.07	<0.001
Current driving status (yes)	-0.09	<0.001	-0.09	<0.001	-0.10	<0.001	-0.10	<0.001
Age	-0.22	<0.001	-0.22	<0.001	-0.18	<0.001	-0.18	<0.001

Education level	0.01	0.469	0.01	0.502	0.01	0.783	0.00	0.824
Distance from public transportation	0.01	0.740	0.01	0.631	-0.01	0.654	-0.01	0.762
Current driving status × distance from public transportation	—	—	-0.06	0.002	—	—	-0.05	0.003

MVPA: moderate-to-vigorous physical activity

Model 1: Distance from public transportation, driving status, and demographic and health-related factors were included by the force entry method.

Model 2: The interaction terms of current driving status or distance from public transportation with demographic and health-related factors, and current driving status with distance from public transportation were added by the stepwise method.

[a]Adjusted R^2 = 0.066, [b]Adjusted R^2 = 0.069, [c]Adjusted R^2 = 0.050, [d]Adjusted R^2 = 0.053

Table 3

Multiple Regression Analysis for the Association of Distance from Public Transportation with Physical Activity among non-Driver (n=1139)

	Steps per day				MVPA			
	Model 1[a]		Model 2[b]		Model 1[c]		Model 2[d]	
	Standardized β	p value	Standardized β	p value	Standardized β	p value	Standardized β	p value
Gender (male)	0.16	<0.001	0.16	<0.001	0.18	<0.001	0.18	<0.001
Living alone (yes)	0.10	0.001	0.10	0.001	0.13	<0.001	0.13	<0.001
Current smoker (yes)	-0.02	0.553	-0.02	0.510	-0.03	0.370	-0.03	0.342
Heart disease (yes)	-0.07	0.014	-0.07	0.018	-0.07	0.017	-0.07	0.021
Age	-0.25	<0.001	-0.25	<0.001	-0.20	<0.001	-0.20	<0.001
Distance from public transportation	—	—	0.08	0.007	—	—	0.06	0.029

MVPA: moderate-to-vigorous physical activity

Model 1: Demographic and health-related factors were included.

Model 2: Demographic and health-related factors, and distance from public transportation were included.

[a]Adjusted R^2 = 0.071, [b]Adjusted R^2 = 0.076, [c]Adjusted R^2 = 0.061, [d]Adjusted R^2 = 0.064

Table 4

Multiple Regression Analysis for the Association of Distance from Public Transportation with Physical Activity among Driver (n=1739)

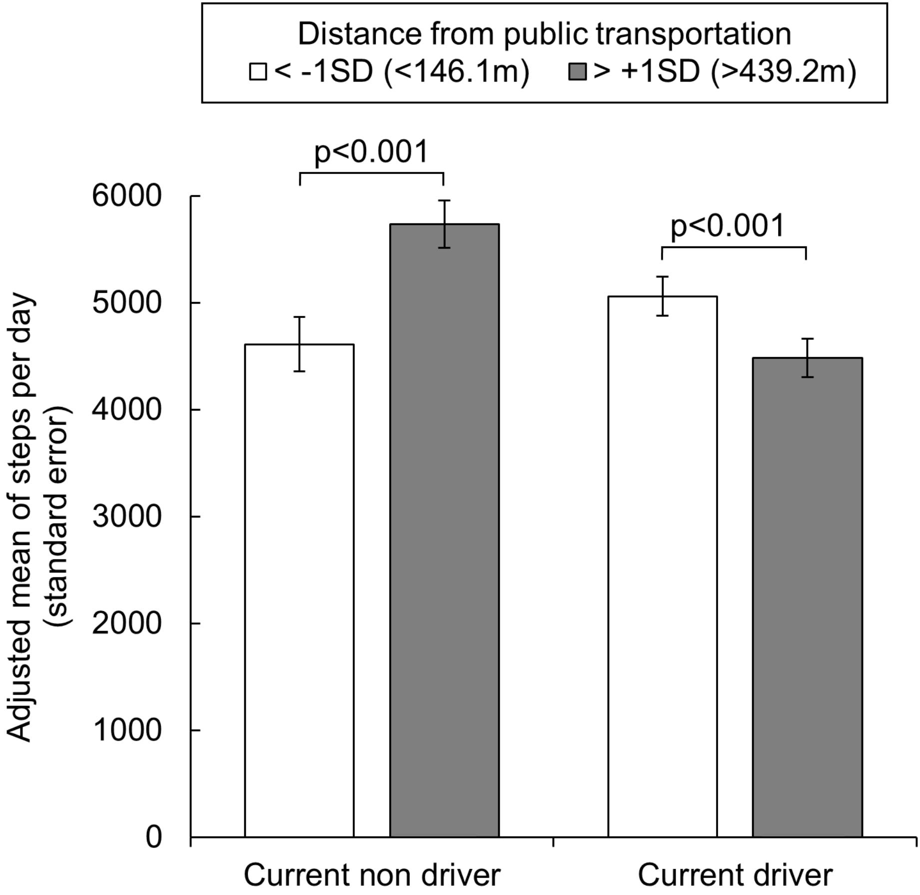
	Steps per day				MVPA			
	Model 1[a]		Model 2[b]		Model 1[c]		Model 2[d]	
	Standardized β	p value	Standardized β	p value	Standardized β	p value	Standardized β	p value
Gender (male)	0.16	<0.001	0.16	<0.001	0.16	<0.001	0.17	<0.001
Living alone (yes)	0.02	0.360	0.02	0.308	0.04	0.155	0.04	0.121
Current smoker (yes)	-0.08	0.001	-0.08	0.001	-0.07	0.006	-0.07	0.006
Heart disease (yes)	-0.06	0.019	-0.06	0.017	-0.06	0.008	-0.06	0.007
Age	-0.22	<0.001	-0.22	<0.001	-0.17	<0.001	-0.17	<0.001
Distance from public transportation	—	—	-0.04	0.097	—	—	-0.05	0.042

MVPA: moderate-to-vigorous physical activity

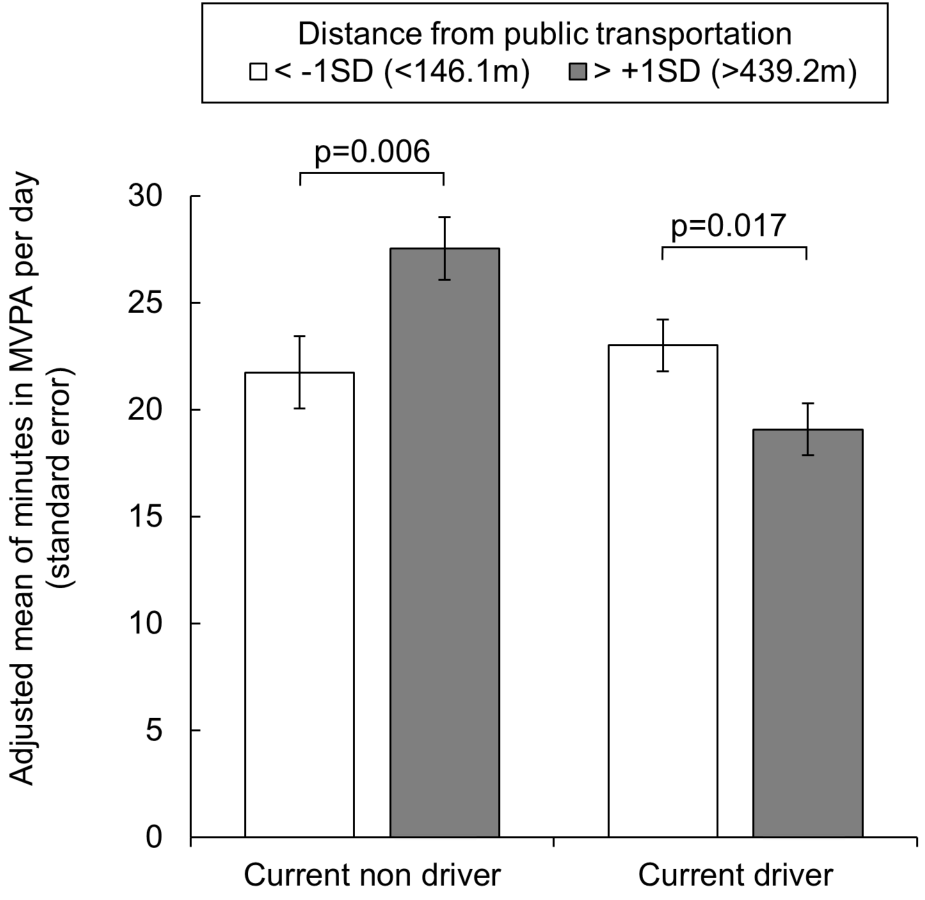
Model 1: Demographic and health-related factors were included.

Model 2: Demographic and health-related factors and distance from public transportation were included.

[a]Adjusted R^2 = 0.061, [b]Aadjusted R^2 = 0.062, [c]Adjusted R^2 = 0.045, [d]Adjusted R^2 = 0.047



Distance from public transportation
< -1SD (<146.1m)
> +1SD (>439.2m)
p<0.001
p<0.001
6000
5000
4000
3000
2000
1000
0
Adjusted mean of steps per day (standard error)
Current non driver
Current driver



Distance from public transportation
< -1SD (<146.1m)
> +1SD (>439.2m)
p=0.006
p=0.017
Adjusted mean of minutes in MVPA per day (standard error)
30
25
20
15
10
5
0
Current non driver
Current driver