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Abstract

This study examined associations between perceived neighborhood environment and physical activity among frail older adults and whether these associations are moderated by fear of falling. Participants were 238 frail older adults. Daily step counts and duration of moderate-to-vigorous physical activity were measured using an accelerometer. Participants completed the abbreviated Neighborhood Environment Walkability Scale; fear of falling and demographic and health-related factors were measured by a questionnaire. The interaction between crime safety and fear of falling was significantly associated with step count (p = 0.009) and moderate-to-vigorous physical activity (p = 0.018) in multiple regression analysis. Stratified according to fear of falling, crime safety was significantly associated with steps (p = 0.007) and moderate-to-vigorous physical activity (p = 0.030) in the low fear of falling group. The results suggest that crime safety is associated with physical activity among frail older adults, and this association is moderated by fear of falling.

Keywords: accidental falls, aged, effect modifier, environment design, fear, frail elderly, health promotion, motor activity, safety, walking

Joint Association of Neighborhood Environment and Fear of Falling on Physical Activity Among Frail Older Adults

Frailty in older adults is recognized as a major public problem in countries with aging populations, including Japan. Frailty represents a state involving higher risk of adverse health outcomes such as falls, hospitalization, and mortality (Fried et al., 2001). The relevance of frailty increases as individuals age (Collard, Boter, Schoever, & Oude Voshaar, 2012). Previous studies have indicated that engaging in physical activity is effective in reducing the risk of health problems in frail older adults (Drey et al., 2012; Giné-Garriga, Roqué-Fíguls, Coll-Planas, Sitjà-Rabert, & Salvà, 2014; Landi et al., 2004; Landi et al., 2007; Langlois et al., 2013; Norton et al., 2001; Yamada, Arai, Sonoda, & Aoyama, 2012). Therefore, the promotion of physical activity among frail older adults should be regarded as a key public health priority.

The identification of modifiable factors associated with physical activity is essential in developing effective promotion strategies (Sallis, Owen, & Fotheringham, 2000). In particular, environmental attributes, which can have long-term effects on large populations, represent an emerging area of research (Sallis et al., 2006). Numerous previous studies have identified environmental factors associated with physical activity in adults. However, although the environmental correlates of physical activity differ according to age group (Shigematsu et al., 2009), evidence of these correlates in older adults is insufficient (Van Cauwenberg et al., 2011). Moreover, some previous studies have suggested that relationships between environment and physical activity differ according to physical function in older adults (Gong, Gallacher, Palmer, & Fone, 2014; King et al., 2011; Satariano et al., 2010). Therefore, the effects of environment on physical activity could also differ between nonfrail and frail older adults. According to previous studies targeting older Japanese adults (Inoue et al., 2011; Saito, Oguma, Inoue, Tanaka, & Kobori, 2013; Tsunoda et al., 2012), esthetics are most commonly reported as correlates of physical activity. However, whether esthetics are also associated with

physical activity in Japanese frail older adults remains unclear.

To improve understanding of the effects of environment on physical activity in frail older adults, examination of the moderators (effect modifiers) of the relationship between the built environment and physical activity is necessary. An ecological model assumes that physical activity is influenced by interactions between factors at multiple levels, and multilevel interventions are more effective in promoting physical activity (Sallis et al., 2006). Specifically, the interactive effects of psychosocial and environmental factors on physical activity constitute an important research topic (Bauman et al., 2012). In accordance with an ecological model (Sallis et al., 2009), previous studies (Carlson et al., 2012; Cerin, Vandelanotte, Leslie, & Merom, 2008; Ding et al., 2012; Kaczynski, Robertson-Wilson, & Decloe, 2012; Van Dyck et al., 2014) have suggested that the relationship between the environment and physical activity is moderated by psychological factors such as self-efficacy, perceived benefits and barriers, and enjoyment. Fear of falling could be an additional moderator of the relationship between environment and physical activity in frail older adults. Previous studies have shown that this population tends to experience fear of falling (Murphy, Williams, & Gill, 2002), and there is an inverse relationship between physical activity and fear of falling (Bruce, Devine, & Prince, 2002; Wijlhuizen, de Jong, & Hopman-Rock, 2007). If the effects of environment on physical activity differ according to fear of falling in older adults, effective environmental strategies to promote physical activity could also differ accordingly. In particular, some studies have suggested that the association between environmental factors and physical activity is stronger in those with a higher number of perceived barriers relative to that of those with fewer perceived barriers (Carlson et al., 2012; Ding et al., 2012). Therefore, because fear of falling could be regarded as a perceived barrier to physical activity, it is possible that the relationship between environment and physical activity is of greater relevance in those with greater fear of falling relative to that of those with

less fear of falling.

The purpose of the present study was to examine the association between neighborhood environment and physical activity among frail older adults in Japan and determine whether it was moderated by fear of falling.

Methods

Participants and Procedures

The present study used the baseline data from a randomized controlled trial examining an exercise program for frail older adults. The protocol for this trial (ID: UMINxxxxxxxx) is available at the UMIN Clinical Trials Registry (http://www.umin.ac.jp/ctr/index.htm), which is accepted by the International Committee of Medical Journal Editors.

Frail older adults were selected from a community-based cohort study (the Xxx Study of Xxxxxx Xxxxxxxx xx xxx Xxxxxx, XXXXX: Xxxxxxx et al., 2013).

Participants of this cohort study were recruited from the residents of X city, a suburban residential area in Japan. Except for participants of previous studies and those with certification of Care Level 3 or higher in the Japanese long-term care insurance system, all residents aged 65 years or older at examination were invited to participate in this cohort study. In total, 14,519 people were invited via postal mail and 5,104 (35.2%) actually participated in it.

Of all participants in this cohort survey, we initially excluded 358 individuals because they had history of Parkinson’s disease, stroke, severe cognitive decline (Mini-Mental State Examination scores of 17 or lower), or missing data. Of 4,746 participants, 1,537 individuals met our operational definition of frail older adults. We operationally defined frail older adults as individuals who met two or more of the following five frailty criteria (Fried et al., 2001), which represented declines in mobility, strength, endurance, physical activity, and nutrition: 1) normal walking speed of <1.0 m/sec, 2) grip strength of <26 kg for men or <17 kg for women,

3) self-reported lack of endurance, 4) no engagement in exercise or sports, and 5) weight loss of >5% in the preceding 2 years. Of these individuals, we excluded 795 because of serious health problems (e.g., a decline in basic activities of daily living and visual or hearing disability), participation in other research projects, extremely low (<0.6 m/sec) or high (>1.2 m/sec) walking speeds, or cessation of residence in X city. We invited the remaining 742 individuals to participate in the trial; of these, 254 agreed and completed the baseline survey. To provide the baseline data, physical activity variables were measured using accelerometers, and other variables were evaluated via questionnaire. Of the 254 participants, there were missing data for 16 (accelerometer data for 12, questionnaire data for three, and both types of data for one). Therefore, data for 238 participants were included in the analyses.

The study was approved by the ethics committee of Xxxxxxx Xxxxx xx Xxxxxxxx xxx Xxxxxxx.

Measures

Physical activity. Average daily step count, and total and locomotive moderate-to-vigorous physical activity (minutes spent engaging in activities involving ≥3 of the metabolic equivalent, which is the expression of the energy cost of physical activity) were used as physical activity variables.

Participants were asked to wear a triaxial accelerometer (HJA-350IT, Active style Pro, Omron Healthcare Co., Ltd., Kyoto, Japan) on their waists all day, except when bathing, and live as normal for 30 days. The monitor results were blinded, and participants could not check their records themselves. If participants wore the accelerometer for ≥10 hours per day for at least 7 days, their data were included. The epoch length of the accelerometer was set at one minute. The present study calculated wearing time of the accelerometer by adding up all epochs in which the metabolic equivalent was estimated as one or higher. This algorithm of wearing time of HJA-350IT has been employed in previous studies (Kim, Tanabe, Yokoyama,

Zempo, & Kuno, 2013; Makizako et al., 2015), and is useful to estimate daily step count and moderate-to-vigorous physical activity accurately (Nakata, 2011). The accelerometer, for which validity was confirmed in a previous study, recorded the intensity (metabolic equivalent) of physical activity (Ohkawara et al., 2011). Compared with the other types of accelerometers that are available in Japan, HJA-350IT can most accurately estimate total energy expenditure in free-living days using the doubly labeled water method (Murakami et al., 2016). The accelerometer can classify physical activity into locomotive and household activities by validated algorithm (Oshima et al., 2010). Locomotive moderate-to-vigorous physical activity would reflect outside walking behavior more closely than step counts and total moderate-to-vigorous physical activity. Thus, the present study also analyzed the data of locomotive moderate-to-vigorous physical activity (minutes per day) in addition to step counts (steps per day) and total moderate-to-vigorous physical activity (minutes per day). Higher values represent higher physical activity for all the three variables.

Perceived neighborhood environment. The Japanese version of the abbreviated Neighborhood Environment Walkability Scale (Inoue et al., 2009) was used to measure perceived neighborhood environment. The scale consists of eight subscales: residential density (five items: range, 5–805), land use mix, diversity (23 items: range, 1–5), land use mix, access (six items: range, 1–4), street connectivity (three items: range, 1–4), walking/cycling facilities (four items: range, 1–4), esthetics (four items: range, 1–4), traffic safety (four items: range, 1–4) and crime safety (five items: range, 1–4). The items of traffic safety and crime safety do not evaluate the rate of traffic accidents and crime rate, or experiences of involvement in accidents and crimes. Alternatively, the items explore one's subjective feelings about safety in the neighborhood. It represents one's subjective feeling about crime safety in their neighborhood. Respondents answered each item by rating them on a 4-point or 6-point Likert scale. The scoring protocol and test-retest reliability of the scale

(intraclass correlation coefficients = 0.76 to 0.96) were described by Inoue, Ohya et al. (2009). Higher scores on each subscale represent environments with a higher walkability. In a population-based Japanese survey, the average score on each subscale was 248 points for residential density, 2.95 points for diversity of land use mix, 2.87 points for access of land use mix (or access), 2.80 points for street connectivity, 2.20 points for walking/cycling facilities, 2.48 points for aesthetics, 2.67 points for traffic safety, and 2.97 points for crime safety (Inoue et al., 2010).

Fear of falling. Fear of falling was assessed using a single item, which was phrased as follows: “Are you afraid of falling?” Participants’ responses were provided on a four-point Likert scale ranging from 1 (*not at all*) to 4 (*very much*).

Demographic and health-related factors. Sex, age, history of chronic diseases (hypertension, diabetes, hyperlipidemia, arthritis, and heart disease), fall experience (in the preceding year), and presence of chronic body pain (continuing pain for 2 months or more) were included as demographic and health-related factors.

Analyses

Firstly, we conducted t-tests to compare whether the average scores for the physical activity variables (average daily step count, duration of total moderate-to-vigorous physical activity, and duration of locomotive moderate-to-vigorous physical activity) differed by demographic and health-related factors (sex, age, history of chronic diseases, fall experience, and presence of chronic body pain). We then calculated Pearson’s correlation coefficients to examine the association of the physical activity variables with neighborhood factors (residential density, diversity of land use mix, access of land use mix, street connectivity, walking/cycling facilities, esthetics, traffic safety, and crime safety), and fear of falling. Psychological studies have commonly treated psychological variables assessed using a Likert scale as continuous data (e.g., Bopp et al., 2014; Caudroit et al., 2012; White et al, 2012).

Therefore, the present study also regarded neighborhood factors and fear of falling as continuous data.

Multiple regression analyses were performed. The dependent variable was physical activity (daily step count, duration of total moderate-to-vigorous physical activity, and duration of locomotive moderate-to-vigorous physical activity). Multiple regression analyses included two models. In Model 1, independent variables included neighborhood environment, fear of falling, and demographic and health-related factors for which significant results were observed in the t tests. The interaction terms for neighborhood environment and fear of falling were added in Model 2. Standardized scores for neighborhood environment and fear of falling were used in the multiple regression analysis. Standardized scores were calculated by mean and standard deviation of each variable. The present study used variance inflation factors as indicators of multicollinearity. In both models, wearing time of the accelerometer was adjusted.

If the interaction terms were significant, stratified multiple regression analyses were conducted. Participants were categorized into low (response of *not at all* or *a little* to the fear of falling item) and high fear of falling groups (response of *somewhat* or *very much* to the fear of falling item). In stratified analyses, independent variables included neighborhood environment and demographic and health-related factors for which significant results were observed in the t tests, and the dependent variable was physical activity. Wearing time of the accelerometer was adjusted.

Statistical significance was set at $p < 0.05$. The Statistical Package for the Social Sciences (SPSS) for Windows 21.0 was used to perform all analyses.

Results

Characteristics of Participants

Participant characteristics are summarized in Table 1. Of the 238 participants, 55.0%

were men, and 60.5% were aged 65–74 years. Of the demographic and health-related factors, sex, age, and diabetes were significantly associated with step count, total moderate-to-vigorous physical activity, and/or locomotive moderate-to-vigorous physical activity.

The mean number of valid days (wearing accelerometer $\geqslant$ 10 hours) was 27.3 days (standard deviation, 4.4 days) and mean wear time of the accelerometer on valid days was 15 hours and 21 minutes (standard deviation, 2 hours and 34 minutes).

Associations of Perceived Neighborhood Environment and Fear of Falling with Physical Activity

Table 2 shows the correlation coefficients for the relationships between physical activity, perceived neighborhood environment, and fear of falling. Higher step count was significantly correlated with higher crime safety and lower fear of falling. Higher locomotive moderate-to-vigorous physical activity was also correlated with lower fear of falling. Total moderate-to-vigorous physical activity was not significantly correlated with perceived neighborhood environment and fear of falling.

The results of the multiple regression analyses for daily step count, and for moderate to vigorous physical activity are shown in Table 3 and 4, respectively. The variance inflation factors for each variable were lower than 2.0. In Model 1, sex, age and crime safety were significantly associated with step count. In Model 2, in addition to these variables, the interaction between crime safety and fear of falling was associated with step count. With respect to total and locomotive moderate-to-vigorous physical activity, although the main effect of crime safety was nonsignificant in both models, the interaction between crime safety and fear of falling was significant in Model 2.

Because this interaction was significant, multiple regression analyses, stratified according to fear of falling (low or high), were performed with crime safety as the

independent variable. In all models, the values of variance inflation factors for each variable were lower than 2.0. Significant associations were observed between crime safety and step count (Table 5), and total and locomotive moderate-to-vigorous physical activity in the low fear of falling group (Table 6). These associations were nonsignificant in the high fear of falling group.

Discussion

The results of the present study indicated that crime safety was associated with physical activity levels in frail older adults. Although numerous cohort studies have examined the environmental correlates of physical activity in adults, further research involving older adults is required (Van Cauwenberg et al., 2011). Moreover, the effect of environment on physical activity in frail older adults has not received adequate attention. The results of the present study indicated that crime safety could influence physical activity among frail older adults.

The types of neighborhood environment associated with physical activity in the present study differed from those observed in previous studies targeting healthy older adults in Japan (Inoue, et al., 2011; Tsunoda et al., 2012; Saito et al., 2013). Of eight environmental factors, crime safety was significantly correlated with physical activity; however, it was not necessarily identified as a significant correlate of physical activity in previous Japanese studies. Although Inoue et al. (2011) reported an association between crime safety and walking as transportation in older men, crime safety was not significantly associated with overall walking behavior in older men and women. Tsunoda et al. (2012) and Saito et al. (2013) also failed to observe a relationship between crime safety and physical activity. In addition, Japanese studies targeting adults did not observe this relationship (Inoue, Murase et al., 2009; Inoue et al., 2010; Kamada et al., 2009). The mean scores of crime safety from the Japanese version of the abbreviated Neighborhood Environment Walkability Scale are similar

between the present (2.9) and previous studies using this scale (3.1 in Inoue et al., 2009; 3.0 in Inoue et al., 2010). Thus, the difference in the scores of crime safety could not explain the discrepancy of this relationship between the present and previous Japanese studies. Alternatively, esthetics (Inoue et al., 2011; Saito et al., 2013; Tsunoda et al., 2012) were the most commonly reported environmental correlates of physical activity in Japanese older adults. Sidewalk or walking facilities (Saito et al., 2013; Tsunoda et al., 2012), shop access (Saito et al., 2013), and observing active people (Inoue et al., 2011; Saito et al., 2013) have also been reported as environmental correlates of physical activity in healthy older adults. One potential explanation for these inconsistencies is that frail older adults would be expected to be more sensitive to crime safety; therefore, the influence of crime safety on frail older adults would be stronger relative to that on healthy older adults. A previous study showed that frail older adults exhibited greater psychological distress than non-frail older adults (Ní Mhaoláin et al., 2012). Another potential explanation is that frail older adults could follow different physical activity patterns (e.g., motivation, quantity, and quality), as indicated in a previous study (Blodgett, Theou, Kirkland, Andreou, & Rockwood, 2015), and influential environmental factors could differ according to those physical activity patterns. According to the findings of the present and previous studies, the relationship between environment and physical activity in frail older adults could differ from that observed in healthy older adults.

The present study found that the relationship between crime safety and physical activity in frail older adults was moderated by their fear of falling. Previous studies (Carlson et al., 2012; Cerin, et al., 2008; Ding et al., 2012; Kaczynski et al., 2012; Van Dyck et al., 2014) have suggested that the association between neighborhood environment and physical activity was moderated by psychological factors. However, none of these studies targeted frail older adults or examined fear of falling as a potential moderator of the relationship between environment and physical activity. According to previous studies (Carlson et al., 2012; Ding

et al., 2012), the relevance of the relationship between environment and physical activity in those with a high number of perceived barriers was greater relative to that observed in those with fewer perceived barriers. Therefore, because fear of falling could be regarded as a perceived barrier, the findings of the present study were inconsistent with those of previous studies (Carlson et al., 2012; Ding et al., 2012). One potential reason that fear of falling could moderate this relationship is that those who experience greater fear could be less motivated to engage in activity, even if the neighborhood environment is desirable. Another potential reason is that the associations between other psychological factors (e.g., self-efficacy) and physical activity could be stronger, relative to the association between physical activity and crime safety, in those with high fear of falling. Further studies are required to determine the interactive effects of fear of falling and environmental factors on physical activity in frail older adults.

The findings of the present study cannot necessarily be generalizable to other ethnic/racial groups. For environment-to-physical activity relationships, some Japanese studies have indicated that there would be cultural differences between Western countries and Japan (Inoue et al., 2010; Tsunoda et al., 2010). In particular, the crime safety scale used in the present study does not reflect the objective crime rate, but represents the participants' subjective feelings about the safety in their neighborhood. According to a report from the Organization for Economic Co-operation and Development (OECD, 2014), while Japan is statistically the second safest country from crime in the OECD countries, the feeling of crime safety among Japanese people is not remarkably high. This report indicates that compared with other populations, Japanese population are more anxious about crime even though their objective crime safety is high. Thus, there is the possibility that the degree of influence of crime safety on physical activity might be different between Japan and other countries.

One of the strengths of the present study was the objective measurement of physical

activity using a triaxial accelerometer. However, the study was also subject to some limitations. First, the data were cross-sectional; therefore, causal associations could not be inferred directly. Second, participants were recruited from one city; therefore, objective elements of the environment could have limited its variability. Third, the sample size was insufficient for further stratified analyses (e.g., according to sex, phenotype, or degree of frailty). Fourth, the neighborhood environment was not measured using objective methods (e.g., a geographic information system); therefore, further large-scale longitudinal studies involving objective assessment of the neighborhood environment and a more representative sample are required.

The limitations of our study notwithstanding, the results contribute to the understanding of the joint association of environmental and psychological factors on physical activity in frail older adults. According to our findings, the use different environmental intervention strategies to those used for healthy older adults or adults in general could be more effective in promoting physical activity in frail older adults. In particular, increasing neighborhood crime-related safety (e.g., improving street lighting, strengthening community networks, providing crime maps, and walking with someone) could encourage and support physical activity in this population. However, the effectiveness of environmental intervention strategies could also differ according to levels of fear of falling. With the results of the present study as a base, further exploration of effective multilevel intervention strategies to promote physical activity in frail older adults is recommended.

Conclusions

Crime safety was significantly associated with physical activity in frail older adults. Stratified according to fear of falling, significant associations were observed only in the group with a low level of fear. The findings indicate that crime safety influenced physical activity in frail older adults, and fear of falling mediated the relationship between crime safety and

physical activity.

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Table 1

Participant Characteristics

			Daily step count			Total MVPA (min/day)			Locomotive MVPA (min/day)		
	n	%	*M*	*SE*	*p* value	*M*	*SE*	*p* value	*M*	*SE*	*p* value
Total	238	100	5,442.4	202.2		14.4	1.1		10.1	1.0	
Sex					**0.003**			**0.031**			**0.002**
Male	131	55.0	**5,973.1**	**290.5**		**16.5**	**1.5**		**12.7**	**1.4**	
Female	107	45.0	**4,792.7**	**263.5**		**11.9**	**1.5**		**6.9**	**1.2**	
Age (years)					**<0.001**			**0.001**			**0.002**
65–74	144	60.5	**6,054.5**	**266.0**		**17.3**	**1.5**		**12.4**	**1.4**	
≥75	94	39.5	**4,504.8**	**285.8**		**9.9**	**1.2**		**6.4**	**1.0**	
Hypertension					0.105			0.051			0.361
No	131	55.0	5,738.5	241.7		16.3	1.4		10.9	1.2	
Yes	107	45.0	5,079.9	336.8		12.1	1.5		9.1	1.5	
Diabetes					0.050			**0.007**			**0.036**
No	192	80.7	5,635.9	229.5		**15.8**	**1.2**		**11.0**	**1.1**	
Yes	46	19.3	4,634.8	404.8		**8.6**	**1.6**		**6.0**	**1.4**	
Hyperlipidemia					0.787			0.657			0.901
No	169	71.0	5,477.4	246.1		14.1	1.2		10.1	1.2	
Yes	69	29.0	5,356.7	353.8		15.1	2.0		9.9	1.7	
Arthritis					0.594			0.870			0.975
No	198	83.2	5,491.1	224.4		14.3	1.2		10.0	1.1	
Yes	40	16.8	5,201.6	466.7		14.8	2.6		10.1	2.1	
Heart disease					0.642			0.904			0.311
No	196	82.4	5,398.8	203.2		14.3	1.1		9.6	0.9	
Yes	42	17.6	5,646.2	649.7		14.7	3.4		12.2	3.2	
Falls in the preceding year					0.994			0.829			0.626
No	196	82.4	5,441.8	220.3		14.5	1.1		10.3	1.1	
Yes	42	17.6	5,445.5	512.5		13.9	2.7		9.0	2.3	
Chronic body pain					0.501			0.310			0.312
No	156	65.5	5,343.6	255.4		15.2	1.3		10.8	1.2	
Yes	82	34.5	5,630.5	330.6		12.9	1.7		8.7	1.5	

Note. M: mean; MVPA: moderate-to-vigorous physical activity; SE: standard error

Findings expressed in bold represent those that were significant at $p < 0.05$.

Table 2.

Correlation Coefficients for the Association of Physical Activity with Perceived Neighborhood Environment and Fear of Falling

			Pearson's correlation coefficient		
	M	*SE*	Daily step count	Total MVPA (min/day)	Locomotive MVPA (min/day)
Neighborhood environment					
Residential density	246.8	5.6	0.00	0.02	0.04
Land use mix, diversity	2.7	0.0	-0.01	-0.01	0.02
Land use mix, access	2.7	0.0	-0.01	-0.07	-0.06
Street connectivity	2.6	0.1	0.03	0.05	0.08
Walking/cycling facilities	2.1	0.1	-0.07	-0.03	-0.05
Esthetics	2.3	0.0	0.06	0.10	0.07
Traffic safety	2.6	0.0	-0.08	-0.05	-0.02
Crime safety	2.9	0.0	**0.14***	0.11	0.12
Fear of falling	2.3	0.1	**-0.17****	-0.10	**-0.14***

Note. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

MVPA: moderate-to-vigorous physical activity; SE: standard error

Findings expressed in bold represent those that were significant at $p < 0.05$.

Table 3

Associations between Daily Step Count and Perceived Neighborhood Environment, and Fear of Falling

	Model 1			Model 2		
	β	*p* value	VIF	β	*p* value	VIF
Sex (female)	**-0.15**	**0.030**	**1.30**	**-0.18**	**0.008**	**1.34**
Age	**-0.31**	**<0.001**	**1.04**	**-0.32**	**<0.001**	**1.07**
Diabetes (yes)	-0.10	0.103	1.04	-0.07	0.274	1.08
Residential density	-0.01	0.948	1.35	-0.01	0.927	1.39
Land use mix, diversity	-0.11	0.166	1.72	-0.10	0.203	1.75
Land use mix, access	0.04	0.621	1.48	0.05	0.467	1.52
Street connectivity	0.01	0.825	1.15	-0.01	0.844	1.18
Walking/cycling facilities	-0.07	0.371	1.63	-0.08	0.283	1.72
Esthetics	0.09	0.207	1.48	0.11	0.143	1.53
Traffic safety	-0.05	0.435	1.16	-0.04	0.501	1.20
Crime safety	**0.17**	**0.009**	**1.13**	**0.14**	**0.030**	**1.17**
Fear of falling	-0.09	0.172	1.24	-0.09	0.184	1.25
Residential density × fear of falling				-0.01	0.939	1.33
Land use mix, diversity × fear of falling				0.15	0.073	1.86
Land use mix, access × fear of falling				-0.05	0.514	1.58
Street connectivity × fear of falling				-0.08	0.236	1.19
Walking/cycling facilities × fear of falling				0.00	0.990	1.82
Esthetics × fear of falling				0.11	0.166	1.75
Traffic safety × fear of falling				0.11	0.083	1.20
Crime safety × fear of falling				**-0.18**	**0.009**	**1.28**

Note. VIF: variance inflation factor

All models were adjusted by wearing time of accelerometer. Findings expressed in bold represent those that were significant at $p < 0.05$.

Table 4

Associations between Moderate to Vigorous Physical Activity and Perceived Neighborhood Environment and Fear of Falling

	Total MVPA (min/day)						Locomotive MVPA (min/day)					
	Model 1			Model 2			Model 1			Model 2		
	β	*p* value	VIF	β	*p* value	VIF	β	*p* value	VIF	β	*p* value	VIF
Sex (female)	**-0.15**	**0.036**	**1.30**	**-0.17**	**0.014**	**1.34**	**-0.18**	**0.009**	**1.30**	**-0.21**	**0.003**	**1.34**
Age	**-0.29**	**<0.001**	**1.04**	**-0.30**	**<0.001**	**1.07**	**-0.25**	**<0.001**	**1.04**	**-0.25**	**<0.001**	**1.07**
Diabetes (yes)	**-0.16**	**0.011**	**1.04**	**-0.13**	**0.047**	**1.08**	-0.12	0.053	1.04	-0.09	0.166	1.08
Residential density	0.03	0.705	1.35	0.02	0.762	1.39	0.04	0.563	1.35	0.03	0.651	1.39
Land use mix, diversity	-0.06	0.460	1.72	-0.05	0.562	1.75	-0.04	0.612	1.72	-0.03	0.750	1.75
Land use mix, access	-0.07	0.355	1.48	-0.05	0.481	1.52	-0.08	0.271	1.48	-0.07	0.369	1.52
Street connectivity	0.03	0.651	1.15	0.01	0.889	1.18	0.06	0.342	1.15	0.04	0.565	1.18
Walking/cycling facilities	-0.04	0.597	1.63	-0.06	0.432	1.72	-0.07	0.403	1.63	-0.08	0.319	1.72
Esthetics	0.11	0.151	1.48	0.12	0.120	1.53	0.09	0.236	1.48	0.10	0.175	1.53
Traffic safety	-0.02	0.717	1.16	-0.01	0.849	1.20	0.02	0.757	1.16	0.03	0.681	1.20
Crime safety	0.11	0.096	1.13	0.08	0.202	1.17	0.12	0.076	1.13	0.09	0.198	1.17
Fear of falling	-0.02	0.753	1.24	-0.02	0.754	1.25	-0.04	0.557	1.24	-0.04	0.552	1.25
Residential density × fear of falling				-0.07	0.289	1.33				-0.05	0.461	1.33
Land use mix, diversity × fear of falling				0.11	0.202	1.86				0.15	0.072	1.86
Land use mix, access × fear of falling				0.04	0.608	1.58				0.04	0.629	1.58
Street connectivity × fear of falling				-0.05	0.497	1.19				-0.07	0.302	1.19
Walking/cycling facilities × fear of falling				0.03	0.679	1.82				0.01	0.900	1.82
Esthetics × fear of falling				0.05	0.497	1.75				0.07	0.421	1.75
Traffic safety × fear of falling				0.10	0.133	1.20				0.10	0.131	1.20
Crime safety × fear of falling				**-0.16**	**0.018**	**1.28**				**-0.17**	**0.014**	**1.28**

Note. MVPA: moderate-to-vigorous physical activity; VIF: variance inflation factor

All models were adjusted by wearing time of accelerometer. Findings expressed in bold represent those that were significant at $p < 0.05$.

Table 5

Association Between Perceived Neighborhood Environment and Daily Step Count, Stratified According to Fear of Falling

	Low fear of falling (*n* = 122)			High fear of falling (*n* = 116)		
	β	*p* value	VIF	β	*p* value	VIF
Sex (female)	-0.16	0.073	1.14	-0.17	0.092	1.20
Age	**-0.32**	**0.001**	**1.11**	**-0.35**	**0.000**	**1.10**
Diabetes (yes)	-0.03	0.712	1.11	-0.15	0.107	1.10
Residential density	-0.03	0.761	1.36	0.04	0.705	1.47
Land use mix, diversity	-0.21	0.055	1.71	-0.01	0.943	1.86
Land use mix, access	0.08	0.449	1.52	0.00	0.975	1.52
Street connectivity	0.03	0.731	1.10	-0.03	0.739	1.29
Walking/cycling facilities	-0.07	0.490	1.60	-0.08	0.490	1.69
Esthetics	0.01	0.922	1.38	0.18	0.118	1.68
Traffic safety	-0.16	0.094	1.19	0.06	0.525	1.21
Crime safety	**0.25**	**0.007**	**1.17**	0.09	0.384	1.24

Note. MVPA: moderate-to-vigorous physical activity; VIF: variance inflation factor

All models were adjusted by wearing time of accelerometer. Findings expressed in bold represent those that were significant at $p < 0.05$.

Table 6

Association Between Perceived Neighborhood Environment and Moderate to Vigorous Physical Activity, Stratified According to Fear of Falling

	Low fear of falling (*n* = 122)						High fear of falling (*n* = 116)					
	Total MVPA (min/day)			Locomotive MVPA (min/day)			Total MVPA (min/day)			Locomotive MVPA (min/day)		
	β	*p* value	VIF	β	*p* value	VIF	β	*p* value	VIF	β	*p* value	VIF
Sex (female)	**-0.18**	**0.045**	**1.14**	**-0.22**	**0.020**	**1.14**	-0.14	0.152	1.20	-0.18	0.080	1.20
Age	**-0.26**	**0.005**	**1.11**	**-0.22**	**0.016**	**1.11**	**-0.35**	**<0.001**	**1.10**	**-0.28**	**0.004**	**1.10**
Diabetes (yes)	-0.09	0.332	1.11	-0.08	0.396	1.11	**-0.20**	**0.035**	**1.10**	-0.14	0.158	1.10
Residential density	0.06	0.539	1.36	0.05	0.650	1.36	-0.01	0.953	1.47	0.02	0.861	1.47
Land use mix, diversity	-0.13	0.227	1.71	-0.13	0.265	1.71	0.02	0.893	1.86	0.08	0.526	1.86
Land use mix, access	-0.09	0.375	1.52	-0.11	0.313	1.52	-0.02	0.835	1.52	-0.03	0.763	1.52
Street connectivity	0.04	0.682	1.10	0.08	0.362	1.10	0.00	0.979	1.29	0.01	0.954	1.29
Walking/cycling facilities	-0.06	0.595	1.60	-0.05	0.624	1.60	-0.03	0.800	1.69	-0.09	0.457	1.69
Esthetics	0.06	0.532	1.38	0.04	0.670	1.38	0.16	0.171	1.68	0.16	0.180	1.68
Traffic safety	-0.14	0.133	1.19	-0.07	0.431	1.19	0.09	0.373	1.21	0.12	0.242	1.21
Crime safety	**0.20**	**0.030**	**1.17**	**0.20**	**0.038**	**1.17**	0.01	0.922	1.24	0.01	0.929	1.24

Note. MVPA: moderate-to-vigorous physical activity; VIF: variance inflation factor

All models were adjusted by wearing time of accelerometer. Findings expressed in bold represent those that were significant at $p < 0.05$.