Sociodemographic Determinants of Pedometer-Determined Physical Activity Among Japanese Adults

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Background: Although previous studies have reported physical activity and its sociodemographic determinants using self-report measures, there have been few studies using pedometers.

Purpose: To ascertain pedometer-determined physical activity and its sociodemographic determinants among community residents living in four Japanese cities.

Methods: A cross-sectional mail survey was conducted from February 2007 to January 2008 with a sample of 4000 residents (aged 20–69 years and 50% male) who were randomly selected from the registry of residential addresses. Complete responses for both questionnaire and pedometer were obtained from 790 residents (48.3±13.7 years, 46.7% male). Associations of 11 sociodemographic variables with steps per day were examined using multiple logistic regression analyses. Data were analyzed in 2010.

Results: Men averaged 8763±3497 steps/day and women averaged 8242±3277 steps/day. Further, 29.0% of men and 27.8% of women walked ≥10,000 steps/day. City of residence, good self-rated health, low educational attainment, and not owning a car were associated with taking ≥10,000 steps/day in men, whereas employed status and dog ownership were associated with walking ≥10,000 steps/day in women.

Conclusions: The results contribute to understanding of step-defined physical activity and its sociodemographic determinants. A diversity of step counts by sociodemographic variables clarifies specific populations among Japanese who are in need of intervention to promote physical activity.
(Am J Prev Med 2011;40(5):566–571)

Introduction

Physical activity promotion is one of the priorities for chronic disease prevention.[1,2] To develop effective intervention strategies, solid evidence of physical activity patterns among specific population groups is needed. Previous studies have reported the association between sociodemographic variables and physical activity.[3–7] However, most of these studies (1) were conducted in Western countries and (2) used self-reported physical activity, with a few exceptions.[8,9] Thus, the generalizability of findings to countries of a different culture, such as Japan, is unclear.

Further, there remains the potential for information bias from self-reported physical activity.[10] Step-counting devices provide an objective output and are becoming widespread as intervention tools.[11,12] Therefore, data related to step-defined physical activity are increasingly important.

Thus, the objectives of the present study are to (1) report step-defined physical activity levels and (2) examine sociodemographic characteristics of people who achieve ≥10,000 steps/day[13] using a randomly selected community sample from four Japanese cities.

Methods

Participants and Data Collection

This cross-sectional study was a part of larger project[14] to investigate physical activity environment. Data were collected from February to March 2007 and from December 2007 to January 2008.

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0749-3797/$17.00
doi: 10.1016/j.amepre.2010.12.023

Four thousand residents (aged 20–69 years, 50% male) living in four Japanese cities (Koganei, Tsukuba, Shizuoka, and Kagoshima) were randomly selected from the registry of residential addresses, stratified by gender, age, and city of residence. Locations, areas, and population sizes of four cities are indicated in Appendix A (available online at www.ajpm-online.net). Koganei lies approximately at the center of Tokyo. Tsukuba is located 50 km northeast of Tokyo within commuting distance from Tokyo. Shizuoka and Kagoshima are the prefectural capitals in mid- and west Japan.

The study was conducted by mail. At first, participants were asked about sociodemographic characteristics and subsequently invited to wear an accelerometer. If participants consented to join, the accelerometer was mailed out. Of the targeted 4000 residents, 1508 responded to the questionnaire (37.7%). Of these, 886 offered to wear the accelerometer, but valid accelerometer data were obtained from 790 participants (overall response rate: 19.8%). All participants provided signed informed consent. The current study received prior approval from the Tokyo Medical University Ethics Committee. Further details of the survey were reported in a previous article.[14]

Assessment of Step Counts

Participants were asked to wear an accelerometer (Suzuken Lifecorder Ex 4 second version, Nagoya, Japan) for 7 consecutive days. This device has a step-counting function with a 35-day memory. Acceleration signals were used only for calculation of device use (wearing and nonwearing time). Previous studies[15,16] have validated the step-counting feature of this device. The step data were systematically processed according to the following rules: (1) nonwear time was defined as no acceleration signal for ≥30 consecutive minutes; (2) a recorded day was deemed valid if it was worn at least 10 hours that day[17,18]; and (3) to be included in the analysis the participant had to have 3 or more valid days of data.[18] Finally, mean steps/day were calculated based on steps of valid days.

Sociodemographic Variables

Gender, age, and city of residence were obtained from the registry of residential addresses. Information on height, weight, self-rated health, education, employment, marital status, child (defined as junior high school students or younger; aged ≤15 years) in household, household motor vehicle, and dog ownership were obtained by questionnaire. BMI was calculated from self-reported weight and height.

Statistical Analyses

Multiple logistic regression analyses were conducted to examine the relationships between sociodemographic variables and steps/day. Steps/day were recoded into three categories, sedentary to low active (Se/LA), <7500 steps/day; somewhat active (SA), 7500–9999 steps/day; and active to highly active (A/HA), ≥10,000 steps/day.[13] All 11 sociodemographic variables were included in the model. Cities of residence were included in the model as dummy variables. Following the analyses of the overall sample, stratified analyses by gender were conducted. The odds of higher step counts (SA and A/HA) compared with Se/LA by 11 sociodemographic attributes were calculated. Significance was considered to be $p<0.05$. Analyses were conducted in 2010 using SPSS, version 17.0.

Results

Men accounted for 46.7% of participants. Mean age was 48.3±13.7 years overall. Mean steps/day were 8763±3497 steps/day in men and 8242±3277 steps/day in women. The prevalence of taking ≥10,000 steps/day was 29.0% in men and 27.8% in women. Further information about participants' characteristics is shown in Appendix B (available online at www.ajpm-online.net).

In multivariate analyses (Table 1), city of residence (Tsukuba or Koganei); good self-rated health; being employed; not having a household motor vehicle; and dog ownership were related to either SA or A/AH or both SA and A/AH. ORs (95% CI) of A/HA, that is, engaging in ≥10,000 steps/day (vs Se/LA) were 1.80 (1.04, 3.12) for Tsukuba residents and 2.03 (1.17, 3.52) for Koganei residents compared with Kagoshima residents; 1.70 (1.18, 2.43) for people with good self-rated health; 1.67 (1.06, 2.63) for employed; 2.40 (1.28, 4.49) for nonowners of motor vehicles; and 1.77 (1.13, 2.76) for dog owners. According to stratified analyses by gender; city of residence (Tsukuba, Koganei, or Shizuoka); good self-rated health; lower educational attainment; and having no household motor vehicle were associated with more steps/day in men. High step-defined activity was associated with good self-rated health, being employed, and dog ownership in women.

Discussion

The present study showed the step-defined physical activity level of residents in four Japanese cities and its association with sociodemographic variables. Most previous studies conducted in Western countries have been based on self-report. Thus, the findings of the current study add new evidence from two perspectives. First, the present study was conducted in Japan and therefore extends understanding of physical activity determinants to include a distinct culture. Second, objective step data were collected. Step-defined physical activity is relevant to health promotion applications because of the potential of step counter to be widely used as an intervention tool.

Participants in the current study appear to be more active compared with national surveys in Japan[19] and the U.S.[20] Japanese survey[19] in 2007 reported that men and women took 7321 steps/day and 6267 steps/day, respectively. Differences in sampling and response rates may explain some of this discrepancy. The current sample did not include older adults (aged ≥70 years) and was primarily living in urban settings. In the 2005–2006 National Health and Nutrition Examination Survey[20] of the U.S., accelerometer-determined physical activity data treated to approximate pedome-

Table 1. ORs for active people, as determined by pedometer, by sociodemographic variables

	Overall (N=790)				Men (n=369)	
	SA (vs Se/LA)		A/HA (vs Se/LA)		SA (vs Se/LA)	
	7500–9999 (vs <7499)		≥10,000 (vs <7499)		7500–9999 (vs <7499)	
	OR (95% CI)	p-value[a]	OR (95% CI)	p-value[a]	OR (95% CI)	p-value[a]
Gender	—	—	—	—	—	—
Men	1.10 (0.77, 1.59)	0.595	1.07 (0.73, 1.55)	0.741	—	—
Women	1.00	—	1.00	—	1.00	—
Age (years)	—	—	—	—	—	—
20–39	1.46 (0.81, 2.63)	0.205	1.24 (0.69, 2.24)	0.474	2.31 (0.88, 6.10)	0.090
40–59	1.58 (0.96, 2.58)	0.069	1.14 (0.70, 1.85)	0.599	1.69 (0.80, 3.57)	0.172
60–69	1.00	—	1.00	—	1.00	—
City of residence	—	—	—	—	—	—
Tsukuba	1.40 (0.84, 2.34)	0.194	1.80 (1.04, 3.12)	0.035	2.69 (1.27, 5.71)	0.010
Koganei	1.59 (0.95, 2.67)	0.079	2.03 (1.17, 3.52)	0.012	2.16 (0.96, 4.87)	0.062
Shizuoka	0.98 (0.58, 1.63)	0.927	1.43 (0.84, 2.45)	0.187	1.20 (0.55, 2.63)	0.649
Kagoshima	1.00	—	1.00	—	1.00	—
BMI	—	—	—	—	—	—
<25	0.93 (0.60, 1.44)	0.737	1.08 (0.68, 1.72)	0.732	0.77 (0.43, 1.36)	0.362
≥25	1.00	—	1.00	—	1.00	—
Self-rated health	—	—	—	—	—	—
Good	1.52 (1.07, 2.16)	0.018	1.70 (1.18, 2.43)	0.004	1.38 (0.82, 2.34)	0.228
Fair or poor	1.00	—	1.00	—	1.00	—
Education (years)	—	—	—	—	—	—
≥13	1.04 (0.71, 1.51)	0.857	0.73 (0.50, 1.07)	0.103	0.95 (0.52, 1.71)	0.853
≤12	1.00	—	1.00	—	1.00	—
Employment status	—	—	—	—	—	—
Employed	1.55 (0.99, 2.43)	0.053	1.67 (1.06, 2.63)	0.028	2.15 (0.85, 5.48)	0.108
Not employed	1.00	—	1.00	—	1.00	—
Marital status	—	—	—	—	—	—
Married	1.53 (0.93, 2.52)	0.094	1.56 (0.94, 2.59)	0.089	1.94 (0.83, 4.55)	0.128
Not married	1.00	—	1.00	—	1.00	—
Child in household	—	—	—	—	—	—
Yes	0.91 (0.60, 1.38)	0.669	0.65 (0.41, 1.01)	0.056	1.04 (0.54, 1.98)	0.911
No	1.00	—	1.00	—	1.00	—
Household motor vehicle (no.)	—	—	—	—	—	—
0	1.88 (1.00, 3.56)	0.052	2.40 (1.28, 4.49)	0.006	4.24 (1.38, 13.01)	0.012
≥1	1.00	—	1.00	—	1.00	—
Dog ownership	—	—	—	—	—	—
Yes	1.65 (1.06, 2.55)	0.026	1.77 (1.13, 2.76)	0.012	1.40 (0.74, 2.67)	0.301
No	1.00	—	1.00	—	1.00	—

(continued on next page)

[a]p-values were calculated by multiple logistic regression analyses adjusted for all other sociodemographic variables listed in the table.
A/HA, active and high active; SA, somewhat active; Se/LA, sedentary and low active

Table 1. *(continued)*

A/HA (vs Se/LA)		Women (n=421) SA (vs Se/LA)		A/HA (vs Se/LA)	
≥10,000 (vs <7499)		7500–9999 (vs <7499)		≥10,000 (vs <7499)	
OR (95% CI)	p-value[a]	OR (95% CI)	p-value[a]	OR (95% CI)	p-value[a]
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
2.52 (0.94, 6.78)	0.067	1.02 (0.47, 2.23)	0.952	0.83 (0.38, 1.83)	0.649
1.37 (0.64, 2.89)	0.416	1.29 (0.65, 2.57)	0.468	1.03 (0.52, 2.03)	0.942
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
2.90 (1.26, 6.68)	0.013	0.77 (0.37, 1.60)	0.477	1.31 (0.62, 2.78)	0.481
3.22 (1.34, 7.73)	0.009	1.28 (0.63, 2.58)	0.493	1.70 (0.81, 3.55)	0.160
2.37 (1.06, 5.32)	0.036	0.85 (0.42, 1.71)	0.649	1.02 (0.49, 2.14)	0.960
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
1.06 (0.57, 1.98)	0.859	1.39 (0.65, 2.96)	0.397	1.01 (0.50, 2.04)	0.983
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
2.46 (1.41, 4.29)	0.001	1.81 (1.11, 2.94)	0.018	1.30 (0.80, 2.12)	0.294
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
0.46 (0.25, 0.84)	0.011	1.16 (0.69, 1.93)	0.582	1.00 (0.59, 1.68)	0.990
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
1.15 (0.49, 2.66)	0.749	1.43 (0.83, 2.45)	0.198	1.92 (1.09, 3.40)	0.024
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
2.15 (0.88, 5.24)	0.093	1.44 (0.75, 2.76)	0.272	1.48 (0.77, 2.86)	0.239
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
0.77 (0.38, 1.57)	0.475	0.78 (0.44, 1.37)	0.385	0.60 (0.34, 1.09)	0.092
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
5.47 (1.81, 16.51)	0.003	1.17 (0.52, 2.65)	0.706	1.47 (0.66, 3.29)	0.347
1.00	—	1.00	—	1.00	—
—	—	—	—	—	—
1.39 (0.71, 2.72)	0.341	1.78 (0.96, 3.29)	0.065	2.17 (1.18, 4.00)	0.013
1.00	—	1.00	—	1.00	—

ter-determined scaling indicated that American men took 7431 steps/day and women took 5756 steps/day. Although the differences of sampling strategy and of device should be considered, participants in the current study appear to be more active.

Gender and age were not significantly related to steps/day in multivariate analyses. In previous studies,[3,4] men and younger adults were more active than women and older adults. In the present study, multivariate analyses included a wide range of sociodemographic variables. Thus, after adjustment for these variables, the effect of gender and age alone appears to be lessened. People in Tsukuba and Koganei were more active than those in Kagoshima. Both Tsukuba and Koganei are in the Greater Tokyo Area.

According to the Nationwide Person Trip Survey in Japan,[21] 22.2% of commuters drive in metropolitan areas (including Koganei); 31.6% in suburban cities of metropolitan areas (including Tsukuba); and 63.0% in core local cities (including Shizuoka and Kagoshima). The differences among cities might be related to existing public transport networks. Koganei also has high walkability, characterized by high density and land use mix.[22,23] Thus, the importance of environmental features was suggested.

Sociodemographic variables associated with steps/day differed by gender. High education level was related to lower steps/day in men. This is inconsistent with previous findings.[3,4,6,7] However, many previous studies have focused on leisure-time physical activity. It is likely that the sociodemographic determinants of total physical activity are different. Physically demanding jobs among less-educated men may be one possible reason for this result. Employment status was an important factor for women. Women without jobs outside the home might have fewer opportunities to walk for transport. Association of motor vehicle ownership and steps/day suggested a car-reliant lifestyle among men. In contrast, women may feel an obligation to walk their dog and increase their activity as a result.

There were some limitations in the current study. First, the response rate might be considered low. If participants were reactive to wearing the accelerometer, they might have been active regardless of their sociodemographic characteristics, leading to an underestimation of the association between sociodemographic variables and steps/day. Second, the study setting was relatively urban because of the original purpose of this survey. Research including rural areas is also needed in the future.

In spite of these limitations, the present study contributes to understanding of step-defined physical activity and its sociodemographic determinants. A diversity of steps/day by sociodemographic variables clarifies specific populations in need of intervention to promote physical activity.

This study was supported by a grant-in-aid from the Japan Ministry of Health, Labor, and Welfare (ID: H19-Junkankitou-Ippan-008 and H20-Junkankitou-Ippan-001) and a grant-in-aid for scientific research (C: 17590556) from the Japan Ministry of Education, Culture, Sports, Science, and Technology.

No financial disclosures were reported by the authors of this paper.

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Appendix

Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.amepre.2010.12.023.

Journal of Aging and Physical Activity, 2011,19, 262-272

Strength-Training Behavior and Perceived Environment Among Japanese Older Adults

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The authors examined the relationship between strength-training behavior and perceived environment in older Japanese adults. An Internet-based survey was conducted of 293 adults age 68.2 ± 2.8 yr. The dependent variable was regular strength-training behavior. The IPAQ environment module, access to facilities for strength training, and home equipment for strength training were environmental factors. Logistic-regression analysis was employed. After demographic variables (gender, age, educational background, household income, body-mass index, self-rated health status, smoking habit, and residential area) were adjusted for, home equipment for strength training (OR = 2.14, 95% CI = 1.50–3.06), access to facilities for strength training (OR = 2.53, 95% CI = 1.32–4.85), and observing active people (OR = 2.20, 95% CI = 1.06–4.58) were positively correlated with regular strength-training behavior. In conclusion, environmental factors associated with strength-training behavior were access to facilities for strength training, having home equipment for strength training, and observing active people.

Keywords: physical activity, ecological model, correlates, public health

Strength training provides numerous health benefits such as the prevention of osteoporosis, cardiovascular disease, and diabetes (Winett & Carpinelli, 2001). In addition to these general benefits, strength training in older adults helps reduce the risk of falling, disability, and cognitive impairment (Chodzko-Zajko et al., 2009; Hurley & Roth, 2000). On the basis of these results, the American College of Sports Medicine and the American Heart Association have recommended strength training as a health-promoting physical activity (Haskell et al., 2007). Furthermore, the Healthy People 2010 campaign set a goal of increasing the proportion of adults regularly involved in strength training by 30% (more than twice a week) by 2010 (U.S. Department of Health and Human Services, 2000).

Despite the obvious benefits, the number of people participating in strength training has remained low, especially in older adults. In the United States, the proportion of those regularly involved in strength training has remained at 21%,

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and age was found to be negatively associated with participation in strength training (Chevan, 2008). In Japan, although 16.5% of adults age 20–29 engage in strength training, only 13.3% of adults 50 years of age or more were found to be involved in it (Harada et al., 2008). Thus, the development of a specific and effective strategy for promoting strength-training behavior is necessary, especially for older people.

To establish an effective strategy, it is necessary to identify the correlates of strength-training behavior. The identification of such correlates would thereby allow researchers to focus on the precise factors that can lead to a behavioral change through applying appropriate strategies. Several recent studies have also investigated the psychosocial factors that correlate with strength-training behavior (Bopp, Wilcox, Oberrecht, Kammermann, & McElmurray, 2004; Plotnikoff, Courneya, Trinh, Karunamuni, & Sigal, 2008; Dean, Farrell, Kelley, Taylor, & Rhodes, 2007; Harada et al., 2008; Cardinal & Kosma, 2004).

Although such psychosocial correlates have been identified, research examining the environmental factors associated with strength-training behavior has been minimal. In terms of an ecological model (Sallis et al., 2006), environmental attributes related to physical activity remain an emerging research area (Wendel-Vos, Droomers, Kremers, Brug, & van Lenthe, 2007). Moreover, most studies investigating environmental correlates have been concerned with specific attributes such as walking (Saelens & Handy, 2008), cycling (de Geus, de Bourdeaudhuij, Jannes, & Meeusen, 2008), or total physical activity (Shibata, Oka, Harada, Nakamura, & Muraoka, 2009). In this respect, only one study has reported that the amount of home exercise equipment is associated with strength-training behavior, yet the availability of such facilities did not show an association (Sallis, Johnson, Calfas, Caparosa, & Nichols, 1997). A further examination of the relationship between strength-training behavior and environmental factors would provide useful information to explore the effectiveness of environmental intervention to promote strength training. The purpose of the current study, therefore, was to investigate the relationship between strength-training behavior and the perceived environment in older Japanese adults.

Method

Participants

The data sample consisted of 293 male and female respondents who provided answers to an Internet-based cross-sectional survey. Implementation of the survey was entrusted to a Japanese Internet research-services organization. The initial sample size and methodology consisted of an equivalent number of approximately 300 men and women age 65–75 years living in Japan—where the potential respondents were randomly selected by the Internet research-services organization from the monitors of its organization in accordance with the sample size and parameters—who were invited to participate in an Internet-based survey via e-mail. All participants were required to provide an e-mail address on registration. The Internet-based questionnaires were placed in a protected area of a Web site, and the potential respondents received the URL in an invitation e-mail. Reward points were provided by the Internet research-services organization as incentives for participation. The reward points could be redeemed for several commercial products. All respondents voluntarily signed an online institutional review board–approved letter of informed consent and provided demographic information. Because 7 of the participants did not respond to a number of questions, their replies were ignored; the responses of the remaining 293 respondents were then used for the purpose of analysis.

Measurements

Strength-Training Behavior. Based on previous studies (Bopp et al., 2004; Harada et al., 2008) and the definition provided by the current recommendations from the American College of Sports Medicine and the American Heart Association (Haskell et al., 2007) and *Healthy People 2010* (U.S. Department of Health and Human Services, 2000), strength training was defined as all activities that serve to enhance muscle strength and endurance, whereby regular training was defined as strength training occurring 2 days or more per week. Exercises using the individual's own body weight (e.g., sit-ups, push-ups, and squats), exercises using portable equipment (e.g., dumbbells and exercise tubes), and exercises using machines or barbells located in sports facilities were listed as examples of strength-training activities.

The stages-of-change for strength-training scale (Harada et al., 2008) was employed to assess regular strength-training behavior. This scale consists of five choices: precontemplation (not engaged in regular strength training and not intending to within the next 6 months), contemplation (intending to engage in strength training within the next 6 months), preparation (engaged in strength training irregularly), action (engaged in regular strength training, but for less than 6 months), and maintenance (engaged in regular strength training for the past 6 months or more). Those in the action and maintenance categories were classified as engaged in regular strength-training behavior, whereas those in the other three stages were classified as not engaged in regular strength-training behavior.

Environmental Factors. Both environmental factors for general physical activity and those specific to strength-training behavior were assessed. The International Physical Activity Questionnaire environmental module (International Physical Activity Prevalence Study, 2002), Japanese version (Inoue et al., 2009; IPAQ-E) was used to assess general environmental factors. In all, seven core and four recommended items were used, consisting of residential density, access to shops, access to public transport, presence of sidewalks, presence of bike lanes, access to recreational facilities, crime safety, traffic safety, observing active people, aesthetics, and household motor vehicles. Residential density was assessed as detached single-family housing; townhouses, row houses, and apartments or condos (two or three stories); a mixture of single-family residences and townhouses, row houses, apartments or condos, and apartments or condos (4–12 stories); and apartments or condos of over 12 stories. The question referring to motor vehicles related to the number of household automobiles used. The other nine items employed a 4-point Likert scale: *strongly agree, somewhat agree, somewhat disagree,* and *disagree.* Good test–retest reliability for the IPAQ-E has been demonstrated (Spearman's correlation coefficients .79–.99) for the Japanese version (Inoue et al., 2009).

Two items assessed specific environmental factors associated with strength-training behavior: access to facilities for strength training and home equipment for strength training. A 4-point Likert scale ranging from *strongly agree* to *disagree* was used for these items. Ninety-six of the participants from the current study answered the same questions after 2 weeks. Test–retest reliability was assessed using Spearman's correlation coefficients, which came to .62 with regard to facilities for strength training and .66 with regard to home equipment for strength training.

All perceived environmental variables were divided into two categories. For residential density, the choice of "detached single-family housing" was categorized as low residential density, and the other four choices were categorized as high residential density. For motor vehicles, responses were categorized as "none" or "one or more." Responses to the remaining 11 items, including strength-training-specific variables, were classified as either "agree" or "disagree."

Demographic Factors. Demographic variables included gender (male and female), age group (65–69 and 70–75 years old), educational level (less than high school graduate, junior college graduate or equivalent, and college graduate or higher), household income level (<¥5 million, ¥5–10 million, and >¥10 million), body-mass index (<24.9 and ≥25.0), self-rated health status (good and poor), smoking habits (yes and no), and residential area (urban, suburban, and rural). Household income of ¥5 million is equal to approximately $56,000 U.S. or 45,000 Euros.

Analyses

To describe the participants, their descriptive statistics with regard to level of education and household income were compared with the data of representative Japanese people 65–74 years old obtained from the 2000 Population Census of Japan (Japan Statistics Bureau & Statistics Center, 2001) and 2006 National Livelihood Survey (Ministry of Health, Labor and Welfare, 2006). The associations between the demographic variables and regular strength-training behavior were analyzed using the chi-square test.

A logistic-regression analysis was then performed, and the crude and adjusted odds ratios (ORs) and 95% confidence intervals (CI) were calculated to identify the environmental factors associated with regular strength-training behavior. Adjustments were made for all the demographic variables.

Statistical significance was set at $p < .05$. The Statistical Package for Social Science (SPSS) for Windows 15.0 was used for all of the analyses.

Results

Characteristics of Respondents

Table 1 presents the characteristics of the 293 respondents; 50.5% were women, 72.4% were age 65–69, 45.4% had graduated from junior high school and high school, 63.1% had a household income less than ¥5 million, 74.3% were of normal weight, 74.4% regarded their health status as good, 85.7% were nonsmokers, and 56.3% lived in a suburban area. Those perceiving their health status as good, as well as those identifying themselves as nonsmokers, were found to be more likely to participate in regular strength training. Although the significance level did not technically reach .05 ($p = .059$), the prevalence of regular strength training was higher in men than women.

The distribution frequency of education level in representative Japanese people 65–74 years old showed that 89.5% were junior high school or high school graduates,

Table 1 Basic Characteristics of Respondents, *n* (%)

	Total	No RST	RST	*p*
Total	293 (100.0)	239 (81.6)	54 (18.4)	
Gender				.059
male	145 (49.5)	112 (46.9)	33 (61.1)	
female	148 (50.5)	127 (53.1)	21 (38.9)	
Age, years				.324
<70	212 (72.4)	170 (71.1)	42 (77.8)	
≥70	81 (27.6)	69 (28.9)	12 (22.2)	
Educational background				.537
≥college graduate	110 (37.5)	91 (38.1)	19 (35.2)	
2 years at college or equivalent	50 (17.1)	38 (15.9)	12 (22.2)	
≤high school	133 (45.4)	110 (46.0)	23 (42.6)	
Household income level				.288
<¥5 million	185 (63.1)	147 (61.5)	38 (70.4)	
¥5–10 million	83 (28.3)	69 (28.9)	14 (25.9)	
>¥10 million	25 (8.5)	23 (9.6)	2 (3.7)	
Body-mass index				.472
<24.9	237 (81.2)	196 (82.0)	42 (77.8)	
≥25.0	55 (18.8)	43 (18.0)	12 (22.2)	
Self-reported health status				.018
good	218 (74.4)	171 (71.5)	47 (87.0)	
poor	75 (25.6)	68 (28.5)	7 (13.0)	
Smoking habit				.042
no	251 (85.7)	200 (83.7)	51 (94.4)	
yes	42 (14.3)	39 (16.3)	3 (5.6)	
Residential area				.418
urban	110 (37.5)	87 (36.4)	23 (42.6)	
suburban	161 (54.9)	132 (55.2)	29 (53.7)	
rural	22 (7.5)	20 (8.4)	2 (3.7)	

Note. RST = regular strength-training behavior.

4.1% were junior college graduates or equivalent, and 6.5% were college graduate or higher (Japan Statistics Bureau & Statistics Center, 2001), and the distribution frequency of household income level showed that 69.2% earned <¥5 million, 23.5% earned ¥5–10 million, and 7.3% earned >¥10 million (Ministry of Health, Labor and Welfare, 2006). Therefore, compared with the distribution frequency of representative Japanese data in the same age groups, the respondents of this study tended to be more educated, although they did not tend to have much higher household income (the difference was less than 10%).

Environmental Factors Associated With Regular Strength-Training Behavior

Overall, 18.4% of the respondents ($n = 54$) engaged in strength-training behavior regularly (twice or more a week). The distributions of environmental factors are shown in Table 2.

Table 2 Environmental Correlates of Regular Strength-Training Behavior

	n (%)	Crude OR	(95% CI)	Adjusted OR	(95%CI)
Residential density					
low	216 (73.7%)	1.00		1.00	
high	77 (26.3%)	0.98	(0.50—1.92)	0.85	(0.40—1.79)
Access to shops					
poor	98 (33.4%)	1.00		1.00	
good	195 (66.6%)	1.97	(0.98—3.94)	1.70	(0.80—3.60)
Access to public transport					
poor	36 (12.3%)	1.00		1.00	
good	257 (87.7%)	2.72	(0.80—9.23)	2.17	(0.61—7.72)
Presence of sidewalks					
no	119 (40.6%)	1.00		1.00	
yes	174 (59.4%)	1.09	(0.60—2.00)	1.00	(0.52—1.93)
Presence of bike lanes					
no	225 (76.8%)	1.00		1.00	
yes	68 (23.2%)	1.20	(0.61—2.37)	1.08	(0.52—2.23)
Access to recreational facilities					
no	145 (49.5%)	1.00		1.00	
yes	148 (50.5%)	1.69	(0.93—3.10)	1.65	(0.87—3.15)
Crime safety					
not safe	213 (72.7%)	1.00		1.00	
safe	80 (27.3%)	1.28	(0.68—2.44)	1.40	(0.70—2.80)
Traffic safety					
not safe	204 (69.6%)	1.00		1.00	
safe	89 (30.4%)	0.86	(0.45—1.65)	0.88	(0.44—1.77)
Seeing people being active					
poor	107 (36.5%)	1.00		1.00	
good	186 (63.5%)	2.31	(1.16—4.61)	2.20	(1.06—4.58)
Aesthetics					
poor	153 (52.2%)	1.00		1.00	
good	140 (47.8%)	1.22	(0.68—2.21)	1.13	(0.60—2.13)
Household motor vehicles					
none	75 (25.6%)	1.00		1.00	
one or more	218 (74.4%)	1.64	(0.78—3.46)	1.63	(0.72—3.68)
Home equipment for strength training					
no	226 (77.1%)	1.00		1.00	
yes	67 (22.9%)	4.48	(2.39—8.43)	2.14	(1.50—3.06)
Access to facilities for strength training					
no	171 (58.4%)	1.00		1.00	
yes	122 (41.6%)	1.57	(1.18—2.09)	2.53	(1.32—4.85)

Note. OR = odds ratio; CI = confidence interval. Adjusted for gender, age, educational background, household income, body-mass index, self-reported health status, smoking habit, and residential area.

As shown in the unadjusted analysis results in Table 2, regular strength-training behavior was significantly associated with observing other individuals being active (OR = 2.31, 95% CI = 1.16–4.61), having home equipment for strength training (OR = 4.48, 95% CI = 2.39–8.43), and having access to facilities for strength training (OR = 1.57, 95% CI = 1.18–2.09). Other items on the IPAQ-E were not significantly associated with regular strength-training behavior.

Even after adjusting for demographic variables, the following components were still found to be positively correlated with regular strength-training behavior: observing active people (OR = 2.20, 95% CI = 1.06–4.58), having home equipment for strength training (OR = 2.14, 95% CI = 1.50–3.06), and having access to facilities for strength training (OR = 2.53, 95% CI = 1.32–4.85). Other environmental factors were not, however, significantly correlated with regular strength-training behavior.

In addition, further analysis was conducted to clarify the impact and interaction of the specific environmental factors. Among those who engaged in strength training regularly (n = 54), 14 respondents (25.4%) did not report both home equipment for strength training and facilities for strength training in their neighborhood. In contrast, among those who did not engage in regular strength training (n = 239), 110 respondents (46.0%) reported home equipment or facilities in their neighborhood.

Discussion

The current study examined the relationship between strength-training behavior and perceived environment in older Japanese adults. The results revealed that observing active people, having home equipment for strength training, and having access to facilities for strength training were correlated with regular strength-training behavior. This finding indicates that the strength-training behavior of older adults may be associated with environmental factors, as has also been found with other types of physical activities (e.g., walking [Saelens & Handy, 2008] and cycling [de Geus et al., 2008]). Consistent with an ecological model (Sallis et al., 2006), the current study suggests that environmental factors provide a useful means by which strength-training behavior may be understood.

Both specific environmental factors (i.e., access to facilities for strength training and having home equipment for strength training) were associated with strength-training behavior. Some types of strength training such as exercise using an exercise machine or barbells require a particular place or equipment. Because the specific environmental factors provide a place or equipment for that type of strength training, these factors would encourage older adults to engage in strength training. Only one of the 11 environmental factors assessing general physical activity was identified as being similarly associated. The current results support the concept of a behavior-specific ecological model (Giles-Corti, Timperio, Bull, & Pikoa, 2005), which proposes that the influence of environmental factors is behavior specific (Giles-Corti et al., 2005). Other studies have subsequently identified behavior-specific environmental correlates, for example, cycling behavior (de Geus et al., 2008) and walking for leisure and for transport (Cleland, Timperio, & Crawford, 2008).

The inconsistency between the results of previous studies and the current study could be partly explained by the behavior-specific measurement strategy. Mixed results have been found in the association of access to facilities with total physical activity level (Addy et al., 2004; Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Brownson, Baker, Housemann, Bernnan, & Bacak, 2001; Sharpe, Granner, Hutto, & Ainsworth, 2004; Shibata et al., 2009), as well as with vigorous physical activity (de Bourdeaudhuji, Sallis, & Saelens, 2003; Giles-Corti & Donovan, 2002; Salmon, Owen, Crawford, Bauman, & Sallis, 2003). The evidence for the relationship between physical activity and home equipment also appears to be inconsistent (Booth et al., 2000; de Bourdeaudhuji et al., 2003; Shibata et al., 2009). With respect to the relationship between strength-training behavior and environmental variables, Sallis et al. (1997) also did not find an association between strength training and the availability of facilities. Such diverse results could, however, be explained by the fact that previous studies did not measure the behavior-specific environment.

Although home equipment and access were associated with regular strength training, about 25% of those who participated in regular strength training did not report both environmental factors specific to strength training. These results indicate that although specific environments would be important, they might not be essential for engaging in strength training. For example, performing squats in the home does not require any particular equipment or place. In contrast, some people would still not engage in regular strength training even if they had home equipment or lived near a facility for strength training.

Two Japanese studies (Inoue et al., 2009; Kamada et al., 2009) using the IPAQ-E demonstrated a positive association between moderate to vigorous physical activity or walking behavior and residential density, access to shops, public transport, recreational facilities, presence of sidewalks or bike lanes, and pleasant aesthetics. The current study, in contrast, did not find a correlation with these factors. As mentioned previously, some types of strength training require a particular place or equipment. However, place or equipment for engaging strength training is not recognized as an environmental factor on the IPAQ-E scale. Therefore, these two items should be assessed in addition to the IPAQ-E when examining environmental supports for strength training. Such factors might be more important for aerobic physical activities such as walking or biking. Observing active people was not correlated with physical activity in two Japanese studies (Inoue et al., 2009; Kamada et al., 2009). A previous Japanese study that did not employ the IPAQ-E scale (Shibata et al., 2009) also indicated that there was no relationship between observing active people and physical activity. Unlike those studies, this study found a positive relationship between observing active people and strength training. There is a possibility that observing active people might motivate older people to engage in physical activity including strength training. Further studies are needed to clarify the nature of the link between observing active people and strength training among older adults.

The current study had a number of limitations; namely, the analysis was cross-sectional, which prevented the identification of cause and effect, and the sample size was quite small. The test–retest reliabilities of two items regarding specific environmental factors were lower than those of the items of the IPAQ-E Japanese version (Inoue et al., 2009). This may reflect the difference in methodology of the survey or in the characteristics of the items. However, because the values were equal to the items of the IPAQ-E Swedish version (ICCs .36–.98: Alexander, Bergman, Hagstromer, & Sjöström, 2006) and English version (ICCs .52–.58: Sallis et al., 2010), the reliability of our findings from these two items might be comparable to other studies using the IPAQ-E scale. In addition, the study was conducted via the Internet. As studies about the Internet surveys have indicated (Eysenbach & Wyatt, 2002; Rhodes, Bowie, & Hergenrather, 2003; Yasunaga, Ide, Imamura, & Ohe, 2006), this may have led to issues of generalization related to selection bias. Thus, the respondents may possibly represent a biased sample, which implies that such findings may not be applicable to the general population. Moreover, the details of strength training, such as the number of sets or repetitions, were not measured. Therefore, the current study cannot refer to the dose of strength training performed by the respondents.

The current study is an early study examining the correlates of strength-training behavior from the viewpoint of environmental attributes. Although the results cannot specify causal relationships, they nevertheless show how environmental factors such as enhancement of access to facilities and availability of home equipment for strength training may play a role in promoting strength-training behavior in older adults.

Acknowledgments

This investigation was supported by a Grant-in-Aid from the Ministry of Health, Labor, and Welfare of Japan (Comprehensive Research on Prevention of Cardiovascular Diseases and Other Lifestyle-Related Diseases: H20-Junkankitou-Ippan-001); a Grant-in-Aid for Scientific Research (C: No.20500604) from the Japan Ministry of Education, Culture, Sports, Science and Technology; Grants-in-Aid for Scientific Research (No. 2080054) from the Japan Society for the Promotion of Science; a Grant-in-Aid for JSPS Fellows (No. 20-6333); Waseda University Grant for Special Research Projects (No. 2010A-093); and Global COE Program "Sport Sciences for the Promotion of Active Life" from the Japan Ministry of Education, Culture, Sports, Science, and Technology.

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運動疫学研究 2011; 13(1): 12-29.

【特別論文】

身体活動のトロント憲章日本語版：世界規模での行動の呼びかけ

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【要約】第3回国際身体活動公衆衛生会議（2010年5月，トロント市）において「身体活動のトロント憲章：世界規模での行動の呼びかけ」が採択された。本憲章は会議を主催した国際身体活動健康学会（International Society of Physical Activity and Health）の協議会の1つであるGlobal Advocacy Council for Physical Activityが中心となって作成したものである。学会終了後，本会議への出席者が中心となって日本語版への翻訳を行った。本稿では日本語版を資料として添付するとともに，憲章作成の背景，翻訳の経緯，憲章の内容等を解説した。

本憲章は，身体活動推進に携わる研究者，専門家，政策決定にかかわる者の合意として世界規模で身体活動推進の優先順位を高めるための行動を呼びかけ（call for action），関連する団体や個人に支援ツール（advocacy tool）を提供するものである。憲章の中心となる部分は，身体活動がもたらす効果の概要，「9つの指針」と「行動の枠組み」であり，身体活動推進の根拠と対策のあり方が示されている。

本憲章は政策立案に際してのチェックリスト，政策決定者の説得，現在行われている事業のチェックや課題の抽出，研究課題の抽出，論文作成時の引用文献などとして有用であり，広く活用されることが期待される。

Key words：トロント憲章，身体活動，運動，支援活動，健康増進

1．緒　言

2010年5月5日から8日にかけてカナダのトロント市で第3回国際身体活動公衆衛生会議（International Congress of Physical Activity and Public Health; ICPAPH）が開催され，「The Toronto Charter for Physical Activity: A Global Call for Action（身体活動のトロント憲章：世界規模での行動の呼びかけ）」が採択された[1)]。本憲章は，身体活動推進に携わる研究者，専門家，政策決定にかかわる者の合意として世界規模で身体活動推進の優先順位を高めるように訴えるもので（行動の呼びかけ：call for action），これを支援するツール（支援ツール：advocacy tool）でもある。学会終了後，この憲章を多くの人に広めるという趣旨に従い，本会議への出席者が中心となって日本語翻訳版を作成した。2011年1月7日時点において，フランス語，スペイン語，ドイツ語等を含む9カ国語で公開されている。本稿では，憲章作成の背景，翻訳の手順，および憲章の内容について概説する。また，原本である英語版と対照する形で日本語版を資料として添付する（資料1）。

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投稿日：2011年1月8日，受理日：2011年2月8日

2．憲章作成の背景

本憲章は会議を主催した国際身体活動健康学

会（International Society of Physical Activity and Health; ISPAH）の協議会の 1 つである Global Advocacy Council for Physical Activity（GAPA）が中心となって作成されたものである。憲章作成の発案は 2008 年に開催された第 2 回 ICPAPH（オランダ・アムステルダム）にさかのぼる。以後，2 年間にわたり草稿の作成，コメントの募集とそれに基づいた修正作業が繰り返されてきた。最終版の確定までに，55 カ国，460 人の研究者・専門家・政策決定者より，1,697 のコメントが寄せられたことが本会議において報告されている。これまでにも，非感染性疾患（noncommunicable diseases）への対策の指針が WHO によって示されているが[2,3]，これらは生活習慣全般にわたるものであった。本憲章は，これらの先行する文書を踏まえて，身体活動推進のための具体的な指針を示すものである。本憲章を採択したトロント会議には世界各国の主要な身体活動研究者・専門家・政策決定者 1,200 名以上が参加しており，現時点における身体活動の専門家によるコンセンサスとも考えることができる。

3．翻訳の手順

翻訳は GAPA が提示する翻訳プロトコルに従って実施した。はじめに 2 人の翻訳者が別々に翻訳を行い，その後，翻訳チームのコアメンバーによって 2 つの翻訳が 1 つの翻訳案に統合された。翻訳案の作成にあたり，適宜，原本作成者と連絡を取り，内容の確認を行った。その後，翻訳グループ内での意見交換を行い，さらに公衆衛生関係のメーリングリスト，第 13 回運動疫学研究会学術集会における発表で広く意見を求めて翻訳を改訂し最終版を確定した。翻訳プロトコルにおいて，本憲章が「身体活動」を扱ったものであり，「運動」のみを扱ったものではないことが強調されている。したがって，挿入する写真は，運動と生活活動の両方が含まれるように配慮した。

4．　憲章の内容

本憲章では，はじめに，身体活動の推進が①健康，②社会の持続的発展，③経済発展に対して恩恵をもたらすことが述べられている。①では心血管疾患，がん，小児肥満，メンタルヘルス，高齢者の自立などと身体活動の関連が取り上げられている。②ではアクティブな移動手段（歩行，自転車，公共交通の利用）によって自家用車の利用が抑制され，温室効果ガスの排出削減・環境負荷の低減を通して社会の持続的発展に資することが示されている。また，③では身体活動推進による医療コストの抑制，健康によって得られる生産性の向上が経済的発展につながることが示されている。②③が①と同じ分量で取り上げられていることは近年の学際的な身体活動研究の動向を反映していると同時に，健康以外の利益を強調することにより，この憲章の社会へのより広い浸透を意図していることがうかがえる。

それに続く，身体活動推進のための「9 つの指針」と「行動の枠組み」は本憲章の中心となる部分である。以下，それぞれについて解説する。

4-1.　9 つの指針：Guiding principles

身体活動推進のための 9 つの指針が示されている。英文では「Guiding principles for a population based approach to physical activity」となっている。ここで，population based approach をどのように訳すべきかが翻訳者間および翻訳者と原本作成者の間で議論となった。ここでは，ハイリスクアプローチの手法を用いることも含めて，「全ての人々の身体活動推進を図る」という意味で考えてもよいことを原本作成者に確認し，「全ての人々を対象とした身体活動推進の指針」と訳出した。

以下，9 つの指針それぞれについて解説する。なお，解説は，9 つの指針に沿って現在，実施されている政策や事業を点検する，という視点で行った。また，解説の内容は本稿の著者の解釈によるものであることを付記する。

1) 全人口および特定の集団（女性，高齢者，子ども，障がい者，勤労者など），特に身体活動を行うことに大きな障壁を有する人々に対して，科学的根拠に基づいた戦略を用いる

行われている事業が全ての住民に届いているのかを考える必要がある。アプローチできていない集団（例えば，健康に関心のない住民）はないだろうか？　全住民を対象とした対策を実施するとともに，特定の集団，例えば，女性，高齢者，子ども，障がい者，勤労者などに対して，どのようにアプローチできているかを考えるべきである。これらの特定の集団には，それぞれ異なったアプローチが有効かもしれない。また，政策・事業が科学的根拠に基づいていることが重要である。

2）社会的不平等，健康の不平等，身体活動機会の不均等を減少させるような平等の戦略を用いる

実施している対策が身体活動機会の不平等，健康の不平等を是正する効果をもっていることを確認する必要がある。近年，ポピュレーションアプローチが健康格差を拡大する可能性が指摘されている。すなわち，健康に関するメッセージを受け取る力が弱い集団，将来リスクをもつ可能性が高い集団（例えば，社会経済的状況が不良な集団）に対するアプローチについて十分に考慮されるべきである。

3）身体不活動の環境的，社会的，個人的な規定要因の改善に取り組む

対策を実施するにあたり，身体活動に影響を与える環境要因，社会的要因，個人要因を理解し，これらに働きかける効果的な戦略を用いるべきである。環境要因としては，運動場所・施設などを含む身体活動の機会の有無，近年研究が盛んに行われている都市の構造（walkability）などがある。社会的要因としては，指導者や運動プログラム，スポーツクラブの存在，地域のソーシャル・キャピタルなどがある。個人的要因としては，性別，年齢等の人口統計学的要因や，現在の健康状態，社会経済的状況，さらに性格，自己効力感，運動の楽しみといった心理的な要因などが含まれる。

4）効果を最大にするために，持続可能な対策を，国や地域の各レベルで複数部門の連携を通じて実施する

身体活動推進対策は，単発的ではなく，継続的に，継続可能な方法で実施する必要がある。その際，多くの関連する部門（保健，労働，教育・スポーツ，都市計画，都市交通，NGO，民間，研究機関など）が協力することにより効果的な対策が行える。他部門との連携は十分に取られているだろうか？　また，国と地方自治体の各レベルでの対策が連携し，効果的に実施されていることが望まれる。

5）研究，実践，政策，評価，調査のための能力を高め（キャパシティ・ビルディング），トレーニングを支援する

身体活動の推進においては研究，実践，政策立案，評価，調査などの能力が必要であり，これらの技能をもつ人材を育成するための支援を行う必要がある。

6）子ども，家族，成人，高齢者のニーズに対応した，生涯を通じたアプローチを行う

子ども，家族，成人，高齢者の身体活動推進には異なる対策が必要となることが多い。それぞれのグループのニーズに対応した施策が求められる。

7）身体活動に関する政治的取り組みを強化し，資源を増大するように，政策決定者や社会一般に対して政策提言・支援活動（アドボカシー）を行う

政策決定者や地域社会に対して，身体活動推進のための取り組みを強化するように働きかける。あるいは身体活動のための機会（運動施設，公園，運動プログラム，歩きやすい街路，公共交通など）を充実させるように働きかける必要がある。

8）文化的差異に配慮し，多様な地域の現状，背景，資源に応じた戦略を採用する

画一的な対策ではなく，地域の特徴に応じた対策が必要である。気候，歴史，風土，文化，都市化の程度，地域に特有の生活習慣，行事などに応じた対策を構築する必要がある。

9）身体活動を行うという選択が容易にできるようにすることで，個人が健康な選択をすることを促進する

最終的に身体活動を行うのは個人だが，身体不活動の問題を個人の責任のみに帰するのではなく，住民（国民）にとって，身体活動を行うことがより容易な選択となるような環境を作ることが重要である。不活動よりも活動的であることを選ぶような環境，社会になっているかを考える必要がある。

4-2. 行動の枠組み：A framework for action

行動の枠組みとして。4 つの行動（対策）領域が示されている。これは上記の 9 つの指針に沿ってどのような行動が取られるべきかを示したもので，各項目（4 つの行動）に対して具体的な対策例が示されている。9 つの指針と同様に，実施されている事業や活動を点検する，という視点で解説を行う。

1）国家政策，行動計画の策定と実行

国家政策と行動計画は示されているか？　日本においては健康日本 21 等がこれにあたるものと考えられる。これらの国家レベルでの政策，行動計画が適切に策定，実行されるための具体的視点，方法が例示されている。

2）身体活動を支援する施策の導入

身体活動に影響する「施策の枠組み」と「規制」