Associations between the settings of exercise habits and health-related outcomes in community-dwelling older adults

Keitaro Makino, Msc1,2)*, Hikaru Iihara, PhD3), Atsushi Mizumoto, PhD3), Kotaro Shimizu3), Toyoki Ishida3), Takeo Furuna, PhD3)

1) Graduate School of Health Sciences, Sapporo Medical University: South 1, West 17, Chuo-ku, Sapporo, Hokkaido 060-8556, Japan
2) Houseikai Health Care Group, Japan
3) Department of Physical Therapy, School of Health Sciences, Sapporo Medical University, Japan

Abstract. [Purpose] The purpose of this study was to examine the associations between the settings of exercise habits and health-related outcomes in community-dwelling older adults. [Subjects] A total of 304 Japanese community-dwelling older adults (70.3 ± 4.1 years; 113 males and 191 females) participated in this study. [Methods] Demographic characteristics, medical conditions, exercise habits, and health-related outcomes were assessed by face-to-face interviews and self-reported questionnaires. Older adults who had exercise habits were classified into two groups: individual- and group-based exercise habits groups, and the health-related outcomes were compared between groups. [Results] The scores for the Geriatric Depression Scale, exercise self-efficacy, and dietary variety of older adults who had group-based exercise habits were better than those of older adults who had individual-based exercise habits. In addition, the exercise settings (individual- and group-based) were significantly associated with scores for the Geriatric Depression Scale (odds ratio = 0.76) and exercise self-efficacy (odds ratio = 1.26), even after adjusting for age and gender. [Conclusion] These results implied that habitual exercise in group settings may have an effective role in promoting exercise self-efficacy and mental health.

Key words: Exercise habits, Group exercise, Exercise self-efficacy

INTRODUCTION

Regular physical activity and exercise habits facilitate healthy aging, improve functional capacity, and prevent disease in older adults. Previous studies have shown that exercise habits maintain muscle strength1) and physical performance3) in older adults. For example, Akune et al. reported that exercise habits in middle age were significantly associated with grip strength, gait speed, one-leg standing time, and the prevalence of sarcopenia in older age3). Regular physical activity was also associated with a lower incidence of morbidity of major chronic diseases, such as coronary heart disease4) and type 2 diabetes5). On the other hand, Lee et al. quantified the effects of physical inactivity on major non-communicable diseases by calculating population attributable fractions associated with physical inactivity. They estimated that physical inactivity causes 6% of the burden of disease from coronary heart disease, 7% of that from type 2 diabetes, and 10% of that from breast cancer and colon cancer and that elimination of physical inactivity would increase the life expectancy of the world’s population by 0.68 years7). In addition, some recent studies have found that physical activity and exercise are associated with cognitive function8–10), mental health11), and health-related quality of life12, 13). Therefore, it is important to maintain regular physical activity and exercise habits.

On the basis of these reports, recommended contents of regular exercise have reached a high level of consensus. For instance, the Japanese Ministry of Health, Labour and Welfare gives clear reference values for intensity, duration, and frequency of habitual exercise required for the good health of older adults in Physical Activity Reference for Health Promotion 201314). However, little is known about differences in the detailed characteristics of health-related outcomes, including medical conditions, depression, dietary variety, functional capacity, fall history, self-efficacy, and self-rated health, between exercise and non-exercise groups or between individual- and group-based exercise groups. We hypothesized that individual- and group-based exercise habits could have different roles with respect to health-related outcomes in older adults, because different effects between individual- and group-based exercise have reported in some exercise intervention studies15, 16). Therefore, it is important to examine the associations...
between the settings of exercise habits and health-related outcomes in community-dwelling older adults.

**SUBJECTS AND METHODS**

**Subjects**

A total of 304 Japanese community-dwelling older adults (70.3 ± 4.1 years, 113 males and 191 females) participated in this study. All participants were ambulatory and independently performed activities of daily living. Participants were excluded if they were hospitalized for longer than 1 week during the 3-month period before the study. Participants were also excluded if they were diagnosed with stroke, Parkinson’s disease, depression, or dementia. We also excluded participants with a Mini Mental State Examination (MMSE) score below 20 from analyses [17, 18]. Finally, we analyzed the data of 266 participants who had completed the study’s face-to-face interviews and self-reported questionnaires. The ethical aspects of the study were approved by the Sapporo Medical University Hospital Ethics Committee (Approval No. 24-2-43). We obtained written informed consent from each patient before study initiation.

**Methods**

Demographic characteristics (i.e., age, gender, annual income, and education level), medical conditions (i.e., hypertension, heart disease, and diabetes mellitus), exercise habits, and health-related outcomes were measured using face-to-face interviews and self-reported questionnaires. Health-related outcomes included the Motor Fitness Scale (MFS), MMSE, Geriatric Depression Scale (GDS), frequency of going outdoors, an 11-item food frequency score, the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC), history of falls, level of exercise self-efficacy, and self-rated health. Exercise habits were defined as engaging in exercise more than three times a week for at least 30 minutes a time. Participants who reported exercise habits were asked about their attendance at group-based exercise using an additional question: “Are you performing group exercise regularly?”

To estimate levels of physical function, the MFS was measured. This scale consisted of 14 items including mobility, strength, and balance. It has been reported to be highly reliable (alpha = 0.92 and test-retest = 0.92) [19]. The MMSE was assessed as a measure of general cognitive function [20]. Depressive symptoms were assessed using the 15-item GDS, which requires yes/no responses to questions about depression [21]. To estimate mobility outside the home, participants were asked the frequency of going outdoors per week, and the responses were recorded on an 8-point scale ranging from “seven days per week” (7) to “less than once per week” (0). The 11-item food frequency score was used to assess dietary variety. It consists of 11 main food groups (fish, meat, eggs, milk, milk products, beans, vegetables, seaweed, potatoes, fruits, and lipids) and participants were asked the frequency of eating these foods in the course of a week using a 4-point scale ranging from “nearly every day” (1) to “very little” (4). Total scores were used (score range 11–44), with lower scores indicating higher dietary variety. The TMIG-IC consists of 13 items regarding high-level functional capacity (5 items for instrumental self-maintenance, 4 items for intellectual activity, and 4 items for social role). The validity and reliability of this index have been previously verified and it is widely accepted in Japan as a tool to assess functional capacity [22]. History of falls was assessed using the following question: “In the past 1 year, have you had any falls including a slip or a trip in which you lost your balance and landed on the floor or ground or a lower level?” The level of exercise self-efficacy was measured on a scale that assessed a participant’s confidence in engaging in exercise when faced with common barriers. Participants rated their levels of confidence on a scale of 1 to 5 in terms of their ability to exercise under the following conditions: tiredness, bad mood, lack of time, holidays, and poor weather conditions. The test-retest reliability (2 weeks) of this scale has been reported (intra-class correlation coefficient= 0.90) [23]. Self-rated health was assessed by asking respondents to describe their health status using a 4-point scale ranging from “very good” (1) to “very poor” (4).

Participants were divided into two groups: a habitual exercise group and a non-exercise group. Then, we classified participants who had exercise habits into two groups according to settings of exercise habits: individual-based exercise habits group and group-based exercise habits group. Mann-Whitney U tests (for continuous variables) and χ² tests (for categorical variables) were performed to compare variables. Firstly, a comparison was made between the habitual exercise group and non-exercise group; then a comparison was made between the individual- and group-based exercise habits groups. In addition, logistic regression analysis was performed to identify the relationships between the settings of exercise habits and health-related outcomes. Crude odds ratios (OR) were calculated for each of the health-related outcomes with significant differences in the comparison between the individual- and group-based exercise habits groups (model 1). In addition, logistic regression analysis was performed adjusted for age and gender (model 2). All statistical analyses were performed using IBM SPSS Statistics 19.0 (IBM Japan Ltd., Tokyo, Japan). The threshold for statistical significance was defined as p < 0.05.

**RESULTS**

One hundred fifteen (43.2%) participants had exercise habits. Sixty (22.6%) participants had individual-based exercise habits, and fifty-five (20.7%) had group-based exercise habits. The scores for the MFS, exercise self-efficacy, and self-rated health of participants who had exercise habits were significantly better than those of participants who had no exercise habits (Table 1). The scores for exercise self-efficacy, the food frequency score, and the GDS of participants who had group-based exercise habits were significantly better than those of participants who had individual-based exercise habits. Participants who had group-based exercise habits had significantly higher ratio of females (Table 2). Logistic regression analysis revealed that differences in the settings of exercise were significantly associated with the GDS scores (OR = 0.76, 95% CI = 0.65–0.90; p < 0.01) and level of exercise self-efficacy (OR = 1.26, 95% CI = 1.11–1.44, p < 0.01), even after adjusting for age and gender.
Table 1. Comparison of characteristics between the non-exercise and habitual exercise groups

|                | Non-exercise (n = 151) | Habitual exercise (n = 115) |
|----------------|------------------------|----------------------------|
| Age (years)    | 70.3 ± 4.2             | 70.1 ± 3.8                 |
| Gender (female, %) | 99 (65.6)             | 74 (64.3)                 |
| Medical conditions (yes, %) |                      |                            |
| Hypertension   | 74 (49.0)              | 58 (50.4)                  |
| Heart disease  | 26 (17.2)              | 14 (12.2)                  |
| Diabetes mellitus | 27 (17.9)             | 15 (13.0)                  |
| Annual income (≥1 million yen, %) | 101 (66.9)          | 78 (67.8)                  |
| Education level (years) | 11.6 ± 2.2           | 11.8 ± 2.3                 |
| MFS (score)    | 11.4 ± 2.7             | 12.1 ± 2.1**               |
| MMSE (score)   | 26.6 ± 2.4             | 26.9 ± 2.1                 |
| GDS (score)    | 4.3 ± 3.0              | 3.7 ± 2.9                  |
| Frequency of going outdoors (days/week) | 4.3 ± 2.0             | 4.4 ± 1.9                  |
| Food frequency score (score) | 24.4 ± 5.9           | 23.2 ± 4.4                 |
| TMIG-IC (score) | 12.0 ± 1.2            | 12.1 ± 1.1                 |
| History of falls (yes, %) | 38 (25.2)            | 23 (20.0)                  |
| Exercise self-efficacy (score) | 13.9 ± 4.4           | 17.3 ± 3.7**               |
| Self-rated health (1–4) | 2.3 ± 0.6            | 2.1 ± 0.5**                |

Data are expressed as means ± standard deviation and frequencies (%). MFS: Motor Fitness Scale; MMSE: Mini Mental State Examination; GDS: Geriatric Depression Scale; TMIG-IC: Tokyo Metropolitan Institute of Gerontology Index of Competence. *p < 0.05; **p < 0.01; p values based on the Mann-Whitney U test for continuous variables and χ² test for categorical variables.

Table 2. Comparison of characteristics between individual- and group-based exercise habits

|                | Individual-based exercise habits (n = 60) | Group-based exercise habits (n = 55) |
|----------------|------------------------------------------|-------------------------------------|
| Age (years)    | 69.9 ± 3.8                               | 70.3 ± 3.8                          |
| Gender (female, %) | 30 (50.0)                     | 44 (80.0)**                          |
| Medical conditions (yes, %) |                      |                                    |
| Hypertension   | 34 (56.7)                                | 24 (43.6)                           |
| Heart disease  | 7 (11.7)                                 | 7 (12.7)                            |
| Diabetes mellitus | 10 (16.7)                  | 5 (9.1)                             |
| Annual income (≥1 million yen, %) | 42 (70.0)                     | 36 (65.5)                           |
| Education level (years) | 12.1 ± 2.5                     | 11.5 ± 1.9                          |
| MFS (score)    | 12.0 ± 2.2                               | 12.1 ± 2.0                          |
| MMSE (score)   | 26.6 ± 2.2                               | 27.1 ± 2.0                          |
| GDS (score)    | 4.5 ± 3.0                                | 2.8 ± 2.6**                         |
| Frequency of going outdoors (days/week) | 4.2 ± 2.0                     | 4.6 ± 1.7                           |
| Food frequency score (score) | 23.9 ± 4.3                     | 22.3 ± 4.4**                        |
| TMIG-IC (score) | 11.9 ± 1.3                                | 12.2 ± 0.9                          |
| History of falls (yes, %) | 11 (18.6)                   | 12 (21.8)                           |
| Exercise self-efficacy (score) | 16.4 ± 4.0                    | 18.2 ± 3.1**                         |
| Self-rated health (1–4) | 2.1 ± 0.6                    | 2.0 ± 0.4                            |

Data are expressed as means ± standard deviation and frequencies (%). MFS: Motor Fitness Scale; MMSE: Mini Mental State Examination; GDS: Geriatric Depression Scale; TMIG-IC: Tokyo Metropolitan Institute of Gerontology Index of Competence. *p < 0.05; **p < 0.01; p values based on the Mann-Whitney U test for continuous variables and χ² test for categorical variables.
However, food frequency scores were not significantly associated with the settings of exercise habits (Table 3).

**DISCUSSION**

The present study examined the associations between the settings of exercise habits and health-related outcomes in community-dwelling older adults. With regard to the presence of exercise habits, the scores for physical functions, exercise self-efficacy, and self-rated health of participants who had exercise habits were significantly better than those of participants who had no exercise habits. Previous studies found that good exercise habits were associated with good physical fitness and good self-rated health, which is congruent with the results of the present study. Self-efficacy is one of the principal Social Cognitive Theory constructs and is defined as an individual’s beliefs about his/her own ability to engage in a task successfully to obtain a desired outcome.

With regard to the settings of exercise habits, we also compared health-related outcomes between different settings of exercise habits. The scores for dietary variety of participants who had group-based exercise habits were significantly better than those of participants who had individual-based exercise habits. This result is in line with a previous study that demonstrated that good exercise habits were associated with good dietary habits.

The scores for the GDS and exercise self-efficacy of participants who had group-based exercise habits were significantly better than those of participants who had individual-based exercise habits. This result is in line with a previous study that demonstrated that good exercise habits were associated with good dietary habits.

In conclusion, we found that group-based exercise habits would be required to reveal the quantitative relationships between amounts of habitual exercise in group settings and health-related outcomes. Therefore, high continuity of exercise might have increased the benefit of exercise habits in participants who reported group-based exercise habits in the present study. For these reasons, group-based exercise habits have important implications for health promotion in community-dwelling older adults.

Our study had several limitations. First, this study was cross-sectional, so it cannot demonstrate causation between exercise habits and health-related outcomes. Therefore, more prospective data are needed to determine the relationship between group-based exercise habits and level of exercise self-efficacy and depressive symptoms. Second, we did not investigate the details of the exercise, such as intensity, duration, and frequency of exercise, and thus further studies would be required to reveal the quantitative relationships between amounts of habitual exercise in group settings and health-related outcomes.

In conclusion, we found that group-based exercise habits were associated with lower levels of depressive symptoms and higher levels of exercise self-efficacy compared with individual-based exercise habits in community-dwelling older adults. These results implied that habitual exercise in group settings may have an effective role in promoting exercise self-efficacy and mental health. Our study results extend our current understanding of the benefits of exercise habits on health promotion in community-dwelling older adults.
REFERENCES

1) Rantanen T, Era P, Heikkinen E: Physical activity and the changes in maximal isometric strength in men and women from the age of 75 to 80 years. J Am Geriatr Soc, 1987, 45: 1439–1445. [Medline] [CrossRef]

2) Aniansson A, Sperling L, Sundgren A, et al.: Muscle function in 75-year-old men and women. A longitudinal study. Scand J Rehabil Med Suppl, 1983, 9: 92–102. [Medline]

3) Akune T, Muraki S, Oka H, et al.: Exercise habits during middle age are associated with lower prevalence of sarcopenia: the ROAD study. Osteoporos Int, 2014, 25: 1081–1088. [Medline] [CrossRef]

4) Powell KE, Thompson PD, Caspersen CJ, et al.: Physical activity and the incidence of coronary heart disease. Annu Rev Public Health, 1987, 8: 253–285. [Medline] [CrossRef]

5) Manson JE, Hu FB, Rich-Edwards JW, et al.: A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. N Engl J Med, 1999, 341: 650–658. [Medline] [CrossRef]

6) Helmerich SP, Ragland DR, Leung RW, et al.: Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. N Engl J Med, 1991, 325: 147–152. [Medline] [CrossRef]

7) Lee IM, Shiroma EJ, Lobelo F, et al. Lancet Physical Activity Series Working Group: Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet, 2012, 380: 219–229. [Medline] [CrossRef]

8) Makizako H, Liu-Ambrose T, Shimada H, et al.: Moderate-intensity physical activity, hippocampal volume, and memory in older adults with mild cognitive impairment. J Gerontol A Biol Sci Med Sci, 2015, 70: 480–486. [Medline] [CrossRef]

9) Sofi F, Valeyce I, Bacci D, et al.: Physical activity and risk of cognitive decline: a meta-analysis of prospective studies. J Intern Med, 2011, 269: 107–117. [Medline] [CrossRef]

10) Yoon JE, Lee SM, Lim HS, et al.: The effects of cognitive activity combined with active extremity exercise on balance, walking activity, memory level and quality of life of an older adult sample with dementia. J Phys Ther Sci, 2013, 25: 1601–1604. [Medline] [CrossRef]

11) Rosenbaum S, Sherrington C: Is exercise effective in promoting mental well-being in older age? A systematic review. Br J Sports Med, 2011, 45: 1079–1080. [Medline] [CrossRef]

12) Uritani D, Matsumoto D, Asano Y, et al.: Relationships between the short- and long-term changes in exercise habit and body composition, blood pressure and health-related quality of life among health program participants. J Phys Ther Sci, 2013, 25: 521–525. [CrossRef]

13) Peungsuwan P, Sermcheep P, Harmmonttre P, et al.: The effectiveness of Thai exercise with traditional massage on the pain, walking ability and quality of life among older adults: cluster randomized trial. J Phys Ther Sci, 2014, 26: 139–144. [Medline] [CrossRef]

14) Ministry of Health: Labour and Welfare of Japan [homepage on the Internet]: Physical Activity Reference for Health Promotion 2013, http://www.mhlw.go.jp/stf/houdou2/29852000002xple.html (in Japanese).

15) Yokoyama N, Nishijima T, Mueda S, et al.: Effect of exercise program participation on personal factors of exercise adherence promotion in middle-aged and elderly subjects: comparison of group and individual exercise program. Jpn J Phys Fit Sport Med, 2003, 52: 249–258 (in Japanese).

16) Cyarto EV, Brown WJ, Marshall AL, et al.: Comparative effects of home- and group-based exercise on balance confidence and balance ability in older adults: cluster randomized trial. Gerontology, 2008, 54: 272–280. [Medline] [CrossRef]

17) Emme M, Meccio C, Stender K: Pooled analyses on cognitive effects of memantine in patients with moderate to severe Alzheimer’s disease. J Alzheimer’s Dis, 2008, 14: 193–199. [Medline]

18) Seo HS, Lee JH, Park YH: Effects of a task-specific exercise program on balance, mobility, and muscle strength in the elderly. J Phys Ther Sci, 2014, 26: 1693–1695. [Medline] [CrossRef]

19) Kinugasa T, Nagasaki H: Reliability and validity of the Motor Fitness Scale for older adults in the community. Aging (Milano), 1998, 10: 295–302. [Medline]

20) Folstein MF, Folstein SE, McHugh PR: “Mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res, 1975, 12: 189–198. [Medline] [CrossRef]

21) Sheikh JA, Yesavage JA: Geriatric Depression Scale (GDS): recent findings and development of a shorter version. In: Clinical Gerontology: A Guide to Assessment and Intervention, Brink TL (ed.). New York: Howarth Press, 1986.

22) Koyano W, Shibata H, Nakazato K, et al.: Measurement of competence: reliability and validity of the TMIG Index of Competence. Arch Gerontol Geriatr, 1991, 13: 103–116. [Medline] [CrossRef]

23) Lamb SE, Jørstad-Stein EC, Hauer K, et al. Prevention of Falls Network Europe and Outcomes Consensus Group: Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe consensus. J Am Geriatr Soc, 2005, 53: 1618–1622. [Medline] [CrossRef]

24) Marcus BH, Bapshaw SW, Levêdre RC, et al.: Using the stages of change model to increase the adoption of physical activity among community participants. Am J Health Promot, 1992, 6: 424–429. [Medline] [CrossRef]

25) Yong MH, Shin J, Yang DJ, et al.: Comparison of physical fitness status between middle-aged and elderly male laborers according to lifestyle behaviors. J Phys Ther Sci, 2014, 26: 1965–1969. [Medline] [CrossRef]

26) Hirakawa Y, Kimata T, Uemura K: Factors associated with self-rated health of rural population: a report from the Prospective Observational Study. J Rural Med, 2014, 9: 40–42. [Medline] [CrossRef]

27) Bandura A: Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev, 1977, 84: 191–215. [Medline] [CrossRef]

28) Marcus BH, Selby VC, Niaura RS, et al.: Self-efficacy and the stages of exercise behavior change. Res Q Exerc Sport, 1992, 63: 60–66. [Medline] [CrossRef]

29) Gorely T, Gordon S: An examination of the transteoretical model and exercise behavior in older adults. J Sport Exerc Psychol, 1995, 17: 312–324. [CrossRef]

30) Neupert SD, Lachman ME, Whitbourne SB: Exercise self-efficacy and control beliefs: effects on exercise behavior after an exercise intervention for older adults. J Aging Phys Act, 2009, 17: 1–16. [Medline]

31) Tucker M, Reicks M: Exercise as a gateway behavior for healthful eating among older adults: an exploratory study. J Nutr Educ Behav, 2002, 34: S14–S19. [Medline] [CrossRef]

32) Ku PW, McKenna J, Fox KR: Dimensions of subjective well-being and effects of physical activity in Chinese older adults. J Aging Phys Act, 2007, 15: 382–397. [Medline]

33) Dishman RK, Buckworth J: Increasing physical activity: a quantitative synthesis. Med Sci Sports Exerc, 1996, 28: 706–719. [Medline] [CrossRef]