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Square-Stepping Exercise and Fall Risk Factors in Older Adults: A Single-Blind, Randomized Controlled Trial

Ryosuke Shigematsu,[1] Tomohiro Okura,[2] Masaki Nakagaichi,[3] Kiyoji Tanaka,[2] Tomoaki Sakai,[4] Suguru Kitazumi,[1] and Taina Rantanen[5]

[1]Faculty of Education, Mie University, Japan.
[2]Graduate School of Comprehensive Human Sciences, University of Tsukuba, Japan.
[3]Research and Development Center for Higher Education, Nagasaki University, Japan.
[4]Faculty of Social Studies, Doshisha University, Japan.
[5]Department of Health Sciences and Finnish Centre for Interdisciplinary Gerontology, University of Jyväskylä, Finland.

Background. Decreased fitness of the lower extremities is a potentially modifiable fall risk factor. This study aimed to compare two exercise programs—square-stepping exercise (SSE), which is a low-cost indoor program, and walking—for improving the fitness of the lower extremities.

Methods. We randomly allocated 68 community-dwelling older adults (age 65–74 years) to either the SSE or walking group (W group). During the 12-week regimen, the SSE group participated in 70-minute exercise sessions conducted twice a week at a local health center, and the W group participated in outdoor supervised walking sessions conducted weekly. The W group was instructed to increase the number of daily steps. Prior to and after the program, we obtained information on 11 physical performance tests for known fall risk factors and 3 self-reported scales. The fall incidence was followed-up for 8 months.

Results. At 12 weeks postregimen, significant differences were observed between the two exercise groups with respect to leg power (1 item), balance (2 items), agility (2 items), reaction time (2 items), and a self-reported scale (1 item); the SSE group demonstrated a marked improvement in the above-mentioned items with Group × Time interactions. Significant time effects were observed in the tests involving chair stands, functional reach, and standing up from a lying-down position without Group × Time interactions. During the follow-up period, the fall rates per person-year in the SSE and W groups were 23.4% and 33.3%, respectively ($p = .31$).

Conclusion. Although further studies are required, SSE is apparently more effective than walking in reducing fall risk factors, and it appears that it may be recommended as a health promotion exercise in older adults.

***Key Words*:** Functional fitness—Walking—Fall risk—Health status.

WALKING is a widely accepted exercise (1) and is used as a means to develop functional fitness in population-based fall prevention programs (2). However, older adults may experience difficulty in walking in unfavorable weather conditions such as rain, wind, cold, or heat waves. Furthermore, the fear of injury, disease, accident, and crime may prevent them from walking outdoors (3,4).

Considering that older adults face these situations in daily life, we have attempted to develop a square-stepping exercise (SSE) that they can easily perform indoors, composed of movements similar to walking (Figure 1) (5). Walking involves only forward-stepping movements, whereas SSE involves varied movements in multiple directions and is performed on a thin mat (100 × 250 cm) that is partitioned into 40 squares (25 cm each). As suggested in previous studies, corrective steps in certain directions are necessary for recovering balance after tripping in order to prevent a fall (6–8). Therefore, it appears logical to hypothesize that the functional ability of the lower extremities is improved to a greater extent with SSE than with regular walking; thus, SSE is more effective in preventing falls. This study aimed to compare the effects of SSE and regular walking on the fall risk factors in older adults.

Methods

The Institutional Review Board of the Kawage Health Center approved the research protocol. All persons provided written informed consent prior to enrollment in the study. The study complied with the CONSORT (Consolidated Standards of Reporting Trials) checklist for randomized controlled trials.

Participants

Persons aged 65–74 years ($n = 2164$) were recruited from Kawage, Mie, Japan. A letter containing information regarding the schedule of the exercise sessions was sent to 700 noninstitutionalized persons (350 women and 350 men) who were randomly selected community residents from the town of Kawage. After consenting to participate, each person was randomly allocated to either the SSE or walking group (W group) by a public health nurse who used a computerized random number generation program in which the numbers 0 and 1 corresponded to the two groups, respectively. The walking and SSE sessions were conducted on different days. The presence of severe neurological or cardiovascular diseases or mobility-limiting orthopedic conditions was considered as an exclusion criterion.

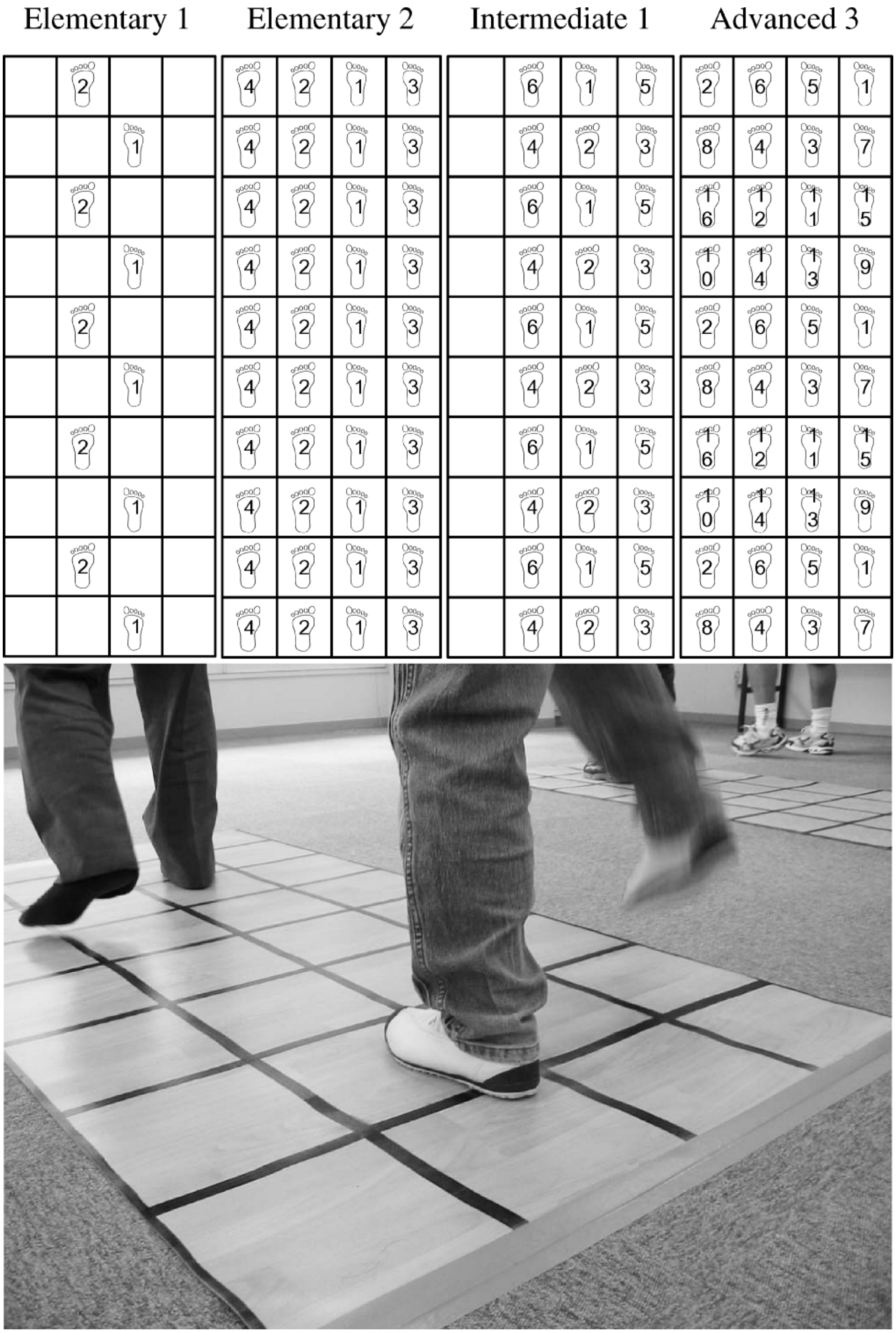

Figure 1. *Top:* Examples of the square-stepping exercise patterns in Elementary 1 and 2, Intermediate 1, and Advanced 3 categories. *Bottom:* Square-stepping exercise.

Outcome Measures

At baseline, the persons completed a questionnaire on vision (5-point Likert scale: 1 = poor and 5 = excellent, higher scores indicate better vision) (9,10); common medical conditions (from among 21 possible common medical conditions such as cerebrovascular disease, hypertension, and heart disease); medication use (yes or no); exercise frequency (4-point Likert scale: 1 = not at all, 2 = once or twice a month, 3 = once a week, and 4 = two or more times a week); and occurrence of falls in the previous year (yes or no). In addition, body weight and height were measured. Body fat was estimated by bioimpedancemetry (HBF-354; Omron Healthcare Co., Ltd., Kyoto, Japan).

The physical performance tests for the fall risk factors were adopted from previous studies and included the following items: number of chair stands in 30 seconds (11), leg extension power (12), single-leg balance with eyes closed (5), functional reach (13), forward/backward tandem walking over a 20-foot distance (14), standing up from a lying-down position (5), stepping with both feet in 10 seconds [persons stepped as quickly as possible for 10 seconds by using a 60 × 55 cm stepping sheet (TKK 5301; Takei Scientific Instruments Co. Ltd., Niigata, Japan)], walking around two cones (5), vertical jump reaction time after a light signal (simple reaction time) (15), and weight transfer time recorded while stepping in the forward/backward/right/left direction after a light signal (choice reaction time) (16). These tests were conducted by individuals who were unaware of the study group assignment (such as public health nurses other than those involved in the randomization, exercise instructors other than those who served in the regimens, and university students who had specialized in exercise gerontology). Each test was measured by the same staff preregimen and postregimen.

Self-reported scales consisted of the fear of falling (17), perceived health status (18), and pleasure during exercise (using a line scale: left end = not pleasant ''0'' and right end = very pleasant ''100''; higher scores indicate considerable pleasure).

The occurrence of falls and trips was also measured during the 8-month follow-up period at the end of the program. A fall was defined as a sudden unintentional change in position that caused an individual to land at a lower level, that is, on an object, the floor, or the ground, due to reasons other than sudden-onset paralysis, epileptic seizures, or overwhelming external forces (19). A trip was defined as the act of stumbling over an object without landing on any part of the body. Trips may cause false-positive results because some individuals may report a trip as a fall (20); therefore, the persons were explained the difference between a fall and a trip and were instructed to record the occurrence of falls and trips separately on a daily basis. All the persons received a prepaid postcard at the beginning of each month, which they returned at the beginning of the subsequent month. A telephonic or face-to-face interview was conducted to ascertain the reported occurrence of falls and trips.

Pedometers (Walking Style HJ-710IT; Omron Healthcare Co.) were provided to the persons of each group one week prior to the study. During the first week, as a pre-regimen, the persons were instructed to continue their routine daily activities and were advised against performing any new exercises. During the period between preregimen and postregimen, they were instructed to wear the pedometers at all times when awake except when bathing. The recorded number of steps also included those completed during all the exercise sessions.

Exercise Regimen

The SSE group participated in the supervised group sessions twice a week over the 12-week period at the Kawage Health Center; each session comprised 15 minutes of warm-up activities such as stretching and calisthenics, 40 minutes of SSE, and 15 minutes of cool-down activities. A detailed description of the SSE method has been provided in another study (5). In brief, SSE was performed on a thin felt mat (100 × 250 cm) that was partitioned into 40 squares (25 cm each). The persons were instructed to walk (step) from one end of the mat to the other according to the step pattern provided (Figure 1). When the persons reached the end of the mat, they were instructed to return to their start positions by walking normally off the mat and then stand in line for the next stepping. The SSE included forward, backward, lateral, and oblique step patterns. After the persons became familiar with each of these step patterns, they were instructed to walk with their heels lifted, that is, on their toes, without treading on the frames of the squares. Each step pattern was repeated 4–10 times to ensure that the persons could complete the pattern, and was followed by the introduction of a more complex step pattern. In total, 196 step patterns were developed and categorized (based on progressively increasing levels of complexity) into 8 categories (Elementary, 1–2; Intermediate, 1–3; and Advanced, 1–3). The persons were encouraged to concentrate in order to successfully perform each progressively more complicated step pattern. Step cadence was not determined; therefore, the persons performed the pattern at their preferred pace. Although they required 15–20 seconds to complete each step pattern initially, they eventually completed each pattern in < 15 seconds.

The persons in the W group were instructed to attend an outdoor supervised walking session at the Kawage Health Center once a week for 12 weeks. These sessions were structured in a manner similar to that of the SSE sessions except that SSE was substituted with a long-distance 40-minute outdoor walking session. Furthermore, the W group was also instructed to increase the number of daily steps, particularly during long-distance walking.

The SSE (n = 32) and W (n = 36) groups were further divided into 2 subgroups (n = 16 and 18 for the SSE and W subgroups, respectively), and the respective sessions were conducted for each subgroup from December 2004 through February 2005 (winter season). These sessions were always supervised by the same instructors who were certified in first aid and were encouraged to report any negative signs or symptoms that they observed in the persons during the sessions due to the exercises.

Statistical Analysis

An outcome analysis was performed using the intention-to-treat principle, and only two-tailed tests of significance were used. All baseline characteristics were compared between the groups by using the Student t test except for sex, vision, medications (proportion of medicated persons), exercise frequency, and falls in the last year because these characteristics were assessed using the chi-square test. Analysis of covariance (ANCOVA) was used to determine the effect of the exercise program on each of the outcome measures by using the baseline characteristics as covariates. For both groups, the proportional hazards models were used to determine the relative hazards associated with the first fall, and these relative hazards were calculated using the Cox model. SPSS 11.5 software (SPSS Inc., Chicago, IL)

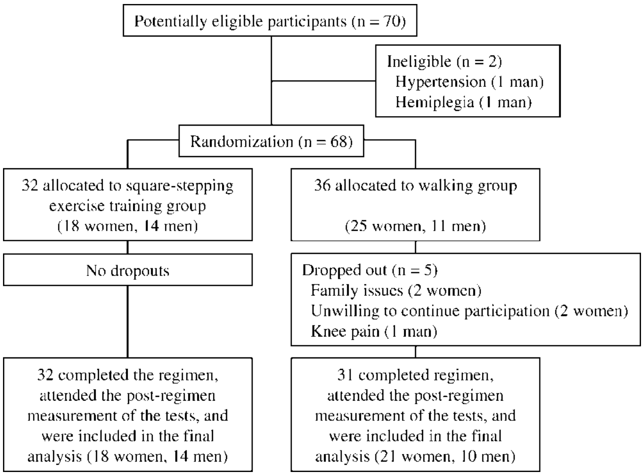

Figure 2. Stagewise progress of the square-stepping exercise and walking groups, including the flow of persons and withdrawals.

was used for all statistical analyses. A value of $p < .05$ was accepted as significant.

Results

Baseline Characteristics and Daily Physical Activity

Of the 70 older adults who consented to participate in the study, 68 were assessed as eligible for the study (Figure 2). Both the SSE and W groups were comparable and well matched with regard to the baseline characteristics (Table 1). The time effect and Group × Time interaction of the daily steps were both significant. The means ± standard errors of the daily average were 7548 ± 453 and 5060 ± 468 at pre-regimen, 7404 ± 493 and 6972 ± 509 at weeks 1–4, 7124 ± 486 and 6773 ± 503 at weeks 5–8, and 6084 ± 505 and 7732 ± 522 at weeks 9–12 for the SSE and W groups, respectively (Table 2).

Table 1. Baseline Characteristics of Study Participants by Randomized Groups

Characteristic	SSE	W	*p*
Female, *n* (%)	18 (56)	25 (69)	.32
Age, y	68.6 ± 2.4	69.5 ± 2.9	.18
Body weight, kg	59.3 ± 11.2	55.6 ± 7.6	.13
Height, cm	157.3 ± 10.0	154.4 ± 6.6	.17
Body fat, %	30.1 ± 5.7	31.5 ± 5.5	.30
Vision*	2.77 ± 0.80	3.09 ± 0.61	.08
Common medical conditions, *n*†	0.97 ± 0.97	0.89 ± 1.11	.75
Medications, *n* (%)	20 (63)	16 (47)	.23
Exercise frequency‡	2.67 ± 1.37	2.76 ± 1.42	.78
Falls in the last year, *n* (%)	8 (26)	5 (15)	.36

Notes: Values express mean ± standard deviation. "Female," "Medications," and "Falls" refer to the number (percentage) of participants who were female, used one or more medications, or had one or more falls in the last year.

*Measured on a 5-point Likert scale: 1 = poor and 5 = excellent; higher scores indicate better vision.

†Measured of 21 possible common medical conditions (e.g., cerebrovascular disease, hypertension, and heart disease).

‡Measured on a 4-point Likert scale: 1 = not at all, 2 = 1 or 2 d/mo, 3 = 1 d/wk, and 4 = ≥2 d/wk.

SSE = square-stepping exercise; W = walking.

Table 2. Daily Steps from One Week Before Regimen and the End of Regimen

Measurement	SSE	W
Pre-regimen	7548 ± 453	5060 ± 468
Weeks 1–4	7404 ± 493	6972 ± 509
Weeks 5–8	7124 ± 486	6773 ± 503
Weeks 9–12	6084 ± 505	7732 ± 522

Notes: Values express mean ± standard error. Time effect and Group × Time interaction were both significant ($p < .001$).

SSE = square-stepping exercise; W = walking.

Adherence and Adverse Effects of the Intervention

The persons in the SSE and W groups attended 21.8 ± 2.9 of 24 sessions (90.9% ± 12.1%) and 9.3 ± 2.6 of 11 sessions (84.2% ± 23.7%), respectively ($p = .15$). None of the persons in the SSE group dropped out of the study, whereas five persons of the W group did (Figure 2). Of these, one of the male persons had developed knee pain due to twisting of the knee during a daily activity (not due to the prescribed walking regimen). The SSE persons conscientiously performed SSE for 40 minutes throughout the regimen. No adverse events such as falls or episodes of fear were experienced by the persons during the sessions. All the persons completed the 8-month follow-up.

Outcomes

The preregimen and postregimen group statistics and Group × Time interactions are presented in Tables 3 and 4. After the 12-week regimen, significant differences were observed between the two exercise groups with respect to leg extension power, forward/backward tandem walking, stepping with both feet, walking around two cones, simple/choice reaction time, and perceived health status with significant Group × Time interactions; the SSE group persons demonstrated a marked improvement in the above-mentioned test items. Significant time effects without Group × Time interactions were observed for three items, that is, chair stands, functional reach, and standing up from a lying-down position; persons of both the groups demonstrated a marked improvement in these tests. Although the number of steps at pre-regimen was statistically higher for the SSE group than for the W group, when this number was included in the analyses as a covariate, the results remained unchanged.

During the 8-month follow-up period, five falls in four persons of the SSE group (fall rate per person-year, 23.4%) and eight falls in seven persons of the W group (fall rate per person-year, 33.3%; $p = .31$) were reported. During the same period, 46 and 60 trips were recorded in the SSE and W groups, respectively, indicating that the rate of falls per trip reported [fall/(fall + trip)] in the SSE group (9.8%) was not significantly lower than that in the W group (11.8%; $p = .50$). The hazard ratio of the W group to the SSE group with respect to the first fall was 2.32 (95% confidence interval [CI], 0.59–9.04; $p = .23$).

Discussion

This single-blind randomized controlled trial was designed to examine whether SSE, which is a novel exercise

Table 3. Functional Fitness Items by Group at Preregimen and Postregimen

Item	Preregimen	Postregimen	Crude Effect (95% CI)	Adjusted Effect (95% CI)*	Group × Time Interaction *p* Value*	Time Effect *p* Value*
Leg strength and power						
Chair stands, $n \cdot 30\ s^{-1}$						
SSE	14.6 ± 0.5	15.8 ± 0.5	1.2 (0.4 to 2.0)	1.2 (0.5 to 2.0)	.42	< .001
W	14.7 ± 0.5	16.3 ± 0.5	1.6 (1.0 to 2.3)	1.7 (0.9 to 2.4)		
Total	14.7 ± 0.3	16.1 ± 0.3	1.4 (0.9 to 1.9)	1.4 (0.9 to 1.9)		
Leg extension power, W						
SSE	318.2 ± 21.8	343.0 ± 19.5	24.8 (1.3 to 48.4)	27.4 (6.9 to 47.9)	.03	.14
W	256.0 ± 21.4	253.1 ± 19.1	−2.9 (−20.5 to 14.7)	−5.5 (−26.0 to 15.0)		
Total	286.6 ± 15.7	297.3 ± 14.7	10.7 (−3.9 to 25.4)	10.9 (−3.8 to 25.6)		
Balance						
Single-leg balance with eyes closed, s						
SSE	9.1 ± 1.2	9.9 ± 1.7	0.8 (−2.2 to 3.8)	0.8 (−1.8 to 3.4)	.99	.39
W	7.9 ± 1.2	8.7 ± 1.7	0.7 (−1.6 to 3.0)	0.8 (−1.9 to 3.5)		
Total	8.5 ± 0.9	9.3 ± 1.2	0.8 (−1.1 to 2.6)	0.8 (−1.0 to 2.6)		
Functional reach, cm						
SSE	27.8 ± 0.9	31.4 ± 0.7	3.6 (1.6 to 5.6)	3.5 (1.9 to 5.2)	.06	< .001
W	29.5 ± 0.9	30.6 ± 0.7	1.1 (−0.1 to 2.3)	1.2 (−0.5 to 2.9)		
Total	28.7 ± 0.6	31.0 ± 0.5	2.4 (1.2 to 3.5)	2.4 (1.2 to 3.6)		
Forward tandem walking, s						
SSE	21.1 ± 0.8	16.8 ± 0.8	4.3 (2.8 to 5.9)	4.3 (2.6 to 5.9)	.01	< .001
W	19.0 ± 0.8	18.1 ± 0.8	0.8 (−0.9 to 2.5)	1.0 (−0.7 to 2.6)		
Total	20.0 ± 0.6	17.5 ± 0.6	2.6 (1.4 to 3.8)	2.6 (1.4 to 3.8)		
Backward tandem walking, s						
SSE	26.3 ± 1.2	21.2 ± 1.5	5.2 (3.1 to 7.3)	5.1 (2.2 to 8.0)	.03	.01
W	24.3 ± 1.2	23.9 ± 1.5	0.4 (−3.1 to 3.8)	0.4 (−2.6 to 3.5)		
Total	25.3 ± 0.8	22.5 ± 1.1	2.8 (0.8 to 4.9)	2.9 (0.7 to 5.0)		
Agility						
Standing up from a lying-down position, s						
SSE	3.48 ± 0.27	3.19 ± 0.28	0.30 (−0.02 to 0.60)	0.26 (0.02 to 0.51)	.86	.01
W	3.58 ± 0.27	3.33 ± 0.28	0.26 (0.07 to 0.44)	0.30 (0.04 to 0.55)		
Total	3.53 ± 0.19	3.26 ± 0.19	0.27 (0.10 to 0.45)	0.28 (0.11 to 0.45)		
Stepping with both feet, $n \cdot 10\ s^{-1}$						
SSE	50.9 ± 2.1	60.7 ± 1.9	9.8 (6.9 to 12.7)	10.1 (7.6 to 12.7)	.04	< .001
W	50.6 ± 2.2	57.1 ± 2.0	6.6 (3.9 to 9.2)	6.2 (3.6 to 8.9)		
Total	50.7 ± 1.5	59.0 ± 1.4	8.2 (6.3 to 10.2)	8.2 (6.4 to 10.1)		
Walking around two cones, s						
SSE	24.0 ± 0.7	21.3 ± 0.6	2.7 (1.4 to 3.9)	2.7 (1.7 to 3.7)	.03	< .001
W	21.9 ± 0.7	20.9 ± 0.6	1.0 (0.4 to 1.7)	1.0 (0 to 2.0)		
Total	22.9 ± 0.5	21.1 ± 0.4	1.8 (1.1 to 2.5)	1.9 (1.1 to 2.6)		
Reaction						
Simple reaction time, $1000\ ms^{-1}$						
SSE	461 ± 14	426 ± 12	35 (11 to 60)	34 (11 to 57)	< .001	.94
W	419 ± 14	453 ± 12	−34 (−54 to −13)	−32 (−55 to −9)		
Total	440 ± 10	439 ± 9	1 (−17 to 19)	1 (−17 to 18)		
Choice reaction time, $1000\ ms^{-1}$						
SSE	982 ± 15	920 ± 14	62 (35 to 89)	60 (37 to 84)	< .001	.01
W	938 ± 15	954 ± 14	−16 (−36 to 4)	−14 (−39 to 11)		
Total	961 ± 11	936 ± 10	25 (5 to 44)	25 (6 to 44)		

Notes: Values in preregimen and postregimen indicate mean ± standard error.
*Adjusted for baseline characteristics as shown in Table 1.
SSE = square-stepping exercise; W = walking; CI = confidence interval.

program, was more effective than regular walking in improving the functional fitness of the lower extremities in older adults. After the 12-week regimen, we observed that one of the most common risk factors for falls (9)—the functional fitness of the lower extremities—was improved to a greater extent in the SSE group than in the W group. Furthermore, the perceived health status was significantly improved in the SSE group. Our study provides new

Table 4. Self-Reported Items by Group at Preregimen and Postregimen

Item	Preregimen	Postregimen	Crude Effect (95% CI)	Adjusted Effect (95% CI)*	Group × Time Interaction p Value*	Time Effect p Value*
Fear of falling*						
SSE	2.00 ± 0.11	2.22 ± 0.12	0.22 (−0.03 to 0.47)	0.21 (−0.03 to 0.46)	.91	.35
W	2.06 ± 0.11	2.28 ± 0.12	0.22 (−0.01 to 0.44)	0.23 (−0.01 to 0.48)		
Pleasure during exercise†						
SSE	72.3 ± 5.0	90.6 ± 3.1	18.3 (9.9 to 26.7)	18.9 (10.2 to 27.7)	.20	.43
W	78.4 ± 4.9	89.3 ± 3.1	10.9 (2.5 to 19.3)	10.6 (1.7 to 19.5)		
Perceived health status‡						
SSE	2.75 ± 0.13	3.28 ± 0.14	0.53 (0.11 to 0.95)	0.58 (0.24 to 0.91)	.002	.01
W	2.81 ± 0.13	2.69 ± 0.14	−0.13 (−0.34 to 0.09)	−0.21 (−0.55 to 0.13)		

Notes: Values in preregimen and postregimen indicate mean ± standard error.
*Measured on a 3-point Likert scale: 1 = very fearful, 2 = fearful, and 3 = not fearful.
†Measured using a line scale: left end = not pleasant; ''0'' and right end = very pleasant; ''100''; higher scores indicate considerable pleasure.
‡Measured on a 5-point Likert scale: 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent.
CI = confidence interval; SSE = square-stepping exercise; W = walking.

evidence that SSE is a more useful exercise program than regular walking for older adults; thus, it may serve as a new form of exercise to prevent falls.

A study by Orr and colleagues (21) revealed that leg-strengthening exercises at light loads (20% of maximal strength) improve balance because they ensure that the muscles remain active throughout the concentric phase of the movement and maintain the level of force output. The exercise intensity and movement in the above-mentioned study were rather similar to those of our step exercises, including the slight extension of the knees and ankles. A leg exercise such as this is assumed to enhance neural function by reducing response latency, effectively recruiting postural muscles, and improving the interpretation of sensory information (21). In addition, the multidirectional steps in the forward, backward, lateral, and oblique directions during SSE lead to better activation of the synergist and agonist leg muscles. Therefore, it is possible that the SSE regimen consequently improves many aspects of the functional fitness of the lower extremities, which is a fall risk factor.

After the SSE persons were familiar with the step patterns, they were instructed to walk with their heels lifted. This movement, which involved small hopping steps, also improved their leg strength (22). A study by Pijnappels and colleagues (8) revealed that during a trip, when the balance of one leg is lost, the other leg is immediately lifted off the floor, in a manner similar to hopping, in order to prevent a fall. This mechanism can explain the reason for the lower number of falls observed in the SSE group than in the W group, as the former appears to have adequate functional ability to prevent falls.

The results of this study imply that SSE could be used as a means of rehabilitation and public health promotion because it has a number of advantages. First, it is possible for fewer staff members (including physicians, public health nurses, and exercise instructors) to simultaneously supervise several older adults with high risk of falling because SSE can be performed within a small indoor space. Second, outdoor walkers can substitute walking with SSE when it rains. In this context, our study proposed a new form of exercise for older adults. Increasing the number of feasible exercises is important for health promotion. Third, SSE requires minimum investment because it involves the use of low-tech equipment. Fourth, because of the significantly small reaction time, which is a cognitive function, SSE may improve information-processing speed and psychomotor processes (23). Based on the results of the current study, we suggest that the variety of step patterns and the level of muscle coordination involved in SSE make it more beneficial than regular walking in reducing fall risk factors. This observation supports the well-known principle regarding specificity of training as the skills targeted by the exercise program were improved. However, walking is known to have beneficial effects on balance and gait speed (24) as well as on cardiorespiratory fitness, blood pressure, and cholesterol levels (25), which were not assessed in this study. Furthermore, from the pedometer readings, we observed that walking could increase the amount of physical activity even during the winter season, whereas SSE might decrease it. Therefore, walking could still be recommended as a health-enhancing form of exercise in older adults.

This study has notable limitations. First, although fall risk factors were lowered in the SSE group, fall rates were not different in the two intervention groups. Furthermore, the occurrence of falls among the elderly adults in each group was not very high. The possible reasons for this observation may be the short follow-up period and the inclusion of persons with a low fall risk. Second, the statistical analysis of each of the 15 outcome measures, including physical performance tests, self-reported scales, and fall occurrence, was performed separately; therefore, there was an increased risk of false-positive findings (type 1 error). The self-reported scales would not be adequately sensitive to a change because each of these scales contained a single item. Third, the pedometer readings revealed that the number of steps in the SSE group was smaller than that in the W group, although our finding is that SSE as an exercise form has a favorable effect on fall risk factors. However, the intensity of the walking regimen, which was not recorded in this study, might not be sufficient to reduce the fall risk. In addition, we did not attempt to standardize the amount of daily activity in the two groups, that is, the W group persons were advised to walk by themselves without supervision; thus, the effects may reflect the persons' interpretation of and compliance with the prescribed exercise regimen. In the same 12-week period, the supervised SSE sessions were conducted twice a week, whereas the supervised walking sessions were conducted only once a week; therefore, unfortunately, we cannot rule out that better participation in the supervised SSE sessions may have improved the outcome in the SSE group.

Conclusion

The findings suggest that SSE is safe and acceptable, and it improves the functional fitness of the lower extremities, which is a fall risk factor, in older adults. The efficacy of this exercise in improving perceived health status was also substantiated. Therefore, this new activity apparently provides an effective, therapeutic, and health-promoting exercise alternative.

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Correspondence

Address correspondence to Ryosuke Shigematsu, PhD, Faculty of Education, Mie University, Kurimamachiya 1577, Tsu, Mie, 514-8507 Japan. E-mail: rshige@edu.mie-u.ac.jp

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