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ORIGINAL REPORT

FEASIBILITY AND EFFECTIVENESS OF A NURSE-LED COMMUNITY EXERCISE PROGRAMME FOR PREVENTION OF FALLS AMONG FRAIL ELDERLY PEOPLE: A MULTI-CENTRE CONTROLLED TRIAL

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Objective: **To determine whether an exercise programme provided by public health nurses is effective in improving physical function and psychological status in elderly people, in reducing falls and risk factors for falls in elderly people, and whether the intervention is a feasible programme within the community.**

Design: **Controlled intervention trial.**

Subjects: **Participants included 144 persons in the intervention group and 124 persons in the control group, who were living at home, aged over 65 years, and with 5 or more risk factors for falls identified using the questionnaire for fall assessment (Suzuki).**

Methods: **For participants in the intervention group, an exercise programme was provided by public health nurses. This comprised a weekly exercise class of 2 hours for 17 weeks, supplemented by daily home exercises. Number of risk factors, physical function and psychological status were compared between the intervention and control groups before and after intervention. The number of further falls during the intervention was also compared between the 2 groups.**

Results: **The programme significantly improved physical function and emotional status, and reduced the number of falls and risk factors for falls. The excellent adherence rate represented broad acceptance of the intervention.**

Conclusion: **The intervention programme was effective and feasible to operate in the community.**

Key words: community, controlled study, elderly, falls, fall prevention, rehabilitation.

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INTRODUCTION

Falls are the most common cause of injury in elderly people that may result in institutionalization and affect health-related quality of life (1). Many studies have identified risk factors for falls. Muscle weakness and poor balance are associated with an increased risk of falls in elderly people (2, 3) and, as such, exercises to improve muscle strength and balance have been the focus of most fall prevention programmes (4–12). It is important that physiotherapists conduct these programmes effectively within their community.

In Japan, the number of frail elderly people has increased rapidly during the past 5 years, with deterioration in physical function reported as the main reason (13). Consequently, the Japanese government and local authorities have promoted community exercise classes as a preventive measure (13). However, there are an insufficient number of physiotherapists working in the community to manage the classes (13–15). Additionally, hospital-based physiotherapists have difficulty helping public health nurses due to work pressures (15).

Public health nurses in Japan generally have been in charge of day-care services for frail elderly people and disabled adults (14). Several studies have reported that home exercise programmes delivered by nurses, who have been trained by physiotherapists, are effective in reducing falls (6, 7). Accordingly, public health nurses are regarded as potential personnel who can provide exercise classes once they receive adequate training by physiotherapists.

According to Gardner et al. (4), exercise programmes should be simple, easily instituted, and provided at low cost if they are part of a public health programme to be introduced widely in the community. Based on these suggestions, we developed a pragmatic exercise programme to be used within the community (8, 9), which involved weekly exercise for 17 weeks supplemented by daily home exercise. In our previous observational study, physical function and psychological status improved after this programme, when performed by physiotherapists (9). The need for exercise classes in the community has increased concurrently with an increasing population of frail elderly people living at home. As a result, there is a great need to develop exercise programmes provided by public health nurses instead of physiotherapists. This study was designed to employ public health nurses, who have been trained and supervised by physiotherapists, to manage the exercise programme.

The purpose of this study was to determine the effectiveness of implementing an exercise programme conducted by public health nurses in improving the physical function and psychological status of elderly people, as a means to prevent falls and to minimize their risk factors. The secondary purpose was to determine whether this is a feasible intervention that can be provided within the community.

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METHODS

Participant recruitment and trial design

The initial study was designed as a randomized controlled trial. However, there were many concerns regarding the potential difficulty of enrolling participants into the control group due to the popularity of the exercise classes among frail elderly people. Furthermore, we wanted to determine the feasibility of conducting the exercise classes in the same community in which participants resided. Therefore, this study was re-designed as a multi-centre controlled trial.

We selected 7 areas where hospital-based physiotherapists had started assisting public health nurses in conducting exercise classes for frail elderly people, but for no more than 3 months before the intervention. They were asked to choose potential participants over the age of 65 years, who were living at home, and with at least 5 risk factors for falls, as identified using the questionnaire for fall assessment reported by Suzuki (16). The questionnaire consists of 15 items, as shown in Table I. A cross-sectional study demonstrated that the number of risk factors identified by the questionnaire is significantly correlated with the number of falls in the previous year, psychological status, and physical function related to muscle strength and balance (17). Elderly persons with at least 5 risk factors were regarded as high-risk fallers (16). Furthermore, the questionnaire has been widely adopted by community health and social care staff to assess falls among elderly people in Japan.

Potential participants who were unable to walk around their home or who had difficulty understanding the study, or who had already been participating in an exercise class at least 4 times a month prior to the start of the intervention were excluded from this study.

Seven day centres that understood the purpose of this study were selected to recruit the participants for the control group. The care professionals at these day centres had received no help from physiotherapists before starting this study. They were asked to choose potential participants using the same criteria.

To determine the sample size for this study, we evaluated the reduction in the rate of falls from previous studies to assess the effect of exercise in elderly people living at home. The results indicated a reduction in the occurrence of falls by 29–49% (5–8, 18). To detect at least a 30% relative reduction in the rate of falls, at a 5% statistical significant level and with a statistical power of 80%, a minimum of 62 participants were needed in the intervention group and the control group. Allowing for a 20% drop-out rate, 75 or more participants were required in each group.

Table I. *Questionnaire for assessment of falling (Suzuki (16)). Participants were allowed to use any equipment. The number of answers that were consistent with the risk for falls was counted as the number of risk factors.*

Q1	Have you fallen during the past year?
Q2	Can you cross the street without taking a rest (while a green traffic signal is on)?
Q3	Can you continue to walk for an entire kilometre?
Q4	Can you put on socks while standing on one leg?
Q5	Can you wring out a wet towel well?
Q6	Have you admitted yourself to a hospital within the past year?
Q7	Do you feel dizzy upon standing up?
Q8	Have you ever had a stroke?
Q9	Have you ever been diagnosed with diabetes?
Q10	Do you take sleeping pills, antihypertensive drugs, or minor tranquillizers?
Q11	Do you often wear sandals or slippers?
Q12	Can you see the letters in a newspaper, or a person's face, clearly?
Q13	Can you hear a person's voice during a conversation with him or her?
Q14	Do you often stumble or slip in your own house?
Q15	Do you have a fear of falling or do you hesitate to go out because you have a fear of falling?

Intervention

Participants in the intervention group attended a weekly exercise class of 2 hours for 17 weeks, supplemented by daily home exercises. The basic programme consisted of 10 minutes of warm-up, 40 minutes of stretching and strengthening the hip flexors, hip extensors, hip abductors and quadriceps muscles, 10 minutes of balance retraining and 5 minutes of cool-down. The participants began each class by warming up for 10 minutes with a minimal workload. They then underwent 10 sets of stretching and strengthening of each muscle within the basic programme. Each strength exercise was performed isometrically without resistance and against gravity. The balance retraining exercises included stepping, tandem walking and sideways walking. The basic programme was interrupted with breaks totalling 10 minutes, which was adjusted to the participants' physical capacity.

The educational programme about falls was performed for approximately 15 minutes in between the exercises. Participants were encouraged to join recreational and tea breaks of approximately 30 minutes, which were held to encourage friendly relations among them. The cool-down exercise was performed just before the end of the class. All exercise sessions were held in training groups of approximately 10 people.

We believed that daily home exercises should be simple enough to be performed easily and continuously by elderly people. Therefore, only 1 or 2 exercises were selected from the basic programme. The participants were asked to perform them at home every day for 15–20 minutes.

All public health nurses who participated in this study received the same training from the senior physiotherapists, based on the programme manual, at the start of the trial. The senior physiotherapists also determined the content of the exercise programmes and daily home exercises based on assessments performed by a separate group of senior physiotherapists. Two to 3 public health nurses managed the classes and implemented the exercises involving the participants. They were able to consult with the physiotherapists about the exercises for and/or problems of the participants whenever they wished.

Participants in the control group were recruited from among elderly people who utilized a day centre once a week. They did not engage in exercises to stretch and strengthen the muscles, nor did they engage in daily home exercises, other than warming-up and cooling down. However, they participated in social programmes, including recreational activities, educational programmes, and tea breaks in the day centres. Any participants who deteriorated in their physical strength were referred to a hospital-based physiotherapy programme.

Assessments

A fall was defined as "unintentionally coming to rest on the ground, floor, or other lower level". All participants were asked about the number of falls they had had during the previous year before the intervention. Each participant was given a fall diary with a monthly sheet to record further falls and was asked to fill in the number of falls during the intervention. The number of further falls was identified every week by the public health nurses or care staff at the day centres. If the participants reported any further falls, the injuries associated with the falls were investigated.

The risk factors for falls were investigated using the questionnaire for fall assessment (Table I), which included questions about history of falls, walking ability, muscle power, disorders, use of medications, vision and hearing, and fear of falls (16). The number of answers that were consistent with the risk of falls was counted as the number of risk factors, which was assessed upon recruiting the participants and after the intervention.

The psychological status of the participants was evaluated before and after the intervention period of 17 weeks using the 15-item version of the Geriatric Depression Scale (GDS-15) (19) and the Falls Efficacy Scale (FES) (20). These assessments were self-administered by the participants themselves, with the guidance of the public health nurses or care staff at the day centres, when needed.

To assess the physical function of the participants, the following measures were performed: hand grasping power (HGP) of both sides, the chair standing test (CST) (21), the timed up-and-go test (TUGT) (22), the functional reach test (FRT) (23), 5-metre walk test (5WT) and 1 leg standing test (LST).

In conducting the 5WT, participants were asked to walk 5 metres as fast as possible, starting from 2 metres behind the start line. The LST was performed with eyes open and the participants were asked to stand on the dominant leg, while raising the other leg fixed at the knee and with hands on their waist. All the tests were conducted twice, and the better value of the 2 tests was selected as the representative one.

Physical function was assessed by a group of senior physiotherapists who were not involved in training the public health nurses working with the intervention group. In the control group, senior physiotherapists working at hospitals near the day centres were asked to assess the physical function of the controls. The assessments were conducted in both groups before and after the intervention period of 17 weeks.

The study protocol was approved by the Research Ethical Committee at the Graduate School of Biomedical Sciences at Nagasaki University. All participants provided signed informed consent.

Statistical analyses

Statistical procedures were performed using SPSS 10.0J for Windows (SPSS Inc, Illinois, USA). χ^2 tests were used to compare the distributions of gender, the proportion of participants who dropped out, the incidence of falls during the year before intervention, and the incidence of falls during intervention between the 2 groups. The Mann-Whitney *U* test was used to assess the difference in the numbers of falls during the previous year before the intervention and during the intervention between the 2 groups. This test was also performed to investigate the differences on the number of risk factors, GDS-15 and FES before and after the intervention between the 2 groups. Unpaired *t*-tests were used to evaluate the significant differences in physical functions between the 2 groups. The paired *t*-test was performed to determine within-group differences in physical function between baseline and 17-week post-intervention values. A 2-sided *p*-value of less than or equal to 0.05 was considered to indicate statistical significance.

RESULTS

Study participants and follow-up

A total of 153 people were screened for the intervention group and 137 for the control group. Of these potential participants, 9 in the intervention group and 13 in the control group chose not to participate in this study. Consequently, 144 participants were enrolled in the intervention group and 124 participants were included as controls.

Sixteen (11.1%) of 144 participants in the intervention group and 14 (11.3%) of 124 participants in the control group withdrew from the trial (Table II). Table II describes the reasons for withdrawal. There was no significant difference between groups in the proportions of participants who withdrew ($p = 0.963$). At 17 weeks follow-up, 128 in the intervention group and 110 in the control group remained in the study. Participants who completed the study attended 90.9% and 91.2% of all possible classes in the intervention and control groups, respectively. There was no significant difference between them ($p = 0.693$).

Participant characteristics

The baseline characteristics of the participants are summarized in Table III. There were no significant differences in terms of age, gender, incidence and number of falls during the past year before the intervention, psychological status (FES and GDS-15), and physical function between the control and intervention groups ($p \geq 0.189$). However, the participants in the intervention group took significantly more drugs (4.7 (2.8)) (mean (SD)) than the control group (3.6 (2.1)) ($p = 0.001$). No changes in medication were made during the intervention and none were found during the study.

Risk factors and additional falls

The mean number of additional falls during the intervention was 0.22 (0.57) and 0.45 (0.10) in the intervention and control groups, respectively, indicating a significant difference between the 2 groups ($p = 0.036$). Furthermore, the number of risk factors in the intervention group (5.4 (2.3)) was significantly smaller than that in the control group (6.3 (2.7)) at 17 weeks follow-up ($p = 0.009$) (Table IV). In other words, the number of additional falls during the intervention and the risk factors for falls decreased significantly after the intervention.

Fig. 1A shows the proportion of each risk factor for falls prior to the intervention. There were no significant differences in any

Table II. *Participants withdrawing from the trial, n (%).*

Reasons for withdrawal	Intervention (n = 144)	Control (n = 124)	p-value
Admission to hospital	6 (4.2)	8 (6.5)	0.424
Admission to nursing home	2 (1.4)	2 (1.4)	0.880
Care for spouse	5 (3.5)	4 (3.2)	0.911
Low back pain and/or knee joint pain	3 (2.1)	0	0.251
Total	16 (11.1)	14 (11.3)	0.963

χ^2 test was used to compare the values of the 2 groups.

Table III. *Baseline characteristics of the participants given as mean with standard deviation (SD) within parentheses if not stated otherwise.*

	Intervention (n = 144)	Control (n = 124)	p-value
Female (%)	85.4	83.1	0.616*
Age (years)	80.2 (6.8)	81.4 (6.1)	0.341‡
current prescribed drugs (n)/(no.)	4.7 (2.8)	3.6 (2.1)	0.001†
Incidence of falls in previous year (%)	43.1	40.3	0.710*
falls in previous year (n)/(no.)	1.26 (1.90)	1.73 (3.84)	0.205†
risk factors of falls (n)/(no.)	6.5 (1.6)	6.5 (2.6)	0.999†
FES	33.1 (5.7)	33.9 (5.3)	0.218†
GDS-15	4.6 (3.1)	5.0 (3.1)	0.189†
R-HGP (kg)	18.5 (6.4)	19.0 (6.8)	0.553‡
L-HGP (kg)	18.1 (6.2)	17.0 (6.4)	0.162‡
CST (sec)	14.2 (8.8)	14.2 (5.8)	0.998‡
FRT (cm)	25.5 (13.5)	24.0 (8.5)	0.267‡
LST (sec)	10.1 (11.2)	10.0 (9.7)	0.922‡
TUGT (sec)	12.8 (7.8)	13.8 (4.8)	0.223‡
5WT (sec)	5.3 (3.7)	5.5 (2.4)	0.649‡

To compare the values of the 2 groups, the following tests were used: *χ^2 test, †Mann-Whitney *U* test, ‡unpaired *t*-test.
FES: Falls Efficacy Scales; GDS-15: 15-item version of Geriatric Depression Scale; R-HGP: hand grasping power of right side; L-HGP: hand grasping power of left side; CST: chair standing test; FRT: functional reach test; LST: 1 leg standing test; TUGT: timed up-and-go test; 5WT: 5-metre walk test.

Table IV. *Results of falls, psychological status and physical function at 17 weeks follow-up (mean (SD)).*

	Intervention (n = 128)	Control (n=110)	p-value
Incidence of further falls (%)	14.1	22.5	0.083*
further falls (n)	0.22 (0.57)	0.45 (0.10)	0.036†
risk factors of falls (n)	5.4 (2.3)	6.3 (2.7)	0.009†
FES	32.8 (6.0)	33.8 (5.6)	0.107†
GDS-15	3.7 (2.7)	5.3 (3.2)	0.000†
R-HGP (kg)	18.6 (5.9)	19.0 (6.5)	0.614‡
L-HGP (kg)	17.9 (6.1)	17.0 (6.2)	0.313‡
CST (sec)	11.2 (10.4)	13.5 (5.4)	0.028‡
FRT (cm)	27.9 (13.4)	24.7 (7.7)	0.023‡
LST (sec)	13.7 (17.8)	10.7 (9.4)	0.098‡
TUGT (sec)	11.1 (6.7)	13.2 (3.9)	0.003‡
5WT (sec)	5.0 (3.1)	5.4 (2.3)	0.270‡

To compare the values of the 2 groups, the following tests were used: *χ^2 test, †Mann-Whitney U test, ‡unpaired t-test.
FES: Falls Efficacy Scales; GDS-15: 15-item version of Geriatric Depression Scale; R-HGP: hand grasping power of right side; L-HGP: hand grasping power of left side; CST: chair standing test; FRT: functional reach test; LST: 1 leg standing test; TUGT: timed up-and-go test; 5WT: 5-metre walk test.

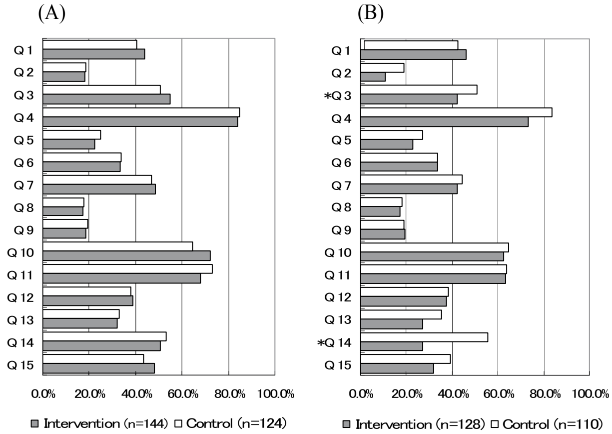

Fig. 1. (A) Proportions of the risk factors for falls in both groups before intervention. The proportions of the risk for falls identified using the questionnaire for falling assessment (Suzuki (18)) were compared between groups before intervention. Each risk factor (Q1–Q15) showed no significant difference between the 2 groups. (B) The proportions of the risk for falls were compared at 17 weeks follow-up in the 2 groups. *The proportions of the risk factors Q3 and Q14 in the intervention group were significantly smaller than those in the control group.

of the risk factors between the 2 groups ($p \geq 0.428$). Fig. 1B shows that 2 risk factors improved significantly ($p = 0.000$) at 17 weeks follow-up. There were no fractures and no serious injuries related to a fall during the intervention in either group.

Psychological status

There were no significant differences in terms of scores on the GDS-15 and FES at the beginning of the intervention between the 2 groups ($p \geq 0.189$) (Table III). FES scores had no significant difference at 17-week follow-up between the 2 group ($p = 0.172$). However, scores on the GDS-15 in the intervention group improved significantly after the 17-week intervention ($p = 0.000$) (Table IV).

Physical function

All participants in the intervention group were asked to perform additional daily home exercises. The mean number of days for which they performed the home exercises during the 17 weeks was 73.6 (38.5) days, or 4.3 days a week. The main home exercises performed were strengthening of the quadriceps muscles (41%) or the hip flexors (11%) or both (42%).

At 17 weeks follow-up, the intervention group showed significant functional improvements in the FRT ($p = 0.023$), CST ($p = 0.028$) and TUGT ($p = 0.003$) compared with the control group. The mean LST in the intervention group at 17 weeks follow-up was 13.7 (17.8) seconds, which was 3 seconds longer than in the control group. However, the difference was not statistically significant ($p = 0.098$) (Table IV).

When comparing physical function before and after the intervention in each group, the intervention group showed significant functional improvements in CST ($p = 0.000$), FRT ($p = 0.000$), LST ($p = 0.002$), TUGT ($p = 0.000$) and 5WT ($p = 0.003$). In contrast, all tests measured, except TUGT ($p = 0.019$), whose effect size was only 0.5 seconds, showed no significant improvement in the control group ($p \geq 0.091$) (Table V).

Gender differences in physical function were investigated. Before the intervention, there were no significant differences between the 2 groups for each gender ($p \geq 0.144$). However,

Table V. *Results of physical function before and after the intervention within each group (mean (SD)).*

	Intervention (n = 128)			Control (n = 110)		
	Baseline	After 17 weeks	p-value	Baseline	After 17 weeks	p-value
R-HGP (kg)	18.2 (6.2)	18.6 (5.9)	0.223	19.4 (6.5)	19.0 (6.5)	0.111
L-HGP (kg)	17.6 (6.1)	17.9 (6.1)	0.417	17.3 (6.1)	17.0 (6.2)	0.202
CST (sec)	14.6 (9.2)	11.2 (10.4)	0.000	14.4 (7.4)	13.5 (5.8)	0.091
FRT (cm)	25.5 (13.2)	27.9 (13.5)	0.000	24.1 (8.8)	24.7 (7.8)	0.284
LST (sec)	10.2 (11.3)	13.7 (17.8)	0.002	10.9 (9.9)	10.7 (9.4)	0.269
TUGT (sec)	13.2 (9.2)	11.1 (6.7)	0.000	13.7 (4.8)	13.2 (3.9)	0.019
5WT (sec)	5.3 (3.3)	5.0 (1.8)	0.003	5.5 (2.5)	5.4 (2.3)	0.485

Paired t-test was used to compare the values before and after the intervention within each group.
R-HGP: hand grasping power of right side; L-HGP: hand grasping power of left side; CST: chair standing test; FRT: functional reach test; LST: 1 leg standing test; TUGT: timed up-and-go test; 5WT: 5-metre walk test.

some differences in physical function improvements were found following the 17-week intervention period. Among the women in the intervention group, FRT and TUGT improved significantly after the intervention ($p = 0.010$ and $p = 0.000$, respectively), but CST did not ($p = 0.081$). On the other hand, among the men in the intervention group, CST improved significantly after the intervention ($p = 0.024$). There were no significant differences between the 2 groups in terms of FRT and TUGT ($p \geq 0.136$) (Table VI).

DISCUSSION

This controlled trial was conducted in 268 frail elderly persons living in the community. There were no significant differences in baseline characteristics between the intervention and control groups, except in the number of drugs taken. No changes in medication were found during the study. It is believed that medication had minimal impact on the study results. Therefore, the 2 groups were considered statistically equivalent, although there were some issues involving recruitment of participants, as discussed later.

In the intervention group, CST, FRT and TUGT, which indicates muscle strength of the lower extremities (21), balance (23), and balance and walking ability (22), respectively, improved significantly after the intervention. As such, this study suggests that the exercise intervention improved muscle strength of the lower extremities, balance and walking ability. The exercise programme consisted of stretching and strengthening the muscles around the hip and knee, as well as balance retraining. The relationship between exercise type and functional improvement has been reported in previous studies. Some studies have noted that muscle strengthening exercises alone do not improve balance function (24, 25). Other studies showed that a combined programme of balance and strength training augments balance function (26, 27), which is consistent with our findings.

In the intervention group, the exercise programme was provided once a week for 17 weeks. The participants performed the 15–20-minute additional home exercises about 4 times a week on average. Carter et al. (10, 28) have reported, based on 2 studies of a twice-weekly 40-minute exercise for 10 and 20 weeks, that their programme appears to provide benefit beyond 10 weeks. Shimada et al. (11) reported functional improvement after intervention of 2–3 times weekly 40-minute exercise for 12 weeks. Furthermore, Wolf et al. (18) showed significant reduction in the rate of falls by intervention of twice-weekly tai chi for 15 weeks. The exercise programmes of these studies were conducted 2 or 3 times a week with the frail elderly persons. The degree of the participants' frailty cannot be compared directly between these previous studies and the current study because the same variables were not used to assess the participants. Nevertheless, based on age, incidence of falls, and the results of the physical function tests, it is likely that the frailty level of the participants among the studies was similar.

This study showed physical improvements and reduction in the rate of falls and in the risk factors for falls. It is therefore suggested that the programme supplemented by home exercises with good compliance resulted in significant improvements. Day et al. (12) found similar significant reductions in the number of falls in a weekly programme (60 minutes per 1-day session) of 15 weeks supplemented by home exercise, which was performed 2 days a week.

Interestingly, there were gender differences regarding improvements in physical function after the intervention (Table VI). CST improved significantly in men, but not in women. Males may be more likely to demonstrate greater improvements in muscle strength of the lower extremities than females.

Table VI. *Comparing values of physical function in each gender between the 2 groups (mean (SD)).*

	Men			Women		
	Intervention	Control	*p*-value	Intervention	Control	*p*-value
Before intervention						
Total (*n*)	21	21		123	103	
R-HGP (kg)	24.5 (7.6)	26.2 (7.1)	0.279	17.5 (5.7)	16.9 (4.4)	0.359
L-HGP (kg)	26.4 (6.0)	25.5 (7.0)	0.640	16.6 (4.9)	15.9 (4.6)	0.153
CST (sec)	11.3 (5.8)	13.1 (5.9)	0.348	14.7 (9.2)	14.4 (5.8)	0.797
FRT (cm)	28.0 (16.0)	27.6 (11.1)	0.926	25.1 (13.0)	23.2 (7.8)	0.200
LST (sec)	10.9 (16.9)	14.0 (17.3)	0.561	10.0 (10.0)	9.2 (7.1)	0.497
TUGT (sec)	12.3 (11.0)	13.3 (5.5)	0.720	12.8 (7.1)	13.8 (4.6)	0.224
5WT (sec)	6.8 (8.0)	5.1 (1.8)	0.334	5.1 (2.4)	5.6 (2.6)	0.144
After the intervention period of 17 weeks						
Total (*n*)	14	18		114	89	
R-HGP (kg)	24.6 (8.1)	28.6 (6.4)	0.136	17.9 (5.2)	17.1 (4.5)	0.229
L-HGP (kg)	27.6 (6.0)	25.0 (7.0)	0.272	16.6 (4.9)	15.8 (4.5)	0.102
CST (sec)	9.0 (3.8)	11.9 (3.1)	0.024	11.4 (10.9)	13.7 (5.6)	0.081
FRT (cm)	30.5 (19.1)	29.6 (9.9)	0.865	27.6 (13.0)	23.7 (6.8)	0.010
LST (sec)	17.0 (21.4)	14.0 (15.4)	0.645	13.3 (10.0)	10.0 (7.6)	0.098
TUGT (sec)	12.6 (14.2)	12.7 (3.2)	0.979	10.9 (5.1)	13.3 (4.0)	0.000
5WT (sec)	5.3 (7.0)	5.0 (1.5)	0.825	4.9 (2.3)	5.5 (2.4)	0.124

R-HGP: hand grasping power of right side; L-HGP: hand grasping power of left side; CST: chair standing test; FRT: functional reach test; LST: 1 leg standing test; TUGT: timed up-and-go test; 5WT: 5-metre walk test. Unpaired *t*-test was used to compare the values between the 2 groups.

These findings are consistent with the study by Beneka et al. (29). As such, separate exercise programmes may be needed for males and females. However, our study results are limited in supporting this assumption given the small number of male participants.

This study showed that GDS-15 scores improved significantly in the intervention group after the 17-week long intervention period. It has been reported that improvements in physical function can lead to better emotional health (30, 31). Therefore, this outcome may be secondary to the physical improvements. As the design of this study may influence the results, we will discuss the issue later. However, emotional stabilization may lead to a more active lifestyle (31), and the decline in emotional stability may reflect the decline in motor function (32). It is suggested that enjoyable social programmes, such as recreation and tea breaks, should be included in the exercise classes, as was the case in this study, although a centre-based programme itself has the additional value of social interaction (4, 33).

Approximately 90% of the participants in the intervention group completed the study and attended 90% of all possible classes. These results showed no significant differences compared with those in the control group. The additional home exercises were performed for approximately 4 days a week. In brief, the exercise programme appeared to have been widely accepted by the participants.

There were 8 (5.5%) participants in the intervention group whose conditions deteriorated to the point of being admitted to a hospital or a nursing home. However, this did not differ significantly from those in the control group. Only 3 participants (2.1%) withdrew from this study because of low back pain and/or knee joint pain caused by the intervention. There were no participants who had serious injuries or disorders as a result of the programme. It is suggested that the exercise programme used in this study is as safe and feasible as an ambulatory service provided at a day centre.

One of the reasons for designing a controlled trial for this study was because of the difficulty in assigning the participants to the control group due to the popularity of the exercise classes among frail elderly people (15). The central and local governments in Japan have encouraged elderly people to join exercise classes to maintain their physical function (13). Furthermore, the governments have recommended that the exercise classes be held in the community, as close to elderly people as possible (13). As a result, the need to ensure the feasibility of providing community-based exercise classes has arisen. Therefore, we chose a controlled study as a pragmatic design rather than a randomized controlled trial.

In this study, the exercise programme improved physical function and psychological status, and reduced the rate of falls and risk factors for falls. It is possible that these successful findings, particularly the improvement in psychological status, were influenced by the instructors' expertise. Moreover, the results may be biased since the participants were not blind to group assignment and were asked to self-report the further falls during the intervention. The participants in the intervention group may not have wanted to report falls, in order to avoid disappointing their instructors (7, 34). As physical function improved significantly in the intervention group, the influence of the participants' attitude may have been minimal.

Finally, it is important to note that the intervention was conducted by public health nurses who used a programme manual and were supervised by physiotherapists in the community setting. The successful results of this study suggest that it is feasible to provide the programme to the entire community. The public health nurses had little experience managing exercise classes at the beginning of this trial. It is thought that the application of the programme manual and supervision by physical therapists can be useful for the actual provision of the programme. In Japan, it is very difficult for physiotherapists to participate regularly in the exercise classes (35). Therefore, it is important to establish a training system for public health nurses and a support system by physiotherapists.

Some issues remain as to whether frail elderly people would continue to perform the exercises even after finishing the intervention, and whether improvements in physical function would lead to an increased level of physical activity. Further prospective studies are needed to investigate these issues.

In conclusion, a weekly exercise programme for 17 weeks, supplemented by daily home exercises, was provided by public health nurses, who were trained and supervised by physiotherapists. The programme improved physical function and emotional status, and prevented falls in frail elderly people living in the community. The excellent adherence rate represented broad acceptance of the intervention. In addition, the programme is efficient because of the participation of public health nurses in place of physiotherapists, who are less available in Japan. It is suggested that this intervention programme can feasibly be provided within the community. However, the questions of whether elderly people can adopt the habit of exercising and change their individual lifestyles remain.

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