

Square Stepping Exercise Within Posyandu-Based Community Programs to Enhance Balance in The Elderly Population

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ABSTRACT

Keywords:

Balance,
Older Adults,
Posyandu,
Square Stepping Exercise,
Balance Training

The elderly is the final phase in the human life cycle which is characterized by a decrease in body functions, such as weakness and balance disorders, which can increase the risk of falling and decrease independence. Therefore, promotive and preventive efforts through physical exercise are needed to maintain fitness and reduce the risk of falling. One of the exercises that has proven effective is the Square Stepping Exercise (SSE), which is a step pattern exercise from simple too complex to training postural and cognitive balance for the elderly. This community service program was carried out at the Ngudi Waras Elderly Posyandu, Senden, Tohudan, Colomadu, involving 30 elderly people aged 60-75 years. The activities carried out included counseling, demonstrations, SSE practices, and evaluation using dynamic balance test before and after interventions. The instruments used were in the form of participant characteristics forms and balance time test. Data analysis was carried out in a descriptive manner based on the BMI category due to the limited number of samples and activity design. Most participants were in the BMI category of overweight (13 people), followed by normal (11 people) and Underweight (6 People). The average time of the dynamic balance test showed improvement in all BMI categories after the implementation of SSE. These result show that SSE can improve the dynamic balance of the elderly without being affected by nutritional status. SSE is effective as a simple exercise that can be applied as a self-directed program at home to improve balance and contribute to the prevention of fall risk in the elderly.

INTRODUCTION

Old age is the final stage in the human life cycle. A person over the age of 60 is categorized as elderly. At this stage, various health problems often arise, one of which is muscle weakness that affects the ability to maintain balance when standing and walking. Balance disorders are a major problem in the elderly because they can cause fear of falling while walking and increase the risk of serious injuries that hinder daily activities (Salari et al., 2025).

Balance disorders in the elderly occur due to a decrease in the body's ability to maintain its position against gravity. The inability to maintain postural balance increases the risk of losing stability when moving, making it easy to fall. According to the World Health Organization (WHO), the prevalence of falls among the elderly is estimated to reach nearly 684,000 cases annually (Salari et al., 2025). Falls are common among the elderly, both in the community and in healthcare facilities, resulting in minor to severe injuries that reduce quality of life.

Promotive and preventive efforts through physical exercise are very important to overcome the effects of the ageing process. Regular physical exercise in appropriate doses has been proven to maintain the physical and mental health of the elderly (Manuel et al., 2024). Balance and functional exercise play a specific role in improving postural control and reducing the risk of falls.

One form of exercise that can be used is the SSE, which is a step pattern exercise that aims to train dynamic balance and movement coordination (Segita et al., 2024). SSE helps the

elderly improve their ability to control body movements through the involvement of the sensory system, thereby supporting stability when moving (Nokham & Kitisri, 2017). This study aims to determine the role of SSE in improving balance in the elderly as a fall prevention measure, as well as contributing to the strengthening of community-based balance exercise programmed through elderly health posts.

COMMUNITY ENGAGEMENT METHOD

1) Target Community and Participants

This community service program is aimed at elderly communities who are members of the Ngudi Waras, Senden, Tohudan, and Colomadu elderly health posts. There were 30 elderly participants aged between 60 and 75 years old. The participants included both men and women, with varying nutritional statuses ranging from thin to normal to obese or overweight based on their Body Mass Index (BMI).

Participants were selected inclusively using simple inclusion and exclusion criteria. The inclusion criteria were elderly individuals aged 60-75 years, registered as active members of the elderly health post, able to stand and walk independently with or without assistive devices, and willing to participate in all program activities. The exclusion criteria included elderly individuals with acute musculoskeletal injuries, severe neurological disorders, uncontrolled cardiovascular condition, or cognitive impairments that limited their ability to follow instructions safely. This inclusive selection approach was applied to provide broad benefits to the community while maintaining participants safety.



Figure 1. Community and Participants

2) Program Design and Implementation Procedures



Figure 2. Community service activities



Figure 3. Community service activities

This community service program was designed in the form of counseling, demonstrations, and hands-on practice of the Square Stepping Exercise (SSE) intervention as a form of balance training for the elderly (Sermsinsiri et al., 2019). The intervention consisted of the following activities:

- a) Data collection on participants to identify demographic characteristics and basic health conditions.
- b) Education through counseling on the importance of balance training and the benefits of SSE as a fall prevention strategy.
- c) Hands-on practice through demonstrations of SSE step patterns, progressing from simple movements to more complex combinations.
- d) Evaluation and closing to conduct a brief discussion and reflection on the experiences of community participants

The implementation method was designed to be participatory by involving *posyandu* cadres as accompanying facilitators to ensure the program's sustainability after the activity ended.

3) Tools, Materials, and Instruments

This program used educational media in the form of information modules, leaflets, and SSE step pattern boards. To assess balance performance, the Time Up and Go Test (TUGT) was used as the primary measurement tool. Participants were instructed to stand up from a chair, walk three meters, turn around, return, and sit down, while the completion time was recorded in seconds. The test was conducted both before (pre-test) and after (post-test) the SSE intervention using standardized procedures.

Additionally, participants' data forms were used to record identity, age, height, weight, BMI, and pre-test and post-test TUGT result. All instruments were designed to be simple and practical to facilitate replication in other Posyandu settings.

4) Data Collection and Analysis

Service data were collected using both quantitative and qualitative approaches. Quantitatively, data were obtained from pre-test and post-test TUGT measurements and analyzed descriptively by calculating average time differences before and after the intervention to observe changes in dynamic balance performances. Qualitatively, data were collected through direct observation and

participant feedback regarding movement ease, confidence, and perceived benefits after training.

Data accuracy was ensured through standardized balance testing procedures and assistance from trained facilitators during measurement.

5) Expected outcomes and justification

The expected outcomes of this community service program include:

- Increased understanding among the elderly of the importance of balance training in preventing the risk of falls.
- Improved dynamic balance ability, as demonstrated by improved post-test scores compared to pre-test scores.
- Implementation of a simple home program in the form of Square Stepping Exercise (SSE) that can be done independently or in groups at home or at the health center.

Before the program, the elderly community lacked structured balance training and had limited knowledge of its benefits. After the program, improvements are expected in motor performance, exercise awareness, and the formation of healthier physical activity habits, supporting the goal of fostering healthy, fit, and independent elderly individuals.

RESULTS AND DISCUSSION

Results

1. Participant Characteristics

This community service program was attended by 30 elderly people aged between 60 and 75 years old. The characteristics of the participants who took part in the activities included gender, age, height, weight, and Body Mass Index (BMI).

Table 1. Participants Characteristics

Participants	Gender	Age's (Year)	Body Height (Cm)	Body Weight (Kg)	BMI	BMI Category
Px 1	Female	67	153	45	19.23	Normal
Px 2	Male	70	165	74	27.20	Overweight
Px 3	Female	66	158	50	20.03	Normal
Px 4	Female	65	153	42	17.94	Underweight
Px 5	Female	75	160	52	20.31	Normal
Px 6	Female	62	155	44	18.32	Underweight
Px 7	Female	64	152	66	28.57	Overweight
Px 8	Male	73	155	42	17.48	Underweight
Px 9	Female	64	153	45	19.23	Normal
Px 10	Female	61	149	49	22.06	Normal
Px 11	Female	67	158	71	28.51	Overweight
Px 12	Female	61	155	68	28.33	Overweight
Px 13	Female	62	156	45	18.49	Underweight
Px 14	Female	73	160	66	25.78	Overweight
Px 15	Male	73	162	66	25.15	Overweight

Px 16	Female	67	160	71	27.73	Overweight
Px 17	Female	63	163	56	21.08	Normal
Px 18	Female	64	158	76	30.45	Overweight
Px 19	Female	72	157	69	28.04	Overweight
Px 20	Male	63	165	62	22.79	Normal
Px 21	Female	65	170	82	28.37	Overweight
Px 22	Female	70	165	54	19.84	Normal
Px 23	Female	60	159	71	28.17	Overweight
Px 24	Female	64	158	57	22.89	Normal
Px 25	Female	63	153	56	23.93	Overweight
Px 26	Female	70	150	41	18.22	Underweight
Px 27	Female	60	160	55	21.48	Normal
Px 28	Female	62	158	67	26.85	Overweight
Px 29	Male	70	156	55	22.60	Normal
Px 30	Female	62	156	44	18.10	Underweight

The table shows that most participants who took part in this activity were overweight, followed by those of normal weight, with a small number underweight. This community service activity was conducted in accordance with ethical principles involving human participants. Ethical approval was obtained from the relevant institutional authority prior to program implementation. All participants were informed about the purpose, procedures, benefits, and potential risks of the activity. Written and verbal informed consent was obtained from all participants before data collection, and participation was entirely voluntary. Participant confidentiality and anonymity were maintained throughout the activity and reporting process.

2. Pre-Test and Post-Test Results for Dynamic Balance

The evaluation of dynamic balance, which was conducted by measuring the time (in seconds) before and after the intervention, produced the following results:

Table 2. Dynamic Balance Pre-Test and Post-Test Results

Participants	Pre-Test	Post-Test
Px 1	13.97	11.21
Px 2	16.23	15.08
Px 3	16.18	11.57
Px 4	13.17	09.92
Px 5	13.11	11.14
Px 6	15.14	13.38
Px 7	14.08	10.27
Px 8	16.58	12.33
Px 9	18.52	12.33
Px 10	10.56	08.57
Px 11	17.3	14.27
Px 12	12.32	9.33
Px 13	14.76	8.92
Px 14	15.33	8.52

Px 15	13.37	13.06
Px 16	12.86	8.27
Px 17	13.83	9.71
Px 18	12.24	9.71
Px 19	15.34	9.52
Px 20	18.8	12.55
Px 21	14.23	9.58
Px 22	15.9	11.1
Px 23	18.2	10.29
Px 24	12.44	10.29
Px 25	15.71	10.7
Px 26	14.18	10.7
Px 27	11.26	8.92
Px 28	12.64	12.32
Px 29	14.14	13.11
Px 30	14.53	12.27

The Shapiro-Wilk test of the pre-test and post-test data showed significance values of $p = 0.790$ for the pre-test and $p = 0.329$ for the post-test ($p > 0.05$). These results indicate that the data are normally distributed, thus fulfilling the assumption for a paired t-test.

Based on the results of the paired t-test, a t-value of 10.085 was obtained with $df = 29$ and $p = 0.001$ ($p < 0.05$). The difference in mean scores between the pre-test and post-test was 3.599 with a 95% confidence interval: 2.869–4.329, indicating a significant difference between the values before and after the intervention.

Descriptively, most participants experienced a decrease in time on the post-test measurement compared to the pre-test, indicating an improvement in dynamic balance ability. Several participants showed a marked improvement, including participant number 14 (15.33 to 8.52 seconds), participant number 19 (15.34 to 9.52 seconds), and participant number 23 (18.20 to 10.29 seconds).

Table 3. Activity Schedule

No.	Research Activities	Week			
		1	2	3	4
1.	Observation of the service location and signing of cooperation agreements with partners				
2.	Preparation and manufacture of SSE tools				

No.	Research Activities	Week			
		1	2	3	4
3.	Implementation of community service with partners				
4.	Data processing and preparation of reports on community service activities and publication of community service activities				

Discussion

Participant characteristic data shows that the majority of participants are overweight, which is generally associated with reduced mobility and a higher risk of falling. However, the post-test results show that SSE is effective in improving dynamic balance even in older adults with these conditions. This certainly confirms that the flexibility of SSE can be useful for various physical conditions (Ghilang et al., 2022).

The improvement in dynamic balance was very evident in most participants. SSE exercises involving step variations in various directions stimulate the musculoskeletal, sensory, and vestibular systems and improve reflex responses. Participants were also instructed to remember different step patterns, thereby engaging cognitive aspects and strengthening the coordination between the brain, nervous system, and body movements (Ni et al., 2024).

The effectiveness of SSE can be understood from two perspectives: (1) simple movement patterns that develop toward higher complexity train the body's adaptation and postural control; (2) the involvement of cognitive functions in remembering movement patterns can improve the integration of the nervous system and muscles. Other studies confirm that SSE is superior in improving dynamic balance and reducing the risk of falls compared to static exercises (Manuel et al., 2024).

From a social perspective, group SSE implementation can provide a motivational effect. Older adults are more enthusiastic about participating in exercise activities due to peer interaction and support from community health workers. This can be a key factor in the sustainability of the program at the community level.

In addition to these findings, the effectiveness of SSE in this study was supported by inferential statistical analysis. The Shapiro Wilk test showed that both pretest and post test data were normally distributed, with significant values of $p = 0.790$ for the pretest and $p = 0.329$ for the post test ($p > 0.05$), thereby fulfilling the assumptions for parametric testing. Based on these results, a paired t-test was conducted to further examine the effect of the intervention.

When compared with other balance exercises, SSE offers advantages due to its dynamic, multidirectional, and progressive movement patterns, which differ from static exercises that focus primarily on maintaining fixed pictures. This characteristic allows SSE to better

reflect functional movement demands encountered in daily activities, thereby supporting its role in fall prevention as reported in broader balance training research.

Nevertheless, this study has several limitations, the relatively small sample size and the absence of a control group limit the generalizability of the findings and restrict causal interpretation. Therefore, although the results are promising, future studies with larger samples and controlled experimental designs are recommended to further confirm the effectiveness of SSE and to compare it directly with other balance training interventions.

CONCLUSION

The community service program with the intervention of Square Stepping Exercise (SSE) successfully achieved its objectives, demonstrating an increase in understanding among the elderly regarding the importance of balance training and improving dynamic balance abilities. Pre-test and post-test results showed an improvement in step pattern completion time in most participants, indicating improved postural control and movement coordination after the SSE intervention.

These findings prove that SSE is an effective and applicable form of balance training in efforts to prevent the risk of falls among the elderly. In addition to training muscle strength and coordination, SSE also involves cognitive aspects that play an important role in maintaining body stability during movement. With simple and easy-to-apply movement patterns, SSE has the potential to become a sustainable independent exercise program to improve balance, mobility, and independence in the daily activities of the elderly.

ACKNOWLEDGEMENTS

The author would like to express his deepest gratitude to all parties who have provided support in conducting this research. Special thanks go to the elderly participants who willingly gave their time and energy to participate in the exercise program. Appreciation is also extended to the physiotherapy team, instructors, and support staff who played an important role in the implementation of the Square Stepping Exercise (SSE) and Otago Exercise (OT) interventions.

Additionally, the author would like to thank Muhammadiyah University of Surakarta for facilitating this research through the provision of facilities and permission, as well as colleagues who have provided valuable suggestions in the process of writing this article.

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