

The Effect of Square Stepping Exercise On Daily Living Activity, Balance And Risk of Falls In The Elderly

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Abstract.

Elderly people often experience decreased independence in daily activities, balance and risk of fall. Management of this problems can be done with non-pharmacological therapy. One of the non-pharmacological therapy that can be applied to the elderly was square stepping exercise. The purpose of this study was to see the effect of square stepping exercise on daily activities, balance and risk of fall in the elderly. The design of this study used quasy experiments with pre and post control groups with a large sample of 20 respondents in each group. The sampling technique used is consecutive sampling with independent variables, namely square stepping exercise, Dependent variable in this study were daily activities, balance and risk of fall. The research instruments used are barthel index, balance test and time up and go test. The research was carried out at the Budi Sejahtera Banjarbaru Elderly Social Protection and Rehabilitation Institution (PPRSLU). The statistical test used in this study was wilcoxon signed test. The test results found that There was an effect of square stepping exercise on the daily activity of the elderly in the intervention group, but there was no effect in the control group. There was no effect of square stepping exercise on the balance of the elderly in the intervention and control groups. there was no effect in the control group. There was no effect of square stepping exercise on the risk of fall of the elderly in the intervention and control groups In elderly, nurses need to help the elderly so that the problem was resolved and able to fight disability. Square stepping exercised can be applied for the daily activity, balance and risk of fall..

Keywords: square stepping exercise, daily activity, elderly, balance and risk of.

I. INTRODUCTION

The aging process causes various physiological changes in the human body, such as decreased muscle mass, strength, bone density, and nervous system function, which plays a role in body coordination and balance. These changes directly impact the ability of the elderly to carry out daily activities or Activities of Daily Living (ADL), thereby reducing their level of independence and quality of life [5]. In addition, increasing age also increases the risk of sarcopenia, a condition of progressive loss of muscle mass and strength, which contributes to decreased mobility, balance, and an increased risk of falls in the elderly [1]. The accumulation of this decline in physical function and increased risk of falls makes the elderly group very vulnerable to functional disorders and activity limitations, which ultimately can have an impact on increasing morbidity and dependence on others.

Globally, falls are a leading cause of unintentional injury and death in the elderly. According to the World Health Organization [2], approximately 684,000 deaths worldwide are caused by falls each year, with the elderly aged 60 and over being the most at-risk group. Epidemiological studies indicate that approximately 30–40% of the world's elderly experience a fall at least once a year [2]. In Indonesia, the results of the 2018 Basic Health Research (Riskesdas) showed that the prevalence of injuries due to falls in the elderly population reached 12.5% and continues to increase with age [3]. Local data from the 2023 South Kalimantan Provincial Health Profile reported that the number of elderly residents in the province reached 9.81% of the total population, and approximately 35% of them experienced mild to severe physical activity limitations [4]. In Banjarbaru City itself, based on a 2023 Social Services report, there was an increase in the number of elderly residents of social institutions and requiring assistance in daily activities. Initial observations at the Budi Sejahtera Banjarbaru Social Services and Rehabilitation Center for the Elderly (PPRSLU) also showed that most elderly people experienced decreased mobility and balance abilities, as well as a history of repeated falls in the past year (Field Observation, 2024).

The decline in physical abilities experienced by the elderly is caused by degenerative processes that affect the musculoskeletal, nervous, and sensory systems. Sarcopenia causes decreased muscle strength and gait speed, while decreased vestibular and proprioceptive function reduces the ability to maintain balance

[6]. These conditions have an impact on the increased risk of falls and loss of independence in performing ADLs [1]. When the elderly fall, they are potentially experiencing fractures, head injuries, and psychological consequences such as fear of falling, which actually reduces physical activity and accelerates functional decline [5]. This cycle leads to a decreased quality of life and socio-economic burden for both individuals and elderly care institutions. Therefore, effective interventions to maintain balance and physical function in the elderly are essential to prevent falls and increase independence in daily living.

One intervention proven effective in improving balance and reducing the risk of falls in the elderly is Square Stepping Exercise (SSE). This exercise consists of multidirectional steps on a gridded surface that combines forward, backward, and sideways movements in a specific pattern, thereby training coordination, motor memory, and dynamic balance. A study by Cha, Kim, and Baek (2022) showed that SSE can improve fitness related to fall prevention and increase Brain-Derived Neurotrophic Factor (BDNF) levels in the elderly [7]. Research by Franco-García et al. (2025) also found that a 12-week SSE program can improve balance, gait speed, and reduce fear of falling [8]. Furthermore, a meta-analysis by Fisseha (2017) proved that SSE significantly improves static and dynamic balance and reduces the risk of falls in the elderly group ($p < 0.001$) [9]. Similar results were reported by Özel et al. (2025), who compared SSE with traditional muscle strengthening exercises and found that SSE was more effective in improving postural stability and agility [10]. The purpose of this study was to look at the effect of square stepping exercise in improve ADL, balance, and reduce the risk of falls in the elderly in the PPRSLU Budi Sejahtera Banjarbaru.

II. METHODS

The design in this study was a quasy experiment with a pre and post control group, the research was carried out from February to March, 2026, the research was carried out at the Elderly Social Protection and Rehabilitation Institution (PPRSLU) Budi Sejahtera Banjarbaru South Kalimantan. The population in this study was all elderly people of 20 respondents in the intervention group and 20 respondents for the control group, independent variables in this study were square stepping exercise, While the dependent variables in this study were Activity daily living, balance and risk of fall. the way of data collection was carried out by first carrying out pre-tests in both groups then the intervention group was given square stepping exercise while the control group was only given according to the procedural of the PPRSLU. The instrument used in this study were *barthel index*, *balance test* and *time up and go test*. The intervention was carried out for 6 days, after that the two groups were given a posttest and assessed, the data analysis used the wilcoxon signed test.

III. RESULT AND DISCUSSION

Table 1. Characteristics of Respondents

Responden characteristic	Intervention group		Control group	
	f	%	f	%
Gender				
Male	12	60	7	35
Female	8	40	13	65
Total	20	100	20	100
Age				
55-65 years old	5	25	6	30
66-74 years old	10	50	8	40
75-90 years old	5	25	6	30
Total	20	100	20	100
Long time in PPRSLU				
< 1 year	8	40	5	25
1-5 years	8	40	10	50
>5 years	4	20	5	25
Total	20	100	20	100

Table 2. Distribution of Activity Daily Living (ADL) before and after intervention at PPRSLU Budi Sejahtera in 2026

ADL

	PRE		POST	
	Klp intervensi	Klp kontrol	Klp intervensi	Klp kontrol
Mandiri	15 (75%)	6 (30%)	20 (100%)	6 (30%)
Ketergantungan ringan	5 (25%)	10 (50%)	0	10 (50%)
Ketergantungan berat	0	4 (20%)	0	4 (20%)
Total	20(20%)	20 (100%)	20 (100%)	20 (100%)

Table 3. Balance Distribution before and after intervention at PPRSLU Budi Sejahtera in 2026

	Keseimbangan			
	PRE		POST	
	Klp intervensi	Klp kontrol	Klp intervensi	Klp kontrol
Gangguan keseimbangan rendah	18 (90%)	7 (35%)	20 (100%)	6 (30%)
Gangguan keseimbangan sedang	2 (10%)	4(20%)	0	4 (20%)
Gangguan keseimbangan berat	0	9 (45%)	0	10 (50%)
Total	20 (100%)	20 (100%)	20 (100%)	20 (100%)

Table 4. Risk of Fall Distribution before and after intervention at PPRSLU Budi Sejahtera in 2026

	Risiko Jatuh			
	PRE		POST	
	Klp intervensi	Klp kontrol	Klp intervensi	Klp kontrol
Tidak berisiko	15 (75%)	14 (70%)	17 (85%)	14 (70%)
Risiko rendah	5 (25%)	4 (20 %)	3 (15%)	4 (20 %)
Risiko tinggi	0	2 (10%)	0	2 (10%)
Total	20 (100%)	20 (100%)	20 (100%)	20 (100%)

Table 5. Square stepping exercise on the activity daily living of the elderly at PPRSLU Budi Sejahtera in 2026

	Intervention group			Control group		
	N	Mean rank	Sum of ranks	n	Mean rank	Sum of ranks
Negatif ranks	6	3.75	7.5	6	1.00	1.00
Positif ranks	13	8.12	97.5	9	6.00	54.00
Ties	1			5		
Uji wilcoxon	P=0.005			P=0.007		

Table 6. Square stepping exercise on the balance of the elderly at PPRSLU Budi Sejahtera in 2026

	Intervention group			Control group		
	n	Mean rank	Sum of ranks	n	Mean rank	Sum of ranks
Negatif ranks	13	7.00	84.00	13	7.08	85.00
Positif ranks	2	10.50	21.00	3	11.67	35.00
Ties	1			0		
Uji wilcoxon	P=0.020			P=0.035		

Table 7. Square stepping exercise on the risk of fall of the elderly at PPRSLU Budi Sejahtera in 2026

	Intervention group			Control group		
	n	Mean rank	Sum of ranks	n	Mean rank	Sum of ranks
Negatif ranks	16	8.00	84.00	18	7808	85.00
Positif ranks	3	10.50	21.00	2	11.67	35.00
Ties	1			0		
Uji wilcoxon	P=1.000			P=1.317		

Based on the results of the study, it was shown that there was an effect of square stepping exercise (SSE) on daily living activities in the intervention group in the elderly with a p value of 0.005, but there was no effect in the control group ($p = 0.007$). The SSE intervention specifically trains the lower extremity muscles through stepping movements in various directions (front, back, side, and diagonal). This movement increases quadriceps muscle power and ankle strength, which are the main foundations in daily mobility. This increase in strength allows the elderly to perform ADL activities such as standing from a chair, walking to the bathroom, and climbing stairs more stably [21]. Improved dynamic balance directly reduces the risk of falls, which is often a major obstacle to ADL independence [22]. Unlike regular walking, SSE is a

"cognitive-motor exercise." Respondents must remember the step pattern and realize it physically. This process involves the prefrontal cortex and cerebellum, which improves executive function. When cognitive function improves, the elderly's ability to plan and execute complex daily activities (IADL) and basic (ADL) becomes more efficient [23]. The neural activation during this exercise stimulates brain plasticity, which helps maintain motor control in old age. Regular administration of SSE has been shown to slow the rate of physical degeneration. By maintaining joint flexibility and nerve coordination, seniors can still perform self-care without assistance. This is crucial because decreased ADL often stems from a sedentary lifestyle. SSE provides sufficient stimulation to trigger synovial release in the joints, thereby reducing stiffness that hinders daily activities [24].

Based on the results of the study, it was shown that there was no effect of square stepping exercise (SSE) on balance in the intervention group in the elderly with a p value of 0.020 or in the control group ($p = 0.035$). Body balance is highly dependent on the strength of the core muscles and lower extremity muscles. In this study, the step pattern in SSE was likely performed with steps that were too small or too slow a tempo, thus not providing sufficient load (overload) to stimulate the neuromuscular system. Without adequate intensity, adaptation to the proprioceptive system and strengthening of the stabilizer muscles does not occur optimally [25]. The process of improving balance in the elderly requires a long time to remodel the degenerated sensorimotor system. If the intervention is carried out for a short duration (for example, less than 4 weeks), then the changes that occur are only temporary and do not reach statistical significance. Dynamic balance requires long-term repetitive training to improve postural sway responses [26].

The results of the study showed no effect of square stepping exercise (SSE) on the risk of falls in the intervention group in the elderly with a p value of 1.000 or in the control group ($p = 1.317$). The risk of falls is strongly influenced by a history of previous falls and the respondent's basic physical condition. In respondents who already have poor gait stance or severe lower extremity muscle weakness (sarcopenia), SSE exercise with standard intensity may not be strong enough to provide a protective effect. Reducing the risk of falls requires a significant increase in muscle strength threshold, which often requires a combination of coordination exercises such as SSE with weight training (resistance training) [27]. The lack of effect in this study may be due to the short duration of the study. The process of adaptation of the central nervous system to improve the postural recovery response when losing balance takes a long time. If the intervention is only carried out for a few weeks, changes in dynamic stability may occur, but are not strong enough to reduce the fall risk score on assessment instruments such as the Morse Fall Scale or Berg Balance Scale [28]. In this study, the intervention was given for 1 week. The risk of falls in the elderly is often triggered by external or environmental factors, such as slippery floors, dim lighting, or the use of inappropriate footwear. Although SSE improves respondents' gait coordination abilities, environmental hazard factors at home remain constant. Therefore, improving motor skills without environmental modifications will not automatically reduce the frequency or risk of falls statistically [29].

IV. CONCLUSION

Based on the results of the study, it was shown that there was an effect of square stepping exercise on the activity daily living of the elderly in the intervention group, but there was no effect on the control group. There was no effect of square stepping exercise on the balance of the elderly in the intervention and control groups. There was no effect of square stepping exercise on the risk of fall of the elderly in the intervention and control groups.

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