

EFFECTS OF SQUARE STEPPING EXERCISE ON COGNITIVE FUNCTION AND MOOD AMONG OLDER ADULTS LIVING IN NURSING HOMES

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ABSTRACT

Background: Older adults living in nursing homes experience environmental and social conditions that differ from those of community-dwelling elderly individuals, which may negatively affect cognitive function and psychosocial well-being, including mood. Non-pharmacological interventions that simultaneously address cognitive and emotional health are therefore needed in long-term care settings. **Objective:** This study aimed to evaluate the effectiveness of square stepping exercise accompanied by music in improving cognitive function and mood status among elderly individuals residing in nursing homes. **Methods:** A quasi-experimental study using a one-group pretest–posttest design was conducted among 33 elderly participants selected through purposive sampling. Cognitive function was assessed using the Mini-Mental State Examination (MMSE), and mood status was evaluated using the Brief Mood Introspection Scale (BMIS). The intervention consisted of square stepping exercise performed for 30 minutes per session, three times per week, over a four-week period. Data were analyzed using paired statistical tests. **Results:** The mean baseline MMSE score was 23.8 ± 2.17 , and the mean BMIS score was 38.1 ± 4.97 . Significant improvements were observed in both cognitive function and mood status following the intervention ($p < 0.05$ for both outcomes). **Conclusion:** Square stepping exercise accompanied by music effectively enhances cognitive function and mood status among elderly individuals living in nursing homes. This intervention may serve as a feasible and beneficial non-pharmacological strategy to support the overall well-being of older adults in institutional care.

Keywords: square stepping exercise; cognitive function; mood status; elderly; nursing homes

INTRODUCTION

The period of older adulthood is an ongoing natural stage of human development that is inevitable for individuals. An individual is considered elderly when they reach the

age of 60 or older (Peraturan Menteri Kesehatan Republik Indonesia Nomor 2052/Menkes/Per/X/2011, 2011; Undang-Undang Republik Indonesia No 13, 1998) (Depkes, 2018; Undang-undang RI no 13). The proportion of the

older population aged 60 years and older has increased globally in recent years (Huang et al., 2019; Nayak et al., 2019). According to WHO, by 2020 the number of older population reached 1 billion and is predicted to double by 2050 (World Health Organization, 2022a). In Indonesia, the percentage of older populations reached 7% in 2015 and began to increase in 2016 and 2017, reaching 8.9% and 9.1%, respectively (Kemenkes RI, 2017). This increase in the number of elderly people puts the country with the highest proportion of senior citizens in Southeast Asia (World Health Organization, 2022b).

As ageing progresses, elderly people experience various changes in life, both physically, cognitively, and psychosocially (Azizah L.M, 2011; Sharma, 2023; Teo et al., 2023). Age-related changes in the human brain include a reduction in brain volume, a decrease in blood flow, and changes in neurochemicals, leading to neurological problems such as dementia, cognitive impairment, stroke, and other adverse effects (H. J. Cha et al., 2022).

Social circumstances and the types of received care influence individual responses to the changes associated with aging (Chan et al., 2015). As the number of elderly people residing in nursing homes has been increasing recently, concern for the health of older people in nursing homes has also increased. Research comparing the health status of the elderly living in nursing homes and the community revealed that quality of life was found

to be lower among those living in nursing homes (Olsen et al., 2016).

Environmental conditions in which older people live far from their families may result in dissatisfaction, anxiety, and despair, as well as affect their perspective on their quality of life. Several studies found that institutionalised elderly people have lower self-esteem and poorer physical health than community-dwelling elderly people (Šare et al., 2021). These findings may also indicate a problem with elevated stress and depression levels among elderly residents in the nursing home (Nuraeni et al., 2023; Putri & Khairani, 2021).

The living conditions have been proven to be associated with the health status, well-being, and quality of life of elderly individuals (O'Neill et al., 2019). A study showed that older people who live in nursing homes have lower cognitive status compared to elderly people who live in the community (Setiyani & Iskandar, 2022; Yılmaz et al., 2021). While many other reasons are contributing to the reduction in function, the effects of living in a nursing home may be one of them. The prevalence of mental health issues among elderly individuals in nursing homes is attributed to their perception of poor nursing care (Pramesona & Taneepanichskul, 2018). Moreover, having a perception of placing older individuals in nursing homes is seen as an idea against cultural norms of dedication to the parents, which affects their health negatively (Setiyani et al., 2019).

Maintaining cognitive performance and psychosocial well-being among individuals residing in nursing homes is essential to minimise the prevalence of dementia and other psychiatric problems. Exercise is an effective approach to prevent and delay the decline in cognitive abilities (Gallou-Guyot et al., 2020; Pratiwi et al., 2024). Regular exercise can also improve physical outcomes, including lowering the incidence of falls and depressive mood in older persons and postponing age-related neurodegeneration (Baek et al., 2024). In general, physical movements have positive impacts on the neurotransmitter functions by increasing blood flow to the brain (H.-J. Cha et al., 2022; Rahmawati et al., 2024).

SSE is a type of walking exercise that is inexpensive and simple to perform in a group setting because it doesn't require high-cost equipment. The square stepping exercise was developed by Shigematsu by performing stepping movements in a certain pattern in various directions (forward, backward, lateral, and diagonal) on a thin base (Shigematsu et al., 2008). It was designed to help elderly people engage in indoor exercise at their convenience.

After being demonstrated, the elderly are asked to remember and memorize the stepping pattern and then practice the pattern. That way, the elderly get a stimulus that stimulates motor and cognitive functions (Wang et al., 2021). In addition, square stepping exercise is also an alternative exercise to improve physical fitness, balance, and reduce

the risk of falls in the elderly (Wang et al., 2021). Moreover, SSE includes both physical and cognitive stimulations, and it can potentially promote social interaction (Shigematsu & Okura, 2006).

The seniors, who have many restrictions, require supportive measures to increase their functional capacity. In this study, the square stepping exercise, combined with musical accompaniment, is expected to have a simultaneous effect on the cognitive and psychosocial functions of the elderly. The square stepping exercise is carried out in a fun manner, with a pattern that is tailored to the skills of each senior person. The square stepping exercise is not only simple but also portable and inexpensive, making it ideal for use at home or in the community (Bherer & Pothier, 2021).

METHOD

Study design

This study employed a quasi-experimental research design with a one-group pretest-posttest design. Data collection was conducted before and after the intervention.

Table 1 Study design

<i>Pre-test</i>	<i>Intervention</i>	<i>Posttest</i>
O_1	X	O_2

Participants

The participants in this study were 33 seniors aged 60 and above (62–81 years), recruited from three private nursing homes in Bandung, Indonesia. Using purposive sampling, the

inclusion criteria included the absence of neurological or mental health issues, the willingness to fully comprehend the study's procedure and purpose, the ability to stand and walk independently, the ability to communicate appropriately, and voluntary participation.

Data collecting procedures

Ethical permission was obtained from the STIKep PPNI Ethical Board under the number III/057.1/KEPK-SLE/STIKEP/PPNI/JABAR/IV/2024.

Eligible participants were asked to follow the research process, and consent was obtained after they were informed about the research procedure and potential risks. Participants who were unable to follow the entire process were excluded from the data analysis. All respondents filled out the MMSE and BMIS as pretest scores. The Mini-Mental State Examination (MMSE) was used to evaluate general cognitive function (23). Psychological Well-being was measured using the Indonesian version of the Brief Mood Introspection Scale (BMIS) (Halim, C., & Rembulan, 2017). Demographic data, including age, gender, marital status, work experience, and medical history, were collected at baseline.

After compiling the module, the intervention was implemented following its contents. The step pattern used in this study was developed based on the Shigematsu (Shigematsu et al., 2008) pattern and modified to meet specific needs. The pattern was determined based on the outcomes of focus group discussions with

caregivers, the elderly, and geriatric nursing experts.

The SSE intervention was conducted three times a week for a period of four weeks, with each session lasting 30-35 minutes. The intervention consisted of steps taken on a 2.1 x 1.2-meter mat, divided into 32 squares. The intervention consisted of three parts: a warm-up, the main exercise, and a cool-down. The warm-up and cool-down sessions consisted of stretching movements that began with the head, neck, upper extremities, and lower extremities. The step patterns given were divided into three different levels of difficulty: easy, medium, and difficult (Figure 1). Each participant performed the exercises starting from the easy level and continuing to the next level according to their abilities. If the participant showed physical symptoms during the intervention, the session would be immediately stopped.

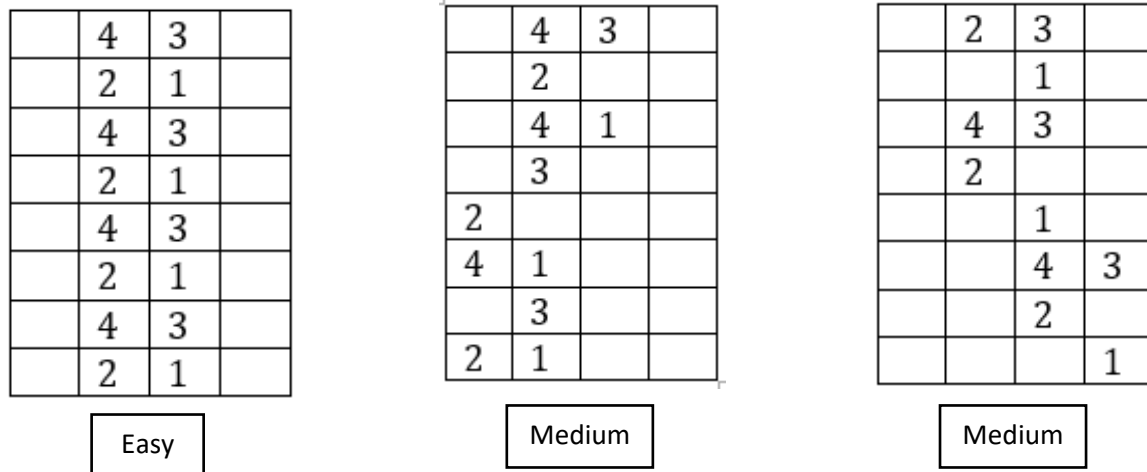


Figure 1. Step patterns by complexity

Table 2 Square stepping exercises intervention

Session	Activities	Duration
Warm-up	Stretching movements (head and neck, shoulders, upper and lower extremities)	5 minutes
SSE Exercises	SSE exercises: easy/medium/hard	15-20 minutes
Cooling-down	Stretching movements (same as warm-up)	5 minutes

RESULTS

Thirty-three seniors from three private nursing home facilities participated in the study's research activities and were included in the data analysis. The baseline of demographic characteristics included age, gender, level of Education, working experience, marital status, reasons for entering nursing homes, and duration of stay.

Table 3 Characteristics of Respondents

Variables	Frequency	%
Gender		
Male	10	30.3
Female	23	69.7
Level of Education		
Not attending school	5	15.2
Elementary school	13	39.4
Junior High School	4	12.1
Senior High School	10	30.3
College	1	3
Past working experience		

Civil	1	3	
Servants/TNI/POLRI			
Employee	6	18.2	
Self-employed	8	24.2	
Farmer	2	6.1	
Servant	4	12.1	
Housewife	12	36.4	
Marital status			
Not married	7	21.2	
Marry	4	12.1	
Widow/widower	22	66.7	
Reasons for entering the nursing home			
Personal choice	15	45.5	
Family decision	18	54.5	
	Min-Max	Average	SD
Age (years)	62 – 81	74.5	7.1
Duration of stay (years)	1 - 16	3.8	3.4

According to the table, characteristics of the subjects mainly consisted of females (69.7%) who were mostly widows/widowers (66.7%), had attained an elementary school

education (39.4%), and were housewives (36.4%). The average age of participants was 74.5 years, with a standard deviation of 7.1. The majority of the participant were sent to the facilities by their family's decision (54.5%) with an average duration of stay of 3.8 ± 3.4 years. The characteristics of the subjects are seen in Table 3.

Table 4 Respondent characteristics based on initial variables (n=33)

Variables	Min - Max	Average	SD
MMSE Score	20 – 28	23.8	2.17
BMIS Score	31 – 50	38.1	4.97

In this study, all participants were assessed using MMSE and BMIS. According to Table 4, the result showed an average MMSE score of 23.8 ± 2.17 , and the BMIS average score was 38.1 ± 4.97 . The evaluation of variables indicated significant differences in the MMSE and BMIS scores compared to pre- and post-intervention ($p < 0.05$) as seen on Table 5.

Table 5 Variable analysis pre-intervention and post-intervention (n=33)

Variables	Test	$\bar{x}$	SD	Δ	Statistics	Sig.
MMSE Score ^a	Pretest	23.8	2.17	2.3	-2.446	0.014**
	Posttest	26.1	4.56			
BMIS Score ^a	Pretest	38.1	4.97	10.6	12,569	0.000**
	Posttest	48.7	10.82			

DISCUSSION

Cognitive function

Following a Square Stepping Exercise (SSE) intervention, the results demonstrated a significant improvement in cognitive function as shown by MMSE scores. There was a substantial difference between the pre-test and posttest results. This demonstrates that cognitive stimulation from square stepping exercises is crucial for improving the cognitive function of senior citizens residing in assisted living facilities.

Before intervention, the overall average MMSE score of the participants was

23.8, falling within the range of mild cognitive impairment (Rambe & Fitri, 2017). The results of this study are in line with the prevalence rate of cognitive decline in the elderly in Indonesia, which reached 35% in 2018 (Kementrian Kesehatan RI, 2018). Whereas certain studies may use different cut-off points, it is believed that the 23/24 score is appropriate for most populations (Folstein et al., 1975, 1983; Moyer, 2014). Generally, an individual experiences a decline in cognitive function as ageing progresses (Feng et al., 2023), resulting in lower cognitive scores for those who are older compared to those who are younger

(Qin et al., 2022). It is known that cognitive function plays a significant role in the independent functioning of older adults. A person's cognitive status significantly influences decision-making ability and behavioural regulation within the framework of executive function (Guarino et al., 2020). Impaired cognitive function in older adults ultimately impacts physical performance and psychosocial well-being (Lee et al., 2023). In addition, cognitive function also influences walking balance, a significant risk factor for falls in the elderly (Adam et al., 2023). The cognitive status of the elderly can serve as a predictor for future falls within this population (Guo et al., 2023).

Cognitive deterioration in older adults is closely linked to the ageing process. The frontal region of the brain, which ages and changes with age, is largely responsible for a person's cognitive abilities (Li et al., 2020; Smith et al., 2020). Cognitive performance is also impacted by cellular neurodegenerative processes, including elevated inflammatory markers, neurotransmitters, and reduced metabolism (Feng et al., 2023; Sargent et al., 2020). However, cognitive decline is not a necessity that occurs as part of the ageing process (Ruan et al., 2020; Sugimoto et al., 2018); therefore, individuals can still maintain their cognitive function as they get older (J. Liu et al., 2023). Implementing appropriate interventions in at-risk populations, such as the elderly, can alleviate and delay functional decline.

In the current study, Square stepping exercise can significantly increase MMSE scores ($p < 0.05$) compared to before the intervention. This indicates that the elderly experience improvements in cognitive aspects such as attention, memory, orientation, and logical thinking skills. The results of this study are in line with previous studies that square stepping exercise can improve executive function in the elderly (H.-H. Liu et al., 2022; Wang et al., 2021). Square stepping exercise is a type of physical-cognitive exercise that makes the elderly complete a given step pattern. Square stepping exercise involves visualizing and remembering a sequence of steps, which requires attention, memory, and planning to do it correctly (Pereira et al., n.d.). Complex step patterns provide their cognitive demands for the elderly so that they have the potential to stimulate their cognitive function (Siqueira et al., 2024). In addition, combined physical-cognitive exercise provides more effective results in improving executive function and memory function (Kraft, 2012; Pellegrini-Laplagne et al., 2023).

Mood status

This study demonstrated that the SSE intervention can enhance the mood of participants. The posttest results indicated an enhancement in the mood status of the elderly compared to the pre-test value, signifying a more positive (pleasant) mood state. The findings of this study align with prior research indicating that SSE can improve psychosocial functioning among the elderly (Kawabata et al.,

2024). In addition, other studies have consistently demonstrated changes in psychosocial characteristics, such as mood status, before and after receiving treatment in the form of square dance exercise, albeit with a slightly different type of intervention (Chang et al., 2021). Increased physical exercise in the elderly has a consequential impact on psychological function and mood status.

Elderly people who are sedentary or physically inactive are more likely to experience mental health issues (Cui et al., 2021). Previous studies revealed that various types of physical exercise, including recreational activities, can reduce the risk of depressive symptoms (Jung et al., 2018; Werneck et al., 2020). This is because exercise allows the body to release the chemical molecules that can suppress depressive behavior (De Sousa et al., 2021).

In the current study, SSE was packaged with a musical background to make it more enjoyable. Physical exercise combined with music may elevate one's mood to be more positive (Suwabe et al., 2021). Music can simultaneously stimulate perception, memory, emotion, and attention in the elderly. Individuals become more accepting and aware of their environment, which contributes to an increased sense of comfort and relaxation. This condition can progressively reduce depressive symptoms and increase mood, making it more pleasant (Kim & Kang, 2021).

Limitations

The design of the current study was a one-group experimental study; future studies with a control group will be able to draw more significant conclusions due to the study's limitations. Furthermore, it is necessary to compare the outcomes in community-dwelling seniors and residential living seniors.

CONCLUSION

Square stepping exercise therapy has an effect on cognitive function and mood in the elderly living in a nursing home. Cognitive function of the elderly increased after SSE exercise, as did the mood status of the elderly, which showed a positive mood. SSE therapy can be applied to the elderly in social care as a physical and cognitive exercise therapy

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Author Contributions

Gilang Dwi Pratiwi contributed to the study conception and design, data collection, intervention implementation, data analysis, and manuscript drafting.

Vita Lucia contributed to the study design, data interpretation, critical revision of the manuscript, and supervision of the research process.

All authors reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Conflict of Interest

The authors declare that there are no conflicts of interest associated with this study.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request, subject to ethical approval and participant confidentiality considerations.

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