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Path Analysis of Ja'i Dance on Fall Risk in Older Adults

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ABSTRACT: The aging process is linked to a decrease in cognitive and physical abilities, which can raise the risk of falls and decrease balance in older people. A new alternative physical workout method for reaching physical fitness is called dance movement therapy, or DMT. The Ja'i dance is a physical activity rooted in culture that combines motor coordination, musical rhythm, bodily movements, and mental stimulation. The purpose of this study was to examine the relationships between brain-derived neurotrophic factor (BDNF) levels, fall risk, cognitive function, balance, and Ja'i dance movement therapy in older adults. 32 senior participants were split into intervention and control groups using a randomized pretest-posttest controlled group design. For six weeks, the intervention group engaged in 30-minute Ja'i dance movement therapy sessions three times a week. The relationships between variables were evaluated using Structural Equation Modeling-Partial Least Squares (SEM-PLS), with path coefficients, t-statistics, and p-values used to determine significance. Ja'i dance had a negative impact on BDNF levels ($\beta = -0.403$; $p = 0.018$) and a positive and significant impact on cognitive function ($\beta = 0.354$; $p = 0.020$). While balance had a negative and significant impact on fall risk ($\beta = -0.486$; $p = 0.005$), cognitive function had a positive and significant impact on balance ($\beta = 0.315$; $p = 0.007$). Along with alterations in BDNF levels, the investigation identified pathways connecting Ja'i dance to fall risk thru cognitive function and balance. Ja'i dance has the ability to improve cognitive and physical abilities and lower the risk of falls as a culture-based intervention.

INTRODUCTION

Degenerative health problems, including cognitive loss, diminished muscle strength, worse balance, and an increased risk of falls, are more common as people age (Sun et al., 2021). Muscle weakness, balance issues, and cognitive deficits are important risk factors for falls. In addition to causing physical harm, falls among the elderly can result in impairment, a lower quality of life, and a higher death rate (Franco et al., 2016). A new alternative physical workout method for reaching physical fitness is called dance movement therapy (DMT).

Dance, as a form of physical activity, offers distinct advantages by integrating body movement, music, rhythm, motor coordination, and social interaction. Elderly people's physical and cognitive abilities have also been shown to gain from dance-based therapies (Liu et al., 2021; Kim et al., 2011; Douka et al., 2019). With a vast variety of traditional dances, Indonesia is a culturally rich country. There are numerous traditional dances in the province of East Nusa Tenggara (NTT) that are very well-liked by the locals; yet, little is known about the health advantages of these dances.

Originating in Bajawa, East Nusa Tenggara, the Ja'i dance is a traditional dance. It is typified by variations in movement direction, auditory reactions to rhythm and music, and repetitive body motions. Walking forward and backward, crossing steps to the front and back, and making semicircular turns are examples of Ja'i dance motions. These qualities enhance cognitive functions, balance, and motor coordination. Regular balance training has been demonstrated to increase memory and spatial cognition, and variations in movement type and direction can improve balance (Karkou et al., 2017; Rogge et al., 2017). The Ja'i dance's energetic motions are comparable to light-to-moderately intense physical exertion (Hadi, 2020; Kareri et al., 2020).

Beyond cognitive and physical factors, physical activity can alter neurobiological pathways via brain-derived neurotrophic factor (BDNF). One neurotrophin that supports brain development and function is BDNF. Thru the PGC-1 α , FNDC-5, and irisin pathways, which are linked to brain tissue plasticity, physical activity and aerobic exercise can alter BDNF levels (De Assis et al., 2018). Nevertheless, there is still a dearth of research combining the Ja'i dance with BDNF, fall risk, balance, and cognitive function. The majority of earlier research has concentrated on clinical outcomes without using a biomolecular approach to explain how these variables interact (Kareri et al., 2020; Manafe et al., 2020; Hadi et al., 2020; Setianingrum et al., 2020).

Therefore, this study was conducted to analyze the relationship between Ja'i dance movement therapy and cognitive function, balance, fall risk, and BDNF levels in the elderly using path analysis.

METHODS

This study employed a randomized pre- and post-test controlled group design to assess changes in BDNF levels, cognitive function, balance, and fall risk between the intervention and control groups. The intervention group participated in a Ja'i dance movement therapy program, whereas the control group received no structured intervention.

Population and Sample

The target population consisted of elderly individuals, while the accessible population comprised elderly individuals attending the GMIT Anugerah Elderly Integrated Health Post (Posyandu Lansia) in Kupang City. Sample size was determined using the Lemeshow formula for comparing two independent samples with continuous data, resulting in a total study sample of 32 subjects.

Inclusion and Exclusion Criteria

Inclusion criteria were: age 60–65 years; willingness to participate and sign informed consent; MoCA-Ina score ≥ 18 ; body mass index < 30 kg/m²; ability to ambulate independently without assistive devices; stable hemodynamics; adequate vision and hearing to participate in exercises; Timed Up and Go Test result ≤ 20 seconds; and Berg Balance Scale score of 41–56. Exclusion criteria were: history of neuromuscular disorders; cardiopulmonary disorders; renal disorders; metabolic diseases; smoking and alcohol consumption; and regular physical exercise participation within the last three months.

Ja'i Dance Intervention

The intervention group received Ja'i dance movement therapy three times a week for six weeks, totaling 18 sessions. Each session lasted 30 minutes. The control group received no specific intervention.

Data Analysis

Data analysis was conducted using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) method to analyze the relationships between variables in the research model. The analysis evaluated the relationships between Ja'i dance movement therapy and both cognitive function and BDNF levels, as well as the relationships between cognitive function and balance, and between balance and fall risk. The significance of the relationships between variables is assessed based on path coefficients, t-statistics, and p-values. A relationship is considered significant if the p-value is < 0.05 .

RESULT AND DISCUSSION

This study involved 32 elderly subjects divided into an intervention group and a control group. The results of the analysis of relationships between variables using SEM-PLS are presented in Figure 1 and Table 1.

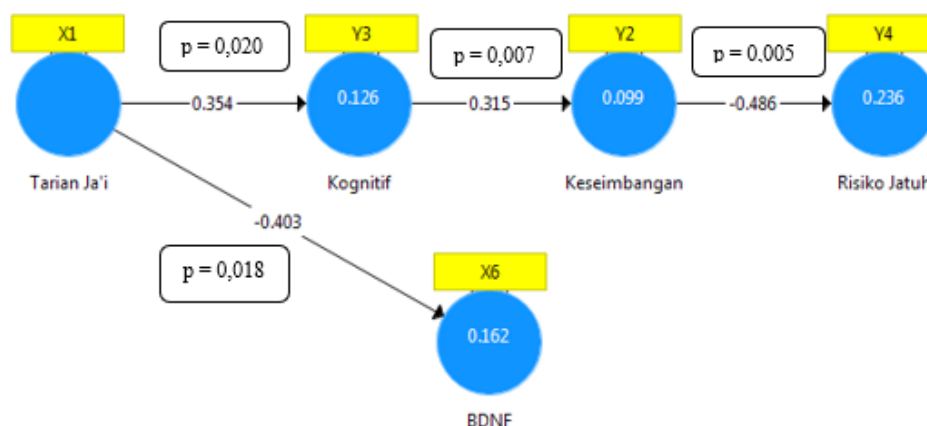


Figure 1. SEM-PLS analysis model.

Table 1. Results of path analysis regarding the relationship of Ja'i dance movement therapy with cognitive function, balance, fall risk, and BDNF levels.

Path Analysis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Balance → Fall Risk	-0.486	-0.472	0.173	2.809	0.005
Cognitive → Balance	0.315	0.312	0.115	2.731	0.007
Ja'i Dance → BDNF	-0.403	-0.410	0.169	2.380	0.018
Ja'i Dance → Cognitive	0.354	0.352	0.151	2.343	0.020

Ja'i dance and cognitive function are positively and significantly correlated, according to Table 1's data ($\beta = 0.354$; $t = 2.343$; $p = 0.020$). Additionally, there is a strong negative correlation between BDNF levels and Ja'i dance ($\beta = -0.403$; $t = 2.380$; $p = 0.018$). Additionally, balance is negatively and substantially correlated with fall risk ($\beta = -0.486$; $t = 2.809$; $p = 0.005$), while cognitive function is positively and significantly correlated with balance ($\beta = 0.315$; $t = 2.731$; $p = 0.007$). Overall, these findings show that there are significant correlations ($p < 0.05$) between all of the routes shown in the research model.

After the six-week Ja'i dance intervention, cognitive performance improved, according to the path analysis results ($\beta = 0.354$; $p = 0.020$). Thru the concurrent stimulation of physical, rhythmic, attentional, and social interaction aspects, dance-based therapies can improve cognitive performance. Continuous cognitive and sensorimotor stimulation is provided by the features of Ja'i dancing, which include repetitive motions, musical rhythm, direction changes, and motor coordination. This is consistent with earlier research showing the advantages of dance therapies for senior citizens' cognitive performance (Liu et al., 2021; Koch et al., 2019; Kareri et al., 2020; Hadi et al., 2020).

Additionally, equilibrium is positively and significantly impacted by cognitive performance ($\beta = 0.315$; $p = 0.007$). Integrating sensory data with appropriate motor responses—processes including cognitive abilities like attention and information processing—is necessary for maintaining balance. The Ja'i dance's motions, which include turning, walking forward and backward, and crossing steps, help improve spatial orientation and sensorimotor integration. Previous studies showing that balancing training can improve spatial memory and cognition provide credence to this (Laophosri et al., 2013; Rogge et al., 2017).

Additionally, balance significantly reduces fall risk ($\beta = -0.486$; $p = 0.005$), suggesting that better balance is linked to a decreased chance of falling. The Ja'i dance's repetitive and rhythmic execution of standing, walking, turning, and changing direction can

enhance dynamic balance, lower-limb muscle strength, and neuromuscular coordination. Therefore, enhancing one's ability to balance could help lower the likelihood of falls in older people.

The Ja'i dance demonstrated a significant negative effect on BDNF levels ($\beta = -0.403$; $p = 0.018$). BDNF responses to physical activity can be influenced by factors such as intensity, duration, exercise characteristics, and the timing of sample collection. Moreover, BDNF levels measured in peripheral circulation do not necessarily reflect BDNF activity within the central nervous system. Changes in peripheral BDNF levels may be linked to exercise adaptation processes and BDNF utilization in target tissues. Therefore, the negative association observed in this study cannot be directly interpreted as a negative impact of the Ja'i dance on neurological function. Such interpretation requires consideration of the complex nature of BDNF responses to physical exercise and the distinctions between peripheral and central responses (Dinoff et al., 2016; De la Rosa et al., 2014; Gholami et al., 2025).

Ja'i dance movement therapy significantly affects cognitive function and BDNF levels in the elderly, while also demonstrating an interrelationship between cognitive function, balance, and fall risk. These findings support the potential of Ja'i dance as a culture-based intervention for improving cognitive and physical function and reducing fall risk among the elderly.

Path analysis results reveal a relationship between Ja'i dance, cognitive function, balance, and fall risk. The positive impact of Ja'i dance on cognitive function—which in turn is linked to improved balance and reduced fall risk—demonstrates that the intervention's benefits extend beyond motor aspects to encompass cognitive dimensions. The characteristics of Ja'i dance—involving repetitive movements, musical and rhythmic stimulation, changes in movement direction, and body coordination—provide simultaneous stimulation to both cognitive and sensorimotor functions.

CONCLUSION

The SEM-PLS analysis results indicate that the mechanism by which Ja'i dance influences fall risk operates through a mediation pathway. Ja'i dance has a positive effect on cognitive function. Improved cognitive function, in turn, positively affects balance, and improved balance subsequently leads to a reduction in fall risk. Thus, the benefit of Ja'i dance in reducing fall risk is not direct; rather, it occurs through the enhancement of cognitive function, which subsequently improves the ability to maintain balance.

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