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The Effectiveness of Combined Hatha Yoga and Tandem Walking Exercise on Balance among Older Adults in Malang

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ABSTRACT

Introduction: Age-related declines in muscle strength, proprioception, and postural control contribute to balance impairment among older adults and increase the risk of falls. Non-pharmacological interventions, particularly structured physical exercise combining relaxation and balance training, have been recommended to improve balance performance. This study aimed to evaluate the effect of a combined Hatha Yoga and Tandem Walking Exercise program on balance among older adults in Malang. scores. **Methods:** A total of 21 older adults aged 60 years and above who met the inclusion criteria participated in the study. Participants underwent a combined Hatha Yoga and Tandem Walking Exercise program three times per week for four weeks. Balance ability was assessed using the Berg Balance Scale (BBS). Data were analyzed using a wilcoxon signed rank test to compare pre-test and post-test balance scores. **Results:** The results demonstrated a statistically significant improvement in participants' balance after the intervention. The mean balance score increased significantly following four weeks of exercise participation, BBS 38.57±4.6 to 44.24±3.6, with a p-value of 0.001 ($p < 0.05$). These findings indicate that the combined exercise program positively affected balance performance among the participants. **Conclusion:** In conclusion, the combination of Hatha Yoga and Tandem Walking Exercise was effective in improving balance ability among older adults after four weeks of intervention. This program may serve as a safe and beneficial non-pharmacological approach to support balance enhancement and fall prevention in the elderly population.

Keywords: *Aged, Balance, Tandem, Walking, Yoga*

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INTRODUCTION

Population aging has become a global public health issue, including in Indonesia, where the proportion of older adults continues to increase each year. Aging is associated with physiological changes such as decreased muscle strength, impaired proprioception, reduced sensory function, and declining neuromuscular coordination, all of which contribute to balance impairment and an increased risk of falls among older adults. Falls are a major concern in the elderly population because they may lead to fractures, reduced mobility, loss of independence, and decreased quality of life (Vaishya & Vaish, 2020) (Giovannini et al., 2022) Balance impairment in older adults is closely linked to degeneration of vestibular, visual, and proprioceptive systems along with declining musculoskeletal function; as balance declines, individuals become more vulnerable to postural instability during both static and dynamic activities (Wang et al., 2022).

Evidence also suggests that specific balance tests and screening tools can help predict

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fall risk or guide interventions findings reported in longitudinal or clinical studies on standing balance tests and tandem stance assessments (Cristina et al., 2024) (Joo et al., 2022). Therefore, physiotherapy interventions focusing on balance training are widely recommended to improve functional ability and reduce fall risk.

Physiotherapy interventions focused on balance training are widely recommended to prevent falls and improve functional ability, and meta-analyses and reviews have documented positive effects of physical exercise on balance and fall prevention in older adults (Papalia et al., 2020). Among such interventions, Hatha Yoga integrates postures, breathing techniques, and relaxation to improve flexibility, muscle strength, proprioception, and postural control, while Tandem Walking Exercise narrows the base of support to challenge postural stability, thus enhancing dynamic balance and neuromuscular coordination.

Although these interventions have shown Although previous studies have demonstrated the effectiveness of Hatha Yoga and Tandem Walking Exercise individually, evidence regarding the combined effect of these two interventions remains limited, particularly among older adults in the Indonesian context. Existing local studies have mainly focused on general physical activity and community-based exercise programs rather than specific combined balance interventions Agustiningrum et al., (2023) and others highlight relationships between physical activity or community-based programs and fall risk, reinforcing the need for effective, context-specific strategies.

Therefore, this study addresses the gap in evidence regarding the effectiveness of combining Hatha Yoga and Tandem Walking Exercise as a physiotherapy intervention to improve balance among older adults. It aims to evaluate such a combined program's effectiveness in enhancing balance and reducing fall risk in older adults in Malang City, thereby offering practical insights for prevention efforts tailored to the local context.

METHODS

This study used an pre-experimental research design with a one-group pre-test and post-test approach. Aiming to evaluate the changes in balance ability among older adults before and after implementing a combined intervention of Hatha Yoga and Tandem Walking Exercise. Informed consent was obtained from all participants involved in the study. Purposive sampling was used to select the participants, namely older adults aged 60 years and above, with no indication of cardiovascular and neuromuscular disorders, and agree to participate in the study. A total of 21 older adults aged 60 years and above who met the inclusion criteria participated in the study. By focusing on this age group, the study aligns with previous research that emphasizes the importance of addressing balance impairment and fall risk among older adults, which is widely recognized as a serious health concern in this population. This study received ethical approval from the Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Malang (Registration No. E.4.d/100/KEPK/FIKESUMM/VIII/2025).

Participant confidentiality and research ethics were maintained throughout the study. All participants provided informed consent prior to participation, and confidentiality as well as participants' rights were fully protected throughout the research process.

The research was conducted at Panti Rahayu Clinic in Malang, Indonesia, from August to October 2025. All participants received 4 weeks interventions of Hatha Yoga followed by Tandem Walking Exercise. The researcher was assisted by 3 physiotherapist whose duties were to conduct history taking, measure balance before and after the intervenition, provide tandem walking intervention and 1 yoga instructor to provide hatha yoga intervention which had been brifed by the researcher beforehand in accordance with the standard operating procedures. The outcome measure for this study used Berg Balance Scale to measure the balance of the participants. The BBS is a widely used clinical tool comprising functional tasks that assess both static and dynamic balance; it provides a total

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score that reflects overall balance performance. The BBS consists of 14 functional tasks assessing static and dynamic balance, with a total score ranging from 0 to 56. Measurements were taken before the intervention (pre-test) and after four weeks of exercise intervention (post-test). The intervention was administered three times per week, with each session lasting approximately 30–45 minutes. Each session combined Hatha Yoga elements postures, breathing, and relaxation aimed at improving flexibility, strength, proprioception, and postural control with Tandem Walking Exercise, which narrows the base of support to challenge stability and neuromuscular coordination. Previous literature underscores the role of structured physical exercise in improving balance and reducing fall risk, providing a rationale for the chosen intervention format (Papalia et al., 2020). Statistical analysis using SPSS 25.0. In this study, a normality test was carried out used Saphiro Wilk Test and it was found that the data was not normally distributed, furthermore, the analysis was continued using a non-parametric test, the Wilcoxon signed rank test. The statistical significant set at 0.05.

RESULTS

A total of 21 participants aged above 60 years old became respondents in this study.

Table 1. Characteristics of Participants (n = 21)

		N%	Mean± Sd
Gender	Male	6 (28.6%)	-
	Female	15 (71.4%)	-
Age (yr)	Pre-elderly	3 (15.3%)	58.00 ± 0.00
	Young elderly	11 (52.4%)	63.82 ± 2.316
	Middle elderly	3 (14.3%)	73.50 ± 3.000
	Old elderly	4 (19.0%)	82.67 ± 1.155
BMI (kg/m^2)	Underweight	3 (14.3%)	16.33 ± 1.528
	Normal	11 (52.4%)	21.64 ± 1.362
	Overweight	4 (19.0%)	25.75 ± 0.500
	Obese	3 (14.3%)	36.00 ± 4.583
Fall History	Yes	15 (66.67%)	-
	No	6 (33.33%)	-
Medical History	Diabetes mellitus	8 (38.1%)	-
	Hypertension	7 (33.3%)	-
	Others	3 (14.3%)	-
	None	3 (14.3%)	-
Pretest BBS		21(100%)	38.57 ± 4.632
	Moderate balance	16 (76.19%)	36.44 ± 2.500
	Good Balance	5 (23.16%)	45.40 ± 2.700

*yr: year; kg: kilograms; m: metres; sd: Standard Deviation; BMI: Body Mass Index; BBS: Berg Balance Scale

The characteristics of the participants presented at the table1; the majority of respondents were women (71.4%), while men accounted for 28.6%. The age distribution shows that more than half of the respondents were in the young elderly category (52.4%) with an average age of 63.82 years (SD 2.32), while the old elderly group had an average age of 82.67 years (SD 1.16). Body mass index results show that most respondents had a normal BMI (52.4%; average = 21.64; SD = 1.36), with a smaller proportion in the underweight (14.3%) and obese (14.3%) categories. Fall history shows that most respondents (66.7%) had a history of falling. Based on medical history, most respondents suffered from diabetes mellitus (38.1%) or hypertension (33.3%). Balance assessment before intervention using the Berg Balance Scale showed an average score of 38.57 (SD 4.63), with the majority of respondents (76.19%) in the moderate balance category and the rest (23.16%) in the good balance category.

Balance ability of participants was measured using the Berg Balance Scale (BBS) prior to the intervention (pre-test) and after four weeks of intervention (post-test). Descriptive analysis showed an increase in the mean BBS score following the intervention.

Prior to inferential analysis, normality testing was conducted. Based on the normality test results, the data were not normally distributed. Therefore, to conclude, the research

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data were not fully normally distributed and therefore non-parametric statistical tests were used for the subsequent analysis (Sari et al., 2024).

Table 2. Normality Test (n = 21)

	Asymp sig 2 tailed
BBS Pre	0.035
BBS Post	0.512

*Data presented as Asym sig 2 tailed Saphiro Wilk Test for to test the normality of data distribution.

Based on the results of the normality test used Saphiro-Wilk Test results showed a significant value of 0.035 < 0.05 indicating that the data was nor normaly distributed. Therefore, the effectiveness test must be conducted using the Wilcoxon Signed Rank Test at a significant level 0.05.

Table 3. Analysis of differences in Balance score before and after the intervention (n = 21)

	Min	Max	Mean±SD	Asymp sig 2 tailed
BBS Pre	25	40	38.57±4.6	0.000*
BBS Post	34	52	44.24±3.6	

Data presented as Mean ± SD; Minimum Score and Maximum Score of BBS; Wilcoxon signed Rank Test comparing pre and post intervention
*Significant different: SD: Standard Deviation, BBS: Berg Balance Scale

The table shows that the average BBS score increased from 38.57 before the intervention to 44.24 after the intervention. This improvement in balance ability is consistent with broader findings in the literature that structured physical exercise can enhance balance performance and help prevent falls among older adults (Papalia et al., 2020).

Based on the Wilcoxon test results, a significance value of 0.001 was obtained, which is less than 0.05. This finding is consistent with the broader literature suggesting that structured physical exercise programs can improve balance and reduce fall risk among older adults (Arik et al., 2023).

The distribution of balance categories based on BBS classification showed a shift from moderate balance category to good balance category after the intervention. Such shifts echo findings from studies that observe functional improvements following targeted balance or mobility interventions in older populations, reinforcing the practical relevance of the programme approach used here (Cohen, 2023)(Joo et al., 2022).

DISCUSSION

The present study found most participants in this study were classified as young-old adults (60–69 years), and the majority of the participants were women (71.4%). The participants reported to have normal BMI average 21 kg/m2 (52.4%). In this study, 66.7% of participants had a history of falls, followed by the results of the examination using the BBS, showing that 76.19% of participants were reported in the moderate balance category and the remaining 23.16% had good balance.

This distribution is commonly observed in community-based elderly studies, as individuals in this age group generally retain better functional capacity and mobility compared to older-old adults (Agustiningrum et al., 2023;Ahmad et al., 2024). Age-related physiological changes, including reductions in muscle strength, proprioception, and neuromuscular coordination, begin to appear more prominently after the age of 60 and progressively worsen with advancing age (Akbar et al., 2021). Therefore, interventions that require active participation, such as Hatha Yoga and Tandem Walking Exercise, are more feasible and safely implemented among young-old adults who still possess sufficient physical endurance and balance capacity (Alifah et al., 2024).

The majority of participants in this study were female. Demographic trends showing a higher proportion of older women compared to men due to longer life expectancy among females (Alita et al., 2021). In addition, older women tend to demonstrate greater participation in health promotion programs and community-based physical activities, including exercise interventions, compared to their male counterparts (Alman & Rini, 2025). Hormonal changes after menopause, particularly reduced estrogen levels, have been associated with

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declines in muscle mass and postural stability, which may increase balance impairment and fall risk in older women (Amira et al., 2023). Consequently, female older adults represent a key target population for balance-focused physiotherapy interventions.

Most participants had a normal Body Mass Index (BMI). Maintaining an ideal or slightly higher BMI in older adults has been associated with better muscle reserves and functional performance, which supports balance and mobility (Arib et al., 2024). Underweight older adults are more likely to experience muscle weakness and postural instability, while severe obesity may impair movement efficiency and balance control (Arifiati et al., 2024). Therefore, the predominance of participants with normal BMI in this study may have contributed positively to their responsiveness to balance training interventions.

A history of falls is a common condition among older adults and contributes to an increased risk of balance disorders. The aging process causes a decline in multisystem function, including the musculoskeletal, sensory, visual, and vestibular systems, which collectively affect postural control (Barı, 2019). Older adults with a history of falls often experience a decline in self-confidence, which limits physical activity, ultimately accelerating muscle strength and coordination decline and increasing the risk of recurrent falls (Vaishya & Vaish, 2020). Slowed neuromuscular responses and impaired sensory integration in older adults with a history of falls increase their vulnerability to falling again, making exercises that emphasize postural control, lower extremity strength, and coordination essential (Ahmad et al., 2024).

Many participants had chronic conditions such as hypertension and diabetes mellitus, which are highly prevalent among older adults (Arik et al., 2023). These conditions are known to affect balance through mechanisms such as peripheral neuropathy, reduced muscle strength, and impaired sensory integration (Bakar et al., 2021). Despite the presence of comorbidities, participants were still able to safely engage in the combined Hatha Yoga and Tandem Walking Exercise program, indicating that this intervention is feasible and applicable for older adults with controlled chronic diseases.

Present study shows a positive short-term effect of combined hatha yoga and tandem walking exercise on increasing balance in the older adults in Malang. Hatha Yoga is a type of exercise that integrates body position (asanas), breathing techniques (pranayama), and meditation, aimed at improving flexibility, muscle strength and balance (Kasse et al., 2014). While, tandem walking exercise is a form of walking exercise in which one foot is placed directly in front of the other, creating a narrow pivot point and testing the body's balance. This program is specifically designed to improve postural control and reduce the risk of falls in older adults(Pérez-De La Cruz, 2021).

Improved balance achieved through Hatha Yoga occurs through enhanced proprioception, the body's ability to detect position and movement of body parts. The various movements in yoga require a high degree of stability control, which in turn strengthens the core muscles and improves coordination between the central nervous system and the muscles that support balance. Furthermore, the breathing techniques used in yoga serve to reduce anxiety levels, which can often trigger instability in older adults (Elangovan et al., 2020). Participate in yoga programs for older adults can significantly reduce the frequency of falls by improving the ability to maintain a balanced standing posture.

The Hatha Yoga and Tandem Walking Exercise interventions in this study showed a positive effect on the balance of older adults, as indicated by an increase in Berg Balance Scale (BBS) scores after 4 weeks of intervention. This improvement is related to the frequency of regular exercise three times per week, which is important for triggering stable neuromuscular adaptation in the elderly, given that muscle strength, proprioception, and vestibular response decline more rapidly in the elderly (di Fronso et al., 2021).

The application of a dropout rule for participants who did not attend training consecutively was implemented to maintain the

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validity of the intervention results. Repeated absences have the potential to eliminate the cumulative effects of training, so that the post-test results do not fully reflect the effects of the intervention provided. Physical interventions in the elderly must be carried out regularly so that neuromuscular adaptation can be maintained (Prastowo et al., 2020).

Physiologically, Hatha Yoga plays a role in improving static balance through core muscle strengthening, increased proprioception, and breath control that supports postural stability. This exercise has been proven to improve balance control and body awareness in older adults (di Fronso et al., 2021).

Meanwhile, Tandem Walking Exercise trains dynamic balance by narrowing the base of support, thereby activating the vestibular, visual, and somatosensory systems to maintain posture during movement. This exercise effectively improves coordination and response to balance disturbances (Setyawan et al., 2022).

The combination of static and dynamic exercises provides more comprehensive neuromuscular stimulation, resulting in more effective coordination between muscle groups and the body's compensatory response to balance disturbances (Wang et al., 2022;Ghasemikaram et al., 2021). Static exercises contribute to improved postural control and basic stability, while dynamic exercises enhance the body's ability to adapt to changes in position and shifts in the center of gravity. These findings are supported by research showing that the ability to maintain tandem stance and perform tandem walking is closely related to postural stability and the risk of falling in older adults, where a decline in ability in both tasks reflects impaired sensorimotor integration (Looney et al., 2023;Joo et al., 2022;Tavares et al., 2024). Therefore, exercises that combine both approaches are considered more effective in improving the elderly's physical readiness to respond to balance disturbances and reducing the risk of falls.

This study has several limitations that need to be considered so that the interpretation of the results remains in a proportional context. First, the research design without a control group means that the changes in balance that occurred after the intervention cannot be compared with a group that did not receive the treatment, so the causal relationship between the intervention and the improvement in balance cannot be fully confirmed. Second, the relatively limited sample size may affect the strength of the statistical analysis and limit the generalization of the research results to a broader elderly population with diverse characteristics.

In addition, the relatively short duration of the intervention did not allow for observation of long-term physiological adaptations or the sustainability of the effects of exercise after the intervention was stopped. External factors such as daily physical activity levels, medication use, comorbidities, and participants' eating habits could not be fully controlled, potentially affecting individual responses to exercise and the balance outcomes obtained. Another limitation relates to the use of a single primary measurement instrument, which, although valid and reliable, does not fully describe all aspects of balance and fall risk in older adults. Therefore, the results of this study should be interpreted with caution and used as a starting point for further research with stronger designs and controls.

CONCLUSION

This study concludes that the combined Hatha Yoga and Tandem Walking Exercise intervention is effective in improving balance among older adults in Malang City, as evidenced by a significant increase in Berg Balance Scale scores following the intervention, indicating enhancements in both static and dynamic balance abilities. These findings directly address the research problem and confirm the study objective, demonstrating that the integrated exercise program can serve as an effective physiotherapy strategy to improve balance performance and potentially reduce fall risk in the elderly population. Based on these results, the combined intervention is recommended for implementation in both community and clinical settings as part of routine balance training programs for older adults, with physiotherapists and health practitioners encouraged to adopt this approach.

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Furthermore, future research is recommended to involve larger sample sizes, incorporate control group designs, extend intervention durations, and explore the integration of technological support such as digital exercise guidance, wearable balance monitoring devices, or tele-rehabilitation platforms to enhance accessibility, adherence, and overall effectiveness of balance training programs for older adults in the community.

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