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Effect of Elderly Exercise on Visual Coordination in Straight Walking: A Pre-Experimental Study

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Abstract

Background: Aging is associated with progressive declines in musculoskeletal and sensorimotor functions, leading to impaired balance, slower reaction time, and increased fall risk. Elderly exercise is commonly recommended to maintain functional ability and mobility in older adults.

Objective: To determine the effect of elderly exercise on visual coordination during straight walking among older adults aged 60–65 years.

Methods: A pre-experimental one-group pretest–posttest study was conducted among 20 older adults recruited through purposive sampling. Participants completed an elderly exercise program twice weekly for four weeks. Visual coordination was assessed using the Human Benchmark Reaction Time Test, while walking performance was measured using the 4-Meter Walking Test. Data were analyzed using paired-sample t-tests with a significance level of $p<0.05$.

Results: Significant improvements were observed following the intervention. The mean difference in 4-Meter Walking Test performance was 2.56 seconds (95% CI: 2.20–2.92; $t=14.85$; $p<0.001$). Visual reaction time improved by 325.50 ms (95% CI: 186.88–464.12; $t=4.92$; $p<0.001$). Reaction time improved by 23.24%, while walking performance improved by 30.36% after four weeks of elderly exercise.

Conclusion: Elderly exercise significantly improves visual coordination and walking performance in older adults. Regular participation in elderly exercise may serve as an effective physiotherapy strategy to enhance dynamic balance and reduce fall risk among community-dwelling older adults.

Keywords
Aged, Exercise Therapy, Postural Balance, Psychomotor Performance, Visual Perception

Introduction

Aging is an inevitable natural process characterized by a decline in physiological functions across multiple body systems. Older adults over the age of 60 commonly experience musculoskeletal, neurological, and sensorimotor changes, leading to impaired motor coordination, balance disturbances, and an increased risk of falls.[1,2] These conditions not only reduce quality of life but also contribute to higher morbidity and mortality rates in the elderly population.

Balance is a fundamental ability required for daily activities, both in static and dynamic conditions. Declines in balance are often influenced by reduced lower-limb muscle strength, impaired visual coordination, and postural changes caused by degenerative processes.[3,4] Several studies have reported that decreased muscle strength and impaired visual coordination significantly increase the risk of falls, resulting in mobility limitations and loss of independence among older adults.[5,6]

One important indicator of dynamic balance is the ability to walk in a straight line. The tandem walking test provides valuable insight into lateral postural stability, which is closely associated with fall risk.[7] Furthermore, effective visual coordination is essential since nearly all functional daily activities depend on the interaction between visual and motor systems.[8] Declines in visual coordination may cause delayed motor responses, thereby increasing the likelihood of falls in older adults.[9]

A structured physical activity intervention, such as elderly exercise, can be an effective approach to reduce these risks. Elderly exercise is simple, accessible, and safe, incorporating movements such as warm-up, stretching, breathing exercises, and cool-down. This form of exercise has been shown to improve muscle strength, maintain joint flexibility, enhance visual coordination, and promote better balance.[10,11] Evidence also indicates that older adults who regularly participate in elderly exercise experience significant improvements in visual reaction time and straight walking ability, ultimately contributing to fall prevention.[12,13]

Based on this background, the present study was conducted to analyze the effect of elderly exercise on visual coordination during straight walking in older adults aged 60–65 years. The findings are expected to provide a meaningful contribution to the development of physiotherapy interventions aimed at improving quality of life among the elderly.

Methods

This study employed a pre-experimental design with a one-group pre-test–post-test approach, without a control group or random allocation. The research was conducted in Banjar Peninjoan, Peguyangan Kangin Village, North Denpasar, from June 25 to July 25, 2025. Participants were recruited using purposive sampling based on predetermined inclusion and exclusion criteria. The total population was 50 older adults, from which a sample of 20 participants was selected. No power analysis was performed; therefore, the study was exploratory in nature.

Inclusion criteria were as follows: (a) older adults aged 60 years and above, (b) able to perform daily activities independently, (c) normal vital signs at baseline, and (d) willingness to participate after signing informed consent. Exclusion criteria included: (a) postural abnormalities (kyphosis, lordosis, or scoliosis), (b) musculoskeletal disorders such as history of injury or falls, and (c)

neurological disorders such as Parkinson's disease or neuropathies. No changes to inclusion, exclusion, or intervention procedures were made during the study.

The intervention consisted of *Senam Sehat Lansia* (Elderly Health Exercise), a structured physical activity program developed by the Rehabilitation Medicine Team of Wava Husada Hospital. The exercise included warm-up, core movements (head, shoulder, arm, and leg exercises), and cool-down, with integrated breathing and concentration techniques. Exercises were performed at low intensity for safety, with each movement completed in 2 × 8 counts. Modifications were applied to slow the pace, ensuring feasibility for all participants. Sessions were conducted twice weekly for four weeks (16:00–17:00 WITA) at the Banjar Peninjoan community hall, supervised by physiotherapists.

All measurements were performed by the same evaluator to minimize inter-rater bias. Assessments were conducted at baseline (pre-test) and immediately after the four-week intervention (post-test). Visual coordination was measured using the Human Benchmark Reaction Time Test, and gait performance was assessed using the 4-Meter Walking Test. No changes were made to the outcome measures after the study commenced.

Data were analyzed using SPSS with the following steps: (1) normality testing, (2) hypothesis testing using paired-sample t-tests, and (3) statistical significance set at $p < 0.05$. No subgroup or additional analyses were conducted. Missing data were handled using a per-protocol analysis approach. The study protocol was approved by the Ethics Committee of Universitas Dhyana Pura (No. 002928/KEP/Universitas Dhyana Pura/2025), ensuring compliance with ethical principles for human research.

Results

A total of 20 older adults aged 60–65 years from Banjar Peninjoan, Peguyangan Kangin, North Denpasar were recruited between June 25 and July 25, 2025. Follow-up was completed by the end of July 2025, and no participants discontinued the study early. All participants completed both pre-test and post-test assessments, with no dropouts reported.

At the first meeting, participants provided written informed consent after being informed about the study procedures. Those meeting the inclusion and exclusion criteria were enrolled. The participant flow diagram is presented in Figure 1.

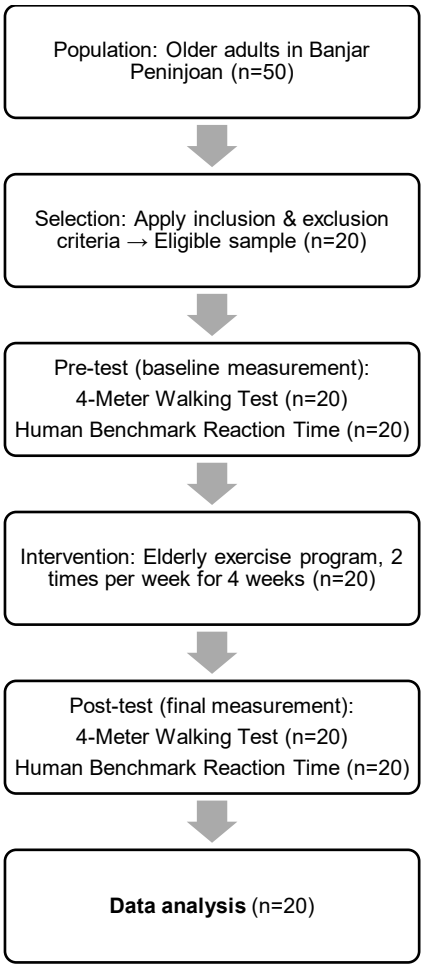

Figure 1. Participant Flow Diagram

At baseline, participants underwent measurement of vital signs, body weight, and height. Functional assessments included the 4-Meter Walking Test for gait performance and the Human Benchmark Reaction Time Test, repeated three times and averaged to evaluate visual coordination. Following baseline assessments, participants underwent a four-week intervention consisting of elderly exercise guided by the Rehabilitation Medicine Team of Wava Husada Hospital. Sessions were held twice weekly and focused on light, safe movements to improve flexibility, muscle strength, and balance, while also promoting motivation, social interaction, and well-being. No subgroup or additional analyses were performed. The demographic distribution of participants is shown in Table 1 and Table 2.

Table 1. Distribution of Participants by Sex

Sex	Frequency	Percentage
Male	4	20%
Female	16	80%
Total	20	100%

Table 2. Distribution of Participants by Age

Age (years)	Frequency	Percentage
60	2	10%
62	3	15%
63	1	5%
64	5	25%
65	9	45%
Total	20	100%

Results of the paired-sample t-test analysis are presented in **Table 3**.

Table 3. Results of Paired-Sample t-Test

Variables	Mean ± SD	95% CI of Difference	t	df	p-value
Pre- vs. Post-Test (4-Meter Walking Test)	2.56 ± 0.77	2.20 – 2.92	14.85	19	0.000
Pre- vs. Post-Test (Reaction Time Test)	325.50 ± 296.18	186.88 – 464.12	4.92	19	0.000

The mean difference in straight walking time between pre-test and post-test was 2.56 seconds (95% CI: 2.20–2.92, $p < 0.001$). For visual reaction time, the mean improvement was 325.50 ms (95% CI: 186.88–464.12, $p < 0.001$).

These findings demonstrate a significant improvement in gait speed and a significant reduction in reaction time following four weeks of elderly exercise intervention ($p < 0.05$). This supports the hypothesis that *Senam Lansia* conducted by the Rehabilitation Medicine Team of Wava Husada Hospital positively influenced visual coordination during straight walking in older adults aged 60–65 years in Banjar Peninjoan, Peguyangan Kangin, North Denpasar.

Discussion

This study involved 20 older adults aged 60–65 years with a predominance of female participants. No control group was included. The elderly exercise intervention carried a low risk of minor injury or fatigue. At baseline, all participants were categorized as having a moderate risk of falling. These findings are consistent with the literature showing that beginning at age 60, individuals typically experience physiological decline, particularly in musculoskeletal and cognitive systems, resulting in reduced muscle elasticity, strength, visual coordination, and reaction time.[14,15]

Following the intervention program of elderly exercise guided by the Rehabilitation Medicine Team of Wava Husada Hospital, the paired-sample t-test demonstrated a significant improvement in dynamic balance. The mean pre-test score from the 4-Meter Walking Test was 22.67 m/sec, compared with 20.26 m/sec post-test. The p-value obtained was 0.000 ($p < 0.05$), indicating a statistically significant difference between pre- and post-intervention values. This suggests that the elderly exercise program effectively improved visual coordination in straight walking among older adults.

The application of elderly exercise demonstrated clear benefits for dynamic balance, fall risk reduction, and lower-limb muscle strength. This aligns with previous findings showing that elderly exercise improves gait and decreases the incidence of falls in older adults.[8] Supportive evidence also indicates that structured exercise enhances postural balance through regular muscle contraction, thereby slowing muscular degeneration.[16]

Similar results were reported by another study in which the proportion of older adults with good dynamic balance increased from 20% to 40% following exercise interventions.[15] This reflects improvements in muscle strength, maximal contraction, and endurance, all of which support independence in daily activities. In addition, a community-based intervention demonstrated an increase in the proportion of older adults with good balance from 68.6% to 74.3% after elderly exercise sessions.[17]

Other studies reinforce these findings, emphasizing that aging is associated with a decline in muscle strength, elasticity, flexibility, and reaction time, all of which contribute to increased fall risk. Physical fitness components, both skill-related and health-related—including coordination, balance, and reaction time—are strongly influenced by regular physical activity.[18] Importantly, our findings revealed a significant improvement in visual reaction time following exercise intervention. This highlights the essential role of visual coordination in straight walking performance, beyond its contribution to postural balance. Faster visual reaction times reflect enhanced integration of the sensorimotor system, where visual stimuli are more efficiently processed and translated into timely motor responses.[19]

Improved visual reaction time has important implications for fall prevention. Older adults with slower reaction times are more likely to experience delays in anticipating environmental changes, such as uneven surfaces or walking obstacles, which increases fall risk. Conversely, enhanced reaction times contribute to faster and more effective motor responses to potential hazards, thus reducing fall risk.[19]

In addition to balance improvements, this study demonstrated a significant enhancement in reaction speed following intervention. Prior research confirms that physical activity, including aerobic low-impact exercise, preserves muscle and connective tissue elasticity, thereby improving reaction time and postural stability.[20] At the study site, participants also reported perceived benefits such as improved fitness, reduced musculoskeletal discomfort, and enhanced motivation and social interaction, suggesting that elderly exercise is a feasible and beneficial promotive-preventive strategy.

This study has several limitations. First, the intervention included only one type of exercise, namely elderly exercise guided by the Rehabilitation Medicine Team, making it difficult to isolate its specific effects compared to other modalities such as tai chi, yoga, or resistance training. Second, the relatively small sample size ($n = 20$) may limit statistical power. Third, the four-week intervention period may not fully capture the long-term effects of elderly exercise on dynamic balance. Fourth, the use of the Human Benchmark application for reaction time assessment may be subject to technical variability. Finally, all assessments were conducted by a single evaluator, which could introduce measurement bias.

The findings of this study are applicable to older adults aged 60–65 years, particularly in urban communities with access to health facilities. However, broader generalization should be made cautiously, as factors such as environment, nutrition, and habitual physical activity may influence outcomes. Nevertheless, the elderly exercise program is practical, low-cost, and safe, making it a promising promotive and preventive strategy for older adult populations.

The results of this study strengthen the theory that regular physical activity can slow degenerative processes in older adults. The significant improvement in dynamic balance observed after intervention suggests that elderly exercise stimulates neuromuscular function, enhances muscle strength, and improves visuomotor coordination. These findings are consistent with previous reports emphasizing the role of physical activity in maintaining cognitive and motor function in older adults. Furthermore, elderly exercise also contributes to mental health by increasing self-confidence and social participation, indirectly supporting fall prevention and improving overall quality of life in late adulthood.

Conclusion

Based on the findings of this study, the elderly exercise program implemented in collaboration with the Rehabilitation Medicine Team of Wava Husada Hospital over a 4-week period demonstrated a positive effect on improving visual coordination in straight-line walking among older adults aged 60–65 years in Banjar Peninjoan, Peguyangan Kangin, North Denpasar. A total of 20 participants were included as study subjects. Elderly exercise can therefore be recommended as a routine program to maintain or enhance visual coordination in older adults. Collaboration between healthcare facilities and community organizations is essential to ensure the sustainability of such programs.

This study has certain limitations. One major limitation was the lack of control over participants' daily activities, which may have influenced the outcomes. Future research should employ a longitudinal design to evaluate the long-term effects of this intervention. Furthermore, including a control group would provide a more robust comparison for assessing the effectiveness of the elderly exercise program delivered by the Rehabilitation Medicine Team of Wava Husada Hospital.

Author Contributions

I Putu Risa Pradnya Dipa: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing Original Draft Preparation
I Gede Arya Sena: Supervision, Methodology, Validation, Writing Review and Editing
Ni Luh Made Reny Wahyu Sari: Investigation, Resources, Data Curation, Writing Review and Editing
Ni Putu Dwi Larashati: Formal Analysis, Visualization, Writing Review and Editing

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Conflict of Interest Statement

The authors declare no conflicts of interest related to this study.

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Ethics Statement

This study was approved by the Ethics Committee of Universitas Dhyana Pura (No. 002928/KEP/Universitas Dhyana Pura/2025). Written informed consent was obtained from all participants before enrollment.

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