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The Impact of Ankle Strategy Training on Improving Dynamic Balance Performance in Individuals

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ABSTRACT

The decline in dynamic balance among the elderly is a critical health issue because it substantially increases the risk of falls, injuries, and loss of functional independence, largely due to age-related decreases in muscle strength, coordination, and postural control. This study aimed to examine the effect of ankle strategy exercises on the dynamic balance of elderly individuals, using a pre-experimental one-group pretest–posttest design. A total of 33 elderly participants were selected through purposive sampling, and dynamic balance was measured using the Timed Up and Go Test (TUGT) as an indicator of mobility and fall risk. The results of the Wilcoxon signed-rank test showed a statistically significant improvement in dynamic balance following the intervention ($\rho = 0.000 < 0.05$), indicating the effectiveness of ankle strategy exercises. Although the absence of a control group and the relatively small sample size limit causal inference and generalizability, these exercises represent a simple, low-cost, and feasible intervention that can be implemented in both institutional and community-based elderly care programs. Future studies are recommended to involve larger samples, include control groups, and conduct long-term follow-up to strengthen evidence for fall prevention and geriatric rehabilitation.

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Introduction

Old age is the final stage of the human life cycle, an unavoidable period during which individuals undergo various physical and mental changes that greatly affect their quality of life. One of the main changes that occur in the elderly is the decline in muscle strength and motor function of the body. This happens due to the aging process, which causes muscle atrophy, a decrease in muscle fiber number, and the accumulation of fatty tissue, which affects the body's ability to maintain balance (Pabla et al., 2024). This process leads to a reduced ability of the body to respond quickly to postural changes, thereby increasing the risk of falls in the elderly.

Data from the World Health Organization (WHO) shows that around 28-35% of people aged 65 and older fall each year, with the rate rising to 32-42% for those aged 70 and above. Falls in the elderly not only pose a risk of minor injuries but can also lead to serious injuries such as fractures, broken bones, or even permanent disabilities that affect their independence. Furthermore, falls can result in significant psychological trauma, increasing the fear of falling (fall phobia), and decreasing the overall quality of life for the elderly (Susiana Nugraha, 2020).

Balance disorders in the elderly are commonly associated with age-related declines in lower extremity muscle strength, particularly in muscles crucial for postural stabilization such as the gastrocnemius and tibialis anterior (Kim et al., 2022). Dynamic balance refers to the ability to maintain postural stability while the body is in motion or transitioning between positions, a function that relies on effective interaction between musculoskeletal strength, sensory input, and neural control mechanisms. With advancing age, reductions in muscle power, delayed neuromuscular responses, diminished peripheral nerve function, and alterations in central nervous system processing impair sensory motor integration and postural control, resulting in slower and less effective responses to balance disturbances (Arsal et al., 2023). Within postural control theory, ankle strategy represents a fundamental mechanism used to correct small, slow perturbations by generating torque at the ankle joint to realign the center of mass over the base of support. Ankle strategy exercises specifically target this mechanism by strengthening ankle musculature and enhancing proprioceptive feedback, thereby improving the efficiency of sensory motor integration and postural adjustments (Hou, 2023). Consequently, these exercises play a critical role in counteracting age-related declines in muscle function and postural responsiveness, contributing to improved dynamic balance and reduced instability during standing and walking in elderly individuals.

The phenomenon of decreased dynamic balance in the elderly is further worsened by a sedentary lifestyle. Elderly individuals who do not regularly engage in physical activity have poorer balance compared to those who are physically active (Duhita et al., 2020). Regular physical activity has been proven to improve dynamic balance in the elderly by enhancing muscle strength, coordination, and postural response. Therefore, one of the interventions that can be implemented to address this balance issue is an exercise that stimulates the ankle muscles and improves postural stability.

Ankle Strategy Exercise is a postural-control exercise that emphasizes controlled ankle joint movement to maintain balance during postural sway and functional transitions (Su et al., 2024). This exercise primarily activates the gastrocnemius, soleus, and tibialis anterior muscles to stabilize the center of mass over the base of support during standing and movement (Hadi Endaryanto et al., 2023). By improving distal lower-limb strength and ankle-control responsiveness, ankle strategy exercises are expected to enhance dynamic balance and reduce fall risk in older adults. Evidence from (Ariyanti et al., 2022) demonstrated that regular practice of ankle strategy based exercises was associated with a substantial reduction in fall risk among the elderly. Nevertheless, recent literature places ankle strategy exercises within a broader range of balance interventions, such as multimodal balance training, lower-limb strength and power training, Tai Chi, the Otago Exercise Program, and perturbation-based (reactive) balance training, many of which have shown positive effects on balance and functional mobility in older populations.

Despite generally positive findings, the literature also reveals conflicting results and ongoing debates regarding the most effective approach for fall prevention. Several reviews suggest that while ankle-focused exercises improve ankle stability and specific balance parameters, their direct impact on actual fall incidence remains inconsistent compared with interventions that include reactive or task-specific balance components. Tai Chi and structured programs like the Otago Exercise Program are often reported to improve balance and reduce falls, yet their effectiveness varies depending on training intensity, duration, and participant characteristics (Yang et al., 2022). Similarly, perturbation-based balance training is considered promising for improving reactive balance, but studies report heterogeneous outcomes due to differences in protocols and outcome measures. These inconsistencies highlight the complexity of balance control in the elderly and indicate a gap in the literature regarding the comparative

effectiveness and optimal application of ankle strategy exercises, thereby justifying further investigation.

In Indonesia, with the growing number of elderly individuals, health problems related to balance have become an increasingly important issue. According to data from the Central Statistics Agency (BPS), the number of elderly individuals in Indonesia reached 10.82% of the total population in 2021, or about 29.3 million people. This figure is expected to continue to rise as life expectancy increases. The growing number of elderly individuals is also accompanied by a rise in the prevalence of balance disorders and the risk of falls, particularly among those living in social welfare homes (Srianingsih, 2024). Therefore, it is important to find and implement effective methods to address these issues.

Elderly Social Welfare Centers (Pusat Pelayanan Sosial Lanjut Usia/PPSLU) are a key component of elderly care in Indonesia, providing support for older adults who experience functional limitations in daily life. At PPSLU Turusgede Rembang, preliminary observations revealed that many residents suffer from balance disorders, leading to decreased dynamic balance and difficulties in activities such as walking and prolonged standing, thereby increasing fall risk (Arifah et al., 2025). Although balance-training interventions have been widely studied in other contexts, the application of ankle strategy exercises within Indonesian institutional elderly care settings remains limited, highlighting the novelty of this approach in addressing balance decline among Indonesian older adults. This intervention contributes to gerontological rehabilitation by offering context-specific evidence for a simple, low-cost, and feasible exercise method that can be supervised by care staff (Scerri & Lungaro-mifsud, 2025). Moreover, if shown to be effective, this exercise approach has strong potential for integration into broader Indonesian healthcare and community-based elderly care programs, such as Puskesmas, Posyandu Lansia, and other social welfare institutions, supporting preventive and rehabilitative efforts to maintain balance, functional independence, and quality of life among the elderly (Rahman et al., 2025).

This study aims to examine the effect of Ankle Strategy Exercise on the dynamic balance of elderly individuals at PPSLU Turusgede, Rembang Regency, by involving 33 elderly participants experiencing dynamic balance disorders. In addition to assessing improvements in physical balance, this study also seeks to explore secondary outcomes related to psychological well-being, such as a potential reduction in fear of falling, as well as perceived quality of life

associated with increased confidence and functional mobility. By enhancing dynamic balance, ankle strategy exercises are expected to contribute directly to fall prevention, thereby reducing the risk of fall-related injuries, supporting long-term mobility, and promoting independence among the elderly (Sabri et al., 2023). The findings of this study are anticipated to provide an evidence-based foundation for developing more effective and comprehensive fall-prevention intervention programs in other elderly social welfare centers and community-based care settings, while also contributing to the advancement of gerontological nursing knowledge and practice in Indonesia.

Furthermore, body balance in the elderly is influenced not only by physiological factors but also by psychological and social conditions, as older adults with balance disorders often develop a fear of falling that leads to avoidance of physical activity and increased passivity, thereby exacerbating physical decline. Interventions such as Ankle Strategy Exercise may help improve confidence in movement, reduce dependence on assistive devices, and enhance overall quality of life; however, the effectiveness of such interventions may vary across subgroups, particularly according to age and the severity of balance impairment, which warrants further stratified analysis in future studies (Tarisa et al., 2025). From a broader perspective, the findings of this study can inform elderly care policies by supporting the integration of simple, structured balance exercises into institutional and community-based programs aimed at promoting active aging and preventing falls. Nevertheless, these results should be interpreted with caution due to study limitations, including the use of purposive sampling, the relatively small sample size, and the absence of subgroup and long-term outcome analyses, all of which may introduce bias and limit generalizability (Fatmawati & Indriani, 2022).

Ultimately, this study has a larger goal: to provide recommendations to social welfare center administrators and other related parties about the importance of integrating balance exercises into elderly care programs. By improving dynamic balance, the elderly can maintain their independence for a longer period, reduce their dependence on others, and enjoy a healthier and more meaningful life. It is hoped that the findings of this research will open new perspectives on the importance of structured physical interventions to improve balance and prevent falls in elderly individuals.

This research offers a comprehensive approach to elderly care by positioning Ankle Strategy Exercise not merely as a form of physical training, but as a targeted intervention that

addresses the negative functional consequences of aging through both muscular strengthening and neuromuscular stimulation. From a theoretical perspective, this exercise supports postural control and sensory–motor adaptation, enabling elderly individuals to better respond to age-related physiological changes affecting balance and mobility. The novelty of this study lies in its application of ankle strategy exercises within an institutional elderly care setting in Indonesia, demonstrating practical feasibility and contextual relevance that have not been widely explored. In terms of practical implications, the findings suggest that with appropriate implementation and supervision, ankle strategy exercises can be integrated into routine elderly care programs to support functional independence, promote active aging, and maintain or even enhance quality of life, including in later stages of aging.

Method

This study employed a quantitative research approach using a pre-experimental one-group pretest–posttest design to evaluate the effect of Ankle Strategy Exercise on dynamic balance in elderly individuals, a design that allows the observation of changes before and after an intervention in a single group (Munir, 2022). The study population consisted of 36 elderly residents with balance disorders at PPSLU Turusgede, Rembang Regency, with 33 participants selected through purposive sampling based on predefined inclusion and exclusion criteria to ensure relevance to the research objectives. Data were collected before and after the intervention through structured observation, interviews, and measurement of dynamic balance using the Timed Up and Go Test (TUGT), an instrument that has been widely applied to assess mobility, balance performance, and fall risk among older adults (Fatmawati & Indriani, 2022). Quantitative data were analyzed using the Wilcoxon signed-rank test to compare pretest and posttest scores, while qualitative data from observations and interviews were analyzed thematically to support interpretation of physical and psychological changes. Although the findings demonstrated a statistically significant improvement in dynamic balance, strong causal conclusions cannot be drawn due to the absence of a control group and the relatively small sample size. In addition, confounding factors such as age, gender, and physical condition were not statistically controlled and may have influenced individual responses to the intervention, explaining why some participants did not experience substantial improvement. These limitations may affect the generalizability of the results; however, Ankle Strategy Exercise remains a simple, low-cost, and feasible intervention that can be practically integrated into

routine elderly care programs to support balance improvement and fall prevention in institutional and community-based settings.

Research Results

The data collected from 33 elderly respondents at the Elderly Social Welfare Center (PPSLU) Turusgede, Rembang Regency, involved intervention and observation of elderly individuals meeting the inclusion and exclusion criteria. The collected data was then categorized into two group is general data and specific data, as outlined below :

General Data of the Research Location

This research was conducted at the Elderly Social Service Center (PPSLU) Turusgede, located on Jl. Nasional Blora - Rembang, Rembang Regency, Central Java Province. PPSLU Turusgede is a social welfare institution owned by the Central Java Provincial Government, which functions to provide social services for neglected elderly individuals, in accordance with the Governor of Central Java's regulations. This institution is part of the Central Java Provincial Social Service, with operational and technical support duties to enhance social welfare. The boundaries of PPSLU Turusgede include Ngotet Village to the north, Kumendung Village to the east, Sulang District to the south, and Kedungrejo Village to the west.

The vision of PPSLU Turusgede is "Towards a Prosperous and Independent Central Java," with a focus on improving the quality and reach of social services and community empowerment. The mission of PPSLU includes building a religious and tolerant society, accelerating bureaucratic reform, strengthening the people's economy, and improving the quality of life of the people of Central Java. The organizational structure of PPSLU Turusgede consists of the Head of the Shelter, Head of the Administrative Subsection, and various other officers responsible for administration, security, and social services for the elderly.

Respondent Characteristics Based on Gender

The respondents in this study were elderly individuals at PPSLU Turusgede, Rembang, conducted in June 2025, with a total of 33 elderly participants.

No.	Gender	F	(%)
1.	Male	17	51.5%
2.	Female	16	48.5%
	Total	28	100%

From the table above, it can be seen that out of the 28 (100%) respondents, the majority, 17 (51.5%), were male.

Respondent Characteristics Based on Age

The respondents in this study were elderly individuals at PPSLU Turusgede, Rembang, conducted in June 2025, with a total of 33 elderly participants.

No.	Age	F	(%)
1.	61 – 65 year	16	48.5 %
2.	66 – 70 year	11	3.3 %
3.	71 – 75 year	6	18.2 %
	Total	33	100 %

From the above, it can be seen that out of the 33 (100%) respondents, the majority, 16 (48.5%), were aged 61-65 years.

Respondent Characteristics Based on Educatiom

The respondents in this study were elderly individuals at PPSLU Turusgede, Rembang, conducted in June 2025, with a total of 33 elderly participants.

No.	Education	F	(%)
1.	Not in School	13	39.4 %
2.	Elementary School	14	42.4 %
3.	Junior High School	4	12.1 %
4.	High School	2	6.1 %
	Total	33	100 %

From the above, it can be seen that out of the 33 (100%) respondents who were the subjects of the study at PPSLU Turusgede Rembang, nearly half of them, 14 (42.4%), have their last level of education as Elementary School (SD).

General Data of Respondents

Identification of Dynamic Balance in the Elderly at PPSLU Turusgede, Rembang Regency, Before Receiving Ankle Strategy Exercise.

No	Dynamic Equilibrium	F	(%)
1.	Poor	9	27.3 %
2.	Not very good	24	72.7 %
3.	Fairly good	0	0%
4.	Good	0	0%
	Total	33	100%

From the above, it can be seen that out of the 28 (100%) respondents, the majority, 16 (57.1%), experienced severe loneliness before receiving Life Review Therapy.

Identification of Loneliness Levels After Life Review Therapy for the Elderly at PPSLU Turusgede, Rembang

No	Risk of Falling	F	(%)
1.	Poor	0	0%
2.	Not very good	0	0%
3.	Fairly good	22	30.3%
4.	Good	11	66.7%
	Jumlah	33	100%

Based on the table above, it can be seen that out of 33 (100%) respondents, the majority, 22 (66.7%), fall into the category of fairly good dynamic balance.

Identification of Dynamic Balance in the Elderly at PPSLU Turusgede, Rembang Regency, After Receiving Ankle Strategy Exercise

Intervention Life Review Therapy	Level Loneliness				Total
	Loneliness	Loneliness Medium	Loneliness Moderat	Loneliness Hight	
Pre-Test	0%	7.1%	35.7%	57.1%	100%
Post-Test	10.7%	46.4%	42.9%	0	100%
Wilcoxon Signed Ranks Test Asym. Sig. (2-tailed) = 0,000					

From the table above, it can be seen that there is an impact of Life Review Therapy on loneliness in the elderly at PPSLU Turusgede, Rembang, as shown by the results where, out of 28 (100%) respondents, the majority, 16 (57.1%), experienced severe loneliness before receiving Life Review Therapy, and after receiving the therapy, nearly half, 13 (46.4%), experienced mild loneliness.

Specific Data of Respondents

Before undergoing Life Review Therapy, the respondents showed different levels of loneliness. A significant portion (57.1%) experienced severe loneliness, 35.7% reported moderate loneliness, and only 7.1% were classified as mildly lonely. None of the respondents were free from loneliness at this point. However, after the therapy, the situation improved significantly. The post-test results revealed that nearly half of the respondents (46.4%) experienced a reduction in loneliness to a mild level, while 42.9% still reported moderate loneliness. Notably, none of the respondents were classified as severely lonely after the therapy, emphasizing the potential effectiveness of Life Review Therapy in alleviating loneliness among the elderly.

The data analysis using the Wilcoxon Signed Ranks Test showed that the intervention significantly reduced loneliness among the elderly in PPSLU Turusgede. The p-value of 0.000 indicated that the changes in loneliness were not by chance, but were a direct result of the

intervention. This statistical evidence supports the effectiveness of Life Review Therapy in reducing loneliness, showing a clear improvement from severe to mild loneliness after the therapy. These findings highlight the potential of Life Review Therapy as a valuable approach for enhancing the emotional and psychological well-being of elderly individuals in institutional care settings. The results also suggest that targeted interventions like Life Review Therapy can significantly improve the quality of life for elderly residents, offering them the opportunity to reflect on and positively engage with their past experiences.

Discussion

This chapter will explain the results and limitations of the research obtained from the research process involving 33 respondents. This study aims to determine whether or not there is an influence of Ankle Strategy Exercise on the dynamic balance of the elderly at PPSLU Turusgede, Rembang Regency.

Before the Ankle Strategy Exercise was implemented, the majority of elderly participants at PPSLU Turusgede demonstrated poor dynamic balance. Based on Table 5.4, as many as 24 out of 33 respondents (72.7%) were categorized as having poor dynamic balance. Measurements using the Timed Up and Go Test (TUGT) showed an average completion time of 21–31 seconds, indicating impaired dynamic balance and an increased risk of falls (Vivi Nur Anisa & Lestari, 2023). Elderly participants experienced difficulty performing balance-related movements independently, such as transitioning from sitting to standing and maintaining postural stability during turning or rotational movements. Balance impairment is recognized as one of the main causes of falls among the elderly, which can lead to physical injuries as well as psychological consequences, including anxiety, reduced self-confidence, and limitations in daily activities (Fatmawati & Indriani, 2022). The decline in balance function is also influenced by age-related physiological changes, particularly in the musculoskeletal and nervous systems, as reflected in this study where 48.5% of respondents were aged 61–65 years (Wardhani & Nisa, 2023). Observational findings further indicated that poor dynamic balance prior to intervention limited the elderly's ability to perform daily activities such as bathing, walking, and moving independently, and in some cases contributed to fall-related psychological trauma and fear of movement (fall phobia). Environmental factors, including inadequate lighting, slippery floor surfaces, and the absence of handrails in high-risk areas, also played a role in increasing fall risk. These conditions negatively affected not only physical health but also the mental and social

well-being of the elderly, reinforcing inactivity and functional dependence (Fatmawati & Indriani, 2022). Therefore, the implementation of Ankle Strategy Exercise was considered necessary to address these balance impairments in a structured and measurable manner.

After the implementation of Ankle Strategy Exercise, a significant improvement in dynamic balance was observed among the elderly participants. Based on Table 5.5, 22 out of 33 respondents (66.7%) demonstrated an improvement to a moderately good level of dynamic balance. The intervention was conducted over four weeks, three times per week, with each session lasting 30–45 minutes, focusing on strengthening ankle musculature and stimulating the proprioceptive system, which is essential for postural control. Post-intervention TUGT measurements showed a notable reduction in completion time from 20–30 seconds to less than 20 seconds, indicating improved balance and a reduced risk of falls. These findings are consistent with previous studies reporting that regular physical exercise enhances muscle strength, coordination, and overall balance in elderly individuals (Wardhani et al., 2020). Interviews conducted after the intervention revealed that many participants felt more confident while walking, experienced reduced fear of falling, and were able to perform daily activities with less assistance. Some elderly individuals even reported discontinuing the use of walking aids and increasing participation in group activities such as morning exercises. From a theoretical perspective, these findings support the principle of neuroplasticity in geriatric rehabilitation, where repeated and consistent training strengthens neuromuscular pathways and improves motor responses to balance disturbances. Previous studies have also demonstrated that ankle strategy exercises can significantly improve dynamic balance and reduce fall risk among the elderly (Nugraha et al., 2022). Improvements in dynamic balance were associated not only with enhanced mobility but also with better psychological well-being, including reduced anxiety and increased self-confidence. Support from caregivers and family members was identified as an important factor in maintaining the continuity and long-term benefits of the exercise program (Milberger et al., 2022).

Statistical analysis using the Wilcoxon test showed a significant effect of Ankle Strategy Exercise on dynamic balance, with a p-value of 0.000 ($p < 0.05$), confirming that the intervention had a meaningful impact. The reduction in TUGT completion time reflected a decrease in fall risk and an increase in functional independence and social participation among the elderly. Although factors such as age, gender, and education level influenced individual

outcomes, the intervention remained effective across participant characteristics, including those with lower educational backgrounds, due to its simplicity and ease of implementation. However, despite these positive findings, this study has limitations, including the absence of a control group and a relatively small sample size, which may affect the strength of causal conclusions and the generalizability of the results. Therefore, future research is strongly recommended to employ a more robust experimental design, such as randomized controlled trials, and to involve larger sample sizes to produce more convincing and generalizable evidence regarding the effectiveness of Ankle Strategy Exercise in improving dynamic balance among elderly populations.

Conclusion

The decline in dynamic balance among elderly individuals is a significant health problem that increases the risk of falls and negatively affects independence and quality of life, mainly due to age-related reductions in muscle strength, coordination, and postural control. This study aimed to analyze the effect of Ankle Strategy Exercise on the dynamic balance of elderly individuals at PPSLU Turusgede, Rembang Regency, using a pre-experimental one-group pretest–posttest design involving 33 participants. Dynamic balance was measured using the Timed Up and Go Test (TUGT), which showed that most participants had poor dynamic balance before the intervention. After the implementation of Ankle Strategy Exercise, a significant improvement in dynamic balance was observed. Statistical analysis using the Wilcoxon signed-rank test revealed a significant effect of the intervention ($p = 0.000$; $p < 0.05$), indicating that Ankle Strategy Exercise effectively improves dynamic balance in elderly individuals. Therefore, Ankle Strategy Exercise can be recommended as a simple, safe, and effective intervention to enhance dynamic balance and reduce fall risk among the elderly in both institutional and community-based care settings.

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