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Tandem Walking Exercise on Muscle Strength in The Elderly in Prunggahan Kulon Village Semanding District, Tuban

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Abstract: The decline in muscle strength among older adults is a major health concern that contributes to reduced mobility, increased risk of falls, and decreased quality of life. This issue becomes more critical as the elderly population continues to grow, particularly in community-based settings where simple and accessible interventions are needed. **Objective:** This study aimed to analyze the effect of tandem walking exercise on muscle strength in older adults in Prunggahan Kulon Village, Semanding District, Tuban. **Methods:** This study employed a quantitative pre-experimental design using a one-group pre-test and post-test approach. A total of 63 elderly participants were selected through purposive sampling. Data were collected using the 30-Second Chair Stand Test (30s-CST) to measure lower limb muscle strength before and after the intervention. The data were analyzed using the Wilcoxon Signed Rank Test. **Results:** The findings showed a significant improvement in muscle strength after the intervention, where most participants shifted from moderate to high muscle strength categories. Statistical analysis indicated a significant difference between pre-test and post-test results ($p < 0.05$). **Implications:** Tandem walking exercise can be applied as a simple, low-cost, and effective intervention to improve muscle strength and reduce fall risk among older adults, particularly in community-based settings. **Originality:** This study provides new evidence on the effectiveness of tandem walking exercise as a specific balance-based intervention focusing on muscle strength as the primary outcome in a village-based elderly population, which remains limited in previous studies.

Keywords: elderly; muscle strength; tandem walking; balance exercise; fall prevention

INTRODUCTION

Older adults are individuals aged 60 years and above who commonly experience progressive decline in physical function as part of the ageing process. This decline is characterized by impaired hearing, worsening vision, reduced muscle strength, slower movement, and decreased body coordination, all of which may limit independence in daily activities and increase the risk of falls (World Health, 2021). Peterson emphasized that decreased muscle strength in older adults contributes to impaired physical mobility (Cruz-Jentoft et al., 2019; Peterson et al., 2010), while Maritta noted that age-related changes in sensory, neurological, cognitive, and musculoskeletal function may further reduce balance

and functional capacity (Sherrington et al., 2019). Therefore, decline in muscle strength among older adults should be understood as an important health problem because it affects not only physical performance, but also overall quality of life.

The urgency of this issue is increasing as the elderly population continues to grow at the global, national, and local levels. Gasril reported that the proportion of the elderly population is increasing worldwide and is expected to continue rising substantially in the coming decades, especially in developing countries (Gasril et al., 2022). In Indonesia, Statistics Indonesia recorded that the elderly population reached 26.82 million in 2020 (Statistics, 2021), while East Java was among the provinces with a large elderly population and a considerable proportion of fall incidents. At the district level, Tuban Health Office reported that the number of older adults in Tuban reached 24,065, including around 4,000 elderly people in Prunggahan Kulon Village. Preliminary observations conducted in May 2025 in this village also found that several elderly individuals showed decreased muscle strength and unstable gait, as indicated by the need to seek support from walls, chairs, or other people while walking. These conditions indicate that maintaining muscle strength in community-dwelling older adults remains a relevant and urgent issue.

Previous studies have shown that muscle strength is a key determinant of physical function in older adults. Sheringgton explained that ageing is associated with a decline in physical and psychological abilities, including reduced musculoskeletal performance and functional limitations in daily life (Sherrington et al., 2019). Likewise, (Cruz-Jentoft et al., 2019; Gao et al., 2021; Mualif & Wirawati, 2021; Peterson et al., 2010) stated that reduced muscle strength may slow body movement and restrict mobility, thereby decreasing independence among older adults. In a descriptive study, Mualif also highlighted that lower-extremity function is closely related to the ability of older adults to maintain stability during walking and physical activity (Mualif & Wirawati, 2021). However, although these studies have confirmed the importance of muscle strength in the elderly, they mainly describe the condition of physical decline rather than testing a simple intervention specifically aimed at improving muscle strength in a village-based elderly population.

A second body of literature has focused on the relationship between balance disorders, fall risk, and physical decline in older adults. Ambrose explained that weak lower-extremity muscles, joint stiffness, gait disturbance, and environmental hazards are important contributors to falls in the elderly (Ambrose et al., 2013; Liu & Latham, 2009). Similarly, falls in older adults are influenced by both intrinsic factors, such as sensorimotor

and musculoskeletal impairments, and extrinsic factors, including environmental conditions and daily activity demands (Ambrose et al., 2013). This group of studies is important because it confirms that muscle weakness and impaired balance are interconnected problems. Nevertheless, much of this literature emphasizes risk identification and prevention of falls, while fewer studies directly examine how a simple physical exercise can improve muscle strength as one of the main underlying factors.

A third group of studies has examined exercise-based interventions for older adults, particularly those intended to improve balance and functional mobility. Tandem walking involves walking in a straight line with a reduced base of support, requiring precise coordination and postural control, particularly in older adults (Beauchet et al., 2009; Hausdorff, 2007). Liu, Sherington and Venezuela reported that tandem walking may improve lower-limb muscle strength and stability in older adults when performed regularly (Liu & Latham, 2009; Sherrington et al., 2019; Valenzuela et al., 2023). These findings suggest that tandem walking exercise has potential as a practical intervention in elderly care. However, previous studies have more often emphasized balance improvement and fall-risk reduction, whereas evidence specifically examining the effect of tandem walking exercise on muscle strength as the primary outcome remains limited, especially in community-based elderly populations at the village level.

Based on these gaps, this study aimed to analyze the effect of tandem walking exercise on muscle strength in elderly people in Prunggahan Kulon Village, Semanding District, Tuban. This study was intended to address the limited evidence on tandem walking exercise as a simple, non-pharmacological intervention specifically directed at improving muscle strength in community-dwelling older adults. By focusing on muscle strength before and after the intervention, this study is expected to contribute to the development of practical nursing and community health strategies for the elderly.

This study was based on the argument that tandem walking exercise may improve muscle strength in older adults because it involves repeated, controlled, and coordinated lower-limb movements that require postural control and neuromuscular activation. As noted (Jones et al., 1999; Syah et al., 2017) this exercise trains body stability through a narrowed base of support during walking. Regular practice is therefore expected to enhance lower-extremity muscle performance, improve motor coordination, and support safer mobility in the elderly. Accordingly, the hypothesis of this study was that tandem walking exercise has a significant effect on improving muscle strength in elderly people.

RESEARCH METHOD

The unit of analysis in this study was the muscle strength of older adults living in Prunggahan Kulon Village, Semanding District, Tuban. This study focused on examining changes in lower-extremity muscle strength among elderly participants before and after the implementation of tandem walking exercise. Therefore, the main subject of analysis was not merely the elderly individuals as respondents, but specifically their level of muscle strength as measured during the research process.

This study used a quantitative approach with a pre-experimental design employing a one-group pre-test and post-test model. This design was selected because the study aimed to examine the effect of tandem walking exercise on muscle strength by comparing participants' condition before and after the intervention within the same group. The use of this design was considered appropriate because it allowed the researchers to identify changes that occurred following the intervention, although without a control group.

The data used in this study were primary data obtained directly from elderly respondents in the research setting. The population consisted of 75 older adults residing in Prunggahan Kulon Village, Semanding District, Tuban. From this population, 63 respondents were selected as the sample using a purposive sampling technique based on predetermined inclusion criteria. The source of information in this study therefore came directly from participants who met the research requirements and were willing to take part in the intervention and assessment process.

Data collection was carried out through several sequential stages. First, the researchers selected participants according to the established inclusion criteria. Second, a pre-test was conducted to measure lower-extremity muscle strength using the 30 Second Chair Stand Test (30s-CST) as the research instrument. After the initial measurement, respondents were given the tandem walking exercise intervention, which was performed by asking participants to walk in a straight line while placing the heel of one foot directly in front of the toes of the other foot. After the intervention period was completed, a post-test was conducted using the same instrument to assess changes in muscle strength. Thus, the main data collection technique in this study was direct physical measurement supported by a standardized functional test.

The collected data were analyzed using both univariate and bivariate statistical analysis. Univariate analysis was applied to describe the characteristics of respondents, such as gender, age, and educational background, as well as the distribution of muscle

strength levels before and after the intervention. Meanwhile, bivariate analysis was conducted using the Wilcoxon Signed Rank Test to determine whether there was a significant difference in muscle strength before and after the tandem walking exercise intervention. The level of significance used in this study was $\alpha = 0.05$, meaning that a p-value of less than 0.05 indicated a statistically significant effect of tandem walking exercise on muscle strength in older adults.

To facilitate readers' understanding of the study procedure, a schematic overview of the research method is presented in Figure 1. This figure describes the flow of the study from sample selection to pre-test and post-test assessment, including the tandem walking exercise intervention and the statistical analysis used to evaluate its effect on muscle strength.

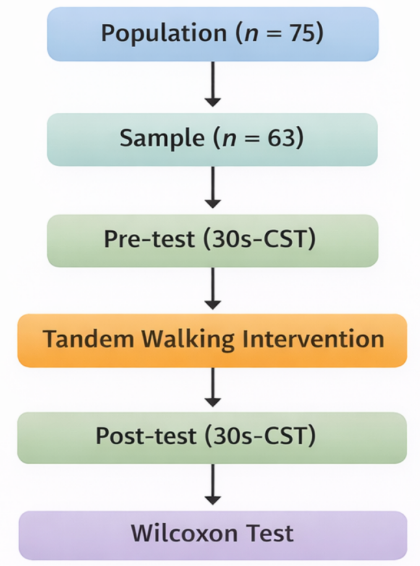

Figure 1. Flowchart of the research procedure

As shown in Figure 1, the study followed a sequential process consisting of participant selection, baseline measurement, intervention implementation, post-intervention measurement, and statistical evaluation.

RESULT

From the data collection conducted on respondents, the author obtained information from 63 respondents by providing interventions and observation sheets to elderly respondents, both male and female, according to the inclusion and exclusion criteria in the working area of the Prunggahan Kulon Village Community Health Center, Semanding

District, Tuban. The data was grouped by the researcher into two, namely general data and specific data.

Respondent General Data

1. Respondent Characteristics Based on Gender

Table 1. Frequency Distribution of Respondents Based on Gender of the Elderly in Prunggahan Kulon Village, Semanding District, Tuban in 2025.

No	Gender	Frequency (*f*)	Presentation
1.	Man	9	14.3%
2.	Woman	54	85.7%
	Amount	63	100%

Source: Primary data from researchers, 2025.

Based on table 1 above, it can be seen that out of 63 (100%) respondents, the majority, 54 (86%) respondents, were female.

2. Respondent Characteristics Based on Age

Table 2. Frequency Distribution of Respondents Based on Age of the Elderly in Prunggahan Kulon Village, Semanding District, Tuban in 2025.

No	Age	Frequency (*f*)	Presentation
1.	60-69 Years	43	68%
2.	70-79 Years	20	32%
3.	>80 Years	0	0%
	Amount	63	100%

Source: Primary data from researchers, 2025.

Based on table 5.2 above, it can be seen that out of 63 (100%) respondents, almost all 43 (68%) respondents were aged 60-69 years.

3. Respondent Characteristics Based on Last Education

Table 3. Frequency Distribution of Respondents Based on Educational Characteristics in Prunggahan Kulon Village, Semanding District, Tuban in 2025.

No	Education	Frequency (*f*)	Presentation
1.	No school	36	57%
2.	Elementary School	27	43%
	Amount	63	100%

Source: Primary Research Data 2025

Based on Table 3, it can be seen that of the 63 (100%) respondents, the majority, namely 36 (57%) respondents, did not attend school. Low levels of education are closely

related to low levels of knowledge. regarding the importance of physical exercise to control balance for the elderly.

Respondent Specific Data

1. Identification of muscle strength levels in elderly people in Prunggahan Kulon Village, Semanding District, Tuban before being given *tandem walking training.*

Table 4. Frequency Distribution of Respondents Based on Muscle Strength Level in the Elderly in Prunggahan Kulon Village, Semanding District, Tuban Before being given *tandem walking training* on November 3, 2025.

No	Muscle Strength Level	Frequency (*f*)	Presentation
1	Tall	4	6.3%
2	Currently	53	84.1%
3	Low	6	9.5%
	Amount	63	100%

Source: Primary data from researchers, 2025.

Based on table 4 above, it is known that out of 63 (100%) respondents, the majority, 53 (84%) respondents, have a moderate level of muscle strength.

2. Identification of muscle strength levels in the elderly in Prunggahan Kulon Village, Semanding District, Tuban after being given *tandem walking training.*

Table 5. Frequency Distribution of Respondents Based on Muscle Strength Level in the Elderly in Prunggahan Kulon Village, Semanding District, Tuban After being given *tandem walking training* on December 6, 2025.

No	Muscle Strength Level	Frequency (*f*)	Presentation
1	Tall	55	87.3%
2	Currently	6	9.5%
3	Low	2	3.1%
	Amount	63	100%

Source: Primary data from researchers, 2025.

Based on table 5 above, it is known that out of 63 (100%) respondents, the majority, 55 (87%) respondents, have a high level of muscle strength.

3. Analysis of the influence before and after giving *tandem walking training* on muscle strength levels in the elderly in Prunggahan Kulon Village, Semanding District, Tuban.

Table 6. Analysis of the influence before and after giving *tandem walking training* on muscle strength levels in the elderly in Prunggahan Kulon Village, Semanding District, Tuban.

***Tandem* Walking Training**	**Muscle Strength Levels in the Elderly**			
	High %	**Moderate%**	**Low%**	**Total%**
Pre-test	4 (6.3)	53 (84.1)	6 (9.5)	63 (100.0)
Post-test	55 (87.3)	6 (9.5)	2 (3.1)	63 (100.0)
***Wilcoxon Test Asymp. Sig (2-tailed)* = 0.001**				

Source: Primary data from researchers, 2025.

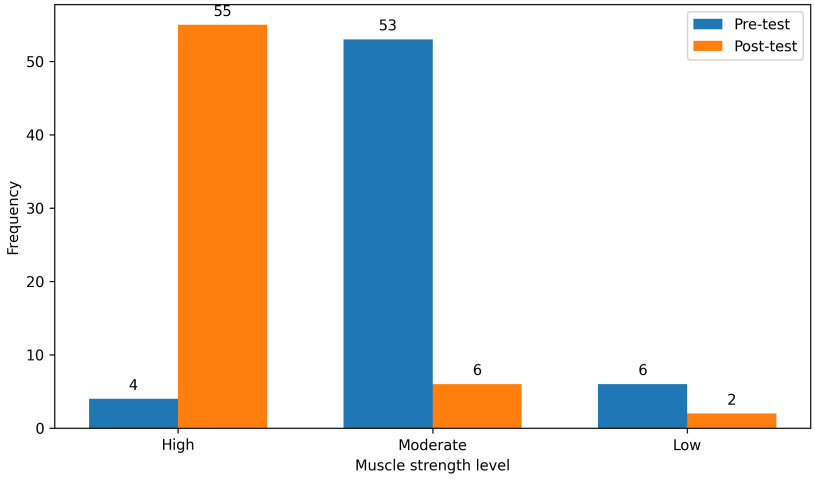

Figure 2. Comparison of muscle strength levels before and after tandem walking exercise among older adults in Prunggahan Kulon Village, Semanding District, Tuban

Table 6 and Figure 2 show a clear change in muscle strength distribution before and after the tandem walking exercise intervention. Before the intervention, most respondents were classified in the moderate muscle strength category, accounting for 53 participants (84.1%), while only 4 participants (6.3%) were in the high category and 6 participants (9.5%) were in the low category. After the intervention, the distribution shifted substantially, with 55 participants (87.3%) classified in the high category, 6 participants (9.5%) in the moderate category, and 2 participants (3.1%) in the low category.

These findings indicate an improvement in muscle strength following the tandem walking exercise intervention, as reflected by the marked increase in the proportion of respondents in the high category and the decrease in the moderate and low categories. The Wilcoxon Signed Rank Test showed a statistically significant difference between pre-test and post-test muscle strength levels ($p < 0.001$). This result indicates that tandem walking

exercise was associated with a significant improvement in muscle strength among older adults.

DISCUSSION

This study examined the association between tandem walking exercise and muscle strength among older adults in Prunggahan Kulon Village, Semanding District, Tuban. The results showed a clear shift in muscle strength levels after the intervention. Before the intervention, most respondents were in the moderate category, while only a small proportion were in the high category. After the intervention, the majority of respondents moved into the high category, and the proportion of respondents in the low and moderate categories decreased. Statistical analysis using the Wilcoxon Signed Rank Test showed a significant difference between pre-test and post-test muscle strength levels ($p < 0.001$). These findings indicate that tandem walking exercise was associated with improved muscle strength among older adults.

The improvement in muscle strength may be explained by the physiological demands of tandem walking exercise. This exercise requires repeated, controlled, and coordinated lower-extremity movements while maintaining postural stability on a narrowed base of support. Such movements stimulate the activation of lower-limb muscles, improve neuromuscular coordination, and enhance postural control. In older adults, whose muscle mass and neuromuscular function generally decline with age, regular physical exercise can provide a positive stimulus for adaptation, including better muscle contraction, improved endurance, and greater functional stability. Therefore, the increase in muscle strength observed in this study is likely related to the repeated activation of lower-extremity muscles during the intervention, which supported functional movement such as standing, walking, and maintaining balance.

The findings of this study are consistent with previous studies reporting the benefits of exercise-based interventions for older adults. Previous research has shown that balance-oriented exercises, including tandem walking, can improve postural control, reduce fall risk, and support functional mobility in the elderly. Studies by (Cadore & Izquierdo, 2013; Syah et al., 2017; Tiedemann et al., 2013) reported that tandem walking or related balance exercises contributed to better physical performance in older adults. The present study supports these findings by showing that tandem walking exercise was associated not only with balance-related improvement but also with better muscle strength distribution after

the intervention. The contribution of this study lies in its focus on a village-based older adult population, thereby providing community-level evidence that tandem walking may be applied as a simple and practical exercise in non-institutional settings.

From an interpretive perspective, these findings suggest that tandem walking exercise may serve as an accessible non-pharmacological strategy to support healthy ageing. Improved muscle strength in older adults is important because it is closely related to independence in daily living, safer mobility, and reduced vulnerability to falls. Muscle weakness in the elderly is not merely a physical limitation, but also a condition that may contribute to dependency, reduced confidence in movement, and lower quality of life. In this context, the findings of the present study strengthen the view that simple physical exercise can play an important role in preserving functional ability among community-dwelling older adults. The results also support the Functional Consequences perspective in geriatric nursing, which explains that age-related physiological decline may be modified through appropriate intervention and adaptive support.

At the same time, the findings should be interpreted with caution because the response to the intervention was not identical across all participants. A small proportion of respondents remained in the low or moderate muscle strength categories after the intervention. This may be influenced by several factors, including advanced age, comorbid conditions, joint pain, sensory decline, nutritional status, daily physical activity, and adherence to the exercise protocol. Field observations also suggested that some older adults had difficulty following movement instructions due to reduced vision, hearing impairment, or limited concentration. These conditions indicate that although tandem walking exercise is promising, its implementation may not produce uniform outcomes in all elderly individuals. The positive implication is that the intervention is simple, low-cost, and feasible in community settings; however, the possible limitation is that its effectiveness may depend on individual health status, supervision, and consistency of practice.

Based on these findings, tandem walking exercise may be considered as part of community-based nursing and elderly health promotion programs. Health workers, community nurses, and family members may collaborate to introduce this exercise as a routine physical activity for older adults, particularly for those with moderate decline in muscle strength and balance. The intervention should be implemented gradually, with clear instructions, supervision, and attention to participant safety. In addition, future programs should consider supportive measures such as family involvement, adaptation of exercise

intensity, and monitoring of elderly participants with comorbidities or sensory limitations. Overall, the findings of this study suggest that tandem walking exercise has practical potential as an easy-to-apply intervention to support muscle strength, mobility, and independence among older adults in community settings.

CONCLUSION

This study demonstrated that tandem walking exercise was associated with a significant improvement in muscle strength among older adults in Prunggahan Kulon Village, Semanding District, Tuban. Prior to the intervention, most participants were classified in the moderate muscle strength category, whereas after the intervention, the majority shifted to the high category. The statistical analysis using the Wilcoxon Signed Rank Test confirmed that this difference was significant ($p < 0.05$). These findings highlight that a simple and structured physical exercise such as tandem walking can support better functional capacity and mobility in older adults.

The main contribution of this study lies in providing empirical evidence on the application of tandem walking exercise as a practical, low-cost, and community-based intervention to improve muscle strength among elderly populations, particularly in village settings. This study extends previous research that primarily focused on balance and fall prevention by demonstrating that tandem walking exercise is also associated with improved muscle strength as a key component of physical function. Therefore, this study contributes to the development of non-pharmacological strategies in geriatric nursing and community health, emphasizing the importance of accessible and sustainable physical activity programs for older adults.

However, this study has several limitations that should be considered. The use of a pre-experimental one-group pre-test and post-test design without a control group limits the ability to draw causal conclusions. In addition, the effectiveness of the intervention may have been influenced by factors such as participant adherence, individual health conditions, age differences, and the need for family supervision during exercise. The requirement to perform the exercise regularly (12 sessions per month) also posed challenges related to time commitment and participant consistency. Furthermore, some respondents required assistance due to limited understanding or sensory decline, which may have affected the uniformity of the intervention. Future research is recommended to use more robust experimental designs, include control groups, and consider additional variables such as

nutritional status, comorbidities, and long-term follow-up to obtain more comprehensive findings.

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