

The Difference In The Effect of Ankle Strategy Exercise And Tandem Strategy Exercise On The Risk of Falls In Elderly Withhypertension At Nalumsari Community Health Center 1

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Abstract.

Hypertension in the elderly can cause balance disorders that increase the risk of falls, so effective balance training interventions are needed. This study aims to analyze the differences in the effects of Ankle Strategy Exercise and Tandem Strategy Exercise on the risk of falls in hypertensive elderly at Nalumsari 1 Community Health Center. The study used a quantitative approach with a quasi-experimental design with a pre-test and post-test design in two groups. The study population was 66 hypertensive elderly, while a sample of 40 respondents was selected using a simple random sampling technique. The research instruments included the Timed Up and Go Test, a sphygmomanometer, a stopwatch, and an observation sheet. Data analysis was carried out using univariate analysis, the Shapiro-Wilk normality test, the Wilcoxon Signed Rank Test, and the Mann-Whitney test. The results showed that both groups experienced a significant decrease in Timed Up and Go Test scores after the intervention with a p value = 0.000. The results of the Mann-Whitney test showed a significant difference in effectiveness between the two groups with a p value = 0.003, where the Tandem Strategy Exercise group had a higher mean rank than the Ankle Strategy Exercise group. It can be concluded that both exercises are effective in reducing the risk of falls in elderly hypertensive patients, but Tandem Strategy Exercise provides better effectiveness than Ankle Strategy Exercise.

Keywords: Ankle Strategy Exercise, Elderly, Fall Risk, Hypertension and Tandem Strategy Exercise.

I. INTRODUCTION

Hypertension is a chronic disease commonly experienced by the elderly and is known as a silent killer because it often develops without obvious symptoms. This condition not only impacts the cardiovascular system but can also disrupt body balance due to reduced blood flow to the brain, the center of balance regulation. This disorder increases the risk of falls, which are a leading cause of disability and even death in the elderly [1]. Fall risk is a condition where a person is more likely to fall and cause physical injury. Therefore, efforts to maintain and improve body balance through balance training are an important strategy to reduce the risk of falls in the elderly [2].

The risk of falls in the elderly remains a significant health issue in many countries. Global studies show that approximately 26.5% of elderly people experience falls each year [3]. In Asia, the prevalence of falls in elderly people aged 65 and over reaches 28–35% and increases to 32–42% in those aged over 70 [4]. In Indonesia, approximately 30% of elderly people aged 65 and over experience falls each year, and half of them have fallen at least once. Approximately 50% of those aged over 80 have experienced falls. The fall rate in Indonesia is recorded at 40.9% [5]. Data from the Central Statistics Agency also shows that there were 1,836 cases of falls in the elderly in Central Java Province during 2021, most of which occurred on terraces and bathrooms of elderly people's homes [6]. Meanwhile, local data on falls in the elderly in Jepara Regency is not yet available, so the prevalence is assumed to follow the national figure, which is approximately 30%.

The risk of falls in the elderly is influenced by various intrinsic and extrinsic factors. Intrinsic factors include central nervous system disorders, sensory disorders, cardiovascular disease, metabolic disorders, visual impairment, muscle weakness, poor posture, and balance disorders, while extrinsic factors include envi-

ronmental conditions, activity, and medication use [7]. In the elderly with hypertension, this condition becomes more complex because long-term hypertension can cause blood vessel damage, thereby inhibiting blood flow to the heart and brain. This impact increases the risk of falls, especially during activities such as climbing stairs or physical activities that require balance. Falls in the elderly can cause soft tissue injuries, fractures, limited mobility, slower healing processes, and even death, thus impacting the quality of life of the elderly [8]. However, to date there has been no systematically implemented intervention at the Nalumsari 1 Community Health Center.

One effort that can be done to improve body balance is through balance training such as tandem strategy exercise and ankle strategy exercise. Tandem strategy exercise aims to train proprioception, body posture, muscle coordination, and movement control so as to improve body stability during movement [9], [10]. Meanwhile, ankle strategy exercise is an exercise that focuses on controlling postural sway through plantar flexion and dorsi flexion movements at the ankle joint so as to improve muscle strength and postural balance [5], [11]. Previous studies have shown that ankle strategy exercise can significantly improve dynamic balance in the elderly [12], [13], while tandem strategy exercise has been proven effective in reducing the risk of falls while increasing postural control and independence in daily activities [14], [15]. However, these studies generally only tested one type of exercise with a pre-experimental design so they have not provided an overview of the effectiveness of both training methods directly in one comparative study.

Based on these conditions, this study aims to analyze the differences in the effects of ankle strategy exercise and tandem strategy exercise on the risk of falls in elderly with hypertension at the Nalumsari 1 Community Health Center. This study is important because the results are expected to be a basis for health workers, especially nurses and physiotherapists, in determining more effective balance exercises as part of evidence-based interventions for fall risk prevention in primary health care. The novelty of the study lies in the direct comparison of the effectiveness of both types of exercises within a single research framework in the elderly population with hypertension in the Nalumsari 1 Community Health Center area, considering that until now there has been no similar research or intervention that has been systematically implemented in that location.

II. METHODS

This study uses a quantitative approach that aims to examine phenomena through numerical measurements and statistical analysis based on the positivist paradigm. The quantitative approach is used to objectively test hypotheses through relationships between variables by viewing reality as something that can be observed, measured, and analyzed systematically. This approach also emphasizes the use of deductive logic, minimizes bias, and allows research results to be generalized and replicated [16]. The study applied a quasi-experimental design with a pre-test and post-test design in two groups. This design was used to analyze differences in fall risk in elderly hypertensives before and after the intervention and to compare the effectiveness of Ankle Strategy Exercise and Tandem Strategy Exercise in reducing fall risk [16].

The population is the entire subject who has certain characteristics according to the research objectives and is the target of drawing conclusions [17]. The population in this study was all elderly people with hypertension registered in the working area of the Nalumsari 1 Community Health Center in the period of October to December 2024, totaling 66 people. The sample size was determined using the formula of a limited population proportion with a confidence level of 95%, a proportion of 0.5, and a margin of error of 10%, resulting in a calculation result of 39.36 respondents which was then rounded to 40 respondents [17]. The sampling technique used simple random sampling, so that every member of the population who met the criteria had an equal opportunity to become a research respondent. Inclusion criteria included elderly people aged over 59 years, suffering from hypertension with systolic blood pressure of more than 140 mmHg, experiencing balance disorders based on the results of the Timed Up and Go Test (TUGT), and willing to participate in the entire series of interventions. The exclusion criteria included elderly people who experienced neurological disorders such as stroke or Parkinson's that affected balance, using walking aids, experiencing severe musculoskeletal injuries such as severe osteoarthritis or fractures, and unwilling to participate in the intervention consistently.

Data collection was conducted using primary and secondary data. Primary data were obtained through the Timed Up and Go Test (TUGT) to measure balance and fall risk, blood pressure measurements before the intervention using a sphygmomanometer to ensure respondents met the criteria for hypertension, and direct observation during the balance exercises. Blood pressure classification refers to the categories of grade 1 hypertension, grade 2 hypertension, and hypertensive crisis according to the guidelines used in the study. Secondary data were obtained from the Nalumsari 1 Community Health Center in the form of data on the number of elderly with hypertension and other supporting information. The research instruments included a stopwatch and a chair for the Timed Up and Go Test, while the data processing used a coding system for the variables of gender, intervention group, and blood pressure category to facilitate the statistical analysis process.

Data analysis was conducted quantitatively using the latest version of SPSS software. Univariate analysis was used to describe the characteristics of respondents and the distribution of research variables including age, gender, blood pressure, and Timed Up and Go Test scores before and after the intervention in the form of minimum, maximum, mean, and standard deviation values. Normality testing was performed using the Shapiro-Wilk test because the sample size was less than 50 respondents. Furthermore, bivariate analysis was used to test differences in Timed Up and Go Test scores before and after the intervention in each group using the Paired t-test if the data were normally distributed or the Wilcoxon Signed Rank Test if the data were not normally distributed. Comparison of the effectiveness of the two intervention groups was conducted using the Independent t-test if the data were normally distributed and homogeneous, while if the data were not normally distributed, the Mann-Whitney U Test was used.

The study was conducted in November 2025 at the Nalumsari 1 Community Health Center. The initial stage of the study began with determining respondents based on inclusion and exclusion criteria, then sampling was carried out using a simple random sampling technique. All respondents underwent blood pressure measurements to determine hypertension status, followed by a pre-test using the Timed Up and Go Test as an initial measure of fall risk. Respondents were then divided into two intervention groups, namely the Ankle Strategy Exercise group and the Tandem Strategy Exercise group. Each group received exercise three times per week for one month with a duration of 10 minutes in each session. After the entire series of interventions were completed, a post-test was conducted using the Timed Up and Go Test to measure changes in fall risk in each group. All data obtained were then coded, processed, and analyzed using statistical tests according to data distribution to determine the effect of each intervention and to compare the effectiveness of Ankle Strategy Exercise and Tandem Strategy Exercise on fall risk in elderly people with hypertension.

III. RESULTS AND DISCUSSION

Respondent Characteristics

1. Age

Table 1. Frequency Distribution of Respondents Based on Age Differences in the Effect of Ankle Strategy Exercise and Tandem Strategy Exercise on the Risk of Falls in Elderly with Hypertension in Nalumsari 1.

Age Group	Mean	Median	Minimum	Maximum
Ankle Strategy Exercise	66.55	64.50	60 years old	82 years old
Tandem Strategy Exercise	66.80	67.50	60 years old	75 years old

Source: Primary Data (2025)

Based on the table above, it is known that the average age of the Ankle Strategy Exercise group is 64 years and the Tandem Strategy Exercise group is 67 years.

2. Gender

Table 2. Frequency Distribution of Respondents Based on Gender Differences in the Effect of Ankle Strategy Exercise and Tandem Strategy Exercise on the Risk of Falls in Elderly with Hypertension in Nalumsari 1.

Gender	Ankle Strategy Exercise		Tandem Strategy Exercise	
	F	%	F	%
Woman	17	85	17	85

Man	3	15	3	15
Total	20	100.0	20	100.0

Source: Primary Data (2025)

Based on the table above, it can be seen that in the Ankle Strategy Exercise group, there were 17 (85%) female respondents and 3 (15%) male respondents, while in the Tandem Strategy Exercise group, there were 17 (85%) female respondents and 3 (15%) male respondents.

Univariate Analysis

1. TUG Test values before and after intervention in the Ankle Strategy Exercise group

Table 3. Frequency Distribution of TUG Test Values Before and After Intervention in the Ankle Strategy Exercise Group

Ankle Strategy Exercise	TUG Test Score				Std. Deviation
	Min	Max	Mean	Median	
Pre-test	18 seconds	30 seconds	21.95	20.00	.832
Post test	12 seconds	27 seconds	18.75	19.00	.849
Mean difference			3.2		

Source: Primary Data (2025)

Based on the table analysis, the average pre-test TUG Test score for the Ankle Strategy Exercise group was 21.95, with a minimum score of 18 seconds and a maximum score of 30 seconds. Meanwhile, the average post-test score was 19.00, with a minimum score of 12 seconds and a maximum score of 27 seconds.

2. TUG Test scores before and after intervention in the Tandem Strategy Exercise group.

Table 4. Frequency Distribution of TUG Test Values Before and After Intervention in the Ankle Strategy Exercise Group

Tandem Strategy Exercise	TUG Test Score				Std. Deviation
	Min	Max	Mean	Median	
Pre-test	13 seconds	29 seconds	20.85	21.00	1.001
Post test	11 seconds	21 seconds	15.70	15.00	.700
Mean difference			5.15		

Source: Primary Data (2025)

Based on the table analysis, the average pre-test TUG Test score for the Tandem Strategy Exercise group was 20.85, with a minimum score of 13 seconds and a maximum score of 29 seconds. Meanwhile, the average post-test score was 15.00, with a minimum score of 11 seconds and a maximum score of 21 seconds.

Bivariate Analysis

1. Results of Normality Test in the Ankle Strategy Exercise Group and the Tandem Strategy Exercise Group

Table 5. Results of the Normality Test for the Ankle Strategy Exercise Group and the Tandem Strategy Exercise Group

Test Of Normality (Shapiro-Wilk)		
Group		Sig.
Ankle Strategy Exercise	Pre-test	.004
	Post-test	.590
Tandem Strategy Exercise	Pre-test	.634
	Post-test	.113

Source: Primary Data (2025)

Based on the results of the normality test above, the Sig value ($p < 0.05$) shows that the data is not normally distributed, so the bivariate analysis uses the Wilcoxon Signed Rank Test.

2. Wilcoxon Signed Rank Test

Table 6. Results of the Wilcoxon Signed Rank Test for the Ankle Strategy Exercise Group and the Tandem Strategy Exercise Group

Group	N	Z	p-value
Ankle Strategy Exercise	20	-3.936	0.000
Tandem Strategy Exercise	20	-3.935	0.000

Source: Primary Data (2025)

Based on the table above, the Wilcoxon test results in the ankle strategy exercise group showed a Z value of -3.936 with a p value of 0.000 (<0.05), so there was a significant difference between the TUG pre-test and post-test. Meanwhile, the Wilcoxon test results in the tandem strategy exercise group showed a Z value of -3.935 with a p value of 0.000 (<0.05), so there was a significant difference between the TUG pre-test and post-test. Because the data was not normal ($p < 0.05$), the Mann-Whitney test was used.

3. Mann-Whitney test

Table 7. Results of the Wilcoxon Signed Rank Test for the Ankle Strategy Exercise Group and the Tandem Strategy Exercise Group

Group	N	Mean Ranks	Sum of Ranks
Ankle Strategy Exercise	20	15.15	303.00
Tandem Strategy Exercise	20	25.85	517.00
Total	40		
Test Statistics			
Variables	Mann-Whitney University	Z	p-value
Delta TUG	93,000	-2,936	0.003

Source: Primary Data (2025)

Based on the results of the Mann-Whitney test, a p-value of 0.003 ($p < 0.05$) was obtained, so it can be concluded that there is a significant difference between the ankle strategy exercise group and the tandem strategy exercise group in reducing TUG values in hypertensive elderly. The mean rank value of the tandem group (25.85) was higher than that of the ankle group (15.15), which indicates that tandem strategy exercise is more effective in reducing the risk of falls.

IV. DISCUSSION

Univariate Analysis

The univariate analysis in this study aimed to describe the characteristics of the respondents and the distribution of Timed Up and Go Test (TUG) scores before and after the intervention in each group. Respondent characteristics analyzed included age and gender. Based on the results, the majority of respondents were in the early to middle elderly age range. This aligns with the characteristics of the elderly population in the study area, where increasing age is directly proportional to an increased risk of balance disorders.

Physiologically, the aging process causes a decrease in muscle mass (sarcopenia), decreased tissue elasticity, and decreased proprioceptive sensitivity. Furthermore, changes in the vascular system occur in elderly people with hypertension, which can affect cerebral perfusion and postural responses. This combination of factors contributes to an increased risk of falls. Therefore, the age characteristics of the respondents in this study are relevant to the research objectives, which focus on improving balance.

Based on gender, the distribution of respondents showed a higher number of women than men. This may be related to the higher life expectancy for women and the greater risk of osteoporosis in older women, which is indirectly linked to the risk of falls.

In the pre-intervention (pre-test) analysis of TUG scores, the average travel time indicated that respondents were in the mild to moderate fall risk category. This indicates that most elderly individuals are still capable of functional mobility, but have experienced decreased balance. After 30 days of intervention, both the ankle strategy exercise and tandem strategy exercise groups showed a decrease in average TUG scores. This decrease in travel time indicates improved mobility and balance abilities.

Clinically, a decrease in TUG scores reflects improvements in motor coordination, lower extremity muscle strength, and postural control. Regular balance training can stimulate neuromuscular adaptation, increase joint stability, and improve the body's response to positional changes. Thus, univariate analysis results indicate that both types of training have a positive impact on the balance of hypertensive elderly individuals.

Bivariate Analysis

The bivariate analysis in this study aimed to determine differences in effectiveness between interventions. The Wilcoxon test was used to determine differences in TUG values before and after the intervention in each group, while the Mann-Whitney test was used to compare the difference in change (Δ TUG) between the two groups.

The Wilcoxon test results showed that both the ankle strategy exercise group and the tandem strategy exercise group experienced a significant decrease in TUG values ($p < 0.05$). This indicates that both types of exercise are effective in improving the balance of hypertensive elderly. Theoretically, ankle strategy exercise focuses on ankle control as an initial response to mild balance disorders. This exercise strengthens the gastrocnemius and tibialis anterior muscles, and improves ankle joint stability, which plays a crucial role in maintaining upright posture.

Meanwhile, the Mann-Whitney test results for Δ TUG values showed a p -value < 0.05 , indicating a significant difference between the two intervention groups. The higher mean rank in the tandem strategy exercise group indicates that this exercise resulted in a greater reduction in TUG values than the ankle strategy exercise. Therefore, it can be concluded that tandem strategy exercise is more effective in improving balance in elderly people with hypertension.

Physiologically, tandem strategy exercise narrows the plane of support, forcing the body to optimize the function of the vestibular, visual, and proprioceptive systems simultaneously. This exercise demands more complex postural control than ankle strategy exercise, resulting in greater neuromuscular stimulation. This increased sensorimotor integration is thought to be responsible for the more significant reduction in fall risk in the tandem group. The results of this study indicate that while both interventions are effective, exercises that provide greater balance challenges tend to produce more optimal adaptations.

Research Limitations

This study has several limitations that should be considered when interpreting the results. First, the relatively limited sample size may affect the generalizability of the results to a broader population. Research with a larger sample size would likely provide greater statistical power.

Second, the 30-day intervention may not have been sufficient to assess the long-term effects of balance training on fall prevention. Certain physiological adaptations, particularly those related to increased muscle mass and joint stability, generally require a longer timeframe.

Third, this study did not strictly control for respondents' physical activity outside of exercise sessions. Variations in daily activity levels may have influenced the balance measurement results. Furthermore, other comorbid factors such as visual impairment, peripheral neuropathy, or the use of certain antihypertensive medications were not thoroughly analyzed.

Fourth, fall risk measurement used only the Timed Up and Go Test without any other instruments, so balance assessment did not cover broader aspects such as static and dynamic balance separately. Nevertheless, this study still makes an important contribution to the development of non-pharmacological interventions to reduce fall risk in older adults with hypertension, particularly at the primary healthcare level.

V. CONCLUSION

This study shows that both Ankle Strategy Exercise and Tandem Strategy Exercise have a significant effect on reducing the risk of falls in elderly with hypertension at Nalumsari 1 Health Center. The results of the Wilcoxon test showed that both groups experienced a significant difference between the Timed Up and Go Test scores before and after the intervention with a p value = 0.000. The results of the Mann-Whitney test also showed a difference in effectiveness between the two interventions with a p value = 0.003. The Tandem Strategy Exercise group had a higher mean rank value than the Ankle Strategy Exercise group, so the exercise was proven to be more effective in reducing the risk of falls in elderly with hypertension. These findings indicate that both balance exercises can be used as non-pharmacological interventions to improve balance and functional mobility in the elderly, with Tandem Strategy Exercise providing more optimal results.

This study still has several limitations, including the relatively limited number of respondents, the one-month intervention duration that cannot yet describe long-term effects, the lack of control for respond-

ents' physical activity outside of the exercise session, and the Timed Up and Go Test as the only fall risk assessment method. Therefore, further research is recommended to involve a larger sample size, extend the intervention duration, control for confounding factors such as physical activity, comorbidities, and use of antihypertensive medications, and combine several balance assessment instruments to obtain more comprehensive results. Practically, the results of this study can serve as a basis for nurses, physiotherapists, and health workers in primary health care to implement Tandem Strategy Exercise as a balance training program in an effort to prevent the risk of falls in elderly people with hypertension.

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