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The Relationship between Handgrip Strength and Balance in the Pelangi Nusantara Elderly Women's Community

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ABSTRACT

Background: As older adults age, they experience a decrease in muscle mass and strength (sarcopenia), which increases the risk of falls and impacts morbidity, mortality, and quality of life. However, evidence on the relationship between handgrip strength and balance, as measured using the timed up and go test, in community-dwelling older adults is still limited, particularly in Indonesia. Thus, the purpose of this study is to examine the relationship between handgrip strength and balance in older adults.
Methods: This study used a cross-sectional study design. The sample size in this study was 35 female individuals who met the inclusion and exclusion criteria. The handgrip strength test used a handgrip dynamometer. Meanwhile, the balance test was measured with a time up and go test. Data normality analysis used the Shapiro Wilk test method (p-value > 0.05), and Pearson correlation to analyze the relationship between two variables (p-value < 0.05).
Results: There was a significant negative correlation between the average right HGS (16.63 kg) and TUG (p-value 0.001 and r-value -0.600) and the average left HGS (15.39 kg) and TUG (p-value 0.002 and r-value -0.513).
Conclusions: : This study shows that dominant handgrip strength in community-dwelling older women is significantly correlated with balance and mobility. These findings expand the evidence in Indonesia that dominant handgrip strength has the potential to be used as an early screening indicator for functional mobility in older adults.

Keywords: handgrip strength; balance; time up and go; elderly

1. Background

Aging is a natural biological process characterized by various physiological and functional changes in the human body (Li et al., 2024). One of the main changes that occurs is characterized by a progressive loss of functional mobility which can increase the risk of injur (Zhong et al., 2024). As we age, physical abilities gradually decline due to reduced muscle mass and weakened muscle strength, a condition known as sarcopenia (Dong et al., 2024; Stotz et al., 2023). With decreased muscle strength and balance, older adults have more difficulty performing daily activities such as walking, rising from a sitting position, and maintaining body stability (Cabrolier-Molina et al., 2025). This situation is relevant to the increasing elderly population in Indonesia since 2021, with the percentage of elderly people increasing by almost 4% in the last decade to 12% (Badan Pusat Statistik Indonesia, 2024). The prevalence of sarcopenia in older individuals in Asia is estimated to be between 4.1 and 11.5% based on the criteria set by the Asian Working Group on Sarcopenia (AWGS) (Bian et al., 2020). As age increases, the prevalence of sarcopenia increases, ranging from 5-13% at age 60-70 years and 11-50% at age 80 and above (Shen et al., 2023).

Sarcopenia is a major problem in the elderly because it is characterized by progressive loss of muscle mass accompanied by an increase in fat mass, thereby increasing the risk of falls and contributing to high morbidity and mortality rates (Sharma et al., 2022). Decreased muscle mass and strength can interfere with daily activities and increase susceptibility to falls (Petnehazy et al., 2024). The frequency of falls and fractures also rises

dramatically with the number of older adults suffering from sarcopenia (Wen et al., 2023). In Indonesia, there are around 30% of cases of falls in elderly people living in the community every year, this incidence increases from 25% at the age of 70 years to 35% at the age of over 75 years (Noorratri et al., 2020). Previous research also reported that about one-third of older adults fall at least once a year, and the median was 4.1% of cases resulting in a fracture (Yeung et al., 2019). Additionally, in a systematic review the incidence of falls doubled when aged 70 years and above (Ortega-Bastidas et al., 2023). Existing evidence suggests that decreased muscle strength (sarcopenia) is a serious problem with widespread impact, necessitating efforts to identify simple and practical predictive factors to assess fall risk in the elderly community. In Indonesia, the relationship between handgrip strength and balance is mostly assessed using the Berg Balance Scale (BBS), which has limitations in terms of time efficiency. To date, research examining the relationship between handgrip strength and balance using the Timed Up and Go (TUG) in older adults in Indonesia is still very limited.

The Time Up and Go (TUG) test is an instrument frequently used to evaluate general physical performance and functional mobility in community-dwelling older adults (Gomes et al., 2023; Svinøy et al., 2021). In recent years, a study also investigated functional mobility using TUG to assess fall risk (Nurmalasari et al., 2019; Soysal et al., 2021). In functional mobility, muscle strength is very important as a predictor, especially in the performance of the TUG test during the sit-to-stand phase, and also plays an important role in the ability to walk and maintain balance (Fahrurozi et al., 2025). One alternative tool for measuring muscle strength is using a handgrip dynamometer, which has minimal side effects, is easily accessible, and is simple for the elderly (Huang et al., 2022). Handgrip strength (HGS) is a simple indicator to measure general muscle strength (Chua et al., 2020). This statement is supported by other researchers who state that HGS can predict bone fractures, functional disorders, quality of life, and cognitive disorders in the elderly (Bohannon, 2019; Salis et al., 2025). Thus, low HGS can reflect decreased muscle mass and body function, length of hospital stay, limitations in physical activity, and increased risk of mortality (Scheerman et al., 2021). Therefore, HGS can be used as an early indicator to predict the overall health status of the elderly (Solikah et al., 2025).

With decreased physiological functions such as muscle strength and balance affecting daily activities, increasing the risk of falls, and limiting their independence (Hou et al., 2024; Petermann-Rocha et al., 2022; Wiedmer et al., 2021). These two aspects are crucial for the health and independence of older adults. Although numerous studies have examined the relationship between handgrip strength and balance, studies in Indonesia generally use the Berg Balance Scale (BBS) as a balance measurement tool, which is time-consuming and impractical for community-based screening (Nathania et al., 2023; Wisyastuti & Mukrim, 2024). To date, scientific evidence specifically examining the relationship between handgrip strength and balance, as measured by the Timed Up and Go (TUG), in community-dwelling older adults in Indonesia, remains limited. Therefore, this study aims to analyze the relationship between HGS and balance in older adults. By understanding this relationship, the results are expected to inform more effective screening and intervention programs to maintain or improve the quality of life of older adults.

2. Methods

In this study, a cross-sectional study design was used. The research subjects consisted of 35 elderly women who have characteristics (age 65.02 ± 7.54 years, weight 59.48 ± 10.03 kg, height 148.82 ± 6.10 cm, BMI 26.84 ± 4.31 kg/m2). In this study, the pre-elderly group was defined as individuals aged 50–59 years, while the elderly group was defined as individuals aged 60 years and above, in accordance with commonly used gerontological classifications. There are inclusion criteria: 1) Having a physical condition that allows when taking the test 2) Age ≥ 50 years 3) Female gender. In addition, there are exclusion criteria 1) Currently experiencing health problems and muscle injuries in the upper or lower extremities 2) Male gender.

Data collection in this study used two test instruments handgrip strength (HGS) and balance (TUG) in elderly women. According to the European Working Group on Sarcopenia in Older People, HGS is the first method

used to diagnose sarcopenia in older women (Sutil et al., 2023). This method has proven to be a powerful and affordable index of muscle mass that will improve the accuracy of body composition measurements in older adults (Moncada-Jiménez et al., 2023). HGS measurements used a Takei brand handgrip dynamometer (Tokyo, Japan), which has proven high validity and reliability in assessing handgrip muscle strength in the elderly population (Savas et al., 2023). In addition, balance testing was measured with the Time Up and Go (TUG) test, which has been shown to be valid in assessing fall risk and functional mobility in the elderly (Zhou et al., 2025).

Before performing the HGS test, subjects performed a warm-up to stretch their arm muscles. During the measurement, they were asked to sit upright in a chair, with their arms at their sides, with their elbows bent at a 90-degree angle. After that, a handgrip was put on the subject's hand, and the subject squeezed it as firmly as they could. Every subject did this three times using both their left and right hands. The screen showed the handgrip strength results. After completing the HGS measurement, the subjects underwent a balance test using a timed up and go test. Before performing the test, the chair was positioned so that it would not shift when the subject moved from sitting to standing. The subject sat in a correct position, with their back and hands resting on the backrest. On the go signal, the subject stood, walked 3 meters to a line on the floor, turned around, then walked back to the chair and sat with their back resting on the backrest. Subjects were asked to walk at a normal pace, wearing their usual footwear, and were allowed to use a walking aid, but not assistance from another person. The test was performed three times, and the fastest time was recorded as the final result. Time is measured using a stopwatch from the go signal until the subject returns to sitting correctly.

Before the data was analyzed further, the raw data that had been obtained were first classified using Microsoft Excel. The data obtained from the test and measurement results were analyzed using SPSS software version 27, after the data that met the requirements were selected, a normality test was carried out using Shapiro Wilk with a significance value (p-value > 0.05). The linearity of the relationship between variables was confirmed before the correlation analysis. Next, the relationship between variables was then tested using the Pearson Correlation test, with a significance value (p-value < 0.05) and the r value as the correlation coefficient value, which indicates the strength of the relationship.

3. Results

The characteristics of the subjects used in this study are presented in this chapter. Table 1 shows the demographic characteristics of the subjects with an age range of 65.02 ± 7.54 years, which after testing for normality showed that the data were normally distributed. Furthermore, height (148.82 ± 6.10 cm), weight (59.48 ± 10.03 kg), and BMI (26.84 ± 4.31 kg/m2) also showed normally distributed data.

Table 1. Demographic Characteristics of Subjects

Variabel	Mean ± SD	p-value
Age	65.02 ± 7.54	0.648
Height (cm)	148.82 ± 6.10	0.963
Weight (kg)	59.48 ± 10.03	0.574
BMI (kg/m^2)	26.84 ± 4.31	0.310

Table 2 shows the handgrip strength (HGS) of the subjects. The right (16.63 ± 3.79 kg) and left (15.39 ± 4.02 kg) HGS values were found to be normally distributed after a normality test. Based on international standards (Tomkinson et al., 2025). In this study, the average age of the subjects was 65.02 years, with an age range of 51-85 years, with a threshold value of 10.9-16.9 kg in elderly women. Furthermore, these values also fall within the muscle weakness category, when compared with the diagnostic limits (<28.0 kg for men and <18.0 kg for women) in the study (Chen et al., 2020).

Table 2. Normality Test Results of Handgrip Strength

Variabel	Mean ± SD	p-value
HGS Right (kg)	16.63 ± 3.79	0.925
HGS Left (kg)	15.39 ± 4.02	0.273

Based on table 3 shows the results of the TUG test on the subject. The TUG test (10.74 ± 2.52) showed a normally distributed data after normality testing. The TUG time threshold in this study was based on previous research, which established a value of 10.2 seconds as an indicator of physiological fall risk in elderly Asians.(Choo et al., 2021)

Table 3. Normality Test Results of Time Up and GO

Variabel	Mean ± SD	p-value
TUG Test (s)	10.74 ± 2.52	0.092

In this table 4 shows the results of the correlation between HGS and the TUG test in the elderly, where the right HGS correlated with the TUG test (p value 0.001 and r value -0.600), and the left HGS correlated statistically significantly with the TUG test (p value 0.002 and r value -0.513). It can be interpreted that the stronger the handgrip, the shorter the TUG completion time, which indicates better functional mobility in the elderly.

Tabel 4. Hasil Statistika Korelasi Variabel

Variable	HGS Kanan	HGS Kiri
TUG Test	.001 r= -.0.583	.002 r= -0.495

4. Discussion

Using a cross-sectional design, this study identified the relationship between handgrip strength (HGS) and balance in older adults as measured using the Time Up and Go (TUG) test. This study demonstrated the relationship between handgrip strength (HGS) and balance in older adults. This indicates that older adults with stronger HGS tend to complete the TUG test faster. Furthermore, the study found that right HGS, with an average of 16.63 kg (r -0.583), had a stronger correlation with TUG time, while left HGS, with an average of 15.39 kg (r -0.495), had a lower correlation. This suggests that the majority of older adults often use their right hand as their dominant hand, indicating overall strength with right HGS.

The result of this study are consistent with previous studies that found HGS to be a useful clinical indicator of physical condition and mobility limitations in older adults (Fahrurozi et al., 2025; Zhou et al., 2025). Other studies have also shown that HGS can be used as a simple screening tool to identify the risk of falls and physical function decline in older adults (Alonso et al., 2018; Bohannon, 2019). Thus, HGS reflects not only the strength of specific muscles in the arm, but also the overall muscle strength of the body, which is related to mobility. In this study, both right and left HGS were found to have a significant negative correlation with TUG. However, a stronger relationship was observed in the right hand, which is generally the dominant hand in most subjects.

These findings may be explained by differences in strength and function between the dominant and non-dominant sides. This suggests that although both sides contribute to mobility, the dominant right hand better represents overall muscle strength capacity. Previous studies have shown differences in right (dominant) and left (non-dominant) HGS, with clinical significance in assessing balance in older adults (Vaishya et al., 2024). In

addition, higher dominant HGS can be used as an early screening tool for fall risk, so that medical personnel can be more practical in identifying fall risk (Nathania et al., 2023; Sumandar et al., 2021).

Dominant HGS is often used as a more representative indicator because it better reflects muscle and neuromuscular adaptation and is frequently used in daily activities. This statement aligns with previous research that has confirmed that daily activity patterns influence right and left HGS in older adults (Han et al., 2025). Previous studies have also shown a strength asymmetry between the dominant and non-dominant sides, where the dominant hand is used more frequently in daily activities, thus contributing to better neuromuscular adaptation and muscle strength (Foley et al., 2025). These results are consistent with the finding that dominant hand HGS is 4–6% higher than non-dominant hand HGS in adult participants (Agtuahene et al., 2023). Previous research found that HGS in the dominant hand was more closely associated with walking performance, balance, and lower extremity muscle strength (Chattalia et al., 2020). This supports our research findings, which suggest that HGS reflects overall functional capacity. Furthermore, hand dominance is also associated with neural and muscular adaptations that play a role in motor coordination and physical performance (Eswari et al., 2025).

The findings of this study have important practical implications for healthcare for older adults. Measuring handgrip strength (HGS), particularly in the dominant hand, can be used as a simple, rapid, and cost-effective initial screening tool to identify the risk of mobility decline and falls in older adults, particularly in primary and community healthcare settings. This study has the advantage of using a simple, practical, and easily understood measurement method for older adults, and no special treatment. The HGS we implemented has proven to be sensitive in assessing overall physical capacity. When combined with the timed up and go test, this measurement can provide a more comprehensive picture of the dynamic balance of older adults. Based on these findings and supported by previous research, lower extremity functional strength training, static and dynamic balance training, and interventions that improve handgrip strength can be considered as preventive methods to reduce the risk of falls in the elderly (Choudhary et al., 2025).

Our study also has several limitations, the most important of which is our small number of subjects (n=35) and our sample size from a single community, making the results less generalizable. In addition, other factors that could potentially influence balance and TUG performance, such as lower extremity muscle strength, nutritional status, chronic diseases, daily physical activity levels, and living environment conditions, were not analyzed in depth in this study. Therefore, further research is recommended to involve a larger sample size and consider these factors to gain a more comprehensive understanding of the relationship between HGS and balance in the elderly.

5. Conclusions

This study demonstrated a significant negative correlation between handgrip strength (HGS) and balance performance as measured by the timed up and go (TUG) test in older adults, with a stronger relationship in the dominant hand than in the non-dominant hand. These findings suggest that HGS in the dominant hand has the potential to be used as a simple and practical early screening indicator to assess the risk of declining mobility and physical function in older adults in public health settings. Practically, these results support the implementation of simple physical activity programs, such as handgrip strengthening exercises using rubber balls or handgrips, static and dynamic balance exercises, and functional lower extremity strength training, which can be performed independently at home or through community-based programs. Future research is recommended to involve larger samples and more diverse populations and include additional variables such as muscle mass and lower extremity muscle strength.

6. Acknowledgements

7. References

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