Research Paper

Elderly Empowerment: Unveiling the Link Between Physical Performance and Daily Activity

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ABSTRACT

Objectives: Declining motor function is a prevalent concern in aging populations, often leading to decreased independence and higher fall risk. Regular physical activity is a key preventive strategy; however, its assessment remains complex, especially in outpatient clinical settings. This study aimed to evaluate the relationship between objective physical performance measures and self-reported physical activity in functionally independent elderly women aged 60–70 years.

Methods: A cross-sectional study was conducted among 66 community-dwelling women. Participants were functionally independent and were assessed for physical activity using the physical activity scale for the elderly (PASE) and for performance using the short physical performance battery (SPPB), the six-minute walk test (6MWT), and handgrip strength. Data were analyzed using Pearson correlations and multiple linear regressions.

Results: Bivariate correlation analysis showed that only the SPPB score was significantly associated with log-transformed PASE scores ($r=0.27$; $P=0.026$). Neither the 6MWT nor handgrip strength showed a significant correlation ($P>0.05$). Multivariate regression confirmed SPPB as the sole independent predictor of physical activity ($\beta=0.012$; $P=0.026$), explaining a modest 6% of the variance ($R^2=0.06$).

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Discussion: Among the three indicators assessed, SPPB emerged as the strongest and only independent correlate of physical activity in this cohort of older women. Given the modest variance explained, SPPB's composite assessment of lower-limb function is associated with habitual physical activity and may be useful as part of screening to identify individuals at risk of sedentary behavior. Clinicians should consider SPPB as a valuable and efficient tool for initial functional assessments.

Highlights

- The SPPB showed a significant positive correlation with physical activity scores in robust older women.
- 6MWT and handgrip strength were not significantly associated with physical activity levels in this cohort.
- SPPB emerged as the sole independent predictor, explaining a modest 6% of the variance in physical activity.
- Incorporating SPPB into clinical screening may be useful for assessing risk of low activity and guiding targeted rehabilitation.

Plain Language Summary

As people age, their ability to move and stay active often decreases, which can affect independence and quality of life. This study looked at how physical performance relates to daily activity levels in healthy women aged 60–70. We tested walking ability, lower-body strength and balance, and hand strength, and compared these results with the participants' self-reported daily activity levels. We found that the lower-body strength and balance test (the short physical performance battery [SPPB]) was the only measure linked to higher activity levels. Walking distance and hand strength were not meaningfully correlated. These findings suggest that a simple and quick test of lower-body function may be useful for identifying older adults at risk of becoming less active. Early detection of this condition means that healthcare providers can better recommend exercise programs that focus on balance and strength, helping older adults to stay independent and reduce their risk of falls.

Introduction

The global demographic shift toward an aging population presents a significant challenge to health systems. This demographic trend requires a proactive approach centered on promotive and preventive care. For older adults, maintaining functional independence is a primary objective to support social participation and quality of life [1]. Functionally healthy elderly women, despite being free of major diseases, still face physiological degenerative processes that affect locomotor capacity and daily physical activity, including decreased muscle mass, strength, and aerobic stamina [2].

Regular physical activity is a cornerstone of healthy aging and serves as an effective preventive measure against chronic diseases and disability. Structured and sustained aerobic and resistance training can restore neuromuscular balance and improve functional capacity [3]. While direct physical activity measurement is often impractical due to technical and economic constraints, there is a clear need for objective and valid performance-based tools. These tools should accurately reflect an elderly person's activity level.

The short physical performance battery (SPPB), the six-minute walk test (6MWT), and handgrip strength are three such widely used and validated measures in geriatric practice. The SPPB assesses balance, gait, and lower limb strength. The 6MWT evaluates submaximal aerobic capacity. Handgrip strength serves as a reliable indicator of overall muscle strength and functional capacity. In parallel, the physical activity scale for the elderly (PASE) provides a self-reported, quantitative assessment of physical activity that has been widely utilized in international studies of aging populations [4, 5].

A research gap exists regarding the association between these specific performance measures and self-reported physical activity, particularly among functionally healthy older women. Understanding this relationship is crucial for informing clinical decisions and designing effective community-based interventions. Therefore, this study aimed to evaluate the association between the 6MWT, handgrip strength, and SPPB with physical activity, as measured by the PASE. Our findings will help identify the most representative functional indicators for this specific population.

Materials and Methods

This was a cross-sectional study specifically designed to examine the magnitude of association between objective physical performance measures and self-reported physical activity in older women. The research was systematically conducted at the Outpatient Rehabilitation Medicine Unit, Islamic Hospital Jakarta Pondok Kopi. Data collection occurred during a fixed period, from July to September 2024.

The study utilized a convenience sampling strategy to recruit participants. The target population was defined as functionally independent, community-dwelling older women seeking assessment at the clinical site. The minimum sample size was determined a priori using a formula to compare two unpaired numerical groups. This calculation required a minimum enrollment of 68 subjects to achieve the desired power of 80%. The final sample size was 66 participants, as two subjects were lost to follow-up due to non-attendance at the final assessment.

Eligible participants were women aged 60-70 years. This boundary aligns with the global definition from the World Health Organization (WHO), which establishes the elderly population at age 60 [6]. The selection of the upper limit of 70 years was based on evidence that the rate of muscle mass decline, which starts at approximately 1% per year in middle age, drastically increases to approximately 3% per year after age 70 [7]. This age restriction was designed to focus the study on a relatively homogenous group before the phase of accelerated functional loss. The final enrolled sample consisted exclusively of women. This was a pre-specified design choice implemented to ensure a homogenous sample and to control for significant biological and hormonal confounding factors that are known to influence physical performance differently between sexes [8].

The primary outcome variable was the physical activity level, quantified using the total score from the PASE. The primary exposure variables were three objective functional measures. Physical activity was assessed using the PASE questionnaire. This tool is globally recognized as valid and reliable for assessing physical activity in older adults [9]. The version utilized has demonstrated acceptable validity and reliability in the Indonesian language (PASE-INA) within community-dwelling elderly populations [10].

Three objective, performance-based measures were administered in a single session. The SPPB assessed lower-extremity function. This tool is highly validated for predicting future disability and mortality in older adults [11]. It consists of balance, gait speed, and sit-to-stand components. The 6MWT was strictly conducted to evaluate submaximal aerobic capacity. The procedure adhered to standardized American Thoracic Society guidelines, confirming its high reliability and clinical relevance [12]. Handgrip strength was measured using a Jamar hydraulic hand dynamometer. This device is the recognized gold standard for assessing peripheral muscle strength, demonstrating excellent test, re-test reliability [13]. The mean value of three maximal contractions from the dominant hand was recorded and expressed in kilograms (kg).

Descriptive statistics were used to characterize the sample. The PASE score was non-normally distributed. It was subsequently log-transformed prior to analysis to meet the assumptions of normality required for linear regression. Bivariate relationships were evaluated using the Pearson correlation coefficient (r) between the log PASE score and the three performance measures. Variables exhibiting a $P \leq 0.25$ were included in the subsequent multivariate linear regression model. This final model reported the unstandardized regression coefficient (β) and the 95% confidence interval (CI). A $P \leq 0.05$ was designated as the threshold for statistical significance.

Results

A total of 66 older women participated in the study. Table 1 summarizes the descriptive characteristics of the participants and primary outcome measures. The log-transformed PASE score was normally distributed, with a mean of 1.3±0.1. When back-transformed, the corresponding activity index yielded a mean of 19.5 (95% CI, 18.7%, 20.3%). Functional performance was assessed using the SPPB, the 6MWT, and handgrip strength. SPPB scores had a non-normal distribution, with a median of 9 (range: 4–12). The median 6MWT distance was 346 meters (range: 122–449), and the average grip strength was 16.2±3.4 kg.

Table 1. Subject characteristics

Variables	Value (n=66)	Reporting Method
Log PASE	1.3±0.1	Mean±SD
Transformed PASE	19.5 (95% CI, 18.7%, 20.3%)	Mean (95% CI)
SPPB (score)	9 (range: 4–12)	Median (min–max)
6MWT (meters)	346 (range: 122–449)	Median (min–max)
Grip strength (kg)	16.2±3.4	Mean±SD

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Abbreviations: SPPB: Short physical performance battery; PASE: Physical activity scale for the elderly; 6MWT: Six-minute walk test; CI: confidence interval.

Table 2. Bivariate correlation between functional measures and log PASE

Variables	Correlation Coefficient (r)	95% CI	P
SPPB	0.27	0.030, 0.481	0.026
6MWT	0.03	-0.214, 0.270	0.782
Grip strength	–0.10	-0.333, 0.147	0.441

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Abbreviations: SPPB: Short physical performance battery; PASE: Physical activity scale for the elderly; 6MET: Six-minute walk test.

Bivariate Pearson's correlation analysis was performed between the log PASE score and the three objective physical performance measures. Only the SPPB score demonstrated a statistically significant positive correlation with log PASE (r=0.27, P=0.026). Conversely, neither the 6MWT nor handgrip strength showed any significant associations with self-reported activity. Table 2 shows the results of this initial correlation test, detailing the coefficient (r) and P for each measure and Table 3 outlines the results of the multivariate linear regression predicting log PASE test. The positive relationship between the SPPB score and the log PASE score is visualized in Figure 1. The lack of correlation for the 6MWT and Grip Strength are shown in Figure 2 and Figure 3, respectively.

A weak positive linear association was observed between functional performance as measured by SPPB and physical activity (log-transformed PASE scores) in older women (r=0.27; P=0.026), suggesting modest correlation strength.

No significant relationship was found between aerobic capacity (6MWT) and physical activity levels (log PASE) (r=0.03; P=0.782), indicating independence between these variables.

The analysis revealed no correlation between peripheral muscle strength (grip strength) and physical activity scores (r=–0.10; P=0.441), underscoring the functional specificity of PASE.

Table 3. Multivariate linear regression predicting log PASE

Predictor	Unstandardized Coefficient (β)	SE	Standardized Coefficient (β)	95% CI	P
Constant	1.171	0.053		1.066, 1.277	<0.001
SPPB	0.012	0.005	0.274	0.002, 0.023	0.026

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Abbreviations: SPPB: Short physical performance battery; PASE: Physical activity scale for the elderly; SE: Standard error.

Regression equation: log PASE=1.171+0.012×SPPB; R^2=0.06.

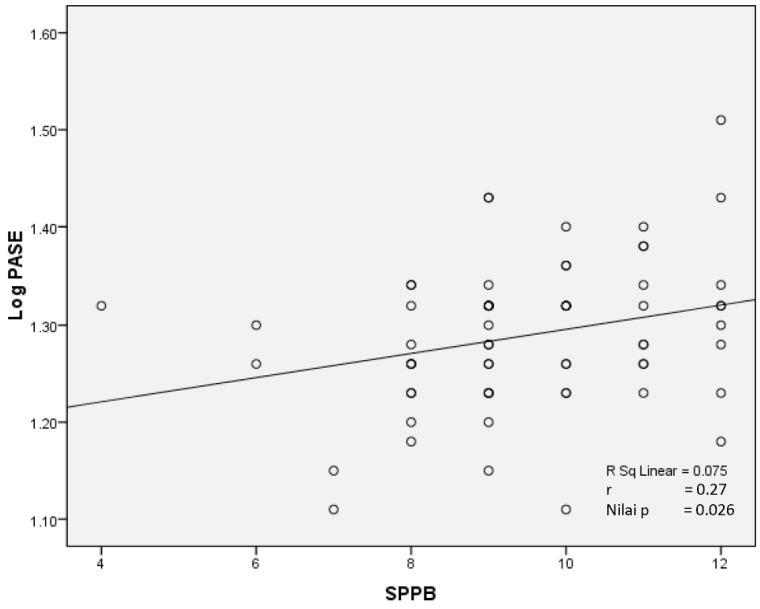

Figure 1. Scatter plot of SPPB scores against log PASE

The multivariate analysis confirmed that the SPPB score was the only significant factor predicting physical activity levels (P=0.026). The results showed a positive relationship: For every one-point increase in a person's SPPB score, their predicted physical activity (Log PASE) increased by 0.012 units. Although this relationship was statistically reliable (meaning the true effect is likely between 0.002 and 0.023), the model had low explanatory power, accounting for only 6% (R^2=0.06) of the differences in activity levels among the women studied (Table 3).

Discussion

This study examined the relationship between objective physical performance measures and self-reported physical activity (PASE) in a healthy cohort of older women. Our most important finding confirms a significant link between the SPPB score and reported activity. This result firmly established the SPPB as the single, crucial independent predictor among the performance measures used (P<0.05).

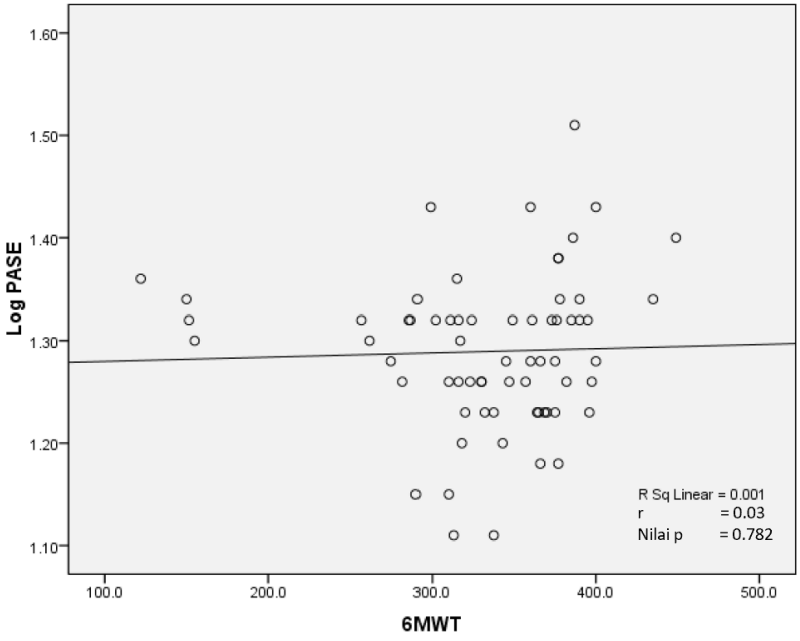

Figure 2. Scatter plot of 6MWT distance against log PASE

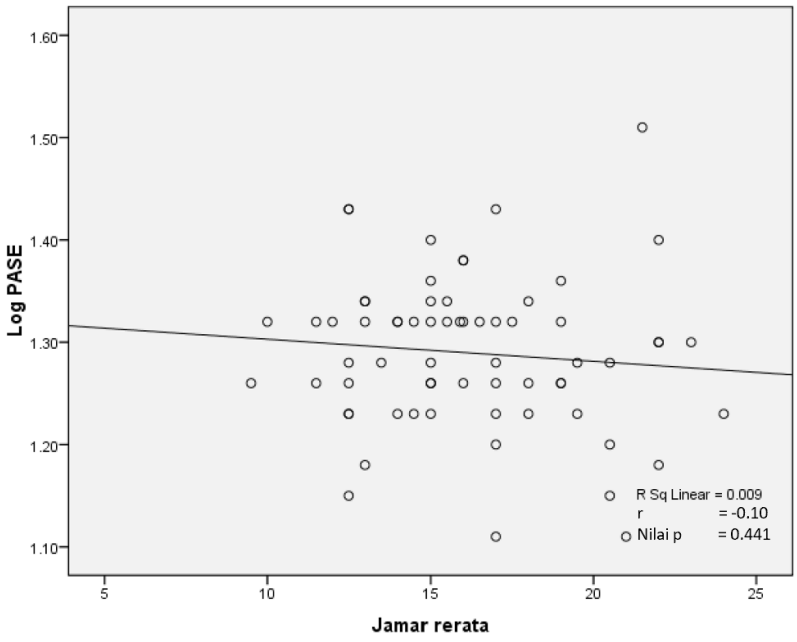

Figure 3. Scatter plot of handgrip strength against log PASE

The SPPB captures a composite function and summarizes three key lower-extremity abilities: Balance, gait speed, and sit-to-stand strength. These specific motor skills are prerequisite movements for the routine daily tasks counted by the PASE, such as household chores and local transport [14]. Thus, the SPPB offers a highly relevant functional proxy for the operational capacity required to sustain an active routine.

Our findings strongly validate the SPPB's robust position in geriatric science. The test's utility in predicting important health outcomes, including cardiovascular events and mortality, is well-documented [11]. Furthermore, our results align well with objective activity studies. Research using accelerometry consistently shows that higher SPPB scores translate directly to more time spent in light and moderate-to-vigorous physical activity [15, 16]. This consistent pattern suggests that functional capacity, measured by the SPPB, serves as the primary mechanism driving habitual activity performance in older individuals.

Notably, neither the 6MWT nor handgrip strength demonstrated a significant association with the PASE scores. This divergence highlights a key conceptual difference: these tests assess maximum capacity, but the PASE tracks actual habitual activity levels. The 6MWT measures submaximal aerobic endurance, or the maximum distance a person can walk. Our highly independent cohort likely has endurance that exceeds the minimal fitness level required for the moderate-intensity daily tasks reported in the PASE. This results in a functional ceiling effect, where the 6MWT loses sensitivity for differentiating activity levels within this healthy group. This is often different in clinical settings; the 6MWT primarily serves to predict cardiorespiratory fitness rather than daily steps in healthy populations [17].

Similarly, handgrip strength primarily captures upper-body strength. Though it is a vital indicator for overall frailty, as recognized by the European Working Group on Sarcopenia, the PASE mainly documents activities dependent on lower-body function [18]. Consequently, its failure to serve as an independent predictor in our model is logical. Previous work supports this: Studies focusing on mobility limitation in women often find that while grip strength is relevant, lower-body measures offer a more direct link to walking and mobility [19].

A key strength of this study is its strictly homogeneous cohort of women aged 60-70 years. We intentionally controlled for sex and age range to minimize major biological confounders, such as variability from advanced age or mixed-sex physiology. This controlled environment allowed us to obtain cleaner, more direct evidence supporting the functional link between the SPPB and physical activity. Ultimately, this focused approach helps resolve inconsistencies reported in broader literature. Clinically, our result provides a clear directive: for screening and tracking activity-related functional decline in similar healthy female cohorts, the SPPB should be the prioritized screening tool [20].

We must acknowledge several limitations despite these insights. First, our cross-sectional design only permits confirming an association; we cannot claim that an improved SPPB score causes increased physical activity. Longitudinal studies will be necessary to establish causality. Second, our use of convenience sampling and exclusive focus on a healthy, independent group introduces selection bias. This limits the generalizability of our conclusions to frail or institutionalized populations. Third, the self-reported PASE questionnaire is inherently subject to recall bias, which may slightly inflate reported activity levels. Finally, the regression model yielded a low explanatory power (R^2=0.06). This low variance signals that most differences in physical activity are driven by unmeasured factors, such as psychological states or environmental conditions. This supports the need for a broad, multidimensional model of physical activity determinants.

Conclusion

This study successfully evaluated the relationship between three objective physical performance measures and self-reported physical activity in functionally healthy older women aged 60–70 years. The SPPB score exhibited a statistically significant positive correlation with physical activity and emerged as the sole independent predictor in the model. Given the modest variance explained (R^2=0.06), this result suggests that the SPPB's composite assessment of lower-limb function is associated with, and may be useful as part of screening for, habitual physical activity in this specific population. Clinicians and researchers should consider the SPPB as a valuable and efficient tool for initial assessment. Future intervention studies should continue to utilize the SPPB as a functional outcome measure.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Dr. Cipto Mangunkusomo National Hospital, Faculty of Medicine, University of Indonesia, Jakarta, Indonesia (Code: KET-1750/UN2.F1/ETIK/PPM. 00.02/2024).

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Authors' contributions

Conceptualization: Umi Sjarqiah and Nury Nusdwinuringtyas; Methodology: Evy Yunihastuti and Ikhwan Rinaldi; Investigation: Aulia Rizka and Maria Regina Rachmawati;Supervision: Ruliando Hasea Purba and Siti Chandra Widjanantie; Review and editing: Muhammad Syauqi Ridhallah;Writing the original draft: Muhammad Jalaluddin Rumi.

Conflict of interest

The authors declared no conflicts of interest.

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