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A Original Article

Relationship of Hand Grip Strength with Sleep Disturbances and Gait Speed in Older Adults: A Pilot Study of Gender Stratified Analysis

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ABSTRACT

Context: Hand grip strength (HGS) is a simple and reliable indicator of muscle function in older adults and may be associated with mobility and sleep quality. evidence regarding these relationships, particularly with gender-specific analysis in the Southern Karnataka population is limited.

Aims: To examine the relationship between hand grip strength with gait speed, and sleep disturbance among older adults living in community-dwelling and to explore gender-specific differences.

Settings and Design: A cross-sectional pilot study.

Methods and Material: Eighteen community-dwelling older adults (8 males, 10 females) aged 60–74 years participated. hand dynamometry is used has assessment for hand grip strength, gait speed using the 4-m gait speed test, and sleep disturbance was assessed by using Pittsburgh Sleep Quality Index (PSQI).

Statistical analysis used: Descriptive statistics, Shapiro–Wilk test, Mann–Whitney U test, Spearman's rank correlation, and gender-stratified linear regression analysis was performed.

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Results: Greater hand grip strength was seen in male participants than females ($p<0.001$), while gait speed and PSQI scores did not differ significantly between genders. There was not any significant association of hand grip strength with gait speed or sleep disturbance. in gender-stratified regression, there was significant association seen between hand grip strength and gait speed in males only ($p=0.014$).

Conclusions: Poorer sleep quality was associated with slower gait speed, whereas hand grip strength showed a gender-specific association with gait speed only in males.

KEYWORDS

• Hand grip strength • Gait speed • PSQI

Key Messages: there is no significant relationship of hand grip strenght with gait or sleep quality

INTRODUCTION

The world is experiencing rapid acceleration of global population aging, which represents one of the most consequential demographic transformations of the twenty-first century[1]. According to the World Health Organization, the proportion of the world's population over 60 years of age is expected to nearly double from 12% to 22% between 2015 and 2050, translating to approximately 2 billion older adults worldwide by mid-century.

Population ageing has emerged to be one of the most significant demographic transitions worldwide. Improvements in healthcare, nutrition, sanitation, and living conditions have contributed to increased life expectancy, resulting in a rapidly growing older adult population2. As individuals age, progressive declines occur in musculoskeletal, neurological, cardiovascular, and sensory systems, leading to reduced physical performance and increased vulnerability to disability, falls, hospitalization, and mortality[3]. Therefore, identifying simple and reliable indicators of functional health in older adults has become an important area of geriatric research.

Muscle strength is a fundamental component of physical function and healthy ageing. Living, maintaining balance, preserving mobility, and preventing functional dependence[4].

Reduced muscle strength has been linked to an increased risk of falls, frailty, disability, institutionalization, and mortality, making it an important marker of overall health status in the elderly population[5].

Handgrip strength assessment requires minimal equipment and can be performed easily in both clinical and community settings[6]. Although it primarily measures the strength of the forearm and hand muscles, research has demonstrated that handgrip strength is strongly correlated with overall muscle strength and physical performance[7]. Consequently, handgrip strength has been increasingly used as a surrogate marker of general health and functional capacity among older adults.

One factor that has received increasing attention in recent years is sleep. Sleep is a fundamental biological process that plays a critical role in overall well-being[8]. Adequate sleep is essential for maintaining physiological homeostasis and supporting optimal physical performance. However, sleep disturbances are highly prevalent among older adults and represent a major public health concern[9].

Epidemiological studies suggest that a substantial proportion of older adults experience one or more forms of sleep disturbance, which can negatively affect physical, psychological, and social functioning[10]. Persistent sleep problems have been associated with fatigue, impaired cognition, mood disorders, decreased quality of life, and increased healthcare utilization[11].

Emerging evidence indicates that sleep disturbances may also influence muscle strength and physical performance[12]. In some studies, it has reported that significant associations between poor sleep quality and reduced handgrip strength in older adults[13].

Another important indicator of physical function in ageing populations is gait speed. Gait speed refers to the rate at which an individual walks and is considered one of

the most informative measures of mobility and functional performance[14]. It reflects the integrated functioning of multiple physiological systems, including the musculoskeletal, neurological, cardiovascular, and sensory systems. Because of its strong predictive value for health outcomes, gait speed has often been referred to as the "sixth vital sign" in geriatric assessment[15].

A decline in gait speed is frequently observed with advancing age and is associated with a range of adverse outcomes. Slower gait speed has been linked to increased risk of falls, disability, hospitalization, cognitive decline, frailty, and mortality[16]. Even small reductions in walking speed may indicate underlying health problems and future functional deterioration. Consequently, gait speed has become an essential component of comprehensive geriatric assessment and is widely used to evaluate mobility and predict health outcomes in older adults[17].

Individuals with lower handgrip strength often exhibit slower walking speeds, poorer mobility, and greater functional impairment compared to those with higher grip strength[18]. Because handgrip strength is simple to assess and strongly associated with mobility outcomes, it may serve as a useful screening tool for identifying older adults at risk of gait impairment.

And recent research has also suggested a potential link between sleep disturbances and gait performance[19]. Older adults experiencing sleep disturbances might be demonstrate slower gait speed and increased gait variability, thereby increasing their risk of falls and mobility limitations[20]. Sleep-related impairments in cognitive and motor function may further contribute to difficulties in maintaining normal walking performance, particularly in complex environments[21].

Gender differences have also been observed in sleep characteristics. Older women frequently report a higher prevalence of sleep disturbances, insomnia symptoms, and poor sleep quality compared to men[22]. Hormonal changes, psychosocial factors, caregiving responsibilities, and differences in health conditions might contribute to these variations. In contrast, men may experience different sleep-related disorders and patterns of age-related sleep change[23]. These differences suggest that the link between hand grip strength and sleep disturbances and physical performance may not be identical across genders.

Furthermore, limited research has specifically explored whether these relationships differ between older aged men and women. Understanding such gender-specific patterns may facilitate the growth of targeted screening approaches and individualized interventions aimed at preserving functional independence and promoting healthy ageing.

By examining these associations separately among men and women, a deeper understanding of gender-specific differences in physical function and contribute to evidence-based strategies for promoting healthy ageing and functional independence among older adults.

And also, there is limited research available regarding these relationships in the South Indian population, where nutritional habits, lifestyle patterns, and socio-cultural factors may differ. Furthermore, gender-specific variations in these associations remain inadequately explored.

MATERIALS AND METHODS

A pilot study was conducted among community-dwelling older adults aged ≥60-74 years over a period from June 2025 to March 2026. The included 18 participants, who were cognitively intact, ambulatory with or without assistive devices, and able to understand and respond to assessment instructions and questionnaires and participants were screened for cognitive impairment using tool MoCA.

Participants were recruited based on predefined inclusion and exclusion criteria. Written informed consent was secured from all participants, with consent forms provided in both Kannada and English to ensure better comprehension.

Sleep quality was assessed using the PSQI, which was self-administered by the participants under supervision to ensure clarity and accuracy.

Muscle strength was assessed using a hand dynamometry, with handgrip strength measured in both dominant and non-dominant hands. participant performed three trials on each hand, and the best of the three trials was recorded for analysis.

Gait speed was assessed using the 4-m gait speed test, where in both usual gait speed and maximal gait speed were evaluated by instructing participants to walk at their normal pace and as fast as safely possible, respectively.

All assessments were conducted in a standardized and controlled environment to ensure consistency. Gender-Stratified analysis was performed to assess differences in handgrip strength, sleep quality, and gait speed between male and female participants.

RESULTS

A total of 18 older adults participated in this pilot study, including 8 males and 10 females, aged 60–74 years. hand grip strength was considered the independent variable, while sleep disturbance (PSQI total score) and usual gait speed were the dependent variables. Descriptive statistics, Shapiro–Wilk normality testing, Spearman's rank correlation, Mann–Whitney U test, and gender-stratified regression analysis was performed.

Table 1: Descriptive Statistics and Gender Comparison of Study Variables

Variable	Gender	Mean ± SD	Median	Min – Max	p-value
Dominant Hand Grip Strength (kg)	Male (n=8)	31.65 ± 6.265	29.25	26.5 – 43.0	< 0.001*
	Female (n=10)	20.37 ± 3.267	21.20	15.7 – 25.0	
Usual Gait Speed (m/s)	Male (n=8)	0.931 ± 0.349	1.025	0.33 – 1.33	0.573
	Female (n=10)	0.923 ± 0.177	0.945	0.59 – 1.14	
PSQI Total Score	Male (n=8)	5.88 ± 1.885	5.0	4 – 9	0.393
	Female (n=10)	6.70 ± 2.003	7.0	3 – 9	

†p-values based on Mann–Whitney U test; *Statistically significant at $p < 0.05$; SD = Standard Deviation; PSQI = Pittsburgh Sleep Quality Index

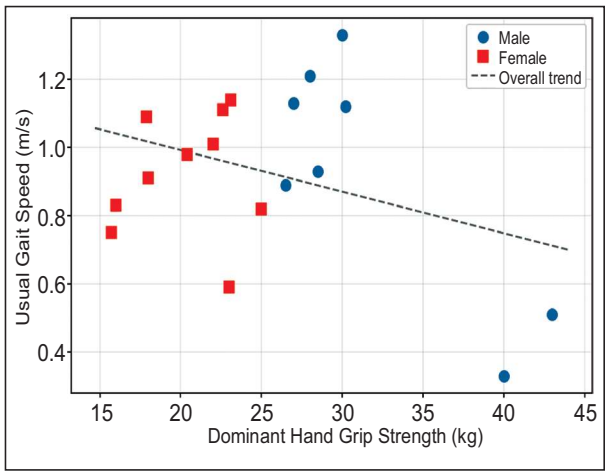


Figure 1: Correlation between hand grip strength (kg) and gait speed (m/s) among older adults

Assessment of Sleep Disturbance

Sleep disturbance was assessed using PSQI, where higher scores indicate poorer sleep quality. Female participants demonstrated a slightly higher median PSQI score than males; however, the gap was not statistically significant (U=30, p=0.393), indicating comparable sleep quality between genders.

Assessment of Hand Grip Strength

Hand grip strength differed significantly between males and females. Male participants displayed significantly greater grip strength (31.65 ± 6.27 kg) than female participants (20.37 ± 3.27 kg) (U=80, p<0.001), indicating a significant gender difference in muscular strength.

Table 2: Spearman's Correlation and Regression Analysis Results

Analysis	ρ / R^2	β (Estimate)	p-value
Grip Strength and Gait Speed	ρ = 0.073	—	0.773
Grip Strength and Sleep Disturbance (PSQI)	ρ = −0.384	—	0.116
Gait Speed and Sleep Disturbance (PSQI)	ρ = −0.607	—	0.008*
Grip and Gait Speed (Males)	R^2 = 0.663	−0.045	0.014*
Grip and Gait Speed (Females)	R^2 = 0.014	0.007	0.737
Grip and PSQI (Males)	R^2 = 0.006	−0.025	0.852
Grip and PSQI (Females)	R^2 = 0.190	−0.267	0.208

*Statistically significant at $p < 0.05$; ρ = Spearman's rho; R^2 = Coefficient of determination; β = Regression coefficient

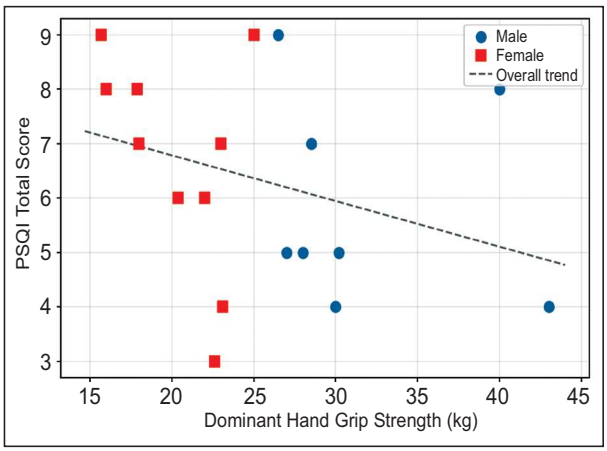


Figure 2: Correlation between hand grip strength (kg) and sleep disturbance (PSQI total score) among older adults ($\rho = -0.384$, $p = 0.116$).

Assessment of Gait Speed

The mean usual gait speed was 0.931 ± 0.349 m/s in males and 0.923 ± 0.177 m/s in females. No statistically significant difference was observed between genders (U=47, p=0.573), suggesting comparable mobility performance.

Correlation Analysis

Spearman's rank correlation analysis demonstrated no significant association between hand grip strength with usual gait speed (ρ=0.073, p=0.773). Similarly, no significant association was observed between hand grip strength with PSQI total score (ρ=−0.384, p=0.116), although a moderate negative trend was noted.

A statistically significant negative correlation was identified between gait speed and PSQI total score (ρ=−0.607, p=0.008), indicating that greater sleep disturbance was associated with slower gait speed.

Gender-Stratified Regression Analysis

Gender-stratified regression analysis was performed to examine whether the relation between hand grip strength and the study outcomes differed between males and females.

Among males, hand grip strength showed a significant association with gait speed (R^2=0.663, β=−0.045, p=0.014), whereas no significant link was observed among females (R^2=0.014, β=0.007, p=0.737).

For sleep disturbance, hand grip strength was not significantly linked with PSQI scores in either males (R^2=0.006, β=−0.025, p=0.852) or females (R^2=0.190, β=−0.267, p=0.208). These findings suggest that the association between hand grip strength and gait speed differed by gender, while no significant gender-specific association was seen between hand grip strength and sleep disturbance in this pilot study.

DISCUSSION

The present study investigated relationship of hand grip strength with sleep disturbances and gait speed in older adults. The main showed that, female participants demonstrated slightly higher PSQI scores than male participants; however, the difference was not statistically significant, indicating comparable sleep quality between genders. This finding is consistent with the meta-analysis by Lu *et al.*, which reported no significant difference in overall PSQI scores between older men and women, despite women exhibiting slightly poorer sleep in some sleep domains[24]. Similarly, Li *et al.* observed that women tended to report poorer subjective sleep quality than men, although gender differences in overall sleep quality have been inconsistent across studies[25].

Male participants there was significantly greater hand grip strength than female participants. This finding is congruent with the study by Wearing *et al.*, who reported that older men had significantly higher hand grip strength than women across all age groups[26]. Similarly, Bohannon *et al.*, stated that males generally exhibit greater grip strength than females because of higher skeletal muscle mass, larger forearm muscle cross-sectional area, and hormonal differences, particularly higher testosterone levels[27].

The present study found no significant statistically difference in gait speed between male and female participants, indicating comparable mobility performance between the two groups. A similar observation was reported by Sialino *et al.*, who found that although women had a slightly lower mean gait speed than men, the determinants of gait speed were largely similar between sexes, suggesting that mobility performance is influenced more by individual health and functional characteristics than by sex alone[28].

The present study demonstrated no significant link between hand grip strength and gait speed. Similarly, no significant link was found between hand grip strength and the PSQI total score, although a moderate negative trend was noted, Zhang *et al.* reported that muscle strength mediated the association

between sleep quality and gait speed among older adults[29]. The discrepancy between the present findings and previous studies might be attributed to the small sample size of the present pilot study, which may have limited the statistical power to detect significant associations, as well as differences in participant characteristics and study methodology.

The present study identified a statistically significant negative correlation between gait speed and PSQI total score, indicating that greater sleep disturbances were associated with slower gait speed. This finding is supported by Zhang *et al*., who reported that poor sleep quality was linked with reduced gait speed and increased risk of mobility limitation in older adults[29].

The current study demonstrated a gender-stratified difference in the link between hand grip strength and gait speed, where a significant positive association was observed among males, while no significant link was found among females.

This finding is partially supported by previous evidence showing that the relationship between muscle strength and physical performance may vary by gender and is influenced by differences in body composition and neuromuscular characteristics. For instance, Fragala *et al*. reported that hand grip strength was a significant predictor of gait performance in older adults, although the strength of this association differs depending on gender and functional status[30]. Similarly, Sialino *et al*. highlighted that gender differences in determinants of gait speed are primarily driven by differences in exposure and sensitivity to physical and health-related factors rather than gender alone, suggesting that associations between strength and mobility might be uniform across genders[28].

In the present study, there was no significant link was observed between hand grip strength and PSQI scores in either males or females, indicating that sleep quality may not be directly influenced by muscle strength.

This finding is supported by evidence suggesting that the relationship between muscle strength and sleep quality is complex and not consistently significant across populations. For instance, the systematic review by Pana *et al*. reported that although some studies demonstrate a link between hand grip strength and sleep quality, the overall findings remain inconsistent, particularly when stratified by gender and sleep duration[31]. Similarly, Chen *et al*. observed that variations in sleep parameters such as sleep duration are associated with muscle strength; however, these relationships were not uniform and were influenced by multiple confounding factors including age, health status, and lifestyle characteristics[32]. Furthermore, broader evidence indicates that sleep quality is a multifactorial construct influenced by psychological, behavioural, metabolic, and health-related factors rather than muscle strength alone.

CONCLUSION

In conclusion, this pilot study examined the relationship between handgrip strength with sleep disturbances and gait speed among community-dwelling older adults, with a focus on gender-specific differences. The findings revealed no significant link between hand grip strength and gait speed or between hand grip strength and the PSQI total score. However, a gender-stratified observed in the link between hand grip strength and gait speed, with a significant positive association among males, while no significant association was found among females, no significant link was observed between hand grip strength and PSQI scores in either males or females, indicating that sleep quality may not be directly influenced by muscle strength. Further large-scale studies are warranted to validate these findings and to better understand these associations in the Southern Karnataka population.

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