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Assessment of Functional Balance and Walking Speed in Yoga practitioners aged 55-65 Years: A Cross-sectional Study

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ABSTRACT

Background: Functional balance and walking speed are key indicators of mobility and independence in middle-aged adults. Age-related musculoskeletal and neuromuscular changes begin during the fifth and sixth decades of life and may adversely affect postural control and gait. Yoga is widely practiced in this age group; however, its influence on functional balance and walking speed remains inconsistent.
Objectives: To assess functional balance and walking speed in yoga practitioners aged 55–65 years and to compare these outcomes with age-matched normative values.
Methodology: A cross-sectional observational study was conducted among 100 yoga practitioners aged 55–65 years selected using purposive sampling. Static balance was assessed using the Single-Limb Stance Test, dynamic balance using the Four-Square Step Test, and walking speed using the 10 Meter Walk Test. The best of three trials for each outcome measure was considered for analysis. Data were analysed using descriptive statistics, and the Wilcoxon signed-rank test was used for intergroup comparison.
Results: Yoga practitioners demonstrated significantly better static balance 32.04 ±9.08 compared with age-matched normative values 30.27±5.29. No statistically significant differences were observed in dynamic balance 7.41±1.77 and walking speed 199.83±44 compare with the normative value 7.49± 0.00 and 191.14± 11.74 respectively. P value <0.05 was considered as level of significance.
Conclusion: Yoga practice was associated with improved static balance in adults aged 55–65 years; however, it did not significantly influence dynamic balance or walking speed. Yoga may be effective for enhancing postural stability, but additional task-specific balance and gait training may be required to improve dynamic functional performance in this age group.

Keywords: *Functional balance; Walking speed; Yoga practice; Middle-aged adults*

INTRODUCTION

Functional balance and walking speed are key indicators of mobility, independence, and overall health in older adults. Balance is essential for maintaining postural stability during daily activities, while walking speed is widely regarded as a sensitive marker of functional capacity, fall risk, and survival. [1,2] Reductions in balance performance and gait speed are associated with increased risk

of falls, functional limitations, and reduced quality of life.

Age-related musculoskeletal and neuromuscular changes typically begin to emerge during the fifth and sixth decades of life. Adults aged 55–65 years may demonstrate declines in muscle strength, joint mobility, proprioceptive function, and neuromuscular coordination, along with early degenerative changes in articular cartilage and weight-bearing joints. [3,4] These changes can negatively influence postural control and gait efficiency even in the absence of clinically apparent disability. Despite the importance of this transitional stage for early identification of functional decline, most balance and gait research has focused on adults aged 65 years and older, resulting in limited evidence specific to individuals aged 55–65 years. [5]

Yoga is a commonly practiced mind–body activity that incorporates physical postures, controlled breathing, and mindful movement. It is widely used among middle-aged and older adults and is generally considered a low-impact form of physical activity with a favourable safety profile. [6] Previous studies have suggested that yoga practice may be associated with measures of physical function, including balance and mobility, potentially through mechanisms such as improved muscular strength, flexibility, proprioception, and postural alignment. [6–9]

A recent systematic review and meta-analysis by Sivaramakrishnan et al. also reported that yoga interventions demonstrated beneficial effects on physical function and health-related quality of life in older adults when compared with active and inactive controls, although outcome-specific effects varied across studies. [10]

However, existing evidence regarding the association between yoga practice and functional balance or walking speed is inconsistent. Systematic reviews and controlled studies have reported variable findings, particularly for dynamic balance and gait-related outcomes. [11,12] Additionally, there is a paucity of observational data examining balance and walking speed specifically among yoga practitioners in the pre-elderly age group of 55–65 years.

Therefore, this cross-sectional study aims to assess functional balance and walking speed in yoga practitioners aged 55–65 years and to compare these outcomes with age-matched normative values. Understanding functional performance in this population may help to characterize balance and gait profiles during an early stage of aging and inform future preventive and interventional research.

Aim: To assess functional balance and walking speed in yoga practitioners aged 55–65 years and to compare these outcomes with age-matched normative values.

Objectives

1. To assess static balance using the Single-Limb Stance Test.
2. To assess dynamic balance using the Four-Square Step Test (FSST).
3. To assess walking speed using the 10-Meter Walk Test (10MWT).
4. To compare static balance, dynamic balance, and walking speed between yoga practitioners and age-matched normative values.

MATERIALS AND METHODS

An observational, cross-sectional study was conducted among yoga practitioners aged 55–65 years. The study population comprised both male and female participants who were recruited from various yoga centers and the surrounding community using a purposive sampling technique. A total of 100 participants were included in the study.

Individuals were eligible for participation if they had been practicing yoga for more than one year and had engaged in regular yoga practice for at least the preceding eight weeks. Regular practice was defined as a minimum of two sessions per week, with each session lasting at least 45 minutes. Participants were excluded if they had any

acute musculoskeletal condition; pathological conditions such as rheumatoid arthritis, Pott's spine (Koch's spine), ankylosing spondylitis, or scoliosis; neurological conditions including radiculopathy or peripheral neuropathy; a history of operative interventions such as total knee replacement, total hip replacement, or spinal surgery; or if they were involved in any organized sports activity.

Participants were selected based on the inclusion and exclusion criteria, and written informed consent was obtained prior to data collection. A self-administered, validated questionnaire was used to collect demographic details and information related to yoga practice. Static balance was assessed using the Single Limb Stance Test [13], dynamic balance was assessed using the Four-Square Step Test [14], and walking speed was assessed using the 10-Meter Walk Test [15]. All outcome measures were administered according to standardized protocols. Each test was performed three times, and the best performance among the three trials was recorded as the final score. Static balance was recorded in seconds, dynamic balance in seconds, and walking speed in cm per second.

The materials used for data collection included a measuring tape, stopwatch, cones, rope, sticks, pen, questionnaire, and a case record form.

Statistical Analysis

Collected data was entered in the MS ExcelSheet and analyzed using the Software Jupyter notebook. Descriptive data were expressed in the form of frequencies and proportions, and continuous variables were expressed in the form of mean and standard deviation. Data was checked for normality using Shapiro Wilk test. It was not following normality. So for inter-group comparison, the Wilcoxon signed rank test was used. And p value less than 0.05 was considered as the level of significance.

RESULT

The results of the study are presented in the form of tables and figures.

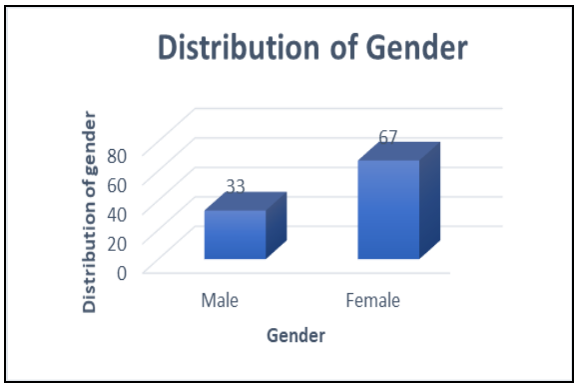

Figure 1: Gender distribution

Figure **1-** Shows the gender distribution of the study participants. Out of the total 100 yoga practitioners, both males-33 and females-67 were included

Table 1. Age distribution as per gender

Gender	Female	Male
Mean	61.13	61.24
SD	4.03	4.10

Table 1- presents the mean age and standard deviation of the participants according to gender. The mean age of female participants was 61.13 ± 4.03 years, while the mean age of male participants was 61.24 ± 4.10 years. This indicates that both male and female participants were comparable with respect to age

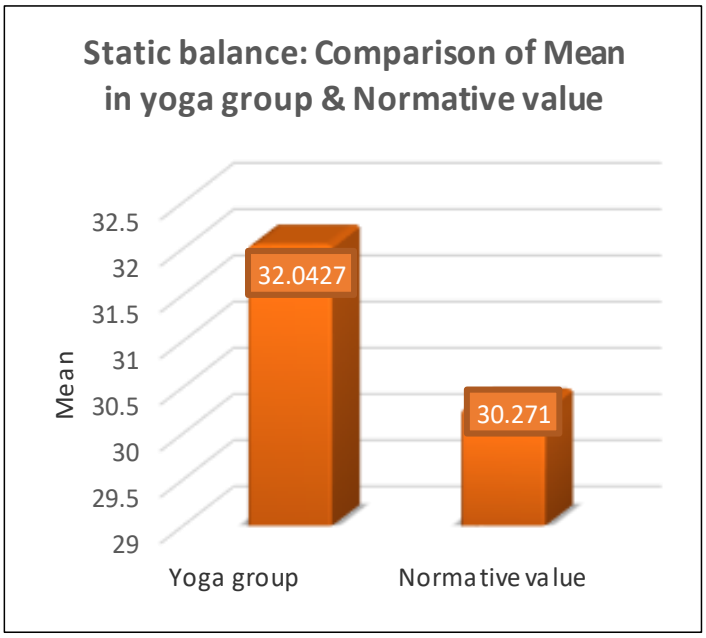

Figure 2: Static balance: Comparison between yoga group and normative value

Figure 2 shows static balance performance of yoga practitioners assessed using the Single-Limb Stance Test. The results W = 1819.500, p-value = 0.0153 indicate that yoga practitioners demonstrated better static balance when compared with age-matched normative values.

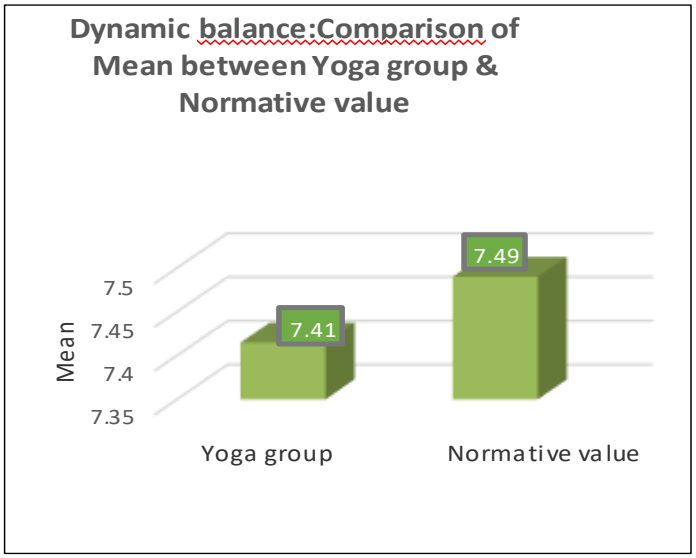

Figure 3: Dynamic Balance: Comparison between yoga group and normative value

Figure 3 shows the dynamic balance performance assessed using the Four Square Step Test. The mean dynamic balance score of yoga practitioners was comparable to age-matched normative values. The Wilcoxon signed-rank test revealed no statistically significant difference in dynamic balance performance (W=2296, p = 0.431).

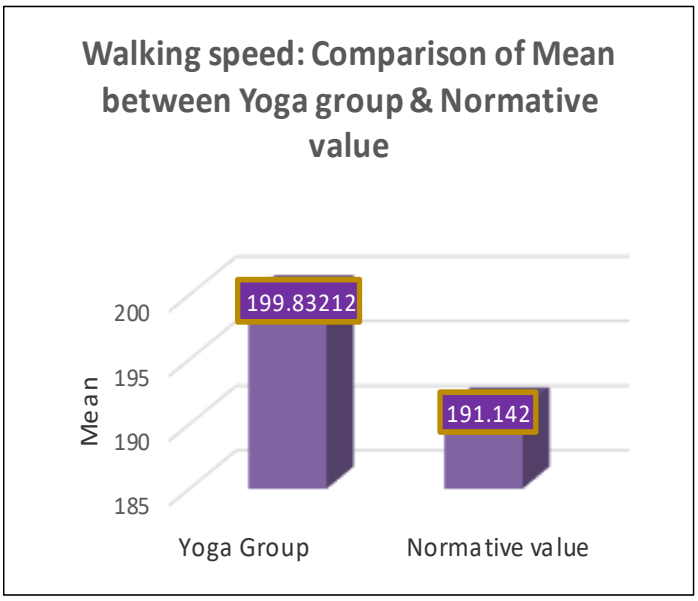

Figure 4: Walking Speed: Comparison between yoga group and normative value

Figure 4 illustrates walking speed measured using the 10-Meter Walk Test. The mean walking speed of yoga practitioners' W = 2139.000, p-value = 0.1844 did not differ significantly from age-matched normative values, indicating no statistically significant improvement in gait speed.

DISCUSSION

The present study evaluated functional balance and walking speed in yoga practitioners aged 55–65 years and demonstrated significantly better static balance, while no significant differences were observed in dynamic balance and walking speed when compared with age-matched normative values. These findings can be explained through task-specific neuromuscular, sensory, and biomechanical adaptations associated with yoga practice.

Static Balance

Static balance depends on the ability to maintain the centre of mass within the base of support through continuous low-amplitude postural adjustments. Yoga practice involves sustained postures and controlled alignment, which require prolonged isometric muscle contractions and co-activation of trunk and lower-limb stabilizers. Woodyard reported that regular yoga practice enhances postural muscle endurance and neuromuscular control through sustained loading of stabilizing musculature, thereby improving static balance performance. [6] Similarly, Jorrakate et al. demonstrated improvements in static balance following yoga interventions, attributing these changes to improved muscular strength and postural alignment. [14]

Yoga also emphasizes precise joint positioning and mindful movement, which may enhance proprioceptive input from muscle spindles and joint mechanoreceptors. Improved proprioceptive acuity enables better postural corrections during quiet standing. Studies by Verma et al. and Wooten SV et al reported significant improvements in postural stability following yoga-based interventions, suggesting enhanced sensory feedback and neuromuscular coordination as key mechanisms. [15,16]

At the central level, yoga integrates focused attention and breath regulation, which may enhance sensorimotor integration and cortical efficiency. Chen XP et al. examine cortical activation during one-leg stance and link changes in cortical activity to postural sway components, supporting a cortical contribution to improved balance regulation in mind–body postures. [17] These combined peripheral and central adaptations plausibly

explain the superior static balance observed in yoga practitioners in the present study.

Dynamic Balance

Dynamic balance requires rapid displacement of the center of mass, reactive stepping, multi-directional movement, and timely neuromuscular responses. Unlike static balance, it depends heavily on muscle power, reaction time, and anticipatory postural control. Jeter PE, while yoga showed beneficial effects on balance overall, the review notes the lack of consistent evidence on reactive and dynamic balance outcomes, partly because most interventions emphasize slow controlled postures rather than unpredictable or high-velocity movements essential for training reactive balance. [18]

For individuals aged 55 to 65 years, early age-related loss of power, reflex speed, proprioception, and somatosensations in the lower limbs are beginning to appear. Literature shows that dynamic balance decreases distinctly with increasing age as compared to static balance in older individuals, which is accounted for affection in sensorimotor coordination. Studies using inertial measurement unit–based assessments have demonstrated significant age-related decline in balance.

In dynamic balance, highlighting for task-specific, perturbation-based training to elicit meaningful adaptations in dynamic postural systems is needed. [19] Traditional yoga practice may not sufficiently challenge these systems; the neuromuscular stimulus may be inadequate to induce meaningful improvements in dynamic balance.

Additionally, Jeter PE et al. emphasized that variability in yoga style, session frequency, and baseline fitness levels contributes to inconsistent findings related to balance outcomes. [18] This heterogeneity may partly explain the absence of significant improvements in dynamic balance observed in the present study.

Walking Speed

Walking speed is a complex functional parameter influenced by lower-limb propulsion, neuromuscular timing, stride length, cadence, and inter-limb coordination. Improvements in gait speed require repetitive cyclic loading at functionally relevant velocities. Elangovan et al. reported that although yoga improves balance and flexibility, it does not provide sufficient gait-specific or velocity-dependent training to enhance walking speed. [20] Similar findings were reported by Van Abbema et al., who observed that exercises not specifically focused on walking had a limited impact on improving walking speed. [21]

In addition, the movements involved in yoga practice accentuate stability rather than the rapid force production. Reid & Fielding (2012) clarified that yoga resulted in strengthening and increasing muscle endurance through slowness in movement. However, it normally does not require rapid or forceful muscle activity, which is required to enhance muscle power and rapid actions like fast walking or rapid balance reactions. [22] This lack of power-oriented and gait-specific stimulus likely explains why walking speed did not differ significantly between yoga practitioners and normative values in the present study.

In general, the results of the study confirm the principle of task specificity in motor control and functional adaptation. Yoga seems to particularly benefit static postural stability by

increasing endurance, processing, and integration in relation to proprioceptive function. However, the lack of elements of perturbation, high velocity, and gait-specific training makes it somewhat ineffective in improving the dynamic balance and walking speed of adults between the ages of 55 to 65 years.

CONCLUSION

Yoga practitioners aged 55 to 65 years exhibiting yoga practice showed significant improvement in static balance when compared to the age-related normal values. However, no significant improvement was found in terms of dynamic balance and walk

speed. The results obtained from this study suggest that though yoga improves postural stability in individuals when it comes to a static task, it may not adequately challenge its neuromuscular aspects regarding dynamic balance and walk speed.

Clinical Implication

Yoga can be effectively used to enhance static balance and postural stability in people within the age group of 55-65 years. However, the benefits of preventing falls can be maximized by incorporating physiotherapy-based training for dynamic balance, reactive stepping, and gait training to manage dynamic balance and walking speed in people within the age group of 55-65 years.

Limitations

The heterogeneity of yoga practice with respect to style was not controlled, thus influencing outcome measures

Future Scope

- Different yoga styles would help reduce heterogeneity and better understand its effects on balance and walking ability.
- To compare yoga with physiotherapy-based dynamic balance and gait training, and also study combined yoga and physiotherapy programs, to identify the most effective approach for improving overall functional mobility
- Future research may explore outcomes in subgroups based on sex, or early musculoskeletal conditions such as mild osteoarthritis to enhance clinical applicability.

Declaration by Authors

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