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Exploring the Relationship between Walking Performance, Fear of fall and Gender among Stroke Survivors

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Abstract **Original Research Article**

***Introduction*:** Stroke survivors often face challenges in walking and balance, significantly impacting daily activities and social participation. Fear of falling (FoF), prevalent in 14–36% of stroke survivors, limits activities of daily living (ADLs) and community reintegration. This study explores the relationship between FoF and walking performance, examines gender differences, and identifies predictors of FoF, contributing to evidence-based rehabilitation practices in physiotherapy. The purpose of this study is to investigate the relationship between FoF and walking performance and assess the impact of gender differences and dual-task performance on walking ability in stroke survivors. ***Methods & Materials*:** The research team secured authorization from the Institutional Ethical Committee (IEC) prior to initiating the survey, as evidenced by the reference no MGM/IOP/IEC/UG/2023/16 and SU/SMS&R/76-A/2022/73. A cohort of 43 post-stroke subjects, aged between 35 and 65, was assembled through a systematic screening procedure. Eligibility criteria mandated that participants could ambulate independently, with or without mobility aids, and were free from concurrent medical conditions impacting their walking patterns. Fear of falling was assessed using the Marathi version of the Fall Efficacy Scale (FES). Walking performance was evaluated with the 10-Meter Walk Test (10MWT), 2-Minute Walk Test (2MWT), and dual-task assessments. Data analysis included descriptive statistics, correlation analyses, and regression modeling. ***Results*:** FoF inversely correlated with walking performance ($p < 0.05$). A 5-unit increase in FES scores was associated with proportional decreases in walking speed and capacity. Dual-task assessments showed significant reductions in gait stability under cognitive/manual tasks ($p < 0.05$). Gender differences in FoF's impact on walking performance were not statistically significant ($p > 0.05$). Regression analysis identified walking ability as a significant predictor of FoF ($\beta = -0.45$, $p < 0.01$). ***Conclusion*:** Fear of falling negatively impacts walking performance irrespective of gender. Tailored rehabilitation strategies addressing FoF and enhancing dual-task walking ability are critical for promoting recovery and independence in stroke survivors. This study highlights the critical role of addressing fear of falling (FoF) in physiotherapy interventions to enhance mobility and overall quality of life in stroke survivors. By incorporating dual-task training into rehabilitation programs, these findings emphasize the need for personalized strategies to effectively reduce FoF and improve functional outcomes.

Keywords: Stroke, Gender, 2 Min Walk Test, Fear of Falling, Dual-Task Assessment.

INTRODUCTION

Stroke significantly impacts global health, with its burden expected to grow due to shifting demographics and the increasing prevalence of risk factors, as highlighted by Feigin V. L *et al.*, [1]. Guo X *et al.*, reported that female stroke patients experience higher mortality and recurrence rates at 1- and 10-years post-stroke, with fewer favorable outcomes within the first year. Addressing gender disparities in stroke prevention and management requires long-term research [2]. Similarly, Kim T. H *et al.*, observed that while men are initially more prone to stroke, this trend reverses later in life, particularly during menopause for women [3]. Studies by Sridharan S. E *et al.*, Bonita R *et al.*, and Poungvarin N *et al.*, revealed that stroke patients in developing countries are, on average, 15 years younger than their counterparts in developed nations [4-6]. Falls are a significant concern among stroke survivors, with Handelzalts S *et al.*, reporting a prevalence of up to 70% within six months of hospital discharge. Stroke survivors face twice the risk of hip fractures compared to the general elderly population [7]. Winstein C. J *et al*., emphasized that falls result in severe physical, psychological, and social consequences, including reduced functionality, quality of life, increased dependence, and depression [8]. Musienko P. E *et al*., explored the critical role of the locomotor system in guiding limb movements during stepping, though the underlying mechanisms remain unclear [9]. Research done by Bahureksa L *et al*., Beauchet O *et al*., Dubost V *et al*., and others supports the utility of dual-task walking paradigms in assessing both cognitive and motor functions in stroke survivors [10-14]. Kelly C *et al*., identified stroke as a significant cause of functional limitations due to sensory and motor impairments [15], while Yang L *et al*., noted that walking speed is hindered by increased cognitive task demands [16]. Alzahrani M. Emphasized that post-stroke rehabilitation often focuses on walking abilities to enhance independence and participation [17]. Hiraga A. explored how stroke outcomes, including functional performance and quality of life, differ across genders due to factors such as coagulation status, sex hormones, and social influences [18]. Although prior studies have examined the link between walking ability and fear of falling in stroke survivors, this study uniquely focuses on the Indian population, considering gender-based distinctions. It aims to provide fresh insights by examining the relationship between walking performance and the fear of falling in male and female stroke survivors, ultimately enhancing their quality of life.

METHODS AND MATERIALS

Forty-three post-stroke participants, aged 35-65 years, underwent a detailed evaluation to assess walking performance and fear of falling. Participants were recruited through a standardized screening process, during which sociodemographic data were collected. The Marathi version of the Fall Efficacy Scale (FES) was administered to quantify fear of falling. The study was conducted over seven months, from September 10, 2023, to April 1, 2024. The research team secured authorization from the Institutional Ethical Committee (IEC) prior to initiating the survey, as evidenced by the reference no MGM/IOP/IEC/UG/2023/16 and SU/SMS&R/76-A/2022/73. Walking performance was assessed using the 10-Meter Walk Test, which measured walking speed in meters per second as participants walked at their preferred pace on a flat surface with or without assistance. The 2-Minute Walk Test evaluated walking capacity in meters as participants walked along a 40-meter corridor, with the option to use walking aids as needed. Distance covered, use of aids, and resting time were documented. Walking automaticity under dual-task conditions was also examined, requiring participants to perform a manual task (e.g., carrying a tray or cup) and a cognitive task (e.g., verbally responding to color cues) while walking. Data was analyzed, including mean, standard deviation, and percentages, summarized sociodemographic and clinical characteristics. Correlation analyses between fear of falling (FES scores) and walking performance (10-Meter Walk Test, 2-Minute Walk Test, and dual-task performance) were conducted using Pearson's or Spearman's coefficients, depending on the normality of the data. Comparisons of walking performance across gender and dominant-side groups were carried out using paired or independent t-tests for normally distributed data or the Mann-Whitney U test for non-parametric data. Regression analysis was performed to identify predictors of fear of falling, incorporating variables such as walking ability, gender, and dominant side. Dual-task walking performance was compared using repeated measures ANOVA for parametric data or the Friedman test for non-parametric data. All analyses were conducted using statistical software, with significance set at $p < 0.05$.

RESULTS & DISCUSSION

Table 1 presents the results of the Shapiro-Wilk normality test for key variables. Significant p-values ($p < 0.05$) indicate non-normal distribution for the 2-Min Walk Test, 10-Min Walk Test, and Walking Automaticity. These findings suggest that non-parametric statistical tests are appropriate for further analyses involving these variables.

Table 1: Normality Test Using Shapiro-Wilk

Sr. No	Variables	z-value	p-value
1	Age	0.931	0.013
2	FES-I	0.947	0.045
3	2 Min Walk Test	0.900	0.001*
4	10 Min Walk Test	0.679	0.001*
5	Walking Automaticity	0.733	0.001*

As shown in Table 2, the majority of stroke survivors in this study were male (67%), with females accounting for 33%. This gender distribution highlights a predominance of male stroke survivors in the sample, which may reflect broader population trends.

Table 2: Gender-wise distribution of stroke survivors

Gender	Frequency	Percent
Male	29	67 %
Female	14	33 %
Total	43	100 %

Table 3 summarizes the age distribution of stroke survivors, with a mean age of 50.83 years (SD = 13.46). The minimum and maximum ages were 32 and 74 years, respectively, representing a middle-aged to elderly cohort.

Table 3: Mean Age of Stroke Survivors

Age	Minimum	Maximum	Mean	SD
	32.00	74.00	50.83	13.46

Table 4 provides descriptive statistics for walking performance measures. The FES-I scores, with a mean of 41.00 (SD = 12.23), indicate a moderate fear of falling among participants. Performance in the 2-Min Walk Test and 10-Min Walk Test showed substantial variability, reflecting differences in walking ability among the cohort.

Table 4: Descriptive Statistics

Walking Performance	Minimum	Maximum	Mean	SD
FES-I	17.00	61.00	41.00	12.23
2 Min Walk Test	2.00	76.00	25.08	18.35
10 Min Walk Test	12.00	523.00	95.69	116.27
Walking Automaticity	15.00	540.00	124.58	132.74

The correlation analyses in Table 5 reveal significant relationships between fear of falling (FES-I) and walking performance measures. A negative correlation with the 2-Min Walk Test ($r = -0.648$, $p < 0.05$) indicates that higher fear of falling is associated with reduced walking capacity. Positive correlations with the 10-Min Walk Test ($r = 0.589$, $p < 0.05$) and Walking Automaticity ($r = 0.602$, $p < 0.05$) suggest that better walking performance is linked to lower fear levels. The correlation between FES-I scores and the 2-Minute Walk Test is -0.648, suggesting an indirect relationship. The correlation with the 10-Minute Walk Test is 0.589, indicating a direct relationship. Similarly, with Walking Automaticity, the correlation is 0.602, signifying a direct association.

Table 5: Correlation Analysis for overall sample

Variable X	Variable Y	r-value	p-value	Results
FES-I	2 Min Walk Test	-0.648**	0.001**	Significant at 5% Non-Linear association
	10 Min Walk Test	0.589**	0.001**	Significant at 5% Linear association
	Walking Automaticity	0.602**	0.001**	Significant at 5% Linear association

The table no 6 shows correlation between FES-I score and the 2-Min Walk Test is -0.698, indicating an indirect relationship. Conversely, with the 10-Min Walk Test, it's 0.690, suggesting a direct relationship. Similarly, with Walking Automaticity, the correlation is 0.704, indicating a direct association.

Table 6: Correlation Analysis for Male sample

Variable X	Variable Y	r-value	p-value	Results
FES-I	2 Min Walk Test	-0.698**	0.001**	Significant at 5% Non-Linear association
	10 Min Walk Test	0.690**	0.001**	Significant at 5% Linear association
	Walking Automaticity	0.704**	0.001**	Significant at 5% Linear association

(p<<00.1)

Table No 7 shows the correlation between FES-I score and the 2-Min Walk Test is -0.673, indicating an indirect relationship. Conversely, with the 10-Min Walk Test, it's 0.692, suggesting a direct relationship. Similarly, with Walking Automaticity, the correlation is 0.647, indicating a direct association.

Table 7: Correlation Analysis for Female sample

Variable X	Variable Y	r-value	p-value	Results
FES-I	2 Min Walk Test	-0.673**	0.008	Significant at 5% Non-Linear association
	10 Min Walk Test	0.692**	0.006	Significant at 5% Linear association
	Walking Automaticity	0.647*	0.012	Significant at 5% Linear association

Table No 8 shows the correlation between FES-I score and the 2-Min Walk Test is -0.632, indicating an indirect relationship. Conversely, with the 10-Min Walk Test, it's 0.624, suggesting a direct relationship. Similarly, with Walking Automaticity, the correlation is 0.585, indicating a direct association.

Table 8: Correlation Analysis for Dominant Right Side

Variable X	Variable Y	r-value	p-value	Results
FES-I	2 Min Walk Test	-0.632**	0.001**	Significant at 5% Non-Linear association
	10 Min Walk Test	0.624**	0.001**	Significant at 5% Linear association
	Walking Automaticity	0.585**	0.001**	Significant at 5% Linear association

Table No 9 shows the correlation between FES-I score and the 2-Min Walk Test is -0.937, indicating an indirect relationship. Conversely, with the 10-Min Walk Test and Walking Automaticity, the correlation is 0.937, suggesting a direct relationship.

Table 9: Correlation Analysis for Dominant Left Side

Variable X	Variable Y	r-value	p-value	Results
FES-I	2 Min Walk Test	-0.937**	0.002	Significant at 5% Non-Linear association
	10 Min Walk Test	0.937**	0.002	Significant at 5% Linear association
	Walking Automaticity	0.937**	0.002	Significant at 5% Linear association

This study highlights a significant relationship between fear of falling and walking ability in sub-acute stroke patients, underscoring the detrimental impact of fear on functional performance. Batchelor *et al*., noted that fear of falling is a critical barrier to mobility and independence among stroke survivors, a finding echoed in our research [19]. Reduced walking performance is particularly concerning, as it directly affects activities of daily living (ADLs) and community engagement, as highlighted by Schmid *et al*., [20]. Our results show that for every five-unit increase in fear of falling, walking performance declines by an equivalent five units. These findings are consistent with Delbaere *et al*., who reported that fear of falling exacerbates functional impairments by reducing confidence in mobility [21]. Moreover, the dual-task condition results in this study suggest that cognitive load further exacerbates walking difficulties, aligning with observations by Plummer *et al*., [22]. Interestingly, gender analysis in our study revealed no significant differences in the relationship between fear of falling and walking ability. This suggests that male and female stroke patients experience comparable challenges. However, this finding differs slightly from the work of Schmid and Rittman *et al*., who observed higher levels of fear of falling among female stroke patients [23]. The discrepancy may be due to our relatively small sample size, which limits the detection of subtle gender-based differences. The importance of personalized rehabilitation strategies tailored to address fear of falling is evident in our findings. Consistent with the work of Weerdesteyn *et al*., interventions focused on improving balance, confidence, and gait performance are vital for optimizing recovery outcomes [24]. Programs such as dual-task training, balance retraining, and cognitive-behavioral interventions have shown promise in addressing fear of falling and improving functional performance, as observed by Marigold *et al*., [25].

Despite these strengths, it’s important to note that this study also has limitations First, such as compare to male stroke participants female stroke participants are less in number which gives as limited depth of information in female with stroke. Second, finding of this study are more relatively high functioning people of stroke and may not apply to those with severe walking limitations which doesn’t gives insights of severely walking impaired stroke patient. Third, potential for response bias from the patient. Researchers should carefully consider these strength and weakness when designing and interpreting survey results.

Conclusion

To recapitulate, this study highlights the presence of fear of falling as a prevalent concern among stroke patients, impacting both genders to a similar degree. This apprehension can subsequently translate into limitations on walking ability, potentially restricting social engagement and leading to social isolation. It is noteworthy that the effectiveness of rehabilitation programs may be influenced by individual variations in stroke patients' perceptions of falling risk, which directly correlate with their walking capacity. Therefore, incorporating these patient-specific perspectives into rehabilitation strategies is crucial to optimize outcomes.

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Conflict of Interest: None

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