

A STUDY ON ASSOCIATION BETWEEN FALL RISK IN ELDERLY AND FRAX SCORE

Lavanya S¹, Kesavaraj KS², Shanthi GS³

¹Assistant Professor, Department of Geriatric Medicine, Government Karur Medical College and Hospital, Karur, Tamil Nadu, India.

²Assistant Professor, Department of Geriatric Medicine, Government Mohan Kumaramangalam Medical College and Hospital, Salem, Tamil Nadu, India.

³Professor and Head, Department of Geriatric Medicine, Madras Medical College, Chennai, Tamil Nadu, India.

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Corresponding Author:

Dr. Lavanya S,
Email: 89lavanyas@gmail.com

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Abstract

Background: Aging in India, with its increasing elderly population, brings forth a growing concern regarding falls and their consequences. This study explores the association between fall risk and the Fracture Risk Assessment Tool (FRAX) scores, examining the prevalence and impact of falls among the elderly population in India. **Materials and Methods:** A cross-sectional study was conducted on 400 participants aged 60 and above at a government hospital outpatient department. Fall risk was assessed using the Performance Oriented Mobility Assessment (POMA) and the Timed Up and Go Test (TUG). FRAX scores specific to the Indian population were calculated. Data on age, gender, BMI, and fall history were collected. Statistical analyses were employed to explore associations. **Result:** The study found a high prevalence of falls, with a strong correlation between high FRAX scores and an increased risk of falls. Advanced age, male gender, and higher BMI were associated with a greater likelihood of fall risk. The study also highlighted the significance of incorporating fall risk data into fracture prediction algorithms, such as FRAX. **Conclusion:** Falls pose a significant challenge for India's aging population, leading to higher healthcare costs and reduced quality of life. The study underscores the importance of considering fall risk in fracture risk assessment, potentially enhancing prediction models like FRAX. This research contributes to the understanding of this multifaceted issue, highlighting the need for interventions that address fall risk alongside fracture prevention.

INTRODUCTION

Aging is an irreversible and universal phenomenon, and with it comes a spectrum of changes, one of the most pervasive being the heightened risk of falls, a prevailing concern among the elderly.^[1] Falls not only diminish the quality of life for older adults but also constitute a significant cause of increased morbidity and mortality within this demographic.^[2] India, as the second most populous nation, harbours a substantial share of the global elderly population, making it a prime arena for studying age-related health challenges.^[3]

As of 2019, India had a population of 135.26 crores, with more than 103.9 million individuals aged 60 years or older, a number projected to grow at a rate of 3.5% annually.^[4] Such demographic shifts necessitate the expansion of health services, facilities, and resources to predict, prevent, and treat age-related mortality and morbidity, ultimately enhancing the quality of life in later years.^[5] Falls and fall-related injuries, notably fractures, are

commonplace among the elderly and pose a significant threat to their well-being. These events frequently lead to life-threatening situations, hospitalizations, and impose substantial burdens on families and caregivers, often culminating in tragic outcomes.^[6]

According to the World Health Organization's global report on falls prevention in older age, the prevalence of falls among those over 65 years old hovers at around 28–35% annually, a proportion that escalates with advancing age and frailty.^[7] In the Indian context, the reported prevalence of falls among individuals aged 60 years and older varies from 14% to 53%. Fears of falling diminished functional activities, and reduced engagement in daily living activities are further consequences of such incidents.^[8]

While falls are typically multifactorial in nature, gait and balance abnormalities stand out as primary contributors. A variety of factors influence a stable gait, including intricate neural networks, musculoskeletal systems, and sensory

processing.^[9,10] Maintaining gait and preventing falls demands the coordinated effort of these components, which may decline with aging. Numerous age-related changes in gait patterns, including reduced velocity, step length, lower limb strength, comorbidity accumulation, polypharmacy (the use of four or more medications), and walking on irregular surfaces, amplify the risk of falls.^[11,12]

Considering these factors, this study was undertaken to address several critical objectives: to assess fracture risk using the FRAX score tailored to the Indian population, investigate the association between fall risk and FRAX score, and delineate the prevalence of fall risk with respect to patient characteristics. Through this research, we aim to contribute to the understanding and management of fall-related issues in the elderly, ultimately enhancing their quality of life and overall well-being.

MATERIALS AND METHODS

Study Setting: Cross-sectional study was conducted at Rajiv Gandhi Government General Hospital, Chennai, India. The study was conducted for a period of one year from January to December 2020.

Study population: The study was conducted among 400 patients who attended the outpatient department of Geriatric Medicine, Rajiv Gandhi Government General Hospital, Chennai, during the study period. The inclusion criteria comprised individuals aged 60 years and above, who willingly consented to participate, and could maintain their Activities of Daily Living (ADL) with or without support. These criteria were chosen to target elderly individuals, the primary population of interest, while ensuring they were in a condition to actively participate in the study.

The exclusion criteria were designed to filter out individuals who might introduce confounding variables. Excluded from the study were patients requiring Intensive Care or Emergency Care at the time of presentation to the OPD, those who declined to participate, moribund patients, individuals who were wheelchair-bound, and those with physical disabilities or visual impairments. This ensured a more homogeneous and suitable study group for assessing the association between fall risk in the elderly and the FRAX score.

Study Methodology: The data collection process for this study was meticulously designed to gather a comprehensive set of information from the elderly participants. Personal details, encompassing demographics and relevant background information, were collected to establish a holistic profile of each participant. Medical history was documented, including details on falls, fractures, parental fracture history, secondary osteoporosis, rheumatoid arthritis, and medication use.

Furthermore, the data collection process involved a comprehensive physical examination, which allowed for the evaluation of various physical attributes and

conditions relevant to fall risk. Anthropometric measurements, such as height, weight, and Body Mass Index (BMI), were recorded, providing insights into the participants' physical status.

Laboratory investigations for secondary osteoporosis were also conducted, including tests for complete blood count, renal function, serum calcium, phosphate, albumin, alkaline phosphatase, thyroid function, liver function, vitamin D levels, and blood glucose levels.

Assessments on the study participants were done to determine fall risk, and the Performance Oriented Mobility Assessment (POMA) and Timed Up and Go Test (TUG) were utilized to assess gait and balance. Weight and height measurements were used to calculate the BMI, an essential indicator of physical health. Lastly, the FRAX score was computed for each participant using an online FRAX calculator, assessing the 10-year probability of fracture risk, specifically Major Osteoporotic Fracture and Hip Fracture. This final step provided a quantitative measure of fracture risk and allowed for the assessment of the association between fall risk and the FRAX score.

Sampling Technique: The sampling technique employed in this study adhered to a systematic approach to ensure the selection of a representative and unbiased sample of elderly participants. Using a stratified sampling method, the population of interest, individuals aged 60 years and above attending the outpatient department of Geriatric Medicine at Rajiv Gandhi Government General Hospital, Chennai, was selected till a sample size of 400 was reached.

Ethical Approval: The study adhered to ethical guidelines and obtained approval from the Institutional Ethical Committee of Madras Medical College, Chennai. Informed written consent were obtained from study participants before data collection.

Statistical analysis: The data analysis was conducted using SPSS version 24. Descriptive statistics included calculating means, standard deviations, and ranges for continuous variables, and percentages for categorical variables. Chi-squared test was utilized to explore the relationships between categorical and continuous variables, respectively. Multivariate statistical methods were then employed to control for potential confounding variables and to perform more in-depth analyses. Logistic regression models were used to assess the impact of various factors on fall risk to explore the relationships between the FRAX score and other variables. A P value of less than 0.05 is considered statistically significant in all these tests.

RESULTS

Among the 400 participants included in the study 281 (70.3%) were male while 119 (29.8%) were female. 32% of participants were in the 60-69 years age group compared to 45% of those in the 70-79 years age

group and 23% were in the 80-90 years age group. Mean age of study participants was 72.8. Mean age of male participants was 73.49, while mean age of female participants was 71.17. 26.3% of male participants were in the above 80 age group compared to only 15.1% of female participants in the same age group.

Mean BMI among study participants was 22.635 with a minimum of 16.6 and maximum of 33.9. In our study 7% of study subjects had BMI less than 18.5, 46.0% had BMI between 18.5 and 23, 42% had BMI between 23 and 27.5, while 5% had BMI >27.5. Mean BMI among male participants was 22.544 and mean BMI of female participants was 22.850. About 103 participants (25.8%) had history of alcohol consumption and 92 participants (23%) had smoking history, all of whom were male.

Out of total 400 older adults 244 had history of falls in the last one year, and its prevalence was about 61%. 75% of participants between 60-69 years had previous history of falls compared to 48.9% in the 70-79 years age group and 65.2% in the 80-90 years age group. The mean age among those with history of falls was 72.39 (SD=7.597) and mean age among those with no previous history of falls was 73.44 (SD= 7.071). 78.2% of female participants had previous history of fall compared to 53.7% of male participants.

Among 400 participants aged 60 and over who had taken part in the Study, 132 subjects (33%) had High risk of fall (POMA score ≤19), 84 (21%) of them had Intermediate risk (POMA score 20-25) and 184 (46%) had Low Risk (POMA score >25). Among the 400 participants 196 (49%) had high fall risk according to TUG score. The details are given in [Tables 1 and 2].

A bivariate analysis was done between fall risk and FRAX. 76% of the participants with a FRAX MOF

percentage of 10 and above had a high or intermediate risk of fall while only 46% of participants with a FRAX MOF score less than 10 had intermediate to high fall risk. There was a statistically significant association between FRAX MOF score and fall risk using POMA score ($\chi^2=25.980, p<0.001$). Those with FRAX MOF score of 10 and above had 3.619 times likelihood of having high or intermediate fall risk compared to those with a FRAX MOF score less than 10.

Among participants with FRAX MOF score more than or equal to 10, 64% had high risk of falls (TUG) compared to 44% among those with FRAX MOF less than 10. Chi-square test was done to analyse the association between TUG score and FRAX MOF and was found to be statistically significant ($\chi^2=12.005, p=0.001$). The odds of having high fall risk were 2.263 times higher among those with a FRAX MOF score more than or equal to 10, compared to those with a score less than 10.

A binomial logistic regression was performed to ascertain the effects of age, BMI, gender, smoking, alcohol consumption and FRAX score on fall risk according to POMA score. The logistic regression model was statistically significant, $\chi^2 = 45.194, p < .001$. Of the six predictor variables only two were statistically significant: FRAX MOF and BMI. Increasing BMI was associated with higher likelihood of high and intermediate fall risk. Participants with >27.5 BMI had 4.896 (95% CI=1.349 - 17.774) times higher odds of intermediate to high fall risk compared to those with BMI<18.5. High FRAX MOF was associated with an increased likelihood of high and intermediate fall risk. Those with FRAX MOF percentage ≥10 had 3.738 times higher odds of having intermediate to high fall risk compared to those with FRAX MOF <10.

Table 1: Association between POMA and patient characteristics.

Patient characteristics		POMA			X2	P value
		High risk	Intermediate risk	Low risk		
Age in years	60-69	24	40	64	32.140	0.001*
	70-79	64	24	92		
	80-90	44	20	28		
Gender	Male	99	45	137	14.163	0.001*
	Female	33	39	47		
BMI	<18.5	4	4	20	18.947	0.004*
	18.5-23	72	28	84		
	23-27.5	48	48	72		
	>27.5	8	4	8		
Smoking	Present	48	44	92	0.160	0.689
	Absent	168	140	308		
Alcohol	Present	48	55	103	3.057	0.080
	Absent	168	129	297		

*Significant P value

Table 2: Association between TUG and patient characteristics.

Patient characteristics		TUG risk of falls		X2	P value
		Normal	High		
Age in years	60-69	80	48	16.457	0.001*
	70-79	92	88		
	80-90	32	60		
Gender	Male	135	146	3.306	0.069
	Female	69	50		

BMI	<18.5	20	8	6.514	0.089
	18.5-23	88	96		
	23-27.5	88	80		
	>27.5	8	12		
Smoking	Present	48	44	0.66	0.797
	Absent	156	152		
Alcohol	Present	55	48	0.319	0.572
	Absent	149	148		

*Significant P value

A binomial logistic regression was performed to ascertain the effects of age, BMI, gender, smoking, alcohol consumption and FRAX score on fall risk according to TUG score. The logistic regression model was statistically significant, $\chi^2 = 41.238$, $p < .001$. Of the six predictor variables four were statistically significant: Age, Gender, BMI and FRAX MOF. Participants in the age group 80-90 years had 2.194 times higher odds of having high risk of falling (95% CI= 1.196 - 4.024). Male participants had 2.529 times the odds of high fall risk compared to female participants (95% CI=1.441 - 4.437). Increasing BMI was associated with higher likelihood of high fall risk. Participants with >27.5 BMI had 4.904 (95% CI=1.373 – 17.517) times higher odds of high fall risk compared to those with BMI<18.5. High FRAX MOF was associated with an increased likelihood of high fall risk. Those with FRAX MOF percentage ≥ 10 had 2.725 (95% CI=1.547 – 4.8) times higher odds of having intermediate to high fall risk compared to those with FRAX MOF <10.

DISCUSSION

The aging population in India faces multifaceted challenges, including economic dependency and dwindling family support. Among the myriad concerns, falls emerge as a pervasive and escalating issue, posing a considerable financial burden on the elderly and their caregivers while compromising their independence in daily activities. It is noteworthy that nearly one-third of older Indian adults above the age of 60 live below the poverty line, with a substantial percentage being economically dependent, particularly among widowed women.

Falls have grave consequences in India, accounting for a substantial share of fall-related mortality and disability-adjusted life years lost per 100,000 population. Consequently, fall prevention has become an urgent public health priority, central to enabling active aging. Effective strategies require collaborative efforts involving healthcare professionals, researchers, policymakers, and healthcare delivery systems to prevent falls and mitigate the burden of fall-related injuries, particularly fractures.

In this cross-sectional study, we enrolled 400 participants aged 60 and above from the OPD of Rajiv Gandhi Government General Hospital (RGGGH). The study's primary objective was to investigate the association between fall risk and FRAX scores in the OPD population. The results

established a statistically significant relationship between FRAX scores and fall risk scores, indicating that high FRAX MOF and FRAX-HF scores were positively associated with an increased risk of falls.

The study revealed a mean age of 72.8 years and a mean body mass index (BMI) of 22.635. A notable proportion of participants, 77%, were under 80 years of age, while 23% were 80 years or older. Males constituted the majority at 70.3%, with females comprising the remaining 29.8%. Interestingly, the 80-plus age group exhibited a higher prevalence of males (89.4%) compared to females (19.6%). This observation may be attributed to elderly individuals with poor health or an inactive lifestyle, often associated with a high risk of falls, choosing not to seek care at the OPD.

The study unveiled a 61% prevalence of a history of falls, with 34.8% occurring in participants under 80 years and 65.2% in those aged 80 or above. Furthermore, females exhibited a higher incidence of falls, with 78.2% compared to 53.7% among male participants. This trend aligns with established findings linking increased fall risk to age-related declines in lower extremity muscle strength, balance, and muscle mass.^[13]

The annual incidence of falls in this study approximated 60%, which mirrors the high prevalence of falls among older adults, particularly in long-term care settings, where nearly half experience falls annually. Additionally, the study established that falls become increasingly common with advancing age. The relationship was highlighted through the progression from 34% among individuals aged 60–69 years to 65.5% in those aged 80–89 years, and 63% in those above 90 years. After employing the MAHC-10 fall risk assessment tool, the risk of falls escalated as follows: 67.9% for the 60–69 age group, 81% for the 70–79 age group, 93% for the 80–89 age group, and 100% for those above 90 years.

Comparing this study's findings to existing Indian studies, we observed that fall prevalence ranged from 14% to 53% in a study of community-dwelling participants and rose to 64% in a long-term care setting. Additional Indian studies reported fall prevalence of 45% in South India,^[14] and 51.5% in North India.^[15] Furthermore, Arnold, C.M,^[16] revealed that 45% of their sample had experienced at least one fall in the past year, with 77% reporting occasional or frequent near falls.

This study demonstrated a prevalence of fall risk as measured by POMA and TUG, with 54% and 49%, respectively. Notably, the 80-plus age group

exhibited a higher prevalence of 69.6%, compared to 30.4% in those under 80 years, using POMA. For TUG, the prevalence was 65.2% in the 80-plus group and 34.8% in the under 80 group. Females exhibited a higher prevalence than males in both POMA (60.5% vs. 51.2%) and TUG (42% vs. 52%). These observations highlight the importance of considering the impact of age, gender, and BMI on fall risk.^[17]

The study further investigated the association between BMI and fall risk. It revealed a higher fall risk in the obese group (BMI >27.5) at 60%, followed by the overweight group (BMI 23-27.5) at 57.1%, and the normal BMI group (<23) at 51%. These findings indicate that an increase in BMI correlates with an elevated risk of falls. However, no significant association was observed between fall risk and a history of alcohol and smoking in this study. Age, male sex, and increasing BMI were found to be significantly associated with a higher likelihood of intermediate risk for falls.

The mean FRAX major and hip scores were 7.701% and 3.767% using POMA and TUG, with subjects at high fall risk displaying higher FRAX scores compared to those without such risk. These results align with a study by Ling-Chun Ou et al., which reported that participants with a history of falls had higher FRAX scores than those without falls. Additionally, Brahmhatt B et al,^[18] in an Indian study found a strong correlation between fall risk assessed with Berg's balance scale, fracture risk using FRAX, and functional ability of the lower limb using the lower extremity functional scale, emphasizing the potential of combining balance and functional measures with FRAX for identifying individuals at risk of falls and related fractures.

The study also highlighted the significance of FRAX in relation to fall risk. Participants with a high FRAX major osteoporotic fracture (MOF) score of ≥ 10 exhibited a 76% higher risk of falls when assessed using POMA compared to those with an FRAX MOF score of <10. The same pattern was observed using TUG, with a 64% higher risk for the group with an FRAX MOF score of ≥ 10 compared to those with <10. In the case of FRAX hip fracture (HF) scores, participants with a score of >3 had a 57.4% higher risk of falls when assessed with POMA. For TUG, this figure was 55.6%. These results indicate a positive association between high FRAX scores and increased fall risk.

Limitations: Several limitations need to be acknowledged in this study. First, the research was conducted in a specific OPD setting, potentially limiting the generalizability of the findings to broader populations. Second, the study primarily relied on self-reported histories of falls, which may be subject to recall bias. Third, while POMA and TUG assessments were used to evaluate fall risk, other assessments or more extensive functional tests might provide additional insights. Fourth, the study's cross-sectional design makes it challenging to establish causality. Lastly, the study did not explore certain

potentially relevant factors like medication use and specific comorbidities that could influence fall risk.

CONCLUSION

This study sheds light on the pressing issue of falls among the elderly in India, a population with unique socio-economic challenges. The prevalence of falls, particularly among the elderly, has significant implications for their well-being, healthcare costs, and quality of life. The study revealed a strong association between fall risk and FRAX scores, indicating that higher FRAX scores were positively correlated with an increased risk of falls. These findings underscore the importance of considering fall risk as a crucial factor in fracture risk assessment, possibly warranting the incorporation of fall risk data into fracture prediction algorithms like FRAX. Such enhancements in assessment tools and interventions can contribute to better outcomes for the elderly population in India. Further research is needed to delve into this complex issue, considering the multifactorial nature of falls and their impact on fracture risk.

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