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Original Research Article

Frailty-driven burden of falls in older adults: a cross-sectional study estimating QALY loss and YLD in an urban Indian population

Surya Kannan*, Jyotsna Deshmukh, Uday Narlawar, Amirtharaj Jaisankar, Disha Vatyani

Department of Community Medicine, Government Medical College, Nagpur, Maharashtra, India

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***Correspondence:**
Dr. Surya Kannan,
E-mail: drsuryakannan@gmail.com

ABSTRACT

Background: Frailty is a multidimensional geriatric syndrome associated with increased vulnerability to adverse outcomes, particularly falls. Although both frailty and falls are common among older adults in India, their combined impact in terms of health loss remains inadequately quantified. This study aimed to estimate the burden of falls among frail and non-frail elderly using quality-adjusted life years (QALY) and years lived with disability (YLD).
Methods: An analytical cross-sectional study was conducted among 200 adults aged ≥60 years in an urban field practice area attached to a tertiary care center in central India. Frailty was assessed using the Edmonton Frail Scale, quality of life using EQ-5D-5L (Indian value set), and fall-related disability using global burden of disease weights. Differences in QALY loss and YLD between frail and non-frail groups were analyzed using appropriate statistical tests, and multivariable linear regression was used to identify determinants of QALY loss.
Results: The overall prevalence of falls was 28.0%, with a higher prevalence among frail individuals (46%) compared to non-frail (10%). Mean QALY loss was significantly higher among frail elderly (0.475±0.185) than non-frail (0.203±0.155; $p<0.001$). Similarly, mean YLD was higher among frail individuals (0.0102±0.0429) compared to non-frail (0.0008±0.0076; $p<0.001$). Frailty was the only significant predictor of QALY loss (β=0.294; 95% CI: 0.229-0.359; $p<0.001$).
Conclusions: Frailty substantially amplifies the burden of falls among older adults. Incorporating frailty assessment into primary care may help identify high-risk individuals and guide targeted fall-prevention strategies.

Keywords: Elderly, Falls, Frailty, India, Quality-adjusted life years, Years lived with disability

INTRODUCTION

The global population is ageing rapidly, with the number of adults aged 60 years and above expected to double by 2050, particularly in low- and middle-income countries.[1] India is undergoing a similar demographic transition, with the proportion of older adults projected to increase from 8.1% in 2011 to 12% by 2026.[2] This shift is accompanied by a growing burden of chronic diseases and geriatric syndromes, which contribute substantially to disability and increasing healthcare needs.[3,4]

Frailty is one such geriatric syndrome, characterized by a decline in physiological reserve and multisystem function, resulting in increased vulnerability to stressors.[5] Globally, the pooled prevalence of frailty has been estimated at approximately 24%, while studies from India report prevalence ranging from 30% to 42% among older adults.[5-7] Frailty is associated with a higher risk of adverse outcomes, including falls, functional impairment, hospitalization, and mortality, making it a key determinant of health in ageing populations.[4]

Falls represent a major public health concern among older adults and are the second leading cause of unintentional injury-related mortality worldwide.8 In India, the prevalence of falls among the elderly ranges from 14% to 53%.[9] The burden of falls is considerable; globally, falls accounted for nearly 19 million years lived with disability (YLD) and 36 million disability-adjusted life years (DALYs) in 2017.[10] In India, fall-related YLDs remain high, reflecting substantial loss of functional independence and quality of life among older adults.[11]

Frailty and falls are closely interrelated, with frailty being an independent predictor of fall risk.[12] Beyond increasing the likelihood of falls, frailty may also amplify their impact, as reduced physiological reserve limits recovery and increases the duration and severity of disability.[2,4] Assessing this amplified burden requires the use of comprehensive measures of health loss, such as quality-adjusted life years (QALY), which reflect health-related quality of life, and YLD, which quantify morbidity.[13,14]

Despite the established association between frailty and falls, there is limited evidence from India quantifying their combined burden in terms of health loss. Most existing studies have examined frailty and fall separately, with few attempts to translate these risks into population-level measures such as QALY or YLD. Generating such evidence is essential for informing public health strategies, prioritizing high-risk groups, and integrating frailty assessment into existing geriatric care programs.[1]

This study aimed to estimate the differential burden of falls among frail and non-frail elderly using QALY and YLD, and to identify factors associated with increased health loss.

METHODS

An analytical cross-sectional study was conducted from January 2026 to March 2026 among older adults aged 60 years and above in an urban field practice area attached to a tertiary care center in central India. The study included elderly individuals (≥60 years) attending the outpatient services of the urban health training center during the study period. Participants were classified into two groups based on frailty status.

A pilot study including 60 participants (30 frail and 30 non-frail) was conducted to estimate variability in EQ-5D utility scores. Based on the pooled standard deviation (0.126), a minimum clinically important difference of 0.05, 80% power, and 95% confidence level, the required sample size was calculated as 200 participants.

Participants were recruited using consecutive sampling until the desired sample size was achieved, comprising 100 frail and 100 non-frail individuals. All individuals aged 60 years and above who provided informed consent were included in the study. Participants with severe cognitive impairment, acute illness at the time of assessment, or inability to respond to the questionnaire were excluded.

Frailty status was considered the primary independent variable and categorized as frail or non-frail. The primary outcome variables were: quality-adjusted life year (QALY) loss and years lived with disability (YLD). Covariates included age, sex, socioeconomic status (assessed using Modified Kuppuswamy scale), multimorbidity (defined as the presence of two or more chronic conditions), polypharmacy (defined as the use of five or more medications), and functional status measured using activities of daily living (ADL).[15]

Frailty was assessed using the Edmonton Frail Scale described by Rolfson et al, a validated multidimensional tool comprising ten domains.[16] Health-related quality of life was measured using the EQ-5D-5L instrument, and utility scores were derived using the Indian value set.[17] Permission to use the EQ-5D-5L instrument was obtained through the EuroQol Research Foundation registration process (Registration number: 77527). Functional status was assessed using the Katz index of activities of daily living.[18] Information on falls was obtained through a structured questionnaire, including history of falls, type of injury, and duration of disability.

QALY loss calculation was estimated using EQ-5D utility scores multiplied by the duration of the health state, representing loss in quality-adjusted survival. YLD was calculated using the standard Global Burden of Disease approach as the product of disability weight and duration of disability.

Data were entered and analyzed using Jamovi v2.6.44 software. Continuous variables were expressed as mean±standard deviation or median (interquartile range), while categorical variables were presented as frequency and proportions. To account for the equal sampling of frail and non-frail participants, weighted estimates were calculated to reflect the distribution of frailty in the underlying population. Weighted prevalence of falls and contribution to total fall burden were estimated using appropriate weights based on observed prevalence, to provide population-level estimates. Differences between frail and non-frail groups were assessed using Mann-Whitney U test due to non-normal distribution. Multivariable linear regression analysis was performed to identify independent predictors of QALY loss, adjusting for potential confounders. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 200 participants were included in the study, comprising 100 frail and 100 non-frail older adults. The mean age of participants was higher among the frail group (71±6.2 years) compared to the non-frail group (68±4.6 years). Females constituted a higher proportion among the frail (56%) compared to non-frail individuals

(48%). Frail participants had lower functional status, with mean activities of daily living (ADL) score of 4.02±1.02 compared to 5.21±0.74 among non-frail individuals. Multimorbidity (65% versus 30%) and polypharmacy (40% versus 11%) were also more common among the frail group (Table 1).

Table 1: Sociodemographic and clinical characteristics of study participants by frailty status (n=200).

Variables	Frail (n=100)	Non-frail (n=100)
Age (years), mean±SD	71±6.2	68±4.6
Sex		
Male, N (%)	44 (44)	52 (52)
Female, N (%)	56 (56)	48 (48)
Socioeconomic status		
Upper, N (%)	15 (15)	23 (23)
Lower, N (%)	85 (85)	77 (77)
ADL[a] score, mean±SD	4.02±1.02	5.21±0.74
Multimorbidity, N (%)	65 (65)	30 (30)
Polypharmacy, N (%)	40 (40)	11 (11)

[a]Activities of daily living.

The overall prevalence of falls in the study population was 28.0%. Falls were markedly more frequent among frail individuals, with 46% reporting at least one fall compared to 10% among non-frail participants. Although both groups were equally represented in the sample, frail individuals contributed a disproportionately higher share of total fall events. When adjusted for the distribution of frailty, the contribution of frail individuals to the overall burden of falls remained substantially higher than that of non-frail individuals (Table 2).

Table 2: Prevalence of falls and contribution to total fall burden by frailty status.

Variables	Frail (n=100)	Non-frail (n=100)
Prevalence of falls, N (%)	46 (46)	10 (10)
Contribution to total falls, %	23	5
Contribution to total falls (weighted)[a], %	16.1	6.5

[a]Weighted estimates were calculated to adjust for the distribution of frailty in the underlying population.

Frail individuals experienced significantly greater health loss compared to non-frail participants. The mean QALY loss was 0.475±0.185 among the frail group, compared to 0.203±0.155 among the non-frail group (p<0.001). Median QALY loss also differed substantially between groups [frail: 0.446 (IQR: 0.341-0.597) versus non-frail: 0.166 (IQR: 0.092-0.285)]. Similarly, mean YLD was higher among frail individuals (0.0102±0.0429) compared to non-frail individuals (0.0008±0.0076), and this difference was statistically significant (p<0.001) (Table 3). These differences are illustrated in Figure 1, which demonstrates the substantially higher distribution of QALY loss among frail individuals compared with non-frail participants (Figure 1).

On multivariable linear regression analysis, frailty was identified as the only significant independent predictor of QALY loss (β=0.294; 95% CI: 0.229-0.359; p<0.001). Other variables, including age (β=-0.001; p=0.616), ADL score (β=0.012; p=0.362), multimorbidity (β=0.005; p=0.841), and polypharmacy (β=-0.027; p=0.377), were not significantly associated with QALY loss after adjustment (Table 4).

Table 3: Comparison of QALY loss and years lived with disability (YLD) between frail and non-frail participants.

Variables	Frail (n=100)	Non-frail (n=100)	P value[a]
QALY[b] loss, mean±SD	0.475±0.185	0.203±0.155	<0.001
QALY[b] loss, median (IQR)	0.446 (0.341-0.597)	0.166 (0.092- 0.285)	
YLD[c], mean±SD	0.0102±0.0429	0.0008±0.0076	<0.001

[a]p values derived using Mann-Whitney U test, [b]Quality-adjusted life years, [c]Years lived with disability

Table 4: Multivariable linear regression analysis of factors associated with QALY loss (n=200).

Variables	B coefficient[a]	95% CI[b]	P value
Frailty (frail versus non-frail)	0.294	0.229-0.359	<0.001
Age (years)	-0.001	-0.005-0.003	0.616
ADL[c] score	0.012	-0.014-0.046	0.362
Multimorbidity (yes versus no)	0.005	-0.047-0.058	0.841
Polypharmacy (yes versus no)	-0.027	-0.088-0.033	0.377

[a]Regression coefficient, [b]Confidence interval, [c]Activities of daily living. Reference category for frailty: non-frail

The relationship between functional status and health loss is further depicted in Figure 2, which shows the distribution of QALY loss across activities of daily living (ADL) scores (Figure 2). Frail individuals exhibited higher QALY loss across the observed range of ADL scores, although the association between ADL score and QALY loss was weak.

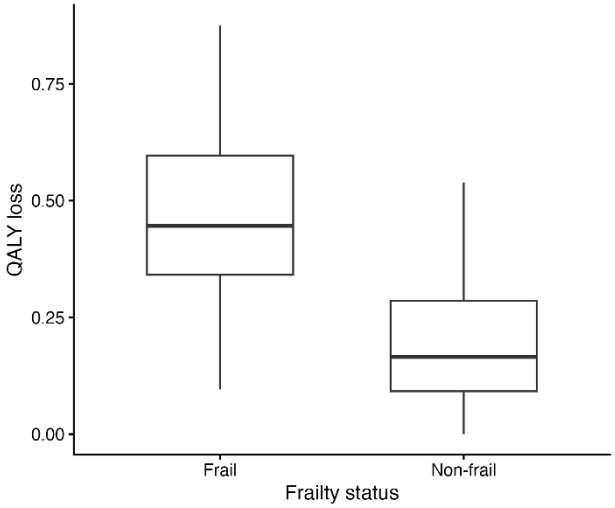

Figure 1: Frality status.

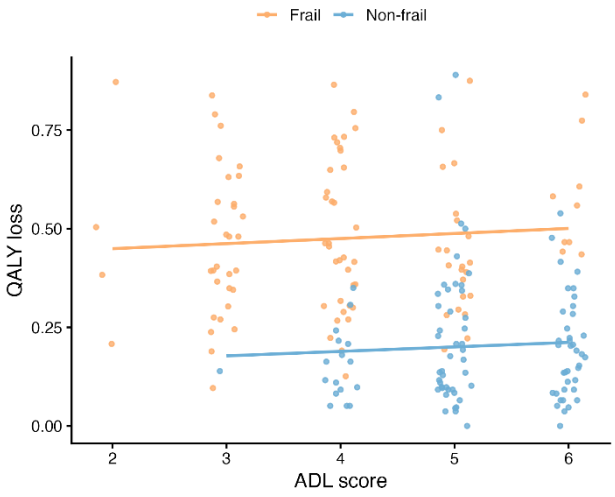

Figure 2: ADL score.

DISCUSSION

The present study quantified the differential burden of falls among frail and non-frail older adults, demonstrating that frailty is a key determinant of health loss. Frail individuals exhibited a substantially higher prevalence of falls (46% versus 10%) and experienced significantly greater health loss, as reflected by higher QALY loss (0.475 versus 0.203) and YLD. The highly skewed distribution of YLD, with a large proportion of zero values, suggests that disability is concentrated in a subset of frail individuals. In multivariable analysis, frailty emerged as the only significant predictor of QALY loss, underscoring its independent contribution to diminished health-related quality of life in this population.

The observed prevalence of falls and their strong association with frailty are consistent with existing epidemiological evidence. Studies from India have reported fall prevalence ranging from 14% to 53% among older adults, with higher rates observed in vulnerable populations.[1,2,8] Similarly, frailty prevalence in Indian settings has been reported to be as high as 30-42%.[5] The finding that frail individuals are more likely to experience falls aligns with previous research identifying frailty as an independent predictor of falls and adverse mobility outcomes among community-dwelling elderly individuals.[12]

Beyond the increased occurrence of falls, the present study provides quantitative evidence of the disproportionate health loss experienced by frail individuals. Globally, falls contribute substantially to disability, accounting for millions of YLDs and DALYs annually.[10] Our findings extend this understanding by demonstrating that frailty amplifies the burden of falls in terms of both quality-adjusted survival and duration of disability. The use of QALY and YLD metrics allows translation of clinical vulnerability into measurable health loss, which is particularly relevant in the Indian context where the availability of EQ-5D value sets has enabled more robust health economic evaluation.[13] The finding that frailty, rather than age or multimorbidity, independently predicts QALY loss highlights its role as a central determinant of health outcomes in older adults.[14]

The mechanisms underlying this amplified burden are multifactorial. Frailty is characterized by a decline in physiological reserve across multiple organ systems, resulting in reduced resilience to stressors.[4,5] Consequently, frail individuals are less able to recover from adverse events such as falls. Even minor injuries may lead to prolonged disability, delayed recovery, and further deterioration in functional status. This reduced capacity for recovery contributes to a sustained increase in YLD and a greater overall loss of quality-adjusted life.[2,12]

Functional decline, particularly in activities of daily living (ADL), appears to play a crucial role in mediating this relationship. Frailty, falls, and ADL dependency exist in a cyclical and reinforcing relationship. Functional impairment increases the risk of falls, while falls further exacerbate disability and dependence.[7,12] Additionally, the psychological consequences of falls, including fear of falling, may lead to reduced mobility, social withdrawal, and physical deconditioning, thereby compounding the overall burden of health loss.[7,12]

The findings of this study have important public health implications in the context of India's ageing population. Despite the significant burden associated with falls, they remain under-recognized in routine primary care. Integrating frailty screening into existing geriatric health services, such as the National Programme for Health Care of the Elderly (NPHCE) and Health and Wellness Centers, may facilitate early identification of high-risk individuals.[1] Targeted interventions focusing on strength training, balance improvement, and medication review could help reduce fall risk and mitigate associated health

loss. Such an approach would allow more efficient allocation of limited healthcare resources by prioritizing individuals most likely to benefit.[19]

This study has certain strengths and limitations. A key strength is the use of standardized measures to quantify health loss in terms of QALY and YLD, addressing an important gap in Indian literature. However, the cross-sectional design limits the ability to establish temporal or causal relationships between frailty, falls, and health loss. The use of self-reported fall history may introduce recall bias. Additionally, the study was conducted in a specific urban field practice area, which may limit the generalizability of findings to other settings.

Frailty is strongly associated with both an increased risk of falls and a disproportionately higher burden of health loss among older adults. By demonstrating that frailty independently predicts QALY loss, this study highlights its importance as a marker for risk stratification. Incorporating frailty assessment into primary care and implementing targeted fall prevention strategies may help reduce disability and improve quality of life among the ageing population.

CONCLUSION

Frailty is associated with a substantially greater burden of falls and health loss among older adults, reflected by significantly higher QALY loss and YLD compared with non-frail individuals. Frailty was the only independent predictor of QALY loss after adjustment for demographic and clinical factors, highlighting its value as a marker for identifying older adults at greatest risk of adverse outcomes. By quantifying fall-related health loss using QALY and YLD in an Indian setting, this study provides evidence that may support the integration of routine frailty screening into primary healthcare and geriatric services to guide targeted fall-prevention strategies and optimize resource allocation.

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