

Deciphering the Interplay of Frailty, Age, and Gender in Orthopedic Surgical Outcomes Among the Elderly: Insights From a Prospective Cohort Study

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Rushama Tandon, MS¹, Ashutosh Kapoor, MS¹, Rajan Kumar Singh, DNB^{1,*} ,
Anil Kumar Verma, DNB¹, and Nand Kishor Kaushale, DNB¹

Abstract

Background: With India's aging population on the rise, the prevalence of frailty among elderly patients undergoing major orthopedic surgeries presents a significant challenge for healthcare systems. Frailty, characterized by decreased physiological reserve and increased vulnerability to adverse health outcomes, necessitates a comprehensive approach to preoperative evaluation and care. This study aims to explore the correlation between frailty and socio-demographic variables, particularly age and gender, utilizing the Edmonton Frailty Scale (EFS) to assess frailty among elderly orthopedic surgery patients.

Material and Methods: A prospective cohort study was conducted, encompassing 157 patients aged 60 years and above, undergoing major orthopedic procedures between June 2019 and June 2021. The EFS was employed to evaluate frailty, categorizing patients across a spectrum from 'Not Frail' to 'Severe Frail'. Statistical analysis was performed to examine the relationship between frailty levels and socio-demographic variables.

Results: The majority of participants were males (59.2%) in the age group of 60-65 years (63.7%). The distribution of frailty revealed 40.1% of patients as not frail, with a substantial proportion displaying varying degrees of frailty. A significant correlation was found between increased frailty severity and advancing age ($P < .001$), while gender differences in frailty distribution suggested a higher predisposition towards severe frailty among females.

Conclusion: The study underscores the high prevalence of frailty among elderly orthopedic patients and its significant association with age and gender. These findings highlight the necessity for frailty-informed preoperative assessments and interventions tailored to the specific needs of elderly patients. Incorporating frailty evaluations into clinical practice can enhance surgical outcomes and improve the quality of care for this vulnerable population.

Keywords

frailty, elderly, orthopedic surgery, Edmonton frail scale, socio-demographic variables, preoperative evaluation

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¹Department of Orthopaedics, Northern Railway Central Hospital, New Delhi, India

*Current affiliation: Department Of Paediatric Orthopaedics, King George's Medical University, Lucknow, India

Corresponding Author:

Rajan Kumar Singh, Department of Orthopaedics, Northern Railway Central Hospital, New Delhi, India.

Email: dr.rajankumarsingh@gmail.com



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Introduction

India stands at the brink of a significant demographic shift, characterized by a rapidly aging population that presents unique challenges and opportunities for healthcare. From a modest count of 20 million elderly individuals in the early phases, the number has surged to 57 million by 1991, with projections estimating a staggering rise to approximately 324 million by 2050. This burgeoning demographic segment predominantly grapples with various health issues necessitating medical interventions, particularly orthopedic surgeries, owing to prevalent degenerative diseases and the fragility of aging bones. The escalating number of elderly patients undergoing such procedures underscores an urgent need to enhance healthcare quality by minimizing medical and surgical complications, curtailing hospital stays, and reducing readmission rates.¹⁻⁴

Traditionally, chronological age has been the cornerstone for predicting surgical outcomes. However, this approach often fails to encapsulate the physiological intricacies of aging, leading to a critical evaluation of “frailty” as a more representative parameter. Frailty, a syndrome marked by decreased strength, endurance, and physiological function, heightens an individual’s susceptibility to dependency, morbidity, and mortality. It embodies a pivotal risk factor for adverse outcomes in elderly surgical patients, meriting comprehensive assessment to tailor preemptive and postoperative care.⁵⁻⁷

In light of these considerations, the present study embarks on an exploratory journey to assess frailty among elderly individuals undergoing major orthopedic surgeries, utilizing the Edmonton Frailty Scale (EFS) as a benchmark.⁸ By delving into the correlation between frailty and socio-demographic variables such as age and gender, this research aims to unveil patterns and predictors that could revolutionize preoperative evaluations and care strategies. This endeavor not only seeks to bridge the gap between chronological and physiological aging but also to enrich the understanding of frailty’s multifaceted impact on surgical outcomes and recovery processes. Through a meticulous examination of frailty’s prevalence and its association with socio-demographic factors, the study endeavors to contribute to the overarching goal of augmenting healthcare delivery for one of society’s most vulnerable groups.

Objectives

The primary objectives of this study are to:

- **Assess the Prevalence of Frailty:** To quantify the prevalence of various components of frailty among the elderly population undergoing major orthopedic surgeries at a tertiary care center.

- **Evaluate the Frailty Index:** To employ the Edmonton Frailty Scale (EFS) for calculating the Frailty Index in patients aged 60 years and above, who are undergoing orthopedic procedures, thereby establishing a quantitative measure of frailty.
- **Correlate Frailty with Socio-Demographic Variables:** To examine the relationship between the Frailty Index and socio-demographic factors, specifically age and gender, to identify patterns or trends that may influence preoperative assessment and care planning.

Material and Methods

Study Design

This research is conceived as a single-center, prospective cohort study, aimed at exploring the nuances of frailty within a defined patient demographic undergoing orthopedic surgeries.

Study Period

Patients admitted and undergoing surgery between June 2019 and June 2021 were included, with a follow-up duration extending to 90 days post-surgery to monitor immediate postoperative outcomes.

Sample Size

The sample size was meticulously calculated using the formula:

$$SS = \frac{Z^2 * (p) * (1 - p)}{C^2}$$

Where: Z represents the confidence level (95%, equating to 1.96), p the estimated prevalence (50%), and C the confidence interval ($\pm 7.8\%$), culminating in a total of 157 patients for a robust statistical analysis.

Inclusion Criteria

- Patients aged 60 years and above.
- Those requiring orthopedic surgical intervention.

Exclusion Criteria

- Patients younger than 60 years.
- Cases involving revision surgery, peri-prosthetic fractures, implant failures, infections, pathological fractures, isolated fractures of non-load-bearing bones, cancer patients, single-level discectomies,

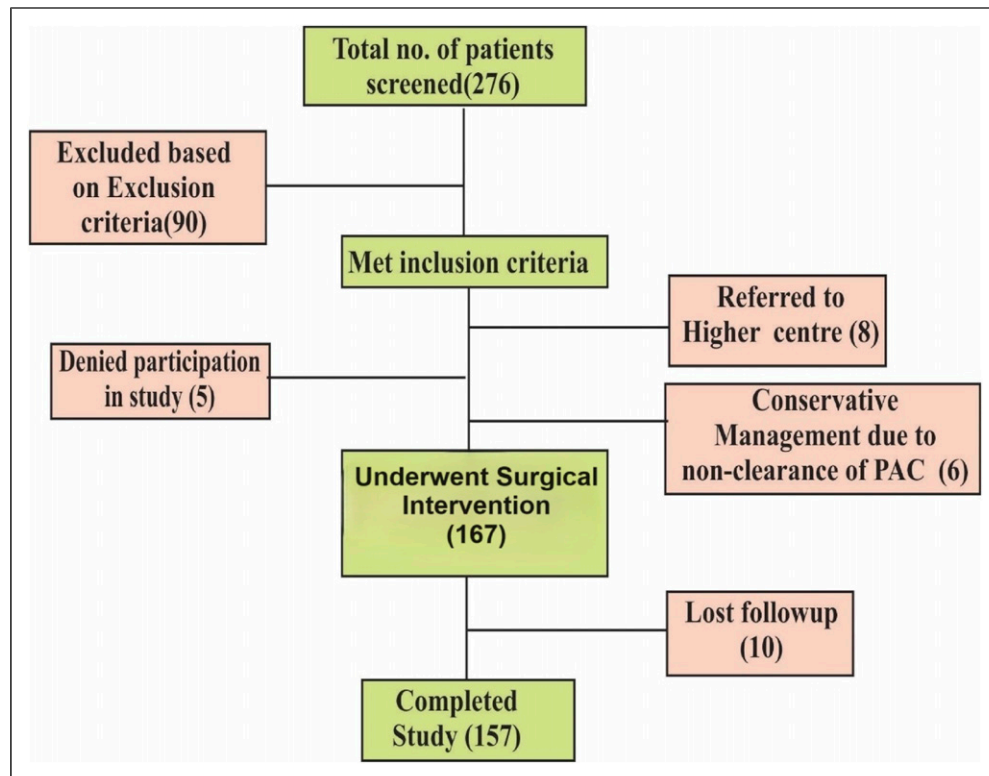


Figure 1. Patient Assessment Flowchart.

outpatient procedures, and conservatively managed patients.

Data Collection

Data were gathered through a comprehensive geriatric assessment, which included the FRAILTY assessment, administered upon admission as part of a broader initiative to enhance patient care. This assessment encompassed various variables, including demographic details, medical history, medication usage, and previous hospital admissions. During this period, we assessed 276 patients aged >60 years and requiring major orthopedic surgical intervention including:

- Major hip surgery
- Spine surgery
- Inter-trochanteric fracture fixation
- Fracture neck of femur
- Total knee and hip replacement
- Lumbar spine fixation
- Cervical spine fixation

Out of these 276 patients, 157 patients included in this study (Figure 1).

STROBE Guidelines followed while preparing the manuscript.

Assessment of Frailty

The Edmonton Frail Scale (EFS) was employed to determine the frailty level among the study participants. This scale evaluates nine domains, including cognition, functional performance, general health status, functional independence, social support, pharmacological condition, nutritional aspect, mental condition, and continence. Based on their scores, participants were classified into five categories: Not Frail, Vulnerable, Mild Frail, Moderate Frail, and Severe Frail (Table 1).

Outcome

Data was used to evaluate the prevalence of frailty in elderly population presenting for major surgery and also, the distribution of frailty on basis of age and gender of patients.

Statistical Analysis

Data were analyzed to extract meaningful insights into the correlation between the frailty index and socio-demographic

Table 1. Table for Edmonton Frail Scale and Scoring Cut off for Different Group of Frailty.

The Edmonton Frail Scale

NAME : _____

d.o.b. : _____ DATE : _____

Frailty domain	Item	0 point	1 point	2 points
Cognition	Please imagine that this pre-drawn circle is a clock. I would like you to place the numbers in the correct positions then place the hands to indicate a time of 'ten after eleven'	No errors	Minor spacing errors	Other errors
General health status	In the past year, how many times have you been admitted to a hospital?	0	1–2	≥2
	In general, how would you describe your health?	'Excellent', 'Very good', 'Good'	'Fair'	'Poor'
Functional independence	With how many of the following activities do you require help? (meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medications)	0–1	2–4	5–8
Social support	When you need help, can you count on someone who is willing and able to meet your needs?	Always	Sometimes	Never
Medication use	Do you use five or more different prescription medications on a regular basis?	No	Yes	
	At times, do you forget to take your prescription medications?	No	Yes	
Nutrition	Have you recently lost weight such that your clothing has become looser?	No	Yes	
Mood	Do you often feel sad or depressed?	No	Yes	
Continence	Do you have a problem with losing control of urine when you don't want to?	No	Yes	
Functional performance	I would like you to sit in this chair with your back and arms resting. Then, when I say 'GO', please stand up and walk at a safe and comfortable pace to the mark on the floor (approximately 3 m away), return to the chair and sit down'	0–10 s	11–20 s	One of : >20 s , or patient unwilling , or requires assistance
Totals	Final score is the sum of column totals			

Scoring :

0 - 5 = Not Frail

6 - 7 = Vulnerable

8 - 9 = Mild Frailty

10-11 = Moderate Frailty

12-17 = Severe Frailty

TOTAL

/17

Administered by : _____

variables, with specific attention to age and gender. Statistical analysis was performed using Pearson chi-square tests, independent sample t-tests and one-way ANOVA.

Statistical Software SPSS version 25 use to ascertain the significance of observed patterns and trends, facilitating a comprehensive understanding of frailty's impact on the elderly undergoing orthopedic surgeries. A *P*-value of less than .05 was considered statistically significant.

Results

In a comprehensive study encompassing 157 subjects, a meticulous breakdown of age demographics unveils compelling insights. Among these individuals, a notable majority, constituting 64% ($n = 100$), fall within the age bracket of 60-65 years. A substantial portion, comprising 21% ($n = 33$), belongs to the age group of 66-70 years, while the remaining 15% ($n = 24$) surpass the age of 70 (Table 2).

Among the 157 participants, 59.2% ($n = 93$) are males aged 60 and above, while the remaining 40.8% ($n = 64$) comprise females within the same age category (Table 2).

Notably, 40.1% ($n = 63$) exhibit non-frail status, indicative of robust health, while 29.3% ($n = 46$) are identified as vulnerable, necessitating targeted interventions. Furthermore, 13.4% ($n = 21$) display mild frailty, 8.9% ($n = 14$) demonstrate moderate frailty, and 8.3% ($n = 13$) are categorized as severely frail (Table 3).

On assessment of the general health status of participants, 2.5% of patients exhibited excellent health, marked by zero hospitalizations, while 41.4% had fair health (1 point), and 10.2% experienced multiple hospital admissions (2 points). Moreover, 16 (10.2%) and 8 (5.1%) individuals were categorized with 3 and 4 points, respectively, indicative of deteriorating health conditions necessitating frequent hospitalizations.

Functional independence, crucial for daily activities, varied among participants. A significant proportion (23.6%) displayed complete autonomy, while 63.1% could perform some tasks independently but relied on assistance for others. Additionally, 13.4% relied entirely on others for routine activities, highlighting varying degrees of dependency within the group.

Medication adherence emerged as a concern, with 40.8% managing without regular medication, 45.2% occasionally missing doses, and 14.0% struggling with consistent adherence, often due to a regimen of five or more prescriptions. Weight loss, reported by 37.6%, and differing emotional states were also noted, with 60.5% feeling content and 39.5% experiencing sadness or depression.

Cognitive function, evaluated using standardized scales, revealed diverse profiles, with 42% exhibiting good cognition, 16% poor cognition, and 42% demonstrating an

Table 2. Age & Gender Distribution of Study Participants.

		Frequency	Percent
Age group	60-65 Yrs.	100	63.7
	66-70 Yrs.	33	21.0
	>70 Yrs.	24	15.3
Gender	Male	93	59.2
	Female	64	40.8
	Total	157	100.0

intermediate level. Furthermore, urinary control issues affected 12.7% of participants, while the majority (87.3%) reported no such concerns.

Social support, vital for mitigating frailty and depression risks, was assessed, with 69.4% benefiting from family support, 29.9% receiving intermittent assistance, and a negligible 0.7% lacking support entirely (Table 4).

On observing gender prevalence in different frailty groups we found that although the number of males is more in almost all groups except severe frail but as the frailty severity increases, the proportion of females increases in each group (Figure 2).

On observing age distribution in different frailty groups we found that as the frailty severity increases the proportion of older individual increases (Figure 3).

Table 4 shows the correlation between frailty levels and age, alongside gender distinctions, among elderly orthopedic surgery patients, as evaluated through the Edmonton Frail Scale (EFS). The table showcases the distribution of patients across various frailty categories, delineated by age groups (60-65 years, 66-70 years, and older than 70 years) and gender (male and female). Noteworthy patterns emerge, with age demonstrating a significant association with frailty severity, as evidenced by a highly significant *P*-value ($<.001$). Conversely, while gender differences in frailty distribution are observed, the corresponding *P*-value (.173) suggests a non-significant association (Table 5).

Discussion

The study examined the prevalence and implications of frailty among elderly patients undergoing major orthopedic

Table 3. Frequency Distribution of Frailty Categories.

		Frequency	Percent
Frailty distribution	Not Frail	63	40.1
	Vulnerable	46	29.3
	Mild Frail	21	13.4
	Moderate Frail	14	8.9
	Severe Frail	13	8.3
	Total	157	100.0

Table 4. Prevalence of Individual Components of Frailty Criteria.

	Frailty points	Frequency	Percent
General health condition	0 points	4	2.5
	1 points	65	41.4
	2 points	64	40.8
	3 points	16	10.2
	4 points	8	5.1
Functional independence	0 points	37	23.6
	1 points	99	63.1
	2 points	21	13.4
Multiple medication	0 points	64	40.8
	1 points	71	45.2
	2 points	22	14.0
Nutrition assessment	0 points	98	62.4
	1 points	59	37.6
Assessment of mood	0 points	95	60.5
	1 points	62	39.5
Cognition	0 points	66	42.0
	1 points	66	42.0
	2 points	25	16.0
Incontinence	0 points	137	87.3
	1 points	20	12.7
Social support	0 points	109	69.4
	1 points	47	29.9
	2 points	1	0.7

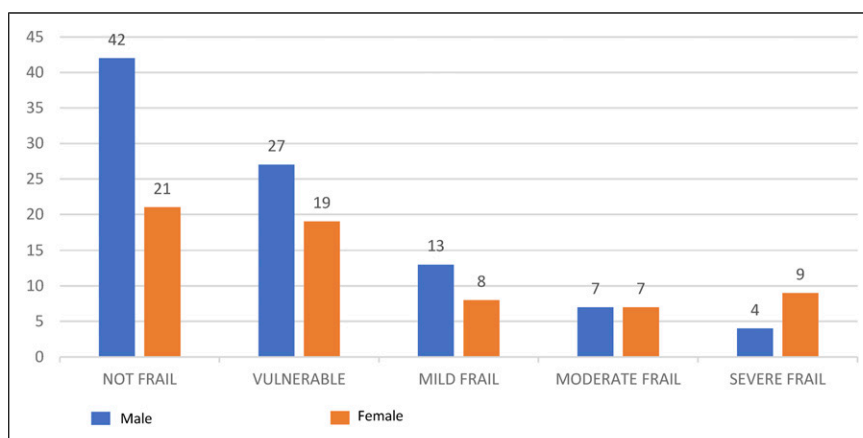
surgeries, utilizing a robust dataset and the Edmonton Frail Scale (EFS) for assessment. The results illuminate the complex interplay between frailty, age, and gender within this demographic.

This study sheds light on the intricate relationship between frailty and socio-demographic variables, particularly age and gender, among elderly patients undergoing major orthopedic surgeries. The utilization of the Edmonton Frailty Scale (EFS) facilitated a nuanced understanding of frailty, highlighting its

prevalence and varying degrees among the study population.

Frailty prevalence in older adults is a significant concern, as evidenced by this study's findings. The research reveals that only 40% of the study population exhibited non-frail status, while the remaining 60% were classified as either vulnerable (29.3%) or frail (~31%). Discrepancies in reported frailty prevalence across studies stem from variations in definitions, inclusion criteria, and study populations. For instance, the SHARE study, encompassing 10 European countries and Israel, reported an overall frailty prevalence of 17%, highlighting regional variations influenced by factors such as sex, age, ethnicity, and socioeconomic status.⁹ In India, limited studies are available on frailty prevalence. A hospital-based study in India reported a frailty prevalence of 33%, while a large population study using the frailty index found a prevalence of 55.5%.^{10,11} Additionally, research by Rohrmann et al¹² highlighted that frailty increases with age and is more prevalent in women than men. Similarly, a meta-analysis by O'Caoimh et al¹³ across 62 countries found common frailty prevalence rates, with variations based on the frailty measurement scale and geographical area, emphasizing the higher prevalence among females using different assessment methods. These findings underscore the need for comprehensive approaches to address frailty among older adults, considering its multifactorial nature and demographic variations.

Frailty components were meticulously assessed in this study, revealing significant findings. Among the patients with a history of multiple hospital admissions, only a small proportion (2.5%) reported excellent general health, while a concerning 5.1% experienced frequent and multiple hospitalizations, indicative of very poor general health. The majority described their general health as fair. Functional independence was notably limited, with only

**Figure 2.** Gender Disparity in Frailty Distribution Among Elderly Orthopedic Surgery Patients.

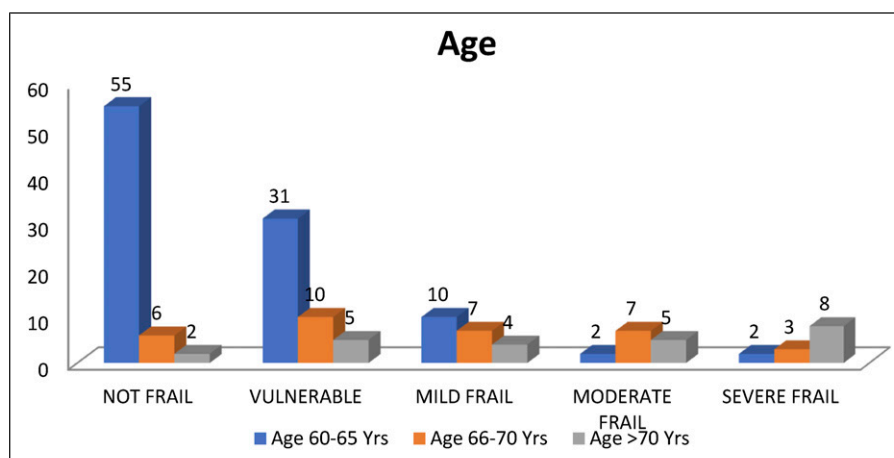


Figure 3. Age-Related Variations in Frailty Severity Among Elderly Orthopedic Surgery Patients.

23.6% being functionally independent, while the majority were either partially dependent (63.1%) or completely dependent (13.4%) on others for daily activities. Polypharmacy emerged as a concern, with 40.8% not requiring regular medication and 14.0% managing five or more prescription drugs but often forgetting doses. Significant weight loss affected 37.6% of the population, while depression was prevalent in 39.5%. Poor cognition was noted in 16%, and urinary incontinence history was reported by 12.7%, highlighting the multifaceted nature of frailty.

Gender disparities in frailty were observed, with a higher overall number of males across different frailty groups. However, the proportion of females increased with the severity of frailty, suggesting a greater vulnerability among females. This aligns with previous studies showing that women are more prone to frailty, with research indicating that women are two times more vulnerable than men in elderly populations.^{14,15} Age played a significant role in frailty determination, with patients of all age groups represented across frailty categories. Nonetheless, the mean age increased with frailty severity, indicating the association between aging and

frailty. Frailty was defined as a complex age-associated syndrome by Kadjo Yves Cedric Adja, resulting from physiological system decline, leading to increased vulnerability to stressors and impaired homeostatic ability.¹⁶ These findings emphasize the intricate relationship between gender, age, and frailty, highlighting the need for comprehensive approaches to address frailty among elderly populations.

Limitations

Despite its insightful findings, this study is not without limitations. This study was conducted during the global COVID-19 pandemic, which may limit generalizability to the current post-pandemic situation. The descriptive and single-center nature of the research also limits the generalizability of the results to wider populations. The study's relatively small sample size and the specific demographic of railway employees and their dependents, who have relatively easy access to healthcare services, may not fully represent the broader elderly population undergoing orthopedic surgeries. Additionally, the absence of long-term follow-up restricts the ability to

Table 5. Association of Frailty Levels With Age and Gender Among Elderly Orthopedic Surgery Patients.

		Edmonton Frail scale					Total	Pearson chi-square	P-value
		Not Frail	Vulnerable	Mild Frail	Moderate Frail	Severe Frail			
Sex	Male	42	27	13	7	4	93	6.365	.173
	Female	21	19	8	7	9	64		
Age	60-65 Yrs.	55	31	10	2	2	100	56.541	<.001
	66-70 Yrs.	6	10	7	7	3	33		
	>70 Yrs.	2	5	4	5	8	24		

assess the sustained impact of frailty on postoperative outcomes.

Conclusion

The study conclusively demonstrates the pervasiveness of frailty among elderly individuals undergoing major orthopedic surgeries and its significant correlation with socio-demographic variables, particularly age and gender. The Edmonton Frailty Scale proves to be a valuable tool in identifying frailty, underscoring the importance of comprehensive preoperative assessments to tailor care plans and interventions. Addressing frailty in this demographic is imperative for improving surgical outcomes, enhancing recovery processes, and ultimately, elevating the quality of life for the elderly.

Recommendations

Based on the study's findings, it is recommended to increase awareness among healthcare professionals about the significance of frailty in elderly patients, emphasizing routine frailty assessments in preoperative evaluations. A multidisciplinary approach integrating nutritional, psychological, and rehabilitative support alongside medical interventions should be adopted to manage frailty effectively. Gender-sensitive assessment and treatment protocols should be developed to address observed differences between males and females. Further research through larger-scale, multi-center studies with diverse populations and longer follow-up periods is essential to validate and expand upon the study's findings. Standardization of frailty assessment tools across healthcare settings is crucial for early identification and intervention. Additionally, preventive strategies focusing on physical activity programs, nutritional support, and medication management plans should be developed to delay the progression from pre-frailty to frailty, ultimately enhancing the care and outcomes for elderly patients undergoing orthopedic surgeries.

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ORCID iD

Rajan Kumar Singh  <https://orcid.org/0009-0002-1398-5294>

Statements and Declarations

Ethical Approval

The study was approved by the Institutional Ethics Committee of Northern Railway Central Hospital, New Delhi. It was conducted according to the ethical standards of Helsinki Declaration (1964) and its subsequent amendments.

Author Contributions

This study was designed and organized by Dr Rushama Tandon and Dr Ashutosh Kapoor. Data collection, analysis and writing of the first draft was by Dr Rajan Kumar Singh, supported by Dr anil kumar verma and Dr Nand kishor kaushal. All authors read and approved the final manuscript.

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Conflicting Interests

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References

1. Ingle GK, Nath A. Geriatric health in India: concerns and solutions. *Indian J Community Med.* 2008;33(4):214-218.
2. Kwok AC, Semel ME, Lipsitz SR, et al. The intensity and variation of surgical care at the end of life: a retrospective cohort study. *Lancet.* 2011 Oct;15378(9800):1408-13. doi: [10.1016/S0140-6736\(11\)61268-3](https://doi.org/10.1016/S0140-6736(11)61268-3)
3. Chow WB, Rosenthal RA, Merkow RP, Ko CY, Esnaola NF, American College of Surgeons National Surgical Quality Improvement Program. Optimal preoperative assessment of the geriatric surgical patient: a best practices guideline from the American college of surgeons national surgical quality improvement program and the American geriatrics society. *J Am Coll Surg.* 2012;215(4):453-466.
4. Morley JE, Vellas B, van Kan GA, et al. Frailty consensus: a call to action. *J Am Med Dir Assoc.* 2013 Jun;14(6):392-7. doi: [10.1016/j.jamda.2013.03.022](https://doi.org/10.1016/j.jamda.2013.03.022)
5. Rohrmann S. Epidemiology of Frailty in Older People. *Adv Exp Med Biol.* 2020;1216:21-27. doi: [10.1007/978-3-030-33330-0_3](https://doi.org/10.1007/978-3-030-33330-0_3)
6. Lekan DA, Wallace DC, McCoy TP, Hu J, Silva SG, Whitson HE. Frailty assessment in hospitalized older adults using the electronic health record. *Biol Res Nurs.* 2016;19(2):213-228.
7. Sieber CC. Frailty - from concept to clinical practice. *Exp Gerontol.* 2017;87(Pt B):160-167.
8. Perna S, Francis MD, Bologna C, et al. Performance of Edmonton Frail Scale on frailty assessment: its association with multi-dimensional geriatric conditions assessed with specific screening tools. *BMC Geriatr.* 2017;17:2.
9. Veronesi F, Borsari V, Martini L, et al. The impact of frailty on spine surgery: systematic review on 10 years clinical studies. *Aging Dis.* 2021;12:625-645.

10. Kendhapedi KK, Devasenapathy N. Prevalence and factors associated with frailty among community-dwelling older people in rural Thanjavur district of South India: a cross-sectional study. *BMJ Open*. 2019 Oct;119(10):e032904. doi:[10.1136/bmjopen-2019-032904](https://doi.org/10.1136/bmjopen-2019-032904)
11. Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: a systematic review and meta-analysis. *BMJ Open*. 2018 Mar;18(3):e018195. doi:[10.1136/bmjopen-2017-018195](https://doi.org/10.1136/bmjopen-2017-018195)
12. Rohrmann S. Epidemiology of frailty in older people. *Adv Exp Med Biol*. 2020;1216:21-27.
13. O'Caoimh R, Sezgin D, O'Donovan MR, et al. Prevalence of frailty in 62 countries across the world: a systematic review and meta-analysis of population-level studies. *Age Ageing*. 2021;50(1):96-104.
14. Op het Veld LPM, van Rossum E, Kempen GJIM, de Vet HCW, Hajema K, Beurskens AJHM. Fried phenotype of frailty: cross-sectional comparison of three frailty stages on various health domains. *BMC Geriatr*. 2015;15:77.
15. Niederstrasser NG, Rogers NT, Bandelow S. Determinants of frailty development and progression using a multidimensional frailty index: Evidence from the English Longitudinal Study of Ageing. *PLoS One*. 2019 Oct;3014(10):e0223799. doi:[10.1371/journal.pone.0223799](https://doi.org/10.1371/journal.pone.0223799)
16. Adja KYC, Lenzi J, Sezgin D, et al. The Importance of Taking a Patient-Centered, Community-Based Approach to Preventing and Managing Frailty: A Public Health Perspective. *Front Public Health*. 2020 Nov;128:599170. doi:[10.3389/fpubh.2020.599170](https://doi.org/10.3389/fpubh.2020.599170)