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Journal of Orthopaedic Surgery and Research (2025) 20:299
https://doi.org/10.1186/s13018-025-05505-9

Journal of Orthopaedic Surgery and Research

RESEARCH

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The modified 5-item frailty index in total hip arthroplasty patients: a retrospective cohort from a low-middle income country

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Abstract

Background Total hip arthroplasty (THA) is increasing in low- and middle-income countries (LMICs) due to rising rates of hip fractures and an aging population. Identifying frail patients at risk for postoperative complications is vital for improving outcomes. This study examines the utility of the Modified 5-Item Frailty Index (mFI-5) in predicting 30-day morbidity and mortality in THA patients in resource-limited settings, where other models like the Elixhauser Comorbidity Measure (ECM) and Charlson Comorbidity Index (CCI) may be impractical due to data constraints.

Methods This retrospective cohort study included 498 patients undergoing THA at tertiary-care hospital between January 2014 and December 2019. Patients were stratified based on their mFI-5 scores (≤ 1 vs. > 1). Postoperative complications, length of stay, and mortality were compared between groups. Multivariable logistic regression was used to assess outcomes.

Results Of the 498 patients, 62.8% had an mFI-5 score ≤ 1, and 37.2% had a score > 1. Complication rates were higher in the mFI-5 > 1 group (17.8%) versus the ≤ 1 group (9.6%). After adjusting for covariates, patients with mFI-5 > 1 had a 97% higher likelihood of complications (aOR = 1.97, 95% CI 1.06–3.70). Each additional hospital day increased complication risk by 13% (aOR = 1.13, 95% CI: 1.05–1.21).

Conclusion The mFI-5 is a practical, efficient tool for predicting postoperative complications in THA patients, particularly in resource-limited environments. Its use in LMICs could improve preoperative planning, reduce complications, and provide better outcome estimates for patients and healthcare providers. Given the growing geriatric population, integrating the mFI-5 into routine THA planning could enhance patient care and resource allocation. Further research is needed to validate its use across larger datasets.

Key Points

Aim This study investigates the utility of the mFI-5 as a reliable predictive tool for post-operative outcomes in patients undergoing THA in resource-limited settings. We hypothesize that mFI-5 can effectively stratify surgical risks, allowing for better perioperative planning in environments with constrained resources.

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Findings The mFI-5 proved to be a reliable predictor of postoperative complications and length of stay (LOS) in patients undergoing THA. Higher mFI-5 scores were significantly associated with increased risks of infections, dislocations, and extended hospital stays, indicating its usefulness in identifying high-risk patients.

Message Implementing mFI-5 in resource limited settings can enhance perioperative decision-making, improve patient outcomes, and reduce the financial burden on patients and healthcare systems in low- and middle-income countries (LMICs).

Keywords Total hip arthroplasty, mFI-5, Frailty index, Postoperative complications, Low- and middle-income countries, Geriatrics, Resource-limited settings, Risk stratification, Length of stay, Predictive model

Introduction

Total hip arthroplasty (THA) is an effective surgical intervention delivering consistent and reliable outcomes for patients with hip conditions [1, 2]. The procedure utilizes prosthetic devices made of metal, plastic, or ceramic to repair or reconstruct diseased or damaged hip joints. [3] It is primarily indicated for patients with end-stage osteoarthritis, however, its utility extends to osteonecrotic, traumatic, inflammatory and even congenital diseases. [4, 5] Although employed across demographics, the frequency of geriatric individuals undergoing the procedure is rising. These individuals can have poor post-operative outcomes given their risk profile [6] and potential complications of the procedure such as infection, dislocation and implant failure, all of which necessitate the need for reliable peri-operative assessment via scoring systems. [7].

Predictive scoring is a strategy employed across the board for various surgeries. Various scoring systems have evolved over the years to demonstrate a high predictive efficacy, [8] allowing informed decision making for physicians and patients. The establishment of predictive scoring in orthopedic surgery is still subject to debate, with American Society of Anesthesiologists (ASA) Physical Status Classification System, the Elixhauser Comorbidity Method (ECM), the Charlson Comorbidity Index (CCI), and the Readmission After Total Hip Replacement Risk Scale (RATHRR) being widely used. These models estimate complication rates by aggregating deficits to measure reduced physiologic reserve.

The modified frailty index, mFI-5, is a frailty score which evaluates five comorbidities—ischemic heart disease (IHD), hypertension, diabetes, chronic obstructive pulmonary disease (COPD), and functional status—offers a streamlined alternative by using fewer variables while yielding comparable predictive accuracy. The total score, ranging from 0 to 5, correlates directly with frailty and the risk of adverse outcomes, such as postoperative complications, extended hospital stays, and mortality. [9] Given its validity and ease-of-application, the mFI-5 is particularly valuable in resource-limited settings, where the lack of standardized medical records, coupled with limited access to healthcare often leads to incomplete patient information. Complications following THA place a significant burden on both patients and healthcare systems, particularly in low-and middle-income countries (LMICs) where out of pocket payment is the norm. Risk stratification models like the ECM and CCI offer increased sensitivity but are often impractical in these settings due to use of numerous variables. The mFI-5, using only five variables, presents a simpler alternative without sacrificing predictive accuracy. [10, 11].

The mFI-5's strength lies in its ease of use, requiring only basic patient history, making it well-suited in resource constrained environment. By identifying high-risk patients preoperatively, healthcare providers can optimize resource allocation, reducing complications which increase costs and care complexity in these settings. Given the average cost of treating an infected arthroplasty is over three times higher than uncomplicated cases, [12] effective risk stratification becomes crucial in cost-saving efforts.

To the best of our knowledge, this study is first of its kind from LMICs aiming to evaluate and validate mFI-5 as a strong predictor of early postoperative outcomes in the setting of a major tertiary referral center in a low- and middle-income country. By providing caregivers with a clearer understanding of the mFI-5's advantages—such as simplicity and reliance on minimal data requirements—as well as its drawbacks, this study seeks to inform perioperative assessment practices through data, particularly where resources are constrained.

Methods

Study design and setting

This retrospective cohort study was conducted at a tertiary care hospital settings adhering to the Declaration of Helsinki principles. Data from a prospective hip arthroplasty registry of the Aga Khan University Hospital (AKUH), a tertiary care hospital in the metropolitan city of Karachi in Pakistan was used. The registry was approved by the Institutional Review Board (IRB) before initiation, and the data qualified for exemption from the ethical review committee.

Study sample

A total of 498 patients who underwent total hip arthroplasty (THA) between January 2014 and December 2019 were included in the final analysis of the study. The study included all the eligible patients during study duration were identified and included in the study.

Inclusion and exclusion criteria

Patients above 18 years of age, who underwent THA at the hospital during the study period, and consented to be to be included in the registry were included in the study. Patients who did not give their consent to be included in the registry were excluded.

Data collection and protection

The study utilized data from the institutional hip arthroplasty registry, established in 2014. The registry provided comprehensive information on patient demographics, medical history, and surgical outcomes. Data from the medical records was manually extracted and entered into an excel sheet by trained individuals to ensure consistency and accuracy. Collected parameters included patient's age, sex, comorbidities, surgical approach, intraoperative complications, postoperative complications, length of hospital stay, and follow-up outcomes. For the purposes of this study, the entire dataset from the registry was utilized without modification for analysis.

All data collected was stored in a secure electronic file, accessible only to the research team. Access to this file was restricted to team members solely for the purpose of analysis, ensuring the protection and confidentiality of patient information.

Outcome variables

The mFI-5 score was categorized into two groups: mFI-5 = 0–1 (Group 1), indicating low frailty patients and mFI-5 = 2–5 (Group 2), indicating high frailty patients. The outcome of the study was post-surgery adverse outcomes. The post-operative adverse outcomes evaluated for each group included complications such as dislocations, infections, venous thromboembolisms, pulmonary embolisms, others (neuropathies, pain, and nerve injuries) and mortality.

Statistical analysis

The data was analyzed using STATA Version 15.0. Descriptive statistics were used to summarize the demographic and clinical characteristics of the patients. Quantitative variables were reported as medians with interquartile ranges (IQR) for non-normally distributed data. Categorical variables were reported as frequencies and percentages.

The incidence of post-operative adverse outcomes, including complications, adverse intra-operative events, 30-day readmission, and 30-day mortality, length of stay was compared between the two mFI-5 groups. To examine potential differences between mFI-5 categories, we compared patient characteristics across groups using the Wilcoxon rank-sum test for continuous variables and chi-square tests for categorical variables. To examine the relationship between outcome (post-operative complications) with the mFI-5 and other covariates, univariable and multivariable logistic regression models were constructed. The assumptions of the models were checked for all our analyses, including the absence of multicollinearity. All p-values were two-tailed, and a value of $p \leq 0.05$ was regarded as statistically significant.

Results

Demographics

Of the 498 patients in the study, 62.8% (313) had a mFI-5 scores of ≤ 1 and 37.2% (185) had a scores > 1. The median age was 50 years (range: 36–63) for patients with an mFI-5 score of ≤ 1 and 65 years (range: 58–72) for those with a score > 1. The proportion of males was slightly higher in the mFI-5 (0–1) group (52.4%) than in the mFI-5 (> 1) group (47.6%). Individuals in the mFI-5 (> 1) group had a slightly higher median body mass index (BMI) of 27.54 kg/m2 (IQR: 23.62–30.04) compared to those in the mFI-5 (0–1) group with a median BMI of 25.78 kg/m2 (IQR: 23.33–29.21). The presence of diabetes (59.46%), hypertension (11.89%), and ischemic heart disease (91.89%) was more common in the mFI-5 (> 1) group.

Peri-operative findings

Patients with mFI-5 scores greater than 1 had higher ASA grades, with 61.6% in grade 3 compared to only 18.5% in the mFI-5 (0–1) group. The use of general anesthesia was slightly lower in the mFI-5 (> 1) group (87.0%) compared to the mFI-5 (0–1) group (94.6%). Median preoperative hemoglobin levels were similar between the groups, at 11.6 g/dL (IQR: 10.8–14.3) for mFI-5 (0–1) and 11.9 g/dL (IQR: 11–13.4) for mFI-5 (> 1).

Postoperative hemoglobin levels were also similar between both groups, with a median of 10.3 g/dL. However, blood transfusions were more frequently required in the mFI-5 (> 1) group (47.0%) compared to the mFI-5 (0–1) group (34.8%). Blood loss was slightly higher in the mFI-5 (> 1) group, with a median of 300 mL (IQR: 200–450) compared to 250 mL (IQR: 170–500) in the mFI-5 (0–1) group. The median length of hospital stay was 6 days for both groups, with a slightly broader range in

Table 1 Demographic and clinical, preoperative, intraoperative, and postoperative characteristics of patients by mFI-5 Categories

Variables	mFI-5 (0–1) N = 313	mFI-5 (> 1) N = 185	*P*-values
Demographic and Clinical Characteristics			
Age in years	Median (IQR): 50 (36–63) years	Median (IQR): 65 (58–72) years	< 0.001
Sex Male Female	164 (52.40%) 149 (47.60%)	88 (47.57%) 97 (52.43%)	0.298
BMI	Median: 25.78 (IQR: 23.33–29.21)	Median: 27.54 (IQR: 23.62–30.04)	0.424*
Presence of Diabetes Yes No	12 (3.83%) 301 (96.17%)	110 (59.46%) 75 (40.54%)	< 0.001
Presence of Asthma/COPD Yes No	5 (1.60%) 308 (98.40%)	22 (11.89%) 163 (88.11%)	< 0.001
Presence of Hypertension Yes No	65 (20.77%) 248 (79.23%)	170 (91.89%) 15 (8.11%)	< 0.001
Presence of IHD Yes No	5 (1.60%) 308 (98.40%)	54 (29.19%) 131 (70.81%)	< 0.001
Ambulatory Status Home with support/non-ambulatory/CBR No support needed	30 (9.58%) 283 (90.42%)	72 (38.92%) 113 (61.08%)	< 0.001
Primary Diagnosis AVN Dysplastic Hip Failed Hip Fracture OA Others (Inflammatory Arthritis/ girdlestone/ Loosening of Prosthesis/ periprosthetic fracture/ Protrusio acetabuli)	82 (26.20%) 24 (7.67%) 21 (6.71%) 88 (28.12%) 73 (23.32%) 25 (7.99%)	24 (12.97%) 1 (0.54%) 31 (16.76%) 95 (51.35%) 24 (12.97%) 10 (5.41%)	< 0.001
Type of Hip Replacement Surgery Left Right Simultaneous Bilateral Staged Bilateral	143 (45.69%) 128 (40.89%) 26 (8.31%) 16 (5.11%)	79 (42.70%) 97 (52.43%) 4 (2.16%) 5 (2.70%)	0.004$
Preoperative Characteristics			
ASA Grade 1 2 3 4	66 (21.09%) 188 (60.06%) 58 (18.53%) 1 (0.32%)	2 (1.08%) 58 (31.35%) 114 (61.62%) 11 (5.95%)	< 0.001$
Type of Anesthesia General Regional/ Epidural/ Spinal/ combination	296 (94.57%) 17 (5.43%)	161 (87.03%) 24 (12.97%)	0.003
Preoperative HB levels	Median (IQR): 11.6 (10.8–14.3)	Median (IQR): 11.9 (11–13.4)	< 0.001*
Intraoperative and Postoperative Characteristics			
Intraoperative Adverse Events Yes No	9 (2.88%) 304 (97.12%)	5 (2.70%) 180 (97.30%)	1.000$
Anticoagulant LMWH Others (Warfarin, Aspirin, Rivaroxaban, combination therapy, and not received)	295 (94.25%) 18 (5.75%)	161 (87.03%) 24 (12.97%)	0.005
Postoperative HB levels	Median (IQR): 10.3 (9.3–11.4)	Median (IQR): 10.3 (9.4–11.3)	0.7582
Blood transfusion Yes No	109 (34.82%) 204 (65.18%)	87 (47.03%) 98 (52.97%)	0.007
Blood loss in ml	Median (IQR): 250 (170–500)	Median (IQR): 300 (200–450)	0.7062
Length of Stay	6 (5–7)	6 (5–8)	0.0055

Table 1 (continued)

*Wilcoxon rank-sum (Mann–Whitney) test

$ Fisher's Exact test; rest of the *P*-values are Chi Square test

the mFI-5 (> 1) group (IQR: 5–8 days). Table 1 outlines the demographic, preoperative, and postoperative characteristics of patients identified across the mFI-5 groups.

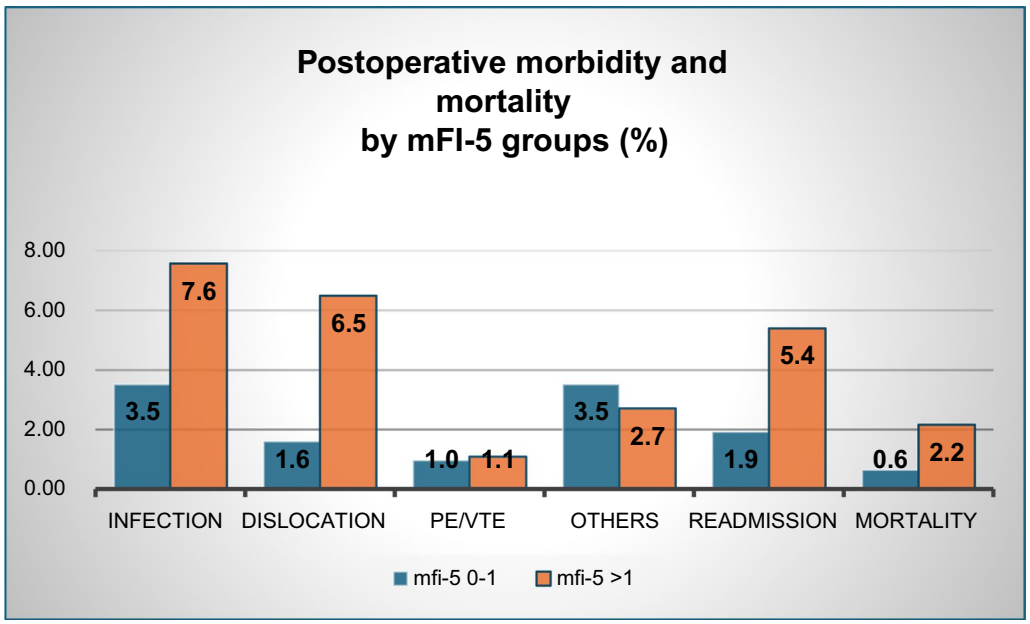
Post-operative complications

Among the 498 patients, those with higher mFI-5 scores (> 1) had a greater incidence of postoperative complications compared to those with lower scores (0–1). In the mFI-5 (0–1) group, 9.6% of patients experienced complications, whereas in the mFI-5 (> 1) group, 17.8% of patients had complications as noted in Fig. 1.

After adjusting for demographic, pre-operative, and postoperative characteristics, patients with mF1-5 scores greater than 1 had 97% higher odds of experiencing postoperative complications compared to those with scores of 1 or less (aOR = 1.97, 95% CI 1.06–3.70). Patients with a diagnosis of fracture had 63% lower odds of complications compared to those with AVN (aOR = 0.37; 95% CI 0.16–0.87). Additionally, higher postoperative hemoglobin levels were significantly associated with a reduced likelihood of complications. For each g/dL increase in postoperative hemoglobin levels, the odds of complications decreased by 26% (aOR = 0.74, 95% CI 0.61–0.90). Table 2 presents the detailed multivariable results for postoperative complications. Length of stay was also associated with post-operative outcomes. With every one-day increase in length of stay, the odds of experiencing complications increasing by 13% (aOR = 1.13; 95%CI 1.05–1.21).

Discussion

This is the first of its kind study to examine the use of mFI-5 in patients undergoing THA in a resource limited setting. The findings strengthen the utilization of mFI-5 as an effective risk stratification and predictive risk scoring tool in a resource limited setting. The study revealed a significant association between the mFI-5 score and 30-day outcome measures in patients undergoing THA in resource-limited settings. The results indicate that patients with high mF1-5 scores had higher odds of experiencing postoperative



Others

Fig. 1 Postoperative morbidity and mortality rates by mFI-5 groups. The bar chart compares the rates of postoperative complications and mortality between patients with low frailty (mFI-5 score 0–1) and those with higher frailty (mFI-5 score > 1). The outcomes include infection, dislocation, pulmonary embolism/venous thromboembolism (PE/VTE), other complications (neuropathies, pain, and nerve injuries), readmission, and mortality. Patients with an mFI-5 score > 1 show higher rates of complications across all categories, with notable increases in infection (7.6% vs 3.5%) and dislocation (6.5% vs 1.6%) compared to those with an mFI-5 score of 0–1

Table 2 Multivariable logistic regression analysis (Outcome: morbidity/complications)

Variable	Univariable			Multivariable		
	OR	**95% CI**	***P*-value**	**aOR**	**95% CI**	***P*-value**
mFI-5 scores 0–1 >1	Ref 2.05	- 1.20–3.48	- 0.008	Ref 1.97	- 1.06–3.70	- 0.032
Age in years	1.008	0.99–1.02	0.318			
Sex Female Male	Ref 0.64	- 0.38–1.11	- 0.115			
BMI	1.04	0.99–1.10	0.081			
Presence of Diabetes No Yes	Ref 1.95	- 1.11–3.41	- 0.019			
Presence of Asthma/COPD No Yes	Ref 0.53	- 0.12–2.32	- 0.407			
Presence of Hypertension No Yes	Ref 1.58	- 0.92–2.69	- 0.092			
Presence of IHD No Yes	Ref 0.92	- 0.39–2.12	- 0.847			
Ambulatory Status Others Home with support/non-ambulatory/CBR	Ref 3.31	- 1.89–5.80	- <0.001			
Primary Diagnosis AVN Dysplastic Hip Failed Hip Fracture OA Others (Inflammatory Arthritis/ girdle stone/ Loosening of Prosthesis/ periprosthetic fracture/ Protrusio acetabuli)	Ref 0.82 2.94 0.54 0.32 1.79	- 0.22–3.11 1.32–6.53 0.25–1.15 0.11–0.94 0.68–4.69	- 0.779 0.008 0.114 0.039 0.231	Ref 0.73 1.92 0.38 0.36 0.89	- 0.19–2.88 0..81–4.53 0.16–0.87 0.12–1.07 0.30–2.60	- 0.66 0.14 0.02 0.06 0.82
Type of Hip Replacement Surgery Left Right Simultaneous Bilateral Staged Bilateral	Ref 1.35 0.87 0.82	- 0.77–2.36 0.24–3.09 0.18–3.77	- 0.285 0.837 0.809			
Type of Anesthesia Others (Regional/ Epidural/ Spinal/ combination) General	Ref 0.56	- 0.24–1.28	- 0.173			
Preoperative HB levels	0.79	0.68–0.92	0.003			
Intraoperative Adverse Events No Yes	Ref 2.88	- 0.87–0.94	- 0.082			
Anticoagulant Others/Not received LMWH	Ref 2.03	- 0.92–4.47	- 0.079			
Postoperative HB levels	0.69	0.57–0.82	<0.001	0.74	0.61–0.90	0.002
Blood transfusion No Yes	Ref 3.64	- 2.08–6.38	- <0.001			
Length of Stay	1.14	1.08- 1.22	<0.001	1.13	1.05–1.22	0.001
Blood loss in ml	1.0006	0.99–1.001	0.126			

complication. Subsequently, with increased number of days in hospital, the likelihood of experience post-op complications also increases.

The outcomes of THA can be affected by various factors, both independent of the patient (type of prosthesis, surgeon expertise, and hospital characteristics) and related to the patient (age, presence of co-morbidities, severity of osteoarthritis, preoperative functional status). [8, 9, 13] Numerous studies have established frailty as a critical determinant of poor surgical outcomes across specialties, with the mFI-5 emerging as a reliable and efficient tool for preoperative evaluation. [14] Recently published data have established the utility of mFI-5 as an independent predictor of postoperative surgical outcomes. [15, 16] Furthermore, a paper by *Traven* et al. noted the risk of complications increased by 25% for every single point increase on the mFI scale, with the risk of 30- day mortality corresponding to as high as 49% [17]. In our analysis patients with mF1-5 > 1 had 97% higher odds of experiencing postoperative complications in concurrence with the findings by *Traven* et al. who also observed an increase in postoperative complications in patients with higher mFI-5 score.

Our results indicate that patients in the high mFI-5 (> 1) group experienced a higher rate of complications, particularly infections and dislocations. One factor contributing to the increased infection rates in the higher mFI-5 group may be the presence of comorbidities, such as diabetes, which is known to impair immune response and increase surgical site infections. [18, 19] Other studies have similarly found that higher mFI-5 scores correlate with increased rates of infections in both general and orthopedic trauma settings, reinforcing our findings. [20, 21].

Notably LOS also emerged as a significant factor influencing postoperative outcomes in our study. Patients with prolonged LOS demonstrated a higher incidence of postoperative complications. Extended hospital stay can reflect both the severity of frailty and development of postoperative complications such as infections (hospital acquired in already immunocompromised patients) and venous thromboembolism (VTE), which are major causes of morbidity, mortality and increased health care costs. [22, 23].

From a public health perspective, mFI-5 has important implications for perioperative management in LMIC. With scarce resources, particularly limited hospital beds, and shortage of trained health care providers, the mFI-5 can assist in optimizing peri-operative planning and by focusing on high-risk individuals. From a public health perspective, mFI-5 can assist in hospital management by providing patients and families with realistic expectations of potential costs, which is particularly important in LMICs where healthcare expenses are often out-of-pocket.

In LMICs, where the prevalence of diabetes exceeds 30%, the impact on postoperative outcomes can be significant. [24] For instance, an observational study by *Hasan* et al. using the NSQIP database highlighted a higher odds ratio for complications in orthopedic surgeries in LMICs, including increased risks for SSIs, sepsis, and readmissions, which aligns with our analysis. [25] In resource-constrained LMICs, high postoperative infection rates can potentially be mitigated through stringent preoperative infection protocols and the use of aggressive perioperative antibiotics. [26].

Interestingly, unlike previous studies, [13, 27] our research did not establish a correlation between 30-day mortality rates between the two groups. This can be attributed to the limitations in our study such as relatively smaller sample size, shorter duration of follow-up and local factors such as patients lost to follow-up, underreporting of deaths by families, impacting the accuracy of the data.

Some limitations were noted in our study. Firstly, due to resource-limitations, we had a smaller sample size limited to patients presenting at a single institution, which can limit the impact on generalizability and warrant further research with larger sample sizes through collaborations with multiple centers to enhance the validity of surgical outcomes. Secondly, risk stratification calculators assign equal weights to patients with different underlying comorbid conditions irrespective of the severity of the individual condition and its impact on the individual patient itself.

However, our study aims to fill in the gap in the literature from LMICs and we hope that our study will allow researchers in LMICs to conduct further, larger, prospective studies to be able to assess outcomes in patients from similar regions.

Conclusion

This is the first of its kind study exploring the Modified 5-Item Frailty Index (mFI-5) in predicting 30-day outcome measures in THA patients in resource-limited settings. With ease in obtaining relevant parameters from the patient's history, the mFI-5 inherently serves as a practical tool to guide perioperative care, promoting shared decision-making, and optimizing patient outcomes in THA procedures. With the increasing incidence of hip fractures due to multiple reasons, [28] hip arthroplasties procedures are going to rise exponentially hence we, through this study, propose the standardization of preoperative mFI-5 scoring to guide perioperative decision making for both patients and caregivers. Policies should be instituted to exercise increased caution in the

treatment approach for patients with high mFI-5 scores to mitigate the risk of post-operative complications. Further larger database research is needed to refine frailty assessments and enhance the validity of risk stratification calculators like the mFI-5 particularly in resource constrained environments.

Acknowledgements
The authors would like to acknowledge Dr. Jaleed Gillani and Dr. Muhammad Mughees Farooq for reviewing and proofreading the manuscript before submission.

Author contribution
Usman Ali: Writing, reviewing and editing, study conception and design, drafting the article, approving the final version for submission, correspondence, and supervising the research project. Shahzil Abdur Rehman Malik: Writing and editing, analysis and interpretation of data, drafting the article. Bilal Iqbal: Writing, reviewing and editing, acquisition of data for the study, routine data collection. Aribah Bhatti: Writing assistance, acquisition of data for the study and routine data collection. Sher Baz Khan: drafting the article, study conception and design, revising the article, and approving the final version for submission. Shahryar Noordin: Supervised the research project, study conception, writing and reviewing and approved the final version for submission. Anum Ali: Supervised the research project, analysis and interpretation of data, drafting the article, and supervising the research group.

Funding
No financial support was provided for this work.

Availability of data and materials
The data used in this study can be obtained from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The retrospective study adhered to the principles outlined in the Declaration of Helsinki. Ethical approval was obtained from Aga Khan University Hospital's Institutional Review Board (IRB), with ERC reference number 2022–1274-23591. A written informed consent was obtained from all participants for their inclusion in the Arthroplasty registry. Clinical trial number: not applicable. Human Ethics and Consent to Participate declarations: not applicable.

Competing Interests
Authors have no competing interest to disclose.

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Received: 29 October 2024 Accepted: 16 January 2025
Published online: 19 March 2025

References

1. Shang J, Wang L, Gong J, Liu X, Su D, Zhou X, Wang Y. Low molecular weight heparin dosing regimens after total joint arthroplasty: a prospective, single-center, randomized, double-blind study. J Orthop Surg Res. 2024;19(1):799. https://doi.org/10.1186/s13018-024-05303-9.
2. Llombart-Blanco R, Mariscal G, Barrios C, Vera P, Llombart-Ais R. MAKO robot-assisted total hip arthroplasty: a comprehensive meta-analysis of efficacy and safety outcomes. J Orthop Surg Res. 2024;19(1):698. https://doi.org/10.1186/s13018-024-05199-5.
3. Bozic KJ, Ong K, Lau E, Kurtz SM, Vail TP, Rubash HE, et al. Risk of complication and revision total hip arthroplasty among Medicare patients with different bearing surfaces. Clin Orthop Relat Res. 2010;468(9):2357–62.
4. Wu Z, Zheng Y, Zhang X. Safety and efficacy of orthopedic robots in total hip arthroplasty: a network meta-analysis and systematic review. J Orthop Surg Res. 2024;19(1):846. https://doi.org/10.1186/s13018-024-05279-6.
5. Li HX, Zhang QY, Sheng N, Xie HQ. Correlation and diagnostic performance of metal ions in patients with pseudotumor after MoM hip arthroplasty: a systematic review and meta-analysis. J Orthop Surg Res. 2024;19(1):723. https://doi.org/10.1186/s13018-024-05198-6.
6. Weaver DJ, Malik AT, Jain N, Yu E, Kim J, Khan SN. The modified 5-item frailty index: a concise and useful tool for assessing the impact of frailty on postoperative morbidity following elective posterior lumbar fusions. World Neurosurg. 2019;1(124):e626–32.
7. Tracy BM, Adams MA, Schenker ML, Gelbard RB. The 5 and 11 factor modified frailty indices are equally effective at outcome prediction using TQIP. J Surg Res. 2020;255:456–62.
8. Pulik Ł, Jaśkiewicz K, Sarzyńska S, Małdyk P, Łęgosz P. Modified frailty index as a predictor of the long-term functional result in patients undergoing primary total hip arthroplasty. Reumatologia. 2020;58(4):213–20.
9. Hofstede SN, Gademan MGJ, Vliet TPM, Vlieland RGHH, Nelissen PJ, de Mheen M-V. Preoperative predictors for outcomes after total hip replacement in patients with osteoarthritis: a systematic review. BMC Musculoskelet Disord. 2016;17:1–11. https://doi.org/10.1186/s12891-016-1070-3.
10. Cooper Z, Rogers SO, Ngo L, Guess J, Schmitt E, Jones RN, et al. Comparison of frailty measures as predictors of outcomes after orthopedic surgery. J Am Geriatr Soc. 2016;64(12):2464–71.
11. Shin JI, Keswani A, Lovy AJ, Moucha CS. Simplified frailty index as a predictor of adverse outcomes in total hip and knee arthroplasty. J Arthroplasty. 2016;31(11):2389–94.
12. Kapadia BH, Banerjee S, Cherian JJ, Bozic KJ, Mont MA. The economic impact of periprosthetic infections after total hip arthroplasty at a specialized tertiary-care center. J Arthroplasty. 2016;31(7):1422–6.
13. Daddimani RM, Madhava Murthy SK, Sharan PM, Patil AD. A prospective study correlating preoperative modified frailty index with one-year mortality in the elderly with hip fractures. Cureus. 2022;14(10):e30951.
14. Gani F, Canner JK, Pawlik TM. Use of the modified frailty index in the American college of surgeons national surgical improvement program database: highlighting the problem of missing data. JAMA Surg. 2017;152(2):205–7.
15. Weaver DJ, Malik AT, Jain N, Yu E, Kim J, Khan SN. The modified 5-item frailty index: a concise and useful tool for assessing the impact of frailty on postoperative morbidity following elective posterior lumbar fusions. World Neurosurg. 2019;124:e626–32.
16. Patel NP, Elali F, Coban D, Changoor S, Shah NV, Sinha K, et al. The 5-factor modified frailty index (mFI-5) predicts adverse outcomes after elective anterior lumbar interbody fusion (ALIF). North Am Spine Soc J. 2023;13:100189.
17. Traven SA, Reeves RA, Sekar MG, Slone HS, Walton ZJ. New 5-factor modified frailty index predicts morbidity and mortality in primary hip and knee arthroplasty. J Arthroplasty. 2019;34(1):140–4.
18. Berbudi A, Rahmadika N, Tjahjadi AI, Ruslami R. Type 2 diabetes and its Impact on the Immune System. Curr Diabetes Rev. 2020;16(5):442–9.
19. Martin ET, Kaye KS, Knott C, Nguyen H, Santarossa M, Evans R, et al. Diabetes and risk of surgical site infection: a systematic review and meta-analysis. Infect Control Hosp Epidemiol. 2016;37(1):88–99.
20. Tracy BM, Wilson JM, Smith RN, Schenker ML, Gelbard RB. The 5-item modified frailty index predicts adverse outcomes in trauma. J Surg Res. 2020;253:167–72.
21. Erne F, Wallmeier V, Ihle C, Braun BJ, Ehnert S, Histing T, et al. The modified 5-item frailty index determines the length of hospital stay and accompanies with mortality rate in patients with bone and implant-associated infections after trauma and orthopedic surgery. Injury. 2023;54(4):1125–31.
22. Durrani MYK, Ali U, Jamil Z, Umer M. Radiological outcomes according to the matta score after the surgical fixation of acetabular fractures. Cureus. 2024;16(11):e74803. https://doi.org/10.7759/cureus.74803.
23. Mirghaderi P, Pahlevan-Fallahy MT, Rahimzadeh P, Habibi MA, Pourjoula F, Azarboo A, Moharrami A. Low-versus high-dose aspirin for venous thromboembolic prophylaxis after total joint arthroplasty: a systematic review

and meta-analysis. J Orthop Surg Res. 2024;19(1):848. https://doi.org/10.1186/s13018-024-05356-w.
24. Pakistan diabetes report 2000–2045 [Internet]. [cited 2024 Oct 2]. Available from: https://diabetesatlas.org/data/en/country/150/pk.html
25 Hasan SH, Ali U, Khan J, Pidani AS, Jivani N, Ziauddin A, Zafar H, Noordin S. Orthopaedic surgery complications at a tertiary care hospital in a low- and middle-income country: a national surgical quality improvement project analysis. JAAOS: Global Res Rev. 2023;7(10):e23. https://doi.org/10.5435/JAAOSGlobal-D-23-00074.
26. Durrani MYK, Ali U, Saeed J, Umer M. Thirty days outcomes of limb salvage surgery in pediatric patients treated at a tertiary care hospital. Cureus. 2024;16(11):e74672. https://doi.org/10.7759/cureus.74672.
27. Traven SA, Reeves RA, Althoff AD, Slone HS, Walton ZJ. New five-factor modified frailty index predicts morbidity and mortality in geriatric hip fractures. J Orthop Trauma. 2019;33(7):319–23.
28. Ali A, Huszti E, Noordin S, et al. Examining treatment targets and equity in bone-active medication use within secondary fracture prevention: a systematic review and meta-analysis. Osteoporos Int. 2024;35:1497–511. https://doi.org/10.1007/s00198-024-07078-5.

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