Frailty Predicts Outcomes After Total Hip Arthroplasty: A Propensity-Matched Analysis of 90,660 Patients Using the mFI-5

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INTRODUCTION: Frailty is increasingly recognized as a determinant of surgical outcomes in orthopaedics, yet its role in predicting both short- and long-term risks following total hip arthroplasty (THA) is not fully defined. The modified 5-item frailty index (mFI-5), which incorporates non-independent functional status, hypertension, chronic obstructive pulmonary disease, congestive heart failure, and diabetes, offers a pragmatic tool for perioperative risk stratification. This study investigates the association between mFI-5 frailty severity and postoperative complications and revision rates following THA, aiming to enhance patient selection and preoperative counseling strategies.

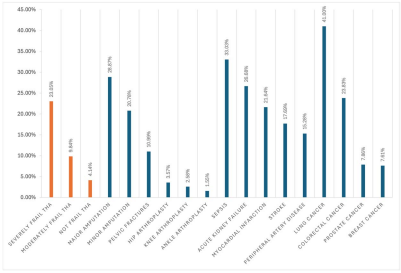
METHODS: A retrospective cohort study was conducted using TriNetX, a global federated health research network, to identify 90,660 patients aged ≥50 who underwent primary THA between 2003 and 2020. Patients were stratified into non-frail (mFI-5: 0–1), moderately frail (mFI-5=2), and severely frail (mFI-5≥3) groups. Propensity score matching (1:1) controlled for age, sex, race, and BMI. We evaluated 90-day medical and surgical complications, and 2- and 5-year revision and mortality rates. Relative risk (RR) and 95% confidence intervals (CI) were calculated using Bonferroni-adjusted thresholds ($p<0.0167$).

RESULTS: Severely frail patients had a 4.4-fold higher risk of 90-day mortality (RR: 4.409, 95% CI: 2.223–8.744) and 2.0-fold higher risk of periprosthetic joint infection (PJI; RR: 2.022, 95% CI: 1.382–2.960) than non-frail patients. They also experienced increased rates of myocardial infarction (RR: 3.608), pneumonia (RR: 2.441), acute kidney injury (RR: 2.924), anemia (RR: 1.818), and sepsis (RR: 2.352). At five years, severe frailty predicted a 58% increased revision risk (RR: 1.579) and a 23.0% cumulative mortality rate, compared to 6.9% in the non-frail cohort (RR: 3.34, 95% CI: 2.871–3.886). Moderately frail patients exhibited intermediate risks, including a 2.1-fold higher likelihood of major cardiopulmonary complications and 60% increased revision risk versus non-frail individuals. A dose-dependent pattern was observed, with severely frail patients demonstrating higher complication and revision rates than moderately frail patients across all endpoints.

DISCUSSION AND CONCLUSION:

Our findings support the mFI-5 as a robust predictor of catastrophic outcomes following THA, yielding three critical insights. First, severe frailty (mFI-5 ≥3) portends a 23% five-year mortality rate, exceeding that of prostate cancer (8%), hip fracture (11%), and stroke (18%), and reflects a state of multisystem collapse secondary to diminished physiologic reserve (Figure 1). This elevated long-term mortality, combined with a 4.4-fold increased risk of 90-day mortality, positions severe frailty not only as a comorbidity but as a potential surgical emergency. Second, the dose-dependent increase in revision risk (60% higher for severe vs. moderate frailty) may stem from biomechanical vulnerability, as frailty-associated sarcopenia impairs osseointegration and chronic inflammation amplifies infection risk—manifesting in a 2.0-fold increased PJI rate at 90 days and potentially initiating cascades of instability and mechanical failure. Third, early systemic complications such as acute kidney injury (2.9-fold risk) and sepsis (2.4-fold risk) drive disproportionate healthcare utilization. Prior studies estimate each unplanned readmission to cost $12,000–$18,000, underscoring the economic burden of frailty-related complications. Importantly, mFI-5 may outperform age alone in prognostication; despite a mean age of 72±8 years across all cohorts, frailty severity remained an independent predictor of adverse outcomes.

In conclusion, this comprehensive matched-cohort analysis found that increasing frailty severity, quantified by the mFI-5, exhibits an independent, stepwise association with elevated risks of adverse outcomes following THA. Patients with moderate frailty demonstrated significantly increased hazards, including a 2.1-fold adjusted risk of major cardiopulmonary complications and a 60% increased likelihood of revision surgery at five years, compared to non-frail patients. Severely frail patients experienced substantially greater morbidity and mortality, manifesting as a 4.3-fold increased hazard for all-cause mortality and a cumulative 5-year revision incidence of 6.4%. Notably, five-year mortality rates reached 23% in the severely frail cohort and 10% in the moderately frail cohort, rates exceeding those reported for several major orthopedic conditions and selected malignancies. These findings underscore the viability of the mFI-5 as a clinically relevant prognostic tool for surgical risk stratification in THA candidates. Orthopaedic surgeons may integrate the mFI-5 into preoperative assessment as it may provide a validated, data-driven approach to identify high-risk patients who may benefit from enhanced preoperative counseling and risk-stratified postoperative care pathways to mitigate complication risks following THA.



Measure	Severely Frail n (% of cohort)	Not Frail n (% of cohort)	Risk Ratio	95% CI	p-value
Medical Complications					
Mortality	44 (1.6%)	11 (0.4%)	4.409	(2.223, 8.744)	**<0.0167**
Superficial Surgical Site Infection	11 (0.40%)	<10	-	-	-
Deep Surgical Site Infection	<10	<10	-	-	-
Wound Dehiscence	41 (1.50%)	26 (0.90%)	1.588	(0.974, 2.589)	0.06
Transfusion	112 (4.40%)	57 (2.10%)	2.098	(1.532, 2.873)	**<0.0167**
Myocardial Infarction	32 (1.30%)	<10	3.608	(1.777, 7.324)	**<0.0167**
Pulmonary Embolism	23 (0.90%)	11 (0.40%)	2.144	(1.047, 4.390)	0.03
Deep Vein Thrombosis	34 (1.30%)	37 (1.40%)	0.952	(0.600, 1.512)	0.83
Acute Kidney Failure	65 (3.20%)	29 (1.10%)	2.924	(1.895, 4.513)	**<0.0167**
Hematoma	<10	<10	-	-	-
Pneumonia	36 (1.60%)	18 (0.70%)	2.441	(1.390, 4.286)	**<0.0167**
Anemia	132 (7.10%)	90 (3.90%)	1.818	(1.401, 2.360)	**<0.0167**
Sepsis	41 (1.60%)	19 (0.70%)	2.352	(1.369, 4.042)	**<0.0167**
Tripping, Slipping, and Falls	56 (2.40%)	20 (0.80%)	3.166	(1.906, 5.259)	**<0.0167**
Healthcare Utilization					
Inpatient Readmissions	72 (2.90%)	48 (1.80%)	1.615	(1.126, 2.317)	**<0.0167**
Emergency Department Visits	105 (6.60%)	93 (4.40%)	1.509	(1.150, 1.979)	**<0.0167**
Surgical Complications					
THA Revision	78 (2.80%)	48 (1.70%)	1.629	(1.141, 2.325)	**<0.0167**
Periprosthetic Fracture	33 (1.20%)	18 (0.60%)	1.859	(1.049, 3.294)	0.03
Periprosthetic Dislocation	62 (2.20%)	28 (1.00%)	2.229	(1.431, 3.473)	**<0.0167**
Periprosthetic Mechanical Complication	29 (1.10%)	20 (0.70%)	1.459	(0.827, 2.573)	0.19
Periprosthetic Joint Infection	78 (2.80%)	39 (1.40%)	2.022	(1.382, 2.960)	**<0.0167**
Proximal Femur Fracture	<10	<10	-	-	-
Aseptic Loosening	<10	<10	-	-	-

Measure	Severely Frail n (% of cohort)	Not Frail n (% of cohort)	Risk Ratio	95% CI	p-value
2 Year					
THA Revision	136 (4.90%)	81 (2.90%)	1.683	(1.285, 2.205)	**<0.0167**
Periprosthetic Fracture	65 (2.40%)	32 (1.10%)	2.06	(1.353, 3.135)	**<0.0167**
Periprosthetic Dislocation	94 (3.40%)	46 (1.60%)	2.057	(1.452, 2.916)	**<0.0167**
Periprosthetic Mechanical Complication	81 (2.90%)	62 (2.20%)	1.315	(0.948, 1.822)	0.1
Periprosthetic Joint Infection	117 (4.20%)	63 (2.20%)	1.878	(1.389, 2.539)	**<0.0167**
Proximal Femur Fracture	25 (0.90%)	11 (0.40%)	2.295	(1.131, 4.654)	0.02
Aseptic Loosening	11 (0.40%)	<10	-	-	-
Mortality	269 (9.50%)	62 (2.20%)	4.348	(3.315, 5.702)	**<0.0167**
5 Year					
THA Revision	178 (6.40%)	113 (4.00%)	1.579	(1.255, 1.987)	**<0.0167**
Periprosthetic Fracture	100 (3.60%)	51 (1.80%)	1.988	(1.425, 2.775)	**<0.0167**
Periprosthetic Dislocation	121 (4.30%)	70 (2.50%)	1.74	(1.303, 2.325)	**<0.0167**
Periprosthetic Mechanical Complication	130 (4.70%)	98 (3.50%)	1.335	(1.032, 1.726)	0.03
Periprosthetic Joint Infection	146 (5.30%)	78 (2.80%)	1.893	(1.445, 2.479)	**<0.0167**
Proximal Femur Fracture	40 (1.40%)	15 (0.50%)	2.692	(1.491, 4.863)	**<0.0167**
Aseptic Loosening	23 (0.80%)	20 (0.70%)	1.149	(0.633, 2.088)	0.65
Mortality	650 (23.00%)	195 (6.90%)	3.34	(2.871, 3.886)	**<0.0167**