The Impact of Bone Frailty vs. BMI on In-Hospital Outcomes Following Primary Total Hip and Knee Arthroplasties

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Introduction

- Total joint arthroplasty (TJA) including total hip and knee replacements is projected to increase significantly in the coming years.
- Although outcomes are generally favorable, obesity and frailty are key risk factors in a growing population of older, comorbid patients.
- This study aims to compare demographics, comorbidities, and postoperative outcomes among three patient groups undergoing total joint arthroplasty: Frail-nonobese; Nonfrail-obese; Frail-obese.

~~Methods~~

We conducted a retrospective cohort study using the NIS(2006-Q3 2015) to identify adults (≥40 years) undergoing total hip or knee arthroplasty. Patients were categorized as frail-nonobese, nonfrail-obese, or frail-obese using ICD-9 codes and the Johns Hopkins Frailty Indicator. Outcomes included complications, length of stay, hospital charges, and discharge disposition. Covariates were balanced using inverse probability of treatment weighting, with pairwise comparisons analyzed via t-tests and logistic regression ($p < 0.05$).

Results

- The study analyzed 1,738,224 TJA patients: 9,554 frail–nonobese, 1,725,402 non-frail–obese, and 3,268 frail-obese.
- Average age was 63; 65.9% were female.

Frail-nonobese:

- older, more likely to use Medicare; Had more comorbidities, particularly Anemia, Heart failure, Renal failure, and Electrolyte disorders; had significantly higher odds of CNS (OR 5.94), cardiac (OR 2.90), GI (OR 3.58), GU (OR 5.42), and infectious (OR 6.25) complications.

Non-frail-obese:

- Higher private insurance rates
- Lower odds of complications compared to frail groups

Frail-obese:

- Increased overall complications (OR 1.32) vs. nonfrail-obese
- Increased odds of anemia (OR 1.35) vs. nonfrail-obese

Table 1: Modified Elixhauser Comorbidities Profile, Stratified by Frailty, Obesity, and Frailty and Obesity

	Frail-Nonobese (n = 9,554)	Nonfrail-Obese (n = 1,725,402)	Frail-Obese (n = 3,268)	P-Value
Acquired Immune Deficiency Syndrome (AIDS)	15 (0.16%)	425 (0.02%)	0 (0 %)	<.0001
Alcohol Abuse	290 (3.03%)	17,053 (0.99%)	75 (2.29%)	<.0001
Deficiency Anemias	1,697 (17.76%)	227,908 (13.21%)	496 (15.17%)	0.0002
Rheumatoid Arthritis/Collagen Vascular Disease	629 (6.59%)	62,755 (3.64%)	155 (4.74%)	<.0001
Chronic Blood Loss Anemias	171 (1.79%)	27,303 (1.58%)	90 (2.75%)	0.4674
Congestive Heart Failure	592 (6.19%)	56,997 (3.30%)	175 (5.37%)	<.0001
Chronic Pulmonary Disease	1,677 (17.55%)	326,961 (18.95%)	752 (23.02%)	0.0137
Coagulopathy	411 (4.30%)	34,268 (1.99%)	145 (4.44%)	<.0001
Depression	1,411 (14.77%)	284,834 (16.51%)	675 (20.65%)	0.0029
Diabetes (Uncomplicated)	1,488 (15.57%)	466,806 (27.05%)	909 (27.83%)	<.0001
Diabetes (Complicated)	220 (2.30%)	51,641 (2.99%)	165 (5.06%)	0.0035
Drug Abuse	235 (2.46%)	12,021 (0.70%)	55 (1.68%)	<.0001
Hypertension	6,288 (65.81%)	1,295,662 (75.09%)	2,508 (76.74%)	<.0001
Hypothyroidism	1,673 (17.51%)	285,237 (16.53%)	659 (20.17%)	0.0376
Liver Disease	166 (1.73%)	22,095 (1.28%)	65 (1.99%)	0.0564
Lymphoma	50 (0.52%)	3,680 (0.21%)	10 (0.31%)	0.0064
Fluid and Electrolyte Disorder	1,750 (18.31%)	160,022 (9.27%)	510 (15.61%)	<.0001
Metastatic Cancer	60 (0.63%)	1,392 (0.08%)	10 (0.31%)	<.0001
Other Neurological Disorders	749 (7.84%)	65,957 (3.82%)	180 (5.51%)	<.0001

Table 2 Demographic and Hospital Factors, Stratified by Frailty, Obesity, and Frailty and Obesity

	Frail-Nonobese (n = 9,554)	Nonfrail-Obese (n = 1,725,402)	Frail-Obese (n = 3,268)	P-Value
Age of Patient (Years)				
Mean (Standard Error)	69.4 (0.28)	62.9 (0.03)	65.0 (0.39)	Missing
Biological Sex of Patient				
Male	3,732 (39.06%)	588, 520 (34.11%)	1,143(34.98%)	< 0.0001
Female	5, 822 (60.94%)	1,136,689 (65.88%)	2,125(65.02%)	
Expected Primary Payor				
Medicare	6,155 (64.43%)	784,851 (45.49%)	1,780 (54.48%)	< 0.0001
Medicaid	538 (5.64%)	71,908 (4.17%)	160 (4.91%)	
Private	2,541 (26.59%)	796,849 (46.18%)	1,212 (37.09%)	
Self-Pay	45 (0.47%)	9,011 (0.52%)	40 (1.22%)	
No Charge	0 (0 %)	1,402 (0.08%)	0 (0 %)	
Other	270 (2.83%)	57,800 (3.35%)	75 (2.29%)	
Race of Patient				
Non-Hispanic White	7,665 (80.23%)	1,213,104 (70.31%)	2,548 (77.96%)	< 0.0001
Non-Hispanic Black	624 (6.53%)	156,964 (9.10%)	305 (9.33%)	
Hispanic	461 (4.82%)	79,522 (4.61%)	175 (5.37%)	
Asian/Pacific Islander	210 (2.20%)	10,038 (0.58%)	40 (1.22%)	
Native American	40 (0.42%)	6,832 (0.40%)	10 (0.31%)	
Other Race	171 (1.78%)	31,420 (1.82%)	50 (1.53%)	
Location/Teaching Status of Hospital				
Rural	28 (0.29%)	158,915 (9.21%)	0 (0 %)	0.4896
Urban Nonteaching	143 (1.49%)	643,838 (37.32%)	25 (0.76%)	
Urban Teaching	119 (1.25%)	726,438 (42.10%)	33 (1.02%)	
Region of Hospital				
Northeast	21 (0.22%)	263,861 (15.29%)	7 (0.23%)	0.1509
Midwest	65 (0.68%)	458,154 (26.55%)	21 (0.64%)	

Table 3:IPTW Inpatient Postoperative Outcomes, Stratified by Frailty and Obesity

	Frail-Nonobese	Nonfrail-Obese	OR_{IPTW} (95% CI)	P-Value
Any complications	24.64%	27.63%	0.86 (0.67 - 1.09)	0.20414
Central Nervous System	0.07%	0.01%	5.94 (1.51 - 23.4)	0.00325
Cardiac Complication	0.62%	0.21%	2.90 (1.47 - 5.76)	0.00126
Deep Vein Thrombosis (DVT)	0.34%	0.30%	1.14 (0.62 - 2.09)	0.67666
Gastrointestinal (GI) Complications	0.23%	0.06%	3.58 (1.08 - 11.9)	0.02403
Genitourinary (GU) Complication	0.48%	0.09%	5.42 (2.49 - 11.8)	0.00000
Hematoma/Seroma	0.54%	0.72%	0.74 (0.32 - 1.74)	0.48976
Wound Dehiscence	0.11%	0.09%	1.23 (0.45 - 3.38)	0.68735
Postoperative Infection	0.15%	0.02%	6.25 (1.81 - 21.5)	0.00069
Pulmonary Embolism (PE)	0.46%	0.30%	1.55 (0.68 - 3.53)	0.29297
Postoperative Anemia	22.81%	26.98%	0.80 (0.63 - 1.02)	0.07120
Peripheral Vascular Disease	0.11%	0.03%	3.32 (0.72 - 15.4)	0.10242
Respiratory	0.14%	0.06%	2.31 (0.68 - 7.90)	0.16468

Discussion

Frailty was a stronger predictor of complications than obesity in TJA patients. Frail–nonobese individuals, often older and Medicare-dependent, had higher risks of CNS, cardiac, GU, and infectious complications. Anemia and electrolyte disturbances were more common, underscoring frailty as a key, BMI-independent risk factor. Addressing frailty may improve outcomes and shift focus beyond obesity.

Conclusion: Frailty, regardless of BMI, was linked to worse outcomes in TJA. Routine frailty assessments could guide preoperative planning, improve safety, and support value-based care.

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