Quantifying the Opportunity Cost of Treating Obese Patients in Total Joint Arthroplasty: A Relative Value Unit Analysis of 613,918 Cases

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INTRODUCTION: There is general agreement between orthopaedic surgeons that operating on higher body mass index (BMI) patients during total joint arthroplasty requires increased effort and time due to increased surgical complexity. Quantifying this difference in effort has been challenging to study and the literature on the topic is sparse. The aim of this study is to compare the compensation when operating on obese patients in primary and revision total hip arthroplasty (THA) and total knee arthroplasty (TKA) using work relative value units (wRVUs).

METHODS: The National Surgical Quality Improvement Program (NSQIP) database was queried for patients undergoing either primary or revision THA and TKA between 2005 and 2018. Operative time, wRVU, and BMI for each patient was extracted and analyzed. The Centers for Medicare & Medicaid Services (CMS) 2025 RVU-to-dollar conversion rate ($32.35), an 8-hour workday, and 160 operative days per-year, procedure weights (33.4% primary THA, 37.5% primary TKA, 7.5% revision THA, 8.0% revision TKA), and average orthopaedic surgeon career length of 34-years were adapted from prior literature and used for all calculations. The annualized compensation change for each BMI group was calculated in reference to the non-obese group and weighted based on the percent of patients in that BMI group (ie. if 50% of primary THA patients had BMI≥45 and unweighted compensation decrease=$10,000, then weighted decrease=$5,000). One-way ANOVA test was used to compare all BMI groups and one-way ANOVA post-hoc test with Bonferroni correction was used for pairwise comparisons. There was a total of 613,918 patients (35.2% primary THA, 57.4% primary TKA, 3.3% revision THA, 4.1% revision TKA) with an average age of 66.17±10.50 years. The majority were female (59.0%), non-smokers (89.7%), and non-diabetics (84.0%).

RESULTS: While there was no difference in total wRVUs among BMI groups for revision procedures (THA, p=0.057; TKA, p=0.083), there were differences among primary procedures (THA, p<0.001; TKA, p<0.001). Operative time was different for BMI groups in all procedures (p<0.001 for all) with ≥45 having the longest time in all procedures. The BMI groups had different wRVU per minute in all procedures (p<0.001 for all), with ≥45 having the lowest in all procedures. When comparing wRVU per minute pairwise, every comparison except 40-45 versus 35-40 (p=0.430) was significant for primary THA and every comparison except ≥45 versus 40-45 (p=0.102) was significant for primary TKA. The <30 group differed from all groups (p=0.007, p<0.001, p<0.001, and p=0.012 in order of increasing BMI) in revision THA and differed from all groups except the 35-40 group (p=0.221) in revision TKA. The highest unweighted annualized compensation decreases ($ [% decrease]) for all procedures was for the ≥45 group, which amounted to $116,228 [17.1%] (primary THA), $51,727 [7.7%] (primary TKA), $91,759 [14.5%] (revision THA), and $53,218 [8.6%] (revision TKA) (Table 1). The total annualized opportunity cost for the average orthopaedic surgeon was $17,395 (primary THA [$7,919]; primary TKA [$5,943]; revision THA [$1,833]; revision TKA [$1,700]), which amounted to $591,430 over the lifetime (Table 1).

DISCUSSION: This study highlights the significant opportunity cost, loss of potential gain from an alternative, associated with operating on obese patients, amounting to over half a million dollars over the surgeon's career. This financial incentive for operating on non-obese patients might partly contribute to some surgeons' strict BMI cutoffs, which can often be restrictive and propagate healthcare inequities in marginalized populations. However, literature suggests that TJAs can be safe and benefit obese patients significantly given proper preoperative optimization. Moreover, in response to the increasing obesity rates, it is increasingly critical to build systemic solutions to incentivize high quality and accessible care for obese patients. Thus, deliberate efforts to reduce this opportunity cost may be beneficial for decreasing surgeons' inclination toward strict BMI cutoffs, increasing equitable care for obese patients.

SIGNIFICANCE/CLINICAL RELEVANCE: This study highlights the decreased compensation when surgeons operate on obese patients for THA and TKA. Addressing this compensation disparity on a systemic level could aid in increasing equitable care for the growing number of obese patients.

IMAGES AND TABLES:

Table 1. Annualized and lifetime opportunity cost by operating on obese patients.

BMI Groups	n (%)	Unweighted Annualized Compensation Decrease ($ [% decrease])	BMI Weighted Annualized Compensation Decrease ($ [% decrease])	Procedure Weighted Annualized Compensation Decrease ($)	Total Annualized Opportunity Cost ($)	Total Lifetime Opportunity Cost ($)
Primary THA (n = 216,053)			23,709 [3.5]	7,919	17,395	591,430
<30	117,258 (54)	–	–			
30-35	55,129 (26)	35,823 [5.3]	9,314 [1.4]			
35-40	28,262 (13)	63,815 [9.4]	8,296 [1.2]			
40-45	10,834 (5)	75,483 [11.1]	3,774 [0.6]			
≥45	4,570 (2)	116,228 [17.1]	2,325 [0.3]			
Primary TKA (n = 352,426)			15,847 [2.4]	5,943		
<30	129,385 (37)	–	–			
30-35	101,914 (29)	13,298 [2]	3,856 [0.6]			
35-40	68,927 (20)	28,502 [4.2]	5,700 [0.8]			
40-45	33,375 (9)	41,172 [6.1]	3,705 [0.6]			
≥45	18,825 (5)	51,727 [7.7]	2,586 [0.4]			
Revision THA (n = 20,163)			24,444 [3.9]	1,833		
<30	11,480 (57)	–	–			
30-35	4,811 (24)	38,185 [6]	9,164 [1.4]			
35-40	2,367 (12)	66,884 [10.6]	8,026 [1.3]			
40-45	943 (5)	90,014 [14.2]	4,501 [0.7]			
≥45	562 (3)	91,759 [14.5]	2,753 [0.4]			
Revision TKA (n = 25,276)			21,247 [3.4]	1,700		
<30	8,985 (36)	–	–			
30-35	7,108 (28)	28,820 [4.7]	8,070 [1.3]			
35-40	4,865 (19)	23,162 [3.8]	4,401 [0.7]			
40-45	2,538 (10)	50,511 [8.2]	5,051 [0.8]			
≥45	1,780 (7)	53,218 [8.6]	3,725 [0.6]			

BMI = body mass index, THA = total hip arthroplasty, and TKA = total knee arthroplasty.