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National Obesity Trends in Revision Total Knee Arthroplasty

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ABSTRACT

Background: The utilization of primary total knee arthroplasty (TKA) in obese patients has increased significantly over the past decade despite overwhelming data that suggest higher failure rates. As such, it is reasonable to expect a parallel increase in obesity rates among revision TKA (rTKA) patients. The purpose of this study was to analyze longitudinal trends in obesity rates among rTKA patients.

Methods: We identified 451,982 rTKA patients using 2002-2012 Nationwide Inpatient Sample weighted discharge data. The Agency for Healthcare Research and Quality obesity comorbidity indicator was used to identify 70,470 obese patients (body mass index, >30) and 335,257 nonobese patients. We evaluated trends in obesity rates over time using chi-square tests and a multivariate logistic regression model, which included several covariates (patient age, gender, and race; payer type; hospital type; and patient health status).

Results: The obesity rate among rTKA patients increased significantly from 9.74% in 2002 to 24.57% in 2012 ($P < .0001$). After adjusting for all factors, patients treated in 2011 (odds ratio [OR]: 4.1, 95% CI: 3.7-4.6, $P < .0001$) or 2012 (OR: 4.5, 95% CI: 4.0-5.0, $P < .0001$) were over 4 times as likely to be obese, compared to patients treated in 2002. Other independent factors that were significantly associated with higher obesity rates include female patients (OR: 1.5, 95% CI: 1.5-1.6) and patients between the ages of 45 and 64 years (OR: 3.2, 95% CI: 3.1-3.3).

Conclusion: The more than 4-fold increase in the obesity rate among patients undergoing rTKA, particularly the middle-age group, over the past decade is an alarming trend. Improved clinical care pathways are needed to manage the obese total knee patient.

The obesity epidemic across the United States and the world continues to expand [1-4]. The World Health Organization reported that in 2014, >600 million people of 18 years and older were obese, with body mass index (BMI) levels $\geq$30 kg/m^2 [1]. The Centers for Disease Control and Prevention's National Health and Nutrition Examination Survey reports that the rate of obesity in the United States remained at a steady rate around 35%-36% between 2009 and 2012 [2-4]. A more striking statistic from the National Health and Nutrition Examination Survey data is that the obesity rate among middle-aged Americans appears to be outpacing the obesity rate of the younger and older age groups. By 2012, the obesity rate increased from 36.6% in 2010 to 39.5% among those between the ages of 40 and 59 years [2-4].

It is not surprising that the rate of total joint arthroplasty procedures is increasing [5-7] in parallel with increasing obesity rates, especially among the middle-age group. As the average age of total knee arthroplasty (TKA) patients decreases [8], the proportion of obese primary TKA patients increases [9,10]. Fehring et al [10] reported that obesity rates among total joint arthroplasty patients increased from 30% to 52% between 1990 and 2005. In spite of the growing body of knowledge of increased complications after TKA in the obese population, the number of procedures performed in this population continues to increase. Odum et al [9] reported that from 2002 to 2009, the rate of obesity among primary TKA patients nearly doubled from 10.6% to 19.8% and that after controlling for a number of factors, TKA patients aged <64 years are 4 times more likely to be obese than older patients.

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Although TKA procedures reduce pain and restore physical function, Ast et al [11] reported that 69% of TKA patients remain at the same preoperative weight. Therefore, TKA may do very little to facilitate a reduction in BMI, and obesity remains a risk factor for subsequent revision [12]. Although patient optimization, including weight management, is possible in the elective primary setting, it may not be possible in the revision setting and revision procedures for catastrophic failure are not elective [13]. It is reasonable to expect that the national rates of obesity among patients presenting for revision total knee arthroplasty (rTKA) would be increasing with a similar trajectory as reported for obesity rates among index TKA. The purpose of the study was to determine the national trends of obesity rates among rTKA patients in the United States over the last decade.

Methods

To examine trends in obesity in rTKA, we analyzed discharge data from the 2002-2012 releases of the Nationwide Inpatient Sample (NIS; renamed the National Inpatient Sample in 2012; Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality [AHRQ]). The NIS contains a 20% sample of hospital discharges in the United States, regardless of the payer. We used the NIS trend weights in our analyses to account for sampling differences in the 2012 NIS. We first identified patients undergoing rTKA using International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) procedure codes for unspecified component(s) (ICD-9-CM 81.55), revisions to all components (ICD-9-CM 00.80), revisions of the tibial component (ICD-9-CM 00.81), revisions of the femoral component (ICD-9-CM 00.82), revisions to the patellar component (ICD-9-CM 00.83), and liner exchanges (ICD-9-CM 00.84).

Patients were classified as either obese or not obese. We used 3 approaches to identify obese patients. First, we sought to identify patients using ICD-9-CM "V" codes (V85.30-V85.45) for BMI. We were only able to identify 101 individuals (0.12%) who had a normal BMI recorded on their discharge summary, leaving a significant proportion of patients without an identifiable weight category. Second, we sought to identify patients with ICD-9-CM diagnosis codes for obesity (ICD-9-CM 278.00-278.01). When using this approach, we noted that 82.51% of records did not include a weight-related ICD-9-CM diagnosis code. Finally, we used the obesity comorbidity indicator included in the NIS. The NIS obesity indicator is based on the AHRQ definition of obesity, BMI >30 kg/m^2. Only 0.50% of patients had a missing obesity comorbidity indicator. Given the least amount of missing data, we elected to use the NIS obesity comorbidity indicator as our criterion for obesity status.

Standard descriptive statistics and bivariate analyses were conducted (Table 1). To analyze trends in obesity in rTKA, we used a multivariate logistic regression model (Table 2). The primary outcome of interest (dependent variable) was obesity status, with the year of revision knee surgery serving as the primary independent variable. We considered several covariates in the regression model, including patient demographics (age, gender, race/ethnicity, and health status), payer type, hospital type, and region. Age, a continuous variable, was collapsed into the following categories: 0-44, 45-64, 65-74, and ≥75 years of age. Race/ethnicity included the following groups: White, African American, Hispanic, Asian/Pacific Islander, Native American, and other. We used the number of chronic condition diagnoses (excluding obesity) included on the patient record as a proxy measure for patient overall health. The primary expected payer was identified as Medicare, Medicaid, private insurance, self-pay, no charge, or other. Hospitals were also classified by Census region: Northeast, Midwest, South, and West.

Table 1
Frequency and Proportion of Factors by Obesity Status.

Variable	Not Obese		Obese		*P* Value
	Frequency	Percentage	Frequency	Percentage	
Year					<.0001
2002	4614	90.26	498	9.74	
2003	27,079	89.24	3264	10.76	
2004	32,150	89.12	3923	10.88	
2005	34,325	87.85	4747	12.15	
2006	28,597	85.42	4883	14.58	
2007	30,988	85.18	5391	14.82	
2008	35,835	81.92	7911	18.08	
2009	32,971	80.38	8048	19.62	
2010	36,685	79.40	9518	20.60	
2011	37,647	77.24	11,092	22.76	
2012	34,365	75.43	11,195	24.57	
Overall	335,257	82.63	70,470	17.37	
Gender					<.0001
Female	190,861	80.06	47,534	19.94	
Male	143,729	86.25	22,918	13.75	
Age group					<.0001
0-44 y	12,860	84.32	2391	15.68	
45-64 y	130,624	77.74	37,392	22.26	
65-74 y	101,650	82.35	21,779	17.65	
≥75 y	90,124	91.01	8,907	8.99	
Race/ethnicity					<.0001
White	221,253	83.15	44,823	16.85	
African American	24,929	74.73	8429	25.27	
Hispanic	12,947	80.61	3114	19.39	
Asian	2237	88.74	284	11.26	
Native American	1073	80.13	266	19.87	
Other/Not specified	72,810	84.31	13,549	15.69	
Payer type					<.0001
Medicare	198,736	84.51	36,440	15.49	
Medicaid	11,623	78.50	3183	21.50	
Private	103,682	79.84	26,176	20.16	
Self-pay	1736	85.77	288	14.23	
No charge	261	79.40	68	20.60	
Other	18,613	81.73	4161	18.27	
Hospital type					<.0001
Urban teaching	157,261	81.82	34,942	18.18	
Urban nonteaching	142,646	83.07	29,065	16.93	
Rural	33,465	84.93	5936	15.07	
Number of comorbidities					<.0001
None	16,196	98.32	277	1.68	
1	20,683	93.59	1417	6.41	
2	28,181	89.26	3391	10.74	
3	30,249	83.37	6033	16.63	
>3	239,948	80.17	59,351	19.83	
Region					<.0001
Northeast	56,854	83.15	11,517	16.85	
Midwest	87,416	80.97	20,540	19.03	
South	126,322	83.30	25,323	16.70	
West	64,666	83.16	13,090	16.84	

Because revision type was not identified with the ICD-9-CM until after 2005, we did not include revision type in our model.

All analyses were performed using the NIS sample weights, which represent national estimates. In addition, all analyses were performed using SAS 9.4 (Cary, NC) with an a priori significance level of 0.05.

Study Sample

The unweighted study sample included 83,093 revision total knee patients from the 2002-2012 NIS data. After applying the NIS weights for national estimates, the sample represents 405,726 patients who had a revision total knee surgery between 2002 and 2012. Of these patients, 59% were female and 41% were male, and the average age at the time of surgery was 65.6 (standard deviation: 11.8) years.