Proportion of Obese Patients Presenting to Orthopedic Total Joint Arthroplasty Clinics

K. Linnea Welton, MD; Joel J. Gagnier, ND, MSC, PhD; Andrew G. Urquhart, MD

abstract

The purpose of this study is to demonstrate that the percentage of obese individuals initially presenting to total joint arthroplasty clinics in a public, tertiary hospital is greater than the proportion of obese individuals in the general population. In a retrospective, comparative study of patients seen in total joint replacement clinics at a public, tertiary hospital with an ICD-9 diagnosis of hip or knee osteoarthritis and documented body mass index, the proportion of obese individuals was compared with recent obesity data for the general population from the Centers for Disease Control and Prevention. Patients who had previously undergone hip or knee replacement surgery were excluded. Comorbid conditions, functional comorbidity index (FCI) scores, and Charlson comorbidity index scores were compared between obese and nonobese cohorts. The study included 499 patients aged 20 to 92 years (mean, 64.3 years), 58.9% of whom were female. Fifty-five percent of patients were obese, a significantly greater percentage than in the national (34.9%; P<.0005; odds ratio [OR]=2.23), regional (29.5%; P<.0005; OR=2.85), and state (31.1%; P<.0005; OR=2.64) populations. Obese patients had significantly more comorbid conditions (P<.002) and higher functional comorbidity index scores (P<.0009). The number of comorbidities and having Medicare/Medicaid insurance were predictive of obesity. This study highlights that the majority of patients presenting to orthopedic total joint arthroplasty clinics are obese and that they come with significantly more comorbidities. The total joint surgeon has a unique opportunity to facilitate weight loss in the obese osteoarthritic patient prior to joint replacement. [Orthopedics. 2016; 39(1):e127-e133.]

The US obesity epidemic has grown tremendously over the past 3 decades. It is estimated that 69% of Americans are now overweight and close to 35% are obese.¹ In addition to expanding waistlines, the population is aging as well.² As a result of the aging population, there are more total joint arthroplasty (TJA) surgeries being performed for osteoarthritis (OA). There has also been an increase in TJAs in younger age groups because of the increasing obesity problem. Aging is a nonmodifiable risk factor for OA of the hip and knee, but obesity is modifiable.

Obese patients who want a total hip arthroplasty (THA) or total knee arthroplasty (TKA) for OA present added challenges to the orthopedic surgeons, anesthesiologists, and ancillary staff who help to manage these patients. Not only do they come with an increased frequency of other medical problems, such as diabetes mellitus, obstructive sleep apnea (OSA), and cardiovascular disease,³,⁶ but the surgical intervention is more technically...
difficult.⁷⁻⁹ Components from preoperative templating are commonly larger than needed because of the increased distance to bone causing radiographic magnification.⁷ A higher incidence of avulsion of the medial collateral ligament and more cases of varus malalignment have also been documented.⁷⁻⁸ Raphael et al⁹ showed a statistically significant increase in intraoperative times in obese vs non-obese patients undergoing TKA. In addition, obese patients have a higher risk of postoperative complications, such as deep venous thrombosis/pulmonary embolism, surgical site infection, negative outcomes, and increased rates of revision.¹⁰⁻¹⁶

Although other studies have retrospectively examined single-center¹⁷ and national¹⁸ trends of obesity in patients who received a TKA, no study to date has examined the overall prevalence of obese patients who are referred to and seen by an orthopedic surgeon for OA of the hip or knee prior to surgical intervention. This is an important difference because prior to TJA, orthopedic surgeons have a window of opportunity to educate patients on the benefits of weight loss, helping to reduce this risk factor for OA and to prevent surgical complications. As such, the current authors sought to determine the prevalence of obese patients initially presenting to TJA clinics compared with the general population.

**MATERIALS AND METHODS**

This retrospective, comparative study was conducted with institutional review board approval. The study cohort consisted of new patients seen in the TJA clinics at a public, tertiary hospital in the Midwest for a diagnosis of OA of the hip or knee who had a documented body mass index (BMI) in their initial encounter. The TJA clinics within this medical center are open to all referrals, including patient self-referrals and outside orthopedic surgeon and primary care physician referrals of patients with knee or hip pain, preferably those aged older than 50 years. No screening is performed. The majority of the referrals are from primary care physicians within the local community, and new patient appointment wait times are less than 4 weeks.

Those patients who had previously undergone a THA or TKA were excluded. In addition to demographic data, such as age, state of residence, insurance coverage, and sex, comorbid conditions (eg, metastatic cancer) documented in the hospital’s electronic charting system were extracted. Patients were scored on the Charlson comorbidity index (CCI)¹⁹,²⁰ and the functional comorbidity index (FCI).²¹ Patient BMIs were categorized into the World Health Organization (WHO) classification system for normal weight (18.5-24.99 kg/m²), overweight (25-29.99 kg/m²), and obese (≥30 kg/m²).²² Obese patients were stratified into class I (BMI 30-34.99 kg/m²), class II (BMI 35-39.99 kg/m²), and class III (BMI ≥40 kg/m²) obesity. The proportion of obese patients seen in the TJA clinics was compared with the Centers for Disease Control and Prevention’s (CDC’s) most recently published national and regional obesity data.²³,²⁴ Comorbid conditions were compared between the obese and nonobese cohorts of the study population.

Based on a prospective power analysis performed with an alpha set at 0.05 and beta of 0.20, a sample size of 428 was required. This was calculated by using the known prevalence of obesity in the US population (34.9% based on the 2012 National Health and Nutrition Survey) and comparing it with the average obesity calculated in 3 months of the patient population to be studied. Patient data were extracted from August 31, 2012, to February 28, 2013, via electronic medical chart review. Chi-square tests were used for categorical variables (proportion of obese and nonobese in the study population compared with national, regional, and state trends; comparison of smoking status/history between obese and nonobese in patient population), and t tests were used for continuous variables (comparison of numbers of comorbidities, FCI, and CCI scores between obese and nonobese patients). Logistic regression analysis was also performed to determine whether specific variables (eg, age, sex, smoking status, number of comorbidities, CCI score, FCI score, insurance type) could predict the presence of obesity in the study cohort. STATA10.0 statistical package (StataCorp, College Station, Texas) was used in all analyses, and significance was set at a P value of .05.

**RESULTS**

Data were extracted for 499 patients who met the inclusion criteria. Mean patient age was 64.3 years (range, 20-92 years). A total of 308 (61.7%) of the 499 patients presented with a diagnosis of knee OA, and 191 (38.3%) presented with a diagnosis of hip OA. Two hundred ninety-four (58.9%) of the 499 patients were female. Regarding insurance status, 5.41% (27 of 499) of patients were uninsured and 32.46% (162 of 499) had solely Medicare/Medicaid coverage. Ninety-eight percent of the study population had residence in the same state as the clinical visit (Table 1).

Mean BMI for all patients was 30.95 kg/m². Of the study population, 54.5%
(272 of 499) of patients were obese, with a mean BMI of 35.32 kg/m². These patients were further stratified into class I obesity (61.4%; 167 of 272), class II obesity (22.7%; 62 of 272), and class III obesity (15.8%; 43 of 272). In the nonobese cohort, mean BMI was 25.73 kg/m², with 62.1% of the group being overweight. When compared with the CDC’s 2011-2012 data, the TJA clinics saw a significantly greater percentage of obese patients than exist in the general population (54.5% vs 34.9%; \( P < .0001 \); odds ratio [OR]=2.24; 95% confidence interval [CI], 1.86-2.69) (Figure). There were also significant differences when comparing the TJA clinics’ data with the CDC’s regional and state data: 54.9% vs 29.5% in the Midwest (\( P < .0001 \); OR=2.86; 95% CI, 2.40-3.42) and 54.9% vs 31.1% in the state population (\( P < .0001 \); OR=2.65; 95% CI, 2.22-3.18).

Average number of comorbid conditions in all patients was 1.81. The average was 1.69 in the nonobese cohort and 2.08 in the obese cohort (\( P < .02 \)) (Table 2). When patients were further subdivided by BMI, there was an average of 1.55 comorbidities in the normal weight group, 1.78 in the overweight group, 1.98 in the class I obesity group, 2.03 in the class II obesity group, and 2.54 in the class III obesity group. Overall, the 5 most common comorbid conditions were hypertension (234 of 499; 46.89%), hyperlipidemia (159 of 499; 31.86%), depression (109 of 499; 21.84%), OSA (85 of 499; 17.3%), and diabetes mellitus (41 of 499; 8.22%). These were followed by coronary artery disease, upper gastrointestinal disease, asthma, chronic obstructive pulmonary disease (COPD), and history of myocardial infarction. The top 5 comorbidities in the nonobese and obese groups were similar except that degenerative disk disease was ranked fifth in the obese group, whereas in the nonobese group, diabetes mellitus was ranked after upper gastrointestinal disease, asthma, coronary artery disease, and anxiety/panic disorder and was equal to COPD.

A total of 495 patients had some documentation of smoking status. In the overall cohort, 57.37% (284 of 495) reported having never smoked, 33.33% (165 of 495) had quit, and 9.29% (46 of 495) were active smokers. In the nonobese group, 56.39% (128 of 227) of patients reported having never smoked, 31.72% (72 of 227) had quit, and 11.89% (27 of 227) were active smokers. In the obese group, 57.99% (156 of 269) reported having never smoked, 34.2% (92 of 269) had quit, and 7.81% (21 of 269) were active smokers. There was no significant difference between the obese and nonobese groups with regard to smoking (\( P = .300 \)).

Mean FCI of the nonobese group (1.74) was significantly lower than that of the obese group (1.76; \( P = .0009 \)). Further subdivision of the BMI category revealed mean FCIs of 1.72 in the normal group, 1.75 in both the overweight and class I obesity groups, 1.79 in the class II obesity group, and 1.7 in the class III obesity group. Mean CCI was 0.68 in the nonobese group and 0.67 in the obese group, which was not significantly different (\( P = .76 \)). On closer evaluation, mean CCI value was 0.65 for the normal BMI group, 0.69 for the overweight group, 0.65 for the class I obesity group, 0.70 for the class II obesity group, and 0.73 for the class III obesity group. The difference between the CCI of the normal BMI group and the values of
the class II and class III obesity groups approached statistical significance ($P=.062$).

Regression analysis revealed that the number of comorbidities was a significant predictor; as comorbidities increased, there was a greater likelihood of obesity ($P=.009; \text{OR}=1.33; 95\% \text{ CI}, 1.08-1.66$) (Table 3). Insurance was also a significant predictor, indicating that those with no insurance were less likely to be obese compared with those with private insurance ($P=.006; \text{OR}=0.215; 95\% \text{ CI}, 0.072-0.641$) and those with Medicare/Medicaid were more likely to be obese than those with private insurance ($P<.001; \text{OR}=8.26; 95\% \text{ CI}, 4.93-13.85$) (Table 3). Several specific comorbidities predicted the presence of obesity, including hypertension, OSA, and diabetes mellitus, whereas degenerative back disease was predictive of being nonobese.

**DISCUSSION**

The results from this study show that the majority of patients seeking consultation for TJA because of symptomatic OA are obese (54.9%). This percentage is considerably greater than the proportions of individuals who are obese on national, regional, and state levels. Importantly, whereas nationally approximately 20% of obese patients with knee or hip OA undergo TJA, this study demonstrates that a much larger percentage of patients seek consultation with an orthopedic joint replacement surgeon. To the authors’ knowledge, this is the only study to date demonstrating the preoperative prevalence of obesity in this population; all others have postoperatively examined patients who underwent TJA.18 This study illustrates a significant difference between the numbers of comorbidities in obese and nonobese cohorts, and, when broken down by BMI category, each 5-point rise in BMI is associated with an increase in comorbidities. This finding is corroborated by Odum et al,18 who used the Nationwide Inpatient Sample and Healthcare Cost and Utilization data to determine the proportion of patients undergoing TKA between 2002 and 2009 who were obese. Obesity alone is a risk factor for postoperative complications and mortality in patients undergoing TKA11 and also has strong association with several substantial comorbid conditions, including diabetes mellitus, hypertension, cardiovascular disease, and OSA.3-6,26 Individually, each of these medical problems poses increased risk to the patient receiving TJA. A prospective study by Stierer and Punjabi27 evaluated nearly 3500 ambulatory surgery patients for the prevalence of OSA and found that those with OSA not only had increasingly difficult intubations and increased need for supplemental oxygen postoperatively, but also required hemodynamic stabilization in a dose-response relationship. Gupta et al28 noted that patients with OSA

### Table 3

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Beta</th>
<th>Standard Error</th>
<th>Wald</th>
<th>df</th>
<th>$P$</th>
<th>Odds Ratio</th>
<th>95% CI</th>
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<td>0.385</td>
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<td>1</td>
<td>.009*</td>
<td>1.338</td>
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Abbreviations: CCI, Charlson comorbidity index; CI, confidence interval; df, degrees of freedom; FCI, functional comorbidity index.

*Statistically significant ($P<.05$).
undergoing TJA had a 39% risk of complications, compared with 18% in patients without OSA. A study by Jamsen et al\textsuperscript{12} used a registry of patients undergoing THA and TKA and analyzed the correlation of obesity and diabetes mellitus with periprosthetic joint infections. They found that diabetes mellitus and obesity alone increased the risk, but together they synergistically increased the likelihood of developing a periprosthetic infection. Several recent studies have shown that having a prior history of cardiovascular disease increases the odds of suffering a cardiovascular complication after TJA.\textsuperscript{29,30}

Any medical issue in the United States cannot be fully discussed without mentioning its financial effect. Regression analysis in the current study showed that the strongest predictor of obesity in the population was having Medicare or Medicaid as the insurance provider (OR=8.26). Medicare and Medicaid reimburse significantly less than private health insurance; in 2009, Medicare reimbursed 20% less and Medicaid 42% less than private health insurance for physician services and 33% to 34% less for inpatient hospital services.\textsuperscript{31-33} It has also been found that obese patients are associated with higher in-hospital costs, longer lengths of stay, and higher rates of discharge to rehabilitation facilities.\textsuperscript{11,34-36} As such, the financial burden of TJA in the obese population is not only higher because of patients’ elevated BMIs but is exacerbated by their association with lower reimbursement from Medicare or Medicaid. This suggests that management of obesity prior to TJA could be more cost effective.

Regarding CCI scores,\textsuperscript{19,20} the current authors found no significant difference between the obese and nonobese cohorts. Because the CCI predicts the likelihood of short-term mortality, when measured in a population seeking consultation for a quality-of-life issue (knee or hip OA) and not a life-threatening condition, it is reasonable that no difference was found. However, the FCI was found to be different between the 2 groups because it is a measure of the effect of comorbid conditions on physical function. In addition to conditions like diabetes mellitus, COPD, and cerebrovascular disease, which are components of both CCI and FCI, the latter also includes asthma, OA, visual impairment, hearing impairment, and osteoporosis, all of which affect physical function directly.\textsuperscript{20} Although the FCI for obese and nonobese cohorts was significantly different statistically, the difference was not clinically significant. Because the FCI scores only differed by 0.02 (ie, a 2% difference in a single comorbidity), this implies a nonmeaningful distinction between cohorts.

Not only is the prevalence of obesity increasing in the United States, but the population is aging as well. The most recent US Census Bureau data show that the 45- to 65-year-old age group makes up the largest proportion of the US population (26.4%) and has the fastest growth rate (31.5% between 2000 and 2010).\textsuperscript{37} The next fastest growing age group comprises those aged 65 years and older, with a growth rate of 13%.\textsuperscript{37} As the elderly and older working-age populations in the United States are increasing in number, they also have higher proportions of obesity, with 39.5% of those aged between 40 and 59 years and 35.4% of those aged 60 years and older being obese, compared with only 30.3% of those aged 20 to 39 years.\textsuperscript{38} As a result, there is an increasing need for more TJAs because the population is aging, and also because younger populations are developing OA due to increasing rates of obesity. Although mean patient age in the current study was 64.3 years, it has been shown that the fastest growing population undergoing TJA comprises those aged 45 to 64 years (188% increase between 2000 and 2009).\textsuperscript{39} As such, the magnitude of difference between the prevalence of obesity in the TJA clinics compared with the US population may be underestimated in this study.

This study is not without limitations. First, only the TJA clinics at a single public academic institution were included. Thus, the generalizability is limited primarily to tertiary referral centers of this kind. Patients at this institution are accepted regardless of insurance provider, and the percentage of the study population insured by Medicare/Medicaid is similar to the most recently published national and state trends (32.9% and 36%, respectively).\textsuperscript{30,41} Geographically, this study is most representative of states and regions with similar obesity profiles; 17 of the 50 US states have an average BMI greater than 30 kg/m\textsuperscript{2}, and 25 states have an average BMI in the overweight category.\textsuperscript{42} Second, the number of comorbidities documented for each patient is likely abnormally low because of a change in the electronic medical record system that occurred 1 month prior to the onset of data collection. Consequently, it is probable that more comorbidities would have led to higher FCI and CCI scores, and regression analysis would have been more significant in the obese cohort because this group had a higher number of comorbidities documented originally. Third, the authors assumed that the measurements taken to calculate the BMI were done consistently (ie, shoes taken off vs kept on could significantly alter the height more than the weight). Finally, the primary objective of this study was to compare the proportion of obese patients in TJA clinics with national, state, and regional percentages. As such, the \textit{a priori} power analysis was determined for this measurement outcome and not for comparing comorbidities, FCI scores, or CCI scores between obese and nonobese cohorts. Had the power analysis been performed for these outcomes, perhaps there would have been more statistical significance.

**Conclusion**

Obesity is an epidemic that shows no signs of abating in the near future. As it persists and expands, so will this population continue to develop symptomatic OA leading to increasing referral to orthope-
dic TJA surgeons. As a result, orthopedic TJA clinics are given a unique opportunity to educate patients on the risks associated with obesity and the benefits of weight loss. There is also an opportunity for getting patients involved in an integrated program for weight loss and control of their associated comorbid conditions. No current consensus exists on how to most effectively help obese patients with hip and/or knee OA lose weight, although several studies have shown that weight loss surgery, increased physical activity, and/or nutritional modifications in this population lead to a reduction in symptoms and improved functional outcome scores. Also, major components in current health care reform are placing increasing value on disease prevention and health care maintenance, along with the implementation of negative incentives on medical complications for both quality and financial purposes. Ultimately, orthopedic TJA surgeons see a disproportionately high number of obese individuals, giving them a distinct opportunity to advocate for weight loss that will positively affect not only the patient and surgeon, but also the health care system as a whole. It is hoped that those establishing public policy or interested in reversing the growing obesity problem may consider these data when programming change or intervention.

References

33. Zuckerman S, Williams AF, Stockley


