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Reliability of International Classification of Diseases, Ninth Edition, Codes to Detect Morbid Obesity in Patients Undergoing Total Hip Arthroplasty

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ABSTRACT

Background: Although the impact of coding errors, with respect to obesity, has been previously reported, it is unclear whether morbid obesity is prone to similar coding inaccuracies. Therefore, the purpose of this study was to evaluate the reliability of coding for morbid obesity in patients who underwent total hip arthroplasty (THA).

Methods: A total of 10,475 primary THAs performed at a single institution from 2004 to 2014 were identified. The presence of International Classification of Diseases, ninth edition diagnosis codes denoting any grade of obesity or morbid obesity during the admission was noted. The sensitivity of coding was evaluated along with the effect of morbid obesity (defined by body mass index or coding) on complications within 90 days of THA.

Results: The sensitivity of obesity coding was 28.3%, while that of morbid obesity was 27.9% (area under the curve: 0.63 vs 0.63, $P = .765$). Among the 882 surgeries performed in morbidly obese patients, a code for any obesity was present in 467 (53%) surgeries, but only 53% (246) of these patients had a code specific for morbid obesity, while 47% (221) had a code for obesity not specifying morbid obesity. Nevertheless, the effects of morbid obesity on complications were similar regardless of how it was defined (coding or body mass index).

Conclusion: Although morbidly obese patients are likely to be easily identified as obese using codes, these patients may not be receiving a specific code. Researchers and clinicians should be aware that coding errors are prevalent even among higher grades of obesity in patients undergoing THA which may lead to suboptimal reimbursements and affect the results of studies using codes.

Obesity is a highly prevalent comorbidity among patients undergoing total hip arthroplasty (THA) and is a well-established risk factor for a number of important complications after THA [1–3]. Although it is defined as having body mass index (BMI) > 30 kg/m^2, many obese patients have very high BMIs and may have different comorbidity and complication profiles compared to those with BMIs slightly over 30 [4,5]. Therefore, many studies stratify obesity based on its severity [5,6]. Very high BMI values (such as BMI ≥40 kg/m^2 or morbid obesity) are being increasingly encountered in the arthroplasty population, and it is widely recognized that higher grades of obesity might be a stronger risk factor for complications after THA when compared with lower grades of obesity [6–9].

As efforts to reduce complications depend on modifying risk factors, there have been multiple studies dealing with morbid obesity, with a number of them relying on administrative databases [9,10]. These databases such as the National Inpatient Sample (NIS) and the Medicare inpatient claims databases use International Classification of Diseases, ninth edition (ICD-9; or recently the 10th edition, ICD-10) codes to identify patients with morbid obesity (code-based morbid obesity) [9,11]. These databases are readily available and contain information about a large number of patients [11]. As many of these studies form the basis for making important

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policy decisions, it is important to understand how reliably such information is represented. Previous studies have shown that the sensitivity of obesity coding is low, and coding errors might affect the results of studies when code-based obesity is used [12–14]. However, it is unclear whether morbid obesity is prone to similar coding inaccuracies. It is assumed that comorbidities such as morbid obesity, which are easy to identify and which might have implications on reimbursement, might be more accurately represented by coding [11].

Therefore, the purpose of this study was to evaluate the reliability of coding for morbid obesity in patients who underwent THA. Specifically, we evaluated (1) the sensitivity of coding in identifying morbid obesity and compared to that of coding for obesity and (2) if there was a difference in complications after THA based on whether morbid obesity was defined by BMI or coding.

Methods

After approval from our institutional review board, all patients who underwent primary THA at a single health system from January 1, 2004 to December 31, 2014 were identified using a query of the electronic medical records. Patient demographics, comorbidities, surgical information, and 90-day complications were obtained from the electronic medical charts. A total of 11,048 primary THAs were identified. After excluding 573 surgeries, which were missing information on BMI, 10,475 surgeries were included. The mean age of the cohort was 62 ± 13 years. There were 4957 (47%) males and 5518 (53%) females. The mean age–adjusted Charlson comorbidity score was 3.3 ± 2.7 [15].

Patients were classified as morbidly obese using 2 methods: (1) BMI and (2) ICD-9 diagnosis codes. Based on BMI, morbid obesity was defined as having a BMI ≥40 kg/m^2 at the time of surgery. Based on coding, morbid obesity was defined as the presence of one or more of the following ICD-9 codes denoting morbid obesity during the admission for THA: 278.01, V85.41-45. In addition, the presence of any code for obesity (278.0, 278.00, 278.01, 278.03, 649.10-14, 793.91, V85.30-39, V85.41-45, V85.54) was evaluated. These codes were the same ICD-9 codes used by the Nationwide Inpatient Sample in the comorbidity classification software and have been used in other studies on morbid obesity and obesity [9,16,17]. The ICD-9 codes associated with a particular admission of THA were obtained from the electronic query of discharge records of the respective admission.

The rates of 90-day complications were analyzed based on whether morbid obesity was defined by BMI or coding. The complications assessed were obtained using ICD-9 diagnosis codes and include superficial infection (codes: 682.6, 686.9, 890, 998.5, 998.51, 998.6, 998.83, 998.59), deep infection/prosthetic joint infection (codes: 996.66-7, 996.69), wound dehiscence/drainage (codes: 998.3, 998.31-2, 890, 890.1-2, 891, 891.1-2, 894, 894.1-2), wound hematoma/bleeding into the joint (codes: 719.15, 719.16, 998.11-3), deep vein thrombosis (DVT) (codes: 451.1, 451.11, 451.19, 451.2, 451.8, 451.9, 453.2, 453.4, 453.89, 453.9), and pulmonary embolism (PE) (codes: 415.11, 415.12, 415.13, 415.19).

Table 1
Utility of Coding in Identifying Obesity and Morbid Obesity in Patients Undergoing Primary Total Hip Arthroplasty Along With the 95% Confidence Intervals.

Value	Morbid Obesity	Obesity
Sensitivity	27.9% (24.9-31.0)	28.3% (26.9-29.5)
Specificity	98.2% (97.9-98.5)	97.3% (96.9-97.7)
Positive predictive value	58.6% (54.1-63.1)	89.2% (87.7-90.7)
Negative predictive value	93.7% (93.4-93.9)	63.3% (62.9-63.8)
Area under the curve	0.63 (0.62-0.65)	0.63 (0.62-0.63)

The sensitivity of coding was defined as the percentage of morbidly obese patients (BMI >40 kg/m^2) concordantly classified as morbidly obese by ICD-9 coding. Similarly, sensitivity of obesity coding was also evaluated. Other parameters of coding reliability such as specificity, positive predictive value, negative predictive value, and area under the curve (AUC) were calculated for both morbid obesity and obesity by comparing code-based obesity to BMI-based obesity. As the area under the receiver operating characteristics curve is not sensitive to the prevalence of obesity, this parameter was used to compare the overall accuracy of coding for obesity and morbid obesity.

Chi-squared tests were used to test the difference in proportions. Annual changes in sensitivity of coding were evaluated using linear regression analysis. Multivariate logistic regression analyses were used to estimate the effect of morbid obesity on complications with age, gender, and Charlson comorbidity score as covariates. A P value of less than .05 was used to determine statistical significance, and 95% confidence intervals were calculated. Statistical analyses were performed with R software (version 3.1.3; R Foundation for Statistical Computing, Vienna, Austria).

Results

Based on the BMI recorded in medical charts, the prevalence of obesity was 44.0% (4608 of 10,475 had a BMI ≥30 kg/m^2), while that of morbid obesity was 8.4% (882 of 10,475 had a BMI ≥40 kg/m^2). Based on coding, the prevalence of obesity was 13.9% (1459 of 10,475 had a code for obesity), while that of morbid obesity was 4.0% (420 of 10,475 had a code for morbid obesity). Patients with morbid obesity were more likely to have a code for obesity (53 vs 28%, P < .001) (Fig. 1). Among the 882 surgeries performed in morbidly obese patients (ie, in those with BMI >40 kg/m^2), a code for obesity was present in 467 (53.0%) surgeries. Among these 467 surgeries with a code for obesity, only 246 (53%) had a code specific for morbid obesity, while the remaining 221 (47%) had a code for

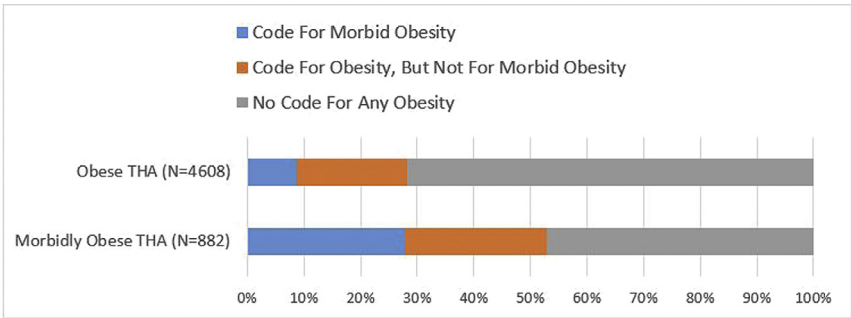

Fig. 1. Prevalence of obesity-related ICD-9 codes in obese and morbidly obese patients undergoing total hip arthroplasty (THA).