



## Original Article

# Postoperative complications in underweight patients undergoing total hip arthroplasty: A comparative analysis to normal weight patients

Mikhail Zusmanovich, Benjamin Kester, James Feng, Ran Schwarzkopf\*

Division of Adult Reconstruction, Department of Orthopaedic Surgery, NYU Langone Medical Center, Hospital for Joint Diseases, New York, NY, 10003, United States

## ARTICLE INFO

## Keywords:

Total hip arthroplasty  
BMI  
Complications  
Malnutrition  
Underweight

## ABSTRACT

**Background:** Underweight patients undergoing total hip arthroplasty have been largely overlooked. The purpose of this study was to evaluate their complications profiles compared to normal weight individuals.

**Methods:** Patients were selected from the NSQIP database, matched, and arranged into 2 groups based on BMI. Complications were recorded and analyzed to determine differences in outcomes.

**Results:** Multivariate analysis demonstrated increased length of hospital stay (LOS) ( $p = 0.006$ ) for underweight patients but failed to demonstrate higher rates of medical or surgical complications.

**Conclusion:** There are no increased rates of infectious or medical complications in underweight patients undergoing THA. However, increased LOS was demonstrated.

## 1. Introduction

In 2012, over 700,100 total knee (TKA) and 468,000 total hip (THA) arthroplasties were performed in the US, making each intervention the first and fourth most frequent inpatient surgical procedures, respectively.<sup>1</sup> Estimates predict that by 2030, over 4 million total joint arthroplasties (TJA) will be performed annually.<sup>2</sup> Increasing hospital costs and an emphasis on improving patient safety have led to the investigation of pre-surgical risk factors and their preventative measures. While obesity has received significant attention from the arthroplasty community, due to the inherent associated medical comorbidities and risks of post-operative complications,<sup>3–5</sup> research concerning TJA in underweight patients and their associated medical comorbidities have been largely understudied.

Malnutrition is a common manifestation in the underweight population and is a modifiable risk factor, affecting 15% of patients in the arthroplasty inpatient setting.<sup>6</sup> Several studies have demonstrated that malnutrition may lead to poor post-operative outcomes, including increased rates of post-operative infection, transfusion, cardiovascular events and renal complications.<sup>7–10</sup> Malnutrition has also been shown to potentially delay mobilization, increase lengths of stay and hospital expenditures.<sup>7,8,11</sup>

Laboratory indicators of malnutrition have included low serum albumin, pre-albumin, retinol-binding protein, transferrin, total cholesterol, and inflammatory markers (i.e. CRP and WBC count).<sup>8,12</sup> However, these indicators can be confounded by underlying physiological or

pathological processes,<sup>12</sup> and are inconsistently collected pre-operatively. BMI, on the other hand, remains to be one of the most well documented exam findings during standard clinic visits, and could prove to be a useful proxy for malnutrition in the underweight patient. The primary aim of this study is to therefore evaluate and compare the complication profile in underweight (BMI < 18.5 kg/m<sup>2</sup>) versus normal weight patients (BMI 18.5–24.9) undergoing total hip arthroplasty. We hypothesize that underweight patients will have higher rates of medical and infectious complications due to underlying medical comorbidities.

## 2. Methods

### 2.1. Data source

Patients participating in the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) were examined. The structure of the ACS NSQIP has been described previously.<sup>13,14</sup> In short, the program prospectively collects detailed data regarding patient demographics, preoperative comorbidities, laboratory values, and specific operative variables. Patients are then followed for 30 days after the index operation, and postoperative complications are collected regardless of whether the patient is an inpatient, has been discharged to their home or other facility, or has been readmitted to another hospital or outpatient facilities. Data is abstracted at each site by surgical certified reviewers using clinical records, physician charts, and by contacting patients directly. Surgical certified reviewers are

\* Corresponding author at: Division of Adult Reconstruction, Department of Orthopaedic Surgery, NYU Langone Medical Center Hospital For Joint Diseases, 301 East 17th Street, New York, NY, 10003, United States.

E-mail address: [Ran.Schwarzkopf@nyumc.org](mailto:Ran.Schwarzkopf@nyumc.org) (R. Schwarzkopf).

<https://doi.org/10.1016/j.jor.2018.02.016>

Received 4 January 2018; Accepted 18 February 2018

Available online 21 February 2018

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formally trained by the ACS NSQIP team with continuing education courses and annual certifications to ensure high quality, standardized data collection. Data definitions are strictly defined and standardized across all participating institutions. Data consistency and reliability are assessed at each hospital through an on-site interrater reliability audit program.<sup>15</sup>

### 2.2. Patient selection and exclusion

Patients who underwent primary total hip arthroplasty between January 1, 2008, to December 31, 2015 were identified using Current Procedural Terminology (CPT) code 27130 (primary total hip arthroplasty) and separated into two groups. Patients with body mass indexes (BMI) < 18.5 kg/m<sup>2</sup> were categorized as underweight, and those with BMIs between 18.5–24.9 kg/m<sup>2</sup> were categorized as normal weight. All cases involving a diagnosis of infection, hip fracture and/or malignancy according to ICD-9 coding were excluded from this study. Propensity match scoring was used to identify a cohort of normal weight patients that were statistically similar to the underweight cohort according to age, sex, and preoperative comorbidities by SPSS Statistics version 22 (IBM, Armonk, NY) at a ratio of approximately 1.6:1. Patients were not matched according to BMI or history of recent weight loss (10%, as defined by NSQIP criteria).

### 2.3. Preoperative variables

Patient demographics, medical comorbidities, and 30-day complications were compared between the two groups. Demographics included age, gender, height, weight, and BMI. Medical comorbidities included a previous history of severe chronic obstructive pulmonary disease, myocardial infarction, congestive heart failure, hypertension requiring antihypertensive medications, bleeding disorders, previous transfusions, diabetes mellitus, dialysis, acute renal failure, ascites, disseminated cancer, and weight loss greater than 10% in the past 6 months prior to surgery.

### 2.4. Outcomes

Postoperative variables included operative time, hospital length of stay, and 30-day reoperation and readmission rates. Postoperative complications encompassed death, deep venous thrombosis, pulmonary embolism, renal insufficiency and failure, urinary tract infections, cerebrovascular accidents, cardiac arrest, myocardial infarction, bleeding requiring transfusion, superficial and deep surgical site infections, and wound disruption. All variables were used as defined in the ACS NSQIP user guide.<sup>16</sup>

### 2.5. Statistical methods

SPSS Statistics version 22 (IBM, Armonk, NY) was used to perform all statistical analyses in this study. Kolmogorov-Smirnov tests of normality were performed and deemed adequate. Univariate analyses of categorical variables were performed using Fisher's exact test. Independent-samples T-test assuming equal variances was used to compare continuous variables between the 2 procedures. A p value less than 0.05 was deemed statistically significant. To demonstrate whether specific preoperative variables were independently associated with higher risk of 30-day postoperative complications, binary logistic regression analyses were performed. Only univariate candidates with an association  $p \leq 0.20$  were included in the model.

## 3. Results

A total of 16,831 patients undergoing total hip arthroplasty with BMI's below 18.5 and those between 18.5 and 24.9 were identified. From the database, patients were matched using propensity scores

**Table 1**  
Characteristics of 840 Normal and Underweight Patients Undergoing Total Hip Arthroplasty.

	Underweight BMI < 18.5 n (%)	Normal Weight BMI 18.5–24.9 n (%)	P-Value <sup>a</sup>
Number of Patients	301	539	na
Female	239 (79.4)	421 (78.1)	0.726
Non-Caucasian	26 (8.6)	70 (13.0)	0.295
Age (mean, yrs)	71.6	72.5	0.096
Preoperative Testing			
Albumin <sup>b</sup>	4.0	4.1	0.326
Hematocrit <sup>b</sup>	39.1	37.7	< 0.001
Current smoker	41 (13.6)	83 (15.4)	0.543
Diabetes mellitus	3 (1.0)	2 (0.4)	0.356
Hypertension requiring medications	138 (45.8)	250 (46.4)	0.886
History of $\geq 10\%$ weight loss	5 (1.7)	0 (0.0)	0.006
Recent congestive heart failure exacerbation	19 (6.3)	35 (6.5)	1.000
History of chronic obstructive pulmonary disease			
Ascites	0 (0.0)	0 (0.0)	1.000
History of active malignancy	0 (0.0)	0 (0.0)	1.000
Dialysis	0 (0.0)	2 (0.4)	0.540
Recent acute renal failure with creatinine $\geq 2$ mg/dL	0 (0.0)	1 (0.2)	1.000
Chronic steroid use	17 (5.6)	29 (5.4)	0.875
Bleeding disorder	2 (0.7)	3 (0.6)	1.000
Preoperative Transfusion $\geq 1$ unit pRBC	2 (0.7)	3 (0.6)	1.000
ASA Class $\geq 3$	128 (42.5)	211 (39.1)	0.342

BMI, body mass index; ASA, American Society of Anesthesiologists; pRBC, packed red blood cells.

<sup>a</sup> Calculated using Fisher's Exact Test for categorical variables and independent samples t-test for continuous variables.

<sup>b</sup> Preoperative laboratory values completed for 47.7% of patients.

based on age, sex, and preoperative comorbidities at a ratio of 1.6 to 1 of normal weight to underweight patients, respectively. The propensity matched scores yielded, a total of 840 patients who underwent primary total hip arthroplasty. Of those, 539 were categorized as normal body weight (BMI 18.5–24.9), while 301 were underweight (BMI < 18.5). 78% were female and 11.4% were non-Caucasian.

There were 2 significant differences in the demographics between the 2 groups. The normal weight group had an average hematocrit that was 37.7 compared with an average of 39.1 in the underweight group ( $P < 0.001$ ) and the underweight group had more patients with a history of > 10% weight loss ( $p < 0.001$ ) compared to the control normal weight group. The difference in hematocrit is likely not clinically significant. There was no statistical difference between levels of preoperative albumin between the two groups. The most prevalent comorbidity was hypertension, which accounted for 48.8% of the underweight group and 46.4% of the normal weight group (Table 1).

A univariate analysis was completed to determine statistical differences in the postoperative complication profile of normal weight and underweight patients undergoing elective total hip arthroplasty. Differences between the 2 groups were observed as seen in Tables 2 and 3.

Based on the univariate analysis, underweight patients had statistically significant longer operative times ( $p = 0.023$ ) and length of hospital stay ( $p = 0.048$ ). Unplanned readmissions ( $p = 0.096$ ) and renal insufficiency ( $p = 0.128$ ) rates were higher in underweight patients and approached significance. There were no observed differences between medical complications including cardiac issues, pneumonia, pulmonary emboli, cerebrovascular accidents, and deep venous thromboembolism. There were also no differences in superficial or deep surgical infections or rates of wound dehiscence (Table 2).

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