Role of Sociodemographic, Co-morbid and Intraoperative Factors in Length of Stay Following Primary Total Hip Arthroplasty

CrossMark

Ifeoma A. Inneh, MPH, Richard Iorio, MD , James D. Slover, MD, MS, Joseph A. Bosco III, MD

Department of Orthopaedic Surgery, NYU Langone Medical Center, Hospital for Joint Diseases, New York, New York

A R T I C L E   I N F O

A B S T R A C T

We aimed to examine and quantify the combined association of patient sociodemographic, preoperative comorbidities and intraoperative factors with extended and prolonged length of stay (LOS) following primary total hip arthroplasty. Longer LOS was associated with Age (≥65 years), BMI ≥30 kg/m^2, ASA score >2, minority race/ethnicity, low SES, general anesthesia, comorbidities of the Circulatory, Genitourinary and Respiratory systems, and operating time. Collectively, being of low SES, advanced age (≥65 years) and minority race/ethnicity was most significantly associated with prolonged LOS (>7 days). The combined associations of lower SES, female gender, advanced age, non-Caucasian race/ethnicity and certain comorbidities presented a synergistically elevated risk for longer LOS and may warrant the need to consider sociodemographic status when allocating resources to hospitals serving such patients.

Rising healthcare costs in the United States (US) and budgetary/fiscal constraints are causing the payers of healthcare led by the Centers for Medicare and Medicaid Services (CMS) to seek ways to encourage hospitals and providers to contain costs and allocate resources appropriately. In order to accomplish this goal, both payers and providers must measure and understand the amount of resources utilized to deliver medical care. Length of stay (LOS) is an important component of the overall cost of care and a marker of resource utilization [1]. It provides an estimate of the resources used to care for a hospitalized patient with a particular diagnosis during the acute inpatient period [2]. As a result, hospitals strive to decrease patient LOS following elective surgical procedures such as joint arthroplasty, as a way to decrease cost of care delivery. Total hip arthroplasty (THA), which is the most effective treatment for end-stage osteoarthritis of the hip, is one of such procedures that has shown a decline in postoperative LOS over the past two decades [3].

As the volume of THA procedures increases, rising healthcare costs must be controlled while maintaining quality to maximize value. Therefore, identifying factors and patients that may present an increased financial burden to the healthcare delivery system is important. Despite the growing tendency to dissociate race/ethnicity and socioeconomic status in healthcare access and utility [5], relatively few studies

[1,4,6–18] have examined the association of preoperative patient-related socioeconomic status (SES) and clinical factors with postoperative outcomes or hospital LOS after hip or knee joint arthroplasty. However, none have examined the collective impact of sociodemographic (i.e. involving a combination of social and demographic characteristics) and clinical (preoperative comorbidities and intraoperative) factors after THA. This study aimed to: 1) examine and 2) quantify the collective association of patient sociodemographic, preoperative comorbidities and modifiable intraoperative factors with extended or prolonged length of stay after elective primary THA.

Patients and Methods

Data Source and Study Population

We retrospectively reviewed patient-level administrative and electronic health record data from a large metropolitan single specialty orthopedic hospital's databases. These included demographic, socioeconomic, preoperative comorbidities, intraoperative surgical factors and postoperative hospital LOS data for 2445 elective primary THA (International Classification of Disease Ninth Edition [ICD-9-CM] procedure code 81.51) cases from September 1, 2011 through January 31, 2014. The sociodemographic characteristics examined included age, patient-reported race/ethnicity, gender, and income estimation from patient zip code and insurance (proxies for SES). Race/ethnicity was categorized as Caucasian or Minority (non-Caucasian). All patients of Hispanic origin, mixed races, African American/Black, Asian Pacific or Native American/Indian origin were classified as Minorities. Preoperative comorbidities were categorized into diseases affecting major body systems and/or conditions using ICD-9 CM codes reported at the time

of index surgery: Infectious Diseases (001–139), Circulatory (390–459), Endocrine (240–279), Digestive (520–579), Genitourinary (580–629), Respiratory (460–519), Blood Disease/Blood Forming Organs (280–289), Central Nervous System (320–389) and Neoplasia (140–239). American Society of Anesthesiologists (ASA) score, body mass index (BMI), and the primary indication for surgery were also noted and analyzed. Intraoperative factors analyzed included operating time (defined as number of minutes from incision to wound closure) and anesthesia type.

Definition of Key Variables

SES was measured using median household per capita income by zip code (at time of index surgery) as generated and reported by the United States National Census Bureau's American Community Survey (ACS) [19] from 2006 to 2010 as opposed to insurance status given that the majority of patients in this cohort had Medicare or a private insurer as primary payer. The national dataset was divided into quartiles with the lowest income quartile defined as low SES. Patients in our study cohort who had zip codes that fell within that income category were classified as low SES. This approach of SES measure was chosen because it is known to reflect aggregate as opposed to individual characteristics of a population, and provides insight into certain social attributes which often influence access to, utility and delivery of healthcare. It has also been successfully utilized in several studies in other disciplines [42–48]. The endpoint or outcome variable of postoperative LOS was calculated as the difference in days between the date of surgery and the date of discharge from the hospital; and was sub-categorized as normal or longer (i.e. appropriate extended or prolonged postoperative LOS). An extended length of stay was defined as greater than 3 days but less than 8 days, based on the median postoperative length of stay at our institution and hospital bed utilization is charged by days. Prolonged length of stay was defined as greater than 7 days.

Statistical Analysis

We employed univariate and stepwise forward multivariate logistic regression analyses to adjust for the effect of multiple variables on outcomes. The ability to predict patients' likelihood of longer (including an extended or prolonged) LOS using patient-related (sociodemographic and preoperative comorbidities) and surgery-related (intraoperative) risk factors for each outcome variable was explored. Covariates included in the model were age, gender, SES, BMI, ASA score, operating time, race/ethnicity, anesthesia type, and presence or absence of certain comorbidities. Operating time was analyzed as a continuous variable (5 min increments), while Age (<65 vs. ≥65 years), BMI (<30 vs. ≥30 kg/m^2 and <40 vs. ≥40 kg/m^2) and Anesthesia type (general vs. regional vs. combined) were analyzed as categorical variables. Multicollinearity was examined and none of the independent/predictor variables were highly correlated. In order to avoid overfitting that could potentially bias the results, only statistically significant univariate variables ($P < 0.05$) were included in the final models. The Hosmer–Lemeshow test and area under the receiver operating characteristic curve (AUC) were used to examine the goodness-of-fit of the models [20]. Only models with non-significant Hosmer–Lemeshow tests (i.e. $P > 0.05$) were accepted. An AUC between 0.7 and 0.8 was considered the threshold for acceptable discriminatory performance and an AUC of >0.8 was considered to be the threshold for good or excellent discriminatory performance [20].

Adjusted Odds Ratios (ORs) and corresponding 95% confidence intervals (CIs) were computed. Categorical variables are summarized as counts with corresponding percentages, while continuous variables are summarized as means and standard deviations or median and interquartile range depending on distribution of data (using the Shapiro Wilk test for normality assumption $P < 0.05$). Statistical significance was set at 0.05. The statistical analysis was performed using IBM

SPSS version 21.0 [21] by an investigator well-trained in these techniques (IAI).

Results

Descriptive Statistics

The age range for this cohort was 21 to 93 years (mean: 62 years; median: 63 years). Of the cohort, 1386 (56%) were females and 276 (11%) patients were of low SES. Minority patients made up 26% of the entire cohort. Among the patients of low SES, 91 were of Caucasian race/ethnicity. Osteoarthritis (88%) was the most frequent indication for undergoing THA, followed by aseptic necrosis (7%), traumatic arthropathy (0.9%) and rheumatoid arthritis (0.7%). Over 65% of patients had at least 5 comorbidities recorded, and 585 (24%) patients had an ASA score >2 (Table 1). Regional anesthesia was administered to 1968 (80%) patients, while 371 (15%) and 23 (0.9%) received general and combined epidural with general anesthesia respectively (Table 2). Postoperative LOS ranged from 1 to 27 days with a mean of 3.5 days. LOS also revealed that: 787 (32%) patients had LOS greater than 3 days, 52 of which were prolonged (>7 days). Among patients who had an extended or prolonged LOS, 15% were of low SES, 59% female, 49% ≥65 years of age, 37% had an ASA score >2, and 34% were of minority race/ethnicity. Of the entire cohort, 1643 (67.2%), 785 (32.1%) and 17 (0.7%) patients were discharged to home, rehabilitation facility or other facility respectively.

Table 1
Patient-Related Factors: Sociodemographic and Clinical Characteristics.

Variables	Entire Sample N = 2445	Extended or Prolonged LOS N = 787
Age (years)		
<65	1379 (56.4)	399 (50.7)
≥65	1066 (43.6)	388 (49.3)
Gender		
Male	1059 (43.3)	323 (41.0)
Female	1386 (56.7)	464 (59.0)
Race/Ethnicity		
Caucasian	1810 (74.0)	521 (66.2)
Minority (non-Caucasian)	635 (26.0)	266 (33.8)
Low SES (as measured by zip code)	276 (11.3)	119 (15.1)
Body Mass Index (kg/m^2)		
<25	671 (27.4)	201 (25.5)
25–29.9	852 (34.8)	239 (30.4)
≥30	914 (37.4)	344 (43.7)
ASA Classification		
≤2	1834 (75.0)	493 (62.6)
>2	585 (23.9)	289 (36.7)
Missing/Unknown	26 (0.1)	5 (0.6)
Comorbidities by Disease Category/Body System		
Blood and Blood Forming Diseases	922 (37.7)3	410 (52.1)
Circulatory	1326 (54.2)	474 (60.2)
Digestive	412 (16.9)	112 (14.2)
Endocrine	1288 (52.7)	439 (55.8)
Genitourinary	195 (8.0)	84 (10.7)
Infectious Diseases	69 (2.8)	31 (3.9)
Mental Disorders	503 (20.6)	161 (20.5)
Neoplasia	43 (1.8)	16 (2.0)
Nervous System	1030 (42.1)	359 (45.6)
Respiratory	317 (13.0)	134 (17.0)

ASA = American Society of Anesthesiologists; LOS = Length of Stay; SES = Socioeconomic status. Data are expressed as frequencies with percentages in parenthesis.