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Race and ethnicity as predictors of hospital-acquired conditions after total hip arthroplasty and total knee arthroplasty

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1. Introduction

Osteoarthritis (OA) is a common, degenerative joint disease affecting function and causing physical disability and pain. The prevalence of hip joint OA in the United States (U.S.) is reported to be as high as 9.7% among people age 45 years and older, and as high as 17% among persons older than 75 years of age. The prevalence of knee OA is estimated at 4.9% of U.S. adults age 26 years and older. Prevalence of both hip and knee OA is reported to be highest among Black Americans (Murphy and Helmick, 2012). The projected number of persons with OA by 2030 is nearly 67 million, or 25% of the adult population. The consequent burdens in terms of quality-of-life and cost of care are expected to be substantial (Bitton, 2009).

Joint arthroplasty is indicated for patients with joint dysfunction in whom conservative treatment of OA has failed. Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA) can successfully relieve pain, restore function, and enhance mobility (Bourne et al., 2010; Memtsoudis et al., 2008). However as with any invasive procedure, total joint arthroplasty is not without risk of complications.

The Centers for Medicare and Medicaid Services (CMS) have instituted measures to reduce avoidable complications for patients. CMS has a non-payment policy for complications and conditions they have labeled Hospital-Acquired Conditions (HACs). CMS has deemed that HACs are reasonably preventable and were not present at the time of admission (Department of Health and Human Services, 2013). Although HACs were developed for use with Medicare and Medicaid patients, the evidence-based guidelines for prevention on which the HACs are identified as appropriate for, and designed for, all patients, regardless of type of payment. While these procedures are not without risk, it is reasonable to expect the post-procedure hospital experience to be free of HACs.

One group of HACs that can have deadly results following a THA or TKA is deep vein thrombosis (DVT) and pulmonary embolism (PE). DVT is one of the most common complications after THA or TKA. If left untreated, 50% of patients with DVT will develop a PE (Bosque et al., 2012). As many as 200,000 deaths a year are attributed to PE and DVT. PE is estimated to be the most common preventable cause of hospital death (Maynard and Stein, 2010). Evidenced-based methods to prevent postoperative DVT and PE can significantly improve outcomes. Because of the risk of hemorrhage and other problems (Breathnach et al., 2016; Nam et al., 2015; Pierce et al., 2015), chemoprophylaxis must be used with caution. Non-pharmacologic interventions are also recommended for prevention (Pierce et al., 2015; Pollak and McBane, 2014). When DVTs and PEs are recognized and treated, the reported rate of death from PE following THA or TKA is 0.1% and 0.2% respectively (Bosque et al., 2012). Yet studies continue to demonstrate that preventative methods are underutilized. In some studies, only 30–60% of eligible patients received prophylaxis (Maynard and Stein, 2010; Pollak and McBane, 2014).

There has been increasing awareness that racial and ethnic minorities in the United States are prone to poorer quality health care as compared to White Americans. In certain procedures, racial and ethnic minorities have experienced adverse outcomes more frequently than White Americans. (American College of Physicians, 2010; Bederman et al., 2012; Dykes and White, 2009; Villarruel, 2006). The purpose of this study was to examine the relationship between race and ethnicity and specific adverse outcomes of primary THA or TKA secondary to OA. Additional patient characteristics (gender, age, primary payer) and hospital characteristics (bed size and geographical location) were included in the study.

1.1. Background/literature

Previous research has focused on both patient and hospital characteristics of adverse outcomes after surgery. Several researchers have explored the role of race as a predictor of adverse events after THA or TKA with contradictory results. Huddleston

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et al. (2009) found race was not a significant predictor of adverse events in Medicare patients undergoing TKA. In contrast, Ibrahim et al. (2005) reviewed over 12,000 cases of veterans undergoing TKA and noted that when compared with White patients, Black patients had a significantly higher relative risk of non-infection-related complications. In addition, Black and Hispanic patients had a significantly higher risk of infection-related complications. SooHoo et al. (2010) found that when compared to White patients, overall risk of complications following THA was higher for Blacks. Conversely, Hispanics and Asians had a lower risk of complications. In other studies, being of Hispanic race was a significant predictor of complications after THA or TKA (Pulido et al., 2008) and Blacks had higher rates of nosocomial infections and adverse surgical outcomes compared to Whites (Studnicki et al., 2013).

Contradictory results were also seen among the research studies that included gender as a risk factor for adverse outcomes after THA and TKA. SooHoo et al. (2010) reported that male patients had a significantly higher risk of complications within 90 days of undergoing THA than did female patients. However, when comparing gender differences specific to thromboembolism risk within 90 days of THA, there was no significant difference. Multiple studies found no significant difference in risk based on gender (Butler et al., 2011; Higuera et al., 2011; Huddleston et al., 2009, 2012; Ibrahim et al., 2005; & Shimoyama et al., 2012).

In regards to patient age, a small ($N = 144$) study by Shimoyama et al. (2012), showed that age did not significantly increase the risk of DVT/PE after either THA or TKA. Conversely, several studies found a positive correlation between adverse outcomes and increasing age (Huddleston et al., 2012; Ibrahim et al., 2005). In another study of predictors of DVT/PE, SooHoo et al. (2010) found patients of younger age were significantly less at risk when compared to patients >65–75 years of age.

Socioeconomic status is a complex variable that may confound the analyses of data. One approach of trying to capture the effect of socioeconomic status is to examine the role of primary payer in relation to outcomes. Compared with non-Medicaid patients, Medicaid patients have a significantly higher prevalence of post-operative in-hospital infection (Browne et al., 2014). Medicare patients have had higher rates of deep vein thrombosis and pulmonary embolism compared to patients whose primary payer was Medicaid, private, or self-pay (Maeda et al., 2011).

The literature review showed inconsistent results in the relationship between race and ethnicity and adverse outcomes after THA or TKA. Further, there is a lack of research that specifically addresses the risk of HACs in relation to patient and hospital characteristics. Thus, the purpose of this study was to examine the relationship between patients' race, age, gender, and primary payer, along with the hospital bed size and geographical region compared to the occurrence of HACs after primary THA or TKA secondary to OA.

2. Methods

This study utilized secondary data analysis in a retrospective cohort design. Data from the 2010 Nationwide Inpatient Sample (NIS) was used. NIS contains data from nearly eight million hospital stays from approximately 1000 hospitals. The NIS is a stratified sample, containing data from 20 percent of U.S. community hospitals gathered by the Healthcare Cost and Utilization Project (HCUP). HCUP is a health care database sponsored by the Agency for Healthcare Research and Quality (AHRQ). Data from state organizations, hospital associations, private organizations, and the Federal government are collected and organized into a national information resource for health care research (HCUP, 2010).

2.1. Subjects

Patients included in this study underwent a primary THA or TKA for treatment of OA. Data from subjects who met the criteria was evaluated for the occurrence of the HACs Deep Vein Thrombosis and Pulmonary Embolism Following Orthopedic Procedures. Those subjects who suffered HACs were compared to subjects who did not experience an HAC. The HCUP data yielded 155,543 cases that met the inclusion criteria for the study. A number of cases ($n = 890$) were positively diagnosed with deep vein thrombosis or pulmonary emboli.

2.2. Variables

At the time 2010 HCUP data was collected, CMS was using International Coding of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) to identify surgical procedures, such as THA and TKA, and HACs. CMS identified Deep Vein Thrombosis and Pulmonary Embolism Following Certain Orthopedic Procedures with several specific ICD-9-CM codes referring to complications following THA or TKA (ICD9Data.com, 2010). Included in this aggregated group are pulmonary embolism and infarction and venous embolism and thrombosis.

The independent variables of this study are organized according to the conceptual model, Sources of Healthcare Disparities (Smedley et al., 2003). Patient characteristics studied include Race/Ethnicity, Gender, Age in Years, and Primary Expected Payer. Race/Ethnicity is divided into categories of White, Black, Hispanic, Asian or Pacific Islander, Native American, or Other.

HCUP data is organized by the hospital characteristics identified as Hospital Bed Size and Hospital Region. HCUP categorized the variable Hospital Bed Size as small, medium, or large. The variable Hospital Region refers to the geographic regions categorized by HCUP as Northeast, Midwest, West, and South regions of the United States.

2.3. Statistical analysis

The secondary database, 2010 HCUP NIS, was used to identify patients admitted for primary THA or TKA due to osteoarthritis during 2010. These cases were then analyzed to determine if any significant correlations existed between patient characteristics and hospital characteristics and the occurrence of HACs identified at the time of hospital discharge. The independent variables that were assessed in correlation with HACs were race/ethnicity, gender, age, primary expected payer, hospital bed size, and hospital region. The independent variables were then assessed for their predictive power using logistic regression.

3. Results

Descriptive and bivariate analysis included 155,543 cases. Over 29% of the cases had a diagnosis of OA and THA, while the majority of cases (70.9%) were diagnosed with OA and TKA. The mean age of patients in the study was 65.98 years (Fig. 1). Males made up 61% of the cases (Table 1). This differs from national data showing more women than men undergo THA (Ruiz et al., 2013) and TKA (National Center for Health Statistics, 2015). The majority of subjects in the study were white ($n = 132,600$, 85.2%). Blacks represented the largest of the minority groups ($n = 11,704$, 7.5%) followed by Hispanics ($n = 5,906$, 3.8%). The primary expected payer was predominantly Medicare ($n = 83,630$, 53.8%). The second largest primary expected payer was private pay ($n = 62,407$, 40.1%).

HCUP defines hospital bed size in relation to several factors, including region of the country. The variable Hospital Bed Size was

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