



The Role of Socioeconomic Status, Race, and Gender in Patient-Reported Outcomes
Following Total Hip Arthroplasty

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Abstract

Background

Disparities in total joint arthroplasty are well-documented. However, much of the research regarding disparities in vulnerable populations receiving total hip arthroplasty (THA) have focused on short-term outcomes. The purpose of this study was to examine the effects of race, gender, and socioeconomic status (SES) on patient-reported outcomes six months following THA.

Methods

Electronic health record data were retrospectively analyzed for 269 individuals who underwent THA at a large urban hospital from 2013-16. Data retrieved included patient demographics, baseline health information, data regarding hospital length of stay when undergoing THA, post-operative complications, and patient-reported function, measured by the Harris Hip Score (HHS) at baseline (pre-operative) and six months post-operatively.

Results

Compared to White patients and male patients, non-White ($p = .01$) and female ($p = .02$) patients were lower-functioning prior to surgery. At six months post-operatively, White patients had significantly better function than non-White patients, ($p = .05$) and patients of higher SES had significantly better function than patients of lower SES ($p = .05$). Regression analyses revealed that, after controlling for race, gender, and SES, the only significant predictor of six-month improvement in HHS was the pre-operative HHS score ($p < .001$).

Conclusion

These results indicate that female, non-White, and lower SES patients undergoing THA may have lower function pre-operatively and may not experience as much improvement in physical function post-operatively as their male, White, and higher SES counterparts.

Further research is needed to determine if race, gender, and socioeconomic differences in pre-operative function lead to long-term disparities in function following THA, using larger sample sizes and outcomes beyond 6 months post-operatively.

Keywords

disparities; hip replacement; outcomes; function

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ABSTRACT

Background. Disparities in total joint arthroplasty are well-documented. However, much of the research regarding disparities in vulnerable populations receiving total hip arthroplasty (THA) have focused on short-term outcomes. The purpose of this study was to examine the effects of race, gender, and socioeconomic status (SES) on patient-reported outcomes six months following THA.

Methods. Electronic health record data were retrospectively analyzed for 269 individuals who underwent THA at a large urban hospital from 2013-16. Data retrieved included patient demographics, baseline health information, data regarding hospital length of stay when undergoing THA, post-operative complications, and patient-reported function, measured by the Harris Hip Score (HHS) at baseline (pre-operative) and six months post-operatively.

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Conclusion. These results indicate that female, non-White, and lower SES patients undergoing THA may have lower function pre-operatively and may not experience as much improvement in physical function post-operatively as their male, White, and higher SES counterparts.

Further research is needed to determine if race, gender, and socioeconomic differences in pre-operative function lead to long-term disparities in function following THA, using larger sample sizes and outcomes beyond 6 months post-operatively.

Keywords: disparities; hip replacement; outcomes; function

INTRODUCTION

Disparities related to joint arthroplasty for individuals with lower extremity osteoarthritis have been well-documented (Bang et al., 2010; Cai et al., 2012; Centers for Disease Control and Prevention, 2009; Chen et al., 2013; Jones et al., 2005; Kane et al., 2007; Skinner et al., 2003; Soohoo et al., 2010), demonstrating that patients who are of White race, male gender, and higher socioeconomic status are more likely to undergo joint arthroplasty. Although much of the research in this area has focused on rates of total knee arthroplasty, there is ample evidence to suggest similar disparities in rates of total hip arthroplasty (THA) [Bang et al., 2010; Dunlop et al., 2008; Shahid et al., 2016; Singh et al., 2014]. More recently, researchers have examined disparities in outcomes following THA and have uncovered disparities affecting several marginalized populations in the United States (Cram et al., 2007; Inneh et al., 2016; Lan & Kamath, 2017; Ponnusamy et al., 2017). However, most of the current research has focused on relatively short-term outcomes (30 days or less).

Studies have found that Black patients undergoing THA are at greater risk for 30-day hospital readmission than White patients (Elsharydah et al., 2018). This may be related to a similar finding that patients of Black race are more likely to receive joint replacement surgery at lower-quality hospitals, which perform comparatively fewer surgeries, than White patients (Cai et al., 2012). In addition, racialized minority patients tend to receive less intensive post-operative rehabilitation care following knee or hip arthroplasty compared to White patients (Freburger et al., 2011), a finding that is echoed in other studies finding race disparities in discharge destination and rehabilitation use after trauma (Bartley et al., 2019, Chun Fat et al., 2019). However, some research indicates that minoritized patients go into surgery with lower levels of function than White patients, so one may assume that those patients would require *more* intensive rehabilitation to achieve similar functional outcomes (Bang et al., 2010; Kane et al., 2007).

Prior research has indicated that women have more functional limitations and more severe pain before undergoing joint arthroplasty compared to men (Maurer & Jones, 2014; Wood et al., 2016). Little research has focused on whether any gender disparities persist amongst those who choose to undergo THA. One study noted that total THA-related charges and costs were lower for women (Lan & Kamath, 2017), but several studies have noted that women are more likely to be discharged to an inpatient institution following hospitalization for THA (Lan & Kamath, 2017; Inneh et al., 2016).

Income and insurance status also appear to play a role in the creation of disparities in the THA population. Patients who are insured by Medicaid are at higher risk for post-operative complications, 30-day hospital readmissions, and death (Singh et al., 2018; Xu et al., 2017). This leads to longer acute care lengths of stay and total costs of inpatient hospitalization. In addition, socioeconomic status also relates to an increased likelihood of being discharged to a lower level of rehabilitation care (i.e. home without home care or to a skilled nursing facility vs. home with home care or to an intensive inpatient rehabilitation facility) (Freburger et al., 2011; Inneh et al., 2016).

Much of the research regarding disparities in marginalized populations receiving THA have focused on short-term outcomes and have not studied how these short-term measures affect

patient pain and function. It is important to understand if disparities in longer-term physical function also exist. Therefore, the purpose of this study was to examine the relationships between race, gender, and socioeconomic status (SES) and patient-oriented outcomes six months following THA.

METHODS

Data Collection

Electronic chart data were retrospectively analyzed for all individuals who underwent THA with a single surgeon (senior author BK) at a large urban hospital between January 2013 and March 2016. THA was performed in supine with a modified Hardinge approach. As is standard of care in this orthopaedic practice, all patients were referred for home health and/or outpatient physical therapy upon discharge from the acute hospital stay. Individuals who underwent unilateral THA for a primary diagnosis of osteoarthritis were included. Individuals who underwent THA for any reason other than osteoarthritis (e.g. fracture, rheumatoid arthritis) were excluded. Several individuals underwent staged bilateral THA, with both surgeries falling within the study window; for those individuals, data from their first surgery were included and data from their second surgery were excluded. Patients were scheduled for an educational session with surgical staff prior to their date of surgery (colloquially referred to as “Joint School”) to ensure appropriate knowledge about the surgery and expectations of the post-operative period. All individuals whose data were accessed had provided written consent to participate in the surgeon’s research registry, approved by the University of Pittsburgh Institutional Review Board.

Data retrieved included patient demographics: gender, race, ethnicity, primary and secondary health insurance, receipt of any Medicaid/Medical Assistance coverage, and age. Health information included body mass index, medical comorbidities (summarized using the Functional Comorbidity Index), inpatient hospital length of stay for THA surgery, discharge destination, and post-operative complications. We did not have data on hand or limb dominance.

Patient physical function was collected pre-operatively and at six months post-operatively using the Harris Hip Score (HHS) (Harris, 1969). The HHS was developed to assess outcomes after hip surgery and covers four primary domains: pain, function, absence of deformity, and range of motion. The maximum score is 100 points (with higher scores indicating better outcomes), and the majority of possible points relate to patient pain (44 points) and function (47 points). The HHS has demonstrated excellent test-retest reliability ($r = 0.94-0.95$), validity (compared to the Western Ontario and McMaster Universities Osteoarthritis Index and the Short Form 36), and responsiveness (Soderman & Malchau, 2001). The HHS is a popular tool worldwide for assessing outcomes after THA. The minimum clinically important improvement threshold for patients’ post-hip arthroplasty is 15.9-18 points on the 100-point scale (Singh et al., 2016).

Household income and highest level of education completed were not routinely collected in the electronic health record, limiting our ability to measure socioeconomic status directly. Instead, the proportion of households with incomes below the United States federal poverty level (FPL) in each individual’s census tract of residence was used as a marker for socioeconomic status. These data were gathered using United States census data (United States Census Bureau, 2018). Low-poverty census tracts were defined as those in which fewer than 20% of household incomes

are below FPL, and high-poverty census tracts were defined as those in which greater than 20% of household incomes fall below FPL (Brookings Institution, 2018).

Data Analysis

Sample demographics were summarized using descriptive statistics. Correlation analyses were used to examine the relationships between race, gender, SES, pre- and post-operative Harris Hip Score, and change in Harris Hip Score. When comparing a dichotomous variable (race, gender, SES) to a continuous variable (any Harris Hip score or change score), we used point biserial analysis. When comparing two continuous variables, we used Spearman correlations due to non-normal distributions of the 6-month post-operative Harris Hip Score data and the change in Harris Hip Score data. We calculated the phi statistic when comparing two nominal dichotomous variables (such as race and gender) and the Cramer's ν statistic when comparing a nominal dichotomous variable to an ordinal variable (such as comparing race with socioeconomic status).

Univariate t-tests (for normally distributed variables) and Wilcoxon rank sum tests (for non-normally distributed variables) were used to compare pre-operative physical function, 6-month post-operative physical function, and the 6-month change in physical function between men and women, between White and non-White patients, and between patients residing in low-poverty and high-poverty census tracts. Normality was assessed graphically using histograms and QQ plots and statistically using the Shapiro-Wilk test.

Multiple regression was used to determine the effects of race, gender, socioeconomic status, and baseline HHS score on the 6th month change in HHS score. The dependent variable was calculated as Change in HHS (6-month post-operative HHS – pre-operative HHS). To test the impact of missing data, a second regression with the same variables was implemented that used multiple imputation to fill in missing values. The multiple imputation method utilized was Markov Chain Monte Carlo with five imputed data sets.

IBM SPSS version 25 (SPSS, Inc., Chicago, IL) was used for data entry; analyses were performed by a trained biostatistician (author CS) using SAS version 9.4 (SAS Institute, Inc., Cary, NC). The alpha level was set at .05 for all analyses.

RESULTS

Data from 269 individuals were available for analysis. Demographic data is summarized in Table 1. A large majority of patients were White, with a sizable minority of patients identifying as Black or African-American, and very few of any other race or ethnicity. This was expected, due to the limited racial and ethnic diversity of the geographic region being studied, so we dichotomized patients who identified as White or Caucasian into one group (“White”) and patients who identified as other races or ethnicities into a second group (“non-White”). The patient sample was split equally between men and women. Most individuals in the sample resided in low-poverty census tracts.

Table 1. Patient Demographics for n = 269 patients

Race	White or Caucasian: n = 235 (86.7%) Black or African-American: n = 30 (11.1%) Any other race: n = 4 (1.5%) Not specified: n = 2 (0.7%)
Ethnicity	Non-Hispanic: n = 265 (97.8%) Hispanic: n = 0 (0.0%) Other/not specified: n = 4 (1.5%)
Gender	Male: n = 134 (49.8%) Female: n = 135 (50.2%)
Socioeconomic status	Low-poverty census tract: n = 225 (83.6%) High-poverty census tract: n = 29 (10.8%) Unknown/data not available: n = 15 (5.6%)
Age	Mean 63.2 years (SD 11.9 years); range 24-89
Primary Health Insurance	Medicare: n = 60 (22.3%) Medicaid/Medical Assistance: n = 15 (5.6%) Private: n = 163 (60.6%) Unknown/data not available: n = 31 (11.5%)

Table 2 describes clinical data for these individuals. On average, patients stayed in the hospital slightly longer than two days, and most were discharged to their homes. By six months post-operatively, average Harris Hip Scores improved more than 34 points, which is well beyond the reported minimum clinically important improvement threshold of 15.9-18 points. A majority of patients (89.5%) achieved at least a 15.9-point improvement on the HHS, which is the lower boundary of the minimum clinically important improvement. The proportion of patients achieving clinically important improvement on the HHS at six months was similar between White (89.5%) and non-White (90.0%) patients and between men (88.9%) and women (90.2%), but patients residing in higher-income neighborhoods were more likely to achieve clinically important improvement than patients residing in lower-income neighborhoods (90.5% vs. 80.0%).

Table 2. Clinical Data for n = 269 patients

Body Mass Index	Mean 29.8 (SD 5.8); range 16.4-48.2
Functional Comorbidity Index	Mean 3.3 (SD 1.8); range 0-10
Length of Stay (for THA hospitalization)	Mean 2.3 days (SD 1.6); range 1-11 days
Discharge Location (following THA hospitalization)	Home: n = 194 (71.6%) Skilled nursing facility: n = 25 (15.5%) Inpatient rehabilitation: n = 32 (11.8%) Unknown: n = 3 (1.1%)
Pre-operative Harris Hip Score	Mean 44.4 (SD 12.7); range 13-84
Six months post-operative Harris Hip Score	Mean 78.6 (SD 16.5); range 34-95
Post-operative complications	No complications: n = 236 (87.7%) One or more complications: n = 33 (12.3%) <i>Stroke: n = 2</i> <i>Wound infection: n = 3</i> <i>Prosthesis infection: n = 7</i> <i>Failed prosthesis stem: n = 6</i> <i>Fall requiring hospital admission: n = 5</i> <i>Periprosthetic fracture: n = 6</i> <i>Hematoma: n = 1</i> <i>Seroma: n = 2</i> <i>Broken cable at trochanteric claw: n = 1</i> <i>Accidental overdose of pain medication: n = 1</i> <i>Hamstring tear: n = 2</i> <i>Trochanteric bursitis: n = 2</i> <i>Other: n = 1</i>

Mean score on the functional comorbidity index was 3.3. The most common comorbidities reported were arthritic conditions (n = 179), degenerative disc disease (n = 82), upper gastrointestinal disorders (n = 82), depression (n = 47), and congestive heart failure (n = 46). Functional comorbidity index scores differed slightly between demographic groups (women 3.6, men 2.9; White patients 3.2, non-White patients 3.6; residents of high-poverty census tracts 3.6, residents of low-poverty census tracts 3.2).

Not unexpectedly, some of the demographic variables were correlated with each other: Race (White vs. non-White) was associated with SES, Cramer's $v = .473$, $p < .001$. However, gender was not associated with race ($\phi = .065$, $p = .768$) or with SES (Cramer's $v = .074$, $p = .686$). Unsurprisingly, pre-operative and post-operative HHS were moderately correlated (Spearman's $\rho = .383$, $p < .001$). The amount of change in HHS from pre- to post-operative also correlated with both the pre-operative HHS (Spearman's $\rho = .472$, $p < .001$) and post-operative HHS (Spearman's $\rho = .541$, $p < .001$). Table 3 describes univariate analysis of pre-operative and six-month post-operative physical function using the HHS. There was a significant difference in pre-operative physical function between White patients and patients of other races, with White patients having a higher average HHS than non-White patients (mean difference 6.94 points, $p = .01$). Significant differences in the pre-operative HHS between men and women were also observed, with men reporting better physical function than women (mean difference 4.1 points, p

= .02). There were no pre-operative significant differences in self-reported physical function between patients of higher and lower SES (mean difference 5.39, $p > .05$), but in general SES was correlated with pre-operative (point biserial = .179, $p=.012$) and post-operative (point biserial = .185, $p = .043$) HHS.

Table 3. Univariate associations with functional outcome for n = 269 patients. Values are mean \pm SD, (n)

	Harris Hip Score pre-operative, $M \pm SD$ (n)	Harris Hip Score, 6 months post-operative, $M \pm SD$ (n)	Harris Hip Score change, $M \pm SD$ (n)
Race			
White (n=235)	45.32 \pm 12.43, (170) ²	79.65 \pm 15.81, (122) ³	35.05 \pm 17.33, (96)
Non-White (n=34)	38.38 \pm 13.16, (26) ²	67.84 \pm 19.91, (12) ³	27.88 \pm 15.47, (10)
Gender			
Male (n=134)	46.30 \pm 11.48, (105) ¹	79.83 \pm 16.71, (64)	35.20 \pm 15.77, (55)
Female (n=135)	42.20 \pm 13.75, (91) ¹	77.47 \pm 16.30, (70)	33.48 \pm 18.79, (51)
SES			
<20% below FPL (n=225)	45.33 \pm 12.04, (166)	79.70 \pm 15.72, (118)	35.30 \pm 15.78, (96) ⁴
\geq 20% below FPL (n=29)	39.94 \pm 17.05, (22)	69.68 \pm 19.48, (6)	15.08 \pm 28.57, (5) ⁴

T-tests were performed to compare pre-operative Harris Hip Scores between demographic groups. Due to data not being normally distributed, non-parametric Wilcoxon rank sum tests were used to compare 6 months post-operative Harris Hip Scores and change in Harris Hip Scores between groups.

¹ p -value from t-test = 0.02, ² p -value from t-test = 0.01, ³ p -value from Wilcoxon rank sum test = 0.05, ⁴ p -value from Wilcoxon rank sum test = 0.05

At the six-month post-operative time point, there was a significant difference (mean difference 11.81, $p = .05$) in HHS change from the pre- to post-operative time point between White and non-White patients. There was a small, non-significant difference in six-month HHS change between men and women (mean difference 2.36 points, $p > .05$). There was a significant difference ($p = .05$) in the six-month HHS change score between patients of higher and lower SES.

Due to this being a retrospective study, we did not perform an a priori power analysis to determine necessary sample size. However, after calculating the observed effect sizes in outcomes differences between patients of different demographic groups, we calculated power post hoc and determined that our analyses had 82% power to detect gender differences, 90% power to detect race differences, and 72% power to detect socioeconomic differences in functional outcomes following THA and TKA.

Regression Analyses

Two regression models were built due to a large proportion of missing data. The first model (Table 4a) included data from patients who had complete pre-operative and six-month post-operative HHS questionnaires, and the second model (Table 4b) used multiple imputation to

complete the missing values. In both models, pre-operative HHS was the only significant predictor of six-month change in HHS after controlling for race, gender, and SES. The coefficients and standard errors for the predictors in the two regression methods were very similar, indicating that the impact of missing data was small.

Table 4a. Regression analyses using only cases with complete data

	Estimate	Standard Error	p-value
intercept	47.73	10.32	<0.0001
White	8.70	5.23	0.10
Female	-0.03	3.05	0.99
High SES	9.52	7.26	0.19
Pre-operative HHS	-0.62	0.12	<0.0001

Table 4b. Regression analyses using multiple imputation to complete missing data

	Estimate	Standard Error	p-value
intercept	10.10	10.93	0.01
White	8.95	4.55	0.07
Female	-0.57	2.67	0.83
High SES	12.19	8.31	0.20
Pre-operative HHS	-0.59	0.18	0.02

Missing Data

Only 36.4% of the 269 records had complete information on age, race, gender, SES, and pre- and post-operative physical function, and missing data is more fully described in Table 5. Most of the absent data was in the six-month follow-up HHS: 31.6% of individuals with baseline HHS data were missing the 6-month score. 15.2% of people were missing both pre-operative and post-operative HHS, and 8.6% were missing only the pre-operative HHS.

Table 5. Missing Data

Variable	Complete n=106	Missing pre, post, or both n=163	p-value*
White, n (%)	96 (90.6)	139(85.3)	0.20
Female, n (%)	51 (48.1)	84(51.5)	0.58
<20% below FPL, n (%)	96 (95.05)	129(84.3)	0.01
Harris_pre, <i>M ± SD</i> , n	45.56 ± 12.76, 106	43.02 ± 12.60, 90	0.16
Harris_6mo, <i>M ± SD</i> , n	79.94 ± 15.86, 106	73.54 ± 18.07, 28	0.06

*Categorical variables p-value from chi-square test, Harris_pre p-value from t-test, Harris_6mo and age p-values from Wilcoxon rank sum test

Of the variables of interest (race, gender, SES, pre-operative and post-operative HHS), only SES was significantly different between people who had complete data and people missing one or

both physical function measurements. People with lower SES were more likely to have complete data ($p = .01$, see Table 5).

DISCUSSION

Results of our regression analyses indicate that patients undergoing THA who are non-White and female reported lower physical function prior to undergoing surgery than patients who are White and male. Six months after surgery, the gap remained between White and non-White patients; the gap closed between men and women; and a new gap in function opened between patients of lower vs. higher socioeconomic status. Therefore, in the post-operative period, differences in function became more prominent based on socioeconomic status, less prominent based on gender, and remained similar based on race.

While most demographic groups, on average, achieved clinically meaningful improvement on the HHS, individuals residing in high-poverty census tracts achieved less functional improvement. Mean improvement on the HHS from pre-operative to six months post-operative was 15.1 points below a common threshold for clinically important improvement. In this study, all patients received surgery from a single surgeon within a single hospital system. While prior studies have suggested that hospital and surgeon characteristics may drive some post-operative disparities following arthroplasty, that is very unlikely in this case due to the study design. Therefore, it is likely that this disparity is driven by some aspect of recovery that was not measured. We hypothesize that there may have been differences in the quantity and/or quality of post-operative rehabilitation received between lower-SES and higher-SES patients, which would be consistent with prior literature that found disparities in post-discharge rehabilitation intensity between patients receiving Medicaid and those on private or commercial insurance (Freburger et al., 2011). Future work should investigate the roles of insurance status, access to rehabilitation care, and the types and amount of postoperative rehabilitation that low-income patients receive following THA.

Our results are consistent with previous literature that has noted that low pre-operative physical function is predictive of low post-operative function following lower extremity joint arthroplasty (Fortin et al., 1999). Prior literature has also noted that race, gender, and socioeconomic status are also predictive of various short-term outcomes following THA – including post-operative complication rates, discharge destination, and hospital readmissions (Elsharydah et al., 2018; Freburger et al., 2011; Inneh et al., 2016; Singh & Cleveland, 2018; Soohoo et al., 2010, Xu et al., 2017). There has been limited research to date regarding disparities in longer-term outcomes following THA, and this study contributes to a growing body of research in this area.

It is unclear whether provider bias plays a role in the generation of functional disparities before or after arthroplasty surgery. It has been documented that female patients and patients of non-White race or Hispanic ethnicity may be lower-functioning at the time of surgery, but we do not know the extent to which medical provider bias contributes to these disparities. Hausmann and colleagues observed that orthopaedic surgeons were more likely to recommend White veterans for joint replacement surgery in the Veterans Affairs system than Black veterans, but this was no longer statistically significant after adjusting for patient preference (Hausmann et al., 2010). These authors also found that Black patients' visits included less discussion of the biomedical aspects of osteoarthritis and arthroplasty, but all other items of discussion were similar for Black and White

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patients (Hausmann et al., 2011). A more recent study found that physicians display a strong implicit preference for White patients over Black patients with osteoarthritis and associated the phrase “medically cooperative” with hypothetical White patients more often than hypothetical Black patients (Oliver et al., 2014). Although we did not measure provider bias in the present study, future research should examine the relationship between provider bias and presence of disparities in surgical outcomes.

Even less research is available regarding the potential effects of provider bias on rehabilitation outcomes post-arthroplasty. However, the demographics of the rehabilitation workforce in the United States do not match the demographics of the general American public. A recent workforce survey from the American Physical Therapy Association showed that 70% of physical therapists are women, and 89% are of White race and non-Hispanic ethnicity (APTA, 2020).

This study has several limitations that should be acknowledged. First, the study sample was nearly 87% White and non-Hispanic, so there was limited race and ethnic diversity in the sample. While these proportions approximately reflect the population of the geographic region, it also limits our ability to make strong conclusions regarding the relationships between race and ethnicity and outcomes in this population. Next, the study was designed and data were analyzed retrospectively. The authors were unable to prospectively measure demographic variables or select outcome measures, so we were limited to the data that existed in each patient’s electronic health record from the hospital system where surgery was received. This also meant that we did not have data regarding the frequency or intensity of rehabilitation services received post-discharge, given that those services were largely received outside the system. The proportion of missing data was fairly high, which may call the validity of the results into question. However, the two regression models (one with only complete cases and one using multiple imputation to replace missing data) led to very similar estimates of the results, which supports the argument that missing data did not substantially bias the results of the study. Finally, our post hoc power analysis demonstrated that our comparison of patients of high vs. low socioeconomic status may have been underpowered (72% power, which is less than the common standard of 80%). We also did not have sufficient statistical power to study interaction effects, so we were unable to include interaction terms in our regression analyses (e.g. whether Black women had significantly different outcomes than women in general).

In this study, we used the Harris Hip Score as a measure of physical function. Prior work has noted that the HHS has ceiling effects (Nilsson & Bremander, 2011), so we explored this in our data set post-hoc. The maximum HHS score is 100 points. At baseline, zero participants had scores above 90 points, and ten participants had scores above 90 points at six-month follow up. No participant scored higher than 95 at any time point in the study. Therefore, we do not feel that ceiling effects of the HHS impacted the results of our study.

Further research is needed with longer follow-up to determine the role that race, gender, and socioeconomic status play in long-term physical function after THA surgery. Because income, insurance, and demographic variables are often shown to be highly correlated, large data sets that allow researchers to explore the independent contributions of these variables will be needed. Development of large databases containing patient-reported outcomes across many hospitals, geographic regions, etc. will be important in supporting this work.

CONCLUSION

Patients undergoing THA who are female and non-White tend to be lower-functioning at the time of undergoing surgery. Further research is needed to determine if these differences in pre-operative function lead to any long-term disparities in physical function following THA.

REFERENCES

- American Physical Therapy Association. (2020, December 1). Physical Therapist Demographic Profile. Retrieved from <https://www.apta.org/your-career/careers-in-physical-therapy/workforce-data/physical-therapist-demographic-profile>.
- Bang, H., Chiu, Y.L., Memtsoudis, S.G., et al. (2010) Total hip and knee arthroplasties: trends and disparities revisited. *Am J Orthop*, 39(9), E95-102.
- Bartley, C.N., Atwell, K., Cairns, B., Charles, A. (2019) Racial and ethnic disparities in discharge to rehabilitation following burn injury. *J Burn Care Res*, 40(2), 143-7.
- Brookings Institution; Elizabeth Kneebone. (2018, June 1). The growth and spread of concentrated poverty, 2000 to 2008-2012. Retrieved from <https://www.brookings.edu/interactives/the-growth-and-spread-of-concentrated-poverty-2000-to-2008-2012/>.
- Cai, X., Cram, P., Vaughan-Sarrazin, M. (2012) Are African-American patients more likely to receive a total knee arthroplasty in a low-quality hospital? *Clin Orthop Relat Res*, 470(4), 1185-93.
- Centers for Disease Control and Prevention. (2009) Racial disparities in total knee replacement among Medicare enrollees—United States, 2000-2006. *MMWR Morbidity and Mortality Weekly Report*, 58, 133-138.
- Chen, J., Rizzo, J.A., Parasuraman, S., Gunnarsson, C. (2013) Racial disparities in receiving total hip/knee replacement surgery: the effect of hospital admission sources. *Journal of Health Care for the Poor and Underserve*, 24, 135-151.
- Chun Fat, S., Herrera-Escobar, J.P., Seshadri, A., et al. (2019) Racial disparities in post-discharge healthcare utilization after trauma. *Am J Surg*, 218(5), 842-6.
- Cram, P., Vaughan-Sarrazin, M.S., Wolf, B., et al. (2007) A comparison of total hip and knee replacement in specialty and general hospitals. *J Bone Joint Surg Am*, 89, 1675-1684.
- Dunlop, D.D., Manheim, L.M., Song, J., Sohn, M.W., Feinglass, J.M., Chang, H.J., Chang, R.W. (2008) Age and racial/ethnic disparities in arthritis-related hip and knee surgeries. *Med Care*, 46(2), 200-8.
- Elsharydah, A., Embabi, A.S., Minhajuddin, A., Joshi, G.P. (2018) Racial disparity in the perioperative care for patients undergoing total knee and hip arthroplasty: a retrospective propensity-matched cohort study. *J Racial Ethn Health Disparities* 5(3), 632-7.
- Fortin, P.R., Clarke, A.E., Joseph, L., et al. (1999) Outcomes of total hip and knee replacement: preoperative functional status predicts outcomes at six months after surgery. *Arthritis Rheum*, 42(8), 1722-8.

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- Freburger, J.K., Holmes, G.M., Ku, L.J., Cutchin, M.P., Heatwole-Shank, K., Edwards, L.J. (2011) Disparities in post-acute rehabilitation care for joint replacement. *Arthritis Care Res* 63(7), 1020-30.
- Harris, W.H. (1969) Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am*, 51(4), 737-55.
- Hausmann, L.R., Hanusa, B.H., Kresevic, D.M., et al. (2011) Orthopedic communication about osteoarthritis treatment: does patient race matter? *Arthritis Care and Research (Hoboken)*, 63, 635-642.
- Hausmann, L.R., Mor, M., Hamusa, B.H., et al. (2010) The effect of patient race on total joint replacement recommendations and utilization in the orthopedic setting. *Journal of General Internal Medicine*, 25, 982-988.
- Ibrahim, S.A., Stone, R.A., Han, X., et al. (2005) Racial/ethnic differences in surgical outcomes in veterans following knee or hip arthroplasty. *Arthritis Rheum* 52(1), 3143-51.
- Inneh, I.A., Clair, A.J., Slover, J.D., Iorio, R. (2016) Disparities in discharge destination after lower extremity joint arthroplasty: analysis of 7924 patients in an urban setting. *J Arthroplasty* 31(12), 2700-4.
- Jones, A., Kwok, C.K., Kelley, M.E., Ibrahim, S.A. (2005) Racial disparity in knee arthroplasty utilization in the veterans health administration. *Arthritis Care and Research*, 53, 979-81.
- Kane, R.L., Wilt, T., Suarez-Almazor, M.E., Fu, S.S. (2007) Disparities in total knee replacements: a review. *Arthritis Rheum*, 57(4), 562-7.
- Lan, R.H., Kamath, A.F. (2017) Post-acute care disparities in total joint arthroplasty. *Arthroplast Today*, 3(3), 187-91.
- Maurer, A., Jones, L.C. (2014) Musculoskeletal healthcare disparities: influence of patient sex, race, and ethnicity on utilization of total joint arthroplasty. *J Long Term Eff Med Implants*, 24(2-3), 233-40.
- Nilsdotter, A., Bremander, A. (2011) Measures of hip function and symptoms: Harris Hip Score (HHS), Hip Disability and Osteoarthritis Outcome Score (HOOS), Oxford Hip Score (OHS), Lequesne Index of Severity for Osteoarthritis of the Hip (LISOH), and American Academy of Orthopedic Surgeons (AAOS) Hip and Knee Questionnaire. *Arthritis Care Res* 63(S11), S200-207.
- Oliver, M.N., Wells, K.M., Joy-Gaba, J.A., Hawkins, C.B., Nosek, B.A. (2014) Do physicians' implicit views of African Americans affect clinical decision making? *Journal of the American Board of Family Medicine*, 27, 177-88.
- Ponnusamy, K.E., Naseer, Z., El Dafrawy, M.H., et al. (2017) Post-discharge care duration, charges, and outcomes among Medicare patients after primary total hip and knee arthroplasty. *J Bone Joint Surg Am* 99(11), e55.
- Shahid, H., Singh, J.A. (2016) Racial/ethnic disparity in rates and outcomes of total joint arthroplasty. *Curr Rheumatol Rep*, 18(4), 20.
- Singh, J.A., Cleveland, J.D. (2018) Medicaid or Medicare insurance payer status and household income are associated with outcomes after primary total hip arthroplasty. *Clin Rheumatol*, 37(9), 2489-96.

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Bove, et al.

- Singh, J.A., Lu, X., Rosenthal, G.E., Ibrahim, S., Cram, P. (2014) Racial disparities in knee and hip total joint arthroplasty: an 18-year analysis of national Medicare data. *Ann Rheum Dis*, 73(12), 2107-15.
- Singh, J.A., Schleck, C., Harmsen, S., Lewallen, D. (2016) Clinically important improvement thresholds for Harris Hip Score and its ability to predict revision risk after primary total hip arthroplasty. *BMC Musculoskelet Disord*, 17, 256.
- Skinner, J., Weinstein, J.N., Sporer, S.M., Wennberg, J.E. (2003) Racial, ethnic, and geographic disparities in rates of knee arthroplasty among Medicare patients. *New England Journal of Medicine*, 349, 1350-9.
- Soderman, P., Malchau, H. (2001) Is the Harris hip score system useful to study the outcome of total hip replacement? *Clin Orthop Relat Res* 384, 189-97.
- Soohoo, N.F., Farnig, E., Liberman, J.R., Chambers, L., Zingmond, D.S. (2010) Factors that predict short-term complication rates after total hip arthroplasty. *Clin Orthop Relat Res*, 468(9), 2363-71.
- United States Census Bureau. (2018, June 1) American FactFinder. Retrieved from <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>.
- Wood, T.J., Thornley, P., Petrucci, D., Kabali, C., Winemaker, M., de Beer, J. (2016) Perioperative predictors of pain catastrophizing, anxiety, and depression in patients undergoing total joint arthroplasty. *J Arthroplasty* 31(12), 2750-6.
- Xu, H.F., White, R.S., Sastow, D.L., Andreae, M.H., Gaber-Baylis, L.K., Turnbull, Z.A. (2017) Medicaid insurance as primary payer predicts increased mortality after total hip replacement in the state inpatient databases of California, Florida, and New York. *J Clin Anesth*, 43, 24-32.