Insurance Payer type and Income are associated with outcomes after total shoulder arthroplasty

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Abstract

Objective: To assess the independent association of insurance and income with total shoulder arthroplasty (TSA) outcomes.

Methods: We used the 1998-2014 U.S. National Inpatient Sample. We used multivariable-adjusted logistic regression to examine whether insurance type and median household income (based on zip code) were independently associated with healthcare utilization (discharge destination, hospital stay duration, total hospital charges) and in-hospital complications post-TSA based on the diagnostic codes (fracture, infection, transfusion or revision surgery). We calculated the odds ratio (OR) and 95% confidence intervals (CI).

Results: Among the 349,046 projected TSA hospitalizations, the mean age was 68.3 years, 54% were female, 73% White. Compared to private insurance, Medicaid and Medicare payers were associated with significantly higher adjusted OR (95% CI) of: (1) discharge to a rehabilitation facility, 2.16 (1.72,2.70) and 2.27 (2.04,2.52); (2) hospital stay >2 days, 1.65 (1.45,1.87) and 1.60 (1.52,1.69); and (3) transfusion, 1.35 (1.05,1.75) and 1.39 (1.24,1.56), respectively. Medicaid was associated with a higher risk of fracture, 1.74 (1.07,2.84) and Medicare payer with a higher risk of infection, 2.63 (1.24,5.57); neither were associated with revision. Compared to the highest income quartile, the lowest income quartile was significantly associated with (OR (95% CI)): (1) discharge to a rehabilitation facility, 0.89 (0.83,0.96); (2) hospital stay >2 days, 0.84 (0.80,0.89); (3) hospital charges above the median, 1.19 (1.14,1.25); (4) transfusion, 0.73 (0.66,0.81); and (5) revision, 0.49 (0.30,0.80), but not infection or fracture.

Conclusion: This information can help to risk-stratify patients post-TSA. Future assessments of modifiable mediators of these complications are needed.

Total shoulder arthroplasty (TSA) is a common surgery being utilized with increasing rates (1). TSA is associated with significant improvements in function, pain and quality of life (2, 3). The overall use of TSA increased from 2.96/100 000 in 1998 to 12.68/100 000 in 2010 (4); the number of hospital admissions for TSA in the US increased from 8,041 in 1998 to 39,072 in 2010 (5). With an increasing rate of utilization, it is important to understand important factors that affect the outcomes of TSA.

Low socioeconomic status and Medicaid insurance status were associated with risk-adjusted poor outcomes in a variety of medical and surgical conditions (6-9). Medicaid is one of the largest public health insurance programs for low income and disabled Americans. Medicaid now provides coverage for 72.5 million patients (10). The complex interplay of low income, access to healthcare, health literacy, patient-physician communication, likely contributes to these associations, especially in the disadvantaged populations. Limited data are available regarding the effect of payer status or household income in patients undergoing total joint arthroplasty.

The association of payer status and outcomes after shoulder arthroplasty has been examined recently. In a study of the 2004-2011 U.S. National Inpatient Sample (NIS) of patients after shoulder arthroplasty, compared to an age- and sex-matched Medicare and Medicaid/uninsured payer status, private insurance payer status was associated with a lower risk of perioperative medical and surgical complications, but no differences in mortality (11). In another 2002-2011 NIS study focused on the type of shoulder arthroplasty, Medicaid was associated with a higher adjusted risk of infection in the combined population of TSA or shoulder hemiarthroplasty (12). Limitations of these studies were that specific complication such as transfusion, revision, etc. was not studied, and there was no analysis of whether healthcare utilization differed by the payer type. A study in another similar patient population, i.e. total knee or hip arthroplasty, showed that Medicaid was associated with higher healthcare utilization (13), mortality (14), and readmission (15, 16). In a 2007-2014 study of State Inpatient Databases including California, Florida, New York, Maryland, and Kentucky, Medicaid-insured patients had greater odds than patients with private insurance, other insurance, and Medicare of inpatient mortality and 30-day and 90-

day readmissions (17). However, findings may not be generalizable to national TSA cohorts since it included only 5 states and the study combined total, partial and reverse shoulder arthroplasty, three surgeries that have different outcomes. Thus, there is limited generalizable information about the relationship of insurance payer status to resource utilization and outcomes after TSA. Income, a key marker of socioeconomic status, has rarely been studied in TSA. Studies suggested an association of income with outcomes after knee arthroplasty (18, 19) .

Our objective was to use a nationally representative sample of patients undergoing TSA to examine if the annual household income and payer status (type of health insurance) were associated with TSA outcomes. We hypothesized that lower annual household income and a Medicaid and Medicare insurance payer status will each be independently associated with poorer post-TSA clinical (infection, transfusion, revision, fracture) and healthcare utilization outcomes (higher charges, longer hospital stay, discharge to rehabilitation facility; all primary outcomes), compared to the highest income and the private insurance payer, respectively.

Methods

Data source and Study Cohort

We used the National Inpatient Sample (NIS) from 1998 to 2014, national representative sample (20). The NIS is part of the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ). The NIS is the largest publicly available all-payer inpatient health care database in the United States, yielding national estimates of hospital inpatient stays. Unweighted, it contains data from more than 7 million hospital stays each year; weighted, it estimates more than 35 million hospitalizations nationally (21). The U.S. NIS is a 20% stratified sample of all discharges from U.S. community hospitals from all participating states that are obtained from the State Inpatient Databases (SID) (20). NIS includes all inpatient care data from individuals regardless of the payer, including those covered

by Medicare, Medicaid, or private insurance, and the uninsured. With a slight change in the design, the NIS is now a sample of discharge records from all HCUP-participating hospitals; for prior years, the NIS was a sample of hospitals (20). The NIS provides new weights to account for the design change.

The NIS contains patient characteristics, hospital characteristics, primary and secondary diagnoses and procedures for the index admission, comorbidity and healthcare utilization associated with the hospitalization (charges, discharge, length of stay). The NIS data are de-identified and publicly available. The University of Alabama at Birmingham's Institutional Review Board (IRB) approved the study (X120207004).

We selected all hospitalizations in the NIS from 1998-2014 with an International Classification of Disease, ninth revision, common modification (ICD-9-CM) code, 81.80 for TSA in the primary position. There have been no changes in the ICD-9 procedure code for TSA during the study duration and the study was performed before the use of ICD-10 codes in the U.S. ICD-9-CM codes for similar procedures in knee or hip, i.e., total knee or total hip arthroplasty have been shown to be valid (22, 23). The NIS has been extensively validated against the National Hospital Discharge Survey and its good performance for many estimates has been previously confirmed (24-26). This ICD-9-CM code for TSA has been used in several previous NIS studies (5, 27, 28).

Outcomes

We examined several outcomes of interest including healthcare utilization (HCU) and clinical outcomes during the index TSA hospitalization. HCU outcomes included the total hospital charges (above the median; $39617), the length of hospitalization (above the median; 2 days after rounding), and the proportion of patients discharged to a rehabilitation facility (short term hospital, skilled nursing facility, intermediate care facility or another type) rather than home. Medians were chosen rather than arbitrary cut-offs, in accordance with previous studies (29-31), being insensitive to extreme values.

We also assessed post-TSA complications based on the presence of the following ICD-9 codes during the index hospitalization in non-primary positions, similar to the methodology used previously by Jain et al. to differentiate these complications from the underlying reason for TSA (27): (1) fracture: 79.01, 79.11, 79.21, 79.31, 79.61, 810.xx, 811.xx, 812.xx; (2) infection: 711.xx, 730.xx, 996.66 or 996.67; (3) transfusion: 99.0x; and (4) revision surgery: 81.83.

Exposure of interest and Covariates

The exposures of interest were health insurance payer and the median household income. Healthcare insurance payer was categorized as Medicare, Medicaid, Private (reference category), other insurance payer or self-pay status, as previously (32). Medicare is a program that provides healthcare coverage for Americans 65 years or older (33), while Medicaid provides coverage for the low income and disabled Americans (10). Median household income based on the patient's zip code was provided by the NIS. Income was divided into quartiles so that the maximum for category/quartile 1 ($25,000 in 1999) was approximately 150% of the 1999 poverty level and the boundary between the second and third categories/quartiles ($35,000) is approximately the national median household income; it varied by year, such that maximum for quartile 1 was $28,999 in 1998 and $39,999 in 2014 as per the NIS (34). The highest income quartile was the reference category.

We adjusted for several covariates including patient characteristics, comorbidity, primary diagnosis, and hospital characteristics, based on their association with arthroplasty outcomes in systematic reviews or clinical studies (35-37). Demographics (age, gender, race/ethnicity) and comorbidity data were obtained from the NIS dataset at the index admission preoperatively and categorized as follows. Age was categorized as <50, 50 to <65, 65 to <80 and ≥80 years. Race/ethnicity was categorized as White, Black, Hispanic and other. Medical comorbidity was assessed using the validated Deyo-Charlson index, which consists of 17 comorbidities, based on the presence of ICD-9-CM codes (38). Primary diagnosis was categorized as rheumatoid arthritis, aseptic bone necrosis, osteoarthritis, fracture or other. Hospital

location and teaching status were categorized as rural, urban-non-teaching and urban teaching. We classified hospital bed size as small, medium or large, as per the NIS procedure. Hospital region was categorized as Northeast, Midwest, South, and West.

Statistical Analyses

We used the revised weights provided by the NIS since the study included the NIS data for years earlier than 2011, since the revised weights make estimates comparable to the new design beginning with 2012 data. These new discharge trend weights replaced the earlier NIS trend weights that were developed for the 1988-1997 NIS following the 1998 NIS redesign.

Summary statistics (mean/median, standard error; proportion) were calculated for the study cohort. We used multivariable-adjusted logistic regression to assess the association of income and payer status with outcomes of interest, including total charges, length of hospital stay, proportion discharged to a rehabilitation facility (health care utilization outcomes), fracture, infection, transfusion or revision (clinical outcomes). Each multivariable model was adjusted for age, race, gender, the primary diagnosis for TSA, and the Deyo-Charlson-score. *A priori*-specified sensitivity analyses additionally adjusted the main models for hospital location/teaching status, hospital bed size, and the hospital region. We used SAS 9.3 (Cary, N.C.) for all the analysis. Odds ratios (OR) and 95% confidence intervals (CI) are presented. A p-value <0.05 corresponding to a 95% CI excluding unity was considered statistically significant.

Results

Cohort characteristics

There were 21,009,225 total NIS admissions for the study duration 1998-2014 in the U.S. (national projection, 622,630,875; **Appendix 1**). The cohort consisted of 72,495 primary TSA procedures performed between 1998-2014 in the U.S. (national projection, 349,046; 0.05% of all national projected admissions; **Appendix 1**). Mean age was 68.3 years, 54% were female, 73% White, 83% with osteoarthritis as the

underlying diagnosis. Of these, 10% were performed in rural areas, 35% in the Southern U.S., and 59% were performed in hospitals with large bed size (**Table 1**). The Deyo-Charlson score was zero in 63%. The insurance payer was Medicaid in 2%, Medicare in 65%, private insurance in 29% and self/other in 4% (**Table 1**). The overall rate of complications during the index admission for TSA was low: fracture, 0.9%; infection, 0.1%; transfusion, 5%; revision, 0.3% (**Table 1**). Mean (standard error) and median total charges were $45,340 (standard error, 556) and $39,617. The mean and median length of hospital stay were 2.3 days (standard error, 0.01) and 1.5 days (inter-quartile range, 1.37). The length of hospital stay was rounded off at 2 days for the median. Eighty-eight percent were discharged to non-home settings and 12% were discharged home.

Insurance type, Income, and healthcare utilization Outcomes after primary TSA

Compared to private insurance, Medicaid was associated with higher OR of discharge to a rehabilitation facility and a hospital length of stay > 2 days (median), but not associated with total charges, with OR of 2.16 **(**95% CI, 1.72, 2.70), 1.65 (95% CI, 1.45, 1.87) and 1.08 (95% CI, 0.97, 1.21), respectively **(Table 2**). Compared to private insurance, Medicare was associated with higher OR of discharge to a rehabilitation facility and a median length of stay > 2 days, and lower odds of total charges above the median, with OR of 2.27 (95% CI, 2.04, 2.52), 1.60 (95% CI, 1.52, 1.69) and 0.92 (95% CI, 0.88, 0.97), respectively **(Table 2**).

In multivariable-adjusted analyses, compared to the highest income quartile, patients in the lowest income quartile had significantly lower OR of 0.89 **(**95% CI, 0.83, 0.96) of discharge to a rehabilitation facility (rather than to home) but a significantly higher OR of 1.19 (95% CI, 1.14, 1.25) of hospital charges above median (**Table 2**). All three lower income quartiles were associated with a lower OR of the length of hospital stay >2 days (i.e., above the median), 0.84 (95% CI, 0.80, 0.89), 0.89 (95% CI, 0.85, 0.94) and 0.90 (95% CI, 0.86, 0.94) (**Table 2**). Other associations are shown in **table 2**.

Sensitivity analyses that additionally adjusted for hospital location/teaching status, hospital region, and hospital bed size, confirmed the findings from the main analysis **(Table 3**).

Insurance type, Income, and Clinical Outcomes after primary TSA

Compared to private insurance, Medicare and other insurance payer status were associated with a higher risk of infection; Medicare, Medicaid, and other insurance payer status were associated with higher risk of transfusion; and Medicaid was associated with a higher risk of fracture (**Table 4**). In multivariable-adjusted analyses, compared to the highest income quartile, patients in the first, second and third income quartiles had significantly lower HRs for transfusion and revision, but not infection or fracture (**Table 4**), findings confirmed with sensitivity analyses (data available on request).

Discussion

In this study of the NIS data from 1998-2014, we found that Medicaid and Medicare payer status and median household income were each associated with outcomes in patients who underwent primary TSA in the U.S. Several findings merit further discussion.

Both Medicaid and Medicare payer status were independently associated with a higher risk of discharge to a rehabilitation facility and a length of hospital stay > 2 days (median) in patients who had undergone TSA, each with an increase in odds ratios by 60% to 127%. The magnitude of the increased risk/odds was impressive. This finding adds to the recent finding of higher 30-day and 90-day readmission rate in Medicaid-insured patients in 2007-2014 study of 5 State Inpatient Databases (17).

Medicaid was associated with a 74% higher risk of fracture and Medicare with a 163% higher risk of infection, a clinically important finding. In a study by Li et al., both Medicaid and Medicare patients were matched by age and sex with patients with private insurance (11). Compared to private insurance, Medicaid patients had 1.5-2 times higher and Medicare patients 1.2-1.4 times higher incidence of medical, surgical and overall complications, using NIS 2004-11 data (11), and 2.3-times higher risk of infectious

complications in a 2007-2014 study of 5 State Inpatient Databases (17). Medical complications ranged from urinary tract infection to acute cardiac event, and surgical complications from wound disruption to implant failure (11). Our finding of 1.6-2.3 times the odds of unfavorable healthcare utilization outcome in patients undergoing TSA and receiving Medicaid or Medicare (relative to private insurance) is consistent with 1.2-2.3 times odds of complications earlier studies (11, 17), and adds new knowledge.

Our study supports the finding from the earlier studies and provides further insight into the healthcare episode related to the hospital admission for TSA. These post-TSA complications are not only undesirable and have additional morbidity for the patients undergoing TSA, but also add to the patient and the healthcare system burden. It is likely that post-TSA medical and surgical complications contribute at least partially to increased utilization in populations with Medicaid or Medicare coverage. Medicare and Medicaid are inherently different insurance programs in that while Medicare provides coverage for people 65 years or older (33), Medicaid provides coverage to low income and disabled Americans (10). Other factors such as socio-economic factors (39), functional status (40, 41), social support (42-44), nutritional status/anemia (45), concomitant medications, musculoskeletal comorbidity (46) etc. might contribute independently to higher healthcare utilization and/or by increasing the complication rate (39-41), for which data were not available in the NIS. Future studies should examine these potential mechanisms of a higher rate of complications and healthcare utilization post-TSA.

Our study also showed that the odds of post-TSA transfusion was 1.3-1.4 times in Medicaid and Medicare populations compared to those with private insurance. Previous studies of TSA reported that older age, higher comorbidity, white race, anemia and coagulation disorders were associated with a higher risk of transfusion (47, 48). Our observation is interesting, since it was independent of age, gender, race/ethnicity and comorbidity, indicating that other patient or clinical characteristics associated with the payer status not measured in our study (e.g., anemia, underlying gastrointestinal disease, poor nutritional status) (49, 50) may be responsible for a higher risk for transfusion in Medicare/Medicaid populations.

We also found that in multivariable-adjusted analyses (adjusted for demographics, comorbidity, insurance status, underlying diagnosis and hospital characteristics), compared to the highest income quartile, the lowest income quartile was associated with significantly lower odds of discharge to a rehabilitation facility, length of hospital stay >2 days (median), transfusion and revision. To our knowledge, none of the previous studies of TSA have examined income as a predictor of TSA outcomes. Our findings dismissed our hypothesis and add to the current knowledge in the field.

Previous studies suggested an association of lower income with outcomes after knee arthroplasty, showing either similar or more gains with arthroplasty (18, 19). Our study adds to this growing literature now showing that compared to the highest income quartile, patients in the lowest income quartile had lower healthcare utilization and lower risk of key complications after TSA. Possible reasons for better outcomes in patients with the lowest income compared to the highest category include a potentially better pre-operative physical status, the need to recover quickly and report back to the job and possibly a lower rate of psychological comorbidity.

Additional factors that were significantly associated with the healthcare utilization and clinical outcomes were age, race, comorbidity and underlying diagnosis. These data should help surgeons and patients in being alerted to patient characteristics that are associated with suboptimal post-surgical outcome.

Our study has several limitations and strengths. The findings may not be applicable to some groups within the U.S., such as veterans (since the NIS excludes federal facilities such as military hospitals and Veterans Affairs medical centers). NIS counts hospitalizations and not procedures, i.e., bilateral procedures are missed and counted as single procedures. Given that simultaneous bilateral TSA are uncommon, this is unlikely to have impacted our estimates greatly. We did not apply any exclusion criteria of prior upper extremity procedure on the contralateral side or other upper extremity joints. It is unclear how prior arthroplasty procedures may have impacted the associations between the insurance/income and arthroplasty outcomes. The NIS provides data on the index hospitalization and post-discharge destination,

and no specific data validated data on prior surgeries. No Bonferroni correction was made for multiple comparisons. A large sample size, the inclusion of only patients with TSA, and adjustment of the analyses for important covariates are additional strengths.

In conclusion, in a study of the U.S. NIS sample from 1998-2014, we found that compared to private insurance, Medicaid and Medicare insurance status were independently associated with higher healthcare utilization and suboptimal clinical outcomes. Lower income was independently associated with better outcomes after TSA, a counterintuitive finding. This information is useful to surgeons and patients. Future studies should examine if the mediating variables that underlie the observed relationships can be clearly identified, and subsequently, if interventions can be designed targeting modifiable factors i.e., the underlying mechanisms of poor outcomes in patients with TSA.

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Table 1. Demographic and other cohort characteristics for national projected sample undergoing primary total shoulder arthroplasty (TSA) between 1998-2014, N=349,046

	N (%), unless specified otherwise
Age, Median (IQR)	68.6 (13.8)
Age category	
<50 years	15,187 (4.35%)
50 - <65 years	97,963 (28.06%)
65 - <80 years	190,755 (54.65%)
≥80 years	44,780 (12.83%)
Gender	
Female	188,958 (54.13%)
Male	159113 (45.87%)
Race	
White	253,798 (72.71%)
Black	11,216 (3.21%)
Hispanic	8,242 (2.36%)
Other/Missing	75,790 (21.71%)
Primary Diagnosis	
Rheumatoid arthritis	5,636 (1.61%)
Aseptic bone necrosis	6,805 (1.94%)
Osteoarthritis	288,195 (82.57%)
Other	39714 (11.38%)
Fracture	8695 (2.49%)
Hospital Location/Teaching	
Rural	34,332 (9.84%)
Urban	144,591 (41.42%)
Urban Teaching	168,903 (48.39%)
Insurance	,
Private	99,512 (28.51%)
Medicare	227,665 (65.22%)
Medicaid	7,219 (2.06%)
Other	12,616 (3.61%)
Self	1,454 (0.42%)
Income Category	
0-25th percentile	62,284 (17.84%)
25-50th percentile	91,951 (26.3%)
50-75th percentile	94,083 (26.9%)
75-100th percentile	93,931 (26.9%)
Hospital Bed size	
Small	59,842 (17.14%)
Medium	83,765 (24.00%)
Large	204,218 (58.51%)
Hospital Region	
Northeast	49,671 (14.23%)

Midwest	97,799 (28.02%)
South	122,684 (35.14%)
West	78,892 (22.60%)
Total Hospital Charges in U.S. $,* median† (IQR)	$39,617 (19,194)
1998-2000	$16,877 (8,084)
2001-2002	$21,802 (11,139)
2003-2004	$26,602 (14,786)
2005-2006	$31,508 (16,796)
2007-2008	$40,228 (23,346)
2009-2010	$46,346 (29,521)
2011-2012	$47,534 (27,981)
2013-2014	$51,275 (30,328)
Deyo-Charlson Score	
0	221,150 (63.36%)
1	94,939 (27.19%)
≥2	32,957 (9.44%)
In-hospital complications	
Fracture	11,702 (3.35%)
Infection	368 (0.11%)
Revision	894 (0.2618335%)
Transfusion	18,335 (5.25%)
Discharge Status	
Inpatient	40,668 (11.65%)
Home	307,802 (88.21%)
Length of Hospital Stay in days, median† (IQR)	1.52 (1.37)
Length of Hospital Stay in days	
≤2	243,994 (69.90%)
>2	105,052 (30.09%)
Died during hospitalization	302 (0.09%)

SE, standard error; IQR, interquartile range

†We provided median (IQR) for continuous measures, age, length of hospital stay and total hospital charges, since these variables had a skewed distribution, rather than a normal distribution.

*Percentage of cases from each time-period were as follows: 1998-2000, 6.6%, 2001-2002, 5.1%; 2003-2004, 7.3%; 2005-2006, 10.3%; 2007-2008, 13.8%; 2009-2010, 19.8%; 2011-2012, 16.9%; 2013-2014, 19.9%

Table 2. Multivariable-adjusted* association of insurance payer and income with total hospital charges, discharge disposition and the duration of hospital stay in the main analysis

	Total hospital charges above the median of $39,617	Discharged to a rehabilitation facility	Median Length of Hospital Stay > 2 days (median rounded off)
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Insurance payer			
Private	**Ref**	**Ref**	**Ref**
Medicare	**0.92 (0.88, 0.97)**	**2.27 (2.04, 2.52)**	**1.60 (1.52, 1.69)**
Medicaid	1.08 (0.97, 1.21)	**2.16 (1.72, 2.70)**	**1.65 (1.45, 1.87)**
Other	**1.28 (1.17, 1.39)**	**1.27 (1.03, 1.57)**	**1.43 (1.29, 1.58)**
Self	**0.63 (0.49, 0.82)**	1.58 (0.97, 2.56)	**1.55 (1.18, 2.04)**
Income category			
0-25th percentile	**1.19 (1.14, 1.25)**	**0.89 (0.83, 0.96)**	**0.84 (0.80, 0.89)**
25-50th percentile	0.97 (0.93, 1.01)	0.98 (0.92, 1.05)	**0.89 (0.85, 0.94)**
50-75th percentile	1.02 (0.98, 1.07)	0.95 (0.89, 1.02)	**0.90 (0.86, 0.94)**
75-100th percentile	**Ref**	**Ref**	**Ref**

Income quartiles are defined so that the maximum for category 1 ($25,000) is approximately 150% of the 1999 poverty level and the boundary between the second and third categories ($35,000) is approximately the national median household income. For example for 2014, Q1 was $1 - 39,999, Q2 was 40,000 - 50,999, Q3 was 51,000 - 65,999; and Q4 was $66,000+.
Median hospital charges were $39,617
OR, odds ratio; Significant Odds ratios are in bold
*Multivariable analyses were additionally adjusted for age, gender, race/ethnicity, comorbidity and primary underlying diagnosis

Table 3. Sensitivity analyses for multivariable-adjusted* association of insurance payer and income with outcomes additionally adjusting main models for hospital location/teaching status, hospital region, hospital bed size

	Total hospital charges above the median	Discharged to rehabilitation facility	Median Length of Hospital Stay > 2 days
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Insurance payer			
Private	**Ref**	**Ref**	**Ref**
Medicare	**0.94 (0.89, 0.98)**	**2.24 (2.01, 2.50)**	**1.59 (1.50, 1.68)**
Medicaid	**1.14 (1.02, 1.28)**	**2.09 (1.67, 2.62)**	**1.65 (1.45, 1.88)**
Other	**1.23 (1.12, 1.34)**	**1.29 (1.04, 1.59)**	**1.45 (1.31, 1.61)**
Self	0.62 (0.48, 0.81)	1.59 (0.98, 2.58)	**1.52 (1.15, 2.00)**
Income category			
0-25th percentile	**1.29 (1.23, 1.36)**	0.93 (0.86, 1.01)	**0.83 (0.79, 0.88)**
25-50th percentile	**1.06 (1.02, 1.11)**	1.00 (0.94, 1.08)	**0.90 (0.85, 0.94)**
50-75th percentile	**1.05 (1.01, 1.10)**	0.97 (0.91, 1.04)	**0.91 (0.87, 0.96)**
75-100th percentile	**Ref**	**Ref**	**Ref**

OR, odds ratio; Significant odds ratios are in bold

*Multivariable analyses were additionally adjusted for age, gender, race/ethnicity, comorbidity and primary underlying diagnosis

Table 4. Multivariable-adjusted* association of insurance and income with infection, transfusion, fracture, revision after primary TSA in the main analysis

	Infection	Transfusion	Revision	Fracture
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Insurance payer				
Medicare	**2.63 (1.24, 5.57)**	**1.39 (1.24, 1.56)**	1.15 (0.73, 1.80)	1.06 (0.67, 1.67)
Medicaid	2.83 (0.85, 9.44)	**1.35 (1.05, 1.75)**	0.65 (0.20, 2.17)	**1.74 (1.07, 2.84)**
Other	**3.67 (1.56, 8.60)**	**1.28 (1.03, 1.59)**	1.13 (0.55, 2.32)	0.81 (0.62, 1.06)
Private	**Ref**	**Ref**	**Ref**	**Ref**
Self	<0.01 (<0.01, <0.01)†	1.57 (0.93, 2.67)	<0.01 (<0.01, <0.01)†	**4.67 (2.31, 9.46)**
Income category				
0-25th percentile	0.77 (0.37, 1.60)	**0.73 (0.66, 0.81)**	**0.49 (0.30, 0.80)**	0.97 (0.76, 1.25)
25-50th percentile	0.68 (0.34, 1.37)	**0.78 (0.72, 0.86)**	**0.67 (0.46, 0.99)**	1.03 (0.82, 1.28)
50-75th percentile	1.12 (0.61, 2.05)	**0.72 (0.66, 0.79)**	0.84 (0.58, 1.20)	1.02 (0.81, 1.27)
75-100th percentile	**Ref**	**Ref**	**Ref**	**Ref**

OR, odds ratio; Significant odds ratios are in bold

*Multivariable analyses were additionally adjusted for age, gender, race/ethnicity, comorbidity and primary underlying diagnosis

†Parameter estimate is too low, related mainly to a very small number of cases making it very imprecise and to be interpreted with caution

Appendix 1. Study flow chart for study sample selection from the U.S. National Inpatient Sample (NIS)