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# Rural vs. Urban Utilization of Total Joint Arthroplasty

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ABSTRACT

The purpose of this study was to analyze the association between patient demographics and hospital demographics on utilization of total joint arthroplasty in rural and urban populations from the National Inpatient Sample database. Any patient that was discharged after a primary total hip or primary total knee arthroplasty was included in this study. Results showed that rural patients living in a Northeastern hospital region compared to West, less than 65 years of age, females, Blacks and Hispanics were less likely to undergo total joint arthroplasty compared to their urban counterparts. Rural patient were more likely to undergo total joint arthroplasty compared to their urban counterparts if they were in the Midwest and had Medicare as their primary payer provider.



Optimal utilization of health care resources depends on the careful balance between the disease presence, access to care for that particular disease and the effective utilization of that access [1]. The Institute of Medicine states that the core needs for health care involve six key factors; safe, effective, patient-centered, timely, efficient and equitable care [2]. There is a vast body of literature investigating the patterns of utilization in total joint arthroplasty (TJA), which have highlighted the disparities linked to gender, race and socioeconomic status thereby not allowing for effective, timely or equitable care in these patients [3–8]. However, little information exists regarding utilization of TJA as it relates to these same disparities in the urban vs. rural populations.

Rural America compromises 2052 counties, contains 75% of the Nation's total land, and is home to 17% of the U.S. population [9,10]. Rural areas are associated with lower levels of health care indicators and rural residents have been shown to have poorer measures in several indicators of population health spurring calls for greater research into rural health and means of addressing these inequalities [11,12]. Obesity and inactivity, two major risk factors for osteoarthritis, are more prevalent in rural America [13,14]. In the case of elective surgical procedures, the Medicare population has seen a discrepancy of utilization between urban and rural populations, with rural Medicare patients having greater odds of utilizing these elective procedures [15]. Francis et al also showed an increased odds of TJA utilization in rural Medicare beneficiaries compared to their urban counterparts in spite of similar prevalence of arthritis in rural and urban populations [16].

The purpose of this study was to determine the association between patient demographics, hospital demographics, and access to care on utilization of TJA in rural and urban populations in a large national hospital database, containing patients of all ages and payer types. This unique analysis allows for further delineation of the disparity in utilization of TJA as it relates to the rural, urban and non-elderly population. Our hypothesis is that non-elderly utilization of TJA in rural patients will be decreased compared to their urban counterparts and discrepancies in TJA utilization that have been previously documented, such as decreased utilization in females and minorities, will be amplified when comparing urban vs. rural patients further emphasizing the large disparity of utilization in these patient populations.

## Materials and Methods

A large national database was used to identify patients who were discharged after a primary total knee arthroplasty (TKA) or primary total hip arthroplasty (THA). Patients were grouped by whether they lived in urban or rural areas based on the National Center for Health Statistics Classification and statistical analysis was done to determine the association between patient demographics, hospital demographics, and access to care on utilization of total joint arthroplasty.

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**Table 1**
Classification Rules Used to Assign Counties to the Six Urbanization Levels of the 2006 NCHS Urban–Rural Classification [20].

| Urban–Rural Category | Classification Rules |
|---|---|
| Metropolitan | |
| Large central metro | Counties in a metropolitan statistical area of 1 million or more population:<br>1) that contain the entire population of the largest principal city of the metropolitan statistical area, or<br>2) whose entire population resides in the largest principal city of the metropolitan statistical area, or<br>3) that contain at least 250,000 of the population of any principal city in the metropolitan statistical area |
| Large fringe metro | Counties in a metropolitan statistical area of 1 million or more population that do not qualify as large central |
| Medium metro | Counties in a metropolitan statistical area of 250,000 to 999,999 population |
| Small metro | Counties in a metropolitan statistical area of 50,000 to 249,999 population |
| Nonmetropolitan | |
| Micropolitan | Counties in a micropolitan statistical area |
| Noncore | Counties that are neither metropolitan nor micropolitan |

Investigational review board approval was obtained by the Committee for Research Involving Human Subjects. The 2008 Nationwide Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality (AHRQ) database was used for analysis in this study [17,18]. The 2008 NIS database compiles hospital discharge information from 40 states, which contains data from approximately 8.1 million inpatient stays in 1000 hospitals and reflects 20% of U.S. hospitals. The information in the NIS database includes sources and types of admissions, diagnoses and procedures, discharge statuses, hospital demographics and patient demographics [17,18].

At the time of analysis the 2008 NIS database was the most current database available. Inclusion criteria was discharge after a primary THA or TKA using the International Classifications of Diseases, Ninth Edition (ICD-9) codes 81.51 and 81.54. The use of TJA was obtained by combining the number of primary TKA and THA among rural and urban patients. Each discharge record in the NIS has an associated weight value which allows for estimation of the national values. Therefore, weighted discharge data were obtained in order to estimate national averages. All identifying patient information was removed prior to analysis.

**Table 2**
Independent Variables Used for Uni- and Multivariate Analysis of Urban vs. Rural Utilization of Total Joint Arthroplasty (TJA).

| Independent Variables | | |
|---|---|---|
| Age | Hospital Region | Charlson Co-morbidity Index[b] |
| 64 years or less | Northeast | Zero |
| 65 years or more | Midwest | One or more |
| | South | |
| Gender | West | Length of Stay |
| Male | | Four days or less |
| Female | Income Quartile in USD[c] | Five days or more |
| | 38,999 or less | |
| Race | 39,000 to 47,999 | |
| White | 48,000 to 62,999 | |
| Black | 63,000 or more | |
| Hispanic | | |
| Other | Primary Payer Type | |
| | Medicare | |
| Hospital Type | Medicaid | |
| Rural | Private | |
| Urban non-teaching | All Others[a] | |
| Urban Teaching | | |

[a] Self pay, no charge and others were combined in a single category.
[b] Co-morbidity was quantified using the nine disease conditions used in Charlson co-morbidity index [30].
[c] Determined by patient zip code.

The primary outcome of interest was urban vs. rural location for patients undergoing primary TJA. Patient location was designated as rural or urban based on the National Council for Health Statistics (NCHS) 2006 rural urban classification scheme for counties [19]. This 6 level classification is scaled from most urban category with large metropolitan central counties, to the most rural with nonmetropolitan noncore counties. Micropolitan and non core areas were considered rural for the purpose of this study (Table 1). Urban vs. rural designation was based off the individual's home zip code.

The independent variables of interest are listed in Table 2 and include age, gender, race, hospital region, hospital type, median household income, payer type, co-morbidities and length of stay.

### *Statistical Analysis*

Univariate analysis for association was performed for each variable in the study and compared to rural or urban utilization of TJA using chi-square test with alpha set at 0.05. Multivariate analysis was performed using all of the independent variables as predictor variables and rural or urban utilization of TJA as the outcome variable with logistic regression models. Odds ratio from the predictive model were considered significant at 95% confidence interval. All analysis was done on SAS version 9.2.

**Table 3**
Frequency Distribution of Rural and Urban Utilizers of TJA, TKA and THA According to Age, Gender, Race, Payer Type, Income, Charlson Co-Morbidity Index, Hospital Type, Hospital Region and Length of Stay.

| | TJA | |
|---|---|---|
| Variables | Rural | Urban |
| Age | | |
| 64 years or less | 75,007 (41.8%) | 305,871(44.4%) |
| 65 years or more | 104,357 (58.2%) | 383,134 (55.6%) |
| Gender | | |
| Male | 72,140 (40.3%) | 266,296 (38.8%) |
| Female | 107,085 (59.7%) | 420,960(61.2%) |
| Race | | |
| White | 122,895 (89.8%) | 458,879 (83.3%) |
| Black | 5426 (4.0%) | 41,962 (7.6%) |
| Hispanic | 3006 (2.2%) | 25,905 (4.7%) |
| Other | 5476 (4.0%) | 23,821 (4.3%) |
| Hospital type | | |
| Rural | 84,677 (47.5%) | 9804 (1.4%) |
| Urban non-teaching | 55,433 (31.1%) | 355,960 (51.6%) |
| Urban teaching | 38,324 (21.5%) | 324,137 (47.0%) |
| Hospital region | | |
| Northeast | 17,624 (9.8%) | 110,937 (16.1%) |
| Midwest | 58,826 (32.8%) | 188,360 (27.3%) |
| South | 74,880 (41.7%) | 242,529 (35.2%) |
| West | 28,132 (15.7%) | 148,128 (21.5%) |
| Income Quartile in USD | | |
| 38,999 or less | 73,296 (42.0%) | 105,319 (15.5%) |
| 39 to 47,999 | 73,820 (42.3%) | 173,310 (25.5%) |
| 48 to 62,999 | 22,929 (13.2%) | 196,057 (28.8%) |
| 63,000 or more | 4300 (2.5%) | 206,202 (30.3%) |
| Primary payer type | | |
| Medicare | 102,983 (57.7%) | 359,620 (52.2%) |
| Medicaid | 5399 (3.0%) | 18,638 (2.7%) |
| Private | 61,972 (34.7%) | 281,326 (40.8%) |
| All others | 8183 (4.6%) | 29,629 (4.3%) |
| Charlson score | | |
| Zero | 106,322 (59%) | 400,712 (58.1%) |
| One or more | 73,140 (41%) | 289,243 (41.9%) |
| LOS | | |
| Four days or less | 153,762 (85.7%) | 602,736 (87.4%) |
| Five days or more | 25,700 (14.3%) | 87,219 (12.6%) |