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Exploring the Determinants of Racial and Ethnic Disparities in Total Knee Arthroplasty:

Health Insurance, Income, and Assets

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Abstract

Objective—To estimate national total knee arthroplasty (TKA) rates by economic factors, and the extent to which differences in insurance coverage, income, and assets contribute to racial and ethnic disparities in TKA use.

Data Source—US longitudinal Health and Retirement Study survey data for the elderly and near-elderly (biennial rounds 1994–2004) from the Institute of Social Research, University of Michigan.

Study Design—The outcome is dichotomous, whether the respondent received first TKA in the previous 2 years. Longitudinal, random-effects logistic regression models are used to assess associations with lagged economic indicators.

Sample—Sample was 55,469 person-year observations from 18,439 persons; 663, with first TKA.

Results—Racial/ethnic disparities in TKA were more prominent among men than women. For example, relative to white women, odds ratios (ORs) were 0.94, 0.46, and 0.79, for white, black, and Hispanic men, respectively ($P < 0.05$ for black men). After adjusting for economic factors, racial/ethnic differences in TKA rates for women essentially disappeared, while the deficit for black men remained large. Among Medicare-enrolled elderly, those with supplemental insurance may be more likely to have first TKA compared with those without it, whether the supplemental coverage was private [OR: 1.27; 95% confidence interval (CI): 0.82–1.96] or Medicaid (OR: 1.18; 95% CI: 0.93–1.49). Among the near-elderly (age 47–64), compared with the privately insured, the uninsured were less likely (OR: 0.61; 95% CI: 0.40–0.92) and those with Medicaid more likely (OR: 1.53; 95% CI: 1.03–2.26) to have first TKA.

Conclusions—Limited insurance coverage and financial constraints explain some of the racial/ethnic disparities in TKA rates.

Total knee arthroplasty (TKA) is increasingly common with over 431,000 procedures performed nationwide in 2004.¹ For persons with severe and potentially disabling osteoarthritis, TKA is “efficacious and cost-effective . . . [it] relieves pain and reduces functional disability.”² As the US population ages, growth in TKAs is expected to accelerate.³

Racial and ethnic disparities in TKA rates, especially among men, are striking. Sharply lower rates of TKA among elderly minorities have now been established by several recent studies using comprehensive administrative data for Medicare beneficiaries.^{4–6} Skinner et al,⁵ using data from virtually all TKAs performed among Medicare Fee-for-Service (FFS) enrollees during 1998–2000 (N = 431,726), found the TKA rate for black men (1.84/1000) to be only 38% of that for non-Hispanic white men (4.84); the rate for Hispanic men was intermediate (3.46). Among women, the corresponding rates were higher overall and less disparate: 5.97 for non-Hispanic whites, 5.37 for Hispanics, and 4.84 for blacks. Similar disparities in TKA have been noted in national data for over 2 decades. Despite increases in TKA use for everyone, the white-minority gap in TKA use has been growing.^{7,8}

Although several studies have examined the role of patient attitudes and preferences toward major surgery,^{9–12} religious beliefs¹³ and willingness to use complementary and traditional care modalities,¹⁴ little work has focused on racial and ethnic disparities in TKA use. It seems likely that racial and ethnic differences in financial constraints contribute to the TKA disparities, because the surgery is itself expensive—nationally the median inpatient cost exceeded \$29,000 in 2004,¹ and there are substantial rehabilitation costs as well as the potential for lost wages. Even for those with full (parts A and B) Medicare FFS coverage, out-of-pocket expenses could reach several thousand dollars. Recent literature points to the increasing burden of out-of-pocket expenditures, even among insured populations.^{15–19}

Two previous studies of the role of financial constraints in TKA disparities among Medicare FFS beneficiaries leave a confusing picture. Mahomed et al⁴ concluded that those “whose income level was low enough to qualify for Medicaid supplementation were much less likely to undergo total knee replacement than individuals who did not receive Medicaid supplementation,” whereas Skinner et al⁶ saw “little association between socioeconomic status and the rate of TKA.” As both studies use Medicare data, part of the difference in results is due to model specification—for instance, in Mahomed et al,⁴ the Medicaid recipients are compared with a reference group that includes those with and without private supplemental coverage.

A study of Canadians aged 55 or older concluded that those with less education and lower income were more likely to need TKA and similarly willing to undergo TKA as those with more education or income.²⁰ To the extent that these findings apply to the United States, lower TKA utilization among minorities with lower SES is not necessarily due to unwillingness to undergo TKA.

A related study of disparities in joint (knee and hip) replacement based on a nationally representative (US) longitudinal survey sample of 6159 Medicare-enrolled adults (age 69 or older) found that those with supplementary Medigap coverage were more likely to have a joint replacement compared with those without.²¹ The apparent difference with Skinner et al⁶ may be due to the more detailed individual-level financial and insurance coverage measures in Dunlop et al.²¹

Although the data used in this study are from the same survey source [Health and Retirement Study (HRS)] as that used in Dunlop et al,²¹ a key distinction is that we exclude hip replacements and examine TKAs exclusively. Differences by gender and race/ethnicity are also examined separately. This follows recent evidence that not only do utilization rates of knee and hip replacements vary considerably, they also differ systematically by gender and race/ethnicity.^{4,6,9,21,22}

There is now much evidence of the association of insurance coverage and other economic indicators with racial and ethnic disparities.^{23,24} Among Medicare enrollees, minorities are less likely to have supplemental insurance coverage, exposing them to higher out-of-pocket

costs.^{23,25} Also minority Medicare beneficiaries report lower rates of office visits, including those to specialists, as well as fewer diagnostic services.¹⁸ Among the poor and previously uninsured, Medicaid coverage is associated with greater use of both preventive and curative health care services.^{26,27}

Methods

Empirical Model

Our empirical model is based on a standard economic model of individual demand for health care.²⁸ The direct individual cost (“price”) of TKA is the out-of-pocket expenses incurred, which differs across individuals by the comprehensiveness of their insurance. Thus, given similar demographic and health conditions, the probability of receiving TKA is greater for those with more comprehensive insurance coverage (lower out-of-pocket expenditures) and more financial resources (income, savings, and other assets). The reduced form model for observing TKA from individual i in year t is specified as:

$$TKA_{it} = f(DEM_{it}, HLTH_{it}, INS_{it}, INC_{it}, UNEMP_{it}, WLTH_{it}, EDUC_{it})$$

where DEM and HLTH are demographic and health indicators, INS is health insurance coverage type, INC and WLTH are household income and wealth, and UNEMP is employment status. Highest educational achievement (EDUC) is included as a proxy for long run income earnings.

Data

We used the longitudinal HRS data from a nationally representative sample of 26,703 individuals born before 1942 and their spouses or partners. Administered by the Institute for Social Research (University of Michigan), the sample resulted from pooling (in 1998) 4 distinct age-based cohorts—2 of which had been surveyed biennially since 1992/1993, whereas the other 2 were formed in 1998.²⁹ HRS was designed to improve our understanding of the health dynamics of aging past age 50, including the relationship of health to economic, social, and demographic factors. Thus, it collects rich information from all these domains. The measures of income, assets, work status used here have been constructed by HRS researchers.³⁰

Study Subjects

Of the 19,973 persons who completed the 1998 survey round, we excluded 1534 subjects who: (1) had a previous (pre-1998) history of knee or hip arthroplasty ($n = 241$), (2) belonged to none of the 3 selected racial/ethnic groups ($n = 409$), or (3) had incomplete covariate data ($n = 884$); 18,439 study subjects remained.

Analytic Data Structure

The HRS cohort was tracked over 3 biennial rounds (2000, 2002, and 2004). We excluded follow-up observations for any of the following: (1) reported TKA in previous round, (2) death, or (3) dropped from survey or incomplete covariate information. To minimize confounding from reverse causation, the outcome measure (whether or not first TKA was reported), was cross-matched with independent covariates reported in the previous survey round. For instance, “presence of a first TKA” in 2002 was matched with demographic, health, and economic conditions as reported in the 2000 survey round. There are 55,469 observations for the 18,439 study subjects—33% of subjects have 8 years of exposure (ie, 4 biennial survey rounds), 43% have 6 years of exposure, 13% have 4 years of exposure, and the remaining 11% have only 1

survey round response (2 years of exposure). The cross-matching is incomplete for some in 1998 because 3715 persons (21%) have no pre-1998 information. For this group, only outcome observations from 2000, 2002, and 2004 rounds are used in the analyses.

Outcome Measure

The main outcome measure is a binary indicator for a first TKA observed in the survey period. Those who responded affirmatively to “have you had or has a doctor told you that you have arthritis or rheumatism?” were asked: “in the last 2 years (or since previous interview) have you had surgery or any joint replacement because of arthritis?” If “yes” the follow-up query was: “which joint was that?” (1 = hip(s); 2 = knee(s); 3 = hand/wrist area; 4 = foot/ankle area; 5 = shoulder(s); 6 = spine; 7 = other). TKA was identified by the response “knee(s).” Those with a prior knee or hip arthroplasty were excluded. Data on prior joint (knee or hip) arthroplasty was available for the 2 cohorts surveyed before 1998—these comprised 79% of the study individuals and 81% of observations. Corresponding information is not available from others—whether this has any systematic effect on identifying first TKA is unclear because those with a prior TKA in one leg are more likely to have another TKA, whereas those with previous TKA in both legs are less likely. The validity of the self-reported TKA outcome depends on recall accuracy. Most studies of the recall of major surgical procedures (hysterectomy, tubal sterilization, cancer surgeries) report high rates of agreement with medical records.^{31–34}

Health Insurance, Income, and Assets

Access to health insurance was categorized in 7 groups. Four of these categories pertain to Medicare beneficiaries with differential out-of-pocket burden: Medicare FFS only, Medicare FFS with Medigap or other secondary coverage, Medicare FFS with Medicaid, and Medicare HMO. The remaining categories distinguish insurance status among those without Medicare: Medicaid, other insurance (employer-sponsored, Department of Defense's TRICARE, or Veterans Administration), and none. Household income was adjusted for inflation and household size, by dividing by the square root of household size.³⁵ Income was summed from all sources: earnings, capital income, employer pension, all Social Security receipts, unemployment or workers compensation, other government transfers (veterans benefits, welfare, and food stamps), and other sources (such as alimony and inheritance). When respondents were unable or unwilling to specify dollar amounts, income ranges were substituted and later used to impute those amounts.³⁰ Earnings were imputed for 7.5% of respondents. Assets were measured from the value of all forms of nonhousing assets, including stocks, bonds, individual retirement accounts, mutual funds, savings and checking balances, debt, vehicles, and businesses. The Consumer Price Index was used to express income and asset amounts in 1993 dollars. Regional differences in cost of living, access, and other factors were captured by dummy indicators for the regions, which is equivalent to limiting comparisons of TKA rates across persons within each region. All financial indicators were included in the multivariate regression analyses. Although they were significantly correlated, the highest correlation (between income and assets) was only 0.56. Because the data comprise a mix of retirees and employed, reliance on assets is more important for 1 group than for other.

Other Measures

The key demographic variables were age, gender, and race. Using the fields for race (white or black) and Hispanic ethnicity, the study sample was categorized as Hispanic, non-Hispanic black, and non-Hispanic white. Health status was captured using several indicators for selected chronic conditions and limitations on physical activities. Presence of a chronic health condition was based on the question, “Has a doctor ever told you that you have?”. The conditions include high blood pressure/hypertension, diabetes, cancer, lung disease, and heart disease

(“heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems”). Note that although these conditions are determined from self-report of a physician diagnosis, the survey query for presence of arthritis (noted earlier) includes nonphysician diagnosed self-report of arthritis. Physical functional limitations were self-reported as difficulty with each selected activity. Following Dunlop et al,²¹ binary indicators (1/0) were used to measure whether a respondent had any difficulty in performing several activities of daily living that involve lower extremities: walking 1 block, getting up from a chair, climbing 1 flight of stairs, and stooping or crouching. We also included body mass index as a health status indicator.

Statistical Methods

We tested cross-tabulations of differences in covariates by race and ethnicity with χ^2 test. We estimated the reduced form equation of the model associating the first TKA with various indicators of potential financial constraint, health conditions, and demographics. Given the binary outcome (presence of first TKA) in a longitudinal data structure, a random-effects (longitudinal) logistic model was estimated first for the whole sample and then for the subsample of those with arthritis; this explores the extent to which racial/ethnic disparities in first TKA are accounted for by disparities in self-reported arthritis. Estimates of odds ratios (ORs) mentioned in the following sections are statistically significant at 95% level (OR not equal to 1) unless otherwise noted. All analyses were performed using STATA 9.2,³⁶ with sampling weights to reflect national distributions for the demographic groups. The Institutional Review Board at Boston University School of Medicine approved the study protocol.

Results

The 18,439 persons in the sample were observed for an average of 6 years (Table 1); 57% were women, 8% Hispanic, and 14% non-Hispanic black. A total of 663 persons had a TKA between 1998 and 2004. The estimated crude rate of first TKA in the nation was 5.9 TKAs per 1000 persons per year [95% confidence interval (CI): 5.4–6.4]. Among women, crude rates varied modestly by race and ethnicity, being 4.2 in Hispanics, 6.4 in blacks, and 6.8 in whites, respectively. Among men, racial/ethnic TKA rates differed more, with the analogous rates being 3.0, 4.3, and 5.4.

Table 2 shows summary statistics of the independent covariates by race/ethnicity. Every covariate differed by race and ethnicity (all $P < 0.001$). Broadly, blacks and Hispanics had more illnesses and more difficulties with physical functioning than whites. Specifically, more blacks had hypertension (63%), diabetes (23%), and were overweight/obese (75%) than whites (45%, 12%, and 61%, respectively). Hispanics had higher rates of diabetes and obesity compared with whites, but lower rates of heart disease, lung disease, and cancer. A key indicator of the need for TKA is difficulty with physical activities of daily living. More blacks than whites reported difficulty with each of the 4 indicators of physical functional health of lower extremities studied; more Hispanics had difficulties than whites on 3 of these 4 indicators (Table 2). Because arthritis was also more common among blacks and Hispanics than whites (Table 1), the need for TKA seems to be greater for blacks and Hispanics than for whites.

Blacks and Hispanics have fewer financial resources than whites (Table 2). For instance, only 13% of whites had annual adjusted incomes less than \$10,000, fully 39% of blacks, and 46% of Hispanics had incomes below this near-poverty level. Similar patterns were observed for household assets and highest educational achievement. The figures for health insurance type are stratified by age, based on eligibility for Medicare's near-universal, aged-based insurance benefit: age 64 or younger versus 65+ (Table 2). In the younger group, 78% of whites had private, VA, or TRICARE coverage, in contrast to 60% of blacks and only 50% of Hispanics.

Other coverage in the under age 65 group, that is, Medicaid or Medicare (disability), was highest for blacks (24%), whereas noninsurance was highest for Hispanics (33%).

In the 65+ group, fully 47% of whites had Medicare FFS plus supplementary coverage, as compared with only 28% of blacks and 14% of Hispanics. The rankings were reversed for Medicare plus Medicaid coverage, at 3%, 15%, and 28%, for the same groups, respectively.

Adjusted differences in TKA rates by race and ethnicity are obtained via regression (Table 3). One model adjusts only for age and illness burden (base model). A comprehensive regression additionally adjusts for economic indicators (economic model). We estimate the economic model both using the whole sample and the 57% of the sample with self-reported arthritis. In all regressions, ORs are estimated with reference to white women, aged 65 or older, because it is the group with the highest crude rates. Given the low base rates of TKA, the estimated ORs can be interpreted as risk ratios.³⁷ TKA rate differences adjusted for age and illness burden (base model) indicate no significant difference in TKA rate between white men and women (OR = 0.94 for white men). The base model also points to significant underutilization of TKA among blacks and Hispanics. The extent of underutilization for black and Hispanic men is much larger (OR: black = 0.46; Hispanic = 0.79) than for black and Hispanic women (OR: black = 0.72; Hispanic = 0.60). All differences except that for Hispanic men are statistically significant at the 5% level. The Hispanic sample sizes are small, with only about 600 men and 800 women.

The economic model (all sample) results indicate sizable and statistically significant associations with type of health insurance, household income, and assets. Note that the sex and race/ethnicity ORs describe differences from white women, whereas other ORs refer other contrasts. For example, among those over the age of 65, coverage that is more comprehensive than basic Medicare FFS coverage seems to be associated with higher TKA rates. This association occurs separately for those with supplemental coverage from Medicaid coverage (OR: 1.27), or from private, VA, or TRICARE insurance (OR: 1.18), as well as for those with Medicare HMO coverage (OR: 1.28). Although none of these factors is individually significant at the 0.05 level, they all point to the same conclusion that additional coverage is associated with higher TKA use. Comparing the main categories for those 47–64 years old reveals that the uninsured had a much lower TKA rate (OR: 0.61) and those with Medicaid, a much higher rate (OR: 1.53) than those with private (employer-sponsored) or TRICARE coverage.

As for associations with income, those in the lowest income category (under \$10K) have an estimated OR of 0.75, and those in the next higher category (\$10K–\$20K) have an OR of 0.79 as compared with those in the highest income tier. Education below high school graduation is associated with 27% lower risk for TKA rate than for the college educated.

The TKA deficits for black and Hispanic women as compared with white women in the base model disappear in the all sample economic model (statistically significant ORs of 0.72 and 0.60 become insignificant ORs of 0.94 and 0.87); the deficits for black men are also reduced (from OR 0.46 to 0.56) in moving from the base to the economic model, but remain large and significant at the 5% level, whereas the OR for Hispanic men even seems to reverse direction (from OR 0.79 to 1.08), although in neither model is there enough precision to achieve statistical significance.

An alternative, but statistically equivalent, specification of the Table 3 models is to replace the 6 gender-race/ethnicity stratified groups into multiple fields to obtain a breakdown in terms of the “pure” effects of sex and race/ethnicity as well as interactions of the two. Estimates from this specification of the economic model (not reported) indicate that the pure effects of sex and race/ethnicity are dominated by the interactions. Thus, for example, the deficit for black men is far more than could be predicted from the lower rates for blacks (overall) in comparison with

whites or men (overall) in comparison with women; at the same time, Hispanic males seem to have even higher rates of TKA than Hispanic females.

Limiting the economic model to the 57% of the people with self-reported arthritis had little effect on TKA ORs for most of the predictor variables. However, the deficit for black males lessens (as the OR shifts from 0.56 to 0.65) and loses its significance (with the 95% CI becoming 0.38–1.11).

Discussion

Administrative data have long shown lower rates of TKA utilization for blacks and Hispanics^{5,8,38} than for whites. However, a better understanding of plausible pathways had to wait for comprehensive survey data with sizable numbers of TKA surgeries among nonwhites. Using data from a nationally representative survey (HRS) that encompasses many more TKAs than previously, we investigated the extent to which underutilization of TKA utilization among blacks and Hispanics is associated with systematic differences in illness burden and functional limitations, prohibitive out-of-pocket costs (measured by comprehensiveness of health insurance coverage), and limited family resources (measured by income and assets). The population covered is aged 47 and older.

Crude TKA rates were notably lower for blacks and Hispanics than for whites, especially among black men. After adjusting for demographic factors, illness burden and physical functional limitations, the deficits narrowed considerably, but the black male deficit remained large (OR = 0.56) and significant at the 0.05 level. Note that given the low base incidence rate of TKA, the reported ORs are approximately equal to risk ratios.³⁷

We further adjusted for economic factors associated with out-of-pocket costs and the presence of resources to pay for them, specifically, type of insurance coverage, family income and assets, and highest educational achievement. As expected, TKA utilization was greater for people with more comprehensive insurance coverage, family income, assets, and education. As blacks and Hispanics have relatively less of these assets than whites, adjusting for them “explains” some of the racial and ethnic differences in TKA rates. However, there was a striking contrast in the adjusted differences between men and women. Among women the differences essentially disappear: the deficit rates of TKA for black women (as compared with white women) decreased from approximately 28% to 6%, and for Hispanic women, from 40% to 13%. But among men, although adjusting for economic factors reduced the estimated rates of TKA (unexplained) underutilization among blacks, the effect was quite modest, with the deficit decreasing from 54% to 44%. Over all these results indicate that the lesser use of TKA among minorities is strongly associated with the greater resource and cost barriers they face.

Comparing these findings with previous studies using administrative data^{4,6} is complicated by the considerable differences in measures used. The lower TKA rates for Medicare beneficiaries with Medicaid coverage (lower income group) found in Mahomed et al⁴ derives from a comparison with all other Medicare beneficiaries. However, these “other Medicare beneficiaries” are a diverse group, varying substantially in insurance coverage (Medigap, Medicare HMO), income, and assets. In the study of Skinner et al,⁶ the only economic indicator was zip code-level income. Thus, its finding of no association with TKA could be reconciled by our findings that the effect of income differences are partly mediated by access to and comprehensiveness of insurance coverage⁶; for instance, we found that the Medicare beneficiaries with Medicaid coverage (that is, low income) have higher TKA rates than those with Medicare FFS coverage only.

As noted earlier, data for this study were drawn from the same survey source as Dunlop et al.²¹ Although we use many of the same measures, our focus is different. For one thing, the

outcome in Dunlop et al²¹ was any joint replacement (ie, knee or hip), we have addressed TKA alone, because racial disparity issues may differ by procedure. Unlike Dunlop et al,²¹ where racial/ethnic differences in surgery rates were not examined by gender, here we examine the strikingly large disparities among men in contrast to the modest differences among women. Also, by including younger people (most of whom do not have Medicare insurance) we could examine the previous finding that blacks and Hispanics were more likely to have TKAs before age 65.³⁹ By focusing on economic constraints, we made finer distinctions than Dunlop et al²¹ in insurance coverage, to better reflect potentially large differences in out-of-pocket costs. Nevertheless the broad thrust of the findings here are largely similar to those of Dunlop et al.²¹ One significant difference is that the residual racial/ethnic disparity in their study is considerably larger (53% deficit rate) even after adjusting for economic factors²¹; this may be due to: (1) combining the sexes (because the deficit for black men is much higher than for women), (2) studying an older cohort (where all have Medicare coverage), and (3) combining hip and knee replacements. In particular, relative to knee replacement, the need for hip replacement is more likely to arise from acute events (falls) at older ages when most beneficiaries have Medicare coverage.

Even after adjusting for financial indicators, sizable disparities in TKA utilization are still estimated, especially for minority men. The literature already offers rich descriptions of alternative plausible factors. In particular, several studies have identified racial and ethnic differences in patient “preferences,”⁴⁰ in patients’ attitudes toward major surgery,^{9–12} their religious beliefs,¹³ their willingness to use complementary and traditional care modalities,¹⁴ and their ability to handle the uncertainty of risks and benefits from surgery.⁴¹ Some of these differences in “preferences” may also be associated with indicators of socioeconomic status and access limitations, financial or otherwise.⁴²

This study has several limitations. First, although the sample size is larger than previous studies on TKA racial/ethnic disparities, some cohorts are still not large. In particular, it contains only 609 Hispanics overall, and only about 200 with a diagnosis of arthritis. This may be why some sizable differences in TKA utilization rates are not statistically significant. Second, the estimated relationships are not causal.⁴³ Differences in income and assets reflect not only differences in ability to pay but also differences in health behaviors and attitudes, family and social supports, and geographic location.²⁴ Third, although the HRS data are rich and sizable, the health status and utilization information is self-reported and clinical indicators of the need for TKA, or pain levels, are not captured. Finally, our data cannot distinguish those who are not financially constrained from those who are simply unwilling to undergo TKA.

An important implication of our findings is that, contrary to some recent evidence, lower utilization of TKA among blacks and Hispanics may be associated with insurance coverage limitations and unaffordable out-of-pocket costs. In particular, this extends to the elderly with Medicare coverage but with prohibitively high out-of-pocket costs. It seems clear that public assistance to lower out-of-pocket burden for the medically needy would increase TKA utilization. In states with low take-up of Medicaid among elderly poor, assistance by providers in enrolling the eligible and needy could also be effective in reducing disparities in TKA use.⁴⁴

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TABLE 1
Sample Counts and Mean Rates of Total Knee Arthroplasty (TKA) by Race/Ethnicity and Sex

Sample	Women			Men			Total
	White	Black	Hispanic	White	Black	Hispanic	
Persons	8026	1597	800	6414	989	613	18,439
Observations	24,250	4760	2419	19,311	2883	1846	55,469
Mean exposure duration (yr)	6.0	5.8	5.9	6.0	5.7	5.8	5.9
Total no. persons with first TKA	332	58	21	219	18	15	663
Persons with self-reported arthritis (%)	68	73	67	56	56	47	63
Mean TKA rate (sample-weighted)	6.8	6.4	4.2	5.4	3.0	4.3	5.9
95% confidence interval of mean TKA rate	6.0–7.6	4.4–8.4	1.9–6.5	4.6–6.1	1.4–4.6	1.9–6.7	5.4–6.4

* Rates per thousand persons per year. These nationally representative rates and confidence intervals are obtained by adjusting for the stratified sampling using sampling weights. Two-year recall rates are also converted to the 1-year rate presented here.

TABLE 2

Sample Characteristics (Based on N = 55,469 Observations for 18,439 Persons)

	White	Black	Hispanic	All
N (observations)	43,561	7643	4265	55,469
Age distribution, yr (%)				
47–64	52	58	63	53
65–74	26	25	23	25
75–110	23	17	13	22
Specified health problems (%)				
Arthritis	56	61	52	57
Overweight or obese	61	75	70	62
Hypertension/high blood pressure	45	63	45	47
Diabetes	12	23	21	14
Cancer	12	9	6	11
Lung disease	9	7	6	9
Heart disease	21	20	14	21
Functional difficulty with (%)				
Walking 1 block	9	16	11	10
Getting up from chair	33	40	37	34
Climbing 1 flight of stairs	12	20	19	14
Stooping or crouching	38	42	38	38
Household income, adjusted for size (%) *				
<\$10K	13	39	46	17
\$10K–\$20K	24	25	25	24
\$20K+	63	36	29	58
Household assets (without house) (%)				
<\$5K	14	52	52	20
\$5K–\$20K	13	18	19	13
\$20K+	74	30	29	67
Currently employed (%)	35	35	39	36
Education (%)				
Less than high school	18	43	59	23
GED or high school	38	30	21	37
At least some college	44	26	20	40
Health insurance (%)—age 64 or younger				
No insurance	14	17	33	16
Medicare FFS only	2	5	2	2
Medicare HMO only	0.6	1.5	1.4	0.8
Medicare with medicaid	0.8	3	2	1.2
Medicare with private/DoD	2	3	0.8	2
Medicaid only	2	11	10	4
Private (employer sponsored)/DoD	78	60	50	74
Health insurance (%)—age 65 or older				
No insurance	0.5	2	2	0.7

	White	Black	Hispanic	All
Medicare FFS only	28	33	23	29
Medicare HMO only	14	13	21	15
Medicare with medicaid	3	15	28	5
Medicare with private/DoD	47	28	14	44
Medicaid only	4	8	9	5
Private (employer sponsored)/DoD	2	2	3	2

* All differences for covariates by race and ethnicity were significant (at $P < 0.001$).

† In all multivariate regressions, covariate values were taken from the survey immediately prior to the reported first TKA.

TABLE 3
Adjusted Odds Ratios for Receipt of Total Knee Arthroplasty: Noneconomic vs. Economic Models

	Base Model (All Sample) OR (95% CI)	Economic Model (All Sample) OR (95% CI)	Economic Model (Arthritis Subsample) OR (95% CI)
Race and sex (ref: white female)			
Black, female	0.72 (0.52–0.99)	0.94 (0.67–1.32)	0.94 (0.67–1.31)
Hispanic, female	0.60 (0.37–0.96)	0.87 (0.54–1.43)	0.94 (0.57–1.54)
White, male	0.94 (0.81–1.10)	0.88 (0.75–1.04)	1.01 (0.86–1.19)
Black, male	0.46 (0.28–0.78)	0.56 (0.33–0.95)	0.65 (0.38–1.11)
Hispanic, male	0.79 (0.47–1.30)	1.08 (0.65–1.81)	1.39 (0.83–2.33)
Age (ref: 65 or older)			
47–64	0.66 (0.57–0.77)	0.72 (0.52–1.01)	0.80 (0.61–1.06)
Having specified health problems			
Overweight or obese	2.64 (2.18–3.20)	2.61 (2.15–3.17)	2.39 (1.97–2.90)
High blood pressure	1.09 (0.94–1.27)	1.11 (0.95–1.29)	1.02 (0.87–1.19)
Diabetes	0.67 (0.54–0.82)	0.68 (0.56–0.85)	0.69 (0.56–0.86)
Cancer	0.85 (0.67–1.07)	0.82 (0.65–1.03)	0.78 (0.62–0.99)
Lung disease	0.78 (0.62–1.00)	0.85 (0.67–1.08)	0.79 (0.63–1.01)
Heart disease	0.89 (0.75–1.06)	0.93 (0.78–1.10)	0.88 (0.74–1.05)
With functional difficulty in			
Walking 1 block	1.42 (1.16–1.75)	1.53 (1.25–1.89)	1.55 (1.26–1.90)
Getting up from chair	1.79 (1.50–2.13)	1.80 (1.51–2.14)	1.38 (1.17–1.64)
Climbing 1 flight of stairs	1.29 (1.06–1.58)	1.41 (1.16–1.73)	1.40 (1.14–1.70)
Stooping or crouching	2.98 (2.46–3.61)	3.05 (2.51–3.69)	2.21 (1.83–2.66)
Health insurance, age 65 +			
Medicare FFS only		Reference	Reference
Medicare HMO only		1.28 (0.94–1.75)	1.28 (0.94–1.74)
Medicare with medicaid		1.27 (0.82–1.96)	1.28 (0.83–1.98)
Medicare with private/DoD		1.18 (0.93–1.49)	1.18 (0.93–1.49)
Health insurance, age 64 or younger			
Private (employer sponsored)/DoD		Reference	Reference
Uninsured		0.61 (0.40–0.92)	0.63 (0.41–0.94)
Medicaid		1.53 (1.03–2.26)	1.45 (0.98–2.14)
Household income			
<\$10K		0.75 (0.58–0.98)	0.76 (0.58–0.99)
\$10K–\$20K		0.79 (0.65–0.95)	0.77 (0.64–0.93)
\$20K+		Reference	Reference
Household assets			
<\$5K		0.65 (0.51–0.84)	0.63 (0.49–0.81)
\$5K–\$20K		0.86 (0.69–1.08)	0.63 (0.67–1.06)
\$20K+		Reference	Reference
Employment status			
Not employed		Reference	Reference
Employed		1.17 (0.95–1.44)	1.28 (1.04–1.58)

	Base Model (All Sample) OR (95% CI)	Economic Model (All Sample) OR (95% CI)	Economic Model (Arthritis Subsample) OR (95% CI)
Highest education (%)			
Less than high school		0.73 (0.58–0.91)	0.69 (0.55–0.87)
GED or high school		1.02 (0.86–1.20)	0.98 (0.83–1.16)
At least some college		Reference	Reference

All regressions included indicators for year (1998, 2000, 2002, and 2004) and 9 national geographic regions. The estimates for health insurance for those aged 64 or younger are based on re-running the regression now using Private/DoD as reference. Bolded OR estimates reject null hypothesis OR = 1 at 5% significance level.