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Patient preferences for total knee replacement surgery: Relationship to clinical outcomes and stability of patient preferences over two years

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Abstract

Objective—Evaluate the relationship between patient preferences for total knee replacement (TKR) with receipt of TKR, and assess participant characteristics that may influence change in willingness to undergo TKR

Methods—Structured interviews of knee osteoarthritis (OA) patients were conducted. Logistic regression models were conducted to assess the association between baseline willingness and eventual receipt of TKR, adjusted for sociodemographic and clinical variables. Mixed models for repeated measures were used to estimate the effects of sex, race, social support, WOMAC, and orthopedic consult on change in willingness.

Results—589 were willing, and 215 were unwilling to undergo TKR. Willing participants, compared to others, were more often White (69.4% vs. 48.4%), with more than a high school education (60.8% vs. 47.0%) and employed (39.1% vs. 26.5%). At follow-up, the odds of having TKR were twice as high among those who were willing to have the procedure at baseline, but this was no longer significant when adjusted for demographic variables (adjusted OR 1.82, 95% CI [0.89, 3.69]). Willingness to undergo TKR declined over two years. Among those who were willing to undergo TKR at baseline but did not obtain one, only 66.5% were still willing at the 2-year follow-up. This decline was less among those who had a greater increase (> median) in

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WOMAC disability (adjusted -0.34 , 95% CI $[-0.47, -0.20]$) than those who had minimal change in their WOMAC disability ($p=0.08$). The decline in willingness was also less among those who had seen an orthopedic surgeon (adjusted -0.32 , 95% CI $[-0.46, -0.17]$) than those who did not ($p=0.05$).

Conclusions—Preference for TKR was consistent with TKR surgery utilization, but not after controlling for patient demographic characteristics. Willingness to undergo TKR declined over time, but this decrease was mitigated by worsening OA-related disability and by consultation with an orthopedic surgeon.

Keywords

osteoarthritis; knee replacement surgery; treatment preference; orthopedic consultation

INTRODUCTION

Non-pharmacologic and pharmacologic therapies may be used to treat patients with knee osteoarthritis (OA) [1, 2]. Knee OA patients who do not obtain adequate pain relief and functional improvement from these conservative therapies may be considered for joint replacement. Total knee replacement (TKR) surgery is an effective treatment option for patients with moderate-to-severe knee OA [2]. Despite its effectiveness, evidence suggests that TKR is an underutilized procedure. Only 13% of candidates receive total knee replacements [3]. It has also been estimated that 3.6 million Americans with knee OA experience unresolved debilitating pain and disability despite attempts at symptom amelioration with the use of conservative treatments [3].

Patient preferences for treatment could influence actual receipt of joint replacement. Preference is the expression of a value for alternative options for action after informed deliberation of risks and benefits [4]. Eliciting preferences for treatment is highly relevant, particularly when there are choices among invasive and less invasive treatments [4]. Only 9–33% of patients with severe knee OA are willing to consider TKR despite its established efficacy [5–7]. And, willingness to undergo joint replacement varies by race, with African Americans less willing than whites [8, 9]. Moreover, a prospective population-based study in Canada suggested that the primary predictor of TKR is willingness to undergo the procedure [5]. Whether this finding can be generalized to the US is unknown. Racial and ethnic diversity, access to surgical treatment, and TKR utilization rate differ between the two countries [10].

Empirical evidence for the stability of patient preferences is primarily based on studies of preferences for life-sustaining treatments [11–16]. Stability of patient preferences has been shown to vary based on patient health status, the specific medical treatment of interest, and the time interval between assessments [11–15]. Patient age, race, education, initial treatment preference, and change in health status may also affect stability [11, 13–16]. For instance, stability of preferences regarding advance directives (i.e., decisions about end-of-life care) is greater among those higher levels of education [13, 15]. Evidence on the stability of patient preferences in regards to treatments that target quality rather than the quantity of life,

however, is lacking. To our knowledge, no study has longitudinally evaluated the treatment preferences regarding joint replacement of patients with knee OA.

The analyses that follow focus on the stability and change in study participant preference for TKR surgery among participants with knee OA. Our primary objective is to evaluate the relationship of patient preference with consultation with an orthopedic surgeon and receipt of TKR surgery over two years of follow-up. Our secondary objective is to describe change in willingness to undergo TKR over time. The final objective is to assess participant characteristics that may influence change in willingness to undergo TKR.

METHODS

Study Sample

Study participants were recruited from the University of Pittsburgh Medical Center Primary Care and Rheumatology Clinics, and the Veterans Affairs (VA) Pittsburgh Healthcare System Primary Care Clinics. Additional participants were sought through direct mailings of clinic and research registries, as well as via local advertisements. This study was approved by the University of Pittsburgh and Veterans Affairs Institutional Review Boards.

We previously reported the specific details of our recruitment methodology [17]. Potential participants 50 years of age were asked about the presence of chronic frequent knee pain based on the National Health and Nutrition Examination Survey arthritis supplement [18]. Those who screened positive were assessed using the Western Ontario McMaster Index (WOMAC) Survey [19]. They then had a knee x-ray done; radiographs were evaluated using the Kellgren-Lawrence (K-L) scoring system [20]. Presence or absence of knee OA was based on the clinical and radiographic classification criteria set by the American College of Rheumatology (ACR) [21].

Inclusion criteria for the study included: African-American or White race, age 50, presence of chronic frequent knee pain, WOMAC summary score 39, radiographic evidence of knee OA (i.e. K-L grade 2), and presence of knee OA by ACR criteria. Exclusion criteria included: prior history of any major joint replacement, terminal illness, inflammatory arthritis (e.g. rheumatoid arthritis, seronegative spondyloarthritis), or dementia. Individuals who met study criteria were invited to complete an initial face-to-face interview. Enrolled participants were also contacted for telephone follow-up six months and two years after the initial face-to-face interview.

Willingness

To determine willingness to undergo TKR, participants were asked: “If your knee pain were ever to get severe, would you be willing to have surgery to replace your knee if your doctor recommended it?” [22]. Responses were measured using a Likert scale from -2 (“definitely not willing”) to +2 (“definitely willing”). As in previous studies, responses were dichotomized to willing (“definitely willing” and “probably willing”) or unwilling (“unsure,” “probably not willing” and “definitely not willing”) [9, 17]. The willingness question was asked at baseline and at the two-year follow-up.

Clinical Outcome Measures

At the six-month and two-year follow-up, participants were asked if they had a consultation with an orthopedic surgeon for knee OA and if they had undergone TKR surgery during the respective study time periods. Actual receipt of TKR surgery was confirmed by patient chart review when available.

Covariates

Socio-demographics—Baseline socio-demographic characteristics gathered included age, sex, race, marital status, annual household income, education attainment, employment status, and type(s) of medical insurance. Current household composition (alone, spouse/significant other, or child/other relative/nonrelative) and number of close friends/relatives were also determined. Functional social support was measured using the 5-item modified Medical Outcomes Study (MOS) Social Support scale [23]. Higher scores suggest more social support (range: 0–100).

Clinical Information—OA-related disease severity was assessed using the 24-item WOMAC.[19] Higher summary scores indicate increased pain, stiffness and functional limitations (range: 0–100). Co-morbid conditions were weighted and summed using the interviewer-based modified Charlson Co-morbidity Index [24]. Quality of life was assessed using the Short Form Health Survey (SF-12, range 0–100 with higher scores indicating better health), from which the physical and mental component summary scores were calculated [25]. Depression severity was assessed using the Patient Health Questionnaire-9 (PHQ-9, range: 0–27) [26]. Higher scores indicate increased severity of depressive symptoms.

Statistical Analysis

Participant socio-demographic and clinical characteristics were described by willingness to undergo TKR at baseline, with the purpose of describing potential confounders of the association between baseline willingness and the two-year outcome measures. Categorical variables were compared by χ^2 analysis. Continuous variables were compared by a two-sample t-test.

Odds ratios and 95% confidence intervals were estimated using logistic regression to assess the association between baseline willingness to undergo TKR (independent variable) and consultation with an orthopedic surgeon within two years (dependent variable). Both unadjusted and adjusted analyses were conducted, with covariates selected *a priori* for inclusion in the adjusted model: age, sex, race, education level, recruitment site, income, medical insurance, social support, and baseline WOMAC total score. Covariates were entered in the regression models in a hierarchical fashion. The analyses described were then repeated after stratifying by race and by sex. Potential interactions between baseline willingness and both race and sex were tested using a likelihood ratio test (LRT) comparing a model with and without an interaction term. Identical strategies were used in assessing the association between baseline willingness to undergo TKR (independent variable) and actual receipt of TKR surgery within two years (dependent variable). As none of the participants in

the VA underwent TKR during the study period, the adjusted models could not include recruitment site as a covariate.

Agreement between baseline willingness and willingness at the 2-year follow-up was assessed using kappa statistic. Agreement was considered less than chance to slight if kappa was 0.2, fair-moderate if kappa was 0.21 and 0.6, and substantial-almost perfect if 0.61 [27]. Agreement was reassessed after stratifying participants by race. In order to remove the influence of patient satisfaction with prior TKR, participants who underwent TKR surgery during the study period were excluded in all analyses that evaluated the two-year change in willingness to undergo TKR.

Mixed models for repeated measures (MMRM) were used to estimate the effects of race, sex, marital status, MOS social support, change in WOMAC pain and disability subscale scores, and orthopedic surgical consultation on change in willingness over two years. Models were also adjusted for age, sex, race, education level, recruitment site, income, medical insurance, MOS social support, change in WOMAC pain score, and change in WOMAC disability score. Interactions between time and each of the variables tested were evaluated using LRTs. Since MMRM were used, participants with missing followup data were included, and thus implicit imputation potentially mitigated bias from dropout, depending on the dropout mechanism [28].

Data management and analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC).

RESULTS

A total of 1828 people were initially considered for participation in the study. 804 were eligible and consented to participate (Figure 1). 589 participants were willing, and 215 were unsure or not willing to undergo TKR surgery at baseline. Willing participants, compared to others, were more often White (69.4% vs. 48.4%) and male (38.2% vs. 30.7%). They were also more likely to have more than a high school education, with an annual household income of \$50,000 and employed (Table 1). Having Medicare, a Health Maintenance Organization insurance plan, or a private insurance (as opposed to Medicaid only or no insurance) was also more common in willing than unwilling participants (92.4% vs. 84.8%).

Differences in baseline psychosocial and clinical profiles were observed. Those willing to undergo TKR were more likely to be married (43.3% vs. 27.0%), had more close friends/relatives (mean 9.86 vs. 7.95), and had higher MOS social support mean scores (73.84 vs. 66.49) than others. In addition, they had lower WOMAC total (48.01 vs. 52.52) and PHQ-9 depression (5.31 vs. 6.07) mean scores, and had higher SF-12 physical health (37.98 vs. 36.48) and mental health (52.12 vs. 50.29) mean scores.

Two-Year Outcomes: Orthopedic Surgery Consultation & TKR Surgery

Out of 804 participants enrolled at baseline, information on orthopedic consultation was available for 685 and information on receipt of TKR surgery was available for 717 at the two-year follow-up. A total of 68 participants reported undergoing TKR by year two; 57

were confirmed by patient medical record review. No self-reported TKRs were found unsubstantiated where medical records were available.

After adjustment for age, sex, race, educational attainment, recruitment site, income, MOS-social support score, and WOMAC total at baseline, there was no significant association between baseline willingness and consultation with an orthopedic surgeon during two years of follow-up (adjusted OR 0.89, 95% CI [0.62, 1.29]). This was found in both African-Americans and whites in race-stratified analyses (Table 2). Among men, willingness to undergo TKR at baseline was significantly associated with decreased odds of seeing an orthopedic surgeon within two years (adjusted OR 0.45, 95% CI [0.23, 0.87]), while women who were willing at baseline had a non-significant increased odds of orthopedic consultation during follow-up (adjusted OR 1.22 (95% CI [0.78, 1.91]), suggesting that sex modifies the association between willingness and consultation with an orthopedic surgeon (LRT for interaction $p=0.012$).

The odds of having TKR surgery within two years was twice as high among those who were willing to have the procedure at baseline, compared to all others (unadjusted OR 2.30, 95% CI [1.15, 4.59]). When adjusted for age, sex and race, however, the association between willingness and actual receipt of TKR attenuated and was no longer statistically significant (adjusted OR 1.82, 95% CI [0.89, 3.69]). This positive association between willingness and receipt of TKR was found among whites (unadjusted OR 2.39, 95% CI [1.07, 6.37]), but not among African-Americans in the unadjusted models (Table 3). When adjusted for age, sex, education, income, and medical insurance type, however, the OR moved towards the null and was no longer statistically significant (adjusted OR 2.01, 95% CI [0.87, 5.49]). While the magnitude of the observed association between willingness and TKR was greater for men than for women in stratified analyses, no significant evidence of an interaction between sex and baseline willingness was found (LRT $p=0.482$).

Change in Willingness

By year 2, information regarding participant willingness to undergo joint replacement was available from 623 out of 736 who had not undergone TKR. There was fair to moderate agreement between baseline willingness and willingness at the 2-year follow-up (Table 4). Patients' preferences were generally stable over 2 years; patients' willingness to undergo TKR did not change in the majority of patients (66.5% among initially willing participants and 75.3% among initially unwilling participants). When preferences changed, however, more switched from willing to unwilling (33.5%) than from unwilling to willing (24.7%). African-Americans more often switched from willing to unwilling than whites (38.7% vs. 31.2%).

There was a general decline in willingness to undergo TKR among participants who did not report having knee replacement surgery. This decline in willingness was less among those who had a greater increase ($>$ median) in WOMAC disability scores (adjusted -0.34 , 95% CI $[-0.47, -0.20]$) than those who had minimal change ($\leq$ median) in their WOMAC disability scores (adjusted -0.51 , 95% CI $[-0.64, -0.37]$). This difference, however, was not statistically significant ($p=0.076$). The decline in willingness was also less among those who had seen an orthopedic surgeon (adjusted -0.32 , 95% CI $[-0.46, -0.17]$) than those

who did not during the study period (adjusted -0.51 , 95% CI $[-0.63, -0.38]$) ($p=0.051$). There was no evidence that participant race, sex, marital status, MOS-social support, or change in WOMAC pain influenced change in willingness over two years (Table 5).

DISCUSSION

Our study is the first to evaluate change in OA patient treatment preferences regarding joint replacement surgery over time. No evidence of an association between willingness to undergo TKR and increased odds of orthopedic surgery consultation was found overall or in race-stratified analyses. Among males, baseline willingness was associated with decreased odds of orthopedic consultation. While the association between baseline willingness and receipt of TKR was positive, adjustment for demographic variables attenuated the magnitude. Among whites, further adjustment for socioeconomic variables further attenuated this association. On average, willingness to undergo TKR surgery decreased over time among those who did not receive TKR. However, this decrease in willingness was mitigated by worsening OA-related disability and by consultation with an orthopedic surgeon.

Finding that willingness to undergo TKR was not consistent with eventual consultation with an orthopedic surgeon and that it was no longer significantly associated with TKR receipt after adjustment for patient sociodemographic characteristics were surprising. Patient preferences have previously been reported to influence the utilization of various medical procedures and treatment [8, 29]. Patient preferences, in fact, had the most substantial influence on patients receiving a recommendation for joint replacement from an orthopedic surgeon in a study of male veterans with knee or hip OA [30]. In turn, receiving this recommendation helped determine whether or not patients underwent joint replacement six months later. Similarly, a study of OA patients in Canada reported that willingness to consider joint replacement was most strongly associated with future joint replacement [5]. Median follow-up time in that prospective cohort study was 6 years, which was longer than in our study. A few studies, however, found that differences in patient preferences minimally explained variations in the use of other medical procedures and treatments (e.g. cardiac procedures) [31, 32].

There was more stability than change in OA patient preferences regarding joint replacement over the period of 2 years. However, there was also a general decline in willingness to undergo TKR, especially among African-Americans. Indeed, in a study of stability of preferences for treatment among nursing home residents, the investigators noted that although most preferences were stable, when preference changes occurred they were toward less intervention [33]. In parallel, the choice to forgo a life-sustaining treatment was twice as stable as the choice to receive treatment over a two-year period in a study of Medicare recipients [11]. As previously mentioned, stability of patient preferences regarding life-sustaining treatments vary based on several different factors [11–16].

The decline in willingness to undergo joint replacement was minimized by a greater increase in OA-related disability. The effect of patient health status on treatment preferences has also been observed in other prospective studies. In a study of older adults' treatment preferences,

declines in physical or psychological functioning resulted in decreased interest in life-prolonging treatment [12]. In a national study of hemodialysis patient preferences for dialysis continuation, patient health conditions had limited effects on changes in treatment preferences [16]. Among persons with AIDS, changes in physical functioning and pain were significant correlates of change in the desire for cardiac resuscitation [15].

There was also less decrease in willingness to undergo joint replacement among those who had had a consultation with an orthopedic surgeon. In a similar fashion, stability of patient preferences regarding advance directives was highest among those who had discussions with their physicians about advance care treatments [13]. Clinicians may stabilize patient preferences by facilitating patient self-understanding and providing information [34]. They may identify treatment preferences and address underlying rationales, influencing decisions that are changeable or appear to be “in process.”[13] Finally, they may educate the patient about the process and potential outcomes of the choices regarding certain treatments in various scenarios [13, 34].

Although this study provides relevant new information about OA patient treatment preferences and their relationship to clinical outcomes, it also has a few limitations. First, the voluntary nature of the participant sample makes it difficult to generalize our findings to individuals who chose not to or could not participate in the study. It is also unknown whether results would generalize to patients of other racial and ethnic backgrounds (e.g. Hispanics, Asian-Americans). Second, there are also missing data from participants who dropped out of the study for unknown reasons, and we cannot know the extent to which missing data might have biased our results. Third, the research design was limited to a follow-up period of two years. With a relatively small number of patients undergoing TKR during this follow-up period, we might have had limited power to detect a significant relation between willingness and receipt of TKR. Participant preferences could be more consistent with receipt of TKR surgery with a longer follow-up time period. Fourth, results are limited to better understanding patient preferences for TKR. They provide no information about preferences for other OA treatments such as anti-inflammatory medicines, narcotics agents and/or corticosteroid injection.

CONCLUSIONS

Consistency between treatment preferences regarding joint replacement and actual utilization of joint replacement surgery warrants further investigation. Changes in treatment preferences over time and the influence of changes in OA-related symptoms on treatment preferences highlight the need for repeated assessment of patient preferences. Finally, the impact of consultations with physicians on changes in treatment preferences emphasizes the need for continuous and effective communications between physicians and patients. In the process, patients will receive the support they need to make the best individualized decisions, and providers will feel confident in the care that they prescribe.

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Figure 1.
Study Flowchart

*Since change in willingness was analyzed using a mixed model for repeated measures, all participants with a baseline willingness response, excluding those who reported having undergone TKR, were included in the analysis. ($n=804-68=736$)

Table 1

Demographic, Clinical and Psychosocial Characteristics by Baseline Willingness to Undergo TKR

Characteristic	Unwilling (n=215)	Willing (n=589)	p-value
Age, mean (SD) years	62.86 (10.74)	62.11 (8.77)	0.319
Sex, n (%) Male	66 (30.7)	225 (38.2)	0.050
Race, n (%)			<0.001
African-American	111 (51.6)	180 (30.6)	
White	104 (48.4)	409 (69.4)	
Education, n (%)			<0.001
High School or GED	114 (53.0)	231 (39.2)	
Post-Secondary Training, Associates/Bachelors Degree	80 (37.2)	247 (41.9)	
Graduate Degree	21 (9.8)	111 (18.9)	
Income, n (%)			<0.001
<\$10000	42 (22.1)	78 (14.3)	
\$10000–\$1999	58 (30.5)	101 (18.6)	
\$20000–\$29999	22 (11.6)	92 (16.9)	
\$30000–\$39999	20 (10.5)	48 (8.8)	
\$40000–\$49999	18 (9.5)	49 (9.0)	
\$50000	30 (15.8)	176 (32.4)	
Employment Status, n (%)			0.001
Full Time	39 (18.1)	172 (29.4)	
Part Time	18 (8.4)	58 (9.9)	
Unemployed	35 (16.3)	50 (8.6)	
Disabled	44 (20.5)	94 (16.1)	
Retired	79 (36.7)	211 (36.1)	
Health Insurance, n (%)			0.008
Medicare/HMO/Private	167 (84.8)	508 (92.4)	
Medicaid Only	15 (7.6)	20 (3.6)	
No Insurance	15 (7.6)	22 (4.0)	
Recruitment Site, n (%) Non-VA	204 (94.9)	549 (93.2)	0.389
Currently Married, n (%)	58 (27.0)	255 (43.3)	<0.001
Household Composition, n (%)			0.001
Lives Alone	103 (48.4)	211 (35.9)	
Lives with Spouse/Significant Other	67 (31.5)	271 (46.1)	
Lives with child, other relative or non-relative	43 (20.2)	106 (18.0)	
# Close friends/relatives, mean (SD)	7.95 (8.90)	9.86 (12.83)	0.045
MOS Social Support, mean (SD)	66.49 (27.54)	73.84 (24.21)	<0.001
Charlson Comorbidity Scale, mean (SD)	2.42 (1.79)	2.34 (1.75)	0.543
WOMAC Total *, mean (SD)	52.52 (16.08)	48.01 (16.76)	0.001
WOMAC Disability *, mean (SD)	35.06 (11.69)	31.98 (11.94)	0.001
WOMAC Pain *, mean (SD)	10.80 (3.49)	9.84 (3.71)	0.001

Characteristic	Unwilling (n=215)	Willing (n=589)	p-value
WOMAC Stiffness *, mean (SD)	4.51 (1.56)	4.22 (1.71)	0.034
PHQ-9 Depression, mean (SD)	6.07 (5.08)	5.31 (5.05)	0.060
SF-12 Physical Health, mean (SD)	36.48(10.62)	37.98(10.67)	0.081
SF-12 Mental Health, mean (SD)	50.29(10.63)	52.12(9.79)	0.024

* Higher scores indicate greater pain, disability and/or stiffness

MOS=Medical Outcomes Study; PHQ-9=Patient Health Questionnaire; SF-12= MOS 12-Item Short Form Health Survey; WOMAC=Western Ontario McMaster Instrument

Table 2

Baseline willingness to undergo TKR and orthopedic surgeon consultation within 2 years, by race and by sex

	Seen by Orthopedics, No. (%)	OR (95% CI)	Adjusted* OR (95% CI)
All			
Unwilling (referent)	93 (45.4)	1.00	1.00
Willing	256 (45.8)	1.02 (0.74, 1.40)	0.89(0.62, 1.29)
African-Americans [†]			
Unwilling (referent)	45 (42.9)	1.00	1.00
Willing	72 (43.6)	1.03 (0.63, 1.70)	0.93 (0.53, 1.62)
Whites [†]			
Unwilling (referent)	48 (48.0)	1.00	1.00
Willing	184 (46.7)	0.95 (0.61, 1.48)	0.87 (0.53, 1.43)
Men [‡]			
Unwilling (referent)	35(55.6)	1.00	1.00
Willing	88(42.3)	0.59 (0.33, 1.03)	0.45 (0.23, 0.87)
Women [‡]			
Unwilling (referent)	58(40.9)	1.00	1.00
Willing	168 (47.9)	1.33 (0.90, 1.98)	1.22(0.78, 1.91)

* Adjusted for age, sex, race, education level, recruitment site, income, insurance type, MOS-Social Support and WOMAC total score at baseline

[†] Likelihood ratio test for interaction between willingness and race was statistically not significant in both unadjusted and adjusted models

[‡] Likelihood ratio test for interaction between willingness and sex: p=0.020 (unadjusted), p=0.012 (adjusted)

MOS=Medical Outcomes Study; WOMAC=Western Ontario McMaster Instrument

Table 3

Baseline willingness to undergo TKR and receipt of TKR surgery within two years, by race and by sex

	TKR Surgery Receipt, No. (%)	OR (95% CI)	Adjusted* OR (95% CI)	Adjusted† OR (95% CI)	Adjusted‡ OR (95% CI)
All					
Unwilling (referent)	10 (5.2)	1.00	1.00	1.00	1.00
Willing	58 (11.1)	2.30 (1.15, 4.59) [§]	1.82 (0.89, 3.69)	1.94 (0.88, 4.28)	2.04 (0.92, 4.53)
African-Americans ^{//}					
Unwilling (referent)	4 (4.0)	1.00	1.00	1.00	1.00
Willing	6 (3.9)	0.98 (0.27, 3.90)	0.98 (0.27, 3.93)	1.72 (0.38, 11.98)	1.70 (0.38, 11.83)
Whites ^{//}					
Unwilling (referent)	6 (6.5)	1.00	1.00	1.00	1.00
Willing	52 (14.1)	2.39 (1.07, 6.37) [§]	2.32 (1.03, 6.22) [§]	2.01 (0.87, 5.49)	2.15 (0.92, 5.93)
Men [¶]					
Unwilling (referent)	3 (5.3)	1.00	1.00	1.00	1.00
Willing	26 (14.0)	2.93 (0.98, 12.60)	2.25 (0.74, 9.82)	2.92 (0.90, 18.88)	3.11 (0.84, 20.18)
Women [¶]					
Unwilling (referent)	7 (5.1)	1.00	1.00	1.00	1.00
Willing	32 (9.5)	1.95 (0.89, 4.91)	1.63 (0.73, 4.15)	1.61 (0.68, 4.47)	1.68 (0.70, 4.69)

* Adjusted for age, sex, and race

† Adjusted for age, sex, race, education level, income, insurance type, and MOS-Social Support

‡ Adjusted for age, sex, race, education level, income, insurance type, MOS-Social Support, and total WOMAC score

§ p<0.05

// Likelihood ratio test for interaction between willingness and race was statistically not significant in all models

¶ Likelihood ratio test for interaction between willingness and sex was statistically not significant in all models

MOS=Medical Outcomes Study; WOMAC=Western Ontario McMaster Instrument

Table 4

Willingness to consider knee replacement surgery [No. (%)] at baseline and at two-year follow-up among those who had not undergone TKR

	Willingness at two-year follow-up		Kappa Coefficient
Baseline willingness	Willing	Unwilling	
	All		
Willing	296 (66.5%)	149 (33.5%)	0.3551
Unwilling	44 (24.7%)	134 (75.3%)	
	African-Americans		
Willing	84 (61.3%)	53 (38.7%)	0.3574
Unwilling	22 (23.7%)	71 (76.3%)	
	Whites		
Willing	212 (68.8%)	96 (31.2%)	0.3266
Unwilling	22 (25.9%)	63 (74.1%)	

Table 5

Change in willingness to consider TKR surgery over two years

	N	Unadjusted Model Estimated change [†] over time (95% CI)	P-value	Adjusted Model* Estimated change [†] over time (95% CI)	P-value
Race					
African-American	281	-0.39 (-0.53, -0.24)		-0.41 (-0.56, -0.25)	
White	455	-0.43 (-0.54, -0.32)		-0.43 (-0.55, -0.31)	
Interaction (time*race)			0.643		0.797
Sex					
Male	262	-0.45 (-0.60, -0.29)		-0.45 (-0.61, -0.28)	
Female	474	-0.40 (-0.51, -0.29)		-0.41 (-0.53, -0.29)	
Interaction (time*sex)			0.613		0.702
Marital Status					
Single	455	-0.43 (-0.54, -0.31)		-0.42 (-0.54, -0.30)	
Married	281	-0.40 (-0.54, -0.26)		-0.43 (-0.58, -0.28)	
Interaction (time*marital status)			0.714		0.918
MOS-Social Support					
median	388	-0.38 (-0.51, -0.26)		-0.39 (-0.53, -0.26)	
> median	348	-0.45 (-0.57, -0.32)		-0.45 (-0.58, -0.32)	
Interaction (time*social support)			0.466		0.565
WOMAC-pain					
median	334	-0.37 (-0.50, -0.25)		-0.43 (-0.56, -0.30)	
> median	288	-0.44 (-0.57, -0.30)		-0.42 (-0.56, -0.28)	
Interaction (time* pain)			0.481		0.908
WOMAC-disability					
median	319	-0.47 (-0.60, -0.35)		-0.51 (-0.64, -0.37)	
> median	303	-0.33 (-0.46, -0.20)		-0.34 (-0.47, -0.20)	
Interaction (time* disability)			0.124		0.076
Seen by orthopedic surgeon					
No	413	-0.50 (-0.61, -0.38)		-0.51 (-0.63, -0.38)	
Yes	283	-0.30 (-0.44, -0.16)		-0.32 (-0.46, -0.17)	

N	Unadjusted Model		Adjusted Model*	
	Estimated change [†] over time (95% CI)	P-value	Estimated change [†] over time (95% CI)	P-value
Interaction (time*ortho surgeon)		0.034		0.051

* Adjusted for age, sex, race, education level, recruitment site, income, health insurance, MOS-Social Support, WOMAC pain score and WOMAC difficulty score

[†] Change on Likert scale measure

MOS=Medical Outcomes Study; WOMAC=Western Ontario McMaster Instrument