African Americans and Whites Are Equally Appropriate to be Considered for Total Joint Arthroplasty

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ABSTRACT. ***Objective.*** Ethnic disparities in the use of total joint arthroplasty (TJA) may be attributed to differences in the clinical appropriateness to undergo TJA. We sought to determine if racial differences in clinical appropriateness for surgery existed among a sample of primary care clinic patients with moderately to severely symptomatic knee or hip osteoarthritis (OA).

Methods. We used the cross-sectional data of 684 patients who are potential candidates for TJA. Using a validated TJA appropriateness algorithm, an appropriateness factor was derived using the following variables: age (50–70 or > 70 yrs), Charlson comorbidity (≤ 1 or > 1), Western Ontario and McMaster Universities OA Index (WOMAC) pain and physical function, and adequacy of previous medical management. We used logistic regression to estimate the association of race with the dichotomous outcome of clinical appropriateness for TJA consideration.

Results. Sample consisted of 425 (62%) whites and 260 (38%) African Americans; 532 (78%) had knee OA and 153 (22%) had hip OA. The mean age was 64 ± 9 years and the mean body mass index was 33.6 ± 8 kg/m^2. The mean overall WOMAC score was 56 ± 14 (range 30–96), suggesting moderately severe OA. There were no significant racial group differences (p = 0.3) in the proportions of those deemed clinically appropriate for TJA. After controlling for potential confounders, race was not a predictor of clinical appropriateness for TJA (odds ratio 1.2, 95% confidence interval 0.8–1.8, p = 0.3).

Conclusion. African Americans and whites were equally appropriate to be considered for TJA. (First Release July 15 2009; J Rheumatol 2009;36:1971–6; doi:10.3899/jrheum.081214)

Key Indexing Terms:
RACIAL DISPARITY TOTAL JOINT ARTHROPLASTY CLINICAL APPROPRIATENESS

Osteoarthritis (OA) is the most prevalent form of arthritis and is among the most common chronic conditions in the United States[1]. Nearly 70 million Americans, approximately 1 of every 3, are affected by arthritis or musculoskeletal disease[2]. Specifically, knee/hip OA is among the leading causes of disability in the US[3,4]. There is no known cure for knee/hip OA.

Total joint arthroplasty (TJA) is an effective treatment option for endstage knee/hip OA. The evidence base for TJA for endstage knee or hip OA has been the subject of several National Institutes of Health (NIH) consensus statements and Agency for Healthcare Research and Quality-sponsored systematic reviews[5-8]. The substantial body of evidence of the effectiveness and safety of TJA makes it one of the most commonly performed elective surgeries in the elderly. With the aging of the US population, the use of TJA is expected to increase over the next few decades.

Numerous studies have documented racial differences in the use of knee or hip joint replacement over the past 10–15 years[9-14]. The reasons for the observed racial disparities remain unclear and cannot be attributed to differences in the prevalence of lower extremity OA[15]. Indeed, the prevalence of knee/hip OA among older African American patients is at least as high as that reported for whites[1,16].

Potential mechanisms of racial differences in the use of TJA are multifactorial and may include patient-level factors (e.g., preference or health beliefs), provider-level factors

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(e.g., physician-patient communication style), and system-level factors (e.g., access to specialist care)[17-19]. A relatively less examined factor is potential racial differences in clinical eligibility for TJA at the time of evaluation in a primary care setting. If African Americans were less clinically eligible or appropriate than whites to be considered for surgery, then bridging the racial gap in receipt of TJA would have no merit.

Our objective was to determine whether racial differences in clinical appropriateness for surgery existed among a sample of primary care clinic patients with moderately to severely symptomatic knee or hip OA. We hypothesized that African Americans were less clinically appropriate for TJA than whites. We applied a previously validated algorithm to determine the clinical appropriateness or eligibility of each patient for TJA[20-23].

MATERIALS AND METHODS

Patient population. Patients were enrolled from the primary care clinics of the Roudebush Veterans Affairs Medical Center (VAMC) and the Wishard Hospital, Indianapolis, Indiana. The Wishard Hospital is a county hospital with an established primary care network consisting of its primary care centers and 6 community health centers located throughout the city. Close to the county hospital, the Roudebush VAMC serves veterans from Indiana and the surrounding states.

Initial identification of potential participants has been described[17]. To be eligible for this study, patients had to be ≥ 50 years of age, have radiographic evidence of OA on the symptomatic joint, and have a Western Ontario and McMaster Universities OA Index (WOMAC) summary score = 30. WOMAC summary score ≥ 30 was chosen based on a report that the mean standard deviation (SD) WOMAC summary score for patients with knee OA undergoing preoperative evaluation for total knee arthroplasty was 27.6 ± 2.9[24]. Patients who had already undergone knee/hip TJA for their knee and/or hip pain were excluded.

Between March 1, 2003, and September 30, 2006, 1478 patients were screened; 748 met the study eligibility criteria. Sixty-four patients (8.5%) declined to participate. We present cross-sectional analyses of the baseline data of the 684 patients who met the study entry criteria.

Study procedures, including written informed consent, were approved by the Indiana University Purdue University Indianapolis Institutional Review Board (IUPUI-IRB).

WOMAC disease severity. Lower extremity OA disease severity was assessed using the WOMAC index, which includes 24 items that probe pain (score range 0–20), stiffness (score range 0–8), and functional limitation (score range 0–68). The WOMAC index has been extensively validated and shown to be a reliable and responsive instrument[25]. Depending on the WOMAC scores, participants were classified as having mild, moderate, or severe level of symptoms. For WOMAC pain, scores of 0–8, 9–14, and 15–20 correspond to mild, moderate, and severe pain, respectively. For WOMAC functional limitation, the severity levels are 0–22 (mild), 23–45 (moderate), and 46–68 (severe).

Adequacy of medical management. Drugs (acetaminophen, nonsteroidal antiinflammatory drugs, tramadol, and narcotic analgesics) and referrals to allied health specialists (physical therapy, occupational therapy, and nutrition) were abstracted from the electronic medical record databases. Previous medical management was considered adequate if any of the following conditions were met within the 24-month period prior to study entry: (1) filled prescriptions for at least 3 different drugs (≥ 30 day supply) for hip or knee pain; or (2) filled prescriptions for 2 different drugs (≥ 30 day supply) and received a referral to one allied health specialist for hip/knee pain or weight reduction; or (3) filled a prescription for 1 drug (≥ 30 day supply) and received referrals to 2 or more allied health specialists.

If none of the conditions was met, previous medical management was considered inadequate[20-23].

Medical comorbidity. Medical comorbidity, an indicator of surgical risk, was assessed using the modified Deyo-Charlson Comorbidity Index[26,27]. The index assigned nonzero weights to 19 conditions based on their risk of mortality[28,29]. The weights can take on values of 1, 2, 3, or 6 and are then summed for each patient. The modified Deyo-Charlson Comorbidity Index has been shown to predict mortality in a cohort of community-dwelling older adults attending a large primary care practice[30]. Depending on the total comorbidity score, participants in the study were classified either in the low (≤ 1) or high (≥ 2) surgical risk category at study entry. The relevant diagnoses were electronically abstracted from the medical record database.

Demographic/socioeconomic status (SES). We also collected data on demographics (sex, education, employment status, income, number of insurance coverage), body mass index (BMI), symptomatic joint (hip or knee), and site of recruitment (county hospital or VAMC). Demographic information was obtained through an interviewer administered questionnaire.

Primary outcome measure. The primary outcome measure was the clinical appropriateness of TJA. Clinical appropriateness for TJA, a dichotomous outcome variable, was obtained for each patient using an algorithm[20-23]. The algorithm classified each patient as either "appropriate" or "not appropriate" based on the following variables: age, adequacy of previous medical management, severity of pain, and functional limitation and surgical risk. For age, the algorithm categorized patients into 2 groups: 50–70 years of age and > 70[20-23]. See Figure 1 for examples of appropriate and inappropriate scenarios. Appropriate characterizes someone who is severely symptomatic (pain and functional limitation) despite adequate medical management, and is also healthy enough to withstand the stress of surgery. A validation study supports the use of the appropriateness algorithm for clinical guidelines or evaluation purposes[22].

Statistical analysis. Mean values and SD were calculated for continuous variables, frequencies and percentages for categorical variables. We compared baseline characteristics of African Americans and whites using chi-squared test for categorical variables and t-test for normally distributed continuous variables. Logistic regression models were fit to estimate the relationship between (self-reported) race, the primary independent variable, and clinical appropriateness for TJA. We adjusted for potential confounders including demographics, BMI, symptomatic joint, and recruitment site. We assessed all possible interactions between (self-reported) race, the primary independent variable, and covariates. The analyses were performed using SAS version 9.1.

RESULTS

Baseline characteristics of the sample. As summarized in Table 1, the sample consisted of 425 (62%) whites and 260 (38%) African Americans; 532 (78%) had knee OA and 153 (22%) had hip OA. The mean age for the entire sample was 64.4 ± 9 years; 59% were men, 64% had less than high school education, 20% were employed (either full or part-time), and 55% reported annual household income < $15,000. The mean overall WOMAC score was 56 ± 14, suggesting at least a moderately severe symptomatic OA. The 2 groups were similar with respect to educational attainment, employment status, number of insurance coverage, and joint type. For WOMAC, there were no differences in the proportions of African Americans and whites within each level of severity of pain and function. Compared to

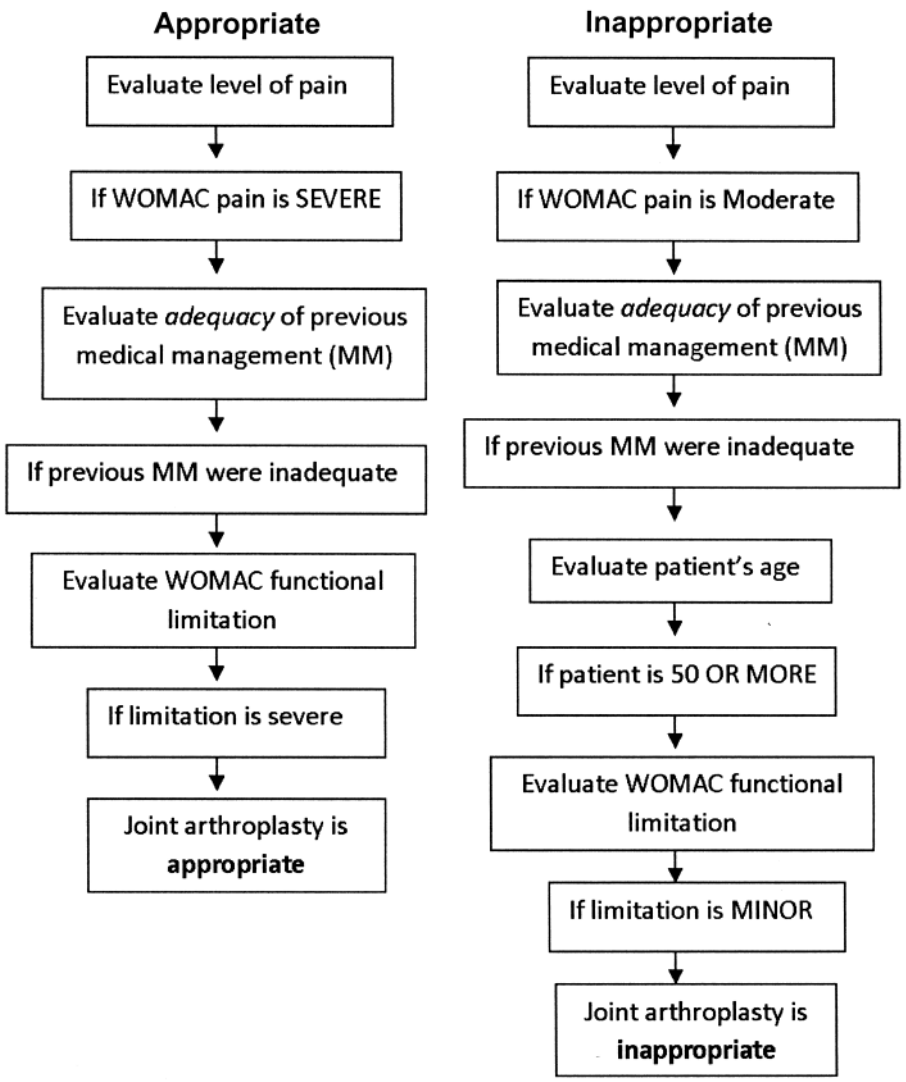

Figure 1. Examples of appropriate and inappropriate scenarios in patients with osteoarthritis under consideration for total joint arthroplasty.

whites, the African American group had more female subjects, had more participants who reported an annual household income < $15,000, had higher BMI, and were more likely to be recruited from the county hospital clinics. A higher proportion of African Americans than whites was in the 50–70 year age bracket. Similarly, more African Americans than whites were classified by the Deyo-Charlson Comorbidity Index as belonging to the low surgical risk category. Interestingly, a smaller proportion of African Americans than whites met the preset definition of having received "adequate" medical management.

Relationship between race and the appropriateness factor. We found no significant ethnic group differences in the proportions of those deemed appropriate for TJA and those deemed inappropriate for TJA (appropriate: 25.5% African Americans vs 29.4% whites; inappropriate: 74.5% African Americans and 70.6% whites; $p = 0.3$). As shown in Table 2, the only factors associated with appropriateness were the SES variables (i.e., education, income, and employment).

In the multivariate models, race was not significantly associated with clinical appropriateness for TJA (Table 3). Being unemployed remained a significant correlate of appropriateness (odds ratio 2.0, 95% CI 1.2–3.3, $p = 0.003$). The interactions of race with education, income, and employment were nonsignificant ($p > 0.2$).

DISCUSSION

In this sample of patients with at least moderately severe OA, we found that African Americans and whites were equally appropriate (or alternatively, inappropriate) to be considered for TJA. The only variable associated with higher likelihood of appropriateness was being unemployed. The

Table 1. Baseline characteristics comparing African American (AA) and whites (W).

Variables	AA (n = 260)	W (n = 425)	p
Age, yrs			
50–70	76.1	66.2	0.006
> 70	23.8	33.7	
Sex			
Male	41.1	70.8	< 0.0001
Female	58.8	29.1	
≤ High school diploma	63.8	64.7	0.8
< $15,000 annual household income	66.5	49.0	< 0.0001
Employment status			
Employed	19.2	19.7	0.8
Not employed	80.7	80.2	
Number of insurance coverage	1.6 ± 0.8	1.5 ± 0.8	0.3
Recruitment sites			
County hospital	64.6	30.1	< 0.0001
VAMC	35.3	69.8	
Body mass index	34.5 ± 8	33.1 ± 8	0.03
Joint type			
Knee joint	80.3	76.0	0.18
Hip joint	19.6	24.0	
Surgical risk†			
≤ 1	75.3	67.5	0.02
> 1	24.6	32.4	
WOMAC pain			
Mild	15.0	20.7	0.13
Moderate	64.6	58.1	
Severe	20.3	21.1	
WOMAC function			
Mild	5.4	2.5	0.16
Moderate	64.8	67.2	
Severe	29.7	30.1	
Adequacy of previous medical management			
Adequate	38.8	58.8	0.0001
Not adequate	61.1	41.1	

Values are % except where indicated. † Deyo-Charlson Comorbidity Index: marker of surgical risk. WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index. VAMC: Veterans Administration Medical Center; For WOMAC pain scores of 0–8, 9–14, and 15–20 correspond to mild, moderate, and severe pain, respectively. For WOMAC function, severity levels are 0–22 (mild), 23–45 (moderate), and 46–68 (severe).

relationships between race and clinical appropriateness were not modified by SES variables. On the basis of clinical eligibility alone, there should be no reason why one racial group should be considered more or less appropriate to receive TJA.

Motivated by the concern that the increasing complexity of medical care was resulting in some patients not undergoing procedures that they needed, and others undergoing procedures that they did not need, Brook, *et al* developed the RAND/UCLA appropriateness method — a method that examines appropriateness of medical care[31]. Combining the available scientific evidence and expert opinion, the RAND appropriateness methodology has been effectively applied in many fields of medicine including coronary revascularization, carotid endarterectomy, and renal transplantation[32-34].

Table 2. Bivariate relationship between independent variables and clinical appropriateness. Data are percentages.

Variables	Appropriate	Not Appropriate	p
Race			0.3
African Americans	25.5 (n = 66)	74.5 (n = 193)	
Whites	29.4 (n = 125)	70.6 (n = 300)	
Sex			0.8
Male	27.7 (n = 113)	72.3 (n = 295)	
Female	28.3 (n = 78)	71.7 (n = 198)	
Education			0.04
≤ High school diploma	30.5 (n = 134)	69.5 (n = 306)	
> High school	23.4 (n = 57)	76.6 (n = 187)	
Annual household income			0.04
< $15,000	31.5 (n = 112)	68.5 (n = 244)	
> $15,000	24.1 (n = 69)	75.9 (n = 217)	
Employment status			0.002
Employed	17.2 (n = 23)	82.8 (n = 111)	
Not employed	30.5 (n = 168)	69.5 (n = 382)	
Number of insurance coverage			0.3
≥ 1	27.5 (n = 178)	72.4 (n = 468)	
< 1	34.2 (n = 13)	65.7 (n = 25)	
Recruitment site			0.6
County hospital	28.8 (n = 85)	71.2 (n = 210)	
VAMC	27.2 (n = 106)	72.8 (n = 283)	
Body mass index			0.1
≥ 30	30.0 (n = 127)	70.0 (n = 296)	
< 30	24.6 (n = 64)	75.4 (n = 196)	
Joint type			0.3
Knee	26.9 (n = 143)	73.1 (n = 388)	
Hip	31.4 (n = 48)	68.6 (n = 105)	

VAMC: Veterans Administration Medical Center.

Table 3. Unadjusted and adjusted relationships between race and clinical appropriateness.

	Appropriateness: Appropriate vs Not Appropriate (95% CI)	p
African Americans†	1.1 (0.8–1.5)	0.5
African Americans† (controlled for BMI and knee or hip joint)	1.2 (0.8–1.7)	0.5
African Americans† (controlled for BMI, joint type, recruitment site* and sociodemographic** variables)	1.2 (0.8–1.8)	0.3

† Reference group: whites. * Wishard County hospital or VA Medical Center; ** Sex, education, employment, income, and insurance coverage. BMI: body mass index.

In orthopedic surgery, Quintana, *et al* developed and validated an appropriateness algorithm for TJA[21-23]. In contrast to the NIH consensus guidelines[5,6], the TJA appropriateness algorithm provides guidance in dealing with more than 100 possible clinical scenarios that a physician may encounter in the clinic. A subsequent validation study of 1500 patients with OA suggested a direct relationship between the TJA appropriateness algorithm and better

health-related quality of life outcomes 6 months after TJA[22].

In the context of disparities in TJA use, ours is the first study to highlight the importance of clinical appropriateness in understanding racial disparity in the use of arthroplasty. Our results are consistent with studies in cardiovascular surgery that examined clinical appropriateness. Oddone, *et al* reported that African American and white patients had a similar distribution of appropriateness scores for carotid endarterectomy[35]. Similarly, Conigliaro, *et al* noted no ethnic differences in the proportions of those who were appropriate or inappropriate for coronary revascularization procedure[36]. On the other hand, Epstein, *et al* have reported that racial differences in the clinical appropriateness were present among patients who were candidates for renal transplantation[37]. Perhaps the role of clinical appropriateness in procedure use varies depending on the disease state and/or the type of surgical procedure in question.

We have found that those who were unemployed, a marker of low SES, were more likely to be appropriate for TJA. The literature supports the association between low SES and poor self-rated health[38-41]. Indeed, in our study, participants with lower SES reported worse WOMAC pain and function (data not shown). Because OA patients with greater joint pain and worse physical function are generally more suitable to undergo surgery, we speculate that "symptom severity" (as measured by self-report) stands as a path variable in the observed relationship between unemployment and TJA appropriateness.

Although we did not observe racial difference in the appropriateness to undergo TJA, more African Americans than whites met the preset definition for inadequate previous medical management. Compared to whites, African Americans may be more reluctant to try different medical treatment options (e.g., physical/occupational therapy) at any given level of symptom severity[42,43]. Racial difference in symptom-reporting to the physician may also explain our finding. Two studies have suggested that African Americans communicate less effectively with their physicians than whites[44,45]. Physician failure to discuss other medical treatment options with African American patients more than whites may also play a role[46,47].

Our study has several limitations. First, the result could only be applied to patients with OA who have at least moderately symptomatic joint and have not had TJA. If the study population included the entire spectrum of OA severity (even those who are mildly symptomatic) or those who have already undergone TJA, the finding may have been completely different. Second, for the set of variables used to define adequacy of previous medical management, we relied on electronic abstraction of the medical record database. Electronic abstraction would not identify medical treatment recommendations that the patient declined for any reason. Third, the RAND methodology itself has a limitation because it is partly based on expert opinion. Nonetheless, there are enough data to support the discriminant and predictive validity of the TJA appropriateness algorithm used in the study[5,6,20-23,48]. Lastly, the cross-sectional design of our study has its inherent limitation. With OA being a progressive disease, clinical appropriateness by race may diverge over time.

We found no racial differences in patients' clinical appropriateness for TJA. In this sample of patients with moderate to severe knee/hip OA, African Americans and whites were equally appropriate (or alternatively, inappropriate) for consideration for TJA. Future studies should reexamine the issue of appropriateness of TJA for patients with OA who have already undergone the procedure.

REFERENCES

1. Lawrence RC, Helmick CG, Arnett FC, et al. Estimates of the prevalence of arthritis and selected musculoskeletal disorders in the United States. Arthritis Rheum 1998;41:778-99.
2. Zhang W, Moskowitz RW, Nuki G, et al. OARSI recommendations for the management of hip and knee osteoarthritis, Part II: OARSI evidence-based, expert consensus guidelines. Osteoarthritis Cartilage 2008;16:137-62.
3. Dunlop DD, Manheim LM, Song J, Chang RW. Arthritis prevalence and activity limitations in older adults. Arthritis Rheum 2001;44:212-21.
4. Rothfuss J, Mau W, Zeidler H, Brenner MH. Socioeconomic evaluation of rheumatoid arthritis and osteoarthritis: a literature review. Semin Arthritis Rheum 1997;26:771-9.
5. NIH consensus conference: Total hip replacement. NIH Consensus Development Panel on Total Hip Replacement. JAMA 1995;273:1950-6.
6. NIH Consensus Statement on total knee replacement December 8-10, 2003. J Bone Joint Surg Am 2004;86:1328-35.
7. Kane RL, Saleh KJ, Wilt TJ, et al. Total knee replacement. Evid Rep Technol Assess (Summ) 2003;86:1-8.
8. Trends in hospital procedures on black patients and white patients. 1980-1987. Report No.: Publication No. 94-0003. Agency for Health Care Policy and Research. Rockville, MD: Agency for Health Care Policy and Research; 1994.
9. Ayanian JZ. Determinants of racial and ethnic disparities in surgical care. World J Surg 2008;32:509-15.
10. Dunlop DD, Manheim LM, Song J, et al. Age and racial/ethnic disparities in arthritis-related hip and knee surgeries. Med Care 2008;46:200-8.
11. Ibrahim SA. Racial and ethnic disparities in hip and knee joint replacement: a review of research in the Veterans Affairs Health Care System. J Am Acad Orthop Surg 2007;15 Suppl:S87-94.
12. Mukamel DB, Weimer DL, Buchmueller TC, Ladd H, Mushlin AI. Changes in racial disparities in access to coronary artery bypass grafting surgery between the late 1990s and early 2000s. Med Care 2007;45:664-71.
13. Suarez-Almazor ME, Souchek J, Kelly PA, et al. Ethnic variation in knee replacement: patient preferences or uninformed disparity? Arch Intern Med 2005;165:1117-24.
14. Skinner J, Weinstein JN, Sporer SM, Wennberg JE. Racial, ethnic, and geographic disparities in rates of knee arthroplasty among Medicare patients. N Engl J Med 2003;349:1350-9.
15. Jordan JM, Helmick CG, Renner JB, et al. Prevalence of knee symptoms and radiographic and symptomatic knee osteoarthritis in African Americans and Caucasians: the Johnston County Osteoarthritis Project. J Rheumatol 2007;34:172-80.
16. Jordan JM, Linder GF, Renner JB, Fryer JG. The impact of arthritis

in rural populations. Arthritis Care Res 1995;8:242-50.
17. Ang DC, Monahan PO, Cronan TA. Understanding ethnic disparities in the use of total joint arthroplasty: application of the health belief model. Arthritis Rheum 2008;59:102-8.
18. Hawker GA. The quest for explanations for race/ethnic disparity in rates of use of total joint arthroplasty. J Rheumatol 2004;31:1683-5.
19. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh CK. Understanding ethnic differences in the utilization of joint replacement for osteoarthritis: the role of patient-level factors. Med Care 2002;40:144-51.
20. Quintana JM, Arostegui I, Azkarate J, et al. Evaluation by explicit criteria of the use of total hip joint replacement. Rheumatology 2000;39:1234-41.
21. Quintana JM, Escobar A, Azkarate J, Goenaga JI, Bilbao A. Appropriateness of total hip joint replacement. Int J Qual Health Care 2005;17:315-21.
22. Quintana JM, Escobar A, Arostegui I, et al. Health-related quality of life and appropriateness of knee or hip joint replacement. Arch Intern Med 2006;166:220-6.
23. Escobar A, Quintana JM, Arostegui I, et al. Development of explicit criteria for total knee replacement. Int J Technol Assess Health Care 2003;19:57-70.
24. Brazier JE, Harper R, Munro J, Walters SJ, Snaith ML. Generic and condition-specific outcome measures for people with osteoarthritis of the knee. Rheumatology 1999;38:870-7.
25. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol 1988;15:1833-40.
26. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. J Clin Epidemiol 1992;45:613-9.
27. Schneeweiss S, Seeger JD, Maclure M, Wang PS, Avorn J, Glynn RJ. Performance of comorbidity scores to control for confounding in epidemiologic studies using claims data. Am J Epidemiol 2001;154:854-64.
28. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373-83.
29. Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. J Clin Epidemiol 1994;47:1245-51.
30. Kieszak SM, Flanders WD, Kosinski AS, Shipp CC, Karp H. A comparison of the Charlson comorbidity index derived from medical record data and administrative billing data. J Clin Epidemiol 1999;52:137-42.
31. Brook RH, Chassin MR, Fink A, Solomon DH, Kosecoff J, Park RE. A method for the detailed assessment of the appropriateness of medical technologies. Int J Technol Assess Health Care 1986;2:53-63.
32. Fitch K, Lazaro P, Aguilar MD, Kahan JP, van Het LM, Bernstein SJ. European criteria for the appropriateness and necessity of coronary revascularization procedures. Eur J Cardiothorac Surg 2000;18:380-7.
33. Gandjour A, Neumann I, Lauterbach KW. Appropriateness of invasive cardiovascular interventions in German hospitals (2000-2001): an evaluation using the RAND appropriateness criteria. Thorac Cardiovasc Surg 2004;52:365-71.
34. Santori G, Valente R, Cambiaso F, Ghirelli R, Gianelli CA, Valente U. Preliminary results of an expert-opinion elicitation process to prioritize an informative system funded by Italian Ministry of Health for cadaveric donor management, organ allocation, and transplantation activity. Transplant Proc 2004;36:433-4.
35. Oddone EZ, Horner RD, Johnston DC, et al. Carotid endarterectomy and race: do clinical indications and patient preferences account for differences? Stroke 2002;33:2936-43.
36. Conigliaro J, Whittle J, Good CB, et al. Understanding racial variation in the use of coronary revascularization procedures: the role of clinical factors. Arch Intern Med 2000;160:1329-35.
37. Epstein AM, Ayanian JZ, Keogh JH, et al. Racial disparities in access to renal transplantation — clinically appropriate or due to underuse or overuse? N Engl J Med 2000;343:1537-44.
38. Krantz G, Ostergren PO. Common symptoms in middle aged women: their relation to employment status, psychosocial work conditions and social support in a Swedish setting. J Epidemiol Community Health 2000;54:192-9.
39. Lahelma E, Arber S, Kivela K, Roos E. Multiple roles and health among British and Finnish women: the influence of socioeconomic circumstances. Soc Sci Med 2002;54:727-40.
40. Mellner C, Krantz G, Lundberg U. Symptom reporting and self-rated health among women in mid-life: the role of work characteristics and family responsibilities. Int J Behav Med 2006;13:1-7.
41. Molarius A, Berglund K, Eriksson C, et al. Socioeconomic conditions, lifestyle factors, and self-rated health among men and women in Sweden. Eur J Public Health 2007;17:125-33.
42. Arega A, Birkmeyer NJ, Lurie JD, et al. Racial variation in treatment preferences and willingness to randomize in the Spine Patient Outcomes Research Trial (SPORT). Spine 2006;31:2263-9.
43. Schnittker J. Misgivings of medicine?: African Americans' skepticism of psychiatric medication. J Health Soc Behav 2003;44:506-24.
44. Johnson RL, Roter D, Powe NR, Cooper LA. Patient race/ethnicity and quality of patient-physician communication during medical visits. Am J Public Health 2004;94:2084-90.
45. Probst JC, Laditka SB, Moore CG, Harun N, Powell MP. Race and ethnicity differences in reporting of depressive symptoms. Adm Policy Ment Health 2007;34:519-29.
46. Honda K. Factors underlying variation in receipt of physician advice on diet and exercise: applications of the behavioral model of health care utilization. Am J Health Promot 2004;18:370-7.
47. Martin MY, Person SD, Shipp M, Green BL, Crowther M, Lee P. Variations in physicians' advice for managing hypertension in women: a study using NHANES III. Prev Med 2006;43:337-42.
48. Quintana JM, Arostegui I, Azkarate J, et al. Evaluation of explicit criteria for total hip joint replacement. J Clin Epidemiol 2000;53:1200-8.