

# Defining Racial and Ethnic Disparities in THA and TKA

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## Abstract

**Background** For minority populations in the United States, especially African Americans, Hispanics, and Native Americans, healthcare disparities are a serious problem. The literature documents racial and ethnic utilization disparities with regard to THA and TKA.

**Questions/purposes** We therefore (1) defined utilization disparities for total joint arthroplasty in racial and ethnic minorities, (2) delineated patient and provider factors contributing to the lower total joint arthroplasty utilization, and (3) discussed potential interventions and future research that may increase total joint arthroplasty utilization by racial and ethnic minorities.

**Methods** We searched the MEDLINE database and identified 67 articles, 21 of which we excluded. By searching Google and Google Scholar and reference lists of the included articles, we identified 40 articles for this review. Utilization disparities were defined by documented lower utilization of THA or TKA in specific racial or ethnic groups.

**Results** Lower utilization of THA and TKA among some racial and ethnic minority groups (African Americans, Hispanics) is not explained by decreased disease prevalence or disability. At least some utilization disparities are independent of income, geographic location, education, and insurance status. Causal factors related to racial and

ethnic disparities may be related in part to patient factors such as health literacy, trust, and preferences. Provider unconscious or conscious biases or beliefs also play a role in at least some healthcare disparities.

**Conclusions** Racial and ethnic THA and TKA utilization disparities exist. These disparities are not explained by lower disease prevalence. The existing data suggest patient education, improved health literacy regarding THA and TKA, and a patient-provider relationship leading to improved trust would be beneficial. Research providing a better understanding of the root causes of these disparities is needed.

## Introduction

Race- and ethnicity-based healthcare disparities have been well established by numerous studies in the literature, in health care generally and in orthopaedics specifically. A 2005 Institute of Medicine report confirmed racial and ethnic minorities receive lower-quality health care and have poorer health outcomes than their white counterparts in the United States [46]. In 2004, the Sullivan Commission concluded racial and ethnic minorities, especially African Americans, Latinos, Native Americans, and some Asian Pacific Islander subpopulations, experience higher rates of illness, disability, and premature death than whites [12]. On average, African Americans have the worst health profile among the racial/ethnic groups. The literature provides numerous examples of race-based disparities both in general access to care issues and regarding usage of specific therapies [5, 10, 39, 43].

Inequality in the healthcare system includes differential rates of not only disease and/or diagnosis but also access to screening or corrective procedures. The incidence of

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angioplasty and coronary artery bypass graft surgery in African American patients is currently  $\frac{1}{2}$  that of non-Hispanic white patients despite a 50% increase in the mortality rate for heart disease. Additionally, African Americans are less likely to receive interventional cardiac procedures than white patients [10, 39, 42]. One study demonstrated cardiac catheterization was less likely to be recommended for male and female African American patients than their white counterparts when trained white and African American actors presented with identical clinical symptoms, age, sex, history, comorbidities, medical testing, and insurance status [42]. Only 37% of Hispanics and 49% of African Americans received a colorectal cancer screening in 2007, compared with 57% of whites [2].

Disparities also extend to musculoskeletal conditions. Osteoarthritis (OA) is the leading cause of disability in the United States and is the main indication for total joint arthroplasty (TJA). More than 27 million adults have OA, a number expected to increase with increasing life expectancies. Activity limitation due to OA was reported by approximately 19 million US adults each year between 2003 and 2005, and  $\frac{1}{2}$  of all adults will develop symptomatic OA of the knee at some point in their lives [36]. THA and TKA are the most commonly performed procedures for OA. TJA is performed to reduce patient pain and suffering, increase quality of life, and improve productivity [40]. This procedure is a safe and cost-effective treatment for alleviating pain and restoring physical function in patients who fail to respond to nonsurgical therapy [38]. Given the established effectiveness of THA and TKA, decreased utilization of TJA in appropriate candidates on the basis of race and/or ethnicity represents a genuine racial or ethnic disparity.

Several steps are required to confirm the presence of a true healthcare disparity or inequity. If the disparity is related to underutilization of a procedure, it is important to establish the diminished utilization is not due specifically to decreased burden or severity of disease or to comorbidities where the greater risks of intervention warrant decreased utilization. For a healthcare disparity to be specifically a racial or ethnic disparity, it is important to establish the disparity persists even after correction for insurance status and access to care. Moreover, social injustices and disparities in health care are not only ethical and moral issues but are also important in terms of their economic burden to the healthcare system.

The purposes of this review were therefore to (1) define utilization disparities for TJA in racial and ethnic minorities, (2) better understand patient factors and provider factors contributing to the lower utilization of TJA, and (3) discuss potential interventions and future research that may increase TJA utilization by racial and ethnic minorities.

## Search Strategy and Criteria

We performed an electronic literature search to identify English-language articles on healthcare disparity in different population groups who had undergone THA or TKA. The MEDLINE database was searched using both Ovid and PubMed interfaces. The searches were limited to studies published between January 1994 and September 2010. The year 1994 was chosen as the start date because the category “Hispanic” was added this year as a demographic category in the Medicare database. The following subheadings were used: arthroplasty or replacement of knee, arthroplasty or replacement of hip, healthcare disparities, health status disparities, minority groups, and population groups. We found 67 articles. We excluded abstracts, letters, comments, and articles describing special implant designs for different ethnic groups, surgical outcomes, complications, comorbidities, thromboprophylaxis, bone morphometry, and utilization of physical therapy. We also excluded studies related to populations outside the United States. After the exclusions, 21 articles were left. To identify additional relevant references, the reference lists of the articles retrieved were checked manually. Among these articles, we searched in the titles using the keywords ethnic or racial disparity and total hip or knee arthroplasty. The same keywords were also used to conduct a search on Google (<http://www.google.com>) and Google Scholar ([scholar.google.com/](http://scholar.google.com/)). Nine articles were identified among the reviewed articles. After adding the relevant articles and the information from the Google and Google Scholar search, a total of 40 references were used in this review.

## Defining Racial and Ethnic Utilization Disparities in TJA

The first purpose of this review was to investigate whether TJA is utilized less frequently in racial and ethnic minorities and whether underutilization of TJA in racial and ethnic minorities is medically justified.

It is important to understand, in some cases, higher utilization may represent inappropriate or overutilization, as has been suggested in the case of some spinal procedures according to the Dartmouth Atlas [48]. Nevertheless, lower utilization of THA and TKA in racial and ethnic minorities has often been referred to as underutilization. While the appropriate utilization of THA and TKA has not been precisely defined, several independent evaluations have demonstrated THA and TKA have been highly successful in decreasing pain and improving function at their current utilization rates [32, 33, 37, 49]. Studies using validated patient-generated outcome tools have demonstrated THA and TKA are among the most cost-effective medical or

surgical interventions based on cost per quality-of-life years [20, 31, 32]. Moreover, quantitative analysis to determine correct TKA utilization among 50,000 patients in both high- and low-utilization counties in Ontario, Canada, demonstrated, even in high utilization counties, there was substantial unmet need, supporting evidence that variation represents underutilization rather than overutilization in the case of TKA [21, 49].

Several studies confirm lower utilization of TKA and/or THA among racial and/or ethnic minorities [11, 15, 35] (Table 1). Lower utilization of THA and TKA has been documented in African Americans and Hispanics. In some studies, lower utilization has been confirmed even after correction for education, income, insurance status, and/or medical comorbidities. The lower utilization of THA and TKA among African Americans and Hispanics cannot be medically justified. The incidence of activity-related OA among African Americans and Hispanics is at least equal to, if not greater than, among non-Hispanic whites [5, 8]. Although one study found the prevalence of OA to be lower in Hispanics than in whites and African Americans [4], more recent work suggests OA-related limitations, higher prevalence of knee symptoms, radiographic knee OA, and symptomatic knee OA are already disproportionately high among older adults and minority groups [3, 9, 18, 38].

Despite similar risks among African Americans and whites for symptomatic knee OA, numerous studies have demonstrated the usage of TKA is lower for African Americans than for whites [28, 44, 45, 47]. Furthermore, there is evidence that racial and ethnic disparities are widening with regard to the utilization of TJA [34]. Older African American and Hispanic persons report OA-related TJAs about 2/3 less frequently than white persons of similar age [13]. Furthermore, studies from both the Medicare system and the Veterans Affairs (VA) systems, in which enrolled patients have similar insurance coverage, confirm African American patients utilize TKA less frequently than

white patients and the differences in utilization cannot be accounted for by geographic variation, insurance coverage, or medical comorbidities [22, 26, 28, 44, 45].

Using the Medicare database, Mahommed et al. [33] analyzed 61,568 patients who had had a primary THA and 13,483 who had had a revision THA during a 1-year period. The authors found rates for primary THA were higher for whites than African Americans and for those with a higher income. Skinner et al. [44] found, even after adjusting for regional variations, income, and insurance status, African American men were markedly less likely than white men to undergo TKA.

Studies within the VA healthcare system have also been useful for identifying existing disparities in patient utilization of TJA [37, 40] due to its usage (an estimated 2.5 million veterans annually) and electronic recordkeeping [40]. Using these databases, Jones et al. [28] evaluated 260,856 VA patients older than 50 years with lower-extremity OA to estimate the racial inequality in TKA. In the 2-year followup period, African Americans were less likely than whites to undergo TKA [28]. Additionally, Ibrahim et al. [26] compared 30-day medical and surgical complications and mortality among white, African American, and Hispanic veterans undergoing TKA (12,108 patients) and THA (6703 patients) over a 5-year period. Although the groups had similar unadjusted 30-day risks of mortality after THA or TKA, African Americans had a higher relative risk of both non-infection-related and infection-related complications after TKA. Hispanic patients had a higher risk of infection-related complications after TKA, but race/ethnicity was not associated with either non-infection-related or infection-related complications after THA [26]. While the VA healthcare system may be limited in some ways (few women), both the VA and Medicare systems control for access to health care and provide a large database for study, allowing a clear race disparity in TJAs to emerge.

**Table 1.** Comparison of arthroplasty usage among races and ethnic groups reported in the literature

Study	Data years	African American	White	Hispanic	Data reported*
Cisternas et al. [11] (2009)	2000–2006	5.6	9.2	NA	Rate (TKA only)
Escalante et al. [15] (2002)	1995–1996	0.49	1.0	0.29	OR (THA only)
McBean and Gornick [34] (1994)	1986	1.09 (hip)	2.47 (hip)	NA	Rate
		1.21 (knee)	2.11 (knee)		
Skinner et al. [44] (2006)	1988–1994; 2000	4.33 (women)	5.68 (women)	4.69 (women)	Rate (TKA only)
		1.60 (men)	4.46 (men)	3.17 (men)	
Skinner et al. [43] (2003)	1998–2000	4.84 (women)	5.97 (women)	5.37 (women)	Rate (TKA only)
		1.84 (men)	4.82 (men)	3.46 (men)	

\* Denotes whether numbers represent rate per 1000 individuals in the healthcare system or an odds ratio (OR) compared to whites; NA = not applicable.

## Patient and Provider Factors Contributing to TJA Utilization Disparities in Racial and Ethnic Minorities

Factors attempting to explain variation among races with regard to health care are typically described as patient-specific, provider-specific, or system-related. While these categories emerge when describing causal factors of racial and ethnic healthcare disparities, it is important to note they are closely related. We will focus on patient and provider factors as system-related factors are difficult to isolate or solve.

From the patient's perspective, barriers to equal care include differences in socioeconomic status; variations in patient recognition of symptoms; thresholds for seeking care; effective communication of symptoms to a provider who understands their meaning; expectations of care; racial and ethnic differences in patterns of self-care; and with regard to TJA, familiarity with procedures, expectations of postoperative outcomes, the influence of prayer on willingness to undergo surgery, and perception of symptoms and adherence to preventive measures and medications [14, 30, 40].

Several studies have attempted to better understand patient factors that play a role in decreased utilization of TKA among African American patients. These studies have demonstrated African American patients are less familiar with TKA than their white counterparts [37], less likely to know someone who has undergone TKA [19, 24, 25, 39], less likely to believe TKA will end in a successful outcome [40], and more likely to anticipate greater perioperative pain and longer recovery [8]. African American patients are also more likely to believe prayer [4, 16, 27, 29] and nontraditional therapies such as herbal remedies will be beneficial [23]. In addition, African American patients have lower trust in the healthcare system in general, and among African American patients, those who do not have a primary care physician have even less trust [17, 25, 47]. While trust and compliance are characterized as patient factors, it is important for us as healthcare providers to recognize our role in facilitating trust and compliance by educating our patients and communicating with them in a culturally competent manner using terminology they understand and can relate to.

We identified no published data specifically on provider-related factors as they relate to lower utilization of THA and TKA in racial and ethnic minorities. However, one study evaluating the role of utilization of TKA in female patients reported both primary care physicians and orthopaedic surgeons were less likely to recommend TKA for a standardized woman actor with moderate OA compared with a male actor with moderate OA and similar presentation [6]. In addition, another study not related to THA or TKA demonstrated physicians were less likely to

recommend cardiac catheterization for African American male and female actors compared with non-Hispanic white actors presenting with identical history and findings [42]. Provider-related factors related to race and ethnicity have yet to be specifically studied in TJA; nevertheless, these studies should make us aware of the potential for conscious or unconscious bias to play a role in some of our treatment recommendations or decisions. More research will be needed to better understand these issues.

## Elimination of Racial and Ethnic TJA Utilization Disparities

Several studies have documented the success, efficacy, and cost-effectiveness of THA and TKA for advanced OA [7, 20, 31, 32, 37]. In addition, disabling OA is at least as prevalent among African Americans and Hispanics as among non-Hispanic whites [9, 35]. Therefore, the evidence would suggest reduction or elimination of racial and ethnic TJA disparities is most likely best accomplished by increasing the utilization of TJA by African Americans and Hispanics with sufficient pain and disability related to OA rather than by decreasing utilization in non-Hispanics whites.

Elimination of utilization disparities requires improving our understanding of the root causes of these disparities from the perspective of the patient, the provider, and the health system as a whole with further research and developing and implementing a plan to address the root causes we are aware of now.

Research to further understand the root causes of TJA utilization disparities would be facilitated by increased funding for health disparity research, particularly as it applies to TJA and musculoskeletal disease. In addition, physician-scientist training programs that provide clinicians with interest in musculoskeletal health disparities with the research background and tools to compete for funding would also facilitate improving this understanding.

Developing and implementing an intervention to improve TJA utilization by racial and ethnic minorities should focus on the patient factors discussed. Patients are more prepared to make informed choices that are in their best interests when they have a good understanding of their condition, the prognosis of their disease, the treatment options, the specifics regarding what is involved with each treatment option, and the likely outcome and risks of intervention. Opportunities to improve minority patients "health literacy" related to joint diseases and TJA include educational programs through medical providers, media outlets, churches and faith organizations, and other community establishments that reach minority patients, particularly those that focus on education and engender

trust. It is also important that we as physicians accept some responsibility in educating our patients, particularly those with a poorer understanding of their disease and options for treatment, to empower our patients to make more informed choices. Given the success rate of TJA, improving racial and ethnic minorities understanding of the natural progression of OA and the documented success of TJA would likely decrease utilization disparities at least as they are related to patient factors.

Racial and ethnic disparities in TJA and in general remain a challenging dilemma. We do not have the answers at this time, but with increased education, awareness, and research, we should have more answers in the future.

## Discussion

For minority populations in the United States, especially African Americans, Hispanics, and Native Americans, healthcare disparities are a serious problem. Several studies have documented racial and ethnic utilization disparities with regard to both THA and TKA. We therefore (1) defined the lower utilization of THA and TKA in racial and ethnic minorities, (2) delineated patient and provider factors contributing to lower utilization of TJA, and (3) discussed potential interventions and future research that may increase TJA utilization by racial and ethnic minorities.

There are limitations to the literature and our study. First, most studies examining racial and ethnic disparities in TJA utilization have been conducted with the Medicare database and this may provide an incomplete view of the level of disparity. Approximately 35% of patients who receive TJAs are younger than Medicare age; therefore, the Medicare population-based studies may underestimate the extent of utilization variations. Second, using the Medicare patient population as the denominator for calculating the TJA population does not reflect the real population, as most are not candidates for arthroplasty [22]. Third, we specifically limited our study to the US population, so our data would not necessarily apply to other countries.

Where are we now? Studies evaluating the prevalence of OA and disability from OA have shown African Americans and Hispanics to have at least equal, if not greater, prevalence of OA and disability related to OA compared with non-Hispanic whites [9, 12]. Therefore, lower utilization is not justified based on need. In the study from the VA Medical Center by Ibrahim et al. [23], there was no difference in the Charlson Comorbidity Index among African Americans, who were less likely to undergo TJA than non-Hispanic whites, who were more likely to undergo TKA. Thus, medical comorbidities do not appear to explain the lower utilization of TJA among racial and ethnic minorities.

The second important issue in understanding where we are now is understanding the etiology of these utilization disparities. The reasons for the observed racial and ethnic disparities in the use of THA and TKA for the management of OA are complex and remain an important subject of research [22].

Where do we need to go? Elimination of racial and ethnic TJA utilization disparities requires a better understanding of the factors responsible for these disparities. There is at least some evidence that patient factors such as less familiarity with TJA, lower expectations with TJA, and decreased trust in the medical system play a role in African American patients being reluctant to undergo TJA. In the attempt to remove these barriers, education and communication are necessary. Both the provider and the patient are required to establish trust and communicate in a manner that allows the other party to understand and be empowered to combat disease. Ideally, the patient should take an active role in learning about his or her condition, and the provider should assess the baseline knowledge of the patient and educate the patient regarding his or her condition, prognosis, treatment options, risks, and expectations. It is important to understand previous unethical abuses in medicine have contributed to the lack of trust many ethnic minorities have for healthcare providers and the healthcare system as a whole (Tuskegee experiments) [1]. Consequently, it behooves us as physicians and healthcare providers to exert empathy and the necessary energy to establish trust, improve the health literacy of our patients, and empower our patients to make informed choices in the best interests of their health.

How do we get there? Education is a tool for containing cost. Providing consumers with more information about their disease has been one of the major developments in the healthcare services market in the recent years. This information can be supplied by the physicians [46]. Recently, innovative patient educational programs with collaboration between medical providers and church or community organizations have led to increased health knowledge and improvements in health status of minority participants in these programs [41]. These programs aim to increase health literacy, improve patients understanding of how to access care, and empower patients to actively participate in medical decision-making and follow through on medical treatment plans. Finally, new research may help identify causes of racial and ethnic disparities, design interventions targeting the elimination of disparities, and evaluate the effectiveness of such programs.

Every human being of any sex, ethnicity, race, or background deserves quality health care. Healthcare providers have an ethical responsibility to value life and maintain the quality of life equally for all patients. Emphasis on compassionate and culturally competent care,



optimization of the patient-physician relationship, and improved diversity and awareness of the healthcare delivery team are all important factors for improving health care for our patients.

## References

- Ad Hoc Panel. *Final Report of the Tuskegee Syphilis Study*. Washington, DC: US Department of Health, Education and Welfare; 1993.
- Agency for Healthcare Research and Quality, US Department of Health and Human Services. 2008 National Healthcare Disparities Report. 2009. AHRQ Publication Number 09-0002. Available at: <http://www.ahrq.gov/qual/qdr08.htm>. Accessed December 7, 2010.
- American Academy of Orthopaedic Surgeons. The burden of musculoskeletal diseases in the United States. Bone and Joint Decade. 2008. Available at: <http://www.boneandjointburden.org>. Accessed October 25, 2010.
- Ang DC, Ibrahim SA, Burant CJ, Siminoff LA, Kwok CK. Ethnic differences in the perception of prayer and consideration of joint arthroplasty. *Med Care*. 2002;40:471–476.
- Betancourt JR, Green AR, Carrillo JE, Ananeh-Firempong O 2nd. Defining cultural competence: a practical framework for addressing racial/ethnic disparities in health and health care. *Public Health Rep*. 2003;118:293–302.
- Borkhoff CM, Hawker GA, Kreder HJ, Glazier RH, Mahomed NN, Wright JG. Patients' gender affected physicians' clinical decisions when presented with standardized patients, but not for matching patients. *J Clin Epidemiol*. 2009;62:527–541.
- Bourne RB, Maloney WJ, Wright JG. An AOA critical issue: the outcome of the outcomes movement. *J Bone Joint Surg Am*. 2004;86:633–640.
- Byrne MM, Soucek J, Richardson M, Suarez-Almazor M. Racial/ethnic differences in preferences for total knee replacement surgery. *J Clin Epidemiol*. 2006;59:1078–1086.
- Centers for Disease Control and Prevention (CDC). Prevalence and impact of arthritis by race and ethnicity—United States, 1989–1991. *MMWR Morb Mortal Wkly Rep*. 1996;45:373–378.
- Chen J, Rathore SS, Radford MJ, Wang Y, Krumholz HM. Racial differences in the use of cardiac catheterization after acute myocardial infarction. *N Engl J Med*. 2001;344:1443–1449.
- Cisternas MG, Murphy L, Croft JB, Helmick CG. Racial disparities in total knee replacement among Medicare enrollees—United States 2000–2006. *MMWR Morb Mortal Wkly Rep*. 2009;58:133–138.
- Dinan MA, Armstrong B, Friedman J, Schulman K. Appendix B: Public funds contributing to revenue supporting programs for medical schools. In: Sullivan Commission on Diversity in the Healthcare Workforce. Missing Persons: Minorities in the Health Professions. Washington, DC: Sullivan Commission on Diversity in the Healthcare Workforce; 2004.
- Dunlop DD, Song J, Manheim LM, Chang RW. Racial disparities in joint replacement use among older adults. *Med Care*. 2003;41:288–298.
- Dykes DC, White AA 3rd. Getting to equal: strategies to understand and eliminate general and orthopaedic healthcare disparities. *Clin Orthop Relat Res*. 2009;467:2598–2605.
- Escalante A, Barrett J, del Rincón I, Cornell JE, Phillips CB, Katz JN. Disparity in total hip replacement affecting Hispanic Medicare beneficiaries. *Med Care*. 2002;40:451–460.
- Figaro MK, Russo PW, Allegrante JP. Preferences for arthritis care among urban African Americans: “I don’t want to be cut.” *Health Psychol*. 2004;23:324–329.
- Gandhi R, Razak F, Davey JR, Mahomed NN. Ethnicity and patient’s perception of risk in joint replacement surgery. *J Rheumatol*. 2008;35:1664–1667.
- Golightly YM, Dominick KL. Racial variations in self-reported osteoarthritis symptom severity among veterans. *Aging Clin Exp Res*. 2005;17:264–269.
- Groeneveld PW, Kwok CK, Mor MK, Appelt CJ, Geng M, Gutierrez JC, Wessel DS, Ibrahim SA. Racial differences in expectations of joint replacement surgery outcomes. *Arthritis Rheum*. 2008;59:730–737.
- Hawker G, Wright J, Coyte P, Paul J, Dittus R, Croxford R, Katz B, Bombardier C, Heck D, Freund D. Health-related quality of life after total knee replacement. *J Bone Joint Surg Am*. 1998;80:163–173.
- Hudak PL, Clark JP, Hawker GA, Mahomed NN, Kreder HJ, Wright JG. “You’re perfect for the procedure! Why don’t you want it?” Elderly arthritis patients’ unwillingness to consider total joint arthroplasty surgery: a quantitative study. *Med Decis Making*. 2002;22:272–278.
- 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 1):S87–S94.
- Ibrahim SA, Siminoff LA, Burant CJ, Kwok CK. Variation in perceptions of treatment and self-care practices in elderly with osteoarthritis: a comparison between African American and white patients. *Arthritis Rheum*. 2001;45:340–345.
- Ibrahim SA, Siminoff LA, Burant CJ, Kwok CK. Differences in expectations of outcome mediate African American/white patient differences in “willingness” to consider joint replacement. *Arthritis Rheum*. 2002;46:2429–2435.
- Ibrahim SA, Siminoff LA, Burant CJ, Kwok CK. Understanding ethnic differences in the utilization of joint replacement for osteoarthritis: the role of patient-level factors. *Med Care*. 2002;40(Suppl 1):I44–I51.
- Ibrahim SA, Stone RA, Han X, Cohen P, Fine MJ, Henderson WG, Khuri SF, Kwok CK. Racial/ethnic differences in surgical outcomes in veterans following knee or hip arthroplasty. *Arthritis Rheum*. 2005;52:3143–3151.
- Ibrahim SA, Zhang A, Mercer MB, Baughman M, Kwok CK. Inner city African-American elderly patients’ perceptions and preferences for the care of chronic knee and hip pain: findings from focus groups. *J Gerontol A Biol Sci Med Sci*. 2004;59:1318–1322.
- Jones A, Kwok CK, Kelley ME, Ibrahim SA. Racial disparity in knee arthroplasty utilization in the Veterans Health Administration. *Arthritis Rheum*. 2005;53:979–981.
- Jones AC, Kwok CK, Groeneveld PW, Mor M, Geng M, Ibrahim SA. Investigating racial differences in coping with chronic osteoarthritis pain. *J Cross Cult Gerontol*. 2008;23:339–347.
- Kane RL, Wilt T, Suarez-Almazor ME, Fu SS. Disparities in total knee replacements: a review. *Arthritis Rheum*. 2007;57:562–567.
- Lavernia CJ, Guzman JF, Gachupin-Garcia A. Cost-effectiveness and quality of life in knee arthroplasty. *Clin Orthop Relat Res*. 1997;345:134–139.
- Losina E, Walensky RP, Kessler CL, Emrani PS, Reichmann WM, Wright EA, Holt HL, Solomon DH, Yelin E, Paltiel AD, Katz JN. Cost-effectiveness of total knee arthroplasty in the United States: patient risk and hospital volume. *Arch Intern Med*. 2009;169:1113–1121; discussion 1121–1122.
- Mahomed NN, Barrett JA, Katz JN, Phillips CB, Losina E, Lew RA, Guadagnoli E, Harris WH, Poss R, Baron JA. Rates and outcomes of primary and revision total hip replacement in the

- United States Medicare population. *J Bone Joint Surg Am.* 2003;85:27–32.
34. McBean AM, Gornick M. Differences by race in the rates of procedures performed in hospitals for Medicare beneficiaries. *Health Care Financ Rev.* 1994;15:77–90.
  35. Murphy L, Schwartz TA, Helmick CG. Lifetime risk of symptomatic knee osteoarthritis. *Arthritis Rheum.* 2008;59:1207–1213.
  36. Nelson CL. Disparities in orthopaedic surgical intervention. *J Am Acad Orthop Surg.* 2007;15(Suppl 1):S13–S17.
  37. NIH Consensus Statement on total knee replacement. *NIH Consensus State Sci Statements.* 2003;20:1–34.
  38. Peterson ED, Shaw LK, DeLong ER, Pryor DB, Califf RM, Mark DB. Racial variation in the use of coronary-revascularization procedures: are the differences real? Do they matter? *N Engl J Med.* 1997;336:480–486.
  39. Rowley DL, Jenkins BC, Fraizer E. Utilization of joint arthroplasty: racial and ethnic disparities in the Veterans Affairs Health Care System. *J Am Acad Orthop Surg.* 2007;15(Suppl 1):S43–S48.
  40. Samuel-Hodge CD, Watkins DC, Rowell KL, Hooten EG. Coping styles, well-being, and self-care behaviors among African Americans with Type 2 diabetes. *Diabetes Educ.* 2008;34:501–510.
  41. Schneider EC, Zaslavsky AM, Epstein AM. Racial disparities in the quality of care for enrollees in Medicare Managed Care. *JAMA.* 2002;287:1288–1294.
  42. Schulman KA, Berlin JA, Harless W, Kerner JF, Sistrunk S, Gersh BJ, Dubé R, Taleghani CK, Burke JE, Williams S, Eisenberg JM, Escarce JJ. The effect of race and sex on physicians' recommendations for cardiac catheterization. *N Engl J Med.* 1999;340:618–626.
  43. 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;349:1350–1359.
  44. Skinner J, Zhou W, Weinstein J. The influence of income and race on total knee arthroplasty in the United States. *J Bone Joint Surg Am.* 2006;88:2159–2166.
  45. Smedley BD, Stith AY, Nelson AR, eds. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care.* Washington, DC: The National Academies Press; 2003.
  46. Suarez-Almazor ME, Soucek J, Kelly PA, O'Malley K, Byrne M, Richardson M, Pak C. Ethnic variation in knee replacement. *Arch Intern Med.* 2005;165:1117–1124.
  47. Van Ryn M, Fu SS. Paved with good intentions: do public health and human service providers contribute to racial/ethnic disparities in health? *Am J Public Health.* 2003;93:248–255.
  48. Weinstein JN, Birkmeyer JD, eds. *The Dartmouth Atlas of Musculoskeletal Health Care.* Chicago, IL: AHA Press; 2000.
  49. Wright JG, Hawker GA, Bombardier C, Croxford R, Dittus RS, Freund DA, Coyte PC. Physician enthusiasm as an explanation for area variation in the utilization of knee replacement surgery. *Med Care.* 1999;37:946–956.