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Racial/Ethnic and Socioeconomic Disparities in Osteoarthritis Management

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Keywords

Osteoarthritis; Race; Black; Hispanic; Latino; Socioeconomic; Disparities; Total joint replacement

Introduction

Osteoarthritis (OA) of the knee and hip are common conditions with significant morbidity. According to Osteoarthritis Research Society International guidelines[1], recommended management includes osteoarthritis education, dietary weight management, exercise and physical therapy (PT), pharmacologic treatment with NSAIDs, intraarticular steroid injections, and total joint replacement. Oral and transdermal opioids are strongly not recommended. We focused our review of disparities in OA management on these interventions. We observed differences in the management of osteoarthritis by race/ethnicity and socioeconomic status (SES) (Table 1)[2], including differences in treatment utilization, barriers to access, and outcomes after treatment.

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Osteoarthritis Education

Osteoarthritis education includes providing patients with information about OA disease progression and self-care techniques. Interventions focused on OA education appear to have positive effects[3–6]. Community-based SMEs, for example, have demonstrated improvements in self-care behavior and self-efficacy compared to controls for up to 1 year after the intervention. Murphy et al.[7] encourages providers to consistently recommend SMEs to all patients.

There is a paucity of data on differences in OA educational interventions by race, and we found no studies explicitly investigating racial differences. A cross-sectional study found overweight/obese blacks and Hispanics with OA were more likely to be advised to lose weight than whites (adjusted OR 1.16 for blacks and 1.32 for Hispanics)[8]. Other studies found no difference by race in participation of self-management education (SME) programs[7] or osteoarthritis education[9].

More evidence is available for differences in OA education by SES. Generally, lower educational attainment is associated with receiving less education from providers[7–11] and lower participation in SMEs (6% for less than high school vs. 14% for college degree)[7].

Dietary Weight Management

There is a paucity of data on racial or socioeconomic differences in dietary weight management in OA patients, though a trial investigating racial differences in diet benefits for knee OA is ongoing[12]. However, there are well documented disparities in obesity by race and SES[13–16]. For example, obesity prevalence for U.S. adults was 37.9% for whites, 46.8% for blacks, and 47% for Hispanics in 2015–2016[15]. Obesity prevalence is higher among those with less education (40% for high school degree or less vs. 27.8% for college graduates) and lower incomes (39% for ≤130% of the federal poverty level vs. 31.2% for ≥350% of the federal poverty level)[16]. Obesity is a risk factor for OA and is affected by genetics, diet, physical activity, income, discrimination, and more[14]. Many of these factors are affected by systemic racism—the system (consisting of structures, policies, practices, and norms) that structures opportunity and assigns value based on phenotype (the social construction known as “race”)[17]. Examples of systemic racism affecting disparities in obesity include food insecurity, understanding of nutrition, ability to exercise regularly, neighborhood environment, and more. National disparities in diet quality have been observed by race, education, and income level, and are persistent or worsen over time[18].

Exercise/Physical Therapy

Utilization/Access

Race and SES have independent effects on PT use in OA. For example, a cross-sectional analysis found reduced likelihood of an outpatient PT visit for blacks [OR 0.55 (95% CI: 0.45–0.68)] and Hispanics [OR 0.73 (95% CI: 0.58–0.93)] compared to whites[19] Adjustment for SES factors attenuated the difference in PT use for Hispanics, but the decreased odds of PT use persisted for blacks. Cross-sectional studies find patients with higher education are

more likely to receive PT, while patients who are black, Hispanic, have low educational attainment, or have public/no insurance are less likely to receive PT[20–22]. Referral patterns may contribute to these differences, as primary care visits covered by Medicaid are less likely to receive PT referral than those covered by private insurance[23]. Patients have reported affordability, insurance coverage, and lack of transportation as barriers for not seeking PT services[24].

Differences also exist in exercise activity by race and SES. While 25% of American adults do not engage in any leisure time physical activity, inactivity prevalence is higher for adults with lower education levels (44.1% for less than high school), Hispanics (32.7%), and blacks (33.1%)[25,26]. Other studies have also found that Hispanics, blacks, and patients with lower education are less likely to engage in exercise[27,28]. Among black adults, a systematic review identified family responsibilities, lack of childcare, financial costs of a gym membership or equipment, long working hours, difficult manual labor, concerns about neighborhood safety, and lack of parks or open spaces as barriers to exercise[29].

Interventions/Outcomes

Interventions focused on exercise improve functional outcomes and may help reduce health disparities. One study on older patients with knee OA found racial differences in baseline health status (RAND-36 general health scores and 6-minute walk distance) but found no difference in scores between whites and blacks after 18 months of exercise therapy[30]. Community based walking programs have also yielded improvements in symptoms, function, and overall health[31–35].

Pharmacologic: NSAIDs

The evidence linking NSAID use to race is mixed. Vina et al.[36] found Hispanics with knee or hip OA used over-the-counter (OTC) NSAIDs less than whites and used prescription NSAIDs more than whites. Prior literature supported differences in NSAID utilization between blacks and whites though directionality conflicted[37–39]. Other studies have found no difference in NSAID use or prescriptions by race[40–42].

Older literature supported differences by race in NSAID drug classes prescribed. Studies from 2003–2005 found blacks and whites were more likely to be prescribed non-selective NSAIDs while whites were more likely to be prescribed COX-2 selective analgesics[43–45]. We did not find more recent studies investigating NSAID drug class prescriptions by race.

There is a paucity of data regarding differences in NSAID use by SES.

Pharmacologic: Opioids (not recommended)

While NSAIDs can be obtained OTC or by prescription, opioids require prescription and thus differences in opioid prescribing patterns by race may reflect provider bias or unequal treatment. There is evidence for systematic undertreatment of pain in blacks compared to whites across medicine[46–52]. Research suggests this could be due, in part, to racial bias and false beliefs about biological differences between blacks and whites[53]. Recent increases in

opioid prescriptions predominantly affected whites[54,55]. Physicians are less likely to prescribe opioids to blacks and Hispanics compared to whites[38,41,43,45,56]. A study of physicians watching videos of patient actors with knee OA found black and Hispanic patients were prescribed opioids less than whites (27% vs. 33% vs. 47%)[41]. When opioids are prescribed, black patients receive a lower days' supply compared to whites[45].

There is less data available for differences in opioid prescribing by SES. A study using national Medicare data found white race, low income, and living in a low education area were independently associated with prolonged opioid prescription (90 days or more)[54].

Intraarticular Steroid Injections

We found no studies examining differences in intraarticular steroid injection use or outcomes by race or SES.

Total Joint Replacement Utilization

There is copious literature on racial disparities in total joint arthroplasty (TJA) utilization[2,57–59]. Whites are more likely to receive TJA than blacks or Hispanics and these differences persist in groups with the same insurance or after controlling for health insurance status[60–71]. These differences also persist after controlling for age and other socioeconomic factors[72–74]. Although race and SES are interconnected, and some studies find socioeconomic factors partially explain racial disparities in TJA use, independent effects from race usually remain.

Racial disparities in TJA use have persisted over the past 30 years[73,75–80]. A retrospective study using the National Inpatient Sample found persistent or worsening disparities in TJA use from 2006–2015[80]. A prospective study of postmenopausal women by Cavanaugh et al. [73] found that among women with health indicators for total knee arthroplasty (TKA), black and Hispanic women were less likely to undergo TKA than whites, even after adjusting for age and SES (adjusted HR 0.75 and 0.65). A multicenter cohort study by Ghomrawi et al.[81] found blacks have higher odds of not receiving TKA when clinically appropriate, suggesting underutilization in blacks rather than overutilization in whites.

Disparities in TJA use by SES has been observed as well. Within a Medicare population, patients dually enrolled in Medicaid have lower rates of primary and revision TJA[65,66]. In settings abroad with universal health coverage, differential TJA use by SES has also been observed[82].

There are likely several factors underlying racial and socioeconomic disparities in TJA use. These include differential access due to systemic racism through factors such as housing, healthcare segregation, and insurance. Studies have investigated personally-mediated barriers at the provider and patient level.

Access

Many patients face issues reaching care. Lack of geographic proximity or transportation limit access. Higher rates of racial residential segregation have been associated with racial

differences in joint arthroplasty rates[64]. This form of systemic racism, resulting in part from government discriminatory practices[83], has also affected the hospitals where blacks and Hispanics receive their care. Low-volume centers have been associated with worse outcomes[84–86] and minorities or patients with low SES receive disproportionately more surgery at low volume centers and lower quality hospitals[78,86–88].

Socioeconomic barriers contribute to lack of access to TJA. Providers and health systems may respond to financial incentives. Pandya et al.[59] suggest several reasons why underinsured or publicly insured individuals lack access to orthopaedic surgery, including preferential appointment processing for privately insured patients in high density areas with high competition, limited reimbursement for Medicaid patients in urban areas, mandates from health systems on percentages of private vs. publicly insured patients, and practices with self-imposed limits on the number of patients they are willing to treat with public or no insurance. Kim et al.[89] found patients with Medicaid are less likely to receive an orthopaedic appointment to be evaluated for TKA compared to Medicare or privately insured patients, with success rates for obtaining an appointment at 30%, 96%, and 100%, respectively. Patients with Medicaid also experienced longer waiting periods, and higher Medicaid reimbursement was correlated with higher likelihood of obtaining an appointment (for every $100 increase: adjusted OR 1.23 for primary TKA, 1.31 for revision). While geographic proximity affects access, being close to urban centers where more providers practice may not translate to greater access for patients with low SES. Medicaid patients are less likely than patients in less populous areas (away from academic centers) to obtain an outpatient orthopaedic appointment[90].

Language barriers also limit access. Greene et al.[91] called randomly selected orthopaedic offices in California specializing in knee surgery using a script to request an appointment for a hypothetical Spanish-speaking or English-speaking 65 year-old man with knee pain. 80% of hypothetical Spanish-speaking patients were asked to rely on nonqualified interpreters for their orthopaedic appointments (e.g. friend or family member) rather than being provided with professional interpretation services.

Provider-level barriers

Physicians have implicit bias[92–97]. In a systematic review, Hall et al.[95] concluded most providers have implicit bias, with positive attitudes toward whites and negative attitudes toward blacks, Hispanics, and dark-skinned individuals. Implicit bias was related to patient-provider interactions[98–101], treatment decisions[102,103], and patient health outcomes[104].

Black patients are less likely to receive an offer for TKA from their surgeons compared to whites[105]. The racial difference in TKA offer and complication rates have been estimated to cause a loss of 72,000 QALYs in black knee OA patients compared to white knee OA patients[106]. The difference in offer rate, however, may be affected by patient “preference” (discussed below). While Hausmann et al.[105] found lower TJA recommendation rates for blacks compared to whites (OR 0.46, 95% CI: 0.26–0.83), this difference was not statistically significant after adjusting for patient preference for TJA (OR 0.69, 95% CI: 0.36–1.31). Oliver et al.[94] found physicians had implicit racial biases (positive attitudes toward whites and negative attitudes toward blacks) and believed whites were more

medically cooperative than blacks; however there was no statistically significant difference for TKA recommendation by race.

Lack of diversity in the physician workforce, especially in orthopaedics, likely contributes to disparities in TJA utilization. The paucity of black, Hispanic, and female orthopaedic surgeons may influence patient trust, "preferences" for care, health-seeking behavior, and physician-patient communication[107–111].

Patient-level barriers

Patient "preference" and mistrust—There is extensive literature investigating the role of patient preference in disparities in TJA use[112–114]. Blacks are less likely than whites to prefer TJA as a treatment option[38,113–120]. Surgeons may be responsive to patient preferences regarding the procedure, decreasing TJA offer rate for blacks[105].

However, disparities research has emphasized individual factors and systemic racism has been underexplored[121]. The Institute of Medicine report Unequal Treatment[122] discusses that for racial minorities, preferences for treatment are difficult to separate from mistrust of healthcare, which stems from racial discrimination and a long history of segregated and inferior care. As Bloche[123] has noted, for blacks "doubts about trustworthiness of physicians and healthcare institutions spring from collective memory of the Tuskegee experiments and other abuses of black patients by largely white health professionals. This legacy of distrust, which, some argue, contributes to disparities in health care provision by discouraging African Americans from seeking or consenting to state-of-the-art medical services, is thus itself a byproduct of past racism". Since patients' negative responses to discrimination may profoundly affect "preference", it is difficult to distinguish "preference" from provider/ systemic racial discrimination[123].

Several factors affecting patient preference have been investigated and are listed below. It is important to note these factors are intimately connected to past and ongoing systemic racism.

Alternative therapies—Studies have observed that blacks and Hispanics may rely more on alternative therapies or non-surgical coping strategies, such as prayer or natural pain remedies, to deal with OA[38,110,124–126]. While this has often been attributed to cultural differences, it is also possible these behaviors reflect adaptions to marginalization and lack of access to the health care system.

Lack of familiarity—Racial differences in personal- and community-level knowledge of TJA procedures have been observed and may influence willingness to undergo surgery[114,115,127,128]. Blacks are less familiar with TJA and are less likely to have friends or family who have undergone the procedure. Lack of familiarity may also stem from exclusion and lower healthcare access. Additionally, there is a self-perpetuating loop where disparities in TJA utilization contribute to lack of familiarity, which reduces willingness to undergo joint replacement surgery.

Outcome expectations—Blacks have lower expectations than whites regarding TJA, expecting longer, more painful postoperative courses and more functional disability after surgery[114,115,120,129–131]. The evidence is mixed on whether lower outcome expectations explain lower willingness to undergo surgery[120,128].

Interventions—While many studies have observed TJA use disparities, there is less research on interventions to reduce disparities. Some interventions have aimed to improve willingness to undergo surgery through education (e.g. decision aids, counseling), to improve familiarity/knowledge of the procedure and improve outcome expectations. Most studies have shown improved willingness for TKA after an intervention[132–135] while one showed more pessimistic TKA expectations[134]. A randomized clinical trial by Ibrahim et al.[135] found patients who received an education decision aid had a higher rate of undergoing TKA compared to controls over the next 12 months (14.9% vs. 7.7%). Limitations to education-focused interventions, however, have been acknowledged. A randomized clinical trial by Vina et al.[136] using a decision-aid and motivational interviewing resulted in no difference in willingness to undergo TKA between intervention and control groups. This may reflect that while individual-level interventions may improve familiarity/knowledge of the procedure, mistrust and the legacy of racism are much more difficult to address.

Total Joint Replacement Outcomes

Symptoms and function

Racial and socioeconomic disparities have been documented for a range of TJA outcomes[137]. Blacks and Hispanics have been found to have worse patient-reported outcomes (e.g. pain, function, satisfaction) after TJA[138–146]. A systematic review by Mehta et al.[138] found blacks had more pain and worse function after THA, though differences were not clinically significant. A systematic review by Goodman et al.[139] found that after TKA, blacks had worse qualify of life, pain, function, and satisfaction. Another study by Goodman et al.[140] found that while worse WOMAC pain and function scores were associated with higher levels of community poverty, this effect was more pronounced in blacks compared to whites. In areas with over 40% poverty, blacks scored 6 points lower than whites for WOMAC pain and 7 points lower than whites for WOMAC function on 2-year postoperative follow up. After TKA, blacks are 3 times more likely to be dissatisfied than whites[146].

Lower SES is associated with worse outcomes as well. Lower education[147,148], low income[145], and Medicaid insurance[149,150] are associated with worse function after TJA.

Length of stay (LOS)

Patients who are nonwhite[151–153] or with low SES have a higher risk for longer LOS after TJA[154–156].

Complications

Blacks and Hispanics have higher complication rates after arthroplasty. A review by Nwachukwu et al.[157] found racial minorities have higher risk for early complications after

TKA, particularly joint infections, and perhaps higher mortality risk after THA. Other studies have found blacks have higher complication rates after TJA (OR 1.58)[78,158].

The evidence for differences in mortality or medical complications is mixed. Some studies have found increased mortality risk for blacks after TJA[65,66,78] while others have found no difference in major complication rate or mortality[159–161].

Race and SES may be associated with surgical complications after TJA. Some studies have found higher risk for postoperative infection in blacks after TKA[66,160,162]. In an insured cohort, blacks and Hispanics had lower odds of deep infection after THA compared to whites (OR 0.62 and 0.58)[161]. Medicaid insurance is associated with higher risk of postoperative in-hospital infection (OR 1.7), wound dehiscence (OR 2.2), and hematoma/seroma (OR 1.3)[163]. Compared to Medicare insurance, privately insured patients have fewer complications and lower mortality after TKA and THA[164,165].

Readmissions

Blacks have higher readmission rates after TJA than whites[66,76,166–168]. Studies have found higher odds for 30-day readmission for blacks compared to whites even after covariate adjustment (OR 1.2)[166–168]. These differences may be worsening over time—30-day readmissions in 1991 were 6% higher for blacks than for whites but 24% higher in 2008[76]. In an insured population, however, blacks and whites had similar 90-day readmission rates after THA[161]. SES may be associated with readmission, as patients from zip codes with lower median incomes are more likely to be readmitted after TKA or THA compared to patients from high median income zip codes (11% vs 8%)[156].

Failure/Revision

Most studies find blacks have higher risk for TJA failure/revision than whites[169–171]. A systematic review by Bass[172] found a pooled hazard ratio of 1.38 (95% CI: 1.20–1.58) for risk of revision TKA in blacks compared to whites. However, in an insured population blacks and Hispanics had lower lifetime all-cause THA revision compared to whites (adjusted HR 0.79 and 0.73)[161]. Risk of inpatient THA dislocation has been found to be higher for blacks (adjusted OR 1.66), Hispanics (adjusted OR 1.56), and patients with low SES as measured by Medicaid insurance (adjusted OR 1.30) or zip code with lower median income (adjusted OR 1.22).

Several factors likely contribute to these disparities. Systemic racism impacts social determinants of health and worsens health outcomes for blacks and Hispanics. Increased rates of comorbidities in racial minorities and poor patients increase risk for worse postsurgical outcomes. Barriers to healthcare access may cause marginalized groups to reach care with more advanced disease. Healthcare segregation leads racial minorities to disproportionately receive care from low-volume and low-quality hospitals. Provider- and institutional-level bias/racism may affect communication, mutual understanding, trust, referral patterns, and treatment decisions.

Conclusion

Racial and socioeconomic disparities exist across several different treatment modalities for the management of OA. Given the historical emphasis on individual/interpersonal mechanisms, future disparities research may benefit from a structural framework, informed by critical race theory[121,173], to highlight institutional and systemic causes for disparities[174]. Clinically, better relations are needed between the healthcare system and historically marginalized communities to increase access, inclusion, and trust. Greater efforts are needed to increase the diversity of clinicians, researchers, and leadership. Continued study, discussions, and training/education can increase engagement on issues of inequity and racism. Quality metrics may help care centers continue to monitor disparities and incentivize improvements. Systemic change to increase health equity ultimately requires policy implementation and active efforts from individuals, health systems, and the greater community.

References:

1. Bannuru RR, Osani MC, Vaysbrot EE, Arden NK, Bennell K, Bierma-Zeinstra SMA, Kraus VB, Lohmander LS, Abbott JH, Bhandari M, Blanco FJ, Espinosa R, Haugen IK, Lin J, Mandl LA, Moilanen E, Nakamura N, Snyder-Mackler L, Trojian T, Underwood M, McAlindon TE. OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. Osteoarthritis Cartilage. 2019 7 3;
2. Ackerman IN, Busija L. Access to self-management education, conservative treatment and surgery for arthritis according to socioeconomic status. Best Pract Res Clin Rheumatol. 2012 10;26(5):561–583. [PubMed: 23218423]
3. Lorig K, Gonzalez VM, Ritter P. Community-based Spanish language arthritis education program: a randomized trial. Med Care. 1999 9;37(9):957–963. [PubMed: 10493473]
4. Wong AL, Harker JO, Lau VP, Shatzel S, Port LH. Spanish Arthritis Empowerment Program: a dissemination and effectiveness study. Arthritis Rheum. 2004 6 15;51(3):332–336. [PubMed: 15188316]
5. Taylor LF, Kee CC, King SV, Ford TABL. Evaluating the effects of an educational symposium on knowledge, impact, and self-management of older african americans living with osteoarthritis. J Community Health Nurs. 2004;21(4):229–238. [PubMed: 15537548]
6. Goeppinger J, Armstrong B, Schwartz T, Ensley D, Brady TJ. Self-management education for persons with arthritis: Managing comorbidity and eliminating health disparities. Arthritis Rheum. 2007 8 15;57(6):1081–1088. [PubMed: 17665471]
7. Murphy LB, Brady TJ, Boring MA, Theis KA, Barbour KE, Qin J, Helmick CG. Self-Management Education Participation Among US Adults With Arthritis: Who's Attending? Arthritis Care Res. 2017;69(9):1322–1330.
8. Fontaine KR, Haaz S, Bartlett SJ. Are overweight and obese adults with arthritis being advised to lose weight? J Clin Rheumatol Pract Rep Rheum Musculoskelet Dis. 2007 2;13(1):12–15.
9. Centers for Disease Control and Prevention (CDC), Hootman JM, Helmick CG, Bolen J,. Monitoring progress in arthritis management--United States and 25 states, 2003. MMWR Morb Mortal Wkly Rep. 2005 5 20;54(19):484–488. [PubMed: 15902071]
10. Carlson SA, Maynard LM, Fulton JE, Hootman JM, Yoon PW. Physical activity advice to manage chronic conditions for adults with arthritis or hypertension, 2007. Prev Med. 2009 9;49(2–3):209–212. [PubMed: 19573554]
11. Dexter P, Brandt K. Relationships between social background and medical care in osteoarthritis. J Rheumatol. 1993 4;20(4):698–703. [PubMed: 8496868]
12. Sorge R Investigating Racial Differences in Diet Benefits for Knee Osteoarthritis [Internet]. clinicaltrials.gov; 2020 4. Report No.: NCT04343716. Available from: https://clinicaltrials.gov/ct2/show/NCT04343716

13. Wong RJ, Chou C, Ahmed A. Long term trends and racial/ethnic disparities in the prevalence of obesity. J Community Health. 2014 12;39(6):1150–1160. [PubMed: 24715435]
14. Byrd AS, Toth AT, Stanford FC. Racial Disparities in Obesity Treatment. Curr Obes Rep. 2018 6;7(2):130–138. [PubMed: 29616469]
15. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity among adults and youth: United States, 2015–2016 [Internet]. Hyattsville, MD: National Center for Health Statistics; 2017. Report No.: 288. Available from: https://www.cdc.gov/nchs/data/databriefs/db288.pdf
16. Ogden CL, Fakhouri TH, Carroll MD, Hales CM, Fryar CD, Li X, Freedman DS. Prevalence of Obesity Among Adults, by Household Income and Education — United States, 2011–2014. MMWR Morb Mortal Wkly Rep. 2017;66(50):1369–1373. [PubMed: 29267260]
17. Camara Phyllis Jones. Confronting Institutionalized Racism. Phylon 1960-. Clark Atlanta University; 2002;50(1/2):7–22.
18. Rehm CD, Peñalvo JL, Afshin A, Mozaffarian D. Dietary Intake Among US Adults, 1999–2012. JAMA. 2016 6 21;315(23):2542–2553. [PubMed: 27327801]
19. Sandstrom R, Bruns A. Disparities in Access to Outpatient Rehabilitation Therapy for African Americans with Arthritis. J Racial Ethn Health Disparities. 2017;4(4):599–606. [PubMed: 27400913]
20. Carter SK, Rizzo JA. Use of outpatient physical therapy services by people with musculoskeletal conditions. Phys Ther. 2007 5;87(5):497–512. [PubMed: 17374630]
21. Iversen MD, Schwartz TA, von Heideken J, Callahan LF, Golightly YM, Goode A, Hill C, Huffman K, Pathak A, Cooke J, Allen KD. Sociodemographic and Clinical Correlates of Physical Therapy Utilization in Adults With Symptomatic Knee Osteoarthritis. Phys Ther. 2018 1;98(8):670–678. [PubMed: 29718472]
22. Beatty PW, Hagglund KJ, Neri MT, Dhont KR, Clark MJ, Hilton SA. Access to health care services among people with chronic or disabling conditions: patterns and predictors. Arch Phys Med Rehabil. 2003 10;84(10):1417–1425. [PubMed: 14586907]
23. Freburger JK, Holmes GM, Carey TS. Physician referrals to physical therapy for the treatment of musculoskeletal conditions. Arch Phys Med Rehabil. 2003 12;84(12):1839–1849. [PubMed: 14669192]
24. Hagglund KJ, Clark MJ, Hilton SA, Hewett JE. Access to healthcare services among persons with osteoarthritis and rheumatoid arthritis. Am J Phys Med Rehabil. 2005 9;84(9):702–711. [PubMed: 16141749]
25. Trends in Meeting the 2008 Physical Activity Guidelines, 2008—2018 [Internet]. 2018. Available from: https://www.cdc.gov/physicalactivity/downloads/trends-in-the-prevalence-of-physical-activity-508.pdf
26. Morbidity and Mortality Weekly Report Data Highlights: Physical Activity [Internet]. Centers for Disease Control and Prevention; 2016 9. Available from: https://www.cdc.gov/physicalactivity/inactivity-among-adults-50plus/mmwr-data-highlights.html
27. Ahmed NU, Smith GL, Flores AM, Pamies RJ, Mason HRC, Woods KF, Stain SC. Racial/ethnic disparity and predictors of leisure-time physical activity among U.S. men. Ethn Dis. 2005;15(1):40–52. [PubMed: 15720048]
28. Goldman D, Smith JP. The increasing value of education to health. Soc Sci Med 1982. 2011 5;72(10):1728–1737.
29. Siddiqi Z, Tiro JA, Shuval K. Understanding impediments and enablers to physical activity among African American adults: a systematic review of qualitative studies. Health Educ Res. 2011 12;26(6):1010–1024. [PubMed: 21873458]
30. Foy CG, Penninx BWH, Shumaker SA, Messier SP, Pahor M. Long-term exercise therapy resolves ethnic differences in baseline health status in older adults with knee osteoarthritis. J Am Geriatr Soc. 2005 9;53(9):1469–1475. [PubMed: 16137274]
31. Callahan LF, Shreffler JH, Altpeter M, Schoster B, Hootman J, Houenou LO, Martin KR, Schwartz TA. Evaluation of group and self-directed formats of the Arthritis Foundation's Walk With Ease Program. Arthritis Care Res. 2011 8;63(8):1098–1107.

32. Wyatt B, Mingo CA, Waterman MB, White P, Cleveland RJ, Callahan LF. Impact of the Arthritis Foundation's Walk With Ease Program on arthritis symptoms in African Americans. Prev Chronic Dis. 2014 11 13;11:E199. [PubMed: 25393747]
33. Callahan LF, Rivadeneira A, Altpeter M, Vilen L, Cleveland RJ, Sepulveda VE, Hackney B, Reuland DS, Rojas C. Evaluation of the Arthritis Foundation's Camine Con Gusto Program for Hispanic Adults With Arthritis. Hisp Health Care Int Off J Natl Assoc Hisp Nurses. 2016;14(3):132–140.
34. Vilen L, Cleveland RJ, Callahan LF. Educational Attainment, Health Status, and Program Outcomes in Latino Adults With Arthritis Participating in a Walking Program. Prev Chronic Dis. 2018 18;15:E128. [PubMed: 30339771]
35. Jones LC, Watkins Y, Alva D. Operation Change: A New Paradigm Addressing Behavior Change and Musculoskeletal Health Disparities. J Racial Ethn Health Disparities. 2018;5(6):1264–1272. [PubMed: 29691790]
36. Vina ER, Hannon MJ, Masood HS, Hausmann LRM, Ibrahim SA, Dagnino J, Arellano A, Kwoh CK. Nonsteroidal Anti-Inflammatory Drug Use in Chronic Arthritis Pain: Variations by Ethnicity. Am J Med. 2019 12 17;
37. Albert SM, Musa D, Kwoh CK, Hanlon JT, Silverman M. Self-care and professionally guided care in osteoarthritis: racial differences in a population-based sample. J Aging Health. 2008 3;20(2):198–216. [PubMed: 18287328]
38. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh 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 8;45(4):340–345. [PubMed: 11501721]
39. Arcury TA, Bernard SL, Jordan JM, Cook HL. Gender and ethnic differences in alternative and conventional arthritis remedy use among community-dwelling rural adults with arthritis. Arthritis Care Res Off J Arthritis Health Prof Assoc. 1996 10;9(5):384–390.
40. Khoja SS, Almeida GJ, Freburger JK. Recommendation Rates for Physical Therapy, Lifestyle Counseling, and Pain Medications for Managing Knee Osteoarthritis in Ambulatory Care Settings: A Cross-Sectional Analysis of the National Ambulatory Care Survey (2007–2015). Arthritis Care Res. 2020 2;72(2):184–192.
41. Maserejian NN, Fischer MA, Trachtenberg FL, Yu J, Marceau LD, McKinlay JB, Katz JN. Variations among primary care physicians in exercise advice, imaging, and analgesics for musculoskeletal pain: results from a factorial experiment. Arthritis Care Res. 2014 1;66(1):147–156.
42. Ausiello JC, Stafford RS. Trends in medication use for osteoarthritis treatment. J Rheumatol. 2002 5;29(5):999–1005. [PubMed: 12022364]
43. Dominick KL, Dudley TK, Grambow SC, Oddone EZ, Bosworth HB. Racial differences in health care utilization among patients with osteoarthritis. J Rheumatol. 2003 10;30(10):2201–2206. [PubMed: 14528518]
44. Shaya FT, Blume S. Prescriptions for cyclooxygenase-2 inhibitors and other nonsteroidal anti-inflammatory agents in a medicaid managed care population: African Americans versus Caucasians. Pain Med Malden Mass. 2005 2;6(1):11–17.
45. Dominick KL, Bosworth HB, Dudley TK, Waters SJ, Campbell LC, Keefe FJ. Patterns of opioid analgesic prescription among patients with osteoarthritis. J Pain Palliat Care Pharmacother. 2004;18(1):31–46.
46. Goyal MK, Kuppermann N, Cleary SD, Teach SJ, Chamberlain JM. Racial Disparities in Pain Management of Children With Appendicitis in Emergency Departments. JAMA Pediatr. 2015 11;169(11):996–1002. [PubMed: 26366984]
47. Shavers VL, Bakos A, Sheppard VB. Race, ethnicity, and pain among the U.S. adult population. J Health Care Poor Underserved. 2010 2;21(1):177–220. [PubMed: 20173263]
48. Anderson KO, Green CR, Payne R. Racial and ethnic disparities in pain: causes and consequences of unequal care. J Pain Off J Am Pain Soc. 2009 12;10(12):1187–1204.
49. Cintron A, Morrison RS. Pain and ethnicity in the United States: A systematic review. J Palliat Med. 2006 12;9(6):1454–1473. [PubMed: 17187552]

50. Green CR, Anderson KO, Baker TA, Campbell LC, Decker S, Fillingim RB, Kalauokalani DA, Kaloukalani DA, Lasch KE, Myers C, Tait RC, Todd KH, Vallerand AH. The unequal burden of pain: confronting racial and ethnic disparities in pain. Pain Med Malden Mass. 2003 9;4(3):277–294.
51. Freeman HP, Payne R. Racial injustice in health care. N Engl J Med. 2000 4 6;342(14):1045–1047. [PubMed: 10749970]
52. Green CR, Hart-Johnson T. The adequacy of chronic pain management prior to presenting at a tertiary care pain center: the role of patient socio-demographic characteristics. J Pain Off J Am Pain Soc. 2010 8;11(8):746–754.
53. Hoffman KM, Trawalter S, Axt JR, Oliver MN. Racial bias in pain assessment and treatment recommendations, and false beliefs about biological differences between blacks and whites. Proc Natl Acad Sci U S A. 2016 4 19;113(16):4296–4301. [PubMed: 27044069]
54. Kuo Y-F, Raji MA, Chen N-W, Hasan H, Goodwin JS. Trends in Opioid Prescriptions Among Part D Medicare Recipients From 2007 to 2012. Am J Med. 2016 2;129(2):221.e21–30.
55. Pensa MA, Galusha DH, Cantley LF. Patterns of Opioid Prescribing and Predictors of Chronic Opioid Use in an Industrial Cohort, 2003 to 2013. J Occup Environ Med. 2018;60(5):457–461. [PubMed: 29135839]
56. Chen I, Kurz J, Pasanen M, Faselis C, Panda M, Staton LJ, O'Rorke J, Menon M, Genao I, Wood J, Mechaber AJ, Rosenberg E, Carey T, Calleson D, Cykert S. Racial differences in opioid use for chronic nonmalignant pain. J Gen Intern Med. 2005 7;20(7):593–598. [PubMed: 16050852]
57. Emejuaiwe N, Jones AC, Ibrahim SA, Kwoh CK. Disparities in joint replacement utilization: a quality of care issue. Clin Exp Rheumatol. 2007 12;25(6 Suppl 47):44–49. [PubMed: 18021506]
58. Shahid H, Singh JA. Racial/Ethnic Disparity in Rates and Outcomes of Total Joint Arthroplasty. Curr Rheumatol Rep. 2016 4;18(4):20. [PubMed: 26984804]
59. Pandya NK, Wustrack R, Metz L, Ward D. Current Concepts in Orthopaedic Care Disparities: J Am Acad Orthop Surg. 2018 12;26(23):823–832. [PubMed: 30180094]
60. Wilson MG, May DS, Kelly JJ. Racial differences in the use of total knee arthroplasty for osteoarthritis among older Americans. Ethn Dis. 1994;4(1):57–67. [PubMed: 7742733]
61. Katz BP, Freund DA, Heck DA, Dittus RS, Paul JE, Wright J, Coyte P, Holleman E, Hawker G. Demographic variation in the rate of knee replacement: a multi-year analysis. Health Serv Res. 1996 6;31(2):125–140. [PubMed: 8675435]
62. Baron JA, Barrett J, Katz JN, Liang MH. Total hip arthroplasty: use and select complications in the US Medicare population. Am J Public Health. 1996 1;86(1):70–72. [PubMed: 8561246]
63. Dunlop DD, Song J, Manheim LM, Chang RW. Racial disparities in joint replacement use among older adults. Med Care. 2003 2;41(2):288–298. [PubMed: 12555056]
64. 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 10 2;349(14):1350–1359. [PubMed: 14523144]
65. 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 1;85(1):27–32. [PubMed: 12533568]
66. Mahomed NN, Barrett J, Katz JN, Baron JA, Wright J, Losina E. Epidemiology of total knee replacement in the United States Medicare population. J Bone Joint Surg Am. 2005 6;87(6):1222–1228. [PubMed: 15930530]
67. 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:S87–94. [PubMed: 17766799]
68. Escarce JJ, McGuire TG. Changes in racial differences in use of medical procedures and diagnostic tests among elderly persons: 1986–1997. Am J Public Health. 2004 10;94(10):1795–1799. [PubMed: 15451752]
69. Escalante A, Espinosa-Morales R, del Rincón I, Arroyo RA, Older SA. Recipients of hip replacement for arthritis are less likely to be Hispanic, independent of access to health care and socioeconomic status. Arthritis Rheum. 2000 2;43(2):390–399. [PubMed: 10693880]

70. Jha AK, Fisher ES, Li Z, Orav EJ, Epstein AM. Racial trends in the use of major procedures among the elderly. N Engl J Med. 2005 8 18;353(7):683–691. [PubMed: 16107621]
71. 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 6;40(6):451–460. [PubMed: 12021671]
72. Bang H, Chiu Y, Memtsoudis SG, Mandl LA, Della Valle AG, Mushlin AI, Marx RG, Mazumdar M. Total hip and total knee arthroplasties: trends and disparities revisited. Am J Orthop Belle Mead NJ. 2010 9;39(9):E95–102. [PubMed: 21290031]
73. Cavanaugh AM, Rauh MJ, Thompson CA, Alcaraz J, Mihalko WM, Bird CE, Eaton CB, Rosal MC, Li W, Shadyab AH, Gilmer T, LaCroix AZ. Racial and ethnic disparities in utilization of total knee arthroplasty among older women. Osteoarthritis Cartilage. 2019 12;27(12):1746–1754. [PubMed: 31404657]
74. Hanchate AD, Zhang Y, Felson DT, Ash AS. Exploring the determinants of racial and ethnic disparities in total knee arthroplasty: health insurance, income, and assets. Med Care. 2008 5;46(5):481–488. [PubMed: 18438196]
75. Hawkins K, Escoto KH, Ozminkowski RJ, Bhattarai GR, Migliori RJ, Yeh CS. Disparities in major joint replacement surgery among adults with Medicare supplement insurance. Popul Health Manag. 2011 10;14(5):231–238. [PubMed: 21506726]
76. Singh JA, Lu X, Rosenthal GE, Ibrahim S, Cram P. Racial disparities in knee and hip total joint arthroplasty: an 18-year analysis of national Medicare data. Ann Rheum Dis. 2014 12;73(12):2107–2115. [PubMed: 24047869]
77. Collins JE, Deshpande BR, Katz JN, Losina E. Race- and Sex-Specific Incidence Rates and Predictors of Total Knee Arthroplasty: Seven-Year Data From the Osteoarthritis Initiative. Arthritis Care Res. 2016;68(7):965–973.
78. Zhang W, Lyman S, Boutin-Foster C, Parks ML, Pan T-J, Lan A, Ma Y. Racial and Ethnic Disparities in Utilization Rate, Hospital Volume, and Perioperative Outcomes After Total Knee Arthroplasty. J Bone Joint Surg Am. 2016 8 3;98(15):1243–1252. [PubMed: 27489314]
79. MacFarlane LA, Kim E, Cook NR, Lee I-M, Iversen MD, Katz JN, Costenbader KH. Racial Variation in Total Knee Replacement in a Diverse Nationwide Clinical Trial. J Clin Rheumatol Pract Rep Rheum Musculoskelet Dis. 2018 1;24(1):1–5.
80. Amen TB, Varady NH, Rajaee S, Chen AF. Persistent Racial Disparities in Utilization Rates and Perioperative Metrics in Total Joint Arthroplasty in the U.S.: A Comprehensive Analysis of Trends from 2006 to 2015. J Bone Joint Surg Am. 2020 5 6;102(9):811–820. [PubMed: 32379122]
81. Ghomrawi HMK, Mushlin AI, Kang R, Banerjee S, Singh JA, Sharma L, Flink C, Nevitt M, Neogi T, Riddle DL. Examining Timeliness of Total Knee Replacement Among Patients with Knee Osteoarthritis in the U.S.: Results from the OAI and MOST Longitudinal Cohorts. J Bone Joint Surg Am. 2020 1 13;
82. Agabiti N, Picciotto S, Cesaroni G, Bisanti L, Forastiere F, Onorati R, Pacelli B, Pandolfi P, Russo A, Spadea T, Perucci CA, Italian Study Group on Inequalities in Health Care. The influence of socioeconomic status on utilization and outcomes of elective total hip replacement: a multicity population-based longitudinal study. Int J Qual Health Care J Int Soc Qual Health Care. 2007 2;19(1):37–44.
83. Rothstein R The Color of Law: A Forgotten History of How Our Government Segregated America. New York; London: Liveright; 2017.
84. Hervey SL, Purves HR, Guller U, Toth AP, Vail TP, Pietrobon R. Provider Volume of Total Knee Arthroplasties and Patient Outcomes in the HCUP-Nationwide Inpatient Sample. J Bone Joint Surg Am. 2003 9;85(9):1775–1783. [PubMed: 12954837]
85. Katz JN, Mahomed NN, Baron JA, Barrett JA, Fossel AH, Creel AH, Wright J, Wright EA, Losina E. Association of hospital and surgeon procedure volume with patient-centered outcomes of total knee replacement in a population-based cohort of patients age 65 years and older. Arthritis Rheum. 2007 2;56(2):568–574. [PubMed: 17265491]
86. Losina E, Wright EA, Kessler CL, Barrett JA, Fossel AH, Creel AH, Mahomed NN, Baron JA, Katz JN. Neighborhoods matter: use of hospitals with worse outcomes following total knee

replacement by patients from vulnerable populations. Arch Intern Med. 2007 1 22;167(2):182–187. [PubMed: 17242320]

87. SooHoo NF, Zingmond DS, Ko CY. Disparities in the utilization of high-volume hospitals for total knee replacement. J Natl Med Assoc. 2008 5;100(5):559–564. [PubMed: 18507209]
88. Cai X, Cram P, Vaughan-Sarrazin M. Are African American patients more likely to receive a total knee arthroplasty in a low-quality hospital? Clin Orthop. 2012 4;470(4):1185–1193. [PubMed: 21879410]
89. Kim C-Y, Wiznia DH, Hsiang WR, Pelker RR. The Effect of Insurance Type on Patient Access to Knee Arthroplasty and Revision under the Affordable Care Act. J Arthroplasty. 2015 9;30(9):1498–1501. [PubMed: 25891434]
90. Patterson BM, Draeger RW, Olsson EC, Spang JT, Lin F-C, Kamath GV. A regional assessment of medicaid access to outpatient orthopaedic care: the influence of population density and proximity to academic medical centers on patient access. J Bone Joint Surg Am. 2014 9 17;96(18):e156. [PubMed: 25232086]
91. Greene NE, Fuentes-Juárez BN, Sabatini CS. Access to Orthopaedic Care for Spanish-Speaking Patients in California. J Bone Joint Surg Am. 2019 9 18;101(18):e95. [PubMed: 31567810]
92. Sabin J, Nosek BA, Greenwald A, Rivara FP. Physicians' implicit and explicit attitudes about race by MD race, ethnicity, and gender. J Health Care Poor Underserved. 2009 8;20(3):896–913. [PubMed: 19648715]
93. Chapman EN, Kaatz A, Carnes M. Physicians and Implicit Bias: How Doctors May Unwittingly Perpetuate Health Care Disparities. J Gen Intern Med. 2013 11;28(11):1504–1510. [PubMed: 23576243]
94. Oliver MN, Wells KM, Joy-Gaba JA, Hawkins CB, Nosek BA. Do physicians' implicit views of African Americans affect clinical decision making? J Am Board Fam Med JABFM. 2014 4;27(2):177–188. [PubMed: 24610180]
95. Hall WJ, Chapman MV, Lee KM, Merino YM, Thomas TW, Payne BK, Eng E, Day SH, Coyne-Beasley T. Implicit Racial/Ethnic Bias Among Health Care Professionals and Its Influence on Health Care Outcomes: A Systematic Review. Am J Public Health. 2015 12;105(12):e60–76.
96. Dehon E, Weiss N, Jones J, Faulconer W, Hinton E, Sterling S. A Systematic Review of the Impact of Physician Implicit Racial Bias on Clinical Decision Making. Acad Emerg Med Off J Soc Acad Emerg Med. 2017;24(8):895–904.
97. FitzGerald C, Hurst S. Implicit bias in healthcare professionals: a systematic review. BMC Med Ethics. 2017 1;18(1):19. [PubMed: 28249596]
98. Blair IV, Steiner JF, Fairclough DL, Hanratty R, Price DW, Hirsh HK, Wright LA, Bronsert M, Karimkhani E, Magid DJ, Havranek EP. Clinicians' implicit ethnic/racial bias and perceptions of care among Black and Latino patients. Ann Fam Med. 2013 2;11(1):43–52. [PubMed: 23319505]
99. Cooper LA, Roter DL, Carson KA, Beach MC, Sabin JA, Greenwald AG, Inui TS. The associations of clinicians' implicit attitudes about race with medical visit communication and patient ratings of interpersonal care. Am J Public Health. 2012 5;102(5):979–987. [PubMed: 22420787]
100. Hagiwara N, Penner LA, Gonzalez R, Eggly S, Dovidio JF, Gaertner SL, West T, Albrecht TL. Racial attitudes, physician-patient talk time ratio, and adherence in racially discordant medical interactions. Soc Sci Med 1982. 2013 6;87:123–131.
101. Penner LA, Dovidio JF, West TV, Gaertner SL, Albrecht TL, Dailey RK, Markova T. Aversive Racism and Medical Interactions with Black Patients: A Field Study. J Exp Soc Psychol. 2010 3 1;46(2):436–440. [PubMed: 20228874]
102. Green AR, Carney DR, Pallin DJ, Ngo LH, Raymond KL, Iezzoni LI, Banaji MR. Implicit bias among physicians and its prediction of thrombolysis decisions for black and white patients. J Gen Intern Med. 2007 9;22(9):1231–1238. [PubMed: 17594129]
103. Sabin JA, Greenwald AG. The influence of implicit bias on treatment recommendations for 4 common pediatric conditions: pain, urinary tract infection, attention deficit hyperactivity disorder, and asthma. Am J Public Health. 2012 5;102(5):988–995. [PubMed: 22420817]
104. Hausmann LRM, Myaskovsky L, Niyonkuru C, Oyster ML, Switzer GE, Burkitt KH, Fine MJ, Gao S, Boninger ML. Examining implicit bias of physicians who care for individuals with spinal

cord injury: A pilot study and future directions. J Spinal Cord Med. 2015 1;38(1):102–110. [PubMed: 24621034]

105. Hausmann LRM, Mor M, Hanusa BH, Zickmund S, Cohen PZ, Grant R, Kresevic DM, Gordon HS, Ling BS, Kwoh CK, Ibrahim SA. The effect of patient race on total joint replacement recommendations and utilization in the orthopedic setting. J Gen Intern Med. 2010 9;25(9):982–988. [PubMed: 20509053]
106. Kerman HM, Smith SR, Smith KC, Collins JE, Suter LG, Katz JN, Losina E. Disparities in Total Knee Replacement: Population Losses in Quality-Adjusted Life-Years Due to Differential Offer, Acceptance, and Complication Rates for African Americans. Arthritis Care Res. 2018;70(9):1326–1334.
107. Ramirez RN, Franklin CC. Racial Diversity in Orthopedic Surgery. Orthop Clin North Am. 2019 7;50(3):337–344. [PubMed: 31084836]
108. Cooper-Patrick L, Gallo JJ, Gonzales JJ, Vu HT, Powe NR, Nelson C, Ford DE. Race, gender, and partnership in the patient-physician relationship. JAMA. 1999 8 11;282(6):583–589. [PubMed: 10450723]
109. Saha S, Komaromy M, Koepsell TD, Bindman AB. Patient-physician racial concordance and the perceived quality and use of health care. Arch Intern Med. 1999 5 10;159(9):997–1004. [PubMed: 10326942]
110. Larkey LK, Hecht ML, Miller K, Alatorre C. Hispanic cultural norms for health-seeking behaviors in the face of symptoms. Health Educ Behav Off Publ Soc Public Health Educ. 2001 2;28(1):65–80.
111. 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 12;94(12):2084–2090. [PubMed: 15569958]
112. Katz JN. Patient preferences and health disparities. JAMA. 2001 9 26;286(12):1506–1509. [PubMed: 11572745]
113. Figaro MK, Russo PW, Allegrante JP. Preferences for arthritis care among urban African Americans: “I don’t want to be cut.” Health Psychol Off J Div Health Psychol Am Psychol Assoc. 2004 5;23(3):324–329.
114. Suarez-Almazor ME, Souchek J, Kelly PA, O’Malley K, Byrne M, Richardson M, Pak C. Ethnic variation in knee replacement: patient preferences or uninformed disparity? Arch Intern Med. 2005 5 23;165(10):1117–1124. [PubMed: 15911724]
115. 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 1;40(1 Suppl):I44–51. [PubMed: 11789631]
116. Byrne MM, O’Malley KJ, Suarez-Almazor ME. Ethnic differences in health panalysis using willingness-to-pay. J Rheumatol. 2004 9;31(9):1811–1818. [PubMed: 15338505]
117. Byrne MM, Souchek J, Richardson M, Suarez-Almazor M. Racial/ethnic differences in preferences for total knee replacement surgery. J Clin Epidemiol. 2006 10;59(10):1078–1086. [PubMed: 16980148]
118. 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 1 15;59(1):102–108. [PubMed: 18163395]
119. Vina ER, Cloonan YK, Ibrahim SA, Hannon MJ, Boudreau RM, Kwoh CK. Race, sex, and total knee replacement consideration: role of social support. Arthritis Care Res. 2013 7;65(7):1103–1111.
120. Allen KD, Golightly YM, Callahan LF, Helmick CG, Ibrahim SA, Kwoh CK, Renner JB, Jordan JM. Race and sex differences in willingness to undergo total joint replacement: the Johnston County Osteoarthritis Project. Arthritis Care Res. 2014 8;66(8):1193–1202.
121. Feagin J, Bennefield Z. Systemic racism and U.S. health care. Soc Sci Med 1982. 2014 2;103:7–14.
122. Smedley B, Stith AY, Nelson AR, editors. Chapter 3: Assessing Potential Sources of Racial and Ethnic Disparities in Care: Patient- and System-Level Factors. Unequal Treat Confronting Racial

Ethn Disparities Health Care [Internet]. National Academies Press (US); 2003. Available from: http://www.ncbi.nlm.nih.gov/books/NBK220359/

123. Bloche MG. Race and discretion in American medicine. Yale J Health Policy Law Ethics. 2001;1:95–131. [PubMed: 12669322]
124. Ang DC, Ibrahim SA, Burant CJ, Siminoff LA, Kwoh CK. Ethnic differences in the perception of prayer and consideration of joint arthroplasty. Med Care. 2002 6;40(6):471–476. [PubMed: 12021673]
125. Bailey EJ. Sociocultural factors and health care-seeking behavior among black Americans. J Natl Med Assoc. 1987 4;79(4):389–392. [PubMed: 3586036]
126. Ibrahim SA, Zhang A, Mercer MB, Baughman M, Kwoh 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 12;59(12):1318–1322. [PubMed: 15699532]
127. Kroll TL, Richardson M, Sharf BF, Suarez-Almazor ME. "Keep on truckin'" or 'It's got you in this little vacuum': race-based perceptions in decision-making for total knee arthroplasty." J Rheumatol. 2007 5;34(5):1069–1075. [PubMed: 17407213]
128. Kwoh CK, Vina ER, Cloonan YK, Hannon MJ, Boudreau RM, Ibrahim SA. Determinants of patient preferences for total knee replacement: African-Americans and whites. Arthritis Res Ther. 2015 12 3;17:348. [PubMed: 26635132]
129. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh CK. Differences in expectations of outcome mediate African American/white patient differences in "willingness" to consider joint replacement. Arthritis Rheum. 2002 9;46(9):2429–2435. [PubMed: 12355491]
130. Figaro MK, Williams-Russo P, Allegrante JP. Expectation and outlook: the impact of patient preference on arthritis care among African Americans. J Ambulatory Care Manage. 2005 3;28(1):41–48. [PubMed: 15682960]
131. Groeneveld PW, Kwoh 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 5 15;59(5):730–737. [PubMed: 18438917]
132. Ibrahim SA, Hanusa BH, Hannon MJ, Kresevic D, Long J, Kent Kwoh C. Willingness and access to joint replacement among African American patients with knee osteoarthritis: a randomized, controlled intervention. Arthritis Rheum. 2013 5;65(5):1253–1261. [PubMed: 23613362]
133. Weng HH, Kaplan RM, Boscardin WJ, Maclean CH, Lee IY, Chen W, Fitzgerald JD. Development of a decision aid to address racial disparities in utilization of knee replacement surgery. Arthritis Rheum. 2007 5 15;57(4):568–575. [PubMed: 17471558]
134. Mancuso CA, Graziano S, Briskie LM, Peterson MGE, Pellicci PM, Salvati EA, Sculco TP. Randomized trials to modify patients' preoperative expectations of hip and knee arthroplasties. Clin Orthop. 2008 2;466(2):424–431. [PubMed: 18196427]
135. Ibrahim SA, Blum M, Lee G-C, Mooar P, Medvedeva E, Collier A, Richardson D. Effect of a Decision Aid on Access to Total Knee Replacement for Black Patients With Osteoarthritis of the Knee: A Randomized Clinical Trial. JAMA Surg. 2017 18;152(1):e164225. [PubMed: 27893033]
136. Vina ER, Richardson D, Medvedeva E, Kent Kwoh C, Collier A, Ibrahim SA. Does a Patient-centered Educational Intervention Affect African-American Access to Knee Replacement? A Randomized Trial. Clin Orthop. 2016 8;474(8):1755–1764. [PubMed: 27075333]
137. Li X, Galvin JW, Li C, Agrawal R, Curry EJ. The Impact of Socioeconomic Status on Outcomes in Orthopaedic Surgery. J Bone Joint Surg Am. 2019 12 9;
138. Mehta BY, Bass AR, Goto R, Russell LA, Parks ML, Figgie MP, Goodman SM. Disparities in Outcomes for Blacks versus Whites Undergoing Total Hip Arthroplasty: A Systematic Literature Review. J Rheumatol. 2018;45(5):717–722. [PubMed: 29419468]
139. Goodman SM, Parks ML, McHugh K, Fields K, Smethurst R, Figgie MP, Bass AR. Disparities in Outcomes for African Americans and Whites Undergoing Total Knee Arthroplasty: A Systematic Literature Review. J Rheumatol. 2016 4;43(4):765–770. [PubMed: 26834217]
140. Goodman SM, Mandl LA, Parks ML, Zhang M, McHugh KR, Lee Y-Y, Nguyen JT, Russell LA, Bogardus MH, Figgie MP, Bass AR. Disparities in TKA Outcomes: Census Tract Data Show

Interactions Between Race and Poverty. Clin Orthop. 2016 9;474(9):1986–1995. [PubMed: 27278675]

141. Lavernia CJ, Alcerro JC, Contreras JS, Rossi MD. Ethnic and racial factors influencing well-being, perceived pain, and physical function after primary total joint arthroplasty. Clin Orthop. 2011 7;469(7):1838–1845. [PubMed: 21409460]
142. Lavernia CJ, Villa JM. Does Race Affect Outcomes in Total Joint Arthroplasty? Clin Orthop. 2015 11;473(11):3535–3541. [PubMed: 26242282]
143. Kamath AF, Horneff JG, Gaffney V, Israelite CL, Nelson CL. Ethnic and gender differences in the functional disparities after primary total knee arthroplasty. Clin Orthop. 2010 12;468(12):3355–3361. [PubMed: 20632138]
144. Allen Butler R, Rosenzweig S, Myers L, Barrack RL. The Frank Stinchfield Award: the impact of socioeconomic factors on outcome after THA: a prospective, randomized study. Clin Orthop. 2011 2;469(2):339–347. [PubMed: 20717856]
145. Barrack RL, Ruh EL, Chen J, Lombardi AV, Berend KR, Parvizi J, Della Valle CJ, Hamilton WG, Nunley RM. Impact of socioeconomic factors on outcome of total knee arthroplasty. Clin Orthop. 2014 1;472(1):86–97. [PubMed: 23633182]
146. Jacobs CA, Christensen CP, Karthikeyan T. Patient and intraoperative factors influencing satisfaction two to five years after primary total knee arthroplasty. J Arthroplasty. 2014 8;29(8):1576–1579. [PubMed: 24768544]
147. Lopez-Olivo MA, Landon GC, Siff SJ, Edelstein D, Pak C, Kallen MA, Stanley M, Zhang H, Robinson KC, Suarez-Almazor ME. Psychosocial determinants of outcomes in knee replacement. Ann Rheum Dis. 2011 10;70(10):1775–1781. [PubMed: 21791452]
148. Bischoff-Ferrari HA, Lingard EA, Losina E, Baron JA, Roos EM, Phillips CB, Mahomed NN, Barrett J, Katz JN. Psychosocial and geriatric correlates of functional status after total hip replacement. Arthritis Rheum. 2004 10 15;51(5):829–835. [PubMed: 15478156]
149. D'Apuzzo MR, Villa JM, Alcerro JC, Rossi MD, Lavernia CJ. Total Joint Arthroplasty: A Granular Analysis of Outcomes in the Economically Disadvantaged Patient. J Arthroplasty. 2016;31(9 Suppl):41–44. [PubMed: 27067471]
150. Martin CT, Callaghan JJ, Liu SS, Gao Y, Warth LC, Johnston RC. Disparity in total joint arthroplasty patient comorbidities, demographics, and postoperative outcomes based on insurance payer type. J Arthroplasty. 2012 12;27(10):1761–1765.e1. [PubMed: 22868072]
151. White RH, McCurdy SA, Marder RA. Early morbidity after total hip replacement: rheumatoid arthritis versus osteoarthritis. J Gen Intern Med. 1990 8;5(4):304–309. [PubMed: 2374042]
152. Weaver F, Hynes D, Hopkinson W, Wixson R, Khuri S, Daley J, Henderson WG. Preoperative risks and outcomes of hip and knee arthroplasty in the Veterans Health Administration. J Arthroplasty. 2003 9;18(6):693–708. [PubMed: 14513441]
153. Collins TC, Daley J, Henderson WH, Khuri SF. Risk factors for prolonged length of stay after major elective surgery. Ann Surg. 1999 8;230(2):251–259. [PubMed: 10450740]
154. Inneh IA, Iorio R, Slover JD, Bosco JA. Role of Sociodemographic, Co-morbid and Intraoperative Factors in Length of Stay Following Primary Total Hip Arthroplasty. J Arthroplasty. 2015 12;30(12):2092–2097. [PubMed: 26190570]
155. Inneh IA. The Combined Influence of Sociodemographic, Preoperative Comorbid and Intraoperative Factors on Longer Length of Stay After Elective Primary Total Knee Arthroplasty. J Arthroplasty. 2015 11;30(11):1883–1886. [PubMed: 26044998]
156. Courtney PM, Huddleston JI, Iorio R, Markel DC. Socioeconomic Risk Adjustment Models for Reimbursement Are Necessary in Primary Total Joint Arthroplasty. J Arthroplasty. 2017;32(1):1–5. [PubMed: 27506724]
157. Nwachukwu BU, Kenny AD, Losina E, Chibnik LB, Katz JN. Complications for racial and ethnic minority groups after total hip and knee replacement: a review of the literature. J Bone Joint Surg Am. 2010 2;92(2):338–345. [PubMed: 20124060]
158. Elsharydah A, Embabi AS, Minhajuddin A, Joshi GP. Racial Disparity in the Perioperative Care for Patients Undergoing Total Knee and Hip Arthroplasty: A Retrospective Propensity-Matched Cohort Study. J Racial Ethn Health Disparities. 2018;5(3):632–637. [PubMed: 28779477]

159. Blum MA, Singh JA, Lee G-C, Richardson D, Chen W, Ibrahim SA. Patient race and surgical outcomes after total knee arthroplasty: an analysis of a large regional database. Arthritis Care Res. 2013 3;65(3):414–420.

160. SooHoo NF, Lieberman JR, Ko CY, Zingmond DS. Factors predicting complication rates following total knee replacement. J Bone Joint Surg Am. 2006 3;88(3):480–485. [PubMed: 16510811]

161. Okike K, Chan PH, Prentice HA, Navarro RA, Hinman AD, Paxton EW. Association of Race and Ethnicity with Total Hip Arthroplasty Outcomes in a Universally Insured Population. J Bone Joint Surg Am. 2019 7 3;101(13):1160–1167. [PubMed: 31274717]

162. Ibrahim SA, Stone RA, Han X, Cohen P, Fine MJ, Henderson WG, Khuri SF, Kwoh CK. Racial/ethnic differences in surgical outcomes in veterans following knee or hip arthroplasty. Arthritis Rheum. 2005 10;52(10):3143–3151. [PubMed: 16200594]

163. Browne JA, Novicoff WM, D'Apuzzo MR. Medicaid payer status is associated with in-hospital morbidity and resource utilization following primary total joint arthroplasty. J Bone Joint Surg Am. 2014 11 5;96(21):e180. [PubMed: 25378513]

164. Veltre DR, Yi PH, Sing DC, Curry EJ, Endo A, Smith EL, Li X. Insurance Status Affects In-Hospital Complication Rates After Total Knee Arthroplasty. Orthopedics. 2018 5 1;41(3):e340–e347. [PubMed: 29494747]

165. Veltre DR, Sing DC, Yi PH, Endo A, Curry EJ, Smith EL, Li X. Insurance Status Affects Complication Rates After Total Hip Arthroplasty. J Am Acad Orthop Surg. 2019 7 1;27(13):e606–e611. [PubMed: 31232798]

166. Lasater KB, McHugh MD. Reducing Hospital Readmission Disparities of Older Black and White Adults After Elective Joint Replacement: The Role of Nurse Staffing. J Am Geriatr Soc. 2016;64(12):2593–2598. [PubMed: 27787880]

167. Girotti ME, Shih T, Revels S, Dimick JB. Racial disparities in readmissions and site of care for major surgery. J Am Coll Surg. 2014 3;218(3):423–430. [PubMed: 24559954]

168. Cram P, Lu X, Kates SL, Singh JA, Li Y, Wolf BR. Total knee arthroplasty volume, utilization, and outcomes among Medicare beneficiaries, 1991–2010. JAMA. 2012 9 26;308(12):1227–1236. [PubMed: 23011713]

169. Bass AR, Mehta B, Szymonifka J, Finik J, Lyman S, Lai EY, Parks M, Figgie M, Mandl LA, Goodman SM. Racial Disparities in Total Knee Replacement Failure As Related to Poverty. Arthritis Care Res. 2019 11;71(11):1488–1494.

170. Dy CJ, Marx RG, Bozic KJ, Pan TJ, Padgett DE, Lyman S. Risk factors for revision within 10 years of total knee arthroplasty. Clin Orthop. 2014 4;472(4):1198–1207. [PubMed: 24347046]

171. Ong KL, Lau E, Suggs J, Kurtz SM, Manley MT. Risk of subsequent revision after primary and revision total joint arthroplasty. Clin Orthop. 2010 11;468(11):3070–3076. [PubMed: 20499292]

172. Bass AR, McHugh K, Fields K, Goto R, Parks ML, Goodman SM. Higher Total Knee Arthroplasty Revision Rates Among United States Blacks Than Whites: A Systematic Literature Review and Meta-Analysis. J Bone Joint Surg Am. 2016 12 21;98(24):2103–2108. [PubMed: 28002374]

173. Ford CL, Airhihenbuwa CO. Critical Race Theory, race equity, and public health: toward antiracism praxis. Am J Public Health. 2010 4 1;100 Suppl 1:S30–35. [PubMed: 20147679]

174. Gee GC, Ford CL. STRUCTURAL RACISM AND HEALTH INEQUITIES. Bois Rev Soc Sci Res Race. 2011 4;8(1):115–132.

Synopsis

We reviewed the literature on racial and socioeconomic disparities in the management of osteoarthritis. Treatments investigated included arthritis education, dietary weight management, exercise/physical therapy, pharmacologic therapy with NSAIDs and opioids, intraarticular steroid injections, and total joint replacement. The amount of evidence for each treatment modality varied, with the most evidence available for racial and socioeconomic disparities in total joint arthroplasty. Blacks, Hispanics, and patients with low SES are less likely to undergo total joint replacement than whites or patients with high SES, and generally have worse functional outcomes and more complications.

Key Points

1. Studies suggest that blacks and Hispanics are less likely to get exercise/physical therapy or opioid prescriptions than whites.
2. Studies suggest that patients with low SES receive less arthritis education from providers, participate less in self-education programs, and get less exercise/physical therapy.
3. There is strong evidence blacks and Hispanics are less likely than whites to undergo total joint replacement and that blacks and Hispanics have worse functional outcomes and more complications.
4. There is moderate evidence that patients with low SES are less likely to undergo total joint replacement than patients with high SES and that low SES is associated with worse functional outcomes and more complications after total joint replacement.

Table 1:

Summary of Literature on Racial and Socioeconomic Disparities in OA Management

OA Treatment	Quantity of Evidence (minimal, some, moderate, many)	Quality of Evidence	Is Data Consistent or Conflicting? In Which Direction?
Recommended Management			
Arthritis Education (race)[7–9]	Minimal	Large cross-sectional	No association
Arthritis Education (SES)[3–11]	Moderate	Large cross-sectional with adjustment	Consistent: higher education associated with higher self-education program use, more provider education
Dietary Weight Management[13–16,18]	Minimal (OA patients)	-	-
	Many (general population)	Large cross-sectional	Consistent: blacks, Hispanics, low income, low education associated with higher obesity rates, worse diet quality
Exercise/Physical Therapy: Access/Use (race)[19,25–29]	Some	Large cross-sectional surveys with adjustment	Consistent: Hispanics, blacks get less PT/exercise
Exercise/Physical Therapy: Access/Use (SES)[20–29]	Moderate	Cross-sectional surveys with adjustment	Consistent: higher education and private insurance associated with more PT/exercise; lower education and Medicaid or no insurance with less PT/exercise
Exercise/Physical Therapy: Outcomes[30–35]	Some	Prospective studies, 6 weeks-18 months follow up	Consistent: PT/exercise programs help regardless of education/race, may help reduce disparities in functional outcomes
Pharmacology: NSAIDs (race)[36–45]	Moderate	Moderate/large retrospective and cross-sectional, with adjustment	Mixed for OTC/prescription NSAID use; Consistent for drug classes: blacks, Hispanics get non-selective NSAIDs, whites get more COX-2 selective NSAIDs (older literature)
Pharmacology: NSAIDS (SES)	Minimal	-	-
Intraarticular Steroid Injections	Minimal	-	-
Total Joint Replacement: Access/Use (race)[2,38–57–74,74–79,81,86–88,91,94,105,112–120,127–131]	Many	Large retrospective with adjustment	Consistent: blacks, Hispanics receive less TKA, THA than whites; Evidence for structural, provider-and patient-level barriers
Total Joint Replacement: Access/Use[59,65,66,82,86,87,89,90]	Moderate	Large retrospective with adjustment	Consistent: low SES associated with less THA, TKA
Total Joint Replacement: Outcomes[65,66,76,78,106,137–146,151–153,157–162,166–172]	Many	Large retrospective and some prospective, with adjustment	Mostly consistent: blacks, Hispanics have worse functional outcomes and more complications
Total Joint Replacement: Outcomes (SES)[137,140,145,147–150,154–156,161,163–165,169,170]	Moderate	Large retrospective with adjustment	Mostly consistent: low SES (insurance, income) associated with worse functional outcomes and more complications
Not Recommended			
Pharmacology: Opioids (race)[38,41,43,45,54–56]	Moderate (OA), Many (general)	Large retrospective and cross-sectional, with adjustment	Mostly consistent: whites more likely than blacks or Hispanics to receive

OA Treatment	Quantity of Evidence (minimal, some, moderate, many)	Quality of Evidence	Is Data Consistent or Conflicting? In Which Direction?
			opioid prescription; days' supply for whites is higher than for blacks
Pharmacology: Opioids (SES)[54]	Minimal	Large retrospective with adjustment	Living in a low-education area or having low income associated with prolonged opioid prescription