

# Osteoarthritis and Cartilage



## Natural history of pain and disability among African–Americans and Whites with or at risk for knee osteoarthritis: A longitudinal study

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### SUMMARY

**Objective:** Compare knee pain and disability between African Americans (AAs) and Whites (WHs), with or at risk of knee osteoarthritis (KOA), over 9 years, and evaluate racial disparities in KOA-related symptoms across socioeconomic and clinical characteristics.

**Design:** Osteoarthritis Initiative (OAI) participants were evaluated annually over 9 years for pain and disability, assessed by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and a numerical rating scale (NRS) for knee pain severity. Mean annual WOMAC pain, NRS pain, and WOMAC disability levels were estimated by race using mixed effects models, adjusted for age, sex, education, marital status, body mass index (BMI), depression, and baseline Kellgren–Lawrence grade score. Race-specific mean WOMAC pain scores were also estimated in analyses stratified by socioeconomic and clinical characteristics.

**Results:** AAs reported worse mean WOMAC pain compared to WHs at baseline (3.69 vs 2.20;  $P \leq 0.0001$ ) and over 9 years of follow-up, with similar disparities reflected in NRS pain severity and WOMAC disability. Radiographic severity did not account for the differences in pain and disability, as substantial and significant racial disparities were observed after stratification by Kellgren–Lawrence grade. Depression and low income exacerbated differences in WOMAC pain between AAs and WHs by a substantial and significant magnitude.

**Conclusions:** Over 9 years of follow-up, AAs reported persistently greater KOA symptoms than WHs. Socioeconomically and clinically disadvantaged AAs reported the most pronounced disparities in pain and disability.

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### Introduction

Osteoarthritis (OA) is the third leading cause of years lived with a disability, and the lifetime risk of developing symptomatic knee osteoarthritis (KOA) is one in two<sup>1,2</sup>. The prevalence and manifestations of KOA may vary across racial groups, however. African–Americans (AAs) have a 1.7 times greater odds of developing radiographic KOA and a 1.5 times greater odds of symptomatic KOA than Whites (WHs)<sup>3</sup>. AA patients with KOA have also reported worse OA-related pain and function on patient-reported outcome measures (PROMs), such as the Western Ontario and McMaster

University Osteoarthritis Index (WOMAC) pain and function scores<sup>4,5</sup>. Population-based samples suggest that racial and ethnic minorities generally report more pain and impairments than non-minorities, not limited to KOA-related pain<sup>6</sup>.

Race disparities in OA health outcomes could be related to differences in socioeconomic and clinical characteristics. Poorer socioeconomic status is generally associated with poorer physical and mental health<sup>7</sup>. Low social support has also been related to poorer health-related quality of life (QOL) among OA patients<sup>8</sup>. In a Veterans Affairs study, lower income, but not marital status, was associated with worse arthritis pain and function<sup>9</sup>. Income did not explain racial differences in pain and function in the study, however. In another study, racial differences in KOA symptoms persisted despite adjustment for sociodemographic and radiographic OA severity<sup>5</sup>, although these racial differences were no longer significant when further controlled for body mass index (BMI) and

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depressive symptoms. Higher BMI has also been associated with poorer daily functions in other OA studies<sup>10</sup>.

While informative, previous studies on racial differences in pain and function in KOA have certain limitations. The study designs are primarily cross-sectional in nature<sup>4,5,9–12</sup>. To our knowledge, no longitudinal study has previously tracked racial differences in KOA symptoms or disability with multiple annual observations over a prolonged period of time. The extent to which the magnitude of racial differences persists or expands over time is unknown. Existing studies are also either limited to research participants with severely symptomatic OA<sup>10–12</sup>, an overwhelming proportion of male veterans<sup>4,10–12</sup>, or those recruited in limited geographic locations<sup>4,5,9–12</sup>.

OA is a chronic disease, and longitudinal studies are necessary to understand whether racial differences in the report of KOA symptoms change over time. PROMs are increasingly used to evaluate patients in clinical practice and to assess the quality of care provided to them<sup>13,14</sup>. They provide patients' perspectives and are the outcomes of greatest importance to patients. Hence, it is important to understand racial differences in patient-reported pain and disability and whether these differences might change over time. The Osteoarthritis Initiative (OAI), a cohort study of persons with or at high risk of developing symptomatic KOA with annual administration of PROMs, provides a unique opportunity for the longitudinal evaluation of racial differences in pain and disability.

The primary objective was to compare self-reported pain and disability between AAs and WHs with or at high-risk of KOA over 9 years of follow-up. The secondary objective was to evaluate racial disparities in KOA-related symptoms over time across socioeconomic and clinical characteristics.

## Methods

### Study design, setting & participants

Our sample consisted of participants in the OAI study. Study overview, objectives and sample selection have been described (<http://oai.epi-ucsf.org/datarelease/StudyOverview.asp>). Briefly, the OAI is a prospective longitudinal cohort study of people 45–79 years of age. Individuals with clinically significant KOA and those at high risk of developing clinically significant KOA were recruited between 2004 and 2006 from the University of Maryland School of Medicine and Johns Hopkins University (Baltimore, MD), Ohio State University (Columbus, OH), University of Pittsburgh (Pittsburgh, PA) and Memorial Hospital of Rhode Island (Pawtucket, RI). Participants were assessed annually through 108 months of follow-up. The study was approved by the Institutional Review Board (IRB) of the OAI Coordinating Center at the University of California, San Francisco and by the IRBs of each site. The present study includes all AA and WH OAI participants, with or at increased risk of KOA, including the progression and incidence cohorts. The progression cohort included participants who had symptomatic KOA in at least one knee at recruitment. The incidence cohort included those at risk for KOA with substantial risk factors including frequent knee symptoms, overweight/obesity, history of knee injury or surgery, family history of total knee replacement, Heberden's nodes, and repetitive knee bending, but without symptomatic KOA in either knee. OAI participants without symptoms, risk factors or radiographic evidence of KOA (i.e., the reference "non-exposed" control cohort) were excluded. The "non-exposed" control cohort also had to have absence of radiographic hand and hip OA. Other racial groups were not sufficiently represented to facilitate other race-stratified analyses and were also excluded. Knees with missing Kellgren–Lawrence (K–L) grade scores at baseline and those with total knee replacement surgery prior to enrollment were also excluded.

### Study variables

#### Outcome measures

Knee pain and disability were assessed using the 24-item WOMAC, with the pain (range: 0–20) and disability (range: 0–68) subscales, respectively<sup>15</sup>. This measure has good face and construct validity<sup>16</sup>, and has high test-retest reliability (Kendall's tau-c 0.48–0.68)<sup>15</sup>. Higher scores indicate more KOA-related symptoms. Knee pain severity in the past 30 days based on a numerical rating scale (NRS) with a range of 0–10 was also assessed.

#### Covariates

Race, sex, age, educational attainment, marital status, and annual household income (<or ≥\$50,000, the median household income in the US at the start of the study in 2002) were self-reported at baseline. BMI was calculated and categorized based on the World Health Organization definition. Comorbidity was measured using the Katz-modified Charlson Comorbidity Index Questionnaire<sup>17</sup>. Depression was ascertained using the validated Center for Epidemiologic Studies Depression Scale (CES-D)<sup>18</sup>, with scores ≥16 suggesting depression<sup>19</sup>. General physical and mental health were assessed using the Short Form Health Survey (SF-12)<sup>20</sup>.

#### Other KOA-related measures

The symptoms and QOL subscale measures from the Knee Injury and Osteoarthritis Outcome Score (KOOS) were used to further describe the sample<sup>21</sup>. Subscale scores range from 0 to 100; lower scores indicate more KOA-related symptoms and lower QOL. Baseline radiographs were centrally read and scored using the K–L system<sup>22,23</sup> for all participants who had at least one follow-up visit knee X-ray.

#### Statistical analysis

Baseline socioeconomic and clinical characteristics were summarized by race at the participant-level. Baseline WOMAC total, pain and disability subscores, pain severity, KOOS Symptoms score, and K–L grade were summarized at the knee-level.

#### Primary analysis

Mixed effects models<sup>24</sup> were used to estimate mean WOMAC pain, knee pain severity, and WOMAC disability, assessed at the knee-level, for AAs and WHs at each annual clinic visit, with 95% confidence intervals (CI), adjusted for age, sex, education, marital status, BMI, CES-D, and baseline K–L grade. The mixed models included three levels, with annual assessments nested within knee, and knees nested within participant. Models were adjusted for variables that could potentially contribute to racial differences in OA-related symptoms<sup>5,8–10</sup>. The estimated race-specific annual means and 95% CIs were plotted over 9 years of follow-up for each outcome. Surgically replaced knees were censored at the time of surgery. Variance components from unadjusted three-level mixed models were estimated with 95% CIs, including variance between participants in each race group, variance between knees within a person, and variance within a knee over annual repeated measures.

Due to an observed decrease in group mean scores among AAs between baseline and the 1-year follow-up visit, change during the first year was directly estimated with statistical comparison of 1 year change in race group means using a likelihood ratio test for the interaction between race and time.

The primary analysis was stratified by presence/absence of radiographic KOA (K–L ≥2), as previous literature<sup>25,26</sup> has reported that AAs tend to have higher prevalence of radiographic KOA than WHs, which could contribute to racial differences in PROMs.

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