

# Prevalence of Hip Symptoms and Radiographic and Symptomatic Hip Osteoarthritis in African Americans and Caucasians: The Johnston County Osteoarthritis Project

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**ABSTRACT.** *Objective.* To report contemporary estimates of the prevalence of hip-related osteoarthritis (OA) outcomes in African Americans and Caucasians aged  $\geq 45$  years.

*Methods.* Weighted prevalence estimates and their corresponding 95% confidence intervals for hip symptoms, radiographic hip OA, symptomatic hip OA, and severe radiographic hip OA were calculated using SUDAAN<sup>®</sup> for age, race, and sex subgroups among 3068 participants (33% African Americans, 38% men) in the baseline examination (1991-97) of The Johnston County Osteoarthritis Project, a population-based study of OA in North Carolina. Radiographic hip OA was defined as Kellgren-Lawrence radiographic grade  $\geq 2$ , moderate/severe radiographic hip OA as grades 3 and 4, and symptomatic hip OA as hip symptoms in a hip with radiographic OA.

*Results.* Hip symptoms were present in 36%; 28% had radiographic hip OA; nearly 10% had symptomatic hip OA; and 2.5% had moderate/severe radiographic hip OA. Prevalence of all 4 outcomes was higher in older individuals; most outcomes were higher for women and African Americans.

*Conclusion.* African Americans in this population do not have a lower prevalence of hip-related OA outcomes as previous studies suggested. Increasing public and health system awareness of the relatively high prevalence of these outcomes, which can be disabling, may help to decrease their effects and ultimately prevent them. (J Rheumatol First Release March 15 2009; doi:10.3899/jrheum.080677)

*Key Indexing Terms:*  
OSTEOARTHRITIS

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Arthritis and other rheumatic conditions are a large, growing, and newly recognized public health problem in the United States<sup>1</sup>. Arthritis affected 46 million adults in 2003-2005<sup>2</sup>, was the most common cause of disability in 1999 in the US<sup>3</sup>, severely affected health related quality of life<sup>4</sup>, and has been associated with significant costs<sup>5</sup>. Direct and indirect costs attributable to arthritis and other rheu-

matic conditions in 2003 totaled an estimated \$128 billion, accounting for ~1% of gross domestic product<sup>6,7</sup>. These burdens are likely to increase as the population ages over the coming decades.

Few epidemiological data are available for specific types of arthritis, making it difficult to identify high-risk groups and target interventions. Osteoarthritis (OA) is the most

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common specific condition, affecting 27 million people in the US in 2005<sup>8</sup>. Knee and hip OA are generally considered to have the greatest influence due to effects on ambulation; OA of these joints accounted for 97% of the 478,000 total knee replacements and 83% of the total hip replacements for arthritis in 2004<sup>5</sup>.

The prevalence of hip OA overall and among demographic subgroups is not well characterized<sup>9</sup>, with the only population-based estimate in the US available from the 1971-1974 NHANES-I survey<sup>10</sup>. A few small studies have suggested a much lower prevalence of hip OA among African black populations than Caucasians<sup>11,12</sup>, but no large recent studies have been performed to directly compare possible racial differences. Further, definitions of hip OA and the most appropriate means to measure it in epidemiologic studies are in flux. While early studies used radiographic measures only, such as the Kellgren-Lawrence scale (K-L)<sup>13</sup>, as the field's standard of measurement for OA<sup>14</sup>, some persons with radiographic OA may have no symptoms, and some of those with even severe symptoms may have normal radiographs. Given that symptoms drive care-seeking and the need for interventions, definitions of clinical or symptomatic OA may be most relevant for clinical and public health practice<sup>14</sup>.

Accurate prevalence estimates of OA are critical for understanding the spectrum of disease, identifying high-risk groups, and guiding intervention efforts efficiently to limit the progression of disease<sup>9,15-17</sup>. We recently analyzed data from the Johnston County Osteoarthritis Project to update and expand older and more narrowly focused prevalence estimates for knee OA<sup>18</sup>. The purpose of the current study is to improve characterization of hip OA in a similar fashion by reporting prevalence estimates from this same study for 4 hip OA-related measures in African American and Caucasian men and women — joint symptoms, radiographic OA, symptomatic OA, and moderate/severe radiographic OA — for the population overall and by age, sex, and race.

## MATERIALS AND METHODS

At the time this study was designed in 1990, Johnston County, North Carolina, had a population of about 81,000 and a rural area of about 800 square miles. It had and continues to have a high prevalence of sociodemographic subgroups at high risk for poor health outcomes. Specifically, a majority of residents (66%) lived in completely rural areas, with the remainder in small towns<sup>19</sup>. African American residents and persons 60 years of age or older constituted 20% and 17% of the population, respectively. Households with limited education and lower income were also common, with 35% of individuals over 25 years of age having less than a high school diploma and roughly 30% of jobs in the county in manufacturing, service, or farming<sup>19,20</sup>.

The sampling and methods of the Johnston County Osteoarthritis Project have been described<sup>18</sup>. In brief, it is a population-based prospective longitudinal cohort study of knee and hip OA designed to be representative of the civilian, noninstitutionalized, African American or Caucasian population aged 45 years and older, who were residents of one of 6 townships in Johnston County for at least 1 year, and who were physically and mentally capable of completing the study's protocol. The protocol involved an initial

home interview, one visit to a local clinic, and a subsequent second home interview about 2 weeks after the clinic visit. The study was approved by the Institutional Review Boards of the University of North Carolina Schools of Medicine and Public Health and the Centers for Disease Control and Prevention. All participants gave written informed consent at the time of recruitment. The baseline evaluation that forms the basis for this report was conducted between 1991 and 1997.

Racial group was self-reported. Hip symptoms were assessed separately for right and left sides of the body by the following question: "On most days, do you have pain, aching, or stiffness in your (right, left) hip?" Hip symptoms were defined for analysis as an affirmative response to this question in at least one hip. All men, and women 50 years of age and older, had a supine anterior-posterior pelvic radiograph with feet in 15° rotation. Hip radiographs were read without knowledge of participant's clinical status, by a single bone and joint radiologist (JBR) using the K-L radiographic atlas for overall hip radiographic grades<sup>13</sup>. This scale defines radiographic OA in 5 categories: K-L grade 0 (normal) had no radiographic features of OA; K-L grade 1 (questionable) had a minute radiographic osteophyte of doubtful pathologic significance; K-L grade 2 (mild) had an osteophyte but no joint space narrowing; K-L grade 3 (moderate) had a moderate diminution of joint space; and K-L grade 4 (severe) had severe joint space narrowing with subchondral bone sclerosis<sup>13</sup>. Interrater reliability assessed with another trained radiologist and intrarater reliability for the radiologist were high (weighted kappa for interrater reliability was 0.86; kappa for intrarater reliability was 0.89), as described<sup>21</sup>. Radiographic hip OA was defined for analysis as K-L grade of at least 2 in at least one hip. Moderate/severe radiographic hip OA was defined as K-L grade 3 or 4 in at least one hip. Symptomatic hip OA was defined as the presence of hip symptoms in at least one hip with corresponding radiographic hip OA in that joint.

All analyses were performed using SAS (version 9.1) for sampling weight calculation and SUDAAN (version 9.0) for weighted population profiles. SUDAAN is a software package designed for the analysis of complex survey data. Weighted prevalence estimates for the 4 hip outcomes and their corresponding 95% confidence intervals were derived for the overall population and for African American and Caucasian men and women in 4 age categories: 45–54 years, 55–64 years, 65–74 years, and 75 years and older. Since women younger than 50 years did not get hip radiographs, the age range for the youngest category of women was 50–54 years for radiographic, symptomatic, and moderate/severe radiographic hip OA outcomes. Women younger than 50 years were included in the estimates of hip symptoms. In order to make inferences to the sampled population at the time of sampling, we standardized our estimates to the 1990 population<sup>18</sup>, since that was the closest point in time to when the baseline sample was drawn. To produce estimates that might be more representative of the current population, we additionally calibrated the estimates to the 2000 Census population distribution.

## RESULTS

The target population of residents age 45 years and older in the 6 townships of the Johnston County Osteoarthritis Project consisted of 57.4% women and 18.5% African Americans (Table 1). A total of 3068 participants completed both the first home interview and clinic examination at baseline. For analysis of hip symptoms, we excluded 71 persons with missing data, leaving 2997 for analysis (Figure 1); there were no significant differences by age, race, sex, or body mass index (BMI) between those with missing hip symptoms data and complete hip symptoms data. For analysis of the 3 radiographic hip outcomes, we excluded 326 women below the age of 50 years (10.6%) who by protocol did not have hip radiography performed, 46 participants (1.5%) with radiographic evidence of inflammatory arthritis

Table 1. Unweighted and weighted distributions of baseline demographic and clinical variables of study participants (n = 3068), Johnston County Osteoarthritis Project, 1991–1997<sup>18</sup>.

Variable	Categories	Unweighted		Weighted	
		Count	%	%*	95% CI
Age group, yrs	45–54	1008	32.9	33.8	31.9, 35.6
	55–64	885	28.8	27.1	25.8, 28.4
	65–74	794	25.9	26.5	25.1, 28.0
	75+	381	12.4	12.6	11.4, 13.8
Sex	Men	1162	37.9	42.6	41.2, 44.0
	Women	1906	62.1	57.4	56.0, 58.8
Race/ethnicity	Caucasian	2069	67.4	81.5	79.4, 83.5
	African-American	999	32.6	18.5	16.5, 20.6
Body mass index kg/m <sup>2†</sup>	< 18.5 (underweight)	35	1.2	1.1	0.8, 1.3
	18.5–24.9 (normal)	749	24.5	25.1	23.9, 26.4
	25.0–29.9 (overweight)	1160	38.0	39.5	38.1, 40.9
	≥ 30 (obese)	1112	36.4	34.3	32.9, 35.8

\* Weighted to the 1990 target population. † World Health Organization categories<sup>31</sup>; values for 12 participants are missing.

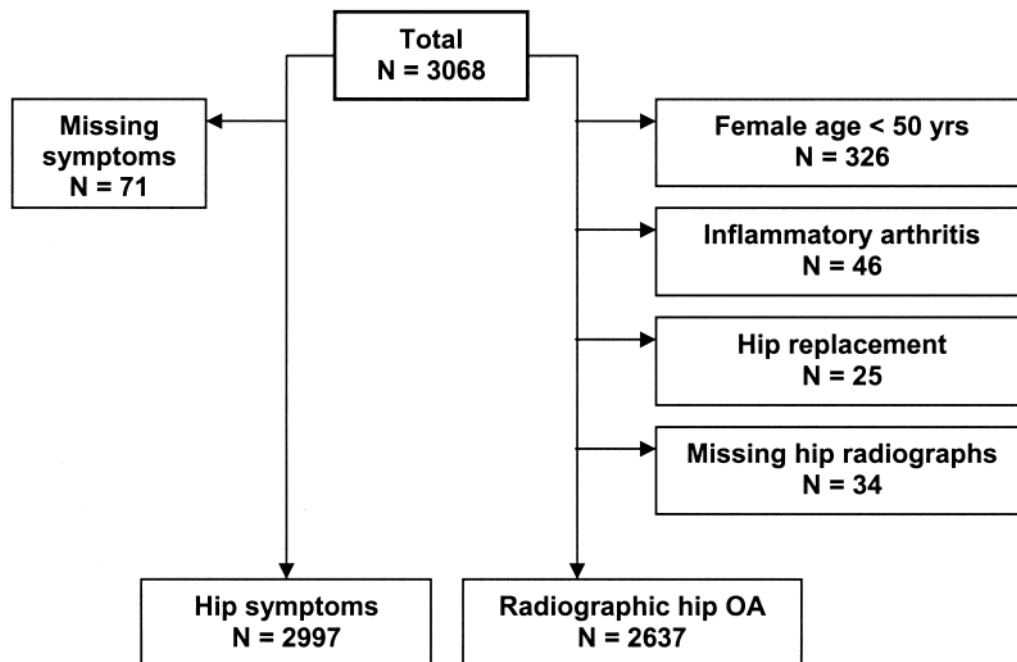


Figure 1. Sample size for hip symptoms and radiographic hip OA analyses: The Johnston County Osteoarthritis Project.

in the knee (n = 17) and/or hip (n = 35), 25 participants who had total hip replacements, and 34 participants with missing hip radiographic data, leaving 2637 for analysis (Figure 1). The 34 individuals with missing hip radiographic data were similar in age, sex, race, and BMI to those with complete hip data.

Overall, 36% reported hip symptoms, 27.6% had radiographic hip OA, 9.7% had symptomatic hip OA, and 2.5% had moderate/severe radiographic hip OA (Table 2). The prevalence of these 4 outcomes was consistently and often

significantly higher for older age groups. Three outcomes (hip symptoms, radiographic hip OA, and symptomatic hip OA) were significantly higher among women compared to men, and 2 outcomes (radiographic hip OA, symptomatic hip OA) were significantly higher among African Americans than Caucasians (Table 2).

Results of age, sex, and racial group stratified analyses are presented in Table 3. Prevalence of hip symptoms was generally similar by age for both sexes and racial groups; for 3 outcomes (radiographic hip OA, symptomatic hip OA, and

Table 2. Weighted prevalence for 4 hip outcomes, all participants and by selected demographic subgroups, Johnston County Osteoarthritis Project, 1991–1997\*.

Demographic Subgroup	Hip Symptoms		Radiographic Hip OA		Symptomatic Hip OA		Severe Radiographic Hip OA	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
All Participants	36.2	34.7, 37.8	27.6	26.3, 28.9	9.7	8.9, 10.6	2.5	2.2, 3.0
Age group								
45–54 <sup>†</sup>	30.7	28.5, 33.0	21.2	19.0, 23.6	5.9	4.7, 7.3	1.4	0.8, 2.4
55–64	35.9	33.6, 38.3	23.0	21.1, 25.1	8.9	7.5, 10.5	1.1	0.8, 1.6
65–74	40.7	38.1, 43.4	31.1	28.9, 33.4	10.8	9.4, 12.5	3.6	2.8, 4.6
75+	42.3	38.3, 46.3	42.9	39.2, 46.7	17.0	14.6, 19.6	5.7	4.3, 7.5
Sex								
Men	31.8	29.8, 33.8	25.4	23.6, 27.3	8.3	7.2, 9.5	2.6	2.0, 3.2
Women	39.5	37.7, 41.5	29.5	27.8, 31.3	11.1	9.9, 12.3	2.5	2.1, 3.1
Race/ethnicity								
Caucasian	36.0	34.3, 37.8	26.6	25.1, 28.1	9.2	8.3, 10.2	2.4	2.0, 3.0
African American	37.1	34.9, 39.4	32.1	29.9, 34.4	12.0	10.3, 13.9	3.1	2.5, 4.0

\* Weighted to the 1990 target population. <sup>†</sup> Radiographic data were available for women only age 50 years and older.

Table 3. Weighted prevalence for 4 hip outcomes, by race/ethnicity, sex, and age group, Johnston County Osteoarthritis Project 1991–1997\*.

Racial/ethnic Group	Age	Hip Symptoms		Radiographic Hip OA		Symptomatic Hip OA		Severe Radiographic Hip OA	
		%	95% CI	%	95% CI	%	95% CI	%	95% CI
Caucasian									
Men	All	31.7	29.6, 34.0	23.8	21.9, 25.9	7.6	6.4, 8.9	2.5	1.9, 3.3
	45–54	30.3	26.5, 34.3	20.9	17.8, 24.5	6.6	4.8, 9.0	1.7	0.9, 3.5
	55–64	29.7	25.7, 34.0	18.5	15.8, 21.7	5.7	4.2, 7.8	0.9	0.5, 1.8
	65–74	33.5	29.9, 37.4	32.0	27.9, 36.3	8.3	6.2, 10.9	5.8	4.3, 7.9
	75+	40.1	32.7, 47.9	30.9	24.6, 38.0	16.2	11.3, 22.7	1.6	0.8, 3.3
Women	All	39.4	37.1, 41.6	29.1	27.1, 31.2	10.8	9.5, 12.2	2.3	1.8, 3.0
	45–54	30.6	27.6, 33.7						
	50–54 <sup>†</sup>			18.5	15.5, 21.9	4.1	2.6, 6.2	1.1	0.4, 3.1
	55–64	39.7	36.3, 43.2	25.1	22.1, 28.3	10.1	8.1, 12.5	1.1	0.7, 1.8
	65–74	45.1	41.2, 49.1	28.7	25.5, 32.1	11.3	9.2, 13.9	1.5	0.8, 2.8
	75+	45.2	39.7, 50.9	47.4	41.8, 53.2	17.6	14.5, 21.2	7.1	5.0, 10.1
African American									
Men	All	32.0	28.5, 35.8	33.2	29.6, 37.0	11.7	9.1, 14.9	2.7	1.7, 4.2
	45–54	26.1	21.0, 32.0	29.3	23.7, 35.6	5.7	3.2, 10.0	0.9	0.4, 2.2
	55–64	35.3	28.4, 42.8	34.2	26.7, 42.6	14.7	8.9, 23.4	1.5	0.6, 3.6
	65–74	41.7	35.7, 48.0	34.1	28.2, 40.6	16.9	12.8, 22.0	5.3	3.4, 8.1
	75+	21.1	12.9, 32.5	43.0	33.3, 53.2	12.9	6.0, 25.5	5.8	1.3, 21.9
Women	All	40.3	37.7, 43.0	31.2	28.2, 34.4	12.2	10.3, 14.5	3.5	2.7, 4.6
	45–54	36.3	32.1, 40.7						
	50–54 <sup>†</sup>			21.3	16.0, 27.7	7.8	4.4, 13.4	0.9	0.3, 2.3
	55–64	42.1	37.4, 46.9	23.6	19.9, 27.8	11.6	8.6, 15.5	1.4	0.5, 3.9
	65–74	42.0	37.4, 46.9	37.1	30.8, 44.0	12.3	8.7, 17.2	5.3	3.7, 7.5
	75+	42.1	34.2, 50.5	45.7	39.5, 52.0	17.7	14.0, 22.0	7.3	4.8, 10.9

\* Weighted to the 1990 target population. <sup>†</sup> Radiographic data were available for women only age 50 years and older.

moderate/severe radiographic hip OA), prevalence was generally higher in those age 75+ years and occasionally for those age 65–74, compared to younger ages in both sex and racial groups, but these differences were not large. One notable exception was the category of African American men aged 75 years and older, in whom the prevalence of hip symptoms and symptomatic hip OA was lower than in the younger age categories.

Women had higher prevalence of hip symptoms than men for both racial groups overall and for several of the age groups within racial groups (Table 3). The prevalence of radiographic hip OA and symptomatic hip OA was higher among Caucasian women than Caucasian men overall and for several of the age groups examined, but there was little difference between African American women and men overall or within age groups for these outcomes. No differences



in prevalence by sex were seen for moderate/severe radiographic hip OA overall or by racial or age groups.

African Americans had a higher prevalence of radiographic hip OA and symptomatic hip OA than Caucasians overall, among men, and for several of the age groups among men, but racial comparisons in women showed no differences (Table 3); no racial differences in the prevalence of hip symptoms or moderate/severe radiographic hip OA were seen overall or by sex or age groups.

Recalibration of these estimates using the population distribution from the 2000 Census did not produce results appreciably different from those produced using the 1990 Census. There were no significant differences in the pattern of observations and no changes in estimates of more than 0.4% (data not shown).

## DISCUSSION

In Johnston County residents aged 45 years and older, these hip OA-related measures occurred at surprisingly high but different frequencies, with hip symptoms occurring most commonly, followed by radiographic hip OA, symptomatic hip OA, and moderate/severe radiographic hip OA. This is the first US study to provide prevalence estimates for these 4 outcomes by age, sex, and race. Contrary to previous indirect comparisons<sup>11,12</sup>, African Americans did not have lower prevalence of radiographic hip OA or moderate/severe radiographic hip OA and were at least as likely as, if not more likely than, Caucasians to have these 4 hip outcomes.

For hip symptoms, the only previous population-based prevalence estimates of hip-related OA outcomes in men and women in the US came from the 1971-1975 NHANES-I and the 1988-1994 NHANES-III. NHANES-I focused on the civilian, noninstitutionalized population age 25-74 (for hip outcomes, men age 25-74 yrs and women 50-74 yrs) in the contiguous US. Defining hip pain as "ever having significant pain in your hips on most days for at least 1 month," this study reported an overall prevalence of 6.6%, and found generally increasing rates by age and roughly similar rates by sex and white/black race<sup>10</sup>. The more recent NHANES-III defined hip pain as "significant hip pain on most days over the preceding 6 weeks" and in analyses confined to those 60 years of age and older, found hip pain reported by 14.3% overall with higher estimates in women than men, a higher estimate among non-Hispanic black men (14.8%) than non-Hispanic white men (12.4%), and the opposite race effect among women<sup>22</sup>. The higher prevalence of hip pain in NHANES-III compared with NHANES-I was speculated to be related to possible nonarticular source of pain in older individuals, or potentially an increase in incidence of hip OA<sup>22</sup>. Our Johnston County prevalence estimates for hip symptoms were about 4-5 times higher for comparable age ranges than NHANES-I and 2-3 times higher than NHANES-III; were higher among women; and were similar by race. Our prevalence estimates are probably

higher in part than these other studies as a result of applying a broader case definition (aching or stiffness as well as pain) without requiring a specific duration criterion ("at least 1 month" or "over the preceding 6 weeks") or "significant" pain. As in NHANES<sup>22</sup> and other studies<sup>23</sup>, we cannot exclude the possibility that some of the reporting of hip symptoms, particularly in women, was related to other or nonarticular sources of pain, such as the lumbar spine or trochanteric bursa. Our data do not suggest that women had more severe radiographic hip OA (see below) as an explanation for this gender difference.

For radiographic hip OA outcomes, the only previous population-based prevalence estimates came from NHANES-I, which defined radiographic hip OA based on the overall K-L grade of non-weight-bearing hip radiographs subjectively synthesized by the nonradiologist readers, using the 1963 *Atlas of Standard Radiographs*<sup>13</sup>. Prevalence of radiographic hip OA among those age 45-54, 55-64, and 65-74 years were about 0.7%, 2.7%, and 3.6%, respectively, and were higher in men than women age 65-74 years (4.6% in men, 2.7% in women). Comparable overall age-specific prevalence figures from our study were 8-30 times higher than those from NHANES-I (at 21%, 23%, and 31%, respectively) and were similar for men and women age 65-74 years. There may be several reasons for the difference. First, NHANES-I radiographs may have been under-read, resulting in an underestimate of the true prevalence<sup>24</sup>. Second, men in rural or nonmetropolitan areas such as Johnston County may have a higher prevalence of radiographic hip OA than those in urban or metropolitan areas<sup>25</sup>. Third, geographic variation in risk factors for hip OA may exist between NHANES-I and our study (the contiguous US and the South, respectively). Finally, differences in radiographic techniques and secular trends in underlying risk factors in the 20-year interval may preclude direct comparisons of estimates between the 2 studies.

A special contribution of this study is the finding that African Americans were at least as likely, if not more likely, to have radiographic and symptomatic hip OA than Caucasians. Prior indirect studies had suggested a much lower prevalence of hip OA among native black Africans<sup>11,12</sup>, as did studies comparing African and Caribbean blacks to European Caucasians<sup>26</sup>. Whether these findings are related to differences in BMI between our and other study populations in different geographic locations cannot be known with certainty, but other potential explanations include differences in physical demands of occupation and daily life, diet, environmental exposures, biomechanics, and genetics. In addition, it has been unclear if the lower rate of total hip replacement surgery among blacks in the US<sup>27</sup> was related to a lower prevalence of hip OA in this demographic group, or to patient preferences, healthcare system, or cultural or other reasons for lower utilization of this treatment modality, as seen in racial disparities of utilization of total knee replace-

ment for knee OA<sup>28</sup>. Our data as well as the report by Tepper and Hochberg showing no significant racial difference in radiographic hip OA in the NHANES-I<sup>10</sup> together suggest that African Americans are not spared radiographic and symptomatic hip OA, and that alternative explanations for racial disparities in the use of joint replacement for hip OA should be investigated. The data also suggest the possibility of unmet need in this group and the need for education of healthcare providers about this issue.

This study has several limitations. First, as is typical for most population-based studies utilizing radiographs for diagnosis, it occurred in a limited geographic region that may not be representative of the US as a whole in terms of geography, rurality, and important factors such as obesity. However, about 70% of our sample was overweight or obese, similar to current figures for the rest of the country<sup>29</sup>, suggesting that the high prevalence of obesity in our sample may not be such a limitation. Second, this study focused only on those age 45 years and older, although these are the ages when OA begins to be detected more commonly. Third, these prevalence estimates were standardized to the 1990 population, since that was the closest point in time to when the baseline sample was drawn. This standard procedure allowed us to make inferences to the sampled population at the time of sampling, which was our goal. However, it is notable that our recalibration of the estimates to the population distribution from the 2000 Census did not produce estimates that were appreciably different. Finally, symptoms were not defined using groin pain, a more specific hip symptom than what people perceive to be hip symptoms, which can mistakenly include sciatica and lumbar pain<sup>23</sup>.

On the other hand, our study has several significant strengths. It occurred relatively recently in a well defined population with a large sample size and a sizable proportion of African Americans and men. The 2 racial groups were recruited from the same geographic location, decreasing the systematic bias that inevitably occurs by comparing racial groups recruited from different geographic regions. Both racial groups underwent identical examination using the same techniques, with very high reproducibility of the radiographic reading procedure. Additionally, participants were well characterized for OA using radiographs and symptoms, allowing 4 outcomes to be examined. Specifically, our estimates of radiographic outcomes excluded people with findings consistent with inflammatory arthritis, thereby sharpening the distinction between those with and those without radiographic hip OA, in contrast to other studies that did not make this clarification<sup>10</sup>. Our estimates may be conservative because we excluded those with hip replacements, most of whom probably had OA<sup>30</sup>. Finally, our exclusions of those with missing symptom or radiographic data were unlikely to bias our results because those with missing data were similar to those with complete data.

Our results have demonstrated that these 4 outcomes rep-

resent a common occurrence for many persons aged 45 years and older, for both sexes, and for African Americans as well as Caucasians. Although these estimates can strictly apply only to the target population in which the study was conducted, it appears likely that the frequencies of these outcomes have substantially increased over the last 20 to 30 years. In the future, as our population ages and the obesity epidemic goes unchecked<sup>29,31</sup>, the prevalence of these hip-related OA outcomes and accompanying disability can be expected to increase for all ages, both sexes, and these racial groups. Reducing this impact will require educating the public and healthcare community about modifiable risk factors for hip OA occurrence and progression, finding new modifiable risk factors, and developing effective interventions to treat, slow progression and ultimately prevent OA.

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