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The Impact of Osteoarthritis in the United States: A Population-Health Perspective

A population-based review of the fourth most common cause of hospitalization in U.S. adults.

Overview: Arthritis, of which osteoarthritis (OA) is the most common type, is the most frequent cause of disability among adults in the United States. The authors reviewed the epidemiologic literature to identify studies that describe the population-based burden of OA—that is, the burden in all adults in the community. They found that 27 million adults—more than 10% of the U.S. adult population—had clinical OA in 2005, and in 2009 OA was the fourth most common cause of hospitalization. OA is the leading indication for joint replacement surgery; 905,000 knee and hip replacements were performed in 2009 at a cost of \$42.3 billion. Obesity is a strong risk factor for OA of the knee and hip. Nurses can improve the quality of life of people with OA by raising awareness among their patients and peers of the substantial OA burden and the strategies, such as physical activity, that can reduce it.

Keywords: epidemiology, osteoarthritis, population-based studies

Arthritis is the most common cause of disability among U.S. adults.¹ Data from 2007 to 2009 show that one in five, or 50 million, U.S. adults reported doctor-diagnosed arthritis in that period; one in nine, or 21 million, had arthritis-attributable activity limitations.² In 2003 the costs attributable to arthritis and other rheumatic conditions were \$128 billion (\$81 billion in medical expenditures and \$47 billion in earnings losses), which represented nearly 1% of that year's U.S. gross domestic product.³ The number of U.S. adults with arthritis is projected to rise to 67 million by 2030.⁴

Osteoarthritis (OA), the most common type of arthritis,⁵ accounts for much of this burden. Our objective was to review the epidemiologic and health services literature in order to describe the personal and societal burden of OA among U.S. adults in the general population. In other words, we studied the OA burden from a population-health perspective. We excluded results from clinic-based studies because these studies may represent only people who have health insurance and access to health care, as well as those who have sought care because they have more severe manifestations of OA.

METHODS

We searched PubMed for studies published in English from 1966 to May 11, 2011, that described the personal and societal impact of OA based on data collected in the United States.



Oleg Trebunski (center), a professional dance coach and instructor, leads a low-impact aerobics Dance for Fun and Fitness class at the Hospital for Special Surgery in New York City. Photo courtesy of the Hospital for Special Surgery.



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First we searched PubMed for articles related to arthritis and OA using standard epidemiologic and health care–burden indicators: *prevalence, incidence, mortality, morbidity, lifetime risk, risk factors, ambulatory care, and hospitalization*. We searched both *arthritis* and *OA* for two reasons: the terms are sometimes used interchangeably, and a public health approach measures all types of arthritis combined. Also, we identified agencies and organizations whose focus is population-health epidemiology (the National Center for Health Statistics), health service use (the Agency for Healthcare Research and Quality [AHRQ]), or delivery of care to people with OA (the American College of Rheumatology and the American Academy of Orthopaedic Surgeons) and searched their Web sites for reports using the terms listed above.

Strong epidemiologic evidence links obesity to an increased risk of symptomatic knee OA and knee replacement.

Then we reviewed materials such as journal articles to identify those that met the search criteria.

Defining OA in epidemiologic studies. Studies on the population-based burden of OA in the United States have used at least three definitions for identifying OA: radiographic, symptomatic, and clinical.

Radiographic OA is based on information from X-rays and can be defined with either individual features or, more commonly, the Kellgren–Lawrence scale of 0 to 4, where radiographic OA is classified as mild (grade 2: joint space narrowing and osteophytes seen on X-ray), moderate (grade 3: many osteophytes, joint space narrowing, sclerosis, and possible bone contour deformity), or severe (grade 4: large osteophytes, marked joint space narrowing, severe sclerosis, and definite bone contour deformity). Typically, OA is defined as a Kellgren–Lawrence grade of 2 or higher. Radiographic OA is used often to study the disease process but less often to characterize OA burden.

Symptomatic OA is defined as the combination of radiographic evidence of OA and symptoms (pain, stiffness) in the radiographically affected joint. Overall, the concordance between pain and radiographic evidence is only modest to moderate—that is, many people have radiographic evidence of OA but no symptoms and vice versa.^{6,7} Because the symptoms

of OA are what lead to its treatment and its costs, symptomatic OA is the most appropriate way of describing the clinical and public health burden.⁶ For this reason, we excluded studies that were based only on radiographic OA.

Clinical OA is based exclusively on clinical information (patient history and physical examination). The American College of Rheumatology's criteria for clinical OA perform well in identifying hand OA, but additional radiographic and laboratory findings are needed for identifying hip and knee OA.^{8–10} Clinical diagnoses are used infrequently in studies of OA burden.

Using self-reports to identify people with specific types of arthritis is unreliable when studying burden. The Centers for Disease Control and Prevention (CDC) recommends that epidemiologic studies of OA rely on information confirmed by a health care provider.¹¹ This is because many people who recognize that they have arthritis generally are incorrect when identifying what type they have.

RESULTS

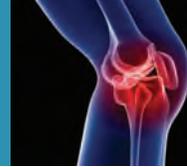
OA may occur as a generalized condition (affecting three or more joint groups) or a localized one (affecting the knee, for example). All of the population-based studies we identified for this review examined the burden of localized OA. The descriptive epidemiology of OA (that is, the characterization of people with OA by, for example, age or race, across time and place) in the United States and worldwide is described in greater detail elsewhere.^{12,13}

OA prevalence (all cases). The National Arthritis Data Workgroup (NADW) used the best available data to estimate that in 2005, 27 million U.S. adults ages 18 years and older had one or more type of clinical OA.¹³ Most of what is known about the prevalence of symptomatic OA is from the Framingham OA Study (a study of knee and hand OA among adults in a suburb of Boston) and the Johnston County Osteoarthritis (JoCo OA) Project (a study of knee and hip OA among blacks and whites ages 45 years and older in Johnston County, North Carolina).^{12,13} We did not identify any population-based data on OA of the spine.

Hand. In the Framingham OA cohort, 6.8% of those ages 26 years and older had symptomatic hand OA (age-standardized rates: men, 3.8%, and women, 9.2%).^{13,14} Using these data, the NADW estimated that 13 million U.S. adults ages 26 years and older had symptomatic hand OA in 2005.

Knee. Using prevalence estimates from the Framingham OA Study, the NADW estimated that in 2005, 9.3 million (4.9%) U.S. adults ages 26 years and older had symptomatic knee OA.¹³ Prevalence

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rises with age and may be higher in women than in men and in blacks than in whites.¹⁵

Hip. The prevalence of symptomatic hip OA among people ages 45 years and older was 6.7% in the Framingham OA Study and 9.7% in the JoCo OA Project.^{12,13} In both, prevalence was highest among older adults (for example, ages 45 to 54 years, 5.9%; ages 75 years and older, 17%).¹⁶ In the JoCo OA Project, prevalence was highest among women and blacks.

OA symptoms such as pain result from changes in the affected joint, including thickening of the joint capsule and the formation of osteophytes.¹⁷ In the JoCo OA Project, 43.3% reported having pain, aching, or stiffness in a knee joint on most days.¹⁵ Reports of pain increased with age (45 to 54 years, 34.2%; 75 years and older, 56.6%) and was higher in blacks than in whites (47.1% and 42.4%, respectively) and in women than in men (47.6% and 37.4%, respectively).

OA incidence (new cases). Because there are limited follow-up studies for OA, there are few estimates of the incidence (new cases of OA) in the U.S. population. A 1995 study showed that among people ages 20 to 89 years at the Fallon Clinic, a treatment facility connected with a community health plan in Massachusetts, one in 1,000 people was diagnosed with symptomatic hand OA each year.¹⁸ Annual incidence among older women and men (10-year age groups, 60 years and older) was four to five per 1,000 women and two to three per 1,000 men. Each year, approximately two in 1,000 people developed symptomatic knee OA; incidence (one per 1,000 people) was similar among middle-aged (40 to 49 years) women and men, but slightly higher (10 and nine per 1,000, respectively) in older adults (70 to 79 years). Less than 1% of the study sample developed symptomatic hip OA annually. It emerged at younger ages in men compared with women (ages 30 to 39 years, eight and zero per 100,000, respectively), but by ages 70 to 79 years, the annual incidence was higher among women than men (six and four per 1,000, respectively). All of these incidence rates have been age and sex standardized.

OA lifetime risk. In the JoCo OA Project, the lifetime risk (by age 85) of symptomatic knee OA was nearly one in two, with the risk rising to almost two in three among those who were obese.¹⁹ A subsequent analysis found that lifetime risk of symptomatic hip OA in this cohort was one in four and that risk of knee or hip OA was the same for men and women and for blacks and whites; body mass index was unrelated to lifetime risk of symptomatic hip OA.²⁰

OA progression has not been examined in community-based studies. Radiographic studies

indicate that there is slow but constant worsening of radiographic hand, knee, and hip OA with aging.^{12,17} Radiographic disease may be relevant to progression to severe symptomatic OA as those with severe radiographic disease may also have severe symptoms.²¹

OA risk factors. Most studies on risk factors have examined incident radiographic OA, and reviews have been published elsewhere.^{12,14,22} The three strongest modifiable risk factors for symptomatic knee OA are obesity, injury, and occupations involving excessive mechanical stress.

Strong epidemiologic evidence links obesity to an increased risk of symptomatic knee OA and knee replacement.^{6,23,24} Women in the Framingham OA study who lost 11 lbs. reduced their risk of symptomatic knee OA by half.²⁵ For hip OA, U.S. and international studies have demonstrated mixed results, with obesity generally associated with symptomatic OA and joint replacement.²⁶ For example, in the Nurses' Health Study (an ongoing study of 238,000 female nurses that started in 1976²⁴) women who were obese, especially at age 18, had an increased risk of undergoing a hip replacement in later life.²⁴

Joint injuries, especially of the knee, resulting from sports, work, or other trauma increase OA risk.^{6,27} Occupations involving excessive mechanical stress have been implicated, including those requiring hard labor, heavy lifting, knee bending, and repetitive motion. Such jobs include those in construction and agriculture for men and cleaning and retail sales for women, among others.

Chronic comorbidities. The few U.S. studies examining comorbidities among people with OA indicate that their risk of developing peptic ulcer and renal disease are at least twice that of people without OA or rheumatoid arthritis; this is likely attributable to their greater use of nonsteroidal antiinflammatory drugs.²⁸ Metabolic syndrome, diabetes, and multiple cardiovascular risk factors (hypertension,^{29,30} abdominal obesity,²⁹ hyperglycemia, elevated triglycerides,^{29,30} a low level of high-density lipoprotein cholesterol, and a waist-to-hip ratio of 0.81 cm or higher) were more prevalent among people with OA in two studies, one of which found the clustering of cardiovascular risk factors to be independent of obesity.^{29,30}

The impact of comorbidities among people with OA is evident in many studies. For example, people with symptomatic OA were at least three times more likely to have difficulty walking and transferring (in and out of the bath, for instance) compared with those without OA, and the likelihood of difficulties increased among those with concurrent risk factors such as obesity.³¹ Other studies demonstrated that people with OA who have comorbidities have higher medical costs than those without comorbidities. In



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a Mayo Clinic population study of data from the 1980s, people with OA incurred significantly higher medical expenses than those without OA or without rheumatoid arthritis for treatment of conditions related to *all* body systems. Another cost-of-illness study found that costs attributable to OA were halved when statistical models were adjusted for comorbidities.³²

Moderate increases in mortality rates have been observed among U.S. adults with knee OA.

Activity and functional limitations. OA symptoms can lead to physical limitations.⁶ Activity limitations are common among people with any doctor-diagnosed arthritis (42.4% reported it in the 2007–2009 National Health Interview Survey).² Because OA makes up the majority of arthritis cases, we hypothesize that there is likely a comparable prevalence of such limitations among people with OA. The three most frequently found functional limitations among people with arthritis are bending or stooping, standing, and walking.³³

Health care use. In 2006 and again in 2007 there were roughly 12.3 million ambulatory care visits and 85,000 ED visits associated with an OA diagnosis.³⁴ According to AHRQ data, in 2009 OA was the primary diagnosis for an estimated 921,000 hospitalizations, with a mean cost per stay of \$45,443; this is more than double the number of hospital stays associated with OA in 1997—418,000.³⁵ In 2009 OA was the fourth most frequent primary diagnosis associated with a hospital discharge (after pneumonia, congestive heart failure, and coronary atherosclerosis),³⁶ whereas it was 16th in 1997.³⁶

Most of the hospitalizations associated with OA are for knee and hip replacement procedures, and OA is the indication for most of these (95% of Medicare-funded knee and hip replacements).^{37,38} According to our calculations using AHRQ data, in 2009 there were 620,192 and 284,708 U.S. hospital discharges associated with total knee and hip joint replacements, respectively, with corresponding hospital expenditures of \$28.5 billion and \$13.7 billion.³⁹

The number of hospitalizations associated with OA is projected to rise with the rapid increase in

the rates of knee and hip replacement among U.S. adults.^{40,41} From 2000 to 2006 the rate of total knee replacement increased by 58%, from 5.5 to 8.7 procedures performed per 1,000 Medicare beneficiaries.⁴² Historically, adults older than 65 years of age were the most likely to undergo joint replacement, but recent studies show more rapidly rising rates among middle-aged adults (45 to 64 years of age).⁴³

In 2007 10% of people receiving home health care had a diagnosis of OA.⁴⁴

Economic impact. There are no recent credible population-level estimates of medical expenditures (direct costs) attributable to OA. In 2003 medical expenditures attributable to arthritis and other rheumatic conditions totaled \$81 billion, of which OA is likely to account for a large proportion.³ According to our calculations using AHRQ data, in 2009 hospital expenditures associated with knee and hip replacements were \$42.3 billion³⁹; OA is likely to be the underlying reason for most of these procedures.

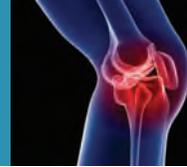
Nevertheless, population-level studies indicate that people with OA are more likely to incur medical costs because of joint replacements and comorbidities.^{32,45} In 1987 people with OA in the Olmsted County Health Care Utilization and Expenditures Database (maintained by the Mayo Clinic) had higher costs associated with medical care of all body systems than those without OA or rheumatoid arthritis did.⁴⁵ Lee and colleagues estimated that in 1996 the direct costs of inpatient, outpatient, and pharmaceutical treatment for people with OA in a large managed care organization, when properly adjusted for all other comorbidities, was 1.5 times higher than for those without OA.³²

One in three U.S. adults ages 18 to 64 years reported in 2002 that arthritis limited her or his ability to work, as well as the type and amount of work⁴⁶; it is likely, because of OA's high prevalence among people with rheumatic conditions, that this is also true of people with OA. There are no current estimates of the indirect costs, such as earnings losses, of OA. In 2003 earnings losses for people ages 18 to 64 years with rheumatic conditions were \$3,613 per person, for a total of \$47 billion.³

Mortality rates. Moderate increases in mortality rates have been observed among U.S. adults with knee OA.⁴⁷ The largest of these studies found that women with radiographic OA of the knee were 50% more likely to die than women of the same age without it; men had a 20% greater likelihood.⁴⁷ Premature death has been attributed to medication-related gastrointestinal and obesity-related cardiovascular diseases.

Disability. A U.S. “burden of disease” study estimated that in 1996 OA accounted for 6.3%

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(940,612) of all years of life lost to disability, ranking it third behind depression and alcohol use and abuse.⁴⁸

Barriers to access to care. There is little information on barriers to care for those with OA. Indirect evidence suggests that a substantial number of people with chronic joint symptoms self-treat and do not ask their health care providers about their symptoms; much of this probably occurs among people with mild or early arthritis.⁴⁹ Getting such people to see a provider is an objective of Healthy People 2020, the federal effort to improve the health of the nation (see <http://1.usa.gov/tjlyur>).

Potential barriers to joint replacement procedures exist, but the specifics are not clear-cut. Although the burden of serious OA is comparable in blacks and whites, multiple U.S. studies indicate that whites undergo joint replacement at a higher rate than blacks.^{42, 50, 51} In 2006 the rate of total knee replacements among U.S. adults ages 65 years and older was 39% lower in blacks than in whites (5.6 and 9.2 per 1,000 people, respectively).⁴² Several studies have shown that these racial differences persist even when access to care is similar. Reasons may include, among blacks, a distrust of the health care system, communication gaps with providers, and low expectations for the procedure's outcomes.^{42, 51} Discussions that are culturally sensitive and tailored to the patient's education level and that address benefits (such as improved physical function) and limitations (such as surgical risks) may help to eliminate this disparity.^{42, 51} Clinic-based studies indicate that there may be greater unmet need for joint replacement among women compared with men; to date, there is no U.S. population-based evidence of this disparity.

DISCUSSION

In 2005 an estimated 27 million U.S. adults—more than 10% of the U.S. adult population—had clinical OA affecting quality of life through pain and functional limitations, lost earnings, concomitant chronic conditions, and chronic disease risk factors. Such issues can have a substantial impact, including the almost 1 million years of life lost to disability in 1996⁴⁸ and the rising number of hospitalizations, primarily for costly joint replacements. In 2009 in the United States, 904,900 knee and hip replacements were performed at a cost of \$42.3 billion, according to our calculations.³⁹ At the current rate of increase in the number of joint replacements, we project that by 2013, at least 1 million total knee and hip replacements will be performed in the United States each year.

Obesity is a strong risk factor for knee OA and knee and hip replacement.^{12, 14, 22-24} It is unknown

whether the rapid rise in joint replacements in recent years, especially among middle-aged adults, is linked to the increased prevalence of obesity across all age groups.^{52, 53} Prevalence estimates from the JoCo OA Project study may shed some light: the high prevalence of OA among that study's participants compared with those in other studies (such as the Framingham cohort) has been attributed partially to the increased prevalence of obesity among the study's participants.^{15, 16} When the JoCo OA Project study began in 1990, the prevalence of obesity among its participants was higher than among people nationwide, but it is now the same.¹⁹ The higher prevalence of obesity in the JoCo OA Project may predict the burden of OA in the United States in coming years. Whether the obesity epidemic will increasingly affect younger adults is an important consideration for OA clinicians and researchers.

Whereas biomedical studies of radiographic OA are important for understanding the pathophysiology of OA, symptomatic OA is a more important focus in a public health approach. This approach is consistent with the interests of nurses and other health care providers, as it is the symptoms of OA that lead to its effects on quality of life and health care use. This review demonstrates the considerable burden of OA but also illuminates the gaps in knowledge on the impact of symptomatic OA. However, differing case definitions, geographic areas, and sociodemographic groups make it challenging to compare results across the studies we examined.

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Despite its profound impact, arthritis is under-recognized by health care providers and those with the condition.⁴⁹ As the largest occupational group in health care delivery, nurses can be a force in changing how OA is perceived and managed on health care's front lines. Routinely asking all adults about the presence of joint symptoms can identify people who are silently struggling with arthritis. These inquiries may also be a critical step in managing other chronic conditions such as heart disease and



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diabetes. For example, physical inactivity is higher among people with diabetes,⁴⁹ heart disease,⁴⁹ and obesity⁵⁴ who also have arthritis, suggesting that arthritis symptoms such as pain are barriers to physical activity.

By identifying arthritis during history taking, providers have an opportunity to discuss how physical activity, including exercise, decreases pain, improves function, and boosts mood.⁵⁵ Self-directed low-impact activities such as walking and swimming are effective. Community-based physical-activity classes, including the Arthritis Foundation Exercise Program that features Walk With Ease, provide guidance on how to exercise safely and reduce the chance of injury (see www.arthritis.org/programs.php). People with arthritis often worry that exercise will exacerbate joint symptoms, but although there can be an initial increase, it is short-lived and benefits are evident within days to weeks of starting an exercise program.⁴⁹

Another evidence-based self-management strategy that can complement usual clinical care is the psychoeducational classes developed by nurse Kate Lorig.^{55,56} Self-management education classes for people with arthritis include the Arthritis Foundation's Self-Help Program⁵⁷ and the Chronic Disease Self-Management Program (known as Living Well with Chronic Conditions in many states).⁵⁸ They help patients with the emotional aspects of living with arthritis and guide them in choosing appropriate exercise and effectively communicating with family members and health care professionals. Benefits include increased self-efficacy and energy and decreased fatigue, anxiety, and depression.⁵⁹ In a national survey of people with arthritis, the CDC learned that respondents were 19 times more likely to attend a self-management education class if it was recommended by a health care provider.⁶⁰ Nurses can be highly influential in increasing the chance that patients will attend these programs.

The CDC currently partially funds the efforts of 12 states to embed self-management education and physical activity classes in self-sustaining systems, such as health care systems, county extension services, and local branches of the Y (see <http://1.usa.gov/vj4ihe>). Because improvements in physical and psychological health can result from self-management strategies, the CDC Arthritis Program has made it a key objective to expand their availability. Nurses can play a critical role in increasing the availability of and referring patients to these interventions, thus improving the health of their patients and the public overall. ▼

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G. Helmick is a medical epidemiologist. Contact author: Louise Murphy, lmurphy1@cdc.gov. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC. The authors have disclosed no potential conflicts of interest, financial or otherwise.

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