

# The Epidemiology of Agriculture-related Osteoarthritis and Its Impact on Occupational Disability

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## ABSTRACT

**Background:** Hip and knee osteoarthritis and undiagnosed chronic joint pain are more prevalent in agricultural workers than other occupational groups, significantly impacting the ability of small farm operators and farm workers to maintain a livelihood.

**Methods:** Agricultural risk factors, economic impacts, national and state AgrAbility data, gender, and farm/non-farm prevalence differences of arthritis and joint arthropathy in a Wisconsin farm cohort are reviewed.

**Results:** Agricultural workers (primarily male) are at increased risk for developing osteoarthritis of the hip and knee. In Wisconsin, the prevalence rate of osteoarthritis is higher in a male farm vs. a male rural non-farm cohort. Arthritis comprises 10%-12% of the disability referrals to state and national AgrAbility programs. Back pain, joint injury, and orthopedic injury account for another 38%. The ability to perform agricultural job duties is significantly affected by arthritis and lack of access to health care. Obesity is an additional independent risk factor for osteoarthritis in the rural population.

**Conclusions:** The agricultural work force is at particular risk for arthritis-related disability. Improved access to health care for diagnosis and treatment can lessen disability. Prevention of arthritis is multi-factorial, involving er-

gonomic improvements, lifestyle modification to prevent obesity, and adequate medical treatment of arthritis.

## INTRODUCTION

According to the Centers for Disease Control and Prevention estimates, in 2001 arthritis and chronic joint pain affected as many as 70 million people, or 1 out of 3 adults.<sup>1</sup> This is similar to the 34% prevalence rate of arthritis among Wisconsin adults in 2000.<sup>2</sup> The prevalence of arthritis increases with age, affecting 60% of those 65 years of age or older, and the number of people with arthritis is expected to double by the year 2030.<sup>3</sup> The average age of farm owner-operators now over age 55 is steadily increasing, while the average age of the farm worker group in larger agricultural operations is significantly younger. This can impact the calculated prevalence rates of osteoarthritis if both populations are lumped together in the analysis of self-reported arthritis symptoms and age-adjustments are not calculated. Osteoarthritis is the most common form of arthritis affecting 21 million adults, while rheumatoid arthritis affects 2.1 million adults. The *Healthy People 2010* document reports arthritis as the leading cause of disability and, according to the National Arthritis Action Plan, an estimated 11.6 million adults will have arthritis-related disability by 2020. Presently arthritis is second only to cardiovascular disease as the leading cause of work disability.<sup>4</sup>

National data on the prevalence of arthritis in agriculture does not exist. Agricultural workers are subject to the same risk factors for developing arthritis as the general population, and have additional risk factors specific to agriculture. The impact of arthritis on agriculture, risk factors specific to agriculture, and issues in determining prevalence of osteoarthritis in the agricultural population will also be discussed.

## MATERIALS AND METHODS

Medical literature from 1989 to the present indexed by

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**Table 1.** Prevalence Risk Ratios of Osteoarthritis and Arthropathy, Unspecified in a Farm Cohort

Cohort	Prevalence osteoarthritis*	Prevalence osteoarthritis and arthropathy unspecified*	PRR <sup>†</sup> (95% CI)	PRR <sup>‡</sup> (95% CI)
	(95% CI)	(95% CI)		
<b>Farm Cohort</b>				
Total combined	122.2 (108.5, 136.0)	147.3 (133.1, 161.6)	1.02 (0.92, 1.14)	1.07 (0.97, 1.19)
Male	118.3 (106.7, 129.9)	145.1 (132.3, 157.8)	1.24 (1.07, 1.45)	1.30 (1.13, 1.49)
Female	125.8 (113.0, 138.6)	149.2 (135.1, 163.2)	0.82 (0.70, 0.97)	0.86 (0.74, 1.00)
<b>Non-Farm Cohort</b>				
Total combined	118.0 (115.8, 120.2)	141.2 (138.8, 143.6)		
Male	108.7 (105.5, 111.9)	131.2 (127.7, 134.7)		
Female	125.0 (122.0, 128.0)	149.1 (145.8, 152.4)		

\* Prevalence rates per 1000 people age-adjusted to 2000 US standard population.

† Prevalence rate ratio of osteoarthritis and allied disorders comparing farm to non-farm based on statistical models adjusting for age and gender.

‡ Prevalence rate ratio of osteoarthritis and allied disorders and of arthropathy, unspecified combined comparing farm to non-farm based on statistical models adjusting for age and gender.

CI = confidence interval

the National Library of Medicine was searched using the subject headings of arthritis, osteoarthritis, joint pain, agriculture, farm, agricultural and farm workers, occupational injuries, risk factors, obesity, and back pain. The World Wide Web was also searched through the Google™ search engine using the same search terms. Unpublished data related to agricultural disability due to arthritis were made available by the National AgrAbility Database at the University of Wisconsin-Madison, the Easter Seals Wisconsin AgrAbility, and the Missouri Arthritis Rehabilitation Research and Training Center. The Epidemiology Research Center of Marshfield Clinic Research Foundation made available unpublished diagnosis-based arthritis prevalence rate data in a central Wisconsin farm cohort.

## RESULTS

### *Prevalence rates of arthritis in a northern and central Wisconsin farm cohort*

Prevalence rates of osteoarthritis and allied disorders and of arthropathy, unspecified (ICD-9 diagnostic codes 715-715.9 and 716.9, respectively) were determined based on diagnoses archived in the medical records of the Marshfield Epidemiologic Study Area (MESA) population.<sup>5</sup> A farm cohort based upon farm residence was compared to a non-farm group in the MESA area. MESA is a Wisconsin 24 ZIP code region

where nearly all residents receive their care from Marshfield Clinic and affiliated hospitals. The residents of the region comprise a population-based cohort that serves as a useful resource in measuring the occurrence of disease in the general and farming population.<sup>5</sup>

Based on statistical modeling, the prevalence rate ratios of arthritis (1.24; 95% confidence interval [CI], 1.07, 1.45) and of arthritis and joint arthropathy combined (1.30; 95% CI, 1.13, 1.49) were increased in male farm residents, but not in female farm residents. The prevalence rate ratios for arthropathy alone showed a mild, but non-significant increase among male farm residents. Age adjusted prevalence rates for female farm residents (149.2 per 1000; 95% CI, 135.1, 163.2) were nearly identical to rates for non-farm females (149.1 per 1000; 95% CI, 145.8, 152.4). Incidence rate ratios for men showed a similar pattern to that of prevalence, although, interestingly, there was a suggestion of decreased incidence rates among farm women. The overall age-adjusted prevalence of arthritis and joint arthropathy per 1000 people in the MESA farm group was 147.3 (95% CI, 133.1, 161.6), or nearly 15%. The overall prevalence in the non-farm group was 141.2 (95% CI, 138.8, 143.6) (Table 1). Other trends noted were increasing prevalence and incidence rates with increasing age. For example, prevalence among farm residents was <5% before age 30, but >50% after age 65. Further investiga-

tion of farm residence risk factors, occupational exposures, and the apparent gender differences has not been assessed at this time. However, because these rates and comparisons were based on clinically detected disease, they would likely be influenced by any existing differences in health care access and utilization.

It is difficult to accurately assess the total numbers or national prevalence of arthritis in the agricultural population due to the inconsistency of farmers falling under the Occupational Safety and Health Act (OSHA) or worker's compensation reporting structure. Medical records may miss many cases due to the lack of medical care, as the farm occupational cohort is generally an underinsured population and the farming community frequently self-treats joint pain without seeking a physician's care. In a survey of 606 Ontario hog farmers, backache, sore knees, and other arthritis symptoms were reported in 71%, 36%, and 21% of the respondents, respectively, but only 2% were under a doctor's care.<sup>6</sup> Off-farm work can also be a potential confounding factor due to longer hours worked and additive physical and ergonomic stressors. The number of farmers having an off-farm job is steadily increasing and is 47% in Wisconsin according to the 1997 US Agricultural Census.<sup>7</sup> A study of back pain in Iowa farmers determined that having a non-agricultural job as the major occupation was a risk factor approaching significance (OR=2.02; 95% CI, 0.98, 4.17; P = 0.055) associated with back pain.<sup>8</sup>

#### *Arthritis risk factors in the general population and agriculture*

Osteoarthritis is the most common form of arthritis in both the general population and the male agricultural occupational work force. Joints primarily affected include the lumbar spine, hips, knees, ankles and feet, and the first carpometacarpal joint at the base of the thumb. Risk factors that are commonly thought to be associated with an increased prevalence of arthritis include age over 65, obesity (defined as a body mass index [BMI]  $\geq 30$ ), female gender, and lower educational and socioeconomic status.<sup>2</sup> Repetitive forceful work is considered to both aggravate and accelerate development of osteoarthritis and aggravate other forms of arthritis. The association with obesity poses a troubling trend for the future in both farm and non-farm populations. A recent study reviewing data from the nurses' health study shows a 2-fold increased risk of total hip replacement comparing women in the highest BMI category of  $\geq 35$  to women in the lowest category of BMI:  $\leq 22$ . Women in the highest category at age 18 had a 5-fold greater risk

of hip replacement.<sup>9</sup> Obesity rates have increased in Wisconsin, as well as nationally. However, the prevalence of obesity tends to be highest in rural women. During the time period 1989-1998, the prevalence of obesity in Wisconsin adults increased from 23% to 34%, an increase of over 40%.<sup>10</sup> The Rural Women's Health Study, an ongoing prospective cohort study at Marshfield Clinic, reported a significantly increased prevalence of obesity (BMI  $\geq 30$ ) in farm residents (39.6%) compared to non-farm residents (31.3%).<sup>11</sup> A study of male and female Finnish farmers reported obesity, age, and gender as weak independent risk factors for disabling knee osteoarthritis with a relative risk ratio of 1.4 (95% CI, 1.2, 1.5) in both genders. Female gender and obesity was associated with a relative risk ratio of 4.8 (95% CI, 2.4, 9.3) for bilateral knee osteoarthritis.<sup>12</sup>

A critical review of the occupational arthritis literature by Maetzel et al reported a strong positive relationship between frequent bending of the knee and osteoarthritis of the knee in men, but was inconclusive in women.<sup>13</sup> Multiple other studies have shown a consistent association between increasing years of farming and hip osteoarthritis, and to a lesser degree knee osteoarthritis.<sup>14-18</sup> An excellent and thorough review of musculoskeletal disorders in farmers and farm workers reported a dose-response trend with statistically significant odds ratios for hip osteoarthritis ranging from 2.1 for those individuals with 1-10 years farming experience to as high as 9.3 for those who had farmed 10 years or more.<sup>14</sup> Tractor driving and milking have also been associated with statistically significant increased odds ratios of hip and/or knee osteoarthritis and chronic joint pain ranging from 1.39 to 2.98.<sup>15-17</sup> Agriculture is considered to have the strongest and most consistent association with hip osteoarthritis as an independent risk factor.<sup>14,18</sup> Tractor driving appears to have the most consistent association with musculoskeletal pain, including back pain and osteoarthritis of the hip and/or knee.<sup>14,15,17</sup> In a Wisconsin study of primarily dairy farmers aged 20-60, the odds ratio was highest (5.2) in farmers 40-49 years old, and was significantly higher than in blue-collar workers of similar ages.<sup>19</sup> There was also a significant association with increased BMI in cases as compared to controls (P = 0.02). It was hypothesized that frequent squatting during machine milking was a significant biomechanical stress, as the farmer would daily squat 8 times for each cow. At that time an average dairy farmer milked 42 cows. Back pain can be a result of osteoarthritis. It has also been consistently noted to have a higher prevalence in farmers and farm laborers.<sup>14,20,21</sup>

Upper extremity joint pain and neck and shoulder pain are also noted to occur commonly in surveys of farmers and farm workers. An evaluation of the US National Health Interview Survey-Occupational Health Supplement, which analyzed self-reported but medically attended hand and wrist arthritis, reported an elevated odds ratio of 3.6 (95% CI, 1.87, 6.93;  $P = 0.001$ ) in the agriculture, forestry, and fisheries industry sector and an odds ratio of 2.71 (95% CI, 1.27, 5.76;  $P = 0.001$ ) in the farmers, forestry, and fishing occupational category.<sup>22</sup> Weaker associations of hand and wrist pain with a prevalence of 28% and an odds ratio of 1.72 (95% CI, 1.34, 2.21) were reported by Gomez et al in an analysis of New York farmers in the Farm Family Health and Hazard Surveillance (FFHHS) study.<sup>17</sup> Hand and forearm pain was weakly associated with farmers in a population-based study of Swedish farmers with an odds ratio of 1.34 (95% CI, 1.09, 1.65).<sup>20</sup> One survey of California migrant farm workers documented an 18% prevalence of wrist pain among this cohort.<sup>23</sup> The New York FFHHS study assessment reported an increased risk of neck and shoulder pain in owner-operators (OR 2.24; 95% CI, 1.45, 3.45) and workers (OR 1.69; 95% CI, 1.17, 2.46), but Holmberg et al did not notice a significant risk in Swedish farmers.<sup>17,20</sup> Fruit picking and small vegetable manual harvesting require significant reaching and working overhead. Accordingly, neck and shoulder conditions account for 12.4% and 14%, respectively, of occupational injuries reported in a survey of California migrant workers.<sup>23</sup>

Comparison of existing studies investigating the rates of osteoarthritis is complicated by the varying outcome measures utilized. Common variables measured include pain symptoms, radiographic findings (such as hypertrophy or joint space narrowing), and total hip arthroplasty. An analysis of the Framingham heart study cohort documented that radiographic findings of severe osteoarthritis were significantly increased (OR 2.22; 95% CI, 1.38, 3.58) in men whose jobs required frequent bending with at least medium job demands, although clinical symptoms occurred in only a small number of the participants.<sup>24</sup> The majority of surveys for arthritis in the United States are based upon self-reported symptoms of joint pain or whether a physician has diagnosed arthritis. The reporting mechanisms also vary within the United States and Europe. Many of the Scandinavian countries have, or have had, a disability and pension structure for farmers that may skew the prevalence rates compared to the United States, which does not have a similar pension structure. The physical

forces and work postures involved in farming and various other agricultural occupations are continuing to change and many of the studies now may look at historical exposures rather than ongoing exposures. Some of the ergonomic improvements in the larger operations include decreased whole-body vibration due to better suspension systems in farm equipment, reduced bending, twisting, and lifting in production thanks to the replacement of bucket and pipeline milking operations with milking parlors, and reduced exposure to heavy lifting through the use of skid-steer loaders to aid in manual farm work. However, these improvements do not necessarily extend to all smaller farm operations seen in Wisconsin and other dairy producing areas. As operations become larger, hired workers do more of the hard physical work rather than the farm owner operators, possibly introducing a confounding factor for the composition of the study cohorts.

Occupational risk factors in agriculture include twisting, turning, persistent awkward postures, reaching, heavy lifting, frequent bending, compression of weight bearing joints by heavy lifting in awkward positions, driving for long periods of time (particularly with exposure to whole-body vibration), and walking long distances over uneven ground.<sup>14,18,25</sup> Forceful and strenuous work is associated with knee osteoarthritis.<sup>13</sup> Forceful work at early ages may also be a significant risk factor. A Swedish study reported an association with heavy physical work before age 16 and an increased risk of hip osteoarthritis (OR 2.06; 95% CI, 1.48, 2.86), but not with participation in sports. Previous significant joint injuries are also considered a risk factor for the development of osteoarthritis. Injuries commonly occur in agricultural work with joint and muscle straining, falling, and contusions from machinery and animals attributable as the leading causes of injuries. An ergonomic evaluation of dairy production undertaken by the National Farm Medicine Center at Marshfield Clinic through a National Institute of Occupational Safety and Health funded project identified the following activities as requiring heavy to very heavy strength requirements: artificial insemination, bedding of cows, cleaning pens, feeding cows, fencing, giving injections, giving oral medications, handling hay and seed, bucket and pipeline milking, rock picking, and spreading lime. Parlor milking was considered light work (unpublished data, 1997).

#### *Disability issues and impact of arthritis upon function*

It is clear that arthritis has an impact upon the ability to perform both work and activities of daily living.

Sprince et al reported that Iowa farmers with physician-diagnosed arthritis were at higher risk for a subsequent animal-related injury (OR=3.0; 95% CI, 1.7, 5.2).<sup>26</sup> An increased risk of a severe farm injury (OR=2.56; 95% CI, 1.52, 4.32) was identified in New York farmers with self-reported joint trouble.<sup>27</sup> Sprince et al hypothesized that impaired lower or upper extremity mobility negatively affected the ability to control or avoid large livestock. The 1996 Behavioral Risk Surveillance System findings indicate that 43% to 58% of those with chronic joint symptoms self-limit their activities.<sup>24</sup> The Wisconsin Behavioral Risk Factor Surveillance System indicates those with arthritis report lower physical activity, higher co-existing health conditions, and lower perceived general health status than those without arthritis.<sup>2</sup> The prevalence rates of arthritis and chronic joint pain do not significantly vary between white non-Hispanic, Hispanic, and black non-Hispanic populations, but published data on the prevalence in the Hispanic population is lacking. However, the rate of arthritis-related limitation of activity is reported to be higher in the Hispanic than white non-Hispanic populations.<sup>28</sup> This latter observation may be the result of inadequately controlled pain secondary to inadequate medical treatment. Roughly 40% nationally of those with chronic joint pain have not been diagnosed by a physician as having arthritis.<sup>25</sup> According to a study among Wisconsin adults with arthritis, 40% of those who know what type of arthritis they have are receiving treatment compared to only 20% of those who did not know what type of arthritis they have.<sup>2</sup>

The farm population, both Hispanic and white non-Hispanic, is at risk for undertreatment of arthritis. A Minnesota study reported that the overall average yearly medical costs for individuals with rheumatoid arthritis was \$3802 and \$2655 for those with osteoarthritis compared to \$1388 for those with no diagnosis of arthritis ( $P = 0.0001$ ).<sup>29</sup> A recent survey of Wisconsin dairy farms reported that 20% of Wisconsin farms are completely uninsured, 25% have at least 1 uninsured family member, and 4 out of 5 have no preventive care coverage, or have major medical with high deductibles.<sup>30</sup> The rates of being uninsured, underinsured, and lacking preventive care were far above the state average for non-farm households. The lack of health coverage will have a significant impact upon adequate treatment of a chronic condition and may directly affect both the physical ability to farm and economically maintain a viable farm operation. Indeed, in a recent prospective study investigating the treatment of acute low back pain, fewer than 5% of the study co-

hort came from within the agricultural section (Reeser, unpublished).

#### *Disability prevention and AgrAbility*

AgrAbility is a program designated to decrease disability in agricultural workers and farmers through the evaluation of occupational and vocational limitations, assistance in obtaining appropriate assistive devices, and the involvement of the Department of Vocational Rehabilitation. AgrAbility is a partnership between the cooperative extension service of land grant universities and Easter Seals, and is administered by the United States Department of Agriculture. In Wisconsin, it is a collaborative effort between the University of Wisconsin Cooperative Extension and Easter Seals Wisconsin.

The numbers of referrals to AgrAbility cannot be used to determine prevalence or risk of arthritis or chronic joint pain, but are helpful in assessing the impact of arthritis upon the ability to function as a farmer. Unpublished 2001-2002 data from the National AgrAbility Project at the University of Wisconsin-Madison Cooperative Extension department identified 756 referrals for assistance of whom 78% were owner operators, 5% spouses or partners of farmers, 4% children of farmers, 4% retired farmers, and 4% farm employees or migrant workers. The greatest percentage (46%) was involved in field crop production followed by 39% in livestock production and 12% in dairy farming. Forty-four percent of the referrals were working full-time, 14% part-time, and 33% were not working. Arthritis was the primary condition accounting for disability in 4% and the secondary cause of disability in 8%. Other musculoskeletal diagnoses, including back injury, joint injury, and orthopedic injury accounted for 20% as a primary condition and 18% as a secondary condition. Wisconsin Easter Seals AgrAbility unpublished data from 1990 through 2002 identified 71 of 725 (9.8%) total referrals listing arthritis as the primary cause of disability. The Missouri AgrAbility Program (<http://www.muhealth.org/~arthritis>) is associated with the Missouri Arthritis Rehabilitation Research and Training Center, which is the only federally funded center for arthritis prevention. A state survey carried out by the Missouri Arthritis Rehabilitation Research and Training Center and Missouri AgrAbility identified 44 farmers and spouses with arthritis. Of these, 29 had a physician diagnosis of arthritis and 15 did not. Osteoarthritis was the most common form of arthritis affecting the following joints in descending order: fingers, knees, shoulders, back, neck, hips, feet, wrists, thumbs, ankles, elbows, and jaw. Problems identified

were difficulty manipulating small objects, restricted lifting, difficulty bending, easy fatigability, limited mobility, difficulty reaching, and increased symptoms with repetitive motion. Twelve of 44 (27%) worked a shorter day on some or most days and 10/44 (23%) worked a few shorter days, while the majority (17/44; 39%) did not alter their workday. Those with a greater number of affected joints worked more partial days.

Prevention of arthritis-related disability includes primary prevention measures such as avoiding jumping and jarring activities, reducing repetitive forces to joints, decreasing injuries to joints, using labor saving work devices, and preventing obesity. Limiting the weight of frequently carried objects (such as feed and seed bags), applying handles to frequently carried objects, and ergonomically improving agricultural tools will decrease the physical forces (load) upon joints. It is also important to decrease exposure to vibration and awkward positioning. Adequate shocks, seat suspension systems, and rear and side-view mirrors on farm machinery are recommended to decrease vibration and awkward positions while driving. Secondary prevention measures include weight reduction and use of assistive devices to unload the affected joint to control symptoms and minimize further load on the joint. Exercises designed to strengthen the muscles acting upon the involved joint enhance the body's ability to dissipate ground reactive forces on the joint, thereby minimizing symptoms and physical limitation. Occupational and physical therapists can instruct the patient in strategies designed to minimize the use of and thereby protect the arthritic joint. Knee osteotomy and/or arthroplasty and total hip arthroplasty should be considered in cases where pain significantly limits participation in activities, impairs mobility, diminishes quality of life, and provides relief for unrelenting nighttime pain not adequately controlled by medications. Nonsteroidal anti-inflammatory medications and acetaminophen may be useful analgesics, but their use should be monitored. AgrAbility is significantly involved in tertiary prevention and will evaluate and aid in obtaining assistive devices to enable those with chronic disabilities to maintain their agricultural occupation and improve performance of activities of daily living. Assistive devices for lower extremity and back involvement may include added handholds and steps on equipment, hand clutches, power lifts to get into farm equipment, automated telescoping or suspended hitches enabling backing tractors directly under 3-point hitches, and automated feeding systems and feed carts. Upper extremity aids may include spinner knobs

on steering wheels and finger-tip braking control. Referrals to Wisconsin AgrAbility (<http://bse.wisc.edu/agrability>) can be made either by a physician or other health care professionals or self-referrals to either the University of Wisconsin Cooperative Extension (608.262.9336) or Easter Seals Wisconsin (800.422.2324).

## CONCLUSION

Arthritis is an increasing national concern and has a particular impact upon farmers and farm workers. A strategy to increase awareness of the risk factors associated with arthritis, healthy lifestyles to decrease obesity, and adequate evaluation and treatment of the effects of arthritis will decrease arthritis-related disability among the agricultural population. Improved surveillance and engineering strategies to identify and reduce the physical forces in agriculture that increase the risk of developing arthritis and which may eventually lead to joint replacement are recommended. A strategy to improve access to health care and treatment of arthritis in the farm population and agricultural workforce is a crucial component for the prevention of unnecessary disability.

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