Prevalence of Arthritis: Analysis of Data from the US Behavioral Risk Factor Surveillance System, 1996–99

FATIMA MILI, CHARLES G. HELMICK, and MATTHEW M. ZACK

ABSTRACT. ***Objective.*** Arthritis and other rheumatic conditions are a large and growing public health problem and constitute the most frequent cause of disability in the United States. Because many people with arthritis do not see a doctor for it, this study uses community surveys to estimate the prevalence of arthritis among adults and to identify subgroups with high prevalence rates of arthritis.

Methods. We used data from a cross sectional random digit telephone survey (the Behavioral Risk Factor Surveillance System) of noninstitutionalized adults aged 18 years or older conducted from 1996 through 1999. Estimates of self-reported arthritis, defined as chronic joint symptoms or doctor diagnosed arthritis, were derived from data in 15 states and Puerto Rico, all of which used an optional arthritis survey module for one or more years from 1996 through 1999.

Results. After adjusting for age, we found that arthritis was more common among several groups not recognized consistently in previous studies to have high prevalence rates of arthritis: separated and divorced people, those out of work or unable to work, and current and former smokers. It was also more common among several previously recognized groups with high prevalence rates of arthritis: older people, women, people with low education, people with low household incomes, physically inactive people, and overweight and obese people.

Conclusion. Because appropriate management can minimize the influence of arthritis, health care providers should ask patients in high risk groups about arthritis symptoms. In addition, clinical and public health interventions may be targeted toward those subgroups with high prevalence rates of arthritis to reduce the disability from arthritis and improve their health related quality of life. (J Rheumatol 2002;29:1981–8)

Key Indexing Terms:
ARTHRITIS CROSS SECTIONAL SURVEY EPIDEMIOLOGY
PREVALENCE SOCIOECONOMIC FACTORS

Arthritis and other rheumatic conditions are a large and growing public health problem that affected 43 million people in the United States in 1997[1] and, with the aging of the "baby boom" generation, will affect an estimated 60 million Americans by 2020[2]. These conditions constitute the most frequent cause of disability in the United States[3], cost $15 billion in direct medical costs in 1992[4], and were associated with 744,000 hospitalizations and 44 million ambulatory care visits in 1997[5]. Because early diagnosis and appropriate management can minimize the effect of rheumatoid arthritis (RA)[6-8] and osteoarthritis (OA)[9,10], health care providers and public health practitioners should be aware of population subgroups at high risk for arthritis. Population based, self-report surveys are needed to understand the overall public health problem of arthritis and identify the 16% of those with arthritis who do not see a doctor for it[11]. Health care system data alone are not adequate.

We estimated the prevalence of self-reported arthritis using data from a population based, self-report survey — the 1996–99 Behavioral Risk Factor Surveillance System (BRFSS) for 15 states and Puerto Rico — and identified subgroups with high prevalence rates of arthritis (using simple demographic and behavioral variables) that health care providers as well as public health practitioners and programs might target for arthritis intervention.

MATERIALS AND METHODS

The BRFSS is an ongoing state based, random digit dialed telephone survey, conducted in the USA by the Centers for Disease Control and Prevention (CDC) and state health departments. The BRFSS collects self-reported health information from a representative sample in each state of the civilian, noninstitutionalized population aged ≥ 18 years[12]. The BRFSS is exempted from human subjects review by the CDC Institutional Review Board because it is surveillance and not research.

We analyzed data from 54,169 respondents in 15 states (Alabama, Arizona, Georgia, Hawaii, Kansas, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Jersey, Ohio, Oklahoma, Rhode Island, West Virginia) and Puerto Rico, all of which used a 6 item optional BRFSS Arthritis Survey Module in a standard manner in one or more years from 1996 through 1999.

We classified people as having self-reported arthritis if they reported having either chronic joint symptoms (CJS) or doctor diagnosed arthritis.

From the Health Care and Aging Studies Branch, Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia, USA.

F. Mili, MD, PhD, Medical Epidemiologist; C.G. Helmick, MD, Medical Epidemiologist; M.M. Zack, MD, MPH, Medical Epidemiologist.

Address reprint requests to Dr. C. Helmick, Health Care and Aging Studies Branch, Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 4770 Buford Highway, Mailstop K45, Atlanta, GA 30341.

Submitted October 29, 2001; revision accepted February 7, 2002.

People were considered to have CJS if they responded "yes" to 2 questions: "During the past 12 months, have you had pain, aching, stiffness, or swelling in or around a joint?" and "Were these symptoms present on most days for at least one month?" People who responded "yes" to the question, "Have you ever been told by a doctor that you have arthritis?" were considered to have doctor diagnosed arthritis. All other respondents, including those who responded "don't know" or who refused to answer the questions described above, were considered not to have arthritis.

To determine the prevalence of self-reported arthritis, we analyzed these data using sample weights and SUDAAN statistical software[13] to account for complex sample survey design of the BRFSS. We examined the prevalence of arthritis among BRFSS participants by categories of 13 demographic and behavioral variables that are easy to collect in the clinic or in public health surveys and that might help identify subgroups with high prevalence of arthritis. These variables were age, sex, race, Hispanic origin, marital status, education, employment status, household income, cigarette smoking, body mass index (BMI), and health insurance, which were asked every year; and physical activity and alcohol consumption, which were asked every other year.

We grouped respondents into 3 age categories: 18–44, 45–64, and 65+ years. Health insurance was defined as a "yes" response to the question "Do you have any kind of health care coverage, including health insurance, prepaid plans such as health maintenance organizations, or government plans such as Medicare?" We grouped respondents into 2 physical activity categories: inactive and active (including irregular and not sustained, regular but not intensive, and regular and intensive) because most people with arthritis are physically inactive. We calculated participants' BMI (weight in kg divided by height in m^2) from their self-reported height and weight and used these values to group them into the 4 National Institutes of Health classes[14]: underweight (BMI < 18.5), normal (18.5 ≤ BMI < 25.0), overweight (25.0 ≤ BMI < 30.0), and obese (BMI ≥ 30.0). We grouped alcohol consumption of respondents into 3 categories: nondrinker, occasional drinker (≤ 29 drinks/mo), and moderate or heavy drinker (> 29 drinks/mo). We estimated arthritis prevalence rates by dividing the weighted number of respondents with self-reported arthritis by the total weighted number of respondents (i.e., the 1996–99 civilian, noninstitutionalized population aged ≥ 18 years) for that state and year and calculated 95% confidence intervals (CI, 2 sided) for these rates.

To identify subgroups with relatively high prevalence rates of self-reported arthritis, we ran separate logistic regression models for each of 13 demographic and behavioral variables and computed prevalence rate ratios (PRR), defined as the prevalence rates of exposure among people with arthritis divided by the prevalence rates of exposure among people without arthritis, and their 95% CI (Table 1). We first assessed differences in PRR in unadjusted models (uPRR) by the 13 variables. After adjusting for the potential confounding effects of age (as a continuous variable), sex, and education, as revealed in previous analyses of the BRFSS data[15,16], we then determined which of the demographic and behavioral groups had significantly different arthritis rates among its subgroups.

In selected analyses, we also adjusted for marital status, employment status, or BMI (specified in results section) when these characteristics were expected to change the PRR based on reports in the literature. For each of 13 demographic and behavioral variables, we reported only age adjusted prevalence rate ratios (aPRR) because further adjustments for sex and education did not change overall estimates except where noted. Models included all 54,169 respondents except for those who responded "don't know," who refused to answer the questions related to each characteristic, or who had missing data, for variables in the models.

We chose to run regression analyses of each of 13 variables adjusted for age, sex, and education, and occasionally adjusted for marital status, employment, or BMI because we were looking for the simple age adjusted associations between these 13 variables on the one hand and arthritis prevalence on the other, thinking that this would be a more useful approach for health care providers seeking to screen for arthritis symptoms among high risk groups. A different approach that created a single regression model for computing adjusted PRR might identify one or 2 groups that remain high risk once adjusted for all the other variables, but we felt this would unnecessarily obscure information that would be useful to the health care providers.

RESULTS

In the 15 states and Puerto Rico 17,556 BRFSS participants reported having arthritis (weighted prevalence rate among adults aged 18 and older = 30%) (Table 1). The weighted state-specific prevalence rates ranged from 18.8% to 36.4%.

The arthritis prevalence rate increased from 17% among those 18–44 years old to 39% among those 45–64 years old to 55% among those 65 years old or older (Table 1). The age adjusted prevalence rate of self-reported arthritis was 30% greater for women than men. Among racial groups, only Asians and Pacific Islanders and those in "other" races had significantly lower age adjusted prevalence rates (60% and 30%, respectively) than whites. Hispanics had a 20% lower aPRR than non-Hispanics, even after further adjustment for sex and education level (data not shown). The age adjusted arthritis prevalence rates were 30% higher among divorced, 40% higher among separated people, and 20% lower among never married people, than among married people.

The age adjusted arthritis prevalence rate was 30% higher among those without a high school diploma and 30% lower among college graduates, than among high school graduates or those with some college education. The age adjusted arthritis rate was 30% to 70% higher among people out of work for any time and 550% higher among those unable to work than among those employed for wages. The age, sex, and education adjusted arthritis rate among homemakers, however, was the same as that among people employed for wages. The aPRR for arthritis was higher for those with lower annual household incomes. Even after adjustment for marital status, education, and employment status, the arthritis rate among those with household incomes less than US $20,000 per year was still 30% to 90% higher than among those with household incomes $50,000 or more in these models (data not shown).

Compared to never smokers, the aPRR for arthritis were 40% higher for former cigarette smokers, 60% higher for daily smokers, and 30% higher for intermittent smokers. Further adjustment for BMI, sex, or education level did not change these findings (data not shown).

The 50% higher uPRR for arthritis among the physically inactive compared to the physically active fell to 20% but remained statistically significant after adjustment for age (Table 1) and after further adjustment for sex, education level, and BMI (data not shown). Even after adjustment for age, the aPRR for arthritis was 30% higher among people who were overweight and 130% higher among those who were obese than among those having a normal BMI; this higher rate persisted even after further adjustments for sex and education level (data not shown).

Although people without health insurance had an unad-

Table 1. Weighted prevalence rates, unadjusted (uPRR) and age adjusted prevalence rate ratios (aPRR) for self-reported arthritis*, by selected characteristics — Behavioral Risk Factor Surveillance System (BRFSS), 15 states and Puerto Rico combined, 1996–99†. *(Continued overleaf)*

Characteristic	Sample Size	Prevalence Rate, %	(95% CI)	uPRR	(95% CI)	aPRR§	(95% CI)
Total	54,169	30	(29–30)	—	—	—	—
Age¶, yrs, continuous	53,838	—	—	1.05	(1.04–1.05)	—	—
Missing	331						
Age¶, yrs, categorical							
18–44	26,510	17	(16–17)	1.0	(Ref)	—	—
45–64	16,024	39	(38–40)	3.1	(2.9–3.3)	—	—
≥ 65	11,304	55	(53–56)	5.6	(5.1–6.0)	—	—
Missing	331						
Sex							
Women	32,371	33	(33–34)	1.4	(1.4–1.5)	1.3	(1.3–1.4)
Men	21,783	26	(25–27)	1.0	(Ref)	1.0	(Ref)
Missing	15						
Race/ethnicity							
White	43,762	31	(31–32)	1.0	(Ref)	1.0	(Ref)
Black	6059	28	(27–29)	0.9	(0.8–0.9)	1.1	(1.0–1.2)
Asian/Pacific Islander	1739	14	(11–16)	0.4	(0.3–0.4)	0.4	(0.4–0.6)
American Indian/Alaska Native	586	29	(24–35)	0.9	(0.7–1.2)	1.1	(0.9–1.5)
Other	1634	18	(16–21)	0.5	(0.4–0.6)	0.7	(0.5–0.8)
Missing	389						
Hispanic ethnicity							
Hispanic origin	5603	22	(21–24)	0.8	(0.7–0.9)	0.8	(0.7–0.9)
Non–Hispanic origin	48,211	31	(30–31)	1.0	(Ref)	1.0	(Ref)
Missing	355						
Marital status							
Married	29,128	31	(30–32)	1.0	(Ref)	1.0	(Ref)
Divorced	7170	35	(33–37)	1.2	(1.1–1.3)	1.3	(1.2–1.4)
Widowed	6422	56	(54–58)	2.9	(2.6–3.1)	1.1	(1.0–1.3)
Separated	1397	32	(28–35)	1.1	(0.9–1.2)	1.4	(1.2–1.6)
Never married	8981	14	(12–15)	0.4	(0.3–0.4)	0.8	(0.7–0.9)
Unmarried couple	891	21	(17–25)	0.6	(0.5–0.8)	1.2	(0.9–1.5)
Missing	180						
Education level							
< High school graduate	7824	43	(42–45)	1.8	(1.7–1.9)	1.3	(1.2–1.4)
High school graduate/ some college	32,159	30	(29–31)	1.0	(Ref)	1.0	(Ref)
College graduate	13,992	22	(21–23)	0.7	(0.6–0.7)	0.7	(0.6–0.7)
Missing	194						
Employment status							
Employed for wages	28,625	22	(22–23)	1.0	(Ref)	1.0	(Ref)
Self-employed	4068	25	(23–27)	1.2	(1.1–1.4)	1.0	(0.9–1.1)
Out of work >1 yr	845	34	(29–38)	1.8	(1.5–2.3)	1.7	(1.4–2.1)
Out of work < 1 yr	1024	23	(20–27)	1.1	(0.9–1.4)	1.3	(1.1–1.6)
Homemaker	4702	33	(31–35)	1.7	(1.6–1.9)	1.3**	(1.1–1.4)
Student	1627	9	(7–11)	0.4	(0.3–0.5)	0.8	(0.6–1.0)
Retired	10,983	53	(52–54)	4.1	(3.8–4.4)	1.1	(1.0–1.2)
Unable to work	2158	69	(66–72)	7.9	(6.8–9.2)	5.5	(4.7–6.5)
Missing	122						
Annual household income, $US							
< 10,000	4263	43	(41–45)	2.4	(2.1–2.7)	1.9	(1.7–2.1)
10,000–19,999	8124	39	(37–40)	2.0	(1.8–2.2)	1.6	(1.4–1.7)
20,000–34,999	12,993	30	(29–32)	1.4	(1.3–1.5)	1.3	(1.2–1.4)
35,000–49,999	8207	27	(25–28)	1.2	(1.1–1.3)	1.2	(1.0–1.3)
≥ 50,000	11,418	24	(23–25)	1.0	(Ref)	1.0	(Ref)
Missing	9164						
Cigarette smoking status							
Current, every day	10,109	32	(30–33)	1.4	(1.3–1.5)	1.6	(1.5–1.7)
Current, some days	2168	25	(23–28)	1.0	(0.9–1.2)	1.3	(1.1–1.5)
Former	12,537	40	(38–41)	1.9	(1.8–2.1)	1.4	(1.3–1.5)
Never	29,179	53	(25–26)	1.0	(Ref)	1.0	(Ref)
Missing	176						

Table 1. Continued.

Characteristic	Sample Size	Prevalence Rate %	(95% CI)	uPRR	(95% CI)	aPRR[§]	(95% CI)
Physical activity							
Inactive	10,449	35	(34–36)	1.5	(1.4–1.6)	1.2	(1.1–1.3)
Active	21,606	26	(26–27)	1.0	(Ref)	1.0	(Ref)
Don't know/not sure, refused, or not asked[††]	22,117						
BMI[‡]							
Underweight	1301	22	(19–25)	0.9	(0.7–1.1)	0.9	(0.7–1.1)
Normal	23,096	24	(24–25)	1.0	(Ref)	1.0	(Ref)
Overweight	18,174	30	(29–31)	1.4	(1.3–1.5)	1.3	(1.2–1.3)
Obese	9281	43	(42–44)	2.3	(2.2–2.5)	2.3	(2.1–2.5)
Missing	2317						
Health insurance							
Yes	47,353	31	(30–31)	1.0	(Ref)	1.0	(Ref)
No	6646	25	(23–26)	0.8	(0.7–0.8)	1.2	(1.1–1.3)
Missing	170						
Alcohol drinker							
Non-drinker	20,523	34	(33–35)	1.0	(Ref)	1.0	(Ref)
≤ 29 drinks/mo	12,784	25	(24–26)	0.7	(0.6–0.7)	0.9	(0.8–0.9)
> 29 drinks/mo	2829	25	(23–28)	0.7	(0.6–0.8)	0.9	(0.8–1.1)
Don't know/not sure, refused, or not asked[††]	18,033						

* People having either chronic joint symptoms or doctor diagnosed arthritis (see text).
† Alabama, Arizona, Georgia, Hawaii, Kansas, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Jersey, Ohio, Oklahoma, Rhode Island, and West Virginia used the optional arthritis module in one or more years from 1996 through 1999 (see text).
§ We ran separate logistic regression models for each of 12 demographic and behavioral variables, adjusting for age as a continuous variable.
¶ For age, results are presented for both the continuous variable and the categorical variable.
** aPRR adjusted for age, sex, and education was 1.0 (0.9–1.1).
†† The BRFSS questions related to physical activity and alcoholic consumption were asked every other year.
‡ Underweight was defined as BMI < 18.5, normal weight BMI 18.5–24.9, overweight BMI 25.0–29.9, and obese BMI ≥ 30.0.
§§ Sample size for categories of selected characteristics may not total 54,169 because of missing values.
BMI: body mass index. CI: confidence interval.

justed arthritis rate 20% lower than those with health insurance, age adjustment reversed this association so that those without health insurance had a 20% higher arthritis rate than those with health insurance. For people aged 65 years or older, however, the arthritis rate among those without health insurance was lower than that among those with health insurance (PRR = 0.7, 95% CI 0.5–0.99).

The uPRR for arthritis among people who had had at least one alcoholic drink in the prior month was 30% lower than that among those who had had no such drinks. After age adjustment, however, this inverse association persisted only at a reduced percentage for those who had had an occasional drink and disappeared for those who consumed alcohol moderately or heavily.

Compared to men, women had higher arthritis prevalence rates at younger ages (for age category 18–44 years: PRR = 1.3, 95% CI 1.1–1.4) and when overweight (PRR = 1.6, 95% CI 1.4–1.7) or obese (PRR = 1.5, 95% CI 1.3–1.7). The higher arthritis rate among those aged 65+ years compared to those aged 18–44 years was more pronounced for women (PRR = 6.3, 95% CI 5.7–6.9) than men (PRR = 4.8, 95% CI 4.2–5.5) and for Hispanics (PRR = 7.7, 95% CI 5.8–10.2) than non-Hispanics (PRR = 5.4, 95% CI 5.0–5.9).

Among people with selected combinations of characteristics with high prevalence rates of arthritis, the age adjusted arthritis prevalence rates were extremely high, ranging from 53.5% among people both divorced and out of work to 81.2% among people both separated and unable to work.

DISCUSSION

The age adjusted prevalence rate of self-reported arthritis was higher among older people, women, separated and divorced people, people who had not graduated from high school, people out of work and those unable to work, people with annual household incomes less than $20,000 per year, current and former smokers, physically inactive people, overweight and obese people, and older people with health insurance (vs older people without). This rate was also lower among Asians and Pacific Islanders, people of Hispanic origin, never married people, students (vs people employed for wages), younger people who had health insurance (vs younger people without), and people who drank

moderately. Further, women had higher arthritis rates than men at all ages, and obese women had a higher arthritis rate than obese men. Even though Hispanics had lower arthritis rates than non-Hispanics, the relationship between older age and arthritis rates was stronger among Hispanics.

Higher rates of self-reported arthritis occurred among several groups not recognized consistently in previous studies as having high prevalence rates of arthritis. The higher rates of arthritis among separated and divorced people could result from the direct effect of arthritis on family dynamics or family income, or from the higher rates of stress related disability[17-19], job loss[20], and depression[21] among those with arthritis, each of which could put stress on a marriage and lead to divorce or separation. In contrast to findings from other studies[17,22,23], we found a lower age adjusted rate of self-reported arthritis among never married people. The reason for this lower rate is not obvious. In one study, however, single people with RA were found to be significantly less likely to become disabled than were married, divorced, or separated people with the disease[24].

People out of work and those unable to work reported higher rates of arthritis than those who were employed for wages. These findings were similar to those in prior clinical studies that associated arthritis with work disability and with an inability to work[4,25-29]. In a 5 year followup study of patients with RA, age, disease severity (more deformed and flaring joints at baseline), jobs requiring greater manual dexterity, and increased desire to be at home all were significantly associated with the loss of the ability to work[29]. Students in our survey had lower rates of self-reported arthritis even after adjustment for age, sex, education, and household income, suggesting that disability from arthritis may make it difficult for people to participate in school activities and that students represent a healthier group than the employed.

The higher rates of arthritis among current and former smokers agree with findings reported by some investigators[30-33] but not others[22,34-37]. The reasons for these higher rates are unclear. Although smokers have lower BMI[34] and are at lower risk for hip or knee OA[22,34-37], BMI did not explain the association of smoking in our study because current and former smokers had higher rates of arthritis even after adjustment for BMI. The apparent protective effect of smoking on arthritis observed by some investigators has been explained by the role played by the many constituents of smoke that act to prevent cartilage destruction[37]. The conflicting results of studies, however, may suggest that smoking has site-specific effects on the bone and joints[33].

Compared with previous results from health surveys, such as the BRFSS[16,38] and the National Health Interview Survey (NHIS)[15,17,25,39-44], our results showed consistent patterns of self-reported arthritis rates by age, sex, race, Hispanic ethnicity, education, income, physical activity, and weight. Our overall prevalence estimate for self-reported arthritis of 30% was greater than that of the NHIS reported by Lawrence, *et al*[44] (15%) for 2 reasons. First, BRFSS focuses on the higher risk adult population aged 18 years or older (rather than the entire population, including low risk children, as NHIS does). Second, the survey questions were different, with the BRFSS questions perhaps being more sensitive.

The increased prevalence of arthritis observed previously among people of low socioeconomic status, as indicated by low education and low income[42,45], may reflect an increased prevalence of antecedent risk factors such as high risk occupations, greater joint injury, and obesity. It may also reflect the consequences of arthritis, such as depression, increased disease activity, and decreased function, that result in job loss or a drop in income.

The higher rates of self-reported arthritis among people with low levels of physical activity even after adjusting for BMI might be because people with arthritis have difficulty performing some physical activities or because they have been incorrectly advised to abstain from physical activity.

Older age, female sex, and being overweight or obese are commonly recognized risk factors for arthritis[17,22,25,46-49]. Although other investigators[50] have attributed the higher prevalence rates of arthritis among women than among men aged 65 years or older to older women's higher rates of overweight and obesity, the higher arthritis rates among older women in our study remained significant even after adjustment for BMI. Among younger women, hormonal and reproductive factors could play a role in their higher rates of arthritis[46,51], but we could not adjust for these factors.

Among people aged 65 years or older, those with health insurance reported higher rates of arthritis than those without health insurance (data not shown), perhaps partly because of their greater opportunity to have rheumatic conditions diagnosed, since people aged 65 years or older without health coverage or insurance (including without Medicare) are more likely to have lower incomes and less education. Less than 5% of Americans 65 years old or older do not have Medicare (Part A) insurance and such a group is unusual. Some of these people may have Medicare without knowing it.

The lower prevalence rates of self-reported arthritis among Asians and Pacific Islanders and among people of Hispanic origin could signify either actual lower arthritis rates among these groups, variations in cultural thresholds for reporting arthritis[52,53], or difficulty answering the survey questions. For example, there are no translations of BRFSS into Asian languages. Accurate Spanish translations exist, but may not be used by all states.

This study has several strengths. (1) Although we could not assess causality in our analyses, we identified characteristics of people with arthritis for screening and interventions. (2) This is the first report describing data on a new case definition of self-reported arthritis incorporating CJS or

doctor diagnosed arthritis. (3) Because we analyzed state based population survey data, our results are generalizable to the populations surveyed and can therefore provide useful data to state arthritis programs and others (such as the US Arthritis Foundation) who implement education programs among groups with higher rates of arthritis. (4) Because the BRFSS combines data from identical state based surveys to create a large sample, the estimates of arthritis rates by selected demographic and other factors derived from it are more precise than those based on smaller samples. (5) Because our analysis is based on self-reported arthritis data, which are thought to produce a more comprehensive estimate than medical records[54] by capturing the population with CJS outside the health care system, the prevalence estimates derived should be more sensitive than those of a study based on medical records alone.

This study also has several limitations. (1) The BRFSS case definition for self-reported arthritis has not yet been validated, although validation studies are under way. The more comprehensive definition of arthritis in this report ("people with CJS or doctor diagnosed arthritis"), however, may better identify those with arthritis and other rheumatic conditions than a prior case definition that included "people with only CJS" (as previously used in the BRFSS[16,38]). (2) Because the BRFSS excludes those without telephones (who may have lower incomes), those in the military, those in institutions (for example, nursing homes), and those younger than 18 years, the data do not represent the entire population in these states and underestimate the true number affected. (3) The time and functional capacity required to complete the BRFSS may limit participation by people with arthritis who have poor health and functional limitations, which may lead to an underestimate of the true rates. (4) Respondents with missing values on the demographic and behavioral variables were excluded from the analyses, but in general, the number of excluded were small and unlikely to affect our prevalence estimates of arthritis, except among subgroups of annual household income who either "don't know" or refuse to answer the corresponding question. (5) Because we analyzed data from only 15 states and Puerto Rico, our results may not be generalizable to other states or to the entire US. (6) Because the BRFSS is a cross sectional survey, we cannot assess causality of associations between arthritis and demographic and behavioral variables.

Several initiatives have been established as part of a US effort to reduce the burden of arthritis. Specifically, the National Arthritis Action Plan (NAAP) — A Public Health Strategy[55] provides a strategy to reduce the occurrence of arthritis and related disability through a partnership network involving public health organizations, health care providers, health plans, insurers, and other interested organizations. Thirty-seven state health departments have started or enhanced arthritis programs in 2000, and all states will have BRFSS arthritis data collected in 2001. Healthy People 2010[56], the decennial set of health objectives for the US, now recognizes arthritis as an important health issue and has set 8 arthritis objectives to be achieved by 2010. Further, interventions and prevention by public health agencies and health care providers, such as weight control, occupational and sports injury prevention, physical activity promotion, and arthritis education may reduce the occurrence and impact of arthritis[56]. Future studies could productively focus on better understanding an individual's barriers to consulting a doctor for arthritis problems and on developing medical and public health interventions to assist in overcoming them. Such studies could also focus on determining the factors associated with higher reporting of arthritis symptoms among the demographic and behavioral subgroups identified in our survey as having high prevalence rates of arthritis. For example, could those factors be in the causal pathway of arthritis occurrence? Do they provoke external stress that in turn precipitates arthritis? Or are they associated with resistance to arthritis treatment?

In summary, these findings have implications for clinical and public health prevention and research. Because early diagnosis and appropriate management can minimize the impact of arthritis[6-10], health care providers should ask patients in these high risk groups about arthritis symptoms. In our survey, newly identified subgroups with high prevalence rates of arthritis included people who were divorced or separated from their spouses, those who were out of work or unable to work, and both current and former smokers. People with combinations of these characteristics were at even higher risk. Public health interventions such as weight loss and control, exercise programs, and the Arthritis Self-Help Course[57] may be targeted toward those subgroups with high prevalence rates of arthritis to reduce the disability from arthritis and improve their health related quality of life.

ACKNOWLEDGMENT

We thank Joe Sniezek, MD, for his helpful comments, and the state BRFSS coordinators who helped conduct the surveys. Jennifer McGinnis and Diane Green, PhD, first identified the limitations of using CJS alone as a case definition, which resulted in the addition of doctor diagnosed arthritis to the case definition.

REFERENCES

1. CDC. Prevalence of arthritis — United States, 1997. MMWR Morb Mortal Wkly Rep 2001;50:334-6.
2. CDC. Arthritis prevalence and activity limitations–United States, 1990. MMWR Morb Mortal Wkly Rep 1994;43:433-8.
3. CDC. Prevalence of disabilities and associated health conditions — United States, 1999. MMWR Morb Mortal Wkly Rep 2001; 50:120-5.
4. Yelin E, Callahan LF. The economic cost and social and psychological impact of musculoskeletal conditions. Arthritis Rheum 1995;38:1351-62.
5. CDC. Impact of arthritis and other rheumatic conditions on the health-care system — United States, 1997. MMWR Morb Mortal Wkly Rep 1999;48:349-53.
6. Weinblatt ME. Rheumatoid arthritis: treat now, not later! [editorial].

Ann Intern Med 1996;124:773-4.
7. Van De Putte LBA, Van Gestel AM, Van Riel PLCM. Early treatment of rheumatoid arthritis: rationale, evidence, and implications. Ann Rheum Dis 1998;57:511-2.
8. Wiles NJ, Lunt M, Barrett EM, et al. Reduced disability at five years with early treatment of inflammatory polyarthritis. Results from a large observational cohort, using propensity models to adjust for disease severity. Arthritis Rheum 2001;44:1033-42.
9. Liang MH, Fortin P. Management of osteoarthritis of the hip and knee. New Engl J Med 1991;325:125-7.
10. Felson DT, Zhang Y, Anthony JM, Naimark A, Anderson JJ. Weight loss reduces the risk for symptomatic knee osteoarthritis in women. The Framingham Study. Ann Intern Med 1992;116:535-9.
11. Rao JK, Callahan LF, Helmick CG. Characteristics of persons with self-reported arthritis and other rheumatic conditions who do not see a doctor. J Rheumatol 1997;24:169-73.
12. CDC. Health risks in America: gaining insight from the Behavioral Risk Factor Surveillance System. Revised edition. Atlanta: US Department of Health and Human Services, CDC; 1997.
13. Shah BV, Barnell BG, Bieler GS. SUDAAN: software for the statistical analysis of correlated data. User's manual, release 6.40 [software documentation]. Research Triangle Park, NC: Research Triangle Institute; 1995.
14. Anonymous. Health implications of obesity. National Institutes of Health Consensus Development Conference Statement. Natl Inst Health Consens Dev Conf Consens Statement 1985;5:1-7.
15. CDC. Arthritis prevalence and activity limitations — United States, 1990. MMWR Morb Mortal Wkly Rep 1994;43:433-8.
16. CDC. Prevalence and impact of chronic joint symptoms — seven states, 1996. MMWR Morb Mortal Wkly Rep 1998;47:345-51.
17. Verbrugge LM, Gates DM, Ike RW. Risk factors for disability among U.S. adults with arthritis. J Clin Epidemiol 1991;44:167-82.
18. Reisine S. Marital status and social support in rheumatoid arthritis. Arthritis Rheum 1993;36:589-92.
19. Ward MM, Leigh JP. Marital status and the progression of functional disability in patients with rheumatoid arthritis. Arthritis Rheum 1993;36:581-8.
20. Meenan RF, Yelin EH, Nevitt M, Epstein WV. The impact of chronic disease: a sociomedical profile of rheumatoid arthritis. Arthritis Rheum 1981;24:544-8.
21. Katz PP. The impact of rheumatoid arthritis on life activities. Arthritis Care Res 1995;8:272-8.
22. Anderson JJ, Felson DT. Factors associated with osteoarthritis of the knee in the first National Health and Nutrition Examination Survey (NHANES I): evidence for an association with overweight, race, and physical demands of work. Am J Epidemiol 1988;128:179-89.
23. Badley EM, Ibanez D. Socioeconomic risk factors and musculoskeletal disability. J Rheumatol 1994;21:515-22.
24. Yelin E, Meenan R, Nevitt M, Epstein W. Work disability in rheumatoid arthritis: effects of disease, social, and work factors. Ann Intern Med 1980;93:551-6.
25. Verbrugge LM. Women, men, and osteoarthritis. Arthritis Care Res 1995;8:212-20.
26. Pincus T, Callahan LF, Sale WG, Brooks AL, Payne LE, Vaughn WK. Severe functional declines, work disability, and increased mortality in seventy-five rheumatoid arthritis patients studied over nine years. Arthritis Rheum 1984;27:864-72.
27. Callahan LF, Bloch DA, Pincus T. Identification of work disability in rheumatoid arthritis: physical, radiographic and laboratory variables do not add explanatory power to demographic and functional variables. J Clin Epidemiol 1992;45:127-38.
28. Reisine ST, Grady KE, Goodenow C, Fifield J. Work disability among women with rheumatoid arthritis: the relative importance of disease, social, work, and family factors. Arthritis Rheum 1989;32:538-43.
29. Reisine ST, McQuillan J, Fifield J. Predictors of work disability in rheumatoid arthritis patients: a five-year follow-up. Arthritis Rheum 1995;38:1630-47.
30. Vessey MP, Villard-Mackintosh L, Yeates D. Oral contraceptives, cigarette smoking and other factors in relation to arthritis. Contraception 1987;35:457-64.
31. Hart DJ, Spector TD. Cigarette smoking and risk of osteoarthritis in women in the general population: the Chingford Study. Ann Rheum Dis 1993;52:93-6.
32. Cerhan JR, Wallace RB, El-Khoury GY, Moore TE. Risk factors for progression to new sites of radiographically defined osteoarthritis in women. J Rheumatol 1996;23:1565-78.
33. Jones G, White C, Sambrook P, Eisman J. Allelic variation in the vitamin D receptor, lifestyle factors and lumbar spinal degenerative disease. Ann Rheum Dis 1998;57:94-9.
34. Felson DT, Anderson JJ, Naimark A, Hannan MT, Kannel WB, Meenan RF. Does smoking protect against osteoarthritis? Arthritis Rheum 1989;32:166-72.
35. Felson DT. The epidemiology of knee osteoarthritis: results from the Framingham Osteoarthritis Study. Semin Arthritis Rheum 1990;20 Suppl 1:42-50.
36. Samanta A, Jones A, Regan M, Wilson S, Doherty M. Is osteoarthritis in women affected by hormonal changes or smoking? Br J Rheumatol 1993;32:366-70.
37. Felson DT, Zhang Y, Hannan MT, et al. Risk factors for incident radiographic knee osteoarthritis in the elderly: the Framingham Study. Arthritis Rheum 1997;40:728-33.
38. CDC. Prevalence of arthritis — Arizona, Missouri, and Ohio, 1991-1992. MMWR Morb Mortal Wkly Rep 1994;43:305-9.
39. CDC. Prevalence and impact of arthritis among women — United States, 1989-1991. MMWR Morb Mortal Wkly Rep 1995; 44:329-34.
40. Helmick CG, Lawrence RC, Pollard RA, Lloyd E, Heyse SP. Arthritis and other rheumatic conditions: Who is affected now, who will be affected later? Arthritis Care Res 1995;8:203-11.
41. CDC. Prevalence and impact of arthritis by race and ethnicity — United States, 1989-1991. MMWR Morb Mortal Wkly Rep 1996;45:373-8.
42. CDC. Factors associated with prevalent self-reported arthritis and other rheumatic conditions — United States, 1989-1991. MMWR Morb Mortal Wkly Rep 1996;45:487-91.
43. CDC. Prevalence of leisure-time physical activity among persons with arthritis and other rheumatic conditions — United States, 1990-1991. MMWR Morb Mortal Wkly Rep 1997;46:389-93.
44. Lawrence RC, Helmick CG, Arnett FC, et al. Estimates of the prevalence of arthritis and selected musculoskeletal disorders in the United States. Arthritis Rheum 1998;41:778-99.
45. Leigh JP, Fries JF. Occupation, income, and education as independent covariates of arthritis in four national probability samples. Arthritis Rheum 1991;34:984-94.
46. Hochberg MC, Spector TD. Epidemiology of rheumatoid arthritis: update. Epidemiol Rev 1990;12:247-52.
47. Felson DT. Weight and osteoarthritis. J Rheumatol 1995;22 Suppl 43:7-9.
48. Cicuttini FM, Spector T, Baker J. Risk factors for osteoarthritis in the tibiofemoral and patellofemoral joints of the knee. J Rheumatol 1997;24:1164-7.
49. Sturmer T, Gunther K-P, Brenner H. Obesity, overweight and patterns of osteoarthritis: the Ulm Osteoarthritis Study. J Clin Epidemiol 2000;53:307-13.
50. Felson DT, Anderson JJ, Naimark A, Walker AM, Meenan RF. Obesity and knee osteoarthritis: the Framingham Study. Ann Intern Med 1988;109:18-24.
51. Silman AJ, Kay A, Brennan P. Timing of pregnancy in relation to

the onset of rheumatoid arthritis. Arthritis Rheum 1992;35:152-5.
52. Wang PP, Elsbett-Koeppen R, Geng G, Badley EM. Arthritis prevalence and place of birth: findings from the 1994 Canadian National Population Health Survey. Am J Epidemiol 2000; 152:442-5.
53. Berkanovic E, Telesky C. Mexican-American, Black-American, and White-American differences in reporting illnesses, disability, and physician visits for illnesses. Soc Sci Med 1985;20:567-77.
54. Edwards WS, Winn DM, Kurlantzick V, et al. Evaluation of the National Health Survey Diagnostic Reporting. National Center for Health Statistics. Vital Health Stat 1994;2:1-114.
55. Arthritis Foundation, Association of State and Territorial Health Officials, and CDC. National Arthritis Action Plan: a public health strategy. Atlanta: Arthritis Foundation; 1999.
56. US Department of Health and Human Services. Healthy people 2010. 2nd ed. 2 vol. Washington, DC: US Government Printing Office; 2000. Available from: URL: http://www.health.gov/healthypeople.
57. Lorig KR, Mazonson PD, Holman HR. Evidence suggesting that health education for self-management in patients with chronic arthritis has sustained health benefits while reducing health care cost. Arthritis Rheum 1993;36:439-46.