Body Mass Index, Weight Change, and Incidence of Self-Reported Physician-Diagnosed Arthritis Among Women

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ABSTRACT

Objectives. This study examined the relationship between body mass index (BMI), weight change, and arthritis in women.

Methods. Data were taken from the 1982–1984 National Health and Nutrition Examination Survey Epidemiologic Follow-Up Study of 3617 women, aged 25 to 74 years.

Results. Women with a BMI greater than 32 at initial interview were at significantly higher risk of developing arthritis than women with a BMI of 19 to 21.9. Compared with stable-weight women with a BMI of less than 25, women who were obese at initial interview (BMI >29) and who subsequently maintained their weight or gained more than 10% of their body weight were at significantly higher risk of developing arthritis.

Conclusions. Attaining and maintaining a healthy weight may reduce the risk of developing arthritis. (*Am J Public Health.* 1999;89:391–394)

Arthritis is a leading cause of increased morbidity, functional limitations,[1–4] and disability.[1,5] Arthritis affected an estimated 40 million persons in the United States in 1995 and is projected to affect 60 million persons by the year 2020,[6] making it essential to identify potentially modifiable risk factors associated with the disease. A potentially modifiable risk factor is body weight. Obesity has been shown to be associated with osteoarthritis of the knee[7–10] and hands[11] and with bilateral hip osteoarthritis[12] in cross-sectional studies. However, the temporal nature of the association could not be established in those studies. The 2 prospective studies of body weight and arthritis have shown heavier body weight to be associated with incident knee osteoarthritis[13] and osteoarthritis of the hands.[14] These studies, however, used different relative measures of weight, making it difficult to relate the findings to actual weight or to compare them across studies.

Weight gain and loss may also affect the risk of arthritis. Few studies have examined such associations. Felson et al.[15] showed that weight loss reduced the subsequent incidence of symptomatic knee osteoarthritis, while Carman et al.[14] found no association between change in body mass index (BMI) and incidence of osteoarthritis of the hand.

The intent of our study was to examine the effect of BMI and weight change on the incidence of arthritis among women.

Methods

We used data from the First National Health and Nutrition Examination Survey (NHANES I, 1971–1975) and the NHANES I Epidemiologic Follow-Up Study (1982–1984). Details of the study are provided elsewhere.[16–19]

Subjects

All women 25 to 74 years of age at initial interview (1971–1975) were eligible for this study (n = 8596). A total of 4979 were excluded because of missing information on body weight (n = 519) or educational attainment (n = 21); pregnancy, either at initial interview or at follow-up (n = 129); self-reported physician-diagnosed arthritis before the 1982–1984 interview (n = 3166); or death or loss to follow-up (n = 1144). Therefore, the data of 3617 women were used.

Variables

The outcome variable in this study was physician-diagnosed arthritis, as reported by participants who responded positively to the question "Were you told by your physician that you have arthritis?" Recalled year of diagnosis was used as the incident year of disease. Midyear (June) and midmonth (day 15) were assigned and used as the month and day, respectively, of incident arthritis. An incident case of arthritis was defined as a case of arthritis occurring in a subject who was arthritis-free until the 1982–1984 interview and subsequently reported having received a diagnosis of arthritis at the 1986, 1987, or 1992 reinterview. Follow-up time was measured as the number of days between the 1982–1984 interview and one of the following endpoints; development of arthritis, death of subject, loss to follow-up, or end of study (1992). If a subject or proxy was unable to recall the year of diagnosis, the date of the interview in which she reported the diagnosis or the date of death was used as the incident date of disease (n = 266).

Body weight and height were measured at the initial interview,[16] and weight was remeasured in 1982–1984.[20] These measures were used to calculate the independent variable,

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BMI (weight in kilograms divided by height in meters squared).

Age (in years) at initial interview, race, education, and smoking were used as covariates. Race was categorized as African American (n = 459) or White (n = 3158). The latter category included Asians and Pacific Islanders (n = 33) and Aleuts, Eskimos, and American Indians (n = 8) because of their similar arthritis and weight patterns.[21] Attained levels of education were grouped into 3 categories: less than high school, high school, and some college or graduate school. Smoking status was defined from initial interview data and retrospective history as current, former, or never.

Analysis

Data were analyzed with proportional hazards regression modeling to account for the varied follow-up times of individuals. The SUDAAN software package,[22] run on an IBM mainframe computer, was used to adjust for the complex study design. Power calculations were not conducted.

BMI was examined both as a continuous variable and in discrete categories to parallel those used in the Nurses' Health study[23] (<19, 19–21.9, 22–24.9, 25–26.9, 27–28.9, 29–31.9, >32). The category 19–21.9 was used as the reference category. Change in BMI between initial interview and follow-up was calculated as a percentage change from the first BMI. Since height at the initial interview was used to calculate BMI at first interview and at follow-up, a change in BMI reflects a change in body weight. Body weight change was divided into 3 categories: weight loss (a decrease in BMI of >10%), weight gain (an increase in BMI of >10%), and no change (≤10% change in BMI). The no-change group was used as the reference category.

BMIs were also divided into broader weight categories that corresponded to the healthy (BMI <25), overweight (BMI 25–28.9), and obese (BMI >29) group definitions suggested in the US Department of Agriculture's 1995 dietary guidelines.[24] To examine whether the association between weight change and incidence of arthritis varied by level of initial BMI, a 9-category variable was created that combined the 3 weight change categories with these 3 BMI levels. The referent category was no weight change and BMI of less than 25.

Results

More than 32% (n = 1168) of the women reported being diagnosed with arthritis by a physician over the years of follow-up. Mean follow-up time was 7.28 years (SD = 2.9). Table 1 presents the characteristics of women with and without arthritis.

Table 2 shows associations between age-adjusted risk factors and incidence of arthritis. Each unit increase in age-adjusted BMI, as a continuous variable, was associated with a 4% increase in incidence of arthritis (relative risk [RR] = 1.04, 95% confidence interval [CI] = 1.02, 1.05). Risk of incident arthritis, after adjustment for age, was 40% higher for African American women than for White women (RR = 1.41, 95% CI = 1.05, 1.80). Smoking status was not associated with arthritis, but after adjustment for age, the risk of developing arthritis was nearly 50% higher for women with less than a high school education (RR = 1.48, 95% CI = 1.21, 1.81) than for women with some college or graduate school. In the multiple regression models, age and education, but not race, were still significantly associated with incident arthritis.

The risk of incident arthritis increased slightly but significantly among participants in most BMI categories higher than 25, but it was highest among women who had BMIs greater than 32 (RR = 1.62, 95% CI = 1.21, 2.18). Trend analysis indicated that BMI was significantly associated with reported arthritis (*P* for trend < .0001). The associations, adjusted for initial BMI, age, race, and education, between weight change and incident arthritis for the overall study population were not significant.

Subjects in the obese category who either gained weight or maintained their

TABLE 1—Weighted Characteristics of 3617 Women at Initial Interview, by Subsequent Development of Arthritis: First National Health and Nutrition Examination Survey, 1971–1975

	Women Who Developed Arthritis (n = 1168)	Women Who Did Not Develop Arthritis (n = 2449)	*P*
Age, mean (SD), y	45.4 (0.5)	41.2 (0.3)	.0001
Quetelet BMI, mean (SD), kg/m^2	25.4 (0.2)	24.1 (0.1)	.0001
Race, %			
African American	11.1	7.7	.001
White	88.9	92.3	
Education, %			
Less than high school	38.2	24.8	.001
High school	40.9	48.7	
College/graduate school	20.9	26.5	
Smoking status, %			
Current smoker	36.6	37.0	NS
Former smoker	10.6	10.1	
Never smoker	52.8	52.9	
Weight change, %			
No change	63.0	61.4	.03
Loss (>10% BMI)	7.7	7.5	
Gain (>10% BMI)	29.3	31.1	

Note. BMI = body mass index; NS = not significant (>.05).

TABLE 2—Association Between Age-Adjusted Risk Factors and Incidence of Self-Reported Physician-Diagnosed Arthritis: First National Health and Nutrition Examination Survey Epidemiologic Follow-Up Study, 1982–1984

	Relative Risk	95% Confidence Interval
Quetelet body mass index, per unit increase	1.04	1.02, 1.05
Age, per year	1.03	1.02, 1.04
African American race, vs White	1.41	1.05, 1.80
Smoking status, vs never smoker		
Current smoker	1.12	0.96, 1.32
Former smoker	1.12	0.88, 1.41
Education, vs college/graduate school		
Less than high school	1.48	1.21, 1.81
High school	1.00	0.83, 1.22

TABLE 3—Association Between Combination Variable[a] (Weight Change × BMI) and Incidence of Self-Reported Physician-Diagnosed Arthritis: First National Health and Nutrition Examination Survey Epidemiologic Follow-Up Study, 1982–1984

	Relative Risk	95% Confidence Interval
Healthy weight (BMI <19–24.9)		
No change (referent)	1.00	. . .
Weight loss	0.84	0.52, 1.37
Weight gain	1.11	0.91, 1.35
Overweight (BMI 25–28.9)		
No change	1.14	0.90, 1.46
Weight loss	1.31	0.81, 2.10
Weight gain	1.19	0.78, 1.80
Obese (BMI >29)		
No change	1.44	1.14, 1.82
Weight loss	1.02	0.69, 1.52
Weight gain	1.62	1.13, 2.32

Note. BMI = body mass index, defined as weight in kilograms divided by height in meters squared.
[a]Adjusted for age, race, and education.

weight were at significantly higher risk of developing arthritis (RR = 1.62, 95% CI = 1.13, 2.32 and RR = 1.44, 95% CI = 1.14, 1.82, respectively) than subjects in the reference category (healthy weight, no change) (Table 3). Women who were obese at initial interview and who subsequently lost more than 10% of their body weight were not at increased risk of developing arthritis as compared with women in the reference category (RR = 1.02, 95% CI = 0.69, 1.52). No other significant associations were seen for BMI–weight change categories.

Discussion

This study examined associations between BMI, weight change, and self-reported physician-diagnosed arthritis. The results, which indicate that obese women are at higher risk of developing arthritis, extend those of cross-sectional studies that have reported associations between obesity and arthritis of the knee[7–10] and hand and wrist.[11] However, this study also showed that not only obese women but overweight women (those with a BMI >25) had a slightly but significantly higher risk of developing arthritis than women whose BMI was between 19 and 21.9. Furthermore, women in the obese category who lost weight were not at higher risk of developing osteoarthritis than women who were in the healthy weight–no change category. Felson et al.[15] reported similar findings; in that study, subjects who lost weight had lower incident risk for arthritis of the knee.

Several other risk factors we examined for arthritis are weight related. Smoking, which is generally associated with lower body weight, has been shown to be protective against risk of arthritis in at least one study of knee osteoarthritis.[25] Our study, which examined smoking status but not intensity, did not show any association between smoking and reported arthritis. Lower attained education was a risk factor for both overweight and arthritis and remained an independent predictor of arthritis even after body weight was controlled for, suggesting that the effect of education is not mediated solely by weight. This finding is consistent with those of other studies,[26,27] and it is unclear what other factors might mediate the relationship.

The strength of our study is that it was a longitudinal study that included a large number of women and examined not only associations between weight and development of arthritis but also the effect of weight change on the incidence of arthritis. However, there are several limitations to the study. Type and site of arthritis could not be assessed, although it has been shown that the majority of women with self-reported physician-diagnosed arthritis have osteoarthritis, and a small proportion may have soft-tissue rheumatism or rheumatoid arthritis.[28] Also, the diagnosis of arthritis was self-reported and was not confirmed by independent physical examination.

Some women with symptomatic arthritis may have been included in the arthritis-free cohort of 1982–1984 because they had not been diagnosed by a physician. To assess the potential effect of this bias, we conducted a sensitivity analysis. In one model, we excluded women who, at the 1982–1984 interview, reported joint pain in any of 5 locations (back, neck, knee, hip, other joints), swelling, or stiffness on most days for at least 1 month (this is the definition suggested by the American College of Rheumatology's subcommittee on symptomatic osteoarthritis classification.[29]) In another model, we excluded women who reported joint pain in any of these 5 locations plus swelling or stiffness. Both models yielded results similar to our findings.

Our results could have been affected by the exclusion of 1144 women who were lost to follow-up, but the mean age and BMI of these women were closer to those of study participants who developed arthritis than to those of participants who did not, suggesting that their exclusion may have led us to underestimate the association between BMI and incident arthritis. To examine the impact on the results of excluding data for 740 women who reported having physician-diagnosed arthritis before the 1982–1984 interview, we reran the analysis. The results showed a stronger association between body weight and arthritis, indicating that exclusion of these data resulted in an underestimate of the association between BMI and arthritis. Finally, we excluded data for women whose date of arthritis diagnosis was unknown but who were assigned the date of their next interview or date of death (n = 266). The results showed no significant differences in the association between body weight and arthritis.

In summary, the results of this study suggest that attaining and maintaining a healthy weight (BMI < 25) at an early age may reduce women's risk of developing arthritis in later life. □

Contributors

N. R. Sahyoun planned the study, analyzed the data, and wrote the paper. M. C. Hochberg and T. Harris contributed to the study design. All authors assisted in interpreting the data and editing the manuscript. All authors are guarantors for the integrity of the research.

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