

Prevalence of Diagnosed Arthritis and Arthritis-Attributable Activity Limitation Among Adults With and Without Diagnosed Diabetes: United States, 2008–2010

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OBJECTIVE—To estimate the prevalence of diagnosed arthritis among U.S. adults and the proportion of arthritis-attributable activity limitation (AAAL) among those with arthritis by diagnosed diabetes mellitus (DM) status.

RESEARCH DESIGN AND METHODS—We estimated prevalences and their ratios using 2008–2010 U.S. National Health Interview Survey of noninstitutionalized U.S. adults aged ≥ 18 years. Respondents' arthritis and DM status were both based on whether they reported a diagnosis of these diseases. Other characteristics used for stratification or adjustment included age, sex, race/ethnicity, education level, BMI, and physical activity level.

RESULTS—Among adults with DM, the unadjusted prevalences of arthritis and proportion of AAAL among adults with arthritis (national estimated cases in parentheses) were 48.1% (9.6 million) and 55.0% (5.3 million), respectively. After adjusting for other characteristics, the prevalence ratios of arthritis and of AAAL among arthritic adults with versus without DM (95% CI) were 1.44 (1.35–1.52) and 1.21 (1.15–1.28), respectively. The prevalence of arthritis increased with age and BMI and was higher for women, non-Hispanic whites, and inactive adults compared with their counterparts both among adults with and without DM (all P values < 0.05). Among adults with diagnosed DM and arthritis, the proportion of AAAL was associated with being obese, but was not significantly associated with age, sex, and race/ethnicity.

CONCLUSIONS—Among U.S. adults with diagnosed DM, nearly half also have diagnosed arthritis; moreover, more than half of those with both diseases had AAAL. Arthritis can be a barrier to physical activity among adults with diagnosed DM.

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Physical activity is a key component of diabetes mellitus (DM) and arthritis management (1–3). Arthritis, which is a barrier to physical activity (4), is the most common cause of disability in the United States (5). DM and arthritis each produce large burdens in the United States (6–8); they also share some risk factors including age and obesity (9,10).

The mechanism of this comorbidity remains uncertain; these co-occurring conditions have been associated with a significant reduction in quality of life and increased risk for other severe complications (11). Understanding the extent to which arthritis produces activity limitation among adults with DM will help raise awareness of the conjoint burden

of these two diseases as well as the need for efforts to promote the benefits of physical activity in managing DM and arthritis.

In this study, we estimated the prevalences of arthritis and the proportion of arthritis-attributable activity limitation (AAAL) among U.S. adults with arthritis aged ≥ 18 years according to diagnosed DM status using 2008–2010 data from the U.S. National Health Interview Survey (NHIS).

RESEARCH DESIGN AND METHODS

The NHIS is an annual, in-person, interviewer-administered survey of health status and behaviors among the U.S. noninstitutionalized population of all ages. One adult per selected household was chosen randomly to participate. This study used the sample adult component, which was limited to adults aged ≥ 18 years. NHIS oversamples blacks, Hispanics, and Asians, with persons of these race/ethnicity groups aged ≥ 65 years having twice the probability of being selected. For this analysis, NHIS data from 2008, 2009, and 2010 were combined. For the sample adult component, unweighted sample sizes (representing U.S. population in millions in parentheses) were 21,781 (75.1 million) in 2008, 27,731 (75.8 million) in 2009, and 27,157 (76.5 million) in 2010 and, final response rates (%) were 62.6, 65.4, and 60.8, respectively (12). We excluded 98 adults with missing values for diagnosed arthritis and 29 with missing values on arthritis-related physical limitation, yielding a final analytic sample of 76,542 adults; the final analytic sample also included 3,124 adults with missing values for height, weight, or physical activity level. We did not find any statistically significant difference for demographic characteristics between adults with and without missing values on DM, arthritis, or AAAL. However, adults with missing values for height, weight, or physical activity level were more likely to be women, adults with

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diagnosed DM and arthritis, and older than adults without any missing values on those variables (all P values <0.05).

In this study, all of the diseases or conditions were based on self-reports of assessments made by a doctor or health professional. Specifically, participants were classified as having self-reported diagnosed DM (hereafter termed either DM or diabetes) if they answered yes to the question, "Other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?" for women, or "Have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?" for men.

Participants were classified as having self-reported diagnosed arthritis (hereafter simply termed "arthritis") if they answered "yes" to the question, "Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?" Those who responded "yes" were then asked, "Are you limited in any way in any of your usual activities because of arthritis or joint symptoms?" Those who responded "yes" to both were categorized as having AAAL.

Other self-reported characteristics of respondents included age, sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, other Hispanic, or other), education (less than high school graduate, high school graduate, or higher than high school graduate), body height, and weight. BMI was calculated as the body weight in kilograms divided by the squared body height in meters. Field representatives collected data after receiving thorough annual training in basic interviewing procedures, as well as concepts and procedures unique to the NHIS.

On the basis of survey participants' responses to six questions about leisure-time activity participation, we multiplied frequency and duration to calculate total weekly, moderate-activity equivalent time with vigorous-intensity minutes receiving twice the credit as moderate-intensity minutes. We then produced three categories congruent with the U.S. Department of Health and Human Services 2008 Physical Activity Guidelines for Americans (13). The categories (in minutes per week) were: meeting recommendations (≥ 150), insufficient activity (10–149), and inactive (<10).

We used Stata 12.0 (StataCorp LP, College Station, TX) to account for the complex multistage sampling design and to produce weighted estimates and 95% CI

and total case estimates. We used unadjusted crude prevalence and proportion of conditions to describe the actual population burden. Logistic regression analysis provided predicted margin and adjusted prevalence ratio (PR) between levels of a variable. For all comparisons, we used a two-sided t test with significance defined as $P < 0.05$.

RESULTS—Among U.S. adults aged ≥ 18 years, from 2008–2010, the yearly prevalence of DM with national estimated cases in millions was 8.8% (95% CI: 8.5–9.1) (20.0 million) and that of self-reported diagnosed arthritis was 22.8% (95% CI: 22.3–23.2) (51.7 million). Adults with DM were more often older, women, non-Hispanic black, of lower education level, and less physically active than adults without DM (Table 1) ($P < 0.05$).

The detailed prevalence of arthritis and the proportion of AAAL among U.S. adults with arthritis by DM status and

characteristics are shown in Table 2. For these adults with DM, 48.1% (95% CI: 46.5–49.7) (9.6 million) had arthritis, for whom the proportion of AAAL was 55.0% (95% CI: 52.9–57.1) (5.3 million). Among adults without DM, 20.3% (95% CI: 19.9–20.8) (42.1 million) had arthritis, for whom the proportion of AAAL was 39.0% (95% CI: 38.0–39.9) (16.4 million).

In comparing prevalences of arthritis, the unadjusted PR was 2.37 (95% CI: 2.28–2.45) for those with DM compared with those without DM; the age-adjusted PR was 1.51 (95% CI: 1.44–1.57). The prevalence of arthritis increased significantly across increasing age-groups regardless of DM status (both P values of tests for linear trend were <0.001). There was a higher prevalence of arthritis among women and non-Hispanic whites for adults with or without DM (Table 2). There was no significant linear trend across education levels for adults with arthritis ($P = 0.649$ for

Table 1—Characteristics of study sample by diagnosed DM status: NHIS*, United States, 2008–2010

Variables	With DM ($n = 7,469$; weight $N = 20.0$ million) [% or mean (95% CI)]	Without DM ($n = 69,073$; weight $N = 207.0$ million) [% or mean (95% CI)]	P value†
Age (years) (mean)	59.6 (59.2–60.1)	44.8 (44.5–45.1)	<0.001
Age-groups (years) (%)			
18–44	14.7 (13.6–15.8)	51.9 (51.2–52.6)	<0.001
45–64	47.9 (46.4–49.4)	33.4 (32.9–34.0)	
≥ 65	37.4 (36.0–38.9)	14.6 (14.2–15.1)	
Women (%)	49.8 (48.3–51.4)	51.9 (51.4–52.4)	0.017
Race/ethnicity (%)			
Non-Hispanic white	64.3 (62.9–65.7)	68.7 (67.9–69.5)	<0.001
Non-Hispanic African American	15.0 (14.0–16.1)	11.2 (10.7–11.8)	
Mexican American	9.1 (8.3–10.0)	8.5 (8.1–9.0)	
Other Hispanic	5.2 (4.6–5.8)	5.2 (5.0–5.5)	
Others	6.4 (5.7–7.1)	6.3 (6.0–6.7)	
Highest education level (%)			
Less than high school graduate	24.4 (23.1–25.8)	14.5 (14.0–15.0)	<0.001
High school graduate	31.5 (30.1–32.9)	26.9 (26.4–27.4)	
More than high school graduate	44.2 (42.6–45.7)	58.6 (57.9–59.3)	
BMI (mean)	31.8 (31.5–32.0)	27.2 (27.1–27.3)	<0.001
BMI groups (%)			
Underweight (<18.5 kg)	0.7 (0.5–1.0)	1.8 (1.7–2.0)	<0.001
Normal weight (18.5 to <25.0 kg)	15.5 (14.5–16.4)	37.6 (37.1–38.1)	
Overweight (25.0 to <30.0 kg)	29.9 (28.6–31.3)	35.4 (34.9–35.9)	
Obese (≥ 30.0 kg)	53.9 (52.3–55.5)	25.2 (24.7–25.6)	
Physical activity level‡ (%)			
Meeting recommendation	29.5 (28.0–31.1)	46.8 (46.1–47.5)	<0.001
Insufficient activity	20.9 (19.7–22.2)	20.3 (19.8–20.7)	
Inactive	49.6 (48.1–51.1)	33.0 (32.2–33.7)	

*All researched variables of NHIS were self-reported. †Two-sided t test for continuous variable and χ^2 test for categorical variable. ‡The categories (in minutes per week) of physical activity level were: meeting recommendations (≥ 150), insufficient activity (10–149), and inactive (<10).

Table 2—Prevalence of diagnosed arthritis among U.S. adults aged ≥18 years and proportion with AAAL among those with diagnosed arthritis, by diagnosed DM status and selected characteristics: NHIS*, United States, 2008–2010

Variables	Diagnosed arthritis (n = 18,391; weighted N = 51.7 million)				Proportion with AAAL among those with diagnosed arthritis (n = 8,128; weighted N = 21.7 million)			
	With DM		Without DM		With DM		Without DM	
	Unadjusted [% (95% CI)]	Age adjusted [% (95% CI)]	Unadjusted [% (95% CI)]	Age adjusted [% (95% CI)]	Unadjusted [% (95% CI)]	Age adjusted [% (95% CI)]	Unadjusted [% (95% CI)]	Age adjusted [% (95% CI)]
Overall	48.1 (46.5–49.7)	32.4 (31.1–33.7)	20.3 (19.9–20.8)	21.5 (21.0–22.0)	55.0 (52.9–57.1)	54.2 (52.0–56.3)	39.0 (38.0–39.9)	39.1 (38.2–40.1)
Age (years)								
18–44	22.7 (19.0–26.5)	—	7.2 (6.8–7.5)	—	49.3 (40.3–58.3)	—	34.8 (32.5–37.0)	—
45–64	46.2 (44.0–48.3)	—	28.3 (27.5–29.0)	—	56.7 (53.5–59.9)	—	39.3 (37.8–40.7)	—
≥65	60.5 (58.3–62.8)	—	48.9 (47.7–50.1)	—	54.2 (51.3–57.1)	—	40.8 (39.2–42.3)	—
Sex								
Men	41.6 (39.3–43.9)	27.8 (26.0–29.5)	16.5 (16.0–17.1)	18.5 (17.9–19.1)	51.7 (48.3–55.1)	50.9 (47.5–54.3)	37.2 (35.7–38.7)	37.5 (36.0–39.0)
Women	54.7 (52.6–56.7)	37.6 (35.7–39.4)	23.8 (23.2–24.4)	24.2 (23.6–24.8)	57.5 (54.8–60.2)	56.7 (54.0–59.4)	40.1 (39.0–41.3)	40.2 (39.0–41.3)
Race/ethnicity								
Non-Hispanic white	51.6 (49.7–53.5)	34.1 (32.5–35.7)	23.7 (23.1–24.3)	23.0 (22.4–23.6)	53.4 (50.8–56.0)	52.3 (49.6–55.0)	37.8 (36.8–38.9)	37.8 (36.8–38.9)
Non-Hispanic African American	47.3 (44.1–50.6)	34.1 (31.5–36.7)	17.8 (16.8–18.8)	21.9 (20.9–23.0)	59.4 (54.7–63.9)	58.9 (54.3–63.6)	43.8 (41.4–46.2)	44.7 (42.2–47.1)
Mexican American	34.9 (30.7–39.3)	26.5 (23.0–30.0)	8.5 (7.7–9.4)	13.9 (12.8–15.0)	59.3 (51.7–66.5)	58.8 (51.4–66.2)	43.7 (39.0–48.4)	44.8 (40.1–49.5)
Other Hispanic	41.7 (36.4–47.2)	29.8 (25.4–34.2)	11.2 (10.2–12.2)	15.0 (13.7–16.3)	58.2 (48.8–67.0)	57.6 (48.6–66.6)	42.9 (37.2–48.8)	43.9 (38.2–49.6)
Others	39.0 (33.8–44.6)	27.3 (23.1–31.5)	11.9 (10.8–13.0)	14.7 (13.5–15.9)	55.6 (47.0–63.9)	55.1 (46.6–63.5)	43.4 (38.8–48.0)	44.1 (39.5–48.6)
Highest education level								
Less than high school graduate	51.9 (49.0–54.8)	32.3 (30.0–34.7)	21.3 (20.3–22.4)	20.2 (19.3–21.1)	62.9 (59.1–66.5)	61.9 (58.1–65.7)	51.5 (49.2–53.8)	50.9 (48.6–53.2)
High school graduate	49.9 (47.2–52.6)	33.6 (31.4–35.8)	23.5 (22.7–24.3)	23.2 (22.5–24.0)	56.0 (52.5–59.5)	55.5 (52.0–59.0)	39.9 (38.0–41.8)	39.9 (38.0–41.8)
More than high school graduate	44.7 (42.6–46.8)	31.7 (30.0–33.4)	18.6 (18.1–19.2)	21.0 (20.5–21.6)	49.1 (45.7–52.6)	48.8 (45.4–52.2)	34.9 (33.7–36.2)	35.3 (34.0–36.5)
BMI (kg/m ²)								
Underweight (<18.9)	31.0 (18.9–46.4)	16.6 (7.7–25.6)	16.0 (13.7–18.5)	15.7 (13.3–18.1)	76.0 (52.7–90.0)	74.1 (53.4–94.8)	51.8 (44.1–59.4)	50.7 (42.9–58.5)
Normal weight (18.9 to <25.0)	40.1 (36.4–43.9)	21.7 (19.3–24.2)	15.7 (15.0–16.3)	17.2 (16.5–17.9)	50.7 (44.9–56.5)	48.0 (42.2–53.7)	35.5 (33.8–37.3)	35.2 (33.5–36.9)
Overweight (25.0 to <30.0)	42.7 (39.9–45.5)	25.7 (23.7–27.7)	20.3 (19.7–21.0)	20.4 (19.8–21.1)	47.0 (43.1–51.0)	45.3 (41.3–49.2)	35.8 (34.2–37.4)	35.8 (34.2–37.4)
Obese (≥30.0)	53.3 (51.2–55.5)	38.7 (36.9–40.6)	27.1 (26.3–28.0)	29.0 (28.2–29.8)	58.7 (55.9–61.4)	58.3 (55.5–61.1)	43.8 (41.9–45.6)	44.7 (42.9–46.5)
Physical activity level†								
Meeting recommendation	38.0 (35.4–40.7)	27.6 (25.5–29.7)	16.4 (15.8–17.0)	19.9 (19.3–20.6)	37.0 (33.1–41.1)	36.9 (32.8–40.9)	27.6 (26.2–29.1)	27.9 (26.5–29.3)
Insufficient activity	48.6 (45.3–51.8)	33.9 (31.3–36.6)	22.3 (21.5–23.2)	23.1 (22.2–23.9)	46.7 (42.2–51.1)	46.4 (41.9–50.8)	37.1 (35.4–39.0)	37.2 (35.4–39.0)
Inactive	54.0 (51.8–56.1)	35.1 (33.2–36.9)	24.6 (23.8–25.3)	22.4 (21.8–23.1)	65.4 (62.6–68.2)	65.0 (62.1–67.9)	50.5 (48.8–52.2)	50.4 (48.6–52.1)

*All researched variables of NHIS were self-reported. †The categories (in minutes per week) of physical activity level were: meeting recommendations (≥150), insufficient activity (10–149), and inactive (<10).

Table 3—PR of diagnosed arthritis among U.S. adults aged ≥18 years and AAAL among those with arthritis from multivariate logistic regressions of diagnosed DM and other characteristics: NHIS*, United States, 2008–2010

Variables	Arthritis				AAAL among U.S. adults with arthritis			
	Total	With DM	Without DM	Total	With DM	Without DM	Without DM	
With DM vs. without DM	1.44 (1.35–1.52)	—	—	1.21 (1.15–1.28)	—	—	—	
Age per 5-year increasing	1.24 (1.23–1.25)	1.15 (1.13–1.18)	1.26 (1.25–1.27)	1.01 (1.00–1.02)	1.01 (0.99–1.03)	1.01 (1.00–1.02)	1.01 (1.00–1.02)	
Women vs. men	1.33 (1.29–1.37)	1.32 (1.22–1.43)	1.34 (1.29–1.38)	1.02 (0.98–1.07)	1.03 (0.94–1.12)	1.02 (0.97–1.07)	1.02 (0.97–1.07)	
Race/ethnicity								
Non-Hispanic white	1 (reference)	1 (reference)	1 (reference)					
Non-Hispanic African American	0.88 (0.84–0.92)	0.92 (0.83–1.00)	0.87 (0.83–0.92)	1.05 (0.99–1.10)	1.07 (0.96–1.17)	1.04 (0.98–1.11)	1.04 (0.98–1.11)	
Mexican American	0.60 (0.56–0.64)	0.68 (0.58–0.78)	0.58 (0.53–0.63)	1.02 (0.91–1.13)	1.03 (0.86–1.19)	1.02 (0.89–1.15)	1.02 (0.89–1.15)	
Other Hispanic	0.67 (0.62–0.72)	0.82 (0.69–0.95)	0.64 (0.58–0.69)	1.02 (0.90–1.15)	1.06 (0.88–1.23)	1.02 (0.87–1.16)	1.02 (0.87–1.16)	
Others	0.72 (0.67–0.77)	0.82 (0.70–0.95)	0.69 (0.64–0.75)	1.11 (1.00–1.21)	1.10 (0.91–1.29)	1.11 (0.99–1.24)	1.11 (0.99–1.24)	
Highest education level								
Less than high school graduate	1.04 (0.99–1.08)	1.06 (0.97–1.15)	1.04 (0.98–1.09)	1.22 (1.15–1.28)	1.14 (1.02–1.27)	1.24 (1.16–1.32)	1.24 (1.16–1.32)	
High school graduate	1.06 (1.02–1.10)	1.02 (0.93–1.10)	1.07 (1.03–1.11)	1.03 (0.98–1.09)	1.06 (0.96–1.17)	1.03 (0.96–1.09)	1.03 (0.96–1.09)	
More than high school graduate	1 (reference)	1 (reference)	1 (reference)					
BMI (kg/m ²)								
Underweight (<18.9)	0.82 (0.69–0.96)	0.68 (0.32–1.04)	0.85 (0.71–0.99)	1.33 (1.13–1.53)	1.49 (0.90–2.09)	1.29 (1.07–1.50)	1.29 (1.07–1.50)	
Normal weight (18.9 to <25.0)	1.0 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	
Overweight (25.0 to <30.0)	1.25 (1.20–1.31)	1.18 (1.04–1.33)	1.26 (1.21–1.32)	1.01 (0.94–1.07)	0.97 (0.83–1.12)	1.02 (0.95–1.09)	1.02 (0.95–1.09)	
Obese (≥30.0)	1.70 (1.64–1.77)	1.63 (1.44–1.82)	1.73 (1.66–1.80)	1.20 (1.13–1.27)	1.20 (1.04–1.36)	1.20 (1.13–1.27)	1.20 (1.13–1.27)	
Physical activity level†								
Meeting recommendation	1 (reference)	1 (reference)	1 (reference)					
Insufficient activity	1.09 (1.05–1.13)	1.18 (1.04–1.31)	1.08 (1.03–1.13)	1.27 (1.19–1.35)	1.22 (1.05–1.40)	1.29 (1.19–1.38)	1.29 (1.19–1.38)	
Inactive	1.10 (1.06–1.13)	1.22 (1.10–1.33)	1.08 (1.04–1.12)	1.68 (1.58–1.79)	1.72 (1.50–1.94)	1.68 (1.57–1.79)	1.68 (1.57–1.79)	

* All researched variables of NHIS were self-reported. † The categories (in minutes per week) of physical activity level were: meeting recommendations (≥150), insufficient activity (10–149), and inactive (<10).

adults with DM and 0.075 for adults without DM). Higher levels of BMI were associated with higher arthritis prevalence among adults with and without DM (*P* for linear effect <0.001). Increasing physical activity levels were associated with lower prevalences of arthritis. After adjusting for other variables (Table 3), adults with DM had a 44% higher risk of prevalent arthritis than those without DM.

In comparing proportions of AAAL among adults with arthritis, the unadjusted PR (95% CI) was 1.41 (1.35–1.47) times greater for those with DM than for those without DM and remained higher even after adjusting for age (1.38 [1.32–1.45]). There was no significant linear relationship (*P* = 0.320) with increasing age for the proportion of AAAL among adults with arthritis and DM. Among adults with arthritis, women had a higher proportion of AAAL than men (Table 2), whereas non-Hispanic whites had a lower proportion of AAAL than among other race/ethnic groups. In addition, regardless of DM status, there were significant linear trends (*P* < 0.001) for the proportion of AAAL, reflecting a higher risk for the lowest education levels. A U-shaped relationship prevailed, with increasing BMI levels among adults with arthritis as evidenced by nonsignificant linear trends for adults with (*P* = 0.123) and without (*P* = 0.144) DM but each having significant quadratic trends (*P* < 0.001), respectively. Higher physical activity levels were associated with lower proportions of AAAL for adults with arthritis for each DM status. After adjusting for the other variables (Table 3), there was a 21% higher risk of the AAAL among those with arthritis and DM than adults with arthritis but without DM.

Interestingly, the pattern of significant associations found for sex, race/ethnicity, highest education level, and BMI with prevalent arthritis (following relevant adjustment for all other factors) was different from the pattern for each factor regarding the proportion of AAAL among adults with arthritis.

CONCLUSIONS—In 2008 to 2010, among U.S. adults aged ≥18 years with diagnosed DM, the prevalence of arthritis was 48.1% (9.6 million), and among those with both diseases, the annual proportion of AAAL was 55.0% (5.3 million). Comparing those with versus without DM, the prevalence of arthritis was 44% significantly higher, and AAAL proportion among adults with arthritis was 21% significantly higher, even after adjusting for age, sex, race/ethnicity, education level, BMI level,

and physical activity level. The prevalence of arthritis was positively associated with age, and being a woman.

However, the association of AAAL and other variables among adults with arthritis differs from the association among adults with arthritis in general. The proportion of AAAL among adults with arthritis, which is related to the progress or severity of arthritis, was not significantly associated with either age or being a woman. These findings are consistent with Felson et al. (14), who found that age and sex may not affect progression of knee osteoarthritis, in spite of the higher noted prevalence of knee osteoarthritis with increased age and being a woman (15).

The proportion of AAAL was lower among non-Hispanic whites than for other race/ethnic groups. This finding warrants further exploration to establish if the higher prevalence of arthritis for non-Hispanic whites is due to a differential exposure to putative risk factors, greater health care accessibility, or greater awareness of existing arthritis. In addition, having lower educational attainment was related to AAAL among adults with arthritis, which might imply that arthritis is related to one's occupational pursuits (16).

Available scientific evidence suggests that physical activity is beneficial for adults with DM and arthritis (1–3) and that arthritis is a major impediment to being physically active (4,17). In our study, we found that physical inactivity was associated with the prevalence of arthritis and much more strongly associated with AAAL among adults with arthritis. Our data thereby support that arthritis is a potential barrier to physical activity, especially among adults with DM. Adults with arthritis need additional guidance on how to overcome the barriers for physical activity that they encounter with this disease.

There are a number of limitations to our study. Our sample was derived from the NHIS, which oversamples blacks, Hispanics, and Asians; however, Native Americans, who have a high prevalence of DM and arthritis, are not well represented. In addition, we encountered 127 adults with missing information of diagnosed arthritis or DM, which did not bias U.S. national burden estimates. In contrast, adults with missing values of body weight, body height, and physical activity level were older and tended to have adverse events, which might make our conclusions more conservative. Our assessment of diagnosed arthritis and DM was based

on self-reported information, which has been shown to be valid for surveillance purposes elsewhere (18,19), yet we cannot rule out the possibility that the willingness to report diagnosed arthritis, AAAL, or risk factors may differ between persons with and without diagnosed DM. Different associations might possibly arise if undiagnosed DM had been included in our analyses. We do not have information on the validity of AAAL. In addition, different subtypes of arthritis, AAAL, and DM may have been incorporated into the overall self-report of diagnosed arthritis and DM, whereas overall self-report of physical activity level incorporated many specific physical activities. Hence, we cannot reconcile a direct impact of any specific subtype of arthritis, or specific joint(s) affected, relative to AAAL or to specific types of leisure-time physical activity. An association between a risk factor and a prevalent disease might have actually been due to recent changes in risk factor, disease incidence, mortality, or a combination of each. For example, our noted association between diagnosed arthritis and AAAL with physical activity might have arisen because the latter might have changed after having been diagnosed with either condition. Because DM status was defined by self-reported information in this study, the association may be different if undiagnosed diabetes had been included to form a total diabetes status and may warrant future study. Finally, the use of some arthritis treatment-related medications such as glucosamine and corticosteroids has been shown to increase users' risk of insulin resistance or DM (20–22). This underscores the complex relationship between DM and arthritis that cannot be resolved using these cross-sectional survey data that cannot address causality. In all, even though the NHIS is an ongoing national, population-based, cross-sectional survey, with very limited capacity to explore causality among variables, it nonetheless reflects an anticipated relationship among arthritis, DM, and AAAL and offers important national burden estimates.

We conclude that nearly half of all U.S. adults with diagnosed DM also have diagnosed arthritis and that more than half of adults with both diseases have AAAL. These findings suggest that arthritis among adults with diagnosed DM can be a substantial barrier to physical activity, which makes more difficult for these persons to practice physical activity or realize the benefits of physical

activity on managing DM and preventing DM complications.

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