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The Association Between Physical Activity and the Risk of Incident Psoriasis

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Abstract

Objective—To examine the association between total physical activity, walking, and vigorous exercise and the incidence of psoriasis in women.

Design—Cohort study.

Setting—The Nurses' Health Study II, a cohort of 116 430 women aged 27 to 44 years in 1991.

Participants—The study population included 86 655 US female nurses who reported whether they had ever been diagnosed as having psoriasis and who completed detailed physical activity questionnaires in 1991, 1997, and 2001. We excluded participants with a history of psoriasis prior to 1991.

Main Outcome Measures—Risk of psoriasis by quintile of physical activity as measured by a metabolic equivalent task score.

Results—We documented 1026 incident psoriasis cases during 1 195 703 person-years of follow-up (14 years, 1991–2005). After adjusting for age, smoking, and alcohol use, increasing physical activity was inversely associated with the risk of psoriasis. The most physically active quintile of women had a lower multivariate relative risk (RR) of psoriasis (0.72 [95% CI, 0.59–

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0.89; $P < .001$ for trend]) compared with the least active quintile. Vigorous physical activity (6 metabolic equivalents) was associated with a reduced risk of psoriasis (multivariate RR for the highest quintile, 0.66 [95% CI, 0.54–0.81; $P < .001$ for trend]); this association remained significant after adjusting for body mass index (RR, 0.73 [95% CI, 0.60–0.90; $P = .009$ for trend]). Walking was not associated with psoriasis risk. In a subset of 550 confirmed psoriasis cases, we observed a similarly reduced risk of psoriasis associated with vigorous physical activity (multivariate RR for the highest quintile, 0.64 [95% CI, 0.48–0.86; $P = .03$ for trend]).

Conclusion—In this study of US women, vigorous physical activity is independently associated with a reduced risk of incident psoriasis.

Psoriasis is an immunologic disorder characterized by systemic inflammation and cutaneous plaques.¹ Prospective studies have demonstrated that higher body mass index (BMI),² weight gain, alcohol intake,³ and smoking⁴ are associated with an increased risk of psoriasis. However, the role of physical activity in psoriasis prevention remains undetermined. Results from cross-sectional studies have been inconsistent; an association between psoriasis and physical inactivity was observed in some studies^{5,6} but not in others.⁷ The Iowa Women's Health Study found that women who engaged in regular physical activity were less likely to have psoriasis than women who denied exercising regularly (age-adjusted odds ratio, 0.8 [95% CI, 0.7–0.9]).⁵ Another study found no difference in mean physical activity between women with and without psoriasis.⁷ These cross-sectional analyses did not adjust for other lifestyle factors, such as BMI, that may vary across groups of differing physical activity levels and do not permit a determination of cause and effect. No prospective studies have evaluated the association between physical activity and incident psoriasis.

Physical activity has been associated with a decreased risk of disorders characterized by systemic inflammation, including type 2 diabetes mellitus,⁸ colon cancer,⁹ coronary artery disease,¹⁰ and breast cancer.¹¹ Walking and vigorous exercise appear to have an equal role in reducing the risk of developing coronary artery disease, type 2 diabetes, and breast cancer. A dose-response relationship has also been demonstrated, with higher amounts of physical activity associated with a lower risk of disease. The relative effects of walking and vigorous activity on psoriasis risk and the dose-response relationship between physical activity and psoriasis remain unknown. It is biologically plausible that physical activity may affect psoriasis risk through effects on systemic inflammatory mediators.

In this study, we prospectively evaluated the association between physical activity and incident psoriasis in a large cohort of women in the United States. We also assessed the association between type of physical activity (eg, walking vs vigorous exercise) and the risk of psoriasis, using detailed, repeated assessments of physical activity, and validated our findings in a subset of confirmed psoriasis cases.

METHODS

PARTICIPANTS

The Nurses' Health Study II (NHS II) is a longitudinal study of 116 430 female registered nurses from 15 US states who were aged 25 to 42 years on enrollment in the study in 1989. More than 90% of the cohort responds to biennial questionnaires. The participants for this

analysis were 86 665 women enrolled in the NHS II who did not have psoriasis at baseline in 1991 and who completed detailed physical activity questionnaires in 1991, 1997, and 2001. We began follow-up in 1991, the first year for which corresponding information on smoking status and alcohol intake was available.

ASSESSMENT OF PHYSICAL ACTIVITY

In 1991, 1997, and 2001, participants reported their average time per week (in 10 categories ranging from 0 minutes to 11 hours) during the preceding year spent engaged in any of the following recreational activities: walking or hiking outdoors; jogging; running; bicycling; performing calisthenics, aerobics, or aerobic dance and/or rowing on a machine; swimming laps; performing other vigorous activities (eg, mowing the lawn); and playing tennis, squash, or racquetball. Participants reported their usual outdoor walking pace (unable to walk, easy/casual [<2.0 mph], normal/average [2.0 – 2.9 mph], brisk [3.0 – 3.9 mph], or very brisk/striding [≥ 4.0 mph]). Each activity was assigned a metabolic equivalent task (MET) value according to established criteria.¹² Each participant's MET score for walking was assigned on the basis of her reported walking pace. We calculated the MET-hours per week for each activity by multiplying the MET score by the participant's reported number of hours per week. Total physical activity was computed as the sum of the MET-hours per week from all individual activities. Vigorous activity summed the MET-hours per week from all the recreational activities listed excluding walking. All activities included as vigorous had intensity scores of 6 MET or more. To most accurately assess a participant's physical activity level preceding the onset of psoriasis, we used the most recently provided physical activity data preceding a participant's reported psoriasis diagnosis (eg, for a participant who was diagnosed as having psoriasis during the interval from 1999 through 2002, we used the physical activity measurement from 1997). Physical activity data were carried forward when not included in the biennial questionnaires. Furthermore, to evaluate long-term levels of physical activity during the study period, we conducted an additional analysis in which we calculated the cumulative averages of the MET scores from all the questionnaires available up to the participant's date of psoriasis diagnosis.

In a separate study, these questions were validated as reproducible measures of physical activity in the NHS II cohort; the overall correlation between physical activity as reported on the questionnaire and recalled after 1 week was 0.79. From this validation study, Wolf et al¹³ concluded that the moderately high correlation suggested that the questionnaire was a valid tool for measuring activity level in the NHS II. In the same validation study, Wolf et al¹³ found moderate levels of reproducibility during a 2-year interval (from 1989 through 1991), with a 2-year test-retest correlation of 0.59.

ASSESSMENT OF PSORIASIS

The primary outcome assessed in the present study was self-reported, physician-diagnosed, incident psoriasis. In 2005, participants were asked whether they had been diagnosed as having psoriasis by a clinician and, if so, the date of the diagnosis in 4-year intervals (before 1991, 1991–1994, 1995–1998, 1999–2002, and 2003 or later). Of the 86 655 participants who responded to the psoriasis question in 2005, 2587 women reported a clinician diagnosis of psoriasis. We excluded 1378 cases from our analysis that were diagnosed before 1991 and

58 cases with no reported date of diagnosis. We excluded women with psoriasis at baseline to ensure that we had a physical activity assessment before the psoriasis diagnosis to limit the effect that psoriasis may have on physical activity. A total of 1151 cases of incident psoriasis occurred from 1991 through 2005; 1026 participants (89.1%) provided survey information on physical activity and were included in our analysis.

A subset of the self-reported psoriasis diagnoses was confirmed using the previously validated Psoriasis Screening Tool (PST) questionnaire, which assigns a diagnosis of psoriasis based on participant responses to 7 questions derived from the National Psoriasis Foundation's survey on psoriasis.^{14,15} The PST was sent to 2068 of the 2587 women who reported a psoriasis diagnosis. The overall response rate was 89.6%, and 92.3% of respondents were confirmed to have psoriasis. Of the women with incident psoriasis who responded with a completed PST questionnaire, 550 were confirmed to have psoriasis by the PST, provided physical activity information, and were included in our analysis.

STATISTICAL ANALYSIS

We computed person-time of follow-up for each participant from the return date of the 1991 questionnaire to the date of psoriasis diagnosis, death from any cause, or the end of the study period, whichever came first. We used Cox proportional hazards regression models to compute hazard ratios as estimates for age-adjusted and multivariate relative risk (RR) of incident psoriasis among women in each MET score quintile group compared with those in the least active quintile. We conducted our tests of linear trend across increasing MET quintiles by treating the quintiles as a continuous variable and assigning the median score for each quintile as its value. We adjusted simultaneously for potential confounding variables, including age (5-year intervals), alcohol intake in drinks per week (none, 0.1–0.3, 0.4–0.7, 0.8–1.1, 1.2–2.3, and 2.4), and smoking status (never, past, and current smoking of 1–14, 15–34, and 35 cigarettes per day). In an additional analysis, we further adjusted for BMI (calculated as weight in kilograms divided by height in meters squared) (<21.0, 21.0–22.9, 23.0–24.9, 25.0–27.4, 27.5–29.9, 30.0–34.9, and 35.0) to evaluate the degree to which the impact of physical activity was mediated through BMI. Covariates were chosen a priori by identifying all possible confounders that were known to have an independent association with physical activity and psoriasis. The accuracy of self-reported anthropometric measures was validated previously among 140 NHS I participants.¹⁶ Self-reported weights were highly correlated with measured values (Pearson $r = 0.97$). Covariates were updated according to questionnaire information every 2 years. To examine the potential effect modification by other variables, we stratified the total and vigorous activity analyses by BMI, smoking status, and alcohol consumption and calculated the P value for interaction. P values were not adjusted for multiple comparisons because our exposures were not independent and we were evaluating a single a priori hypothesis. The proportional hazards assumption was not violated. Statistical analyses were performed using commercially available software (SAS, version 9; SAS Institute, Inc). The institutional review board of Partners Health Care System approved this study.

RESULTS

The 1026 cases of incident psoriasis among participants who reported physical activity information during the 14-year follow-up period corresponded to an incidence rate of 86 per 100 000 person-years. Demographic characteristics were tabulated according to quintile of total physical activity in MET-hours per week (Table 1). As previously described, women who reported greater amounts of physical activity were younger, had a lower BMI, consumed more alcohol, and were less likely to be current smokers.^{10,17}

The total physical activity score in MET-hours per week, which included vigorous activity and walking, was inversely related to the risk of psoriasis (Table 2). We observed a decreased age-adjusted RR of psoriasis in women in the most physically active quintile compared with the least active quintile of women (0.71 [95% CI, 0.58–0.87; $P < .001$ for trend]). This risk remained significant after adjusting for age, smoking, and alcohol intake (0.72 [95% CI, 0.59–0.89]). Although the multivariate RRs did not reach statistical significance for women in the middle quintiles of total physical activity, we found a significant trend toward a decreased risk of psoriasis with increased activity ($P < .001$ for trend), consistent with a negative association between physical activity level and risk of psoriasis. After further adjustment for BMI, the RR was 0.85 (95% CI, 0.69–1.04; $P = .09$ for trend).

We next evaluated the association between the type of physical activity and the risk of incident psoriasis. Vigorous physical activity was associated with a significantly reduced risk of incident psoriasis (Table 2). We observed a decreased age-adjusted RR of psoriasis for women in the highest quintile of vigorous activity compared with the least active quintile of women (0.66 [95% CI, 0.54–0.80; $P < .001$ for trend]). This risk remained significant after adjusting for age, smoking, alcohol intake, and BMI in 7 categories (<21.0, 21.0–22.9, 23.0–24.9, 25.0–27.4, 27.5–29.9, 30.0–34.9, and 35.0) (0.73 [95% CI, 0.60–0.90]). Adjustment for BMI as a continuous variable did not change the statistical significance of our results. A significant trend toward a decreased risk of psoriasis occurred with increased vigorous physical activity ($P = .009$ for trend), although the multivariate RRs did not reach statistical significance for women in the middle quintiles of physical activity. The statistical significance of our results did not change when we used cumulative average physical activity as our exposure of interest (eTable; <http://www.archdermatol.com>).

There was no evidence of effect modification in the total or vigorous physical activity analyses. For the total physical activity analyses, there was no effect modification by BMI ($P = .43$ for interaction), alcohol intake ($P = .82$ for interaction), or smoking status ($P = .12$ for interaction). For the vigorous activity analyses, there was no effect modification by BMI ($P = .99$ for interaction), alcohol intake ($P = .72$ for interaction), or smoking status ($P = .24$ for interaction).

Approximately 6.3% of women reported any running; 11.7%, any jogging; 32.6%, any bicycling; 32.5%, performing any calisthenics, aerobics, or aerobic dance or rowing; 10.8%, any swimming; and 5.5%, playing any tennis, squash, or racquetball. After adjusting for other vigorous activity, walking, age, smoking status, and alcohol intake, the RR for

psoriasis was 0.37 (95% CI, 0.19–0.72; $P = .002$ for trend) for women who reported running for more than 1 h/wk compared with women who did not run. The multivariate RR was 0.54 (95% CI, 0.33–0.88; $P = .03$ for trend) for women who reported participating in aerobics for at least 4 h/wk compared with women who did not participate in aerobics. The risk reductions for running and aerobics remained significant at 0.45 (95% CI, 0.23–0.87; $P = .02$ for trend) and 0.59 (95% CI, 0.36–0.96; $P = .2$ for trend), respectively, after further adjustment for BMI. Other vigorous activities (bicycling, jogging, swimming, and playing tennis) were not associated with the risk of psoriasis. Time increments were chosen a priori and were based on original questionnaire wording.

Walking was not associated with a reduced risk of psoriasis (Table 2). To minimize any potential confounding by vigorous activity, we limited our analysis to women who reported no physical activity other than walking. The lack of an association between walking and psoriasis risk persisted when we included women in our analysis who reported participation in both walking and vigorous activities and adjusted for vigorous activity participation. We also found no association between the cumulative average number of hours per week spent walking as assessed in 1989, 1991, 1997, and 2001 and the incidence of psoriasis or between walking pace and incident psoriasis.

We observed a decreased multivariate RR of psoriasis in women with confirmed psoriasis cases who participated in more than 31.9 MET-hours per week of all types of physical activity (RR, 0.62 [95% CI, 0.46–0.84; $P = .001$ for trend]) or in 20.9 or more MET-hours per week of vigorous physical activity (RR, 0.57 [95% CI, 0.43–0.76; $P = .002$ for trend]) (Table 3). In our calculations, 20.8 MET-hours per week of vigorous activity is the equivalent of 2 h/wk of running or 3 h/wk of swimming or tennis. The risk reduction associated with vigorous activity remained significant after adjustment for BMI (RR, 0.64 [95% CI, 0.48–0.86; $P = .03$ for trend]). There was no effect modification by BMI, alcohol intake, or smoking status in the total or vigorous activity analyses in participants with confirmed psoriasis.

COMMENT

In this study of US women, vigorous physical activity was independently associated with a decreased risk of psoriasis. The association between vigorous activity and psoriasis risk remained significant after adjustment for BMI and was strengthened in a subset of validated psoriasis cases. The association between BMI and psoriasis has been previously evaluated,² but, to our knowledge, this is the first study to investigate the independent association between physical activity and psoriasis.

Our results suggest that participation in at least 20.9 MET-hours per week of vigorous exercise, the equivalent of 105 minutes of running or 180 minutes of swimming or playing tennis, is associated with a 25% to 30% reduced risk of psoriasis compared with not participating in any vigorous exercise. This amount of vigorous activity is roughly equivalent to the current US Department of Health and Human Services recommendation for greater health benefits. In 2008, the department updated its physical activity guidelines to prescribe a weekly minimum of 150 minutes of moderate-intensity aerobic activity or 75

minutes of vigorous activity in addition to 2 or more days of muscle strengthening activity.¹⁸ For even greater health benefits, it recommended 300 minutes of moderate-intensity or 150 minutes of vigorous-intensity exercise weekly. Despite federal recommendations, only 43.3% of US adults engage in the minimum recommended level of physical activity. Even fewer US adults (28.4%) meet recommendations for greater health benefits.¹⁹ Increased participation in vigorous physical activity would decrease the incidence of comorbid disorders associated with psoriasis, including coronary heart disease,¹⁰ stroke,²⁰ and myocardial infarction²¹; would cut related health care costs; and, based on the association observed in this study, may have the potential to decrease the incidence of psoriasis.

Although the RRs for women in the middle quintiles of physical activity did not reach statistical significance in this study, they contribute to the significant trend across all quintiles toward a decreased risk of psoriasis with increased total or vigorous activity. In addition, it is possible that there is a threshold effect, in which a minimum level of vigorous physical activity must be reached before a statistically significant reduction in psoriasis risk is observed. In such a situation, we would not expect to see a linear dose response. The association between vigorous activity and psoriasis risk remained after adjustment for BMI as a categorical or continuous variable, indicating that the reduction in risk is independent of BMI.

Among the individual vigorous activities we evaluated, only running and performing aerobic exercise or calisthenics were associated with a reduced risk of psoriasis. Other vigorous activities, including jogging, playing tennis, swimming, and bicycling, were not associated with psoriasis risk. The highly variable intensity at which these activities are performed may account for this finding. In contrast, the running question specifies that an individual maintain at least a 6 mile-per-hour (10 minute-per-mile) pace. In addition, many individuals participate in a range of vigorous activities, each for shorter periods of time, rather than only 1 vigorous activity for an extended time period. As a result, fewer women are in the higher MET groups when we break down MET scores by individual activity than when we look at vigorous activity as a composite. This loss of power may explain why some of the individual activities do not meet statistical significance.

The mechanism whereby physical activity reduces psoriasis risk deserves further study. It is biologically plausible that vigorous activity could modulate a state of chronic inflammation and/or immune activation that predisposes women to develop psoriasis. An overexpression of proinflammatory cytokines relative to anti-inflammatory cytokines plays a significant role in psoriasis pathogenesis,¹ and conditions marked by increased chronic inflammation, such as obesity, may put individuals at increased risk for psoriasis.² Physical activity is known to decrease chronic inflammation and specifically lowers levels of proinflammatory cytokines, such as tumor necrosis factor,²² interleukin 6 (IL-6),²³ and leptin.²² Physical activity can elevate levels of anti-inflammatory cytokines, including adiponectin, independent of BMI.²⁴ Among women with similar BMIs, physically active women have lower levels of the inflammatory marker C-reactive protein (CRP).²⁵ In healthy men and women, IL-6 and CRP levels have been correlated with physical activity level after correction for BMI.²⁶ Interventional studies also have provided evidence to support the anti-inflammatory role of

physical activity. Among obese young women, a 7-month exercise program decreased levels of CRP, leptin, and tumor necrosis factor and elevated adiponectin levels.²² A similar study in elderly men found that a 12-month physical activity intervention lowered serum IL-6 levels.²³

The protective benefits of physical activity could also be mediated through its effect on mood. Exercise decreases anxiety and stress, improves emotional well-being,²⁷ and may be an effective treatment for depression.²⁸ Stressful life events are associated with new-onset psoriasis and may trigger psoriasis exacerbations.²⁹ Psychological stress is believed to affect psoriasis via immune system modulation and increased T-cell activation.²⁹

Another important finding in our study is that walking and vigorous physical activity did not confer similar reductions in psoriasis risk; only vigorous activity decreased the risk of incident psoriasis. This finding may be explained by the greater effects of moderate to vigorous activity on systemic inflammation. In an interventional trial, a 12-week low- to moderate-intensity aerobic exercise program did not change serum tumor necrosis factor, IL-6, and CRP levels in obese female participants.³⁰ However, vigorous-intensity aerobic exercise can reduce serum levels of chronic inflammatory markers. Obese young women significantly decreased serum IL-6, tumor necrosis factor, leptin, and CRP levels and increased adiponectin levels after 7 months of training at an intensity level of 6 to 7 METs for a total of an estimated 22 MET-hours per week.²² The significant effect of vigorous exercise on inflammatory markers may explain the preferential effect of vigorous activity compared with walking on psoriasis risk.

Our study included a prospective design, a large cohort size, detailed physical activity assessments, comprehensive assessment of covariates, and access to a subset of confirmed psoriasis cases. The exclusion of women with physician-diagnosed psoriasis at baseline and the use of physical activity data reported before the diagnosis of psoriasis eliminate the effect that psoriasis may have had on activity levels. In addition, by using physical activity reports before the onset of psoriasis, we decreased the effect of recall bias on activity measurements. We were able to control for as many risk factors (age, BMI, smoking status, and alcohol intake) as met the definition for possible confounders in our analysis. In addition, by controlling for BMI, we eliminated a biological intermediate that may be one route through which physical activity decreases the risk of psoriasis. As a result, our multivariate analyses that controlled for BMI may represent a conservative estimate of the true association between physical activity and psoriasis.

Our study has several limitations. We relied on self-reported psoriasis diagnoses rather than a dermatologist's physical examination. However, in our preliminary analyses using the PST to validate self-reported diagnoses, we found self-reports to be more than 90% accurate. Furthermore, we found a stronger association between overall and vigorous physical activity and the risk of incident psoriasis in a subset of confirmed psoriasis cases than we did in all self-reported cases, indicating a true association. Our analysis also relied on the participants' self-reported date of psoriasis diagnosis to perform a prospective analysis. Inaccurate recall of onset date could result in misclassification. Subclinical disease activity before psoriasis diagnosis is not a likely driver of our association, given that our analysis of cumulative

average physical activity did not change the statistical significance of our results. Furthermore, we excluded individuals with disease at baseline and used physical activity measures preceding diagnosis to further decrease the potential impact of subclinical disease. Psoriatic arthritis is also unlikely to have affected our findings, given that a diagnosis of cutaneous psoriasis precedes the onset of arthritis in most adults. In the future, we plan to verify the accuracy of reported onset dates by checking the correlation with dates in physician notes. Our analysis controlled for as many known risk factors as met the definition for possible confounders; however, we cannot rule out the possibility that unmeasured factors, including socioeconomic status, health care access, or stress, may contribute to the observed association. However, because we conducted this study in an occupational cohort of women with similar education and training, it is reasonable to assume that our results were less affected by residual confounding.

Our analysis did not adjust for time spent outside while physically active. Given that UV exposure is an effective psoriasis treatment,³¹ it is possible that UV exposure during physical activity contributed to the reduced risk of psoriasis. If this were the case, we would have expected to observe an equal benefit from outdoor walking, which we did not. Women who participated in more than 10 MET-hours per week of outdoor walking, the equivalent of at least 4 hours spent outside if walking at an average pace, did not have a reduced risk of developing psoriasis. In contrast, women who ran for only 1 or more hours per week had a significantly reduced risk of developing psoriasis. Given these findings, UV exposure while outdoors is unlikely to drive the observed effect.

In conclusion, we found that vigorous physical activity was independently associated with a reduced risk of incident psoriasis. The observed dose-response gradient with increased physical activity supports a causal association between physical activity and a reduced risk of psoriasis. In addition to providing other health benefits, participation in vigorous exercise may represent a new preventive measure for women at high risk of developing psoriasis. Additional corroborative studies and further investigations into the mechanisms by which physical activity protects against new-onset psoriasis are needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics According to Physical Activity Status at 1991 Baseline Analysis

Characteristic	Physical Activity, MET-hours/wk ^a				
	0.2-3.8 (n = 16 961)	3.9-9.0 (n = 17 617)	9.1-16.9 (n = 17 448)	17.0-31.8 (n = 17 460)	31.9 (n = 17 169)
Age, mean (SD), y ^b	36.8 (4.6)	36.4 (4.6)	36.3 (4.6)	36.0 (4.7)	35.6 (4.7)
BMI, mean (SD)	25.8 (6.3)	25.1 (5.6)	24.4 (5.0)	24.0 (4.6)	23.4 (4.3)
Smoking, No. (%) ^c					
Never	11 279 (66.6)	11 827 (67.2)	11 651 (66.9)	11 526 (66.1)	10 979 (64.0)
Current	2272 (13.4)	2126 (12.1)	1904 (10.9)	1755 (10.1)	1857 (10.8)
Past	3390 (20.0)	3646 (20.7)	3868 (22.2)	4161 (23.9)	4310 (25.1)
Alcohol intake, mean (SD), g/d	2.6 (6.0)	2.8 (5.9)	3.1 (5.9)	3.4 (6.1)	3.8 (6.3)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); MET, metabolic equivalent task.

^a Calculated by multiplying the MET score by the participant's reported activity in hours per week.^b Indicates age in 1991.^c Because of missing data, numbers might not equal the total number of patients in each category. Percentages have been rounded and might not total 100.

Table 2
Age-Adjusted and Multivariate RRs for Incident Psoriasis by Amount of Total Physical Activity, Vigorous Activity, and Walking Among Women^a

MET-hours/wk ^b	No. of Incident Cases of Psoriasis	Age Adjusted		Multivariate ^c		Multivariate ^{c,d}	
		RR (95% CI)	P Value for Trend	RR (95% CI)	P Value for Trend	RR (95% CI)	P Value for Trend
Total physical activity							
0.2–3.8	222	1 [Reference]		1 [Reference]		1 [Reference]	
3.9–9.0	236	1.06 (0.89–1.28)		1.09 (0.90–1.31)		1.14 (0.95–1.37)	
9.1–16.9	214	0.96 (0.79–1.16)	<.001	0.98 (0.81–1.19)	<.001	1.07 (0.89–1.30)	.09
17.0–31.8	198	0.89 (0.73–1.07)		0.91 (0.75–1.10)		1.02 (0.84–1.24)	
31.9	156	0.71 (0.58–0.87)		0.72 (0.59–0.89)		0.85 (0.69–1.04)	
Vigorous activity							
None	299	1 [Reference]		1 [Reference]		1 [Reference]	
0.1–4.5	151	0.88 (0.72–1.07)		0.88 (0.72–1.08)		0.91 (0.74–1.11)	
4.6–9.7	217	0.89 (0.75–1.07)	<.001	0.89 (0.75–1.07)	<.001	0.93 (0.77–1.11)	.009
9.8–20.8	205	0.85 (0.71–1.02)		0.86 (0.71–1.03)		0.91 (0.76–1.09)	
20.9	154	0.66 (0.54–0.80)		0.66 (0.54–0.81)		0.73 (0.60–0.90)	
Walking							
0.0–0.6	100	1 [Reference]		1 [Reference]		1 [Reference]	
0.7–2.5	52	0.79 (0.56–1.11)		0.82 (0.58–1.15)		0.82 (0.59–1.16)	
2.7–3.8	58	0.83 (0.60–1.15)	.45	0.87 (0.63–1.21)	.68	0.92 (0.66–1.28)	.69
4.0–8.5	41	0.93 (0.64–1.33)		0.98 (0.67–1.41)		1.06 (0.73–1.54)	
10.0	48	0.85 (0.60–1.20)		0.89 (0.63–1.26)		1.02 (0.71–1.46)	

Abbreviations: MET, metabolic equivalent task; RR, relative risk.

^aVigorous activity is defined as at least 6 METs per hour. Walking analysis excludes women who performed vigorous activities.

^bCalculated by multiplying the MET score by the participant's reported activity in hours per week.

^cAdjusted for age, smoking (never, past, or current, including 1–14, 15–34, and 35 cigarettes per day), and alcohol intake in quintiles of drinks per week (none, 0.1–0.3, 0.4–0.7, 0.8–1.1, 1.2–2.3, and 2.4).

^dAdjusted for body mass index (calculated as weight in kilograms divided by height in meters squared) (<21.0, 21.0–22.9, 23.0–24.9, 25.0–27.4, 27.5–29.9, 30.0–34.9, and 35.0).

Table 3
Age-Adjusted and Multivariate RRs for Confirmed Incident Psoriasis by Amount and Type of Physical Activity^a

Variable	No. of Incident Cases of Psoriasis	Age Adjusted			Multivariate ^b			Multivariate ^{b,c}		
		RR (95% CI)	P Value for Trend	RR (95% CI)	P Value for Trend	RR (95% CI)	P Value for Trend	RR (95% CI)	P Value for Trend	
Physical activity, MET-hours/wk ^d										
0.2–3.8	118	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]		
3.9–9.0	125	1.06 (0.82–1.36)		1.07 (0.83–1.38)		1.14 (0.88–1.46)		1.14 (0.88–1.46)		
9.1–16.9	131	1.10 (0.86–1.42)	<.001	1.12 (0.87–1.44)	.001	1.25 (0.97–1.61)		1.25 (0.97–1.61)		.08
17.0–31.8	104	0.87 (0.67–1.14)		0.89 (0.68–1.16)		1.02 (0.78–1.33)		1.02 (0.78–1.33)		
31.9	72	0.62 (0.46–0.83)		0.62 (0.46–0.84)		0.75 (0.56–1.02)		0.75 (0.56–1.02)		
Vigorous activity, MET-hours/wk ^{d,e}										
None	167	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]		
0.1–4.5	72	0.72 (0.54–0.95)		0.73 (0.55–0.96)		0.75 (0.57–1.00)		0.75 (0.57–1.00)		
4.6–9.7	122	0.89 (0.70–1.13)	<.001	0.88 (0.69–1.11)	.002	0.91 (0.72–1.16)		0.91 (0.72–1.16)		.03
9.8–20.8	115	0.84 (0.66–1.07)		0.84 (0.66–1.08)		0.91 (0.71–1.16)		0.91 (0.71–1.16)		
20.9	74	0.56 (0.42–0.73)		0.57 (0.43–0.76)		0.64 (0.48–0.86)		0.64 (0.48–0.86)		

Abbreviations: MET, metabolic equivalent task; RR, relative risk.

^a Incident psoriasis was confirmed using the Psoriasis Screening Tool.

^b Adjusted for age, smoking (never, past, or current, including 1–14, 15–34, or 35 cigarettes per day), and alcohol intake in quintiles of drinks per week (none, 0.1–0.3, 0.4–0.7, 0.8–1.1, 1.2–2.3, and 2.4).

^c Adjusted for body mass index (calculated as weight in kilograms divided by height in meters squared) (<21.0, 21.0–22.9, 23.0–24.9, 25.0–27.4, 27.5–29.9, 30.0–34.9, and 35.0).

^d Calculated by multiplying the MET score by the participant’s reported activity in hours per week.

^e Defined as at least 6 METs per hour.