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Psoriasis as an Independent Risk Factor for Cardiovascular Disease: An Epidemiologic Analysis Using a National Database

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Abstract

Background: Psoriasis is known to be associated with metabolic syndrome, a well-established risk factor for ischemic heart disease and stroke. Emerging evidence indicates that psoriasis is an independent risk factor for cardiovascular disease and stroke.

Objective: To evaluate whether psoriasis is independently associated with myocardial infarction (MI), ischemic heart disease (MI, angina pectoris, or coronary heart disease), and stroke, we conducted a cross-sectional study using the US National Health and Nutrition Examination Survey (NHANES) database.

Methods: Data on clinical history of psoriasis, MI, angina pectoris, coronary heart disease, and stroke from the questionnaire as well as laboratory parameters on serum lipid and uric acid levels in the cycle years 2003-2006 and 2009-2012 were analyzed. Multivariate analysis with logistic regression modelling was performed with the aforementioned cardiovascular events or stroke as the dependent variables and with risk factors such as age, gender, ethnic group, current smoking status, alcohol consumption, metabolic syndrome, hyperuricemia, and psoriasis as independent variables.

Results: There were 520 cases of psoriasis, and 108 of them had metabolic syndrome (20.8%). Well-established cardiovascular risk factors such as age, gender, ethnic group, smoking, alcohol consumption, metabolic syndrome, and hyperuricemia were also found to have significant associations with MI and ischemic heart disease (all *P* values <.001). Psoriatic patients were at significantly higher risks of developing MI (odds ratio [OR] 2.24; 95% CI: 1.27-3.95; *P* = .005) and ischemic heart disease (OR 1.90; 95% CI: 1.18-3.05; *P* = .008), but not stroke (OR 1.01; 95% CI: 0.48-2.16; *P* = .744), after adjustment was made for major cardiovascular risk factors.

Conclusion: This study provides epidemiological evidence that psoriasis may be independently associated with the development of MI and ischemic heart disease. Physicians should be cognizant of any underlying cardiovascular risk factors, especially among psoriatic patients with metabolic syndrome, and manage them according to national guidelines.

Résumé

Contexte : On sait que le psoriasis est associé au syndrome métabolique, un facteur de risque reconnu de cardiopathie ischémique et d'accident vasculaire cérébral. De nouvelles données montrent que le psoriasis est un facteur de risque indépendant de maladie cardiovasculaire et d'accident vasculaire cérébral.

Objectif : Au moyen d'une étude transversale de la base de données de l'enquête nationale américaine sur la santé et la nutrition (National Health and Nutrition Examination Survey – NHANES), nous cherchons à évaluer si le psoriasis est associé de façon indépendante à l'infarctus du myocarde (IM), à la cardiopathie ischémique (IM, angine de poitrine ou coronaropathie) ou à l'accident vasculaire cérébral (AVC).

Méthodes : Des données, tirées du questionnaire, sur les antécédents cliniques de psoriasis, d'IM, d'angine de poitrine, de coronaropathie et d'AVC, ainsi que les paramètres de laboratoires pour les lipides sériques et les taux d'acide urique ont été analysés pour les cycles 2003-2006 et 2009-2012. Une analyse multivariée à modèle de régression logistique a été effectuée pour les événements cardiovasculaires susmentionnés et l'AVC comme variables dépendantes, en tenant compte des facteurs de risque tels que l'âge, le sexe, le groupe ethnique, les habitudes de tabagisme actuelles, la consommation d'alcool, le syndrome métabolique, l'hyperuricémie et le psoriasis comme variables indépendantes.

Résultats : Notre étude regroupait 520 patients atteints de psoriasis, dont 108 présentaient un syndrome métabolique (20,8 %). On a aussi constaté une association significative des facteurs de risques bien établis, tels que l'âge, le sexe, le groupe ethnique, le tabagisme, la consommation d'alcool, le syndrome métabolique et l'hyperuricémie, à l'IM et aux cardiopathies ischémiques (toutes les valeurs de *P* < 0,001). Les patients atteints de psoriasis étaient plus susceptibles de développer un IM (rapport des cotes [RC], 2,24; IC à 95 %, 1,27-3,95; *P* = 0,005) ou une cardiopathie ischémique (RC, 1,90; IC à 95 %, 1,18-3,05;

P = 0,008) mais pas un AVC (RC, 1,01; IC à 95 %, 0,48-2,16; *P* = 0,744), après ajustement en fonction des principaux facteurs de risque cardiovasculaires.

Conclusion : Cette étude fournit des données épidémiologiques probantes révélant que le psoriasis peut être associé de façon indépendante au développement de l'IM et de la cardiopathie ischémique. Les médecins devraient être conscients de tout facteur de risque cardiovasculaire sous-jacent, particulièrement chez les patients atteints de psoriasis et présentant un syndrome métabolique, pour le gérer en fonction des lignes directrices nationales.

Keywords
psoriasis, dermatology, inflammatory dermatoses

Psoriasis is an immune-mediated, chronic inflammatory skin disorder that affects approximately 2% to 3% of the population in the United States.[1] Psoriasis, perhaps as a result of enhanced systemic inflammation and resulting atherosclerosis, has been associated with cardiovascular disease. Patients with psoriasis are also more likely to develop hypertension, hyperlipidemia, obesity, diabetes mellitus, and metabolic syndrome, which are all well-established risk factors for cardiovascular morbidities such as ischemic heart disease and stroke. It is not known, however, whether psoriasis serves as an independent risk factor for cardiovascular disease and stroke or whether psoriasis mediates its effects through metabolic syndrome and related disorders. Various studies have evaluated the relationship between psoriasis and cardiovascular disease or stroke; however, the results are conflicting. There is growing evidence that psoriasis increases the risk of cardiovascular events, even after adjustment for major cardiovascular risk factors.[2-4] In contrast, some studies failed to corroborate the finding that psoriasis is independently associated with cardiovascular disease.[5,6] We therefore aim to evaluate whether psoriasis is independently associated with an increased risk of myocardial infarction (MI), ischemic heart disease (MI, angina pectoris, or coronary heart disease), and stroke, after taking into account major cardiovascular risk factors, in a cross-sectional study using the US National Health and Nutrition Examination Survey (NHANES) database.

Methods

Study Population

NHANES is a periodic annual population survey of the civilian US population. It uses a stratified multistage probability sampling design. In our analysis of interest, randomly selected individuals aged 20 to 59 years were interviewed in their homes about the below-mentioned variables of interest. We analyzed data on clinical history of cardiovascular disease, stroke, and psoriasis from the questionnaire as well as laboratory parameters on serum lipid and uric acid levels in the cycle years 2003-2006 and 2009-2012.

Dependent Variables

Diagnoses of cardiovascular disease or stroke were identified from the questionnaire by positive responses to whether a doctor or other health professional ever told the participant that he or she had MI, angina pectoris, coronary heart disease, or stroke.

The primary outcome of interest was a prior diagnosis of MI. Stroke was included and analyzed independently as another primary outcome for comparison. The secondary outcome of interest was ischemic heart disease, defined as a composite cardiovascular endpoint that included MI, angina pectoris, or coronary heart disease.

Independent Variables

Diagnosis of psoriasis was identified from self-reported responses to whether participants were ever told by a doctor or other health care professional that they had psoriasis in the cycle years 2003-2006 and 2009-2012. Severity of psoriasis was identified from the 2003-2006 dermatology section and the 2011-2012 medical conditions section of the questionnaire data. Information on the severity of psoriasis was not available in the cycle year 2009-2010. Degree of psoriasis was assessed using the question "Do you currently have (1) little or no psoriasis, (2) only a few patches (that could be covered by one or two palms of your hand), (3) scattered patches (that could be covered between three and ten palms of your hand), or (4) extensive psoriasis (covering large areas of the body that would be more than ten palms of your hand)?"

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Metabolic syndrome was defined based on the criteria and thresholds published in the 2009 Joint Scientific Statement.[7] Participants who met 3 or more of the following criteria were identified as having metabolic syndrome: increased waist circumference, diabetes mellitus, hypertension, hypertriglyceridemia, and low high-density lipoprotein cholesterol (HDL-C).[7] We adapted the criteria on diabetes mellitus and hypertension to be self-reported responses to whether participants were ever told that they had diabetes mellitus and whether they had a history of high blood pressure readings on 2 separate occasions. Categorical cut points were ≥170 mmol/L or ≥150 mg/dL for high triglyceride level and <1.04 mmol/L or <40 mg/dL in males or <1.30 mmol/L or <50 mg/dL in females for low HDL-C level. Increased waist circumference was based on the recommended waist circumference thresholds for the US population: ≥102 cm in males and ≥88 cm in females.[8] In addition, known cut-offs for males and females were used to identify patients with a hyperuricemic state. The levels used were ≥458 μmol/L or ≥7.7 mg/dL in males and ≥393 μmol/L or ≥6.6 mg/dL in females.[9]

Demographic variables such as age, gender, and ethnic group as well as lifestyle factors such as smoking and alcohol consumption were included for analysis as possible confounding factors. Ethnic groups were categorized into Mexican American, other Hispanic, non-Hispanic white, non-Hispanic black, and other race. Current smoking status was assessed using the questionnaire question "Do you now smoke cigarettes?" Alcohol consumption was assessed by self-reported information from the questionnaire, and this was further dichotomized into 5 or more drinks daily and fewer than 5 drinks daily.

Data Analysis

Analysis of the relationship between cardiovascular disease and psoriasis was done using chi-square or Fisher exact tests. Multivariate analysis with logistic regression modelling was performed with cardiovascular disease or stroke as the dependent variable and with age, gender, ethnic group, current smoking status, alcohol consumption, metabolic syndrome, hyperuricemia, and psoriasis as the independent variables. The regression models were built using backward variable selection method with a threshold of $\alpha > .15$ to remove any nonsignificant variables. Psoriasis is included in all our models as it is the variable of interest. The Hosmer-Lemeshow goodness-of-fit test was used to evaluate whether the models adequately fit the data. The statistical package for social sciences (IBM SPSS version 22) was used to evaluate statistical significance. Odds ratio (OR), 95% confidence interval (CI), and *P* values were calculated to test the null hypotheses of no association between a history of psoriasis and MI, ischemic heart disease, or stroke. A 2-sided *P* value of <.05 was considered statistically significant. Multicollinearity between the independent variables was assessed using the variation inflation factor.

Clinical information and laboratory data of the NHANES were available from the publicly accessible database of the US Centers for Disease Control and Prevention. NHANES was approved by the US National Center for Health Statistics Ethics Review Board and documented consent was obtained from study participants.

Results

The analysis included 50 912 subjects who self-reported whether they had a history of psoriasis and cardiovascular disease for the cycle years 2003-2006 and 2009-2012. The mean age of our study population was 49.7 years.

There were 520 cases of psoriasis, and 108 (20.8%) of them had metabolic syndrome. Age, ethnic group, current smoking status, and metabolic syndrome were significantly associated with psoriasis. Table 1 shows the distribution of demographic characteristics and cardiovascular risk factors among those with and without psoriasis. Among patients with psoriasis, 32 (6.3%) had MI, 55 (10.6%) had ischemic heart disease, and 16 (3.2%) had stroke. Psoriatic patients were at significantly higher risks of developing MI and ischemic heart disease, but not stroke, compared with controls. Well-established cardiovascular risk factors such as age, gender, ethnic group, smoking, alcohol consumption, metabolic syndrome, and hyperuricemia were also found to have significant associations with MI and ischemic heart disease in our analysis (all *P* values <.001). Table 2 summarizes the relationship between psoriasis and other risk factors for cardiovascular disease.

In the multivariate logistic regression models, psoriatic patients remained at significantly higher risks for MI and ischemic heart disease (OR 2.24; 95% CI: 1.27-3.95; $P = .005$; and OR 1.90; 95% CI: 1.18-3.05; $P = .008$, respectively). The Hosmer-Lemeshow goodness-of-fit test demonstrated a statistically significant degree of inadequate fit in the models for MI and ischemic heart disease ($P = .022$ and $P = .003$, respectively). This significant association, however, was not observed between psoriasis and stroke in the final model (OR 1.01; 95% CI: 0.48-2.16; $P = .744$). The Hosmer-Lemeshow goodness-of-fit test indicated a well-calibrated model for stroke ($P = .077$). The final logistic regression models, which applied the backward selection method to eliminate nonsignificant covariates of MI, ischemic heart disease and stroke, are summarized in Table 3. Severity of psoriasis was not found to be significantly associated with the occurrence of MI, ischemic heart disease, and stroke ($P = .811$, $P = .733$, and $P = .669$, respectively). Similar results were found in the multivariate regression analysis with the aforementioned confounding factors. There was no evidence of multicollinearity between the independent variables in the models.

Table 1. Distribution of Characteristics for Patients With and Without Psoriasis.

Characteristics	With Psoriasis	Without Psoriasis	*P* Value
Mean age, y	43.2	47.2	<.001
Gender, n			.653
Male	257	9232	
Female	263	9833	
Ethnic group, n			<.001
Mexican American	46	3290	
Other Hispanic	42	1550	
Non-Hispanic white	319	8112	
Non-Hispanic black	70	4382	
Other race	43	1731	
Current smoker, n			.035
Yes	128	4079	
No	154	3801	
Alcohol consumption (≥5 drinks daily), n			.061
Yes	81	2264	
No	314	11 127	
Metabolic syndrome, n			<.001
Yes	108	2552	
No	155	6463	
Hyperuricemia, n			.188
Yes	77	2449	
No	443	16 616	

Discussion

In our study, patients with psoriasis had a significantly higher prevalence of major cardiovascular risk factors such as smoking and metabolic syndrome compared with those patients without psoriasis. This corroborates with the findings of other studies that also reported an increased prevalence of cardiovascular risk factors in psoriatic patients.[10-12] We have investigated psoriasis as an independent risk factor of cardiovascular disease and stroke, after adjusting for confounding variables such as metabolic syndrome, hyperuricemia, smoking, and excess alcohol consumption. In addition, associations of these well-established cardiovascular risk factors with cardiovascular disease and stroke were examined.

Psoriasis was associated with significantly increased risks of MI and ischemic heart disease, but not stroke, after adjustment was made for major risk factors and potential confounding variables in this study. This is consistent with the results of a meta-analysis, which included 503 686 cases and 29 686 694 controls, reporting a positive association of psoriasis with ischemic heart disease including MI, angina pectoris, or ischemic heart disease (OR 1.5; 95% CI: 1.2-1.9).[13] However, this relationship was not observed in stroke/transient ischemic attack (OR 1.1; 95% CI: 0.9-1.3) and cardiovascular mortality (OR 0.9; 95% CI: 0.4-2.2).[13] A recent retrospective cohort study similarly reported that compared with matched controls, psoriatic patients experienced a significantly higher risk of MI, with a hazard ratio of 1.31 (95% CI: 1.14-1.51) in mild psoriasis and a hazard ratio of 1.28 (95% CI: 1.02-1.30) in severe psoriasis.[14]

Severity of psoriasis was not significantly associated with MI, ischemic heart disease, or stroke in our study. Similarly, a recent large cohort study consisting of 48 523 psoriatic patients and 208 187 controls with a median follow-up of 5.2 years also failed to find any significant association between severity of psoriasis and the 3- to 5-year risk of any major cardiovascular events (defined as MI, acute coronary syndrome, unstable angina, and stroke) after taking into account the established risk factors.[15] This contrasts with findings of a population-based cohort study consisting of 127 139 patients with mild psoriasis, 3837 patients with severe psoriasis, and 556 995 controls, which showed that the relative risk of MI increased with increasing severity.[10] This increase in risk was observed across all age groups, but the effect was attenuated with increasing age.[10]

Metabolic syndrome was significantly associated with both psoriasis and cardiovascular comorbidities including MI, ischemic heart disease, and stroke in the present study. Although the risks were attenuated after adjustment was made for confounding variables, metabolic syndrome was still associated with more than 2 times the risk of developing these cardiovascular comorbidities. Metabolic syndrome, being closely related to both psoriasis and cardiovascular disease, has been postulated to be an intermediate factor along the pathway from psoriasis to cardiovascular disease.

Table 2. Distribution of Risk Factors for Cardiovascular Diseases (Crude Odds Ratios).

	Myocardial Infarction		Ischemic Heart Disease		Stroke	
Characteristics	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Psoriasis						
Yes	2.23 (1.55-3.23)	<.001	2.23 (1.67-2.97)	<.001	1.08 (0.65-1.80)	.755
No	1.00		1.00		1.00	
Age	1.07 (1.07-1.08)	<.001	1.07 (1.07-1.08)	<.001	1.07 (1.06-1.07)	<.001
Gender						
Male	2.03 (1.70-2.43)	<.001	1.70 (1.49-1.94)	<.001	0.94 (0.79-1.12)	.477
Female	1.00		1.00		1.00	
Ethnic group		<.001		<.001		<.001
Mexican American	0.45 (0.34-0.60)		0.49 (0.40-0.61)		0.58 (0.43-0.77)	
Other Hispanic	0.66 (0.47-0.93)		0.72 (0.56-.93)		0.65 (0.44-0.95)	
Non-Hispanic white	1.00		1.00		1.00	
Non-Hispanic black	0.63 (0.50-0.78)		0.69 (0.58-0.82)		1.22 (1.00-1.49)	
Other race	0.47 (0.32-0.68)		0.52 (0.39-0.68)		0.78 (0.56-1.10)	
Current smoker						
Yes	0.70 (0.57-0.87)	<.001	0.62 (0.52-0.73)	<.001	0.81 (0.65-1.02)	.070
No	1.00		1.00		1.00	
Alcohol consumption (≥5 drinks daily)		<.001		<.001		<.001
Yes	2.15 (1.74-2.65)		1.94 (1.64-2.29)		2.02 (1.61-2.53)	
No	1.00		1.00		1.00	
Metabolic syndrome						
Yes	4.09 (3.26-5.12)	<.001	4.22 (3.55-5.02)	<.001	4.05 (3.19-5.14)	<.001
No	1.00		1.00		1.00	
Hyperuricemia						
Yes	2.33 (1.92-2.84)	<.001	2.38 (2.05-2.77)	<.001	2.34 (1.92-2.85)	<.001
No	1.00		1.00		1.00	

Boehncke et al[16] proposed that systemic inflammation leads to insulin resistance and thus the development of metabolic syndrome, which, in turn, promotes endothelial cell dysfunction and atherosclerosis, eventually resulting in cardiovascular comorbidities. In contrast, some have proposed that the chronic inflammatory process inherent in psoriasis may also be independently associated with cardiovascular disease. As a T helper 1 (Th1) disease, psoriasis promotes the activation of inflammatory cells and overproduction of proinflammatory cytokines, such as tumor necrosis factor (TNF)-α, interferon-γ, interleukin (IL)-2, and IL-17, resulting in cytokine-induced endothelial damage.[17] Elevated serum levels of IL-17 have been associated with acute coronary syndrome,[18] while TNF-α was demonstrated to exert a detrimental effect on cardiomyocytes.[19] Another common pathway between psoriasis and cardiovascular disease involves oxidative stress. Increased levels of reactive oxygen species and free radicals found in psoriatic patients contribute to atherogenic processes by promoting the production of oxidized low-density lipoprotein cholesterol.[20,21] Exacerbation of psoriasis has been shown to be associated with enhanced oxidative stress and atherogenic risk.[13] Although other risk factors prevalent in psoriatic patients favor the development of atherosclerosis, there appears to be a more explicit association between psoriasis and cardiovascular disease. Several studies have suggested a direct causal relationship between psoriasis and cardiovascular disease. One study showed increased arterial stiffness, which was associated with the duration of disease, in psoriatic patients, compared with healthy controls.[22] This increase in arterial stiffness was independent of other cardiometabolic risk factors.[22] Similarly, another study demonstrated increased coronary artery calcification in patients with psoriasis compared with healthy controls.[23]

Hyperuricemia was associated with significantly increased risks of MI, ischemic heart disease, and stroke; this relationship remained significant for MI and ischemic heart disease in the multivariate logistic regression model. Age was also significantly associated with MI, ischemic heart disease, and stroke; for every 1-year increase in age, risk was increased by about 6% to 7%. Elevated serum uric acid level has been shown to increase the risk of cardiovascular mortality.[24] Some studies have reported improvement in endothelial function after treatment with xanthine oxidase inhibitors in patients with diabetes, hypertension, or asymptomatic hyperuricemia.[25,26] Metabolic syndrome and other cardiovascular risk factors are also more prevalent in older males.[27]

Table 3. Multivariate Logistic Regression of Risk Factors for Cardiovascular Diseases (Adjusted Odds Ratios).

	Myocardial Infarction		Ischemic Heart Disease		Stroke	
Characteristics	Adjusted OR[a]	*P* Value	Adjusted OR[b]	*P* Value	Adjusted OR[c]	*P* Value
Psoriasis						
Yes	2.24 (1.27-3.95)	.005	1.90 (1.18-3.05)	.008	1.01(0.48-2.16)	.744
No	1.00		1.00		1.00	
Age	1.06 (1.05-1.07)	<.001	1.07 (1.06-1.08)	<.001	1.06(1.05-1.08)	<.001
Gender						
Male	1.53 (1.10-2.13)	.013	1.60 (1.25-2.04)	<.001	—	—
Female	1.00		1.00		—	
Ethnic group		.050		.009		.011
Mexican American	0.52 (0.29-0.94)		0.62 (0.42-0.94)		1.28 (0.79-2.09)	
Other Hispanic	0.50 (0.24-1.05)		0.57 (0.34-0.96)		0.72 (0.34-1.53)	
Non-Hispanic white	1.00		1.00		1.00	
Non-Hispanic black	0.67 (0.44-1.02)		0.63 (0.46-0.87)		1.81 (1.27-2.60)	
Other race	0.83 (0.42-1.65)		0.60 (0.35-1.03)		1.07 (0.54-2.13)	
Current smoker						
Yes	1.45 (1.02-2.06)	.040	1.48 (1.13-1.94)	.023	1.79 (1.27 -2.52)	<.001
No	1.00		1.00		1.00	
Alcohol consumption (≥5 drinks daily)		.060		—		—
Yes	1.38 (0.99-1.93)		—		—	
No	1.00		—		—	
Metabolic syndrome						
Yes	2.40 (1.74-3.32)	<.001	2.79 (2.18-3.57)	<.001	2.45 (1.78-3.37)	<.001
No	1.00		1.00		1.00	
Hyperuricemia						
Yes	1.44 (1.02-2.02)	.036	1.35 (1.06-1.81)	.040	—	—
No	1.00		1.00		—	

[a]Adjusted for age, gender, ethnic group, smoking status, alcohol consumption, metabolic syndrome, and hyperuricemia.
[b]Adjusted for age, gender, ethnic group, smoking status, metabolic syndrome, and hyperuricemia.
[c]Adjusted for age, ethnic group, smoking status, and metabolic syndrome.
—, Not applicable.

Therefore, early identification of underlying hyperuricemia, metabolic syndrome, and other cardiovascular risks factors is important in the management of psoriasis, especially among older male patients.

Both current smoking status and excess alcohol consumption had significant associations with MI, ischemic heart disease, and stroke in this study. Psoriatic patients have been found to be more likely to smoke and drink alcohol excessively, which are two important independent lifestyle factors associated with the development of cardiovascular disease.[28-30] It has been demonstrated that psoriatic patients who smoke cigarettes have higher percentage of circulating T helper 17 (Th17) cells in the peripheral blood, compared with nonsmokers.[31] Like psoriatic plaques, atherosclerotic plaques have increased activated Th1/Th17 cells as well as corresponding cytokine production.[32,33] Excessive alcohol intake, which is associated with alcoholic cardiomyopathy, atrial fibrillation, and hemorrhagic stroke, has been reported in up to 30% of psoriatic patients.[30,34]

One of the strengths of this study was the large population-based sample. Study participants were randomly selected from a general population with diverse ethnic groups. This allowed characterization of the risks of cardiovascular disease and stroke among different ethnic groups and better generalizability of our findings. This large population-based study provides some epidemiological evidence that psoriasis may be associated with cardiovascular disease, independent of metabolic syndrome. The cross-sectional design is the major limitation of this study, making it susceptible to reverse causation. The temporal relationship between psoriasis and cardiovascular disease cannot be established. In addition, the Hosmer-Lemeshow goodness-of-fit test indicated a significant degree of miscalibration in our models for MI and ischemic heart disease. It should be noted, however, that a significant Hosmer-Lemeshow test can result from a model with large sample size and does not necessarily suggest that a model is miscalibrated. Another important limitation is that since the diagnosis of psoriasis is self-reported, there is a potential for recall bias and differential misclassification, thus confounding the true measure of association. Moreover, diagnoses of psoriasis via self-reported questionnaire have not been validated. Severity of psoriasis was based on

patients' self-reported scores, instead of an objective, standardized scoring system such as Psoriasis Area Severity Index (PASI), thus precluding a more accurate assessment of clinical severity. Furthermore, inability to differentiate between haemorrhagic and thrombotic stroke using NHANES questionnaires may limit this study's ability to better characterize the association between psoriasis and stroke. Finally, since information on treatment for psoriasis was not available, it was not possible to investigate the effect of systemic or biologic therapies on modulating the risk of cardiovascular events.

In conclusion, this study provides epidemiological evidence that psoriasis may play a role in the development of MI and ischemic heart disease, after well-established cardiovascular risk factors are considered. This potentially can have important clinical implications, especially in psoriatic patients who have yet to develop or fulfill the criteria for metabolic syndrome. More prospective, population-based, long-term studies are needed to evaluate the effect of objectively assessed disease severity on cardiometabolic risk factors and determine whether psoriasis is an independent risk factor for cardiovascular disease. While treating psoriasis with systemic or biologic agents may modulate cardiovascular risk,[35] certain therapies can predispose psoriatic patients to major adverse cardiovascular events.[36,37] More randomized controlled trials are needed to evaluate the associations between psoriasis therapies and major adverse cardiovascular events. Until further evidence is available regarding the cardiovascular safety of these treatments, it is important for physicians to be cognizant of any underlying cardiovascular risk factors, especially among psoriatic patients with metabolic syndrome, and to manage these according to national guidelines.

Declaration of Conflicting Interests

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