Original Article

Prevalence of Metabolic Syndrome in Psoriasis and Levels of Interleukin-6 and Tumor Necrosis Factor-α in Psoriasis Patients with Metabolic Syndrome: Indian Tertiary Care Hospital Study

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Abstract

Background: Psoriasis is a chronic inflammatory multisystem disease, found to be associated with metabolic syndrome (MS) and increased levels of cytokines. To evaluate the prevalence of MS in psoriasis and to determine the levels of interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α) in psoriasis patients with MS. **Methods:** Observational study on 334 psoriasis patients and 230 controls. MS was diagnosed by the presence of three or more criteria of original, revised, and modified National Cholesterol Education Program's Adult Treatment Panel III (NCEP ATP III). **Results:** MS was significantly more common in psoriasis patients than in controls (multivariate odds ratio [95% confidence interval] of original NCEP ATP III = 5.73 [2.99–10.99], revised NCEP ATP III = 4.44 [2.43–8.10], and modified NCEP ATP III = 6.00 [3.43–10.52]). Higher prevalence of abdominal obesity (66.2% vs. 47%, $P < 0.001$), hypertriglyceridemia (40.4% vs. 29.6%, $P = 0.009$), systolic blood pressure (BP) ≥130 mmHg (25.1% vs. 7.4%, $P < 0.001$), diastolic BP ≥85 mmHg (30.2% vs. 12.2%, $P < 0.001$), and fasting plasma glucose ≥100 mg/dl (17.4% vs. 9.1%, $P = 0.005$) among psoriasis patients as compared to controls. Mean (standard deviation) values of IL-6 and TNF-α were 76.7 (73.9) pg/ml and 234.3 (273.9) in subgroup of psoriasis patients with MS ($n = 42$), significantly higher than the normal population ($P < 0.0001$). **Conclusion:** MS is more common in psoriasis. IL-6 and TNF-α is significantly higher in psoriasis patients with MS, signifying their role in pathogenesis of psoriasis and MS.

Keywords: *Comorbidities, cytokines, metabolic syndrome, psoriasis*

Introduction

Psoriasis is a chronic inflammatory genetically determined multisystem disease affecting about 0.44%–2.8% of the Indian population.[1] Interaction between T lymphocytes, mast cells, macrophages, and dendritic cells involving various cytokines including interleukins (ILs) such as IL-1, IL-2, IL-6, interferon-γ (INF-γ), and tumor necrosis factor-α (TNF-α) in psoriasis lead to the systemic manifestations of the disease.[2] Psoriasis has been found to be associated with obesity, metabolic syndrome (MS),[3,4] and cardiovascular (CVS) comorbidities.[5,6] Using the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria, study done by Gisondi *et al*. found that MS was significantly more common in psoriasis patients than in controls (30.1% vs. 20.6%, odds ratio [OR]: 1.65; 95% confidence interval [CI] - 1.16–2.35; $P = 0.005$.) after the age of 40 years.[3] National Health and Nutrition Examination Survey (NHANES) reported 39.9% prevalence of MS in psoriasis cases and 23.5% among controls.[4]

MS is associated with chronic low-grade inflammation involving cytokines IL-1, IL-2, IL-6, INF-γ, and TNF-α, led to increased risk of atherosclerotic CVS disease (CVD) and Type 2 diabetes mellitus (DM).[7,8]

Currently, there are few published studies done in the Indian population with regard to the prevalence of MS in psoriasis. Our study is a part of larger study in which we evaluate the efficacy and safety of insulin sensitizers in patients with psoriasis having MS, divided into topical[9] and systemic cohort (unpublished data). We did study not only the prevalence of MS in psoriasis as compared to controls but also evaluated the differences in the characteristics among psoriasis patients with or without MS. Secondary objective was to study the

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levels of IL-6 and TNF-α in psoriasis cases having MS. Therefore, we endeavored to evaluate the prevalence of MS in psoriasis patients attending tertiary care hospital using original,[10] revised,[8,11] and modified NCEP ATP III criteria.[12]

Methods

The study was conducted at our institute, from January 2010 to June 2011. The study was approved by Institute Ethics Committee, Postgraduate Institute of Medical Education and Research, Chandigarh, India. All subjects satisfying the inclusion-exclusion criteria were enrolled in the study after taking written informed consent.

Study design

For assessment of point prevalence of MS in patients with psoriasis, a case of psoriasis was defined as a clinical diagnosis of psoriasis regardless of age sex or severity of disease. Controls were defined as patients with dermatoses other than psoriasis having no known association with MS attending dermatological outpatient department. Primary end point was to study the prevalence of MS in a case–control study in psoriasis patients. Secondary objective was to study the levels of IL-6 and TNF-α in psoriasis cases having MS.

MS assessment was done by the presence of three or more criteria of the modified NCEP ATP III:[12] waist circumference >90 cm in men and >80 cm in women, hypertriglyceridemia ≥150 mg/dl, high-density lipoprotein (HDL) cholesterol <40 mg/dl in males and <50 mg/dl in females, blood pressure (BP) ≥130/85 mmHg, and fasting plasma glucose (FPG) ≥110 mg/dl. The assessment of MS by original and revised NCEP ATP III criteria was also done. Original NCEP ATP III criteria are similar to modified NCEP ATP III except abdominal obesity (waist circumference >102 cm in men and >88 cm in women).[10] While revised NCEP ATP III criteria are similar to original NCEP ATP III except for blood glucose level cutoff is defined as ≥100 mg/dl.[8,11]

Statistical analysis

Data were expressed as mean ± standard deviation (SD) (95% CIs), numbers (percentages), and median (interquartile range). Baseline characteristics between psoriasis and controls were compared using an independent t-test for numerical variables and Chi-square test for categorical variables.

The prevalence of MS was calculated according to the presence of psoriasis. Logistic regression was performed to evaluate the association between psoriasis and the presence of MS and the results were expressed as OR. First, logistic regression was done without adjustment and then with adjustment of the covariates that are known to affect the prevalence for MS. Age, sex, body mass index (BMI) are known to affect the prevalence of MS. Smoking status and alcohol intake were also entered as covariates because of their known association with insulin sensitivity, diabetes, and weight. Since, serum levels of glucose, triglycerides, HDL cholesterol, waist circumference and BP are all part of the definition of the MS and were therefore excluded from the multivariate model. The frequency of MS features between psoriasis and controls was compared using Pearson Chi-square test. The difference in prevalence of MS between psoriasis and controls among different age groups was done by Kolmogorov–Smirnov Z-test. Spearman's rho and Pearson correlation were used to study the correlation between MS and categorical variables and numerical variables, respectively.

Results

The baseline characteristics of psoriasis and control population were shown in Table 1. The mean age of participants in psoriasis patients was 39.1 years and in control was 35.4 years. Mean age, prevalence of DM, hypertension (HTN), history of alcohol intake and smoking, BMI, and total cholesterol were significantly higher in individuals with psoriasis compared to controls [Table 1]. Similarly, parameters of MS, namely, waist circumference, FPG, serum triglyceride levels, systolic BP (SBP), and diastolic BP (DBP) were significantly higher in psoriasis cases as compared to controls [Table 1].

The prevalence of MS according to original, revised, and modified NCEP ATP III criteria was 30.8%, 32.6%, and 40.9% among individual with psoriasis and 8.7%, 10.9%, and 12.2% among controls, respectively [Table 2]. The OR for psoriasis patients with MS as compared to controls was 4.81 (95% CI - 2.85–8.13), 4.05 (95% CI - 2.50–6.55), and 5.04 (95% CI - 3.19–7.96) on univariate analysis and 5.73 (95% CI - 2.99–10.99), 4.44 (95% CI - 2.43–8.10), and 6.00 (95% CI - 3.43–10.52) after adjustment for age, sex, BMI, smoking status, and alcohol intake for original, revised, and modified NCEP ATP III criteria, respectively.

The prevalence of individual components of the MS according to the presence of psoriasis is shown in Table 3. Waist circumference, hypertriglyceridemia, high SBP, high DBP, high FPG (revised and original NCEP ATPIII Criteria) were significantly more prevalent in psoriasis as compared to controls. Higher percentage of individuals with psoriasis meets the modified NCEP ATPIII criteria for MS and increased percentage of an individual with psoriasis has three or more than three components of MS [Figure 1]. Significantly higher prevalence of MS was seen in all age groups in psoriasis patients as compared to controls [Figure 2].

Psoriasis patients with MS had significantly higher mean age, age of onset, and total duration of disease as compared to psoriasis patients without MS [Table 4]. Remission, joint involvement, and history of HTN and DM were more prevalent in psoriasis patients with MS as compared

Table 1: Baseline characteristics of psoriasis patients and controls

Baseline characteristics	Psoriasis (*n*=334)	Controls (*n*=230)	*P* (two-sided)
Age (years), mean±SD	39.1±14.0	35.4±14.7	0.003
Male/females, *n* (%)	209/125 (63.7/46.3)	146/84 (63.5/46.5)	0.859
DM, *n* (%)	25 (7.6)	3 (1.3)	0.001
HTN, *n* (%)	61 (18.6)	12 (5.2)	<0.001
CAD, *n* (%)	1 (0.3)	2 (0.9)	0.571
Alcohol, *n* (%)	75 (22.9)	33 (14.3)	0.022
Smoking, *n* (%)	59 (18)	20 (8.7)	0.003
Vegetarian, *n* (%)	188 (57.3)	133 (57.8)	0.730
BMI (kg/m^2), mean±SD	24.8±5.1	23.1±4.4	<0.001
WC (cm), mean±SD	92.8±13.4	87.4±11.4	<0.001
Waist: hip ratio, mean±SD	0.94±0.07	0.92±0.06	<0.001
FPG (mg/dl), mean±SD	89.7±21.2	85.7±11.4	0.009
Total cholesterol (mg/dl), mean±SD	176.8±38.0	168.1±35.6	0.008
Triglycerides (mg/dl), mean±SD	151.2±78.0	133.3±52.5	0.003
HDL (mg/dl), mean±SD	45.7±9.3	45.8±10.7	0.921
LDL (mg/dl), mean±SD	111.9±30.6	106.6±30.1	0.056
SBP (mmHg), mean±SD	125.8±14.5	119.5±11.8	<0.001
DBP (mmHg), mean±SD	80.4±8.8	77.7±7.5	<0.001

DM: Diabetes mellitus; HTN: Hypertension; CAD: Coronary artery disease; BMI: Body mass index; FPG: Fasting plasma glucose; HDL: High-density lipoprotein; LDL: Low-density lipoprotein; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; SD: Standard deviation; WC: Waist circumference

Table 2: Prevalence of metabolic syndrome in psoriasis and controls

MS	Psoriasis, *n* (%)	Controls, *n* (%)	Unadjusted OR (95% CI)	*P*	Multivariate OR (95% CI)	*P*
Total	*n*=334	*n*=230				
Original NCEP ATPIII[10]	101 (30.8)	20 (8.7)	4.81 (2.85-8.13)	<0.001	5.73 (2.99-10.99)	<0.001
Revised NCEP ATPIII[8,11]	107 (32.6)	25 (10.9)	4.05 (2.50-6.55)	<0.001	4.44 (2.43-8.10)	<0.001
Modified NCEP ATPIII[12]	134 (40.9)	28 (12.2)	5.04 (3.19-7.96)	<0.001	6.00 (3.43-10.52)	<0.001
Male	*n*=209	*n*=145				
Original NCEP ATPIII[10]	49 (23.4)	7 (4.8)	7.10 (2.95-17.07)	<0.001	7.22 (2.62-19.88)	<0.001
Revised NCEP ATPIII[8,11]	54 (25.8)	11 (7.6)	4.70 (2.31-9.60)	<0.001	4.72 (1.97-11.34)	0.001
Modified NCEP ATPIII[12]	77 (36.8)	15 (10.3)	5.06 (2.76-9.25)	<0.001	5.80 (2.77-12.15)	<0.001
Female	*n*=125	*n*=85				
Original NCEP ATPIII[10]	52 (41.6)	13 (15.3)	3.95 (1.98-7.86)	<0.001	4.31 (1.84-10.13)	0.001
Revised NCEP ATPIII[8,11]	53 (42.4)	14 (16.5)	3.73 (1.90-7.33)	<0.001	3.93 (1.72-8.98)	<0.001
Modified NCEP ATPIII[12]	57 (45.6)	13 (15.3)	4.64 (2.33-9.23)	<0.001	5.26 (2.27-12.18)	<0.001

Multivariate OR refers to ORs obtained using a logistic regression model after adjustment for age, sex, BMI, smoking status, alcohol. Age divided into five groups - <30, 31-40, 41-50, 51-60, >60, BMI divided into <25, >25. BMI: Body mass index; ORs: Odds ratios; CI: Confidence interval; NCEP ATPIII: National Cholesterol Education Program's Adult Treatment Panel III; MS: Metabolic syndrome

Table 3: Prevalence of individual metabolic abnormalities of the metabolic syndrome (modified National Cholesterol Education Program's Adult Treatment Panel III criteria) in psoriasis and control groups

MS parameters	Psoriasis (*n*=334), *n* (%)	Controls (*n*=230), *n* (%)	Unadjusted OR (95% CI) (Mantel-Haenszel)	*P*	Multivariate OR (95% CI)	*P*
WC (males >90 cm, females >80 cm)	221 (66.2)	108 (47)	2.21 (1.57-3.11)	<0.001	2.33 (1.62-3.35)	<0.001
Hypertriglyceridemia (TG ≥150 mg/dl)	135 (40.4)	68 (29.6)	1.62 (1.13-2.31)	0.009	1.63 (1.13-2.35)	0.009
Low HDL (males <40, females <50 mg/dl)	148 (44.3)	92 (40.0)	1.17 (0.83-1.65)	0.361	1.2 (0.82-1.74)	0.350
High SBP (≥130 mmHg)	84 (25.1)	17 (7.4)	4.2 (2.42-7.31)	<0.001	4.52 (2.57-7.95)	<0.001
High DBP (≥85 mmHg)	101 (30.2)	28 (12.2)	3.13 (1.98-4.95)	<0.001	3.47 (2.16-5.57)	<0.001
High FPG, original (≥110 mg/dl)	31 (9.3)	4 (1.7)	5.78 (2.01-16.61)	0.001	5.69 (1.95-16.61)	0.001
High FPG, revised (≥100 mg/dl)	58 (17.4)	21 (9.1)	2.09 (1.23-3.56)	0.006	2.16 (1.26-3.72)	0.005

Multivariate OR refers to ORs obtained using a logistic regression model after adjustment for age, sex, BMI. Age divided into five groups - <30, 31-40, 41-50, 51-–60, >60, BMI divided into <25, >25. BMI: Body mass index; ORs: Odds ratios; CI: Confidence interval; MS: Metabolic syndrome; WC: Waist circumference

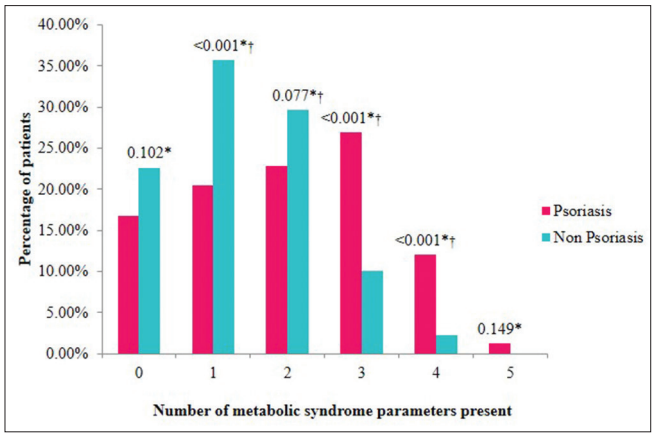

Figure 1: Frequency distribution of metabolic syndrome (modified National Cholesterol Education Program's Adult Treatment Panel III criteria) components in psoriasis and control population. *- *P* value, † - Statistically significant difference between two groups

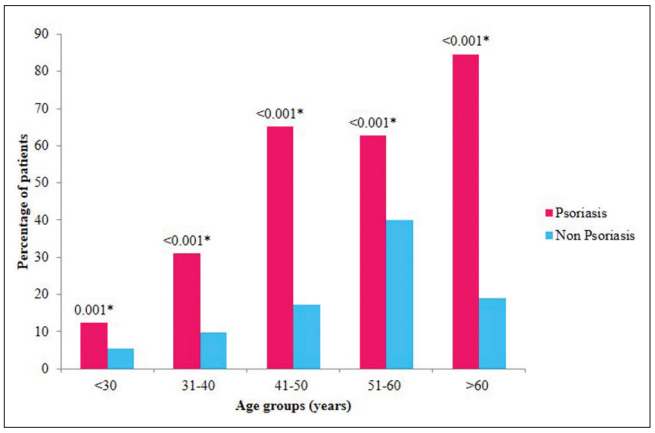

Figure 2: Percentage prevalence of metabolic syndrome (modified National Cholesterol Education Program's Adult Treatment Panel III criteria) in different age groups in psoriasis patients and controls. *- *P* value statistically significant between two groups

to the absence of MS. All parameters of MS (waist circumference, serum triglycerides, HDL cholesterol, SBP, DBP, and FPG), BMI, waist to hip ratio, total cholesterol, and low-density lipoprotein cholesterol had significantly higher mean values except HDL cholesterol (significantly lower) in psoriasis patients with MS as compared to psoriasis patients without MS. Mean (SD) values of IL-6 and TNF-α were 76.7 (±73.9) pg/ml and 234.3 (±273.9) in subgroup of psoriasis patients with MS (n = 42), significantly higher than the mean values present in normal population ([IL-6 = 1.79 ± 2.03 and TNF-α = 2.74 ± 0.94], $P < 0.0001$ for both IL-6 and TNF-α).

Discussion

A hospital-based case–control study showed that MS was significantly more common in psoriasis patients than in controls (30.1% vs. 20.6%, OR: 1.65; 95% CI - 1.16–2.35; $P = 0.005$) after the age of 40 years.[3] Psoriasis patients who had hyperleptinemia were found to be female ($P < 0.001$) and manifest obesity ($P = 0.002$) and MS ($P = 0.003$).[13] Recently, a study done by The NHANES had estimated 39.9% prevalence of MS among psoriasis cases as compared to 23.5% among controls.[4] Comparison of prevalence of MS in cases and controls in our study with regard to NHANES, hospital-based case–control study is shown in Table 5.

The prevalence of MS in those with psoriasis was nearly three times as compared to controls (12.2% prevalence), and excess prevalence remained substantial after adjustment for covariates such as age, sex, BMI, smoking status, and alcohol. Our results were found to be similar to the findings of a study done by Langan *et al*.,[14] Zindanci *et al*.,[15] Madanagobalane *et al*.,[16] Nisa and Qazi,[17] and Ali *et al*.[18] These findings may partially explain the increased risk of CVS morbidity and mortality among psoriasis patients. Large population-based cohort studies in the United Kingdom demonstrated increased risk of myocardial infarction, stroke and CVS mortality in patients with severe psoriasis.[4,19] Recently, three meta-analyses of CVD in psoriasis had supported these findings.[20-22] Females with psoriasis demonstrated a 63% increased risk of future diabetes compared to controls. Gelfand *et al*. found higher mortality risk for arterial and venous thrombosis along with myocardial infarction especially in young patients with severe psoriasis. Finally, patients with severe psoriasis were found to die about 3–4 years earlier than patients without psoriasis.[23] As these CVS outcomes are known complications of the MS, its increased prevalence in psoriasis may contribute to the CVS complications, as observed in psoriasis patients. MS is a strong predictor of CVDs, diabetes and stroke and significantly increases the risk of CVS mortality.[24] MS also increases the risk of all-cause and colon cancer mortality.[25]

We have found that the prevalence of MS is significantly higher in psoriasis patients as compared to controls among all age groups and prevalence increases with increasing age. A very consistent finding among different studies is that prevalence of MS is strictly age dependent, increasing sharply after the age of 60.[26] The prevalence of MS in psoriasis patients had a direct correlation with disease duration, the results similar to the case–control study done by Gisondi *et al*., which found that the prevalence of MS after the age of 40 was significantly higher in psoriasis patients compared with controls and it directly correlates to duration of psoriasis.[3] Significantly more number of controls individuals without MS was smokers as compared to MS with psoriasis. This may be because of the increased number of individuals who quit smoking on physician advice in psoriasis patients with MS.

In this study, we observed that abdominal obesity and disturbances in lipid profiles were the most important factors contributing to the increased prevalence of MS. These were followed by low HDL, BP, and FPG levels. NHANES

Table 4: Descriptive characteristics of psoriasis patients with and without metabolic syndrome (Modified NCEP ATPIII criteria)

Characteristics	Psoriasis patients with MS (*n*=134)	Psoriasis patients without MS (*n*=200)	Chi-Square value*/Mean difference (95%CI)†	*P*
Age (years), (Mean±SD)	47.6±12.5	33.4±11.9	14.2 (11.5-16.8)†	<0.001‡
Male/Females, *n* (%)	77/57 (57.5/42.5)	132/68 (66/34)	2.497*	0.114
Age of onset (years), (Mean±SD)	38.8±13.4	26.9±12.0	11.8 (8.9-14.5)†	<0.001‡
Total duration of disease (years), (Mean±SD)	8.9±9.4	6.5±6.9	2.4 (0.6-4.2)†	<0.001‡
Seasonal Exacerbation, *n* (%)	88 (65.7)	121 (60.5)	0.916*	0.338
Seasonal improvement, *n* (%)	86 (64.2)	114 (57)	1.721*	0.190
Remission, *n* (%)	102 (76.1)	128 (64)	5.496*	0.019‡
Nail involvement, *n* (%)	91 (67.9)	119 (59.5)	2.432*	0.119
Joint involvement, *n* (%)	31 (23.1)	19 (9.5)	11.718*	0.001‡
DM, *n* (%)	22 (16.4)	3 (1.5)	25.787*	<0.001‡
HTN, *n* (%)	51 (38.1)	10 (5)	58.747*	<0.001‡
Family H/O Psoriasis, *n* (%)	14 (10.4)	28 (14)	0.921*	0.337
Alcohol, *n* (%)	35 (26.1)	40 (20)	1.726*	0.190
Smoking, *n* (%)	15 (11.2)	44 (22)	6.442*	0.011‡
Vegetarian, *n* (%)	78 (58.2)	110 (55)	0.336*	0.562
BMI (kg/m^2), (Mean±SD)	27.5±4.2	23.0±4.8	4.5 (3.5-5.5)†	<0.001‡
Waist circumference (cm), (Mean±SD)	101.1±10.1	87.3±12.4	13.9 (11.3-16.4)†	<0.001‡
Waist: Hip	0.98±0.06	0.91±0.07	0.06 (0.05-0.08)†	<0.001‡
PASI, (Mean±SD)	15.2±6.9	16.5±8.5	1.3 (–1.4-3.9)†	0.535
ESI, (Mean±SD)	6.3±1.8	6.1±1.9	0.3 (–0.1-0.7)†	0.185
PGA, (Mean±SD)	4.0±1.3	3.8±1.4	0.3 (–0.0-0.6)†	0.080
FPG (mg/dl), (Mean±SD)	99.9±27.7	82.8±10.9	17.2 (12.9-21.4)†	<0.001‡
Total Cholesterol (mg/dl), (Mean±SD)	192.8±42.1	166.1±30.9	26.7 (18.9-34.6)†	<0.001‡
Triglycerides (mg/dl), (Mean±SD)	187.3±103.6	126.9±39.1	60.4 (44.5-76.2)†	<0.001‡
HDL (mg/dl), (Mean±SD)	43.9±10.0	47.2±9.1	–3.2 (–1.1-(–5.3))†	0.003‡
LDL (mg/dl), (Mean±SD)	118.9±35.5	106.9±26.2	11.9 (5.3-18.5)†	<0.001‡
SBP (mmHg), (Mean±SD)	134.3±14.7	120.1±11.2	14.2 (11.4-16.9)†	<0.001‡
DBP (mmHg), (Mean±SD)	85.8±8.6	76.7±6.9	9.1 (7.4-10.7)†	<0.001‡

*Chi-square test was used to compare categorical variables, †Student's *t*-test was used to compare numerical variables, ‡Statistically significant difference between two groups. SD: Standard deviation; DBP: Diastolic blood pressure; SBP: Systolic blood pressure; HDL: High-density lipoprotein; LDL: Low-density lipoprotein; DM: Diabetes mellitus; HTN: Hypertension; FPG: Fasting plasma glucose; ESI: Elastase-specific inhibitor; PASI: Psoriasis Area Severity Index; PGA: Psoriasis Global Assessment; MS: Metabolic syndrome; WC: Waist circumference; OR: Odds ratio; CI: Confidence interval

study[4] and hospital-based case–control study[3] also found that MS in psoriasis was primarily associated with obesity and high triglyceride levels. A recent meta-analysis reported an increased prevalence of traditional CVS risk factors, but not all studies found an association of psoriasis with diabetes.[27] As our study was a cross-sectional type of study, the directionality of association between psoriasis and MS could not be determined. We cannot conclude what happened first, psoriasis or MS.

We have found that psoriasis patients have a significantly higher BMI and waist circumference as compared to controls. Evidence suggests that insulin resistance plays prime role in the development of MS. Evidence from cohort studies points that obesity is associated with future development of psoriasis.[28] Obesity is a proinflammatory state, and adipose tissue is a rich source of inflammatory mediators known as adipocytokines. Furthermore, central obesity is associated with abnormal levels of IL-6 and TNF-α, and as these mediators have well known role in the pathogenesis of psoriasis, it can be concluded that central obesity is the central determinant in the development of psoriasis and MS as well as other inflammatory diseases such as atherosclerosis and asthma. Furthermore, the evidence is accumulating that similar to other chronic inflammatory diseases such as systemic lupus erythematosus and rheumatoid arthritis; psoriasis may, in fact, be a true systemic inflammatory process, intimately linked with atherosclerosis.[6,29,30] We had observed a significant increase in the levels of IL-6 and TNF-α in psoriasis patients with MS as compared to the normal population.

Similar to results for the frequency distribution of the MS components according to the presence of psoriasis in NHANES study,[4] significant more number of patients had three or more components of MS in our study.

The close association between psoriasis and MS could be explained by shared genetic risk loci, as indicated in recent

Table 5: Comparison of prevalence of metabolic syndrome in cases and control in the National Health and Nutrition Examination Survey, hospital-based case-control study by Gisondi *et al.*, UK-based study by Landan, study by Zindaci *et al.*, Madanagobalane *et al.* and our study

MS	Original NCEP ATPIII[10]		Revised NCEP ATPIII[8,11]		Multivariate OR* (95% CI)	*P*
	Psoriasis (%)	Controls (%)	Psoriasis (%)	Controls (%)	Revised NCEP ATPIII[8,11]	
Our study						
Total	30.8	8.7	32.6	10.9	4.44 (2.43-8.10)‡	<0.001‡
Male	23.4	4.8	25.8	7.6	4.72 (1.97-11.34)‡	<0.001‡
Female	41.6	15.3	42.4	16.5	3.93 (1.72-8.98)‡	<0.001‡
NHANES[4]						
Total	31.4	17.1	39.9	23.5	1.96 (1.02-3.77)‡	
Male	28.8	18.8	30.6	26.6	1.08 (0.45-2.58)	
Female	33.7	15.4	47.9	20.4	2.80 (1.12-6.96)‡	
Case–control study[3]						
Total	30.1	20.6			1.65 (1.16-2.35)‡	0.005‡
Langan *et al.*[14]						
Total	34	26			1.41 (1.31-1.51)‡	
Zindaci *et al.*[15]†						
Total	53	39			2.94 (1.40-6.19)‡	<0.01‡
Madanagobalane *et al.*[16]						
Total	44.1	30				0.025‡

*Multivariate OR for revised NCEP ATPIII criteria; †MS criteria by International diabetes foundation; ‡Statistically significant difference between two groups. MS: Metabolic syndrome; NHANES: National Health and Nutrition Examination Survey; NCEP ATPIII: National Cholesterol Education Program's Adult Treatment Panel III; OR: Odds ratio; CI: Confidence interval

genome-wide association studies. For example, CDKAL1 has been associated with both psoriasis and Type II DM, and PTPN22 has been found to be associated with many diseases, including psoriasis and Type I diabetes.[7]

The strengths and limitations of our study need to be commented on. This study was done in a tertiary care hospital in India, catering a large Northern area, so the results of the study are likely to be generalizable to at least northern part of India. Our study had suggested a statistically significant difference in the prevalence of MS in psoriasis patients as compared to controls which were maintained when male and females psoriasis patients were compared with respective controls.

First limitation, a sample size of our study was relatively small for an epidemiological study for the estimation of prevalence of MS in psoriasis. Our study was not designed to assess the correlation between psoriasis and MS, i.e., whether psoriasis preceded MS or MS preceded psoriasis, which can be answered in prospective cohort studies with adequate sample size.

Conclusion

The increased prevalence of MS among the individuals with psoriasis along with statistically significant higher levels of IL-6 and TNF-α, impose increased risk of CVDs, diabetes and stroke. With lifestyle changes in the Indian population, it is of importance that MS should be prevented in psoriasis so as to decrease the morbidity and mortality and improve the quality of life.

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Conflicts of interest

There are no conflicts of interest.

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