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Prevalence of Metabolic Syndrome and Elevated C-Reactive Protein among Patients with Chronic Plaque Type Psoriasis and Its Correlation With Diseaseseverity: A Hospital-Based Cross-Sectional Study

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Abstract
Background: *Previous epidemiological studies suggest an association between psoriasis and metabolic syndrome and risk of subclinical atherosclerosis. However, there is a paucity of data in the Indian population on these associations.*
Objectives: *To evaluate the prevalence of metabolic syndrome in patients with chronic plaque psoriasis compared to healthy controls and to correlate the prevalence of metabolic syndrome with severity of psoriasis as well as to assess the levels of C-reactive protein as a marker of disease severity.*
Methods: *A hospital-based cross-sectional study was performed on 100 patients with chronic plaque type psoriasis and 100 controls. Psoriasis was categorized as mild, moderate and severe based on psoriasis area and severity index (<10, 10–14 and >14, respectively) and as disease of short (<1 year), intermediate (1–3 years) and long duration (>3 years). In all patients and controls, body mass index was calculated, blood pressure and waist circumference were measured and fasting blood sugar, lipid profile and C-reactive protein levels were estimated. Metabolic syndrome was diagnosed by the presence of 3 or more of the modified National Cholesterol Education Program's Adult Treatment Panel III criteria.*
Results: *The prevalence of metabolic syndrome was significantly more in psoriasis patients than in controls (43% vs. 20%, odds ratio = 3.0175).*
Psoriatic patients also had a significantly higher prevalence of hypertension, abdominal obesity and diabetes. There was a significant trend to increase in prevalence of metabolic syndrome, hypertension and type 2 diabetes mellitus with increased severity and longer duration of psoriasis. CRP levels were found to be significantly higher among psoriatic patients compared to controls and found to be elevated among 33% of psoriasis patients compared to only 15%controls(p=0.0035)
Limitation: *This was a hospital-based cross-sectional study with a relatively small sample size. A prospective study with a larger sample would have validated the results further.*
Conclusion: *There is a significantly higher prevalence of metabolic syndrome among psoriasis patients as compared to controls; the prevalence of metabolic syndrome and its components increases with severity and duration of psoriasis. We suggest that patients with moderate to severe psoriasis be screened routinely for metabolic syndrome and cardiovascular diseases and encouraged to correct modifiable cardiovascular risk factors.*

Key words: *Metabolic syndrome, psoriasis, comorbidities, subclinical atherosclerosis*

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I. Introduction

Psoriasis is an immune‑mediated skin disease characterized by hyperproliferation of keratinocytes which is initiated and maintained by inflammatory mediators.[1] Psoriasis, which was primarily considered a cutaneous disease, is recently being identified as an associate of systemic inflammation.[2] In recent years, psoriasis has been recognized as a systemic disease associated with the metabolic syndrome or its components

such as obesity, insulin resistance, hypertension, and atherogenic dyslipidemia.[3]There is a complex network of inflammatory and immune cells, cytokines, chemokines and growth factors, all of which interact with one another to initiate a cascade of inflammatory events resulting in T‑cell infiltration in the epidermis and dermis.[4-7] Recently the concept of "psoriatic march" has been proposed, in which chronic cutaneous inflammation in psoriasis leads to systemic inflammation, which, in conjunction with increased oxidative stress triggers a cascade of events including oxidative stress, dyslipidemia, endothelial dysfunction and insulin resistance which increases the risk of cardiovascular complications in these patients.[8-10] Recent studies have shown a rise in plasma lipid and lipoprotein levels with an increase in the levels of triglycerides and cholesterol in subjects with psoriasis, compared to controls.[11-12]It has been observed that patients with psoriasis have a disturbance in lipid metabolism and a predisposition for atherosclerosis.[13] This alteration in lipid profile is due to the inflammatory milieu maintained by the cytokines[14-15] although there are some reports which show a normal lipid profile in psoriasis.[16] Low‑density lipoprotein, on oxidation, induces monocyte infiltration and smooth muscle proliferation and favors atherosclerotic plaque formation.[17] High‑density lipoprotein is involved in reverse cholesterol transport and inhibition of monocytic infiltration and thus suppresses atherogenicity.[18] Thus, atherogenic dyslipidemia has been linked to the inflammatory process in psoriasis.

The association of psoriasis with enhanced atherosclerosis and risk of cardiovascular disease (CVD) may account for higher morbidity and mortality rates in psoriatic patients. The intensity of inflammation and skin changes in psoriasis may not only indicate the severity of psoriasis but also that of other systemic pathologies.[19]

C-reactive protein, although nonspecific, is known to be the most sensitive indicator of inflammation, the magnitude of its increase correlating with the extent of tissue injury and inflammation severity.[20] It has a short half-life of 6-8 hours making it an appropriate tool for following disease course.[21] Many studies have demonstrated an association between increased blood CRP levels, neutrophil activation, and CVD, thus suggesting CRP to be an independent risk factor for CVD.

Despite evidence suggesting that Indians are genetically and environmentally more susceptible to develop metabolic syndrome, there is a paucity of data on the association between psoriasis and metabolic syndrome from the Indian subcontinent.[22-27] In this study, we undertook a comparison of the lipid profile and components of metabolic syndrome, in patients with psoriasis, and in controls. Our objective was to evaluate the prevalence of metabolic syndrome in patients of chronic plaque type psoriasis compared to healthy controls and to correlate the prevalence of metabolic syndrome with severity and duration of psoriasis. Further,there is a paucity of studies addressing whether and to what extent the CRP levels are raised among psoriatic patients and if the marker can play a role in assessment of disease severity. Our aim was to evaluate the role of CRP as a marker of disease severity and cardiovascular risk factor in patients with psoriasis.

II. Materials and Methods

This study was conducted in the Department of Dermatology of a tertiary care institution in Jharkhand, between August, 2016 and September, 2017, after being approved by the Institutional Ethics Committee. It was a hospital-based, case-control study. The study group included 100 consecutive patients of chronic plaque type psoriasis and an equal number of age and gender matched healthy controls. All consecutive clinically diagnosed cases of chronic plaque type psoriasis (excluding inflammatory disorders) above the age of 18 years not receiving any systemic treatment for psoriasis and not on any other medications affecting carbohydrate and lipid metabolism (beta-blockers, thiazides, corticosteroids, and lipid-lowering agents) for at least one month prior to enrolment were included in the study. Controls were equal number of age and gender matched normal healthy individuals (attendants of patients and staff members of the hospital) as well as patients with other non-inflammatory diseases like nevi, veruccae, seborrhoeic keratosis etc.

Clinical and anthropometric parameters and existence of co‑morbidities and treatment details were recorded in a pre-designed proforma. The study groups were evaluated recording their demographic, biometric and the other relevant data, including age, sex, weight, height, body mass index, waist circumference, blood pressure, smoking and alcohol consumption habits, duration of disease, type and severity of psoriasis, presence and distribution of psoriatic arthropathy and concomitant medications.

Relevant data included age, gender, weight, height, body mass index, waist circumference, blood pressure, smoking, alcohol abuse, age of onset, and duration of psoriasis. Severity of psoriasis was assessed according to Psoriasis Area and Severity Index (PASI) score, determined by the same investigator in all 100 cases. Investigations carried out included fasting lipid profile, fasting and postprandial blood glucose, and C-reactive protein (immunoturbidimetry). Metabolic syndrome was diagnosed by the presence of three or more criteria of the National Cholesterol Education Program's Adult Panel III (ATP III) criteria.[28]

Psoriasis was classified as of short (<1 year), intermediate (1–3 years) or long (>3 years) duration. Patients were classified as having mild, moderate or severe psoriasis based on the psoriasis area and severity index (PASI) score (<10, 10-14 and >14 respectively). PASI <10 was considered as mild disease and PASI ≥10

was considered as severe disease.[29] Body mass index was calculated as the ratio of weight in kg to the square of height in metres. Waist circumference was measured by locating the uppermost part of the hip bone and placing a measuring tape around the abdomen snugly but without causing compression of the skin, ensuring that the tape washorizontal. Blood pressure was recorded as an average of two measurements, taken 5 minutes apart after subjects had been at rest for at least 10 minutes. A venous blood sample was taken in all patients and controls, after overnight fasting (at least 8 hours) to estimate the fasting blood sugar (enzymatic method), fasting lipid profile (enzymatic method) and C-reactive protein (immunoturbidimetry). Waist circumference >102 cm in men or>88 cm in women, hypertriglyceridemia ≥150 mg/dL, high-density lipoprotein cholesterol <40 mg/dL in men or <50 mg/dL in women, blood pressure ≥130/85 mmHg and fasting plasma glucose ≥100mg/dL were the criteria for diagnosing metabolic syndrome.

Statistical analysis

Data analysis was done using Stata software version 11.1. Quantitative characteristics such as age, waist circumference, systolic and diastolic blood pressure, high-density lipoprotein and triglyceride levels were compared between patients and controls using a two-sample *t*-test. Qualitative variables such as sex, duration and severity classifications of disease, smoking and alcohol use were compared between patients and controls using Chi-square test. The prevalence of metabolic syndrome and its components in patients with chronic plaque type psoriasis of different severities and durations was compared using a trend Chi-square test. The prevalence of metabolic syndrome among patients was calculated as a proportion along with a 95% confidence interval. The correlation of different study parameters with severity of psoriasis was assessed by one-way ANOVA. Odds ratio was also calculated along with 95% confidence intervals after categorizing study variables. A $P < 0.05$ was considered to be statistically significant.

III. Results

Demographic characteristics of the study population and disease characteristics are reported in Table 1. The study included 100 patients with chronic plaque type psoriasis and an equal number of age and gender matched healthy controls. The mean age of the patients with psoriasis was 38.6 ± 12.33 years (mean ± SD). Maximum number of patients were in the age group 41-50 years. 9 patients with psoriasis had co‑existent psoriatic arthritis. The duration of psoriasis in our patients ranged from 4 months to 33 years while the psoriasis area and severity index (PASI) score of the 100 patients with psoriasis ranged from 2 to 30;mean PASI being 9.5 ± 6.3.The baseline characteristics between Psoriasis cases and the controls were comparable.

Based on modified National Cholesterol Education Program's Adult Treatment Panel III criteria, metabolic syndrome was diagnosed in 43 (43%) patients with chronic plaque type psoriasis and 20 (20%) healthy controls (43% versus 20%).This difference was statistically significant(p = 0.0006) with an odds ratio of 3.0175 with 95% confidence interval 1.6072–5.6655.

On studying the components of the metabolic syndrome, the following were found to be morecommon in psoriasis patients than in controls: central obesity in 32% versus 12% (odds ratio = 3.45, confidence interval 1.65–7.20), hypertension in 62% versus 25% (odds ratio = 4.89, confidence interval 2.67–8.98) and type 2 diabetes mellitus in 41% versus 19% (odds ratio = 2.96, confidence interval 1.56–5.61) [Table 2].

Table 1 : Demographic details of Psoriasis Cases and controls

Characteristics	Cases(100)	Controls(100)	P
Demographic details			
Age (Mean ±S.D.)(years)	38.6±12.33	37.4±10.93	0.4673
Male.n (%)	73(73%)	70(70%)	0.6392
Female , n(%)	27(27%)	30(30%)	0.6392
Smoking, n(%)	38(38%)	29(29%)	0.1786
Disease details			
Duration of psoriasis, mean ±S.D.(years)	8.3±5.24	Not applicable	
Short(<1 year), n(%)	12(12%)		
Intermediate(1-3 years, n(%)	21(21%)		
Long(>3 years),n(%)	67(67%)		
Psoriasis area and severity index(PASI), mean ±S.D.	9.5±6.3		
Mild (PASI<10), n(%)	64(64%)		
Moderate (PASI 10-14), n(%)	23(23%)		
Severe (PASI>14), n(%)	13(13%)		
Mean±S.D. of various study parameters			
Body mass index(kg/m²)	25.2±4.25	23.1±4.11	0.0005
Waist circumference(cms)			
Male	87.6±10.53	84.3±6.65	0.0273
Female	90.5±12.25	83.2±8.23	0.0101

Systolic blood pressure (mm Hg)	130.3±14.32	122.2±10.20	<0.0001
Diastolic blood pressure(mm Hg)	83.5±9.13	76.3±8.20	<0.0001
Serum Triglycerides(mg/dL)	143.5±70.33	126.3±42.25	0.0373
Serum HDL(mg/dL)			
Males	42.5±8.33	45.2±5.25	0.0225
Females	44.3±4.26	49.6±7.45	0.0020
Fasting blood sugar	99.8±17.35	90.5±10.53	<0.0001
C-Reactive protein (mg/L)	9.00±2.7	3.10±0.2	<0.0001
CRP>5mg/L, n(%)	33(33%)	15(15%)	0.0035

Table 2 :Prevalence of metabolic syndrome and its components in 100 patients with chronic plaque type psoriasis and 100 controls based on NCEP ATP III criteria

Study parameter	Psoriasis *n*(%)	Control *n*(%)	*P*	OR (95% CI)
WC (>102 cms in males, >88 cms in females	32(32%)	12(12%)	0.0010	3.45(1.65-7.20)
Hypertension(≥130/85 mm Hg)	62(62%)	25(25%)	<0.0001	4.89(2.67-8.98)
Triglycerides(≥150mg/dL)	48(48%)	16(16%)	<0.0001	4.85(2.50-9.41)
HDL(<40mg/dL in males; <50mg/dL in females)	56(56%)	40(40%)	0.0241	1.9091(1.09-3.35)
FBS≥ 100mg/dl	41(41%)	19(19%)	0.0009	2.96(1.56-5.61)
Metabolic syndrome(MS)	43(43%)	20(20%)	0.0006	3.02(1.61-5.67)

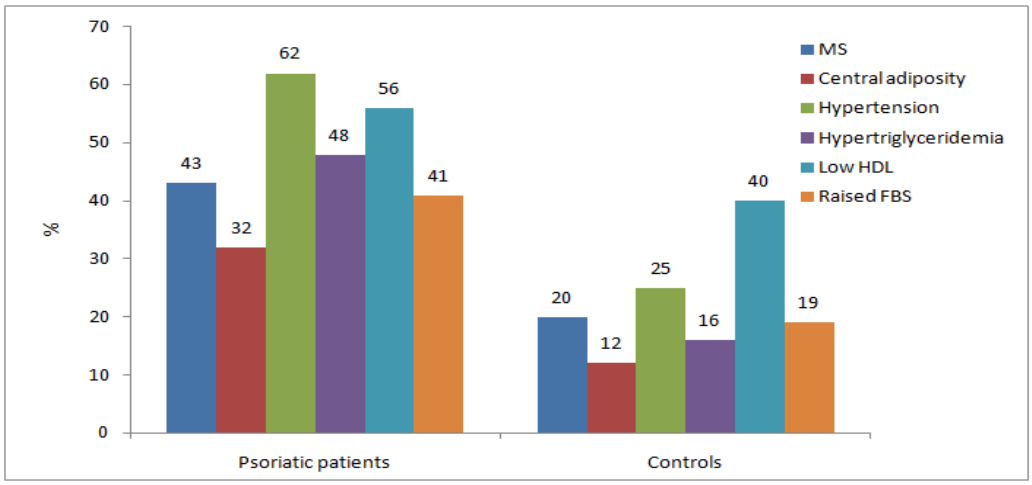

Figure1: Prevalence of metabolic syndrome and its components among psoriatic patients and controls

Table 3:Association of metabolic syndrome with severity of chronic plaque type psoriasis

Characteristics	Mild (PASI<10) n=64	Moderate (PASI 10-14) n=23	Severe (PASI >14) n=13	P
Waist circumference (Mean ±S.D.)(cms)	87.3±10.5	88.8±9.4	95.3±10.25	0.041
Obesity , n (%)	15(23.5%)	6(24.2%)	5(38.6%)	0.44
SBP(Mean ±S.D.)(mm Hg)	126.3±15.13	133.3±12.62	138.7±10.25	0.007
DBP, (Mean ±S.D.)(mm Hg)	81.2±9.26	83.4±6.25	89.8±10.2	0.007
Hypertension (HTN), n(%)	35(54.69 %)	16 (69.57 %)	11 (84.62 %)	0.02
Triglycerides (mean ±S.D.(mg/dl)	127.2±63.25	141.3±76.84	153.5±82.3	0.389
High TG, n(%)	25(39.06%)	14 (60.86 %)	9 (69.23 %)	0.02
HDL (mean ±S.D.(mg/dl)	43.2± 7.53	40.3±4.15	38.6±2.35	0.028
Low HDL, n(%)	30(46.88 %)	13(56.52 %)	10 (76.92 %)	0.032
Fasting blood sugar, (mean ±S.D.) (mg/dl)	96.8±16.63	103.9±18.92	109.5±20.56	0.035
Impaired glucose metabolism(IGM), n(%)	19(29.69 %)	13 (56.52 %)	9 (69.23 %)	<0.001
Components of metabolic syndrome				
0	9(14.06 %)	2 (8.69 %)	1 (7.7%)	
1	20 (31.25 %)	4 (17.39 %)	1 (7.7%)	
2	18 (28.12 %)	2 (8.70%)	1 (7.7%)	
≥3	17 (26.5 %)	15 (65.22%)	11 (84.62 %)	
Metabolic syndrome (MS)	17 (26.5 %)	15 (65.22%)	11 (84.62 %)	<0.0001
C-Reactive protein (mg/L)	6.3±0.3	8.10±0.5	11.6±1.2	<0.0001
CRP>5mg/L, n(%)	16(25%)	10(43%)	7 (53.85 %)	0.0006

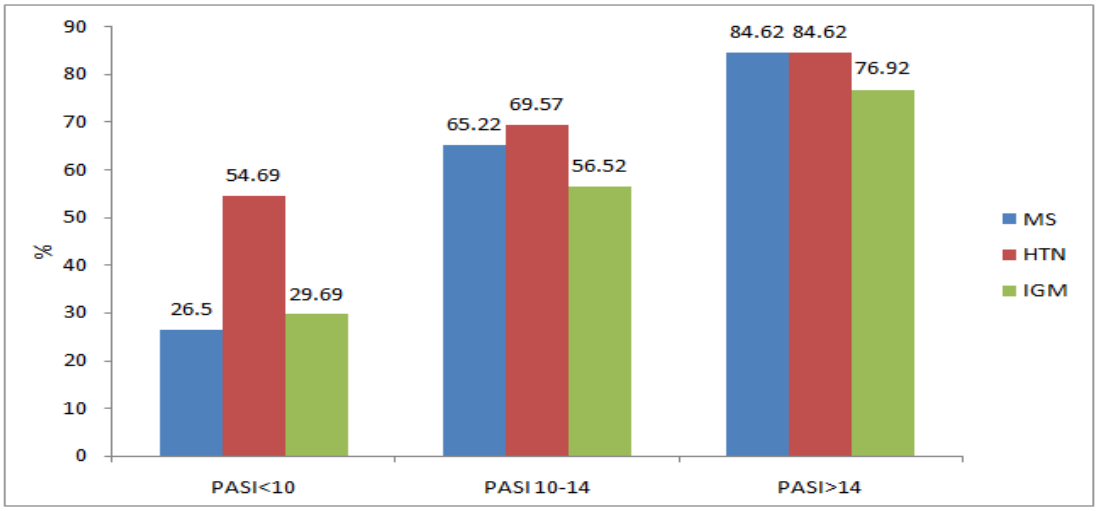

Figure2: Prevalence of metabolic syndrome, hypertension and impaired glucose metabolism increasing with severity of psoriasis

Correlation of prevalence of metabolic syndrome and its components with severity and duration of chronic plaque type psoriasis

There was a linear trend of increase in the prevalence of metabolic syndrome with increasing severity of psoriasis ($P < 0.0001$) and it remained statistically significant with odds ratio for metabolic syndrome being 5.18 (95% confidence interval, 1.86–14.40; $P = 0.0016$) among patients with moderately severe psoriasis and 15.21(95% confidence interval, 3.05–75.73; $P = 0.0009$) among patients with severe psoriasis vis-a-vis patients with mild psoriasis [Table 3].

Patients with psoriasis of long duration had a higher prevalence of metabolic syndrome (34, 50.75%) when compared to those with disease of short and intermediate duration [2 (16.67%) and 7 (33.31%) respectively]. There was also a statistically significant linear trend of increase in the prevalence of metabolic syndrome with increase in the duration of psoriasis ($P = 0.04$). As regards the association of components of metabolic syndrome with severity of psoriasis, patients with severe chronic plaque psoriasis had significantly higher prevalence of hypertension, hypertriglyceridemia and diabetes than those with mild psoriasis [Table 3 and Figure 2].

CRP was significantly elevated (>5 mg/L) in psoriatic patients when compared with controls (33% versus 15%) (P =0.0035). The mean CRP value of psoriatic patients was9.0±2.7 mg/L compared to 3.10±0.2 mg/L in the control group with a statistically significant difference ($p<0.0001$).47.22% of Psoriatic patients with severe disease (PASI > 10) showed elevated levels of CRP compared to 25% patients with mild disease (PASI < 10) (P=0.0253). Elevated levels of CRP was seen more in psoriatic patients with metabolic syndrome(37.20%) when compared with psoriatic patients without metabolic syndrome(12.28%) and the difference was statistically highly significant (P = 0.001)(Table 3, Figures 3a and 3b)

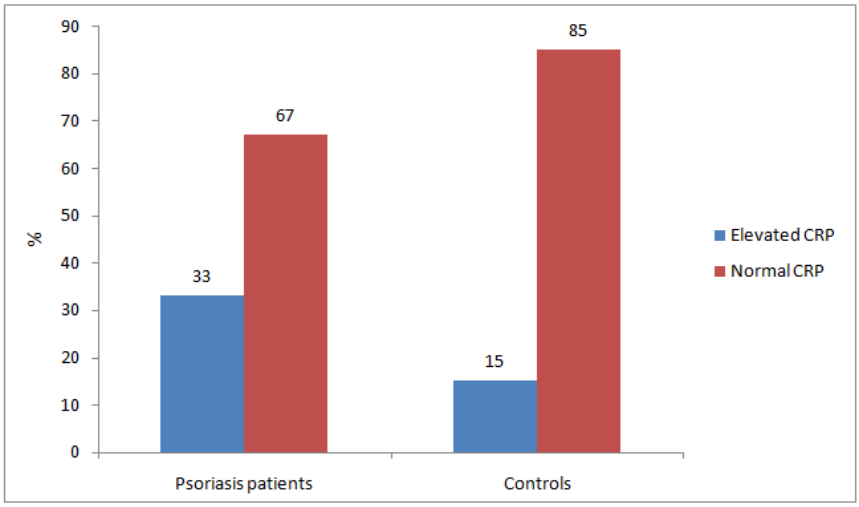

Figure 3a: Prevalence of elevated CRP among psoriasis patients and controls

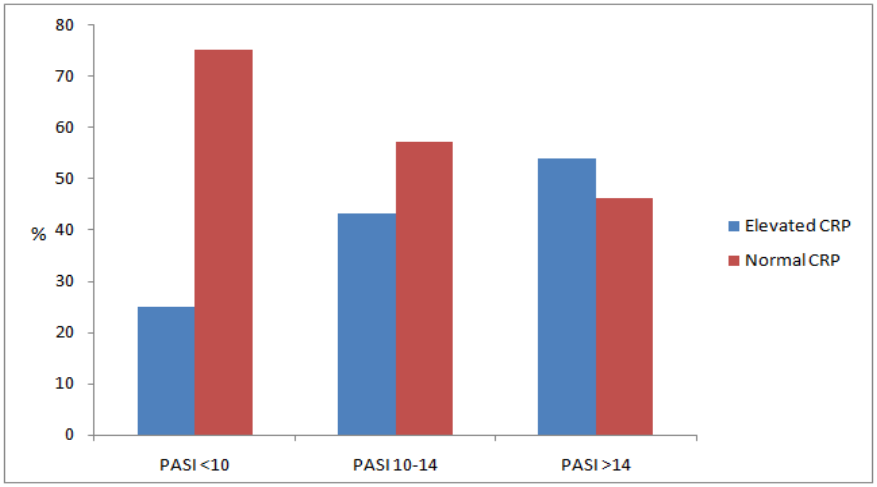

Figure 3b: Prevalence of elevated CRP with increasing severity of Psoriasis

IV. Discussion

Psoriasis is a systemic inflammatory disease with concomitant co‑morbidities. It is known that patients with severe forms of psoriasis have a reduced life expectancy which might be due to cardiovascular complications such as myocardial infarction or stroke. The disease has been associated with abnormal lipid metabolism and a high frequency of cardiovascular events resulting in increased morbidity and mortality. Abnormalities in lipid metabolism may be another important contributory factor in the pathogenesis of psoriasis. There are many reports showing increased pro‑atherogenic lipid profile, resulting in increased cardiovascular events.[11-15] Chronic inflammation, the hallmark of psoriasis, and paradoxically, treatment of psoriasis, may both result in dyslipidemias. Conversely, there are certain studies showing a normal lipid profile.[16] In our study, patients with psoriasis had significantly higher levels of serum triglycerides and low HDL levels when compared to controls, suggesting the presence of atherogenic dyslipidemia in psoriasis. These findings are in concordance with the observations of Kadam*et al*., Jyothi*et al*. and Samuel and Murari et al.[30-32]

Nemati*et al*., on the other hand, observed that there were no significant statistical differences in serum levels of lipoprotein(a), triglycerides, very low‑density lipoprotein cholesterol and high‑density lipoprotein cholesterol between psoriasis patients and controls,[33]atherogenic index correlated positively with each other, as well as with disease severity, thus showing an association with increased cardiovascular risk in psoriatic patients. The combined effect of atherogenic dyslipidemia, oxidative stress and systemic inflammation in psoriasis leads to its co‑morbidities, through a cascade of events referred to as "psoriatic march" which ultimately leads to endothelial dysfunction, insulin resistance and cardiovascular disease. As psoriasis and cardiovascular disease are both T helper 1/T helper 17 mediated inflammatory diseases with a common pathogenesis, psoriasis can be considered as an individual risk factor for development of cardiovascular events.

We found a linear increase in the occurrence of metabolic syndrome as the severity and duration of psoriasis increased. Though Gisondi*et al*in a study of patients with psoriasis of longer than 6 months'duration observed an increased occurrence of metabolic syndrome in psoriasis patients, they did not find anycorrelation of metabolic syndrome with the severity of psoriasis.[34] In a study from Germany, Sommer*et al.*noted that hospitalized treatment-resistant patients with chronic plaque psoriasis were significantly more likely (odds ratio: 5.92) to have metabolic syndrome as compared to controls and this correlation was stronger for patients with greater body surface area involvement.[35] They did not observe any difference in the prevalence of metabolic syndrome amongst patients who had had their psoriasis for less than or more than 15 years. However, 15 years may have been too long a cut-off period as it probably takes the inflammatory triggers of psoriasis much less time to initiate metabolic syndrome. Langan*et al*. also observed an increasing trend of the presence of metabolic syndrome with increasing severity of psoriasis.[36]Nisa and Qazi reported an increased prevalence of metabolic syndrome in patients with psoriasis (28%) as compared to controls (6%) with an odds ratio of 6.09.[37]

Pereira *et al.* in a study on 77 patients with chronic plaque psoriasis from Mumbai, India and Lakshmi *et al.* in a study of 40 patients with chronic plaque psoriasis from South India were not able to demonstrate any significant association between metabolic syndrome and psoriasis in comparison to controls.[38-39]More recently, Madanagobalane and Anandan with the use of the South Asian-modified National Cholesterol Education Program's Adult Treatment Panel III criteria observed that metabolic syndrome was significantly more common in psoriasis patients (44.1%) than in controls (30%) but did not note any correlation with severity.[40] Sharma et alhad also shown increased risk of metabolic syndrome in patients with psoriasis, especially in those with long-standing psoriasis and active joint disease.[41]There is substantial data to suggest that prevalence of various

components of metabolic syndrome is higher in patients with psoriasis. From India, while Madanagobalane and Anandan, reported a higher prevalence of obesity in psoriasis patients than in controls, Nisa and Qazi did not observe any such difference in the occurrence of central obesity.[37,40]

We observed a linear relationship between the severity of psoriasis and prevalence of hypertension and diabetes. Though several studies from the Westhave shown an association between hypertension and psoriasis, Indian studies have been equivocal.[42-44]

However, the studies by Pereira *et al*., Madanagobalane and Anandan, Nigam and Dayal and Sundharam*et al*. corroborate our observations on the association of psoriasis and diabetes[39,40,45-46]Langan*et al*. noted a similar relationship of severity of psoriasis to the presence of obesity, hypertension and elevated fasting blood sugar.[47] However, they categorized the severity of disease based on the percentage of body surfacearea involvement which may be a poor marker of the severity of inflammation. Of all the components of metabolic syndrome, inconsistencies across various studies are maximal with respect to dyslipidemia, with some studies indicating an association of dyslipidemia with psoriasis and others noting an association with respect to levels of some components of serum lipids.[37,40,42,44,47,48]

Unlike the earlier rejection of CRP as an empirical test because of its perceived lack of specificity, the current stress over CRP is widely characterized by failure to recognize appropriately the nonspecific nature of the acute phase response.[49] The plasma half-life of CRP is constant under all conditions of health and disease, so that the sole determinant of circulating levels of CRP is the synthesis rate, which thus directly reflects the intensity of pathological process stimulating CRP production.[49-50]

Several studies have investigated the role of CRP in psoriasis. Two studies by Vanizor *et al*. have shown that patients with psoriasis have significantly high baseline levels of CRP compared with healthy controls ($p < 0.004$ and $P < 0.001$).[51-53]Malbris *et al*. noted that patients with psoriasis had higher levels of CRP compared with controls, with a positive correlation between CRP and total plasma cholesterol.[54] In our study, CRP was elevated (>5 mg/L) in 52% of psoriatic patients compared to 14% of control population and the difference was statistically highly significant ($P = 0.001$). Similar results were observed by Rocha-Periera *et al*[55] in a study evaluating inflammatory markers in patients with mild or severe psoriasis. In a study by Kimbell *et al*[51] CRP levels correlated with the presence and severity of disease, with the lowest levels seen in the control group and progressively higher CRP levels observed in patients with increasing disease severity. Compared with controls, patients with mild and severe psoriasis had significantly higher levels of CRP (mean ± standard deviation; 0.31 ± 0.02 mg/dL versus 0.90 ± 0.27 mg/dL; $P < 0.001$). Further comparison indicated that patients with severe psoriasis had significantly higher levels of CRP than those with only mild disease (mean ± standard deviation; 0.63 ± 0.03 mg/dL versus 1.16 ± 0.07 mg/dL; $P < 0.001$). In our study also, we found a significant association between disease severity and elevated CRP levels. Psoriatic patients with severe disease (PASI > 10) had significantly higher levels of CRP than those with mild disease (PASI < 10) (44% versus 25%) (P value = 0.003). Thus, these results were consistent with the characterization of psoriasis as an inflammatory response that worsens with increasing disease severity. Several other studies have also reported a correlation between increased levels of CRP and PASI.[3,20,56]Thus, CRP can be considered as a useful marker of disease severity that could be used to monitor the disease course and its treatment.

CRP is an independent risk factor for CVD.[21,57] The greater than expected incidence of coronary artery disease in psoriatic patients might be attributable to the high levels of this marker.[58] Several studies have reported a link between the levels of CRP and CVD, hypertriglyceridemia, abnormal blood pressure, and insulin resistance.[49,58,59]In our study, when we compared the CRP levels in psoriatic patients with and without the metabolic syndrome, CRP was significantly elevated in patients with the metabolic syndrome (38% versus 13%, $P = 0.001$). Possible specific associations of CRP with CVD include binding of CRP selectively to LDL, especially "damaged" LDL, deposition of CRP in most atherosclerotic plaques, and co-deposition of CRP with activated complement in acute myocardial infarction lesions.[49] Raised baseline CRP values are also associated with many features of insulin resistance and the metabolic syndrome. It has been suggested that the inflammatory process in psoriasis, which is characterized by elevated levels of CRP, is connected to increased arterial stiffness and premature development of atherosclerosis. These findings provide further evidence of a link between inflammation and CVD in patients with psoriasis.[3]

There is a recent emphasis on the "high-sensitivity" CRP, abbreviated as hs CRP. The "high sensitivity" refers to the lower detection limit of the assay procedure being used. The actual CRP analyte, the plasma protein that is being measured, is the same regardless of the assay range.[49]Various studies have demonstrated that hs CRP independently predicts cardiovascular risk and has additive prognostic value at all levels of the metabolic syndrome or in the prediction of type 2 diabetes mellitus.[60]

A limitation of our study wasa relatively smaller sample size, involving only 200 study subjects, A larger sample size would have validated our results further. Finally, different morphological types of psoriasis were not included and follow‑up after treatment was not undertaken. The hypothesis that metabolic syndrome can occur more frequently in psoriasis needs to be validated in large prospective studies.

V. Conclusion

We found a higher prevalence of metabolic syndrome and its individual components in patients with psoriasis; these could play a role in accelerating the development of atherosclerosis. Though the association was seen at all severities of psoriasis, it increased as severity of disease increased.We suggest that patients with moderate to severe psoriasis and those with psoriasis for longer than 3 years be screened routinely for metabolic syndrome and cardiovascular disease and also be encouraged to correct their modifiable cardiovascular risk factors aggressively. There has been no accurate laboratory tool to assess the psoriasis severity and progress. PASI is currently the preferred method for the evaluation of disease severity. However, the subjective nature and limited utility for non–plaque-type disease limits its use. CRP estimation is inexpensive, widely available, and can be easily carried out in an outpatient clinical setting. CRP along with PASI could be used as a powerful and sensitive blood marker to evaluate psoriasis disease severityas it is not based on visual evaluation of the lesions. It can be used to monitor the disease course and treatment. As there is evidence supporting the link between inflammation and CVD in patients with psoriasis, elevation of CRP may be considered as a risk factor for CVD in patients with psoriasis. However, further research especially using highly sensitive techniques for CRP determination is required to confirm this observation.

Conflicts of interest
There are no conflicts of interest.

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