

*Original article*

**Metabolic syndrome in autoimmunity. Epidemiological cross-sectional analysis of a complex interaction in a Latin American population**

*Síndrome metabólico en autoinmunidad. Análisis transversal epidemiológico de una interacción compleja en una población latinoamericana*

*Síndrome metabólica na autoimunidade: análise transversal epidemiológica de uma interação complexa em uma população Latino Americana*

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**Juan Camilo Martínez**Universidad Autónoma de Bucaramanga, Bucaramanga, Colombia / [jmartinez347@unab.edu.co](mailto:jmartinez347@unab.edu.co) <https://orcid.org/0009-0002-9940-0153>**Juan Camilo Mayorca**Universidad Autónoma de Bucaramanga, Bucaramanga, Colombia / [jmayorca@unab.edu.co](mailto:jmayorca@unab.edu.co) <https://orcid.org/0009-0006-3437-5216>**María Alejandra Cala**Universidad Autónoma de Bucaramanga, Bucaramanga, Colombia / [mcala141@unab.edu.co](mailto:mcala141@unab.edu.co) <https://orcid.org/0000-0002-2406-6763>*Received on 20/6/2023, approved on 17/7/2023, published on 14/7/2023***Abstract**

The link between metabolic syndrome and autoimmune disorders leads to increased cardiovascular morbidity and mortality. A cross-sectional study was conducted in 2018 with a sample of 253 patients: 140 with rheumatoid arthritis, 68 with lupus, and 45 with psoriasis. Their variables were compared to controls with similar characteristics ( $n = 123$ ). ANOVA was used for quantitative variables, and chi-square for qualitative ones. The mean age found was  $43.69 \pm 9.0$ ; 280 (74.5 %) were female patients. Metabolic syndrome was found in 55.5 % of patients with psoriatic arthritis, 48.5 % of lupus patients, 31.4 % in rheumatoid arthritis, and 34.9 % in controls ( $p = 0.007$ ). The components of metabolic syndrome showed a larger waist circumference in lupus patients ( $p = 0.001$ ) and hypertension in psoriasis patients ( $p = 0.001$ ). It is concluded that the presence of metabolic syndrome should be investigated in patients with autoimmune diseases, as there is a significant association between it and autoimmune rheumatologic diseases.

**Keywords:** cardiovascular diseases, rheumatoid arthritis, psoriatic arthritis, epidemiology**Resumen**

El vínculo entre el síndrome metabólico y los trastornos autoinmunes conduce a una mayor morbimortalidad cardiovascular. Se realizó un estudio transversal durante el 2018 con una

muestra de 253 pacientes: 140 con artritis reumatoidea, 68 con lupus y 45 con psoriasis. Sus variables se compararon con los controles de similares características ( $n = 123$ ). Se utilizó el ANOVA para las variables cuantitativas y chi-cuadrado en las cualitativas. En cuanto a la edad, la media encontrada fue de  $43.69 \pm 9.0$ ; 280 (74.5 %) eran pacientes del género femenino. El síndrome metabólico se encontró en el 55.5 % con artritis psoriásica; el 48.5 % de los pacientes con lupus; el 31.4 % en artritis reumatoidea; y en el 34.9 % de los controles ( $p = 0.007$ ). Los componentes del síndrome metabólico mostraron una mayor circunferencia de cintura en pacientes con lupus ( $p = 0.001$ ), e hipertensión en pacientes con psoriasis ( $p = 0.001$ ). Se concluye que, la presencia del síndrome metabólico debe investigarse en aquellos pacientes con enfermedad autoinmune, puesto que existe una asociación importante de este con las enfermedades autoinmunes de tipo reumatológico.

**Palabras clave:** enfermedades cardiovasculares, artritis reumatoidea, artritis psoriásica, epidemiología.

## Resumo

A ligação entre síndrome metabólica e distúrbios autoimunes leva ao aumento da morbidade e da mortalidade cardiovascular. Foi realizado um estudo transversal durante o ano de 2018 com amostra de 253 pacientes: 140 com artrite reumatóide, 68 com lúpus e 45 com psoríase. Suas variáveis foram comparadas com controles com características semelhantes ( $n = 123$ ). A ANOVA foi o método utilizado para as variáveis quantitativas e qui-quadrado para as qualitativas. Em relação à idade, a média encontrada foi de  $43,69 \pm 9,0$ ; 280 (74,5 %) eram pacientes do sexo feminino. A síndrome metabólica foi encontrada em 55,5% com artrite psoriática; 48,5 % dos pacientes com lúpus; 31,4 % na artrite reumatoide; e em 34,9 % dos controles ( $p = 0,007$ ). Os componentes da síndrome metabólica apresentaram maior circunferência da cintura em pacientes com lúpus ( $p = 0,001$ ) e hipertensão em pacientes com psoríase ( $p = 0,001$ ). Conclui-se que a presença de síndrome metabólica deve ser investigada naqueles pacientes com doença autoimune, uma vez que existe importante associação desta com doenças autoimunes do tipo reumatológico.

**Palavras-chave:** doenças cardiovasculares, artrite reumatóide, artrite psoriática, epidemiologia.

## Introduction

Cardiovascular disease is one of the main causes of morbidity and mortality in patients with systemic lupus erythematosus (SLE), rheumatoid arthritis (RA) and psoriatic arthritis (PsA). It has been described that, in the female gender, SLE increases the risk of developing cardiovascular disease (CVD) by 5-6 times. The risk for women with SLE, aged 35-44, increases more than 50 times (Manzi *et al.*, 1997). CVD was more prevalent in RA (10.5 %) than in PsA (7.2 %). Patients with RA have a 2-3 times higher risk of myocardial infarction and up to a 50 % higher risk of CVD mortality (Castañeda *et al.*, 2015).

The metabolic syndrome includes a group of classic CVD risk factors, such as central obesity, hypertension, hypertriglyceridemia (TG), and low high-density lipoprotein cholesterol (HDL-c) (Targher *et al.*, 2006). In addition, metabolic syndrome is related to inflammatory activity and the cytokines involved such as interleukin-6 and TNF- $\alpha$ , which facilitate insulin resistance.

Several studies report that patients with metabolic syndrome have elevated levels of C-reactive protein (CRP), interleukin-1 $\beta$  (IL-1 $\beta$ ), IL-1, P-selectin, intercellular adhesion molecule, and leptin (Salmenniemi *et al.*, 2004; Sidiropoulos *et al.*, 2008).

Several medications such as anti-inflammatories and immunosuppressants may play a role in metabolic syndrome and CVD (Bellomio *et al.*, 2009). In various studies, the prevalence rates of metabolic syndrome in patients with SLE, RA, and PsA ranged from 16.3 % to 45.2 %, 13.9 % to 51.3 %, and 25.5 % to 44 %, respectively (Mok, Ko *et al.*, 2011; Bostoen *et al.*, 2014; Haroon *et al.*, 2016; Medeiros *et al.*, 2016; Slimani *et al.*, 2017; Gomes *et al.*, 2018).

SLE, RA, and PsA are three prevalent and indicative disorders in rheumatology. The assessment of comorbidities can play a role in prioritizing and selecting appropriate treatments and management. This study aimed to evaluate and compare the prevalence of metabolic syndrome in these three disorders. Emphasis was also placed on certain characteristics of these disorders

concerning metabolic syndrome and factors that could be related to them, as observed in research conducted by Zonana-Nacach *et al.* (2008), Labitigan *et al.* (2014), and Özkan *et al.* (2017).

## Materials and Methods

### Patients

The study was cross-sectional and conducted in 2018. It included 68 consecutive patients with SLE, diagnosed according to the classification criteria of the *International Systemic Lupus Collaborating Clinics* (Petri *et al.*, 2012); 140 patients with RA, diagnosed based on the criteria of the *American College of Rheumatology and the European League Against Rheumatism* (Aletaha *et al.*, 2010); 45 patients with PsA diagnosed according to the Classification Criteria for Psoriatic Arthritis proposed by Taylor *et al.* (2006); and 123 eligible controls of the same age, who attended a hospital in South America during this period, including patients without inflammatory diseases or rheumatic conditions (such as osteoarthritis, mechanical low back pain, and fibromyalgia).

Patients with other rheumatological disorders, including overlap syndrome, and those using glucocorticoids for other conditions were excluded. The patients were between 20 and 60 years of age; 5 patients with SLE, 3 patients with PsA, and 12 patients with RA were excluded from the study as they fell outside the age range.

The optimal patient sample size was determined with 45 patients with PsA, as they had the highest prevalence rate of metabolic syndrome, for a confidence level exceeding 95 %. To reduce potential bias, researchers attempted to recruit participants within a specific age range and from both public and private healthcare services. Sequential sampling was conducted to detect a statistically significant difference between at least two groups.

### Evaluation and Data Collection

Patients in each group were clinically evaluated based on their specific diseases: Systemic Lupus Erythematosus Disease Activity Index (SLEDAI), Systemic Lupus Erythematosus Damage Index

(SDI), and Health Assessment Questionnaire (HAQ) for SLE; Disease Activity Score (DAS-28) and HAQ for RA and PsA. The diagnosis of metabolic syndrome was based on the criteria proposed by the *Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults* (2001).

All participants were clinically and biochemically evaluated to define their metabolic profiles: type 2 diabetes with or without treatment, blood pressure, lipid profile (HDL-c and TG), fasting blood glucose and waist circumference.

Metabolic syndrome was consecutively evaluated and recorded by the medical staff, according to the *Adult Treatment Panel of the National Cholesterol Education Program III*, and the International Diabetes Federation (IDF), according to Targher *et al.* (2006). Metabolic syndrome was considered to be present, if patients met at least three or more of the following conditions:

1. Abdominal circumference  $\geq 102$  cm for men and  $\geq 88$  cm for women.
2. The patient is currently using an antihypertensive agent, has a systolic blood pressure  $\geq 130$  mmHg, or a diastolic blood pressure  $\geq 85$  mmHg.
3. HDL cholesterol level.
4. TG level  $\geq 150$  mg/dl.
5. Fasting glucose  $\geq 110$  mg/dl.

The criteria established by the IDF included a waist circumference  $\geq 94$  cm for men and  $\geq 80$  cm for women, in addition to other defining criteria for metabolic syndrome. Furthermore, variables such as age, gender, and treatment modalities (current therapies including hydroxychloroquine, prednisolone, and methotrexate) were also considered. The cumulative dose of prednisolone was calculated based on the duration of treatment and the accumulated dose (in grams) of prednisone or equivalent medication at the time of enrollment in the study, including the application of pulse glucocorticoid therapy.

The waist circumference of each patient was measured at the end of a normal exhalation, along a horizontal line at the level of the iliac crest, parallel to the ground. Blood pressure (BP) was

measured twice at rest, and the lower measurement was used for both systolic and diastolic blood pressure.

Blood was drawn from patients after an overnight fasting period, and enzymatic assays were used to measure glucose and lipid profiles (total cholesterol, HDL cholesterol, low-density lipoprotein cholesterol [LDL-c], and triglycerides [TG]).

### Statistical Analysis

Demographic and clinical characteristics and the components of the metabolic syndrome were evaluated in patients and controls. Age-adjusted prevalence was calculated by direct methods.

Statistical analysis was performed by ANOVA to compare quantitative variables, and chi-square tests were used to compare qualitative variables between the 4 groups using SPSS version 21 (Chicago, USA). Results were considered significant for p values < 0.05.

### Results

The average age of the participants was 43.69 ± 9.0, and 74.5 % were female. Table 1 shows the demographics, clinical, and laboratory characteristics of the 253 patients (68 SLE, 140 RA, 45 PsA) and 123 age-matched controls who completed the study.

**Table 1**

*Demographic data, clinical, and laboratory characteristics of patients studied.*

Variables	SLE (68)	PsA (45)	RA (140)	Controls (123)	p-Value*	Post hoc testing P**
Age	42.14±11.52	44.00± 9.8	44.70±5.0	43.30±10.5	0.259	-
Female: N (%)	66 (97.1 %)	29 (66.4 %)	115 (82.1 %)	70 (56.9 %)	<0.001	-
History of hypothyroidism: N (%)	22 (32.4%)	19 (42.2 %)	13 (9.3 %)	-	<0.001	-
Family history of myocardial infarction or stroke: N (%)	18 (27.3 %)	20 (44.4 %)	37 (26.4 %)	-	0.062	-
BMI	29.27±5.05	29.67±5.7	30.17±6.9	28.69±5.0	0.241	-
Waist circumference	96.75±11.0	99.47±13.5	99.43±17.8	97.06±11.7	0.420	-
Systolic blood pressure	119.34±15.3	130.56±14.75	122.61±12.9	122.32±14.1	0.001	PsA vs other: <0.005



Variables	SLE (68)	PsA (45)	RA (140)	Controls (123)	p-Value*	Post hoc testing P**
Total cholesterol	175.26±37.4	183.40±28.0	191.33±75.8	196.24±41.7	0.076	-
Low-density cholesterol	100.10±31.3	114.00±22.6	107.80±28.4	116.29±30.5	0.003	SLE vs controls: 0.002
High-density cholesterol	49.12±13.8	47.93±9.6	51.89±15.0	48.46±12.3	0.138	-
Triglycerides	135.57±64.7	131.60±51.4	136.49±61.0	147.84±80.7	0.401	-

**Note:** SLE: systemic lupus erythematosus; PsA: psoriatic arthritis; RA: rheumatoid arthritis.

\* Derived from one-way analysis of variance (continuous variables) or chi-square test (categorical variables).

At the time of the study, in the SLE group, 63 patients (92.6 %) were receiving prednisolone, 12 patients (17.6 %) were on methotrexate, and 49 patients (72.1 %) were using hydroxychloroquine. In the RA group, the medications were as follows: prednisolone in 105 patients (75 %), methotrexate in 82 patients (58.6 %), hydroxychloroquine in 78 patients (55.7 %), leflunomide in 8 patients (5.7 %), and sulfasalazine in 14 patients (10 %). In the PsA group, 19 patients (42.2 %) were receiving prednisolone, 8 patients (17.8 %) were on sulfasalazine, 28 patients (62.2 %) were taking methotrexate, and 3 patients (6.6 %) were using biologic agents (Etanercept or Infliximab).

Patients with PsA had the highest HAQ and DAS 28 scores, indicating a higher degree of functional impairment and disease impact ( $p < 0.05$ ). Table 2 displays the clinical and chemical variables of patients with SLE, PsA, and RA.

**Table 2**

*Clinical and laboratory characteristics in patients with SLE, PsA and RA.*

Variables	SLE (68)	PsA (N=45)	RA (140)	p-Value*	Post hoc testing P**
Duration of Disease	6.43± 6.5	2.00±5.1	3.88± 4.0	<0.001	SLE vs other: <0.05
HAQ Score, mean ± SD	0.268±0.4	1.14±1.5	0.545±0.6	<0.001	PsA vs other: <0.001
DAS 28 score, mean ± SD	-	3.70±1.45	3.11±1.3	0.023	-
SLEDAI, mean ± DE	1.12±2.0	-	-	-	-
SDI, mean ± DE	0.75±1.2	-	-	-	-
Prednisolone use: N (%)	63 (95.5 %)	19 (42.2 %)	105 (91.3 %)	<0.001	SLE vs other: <0.005
Prednisone, current daily dose, mean ± SD (mg/d)	11.89±11.0	6.57±12.2	6.08±3.6	0.001	SLE vs other: <0.005



Variables	SLE (68)	PsA (N=45)	RA (140)	p-Value*	Post hoc testing P**
Hydroxychloroquine use: N (%)	49 (74.2 %)	-	78 (56.1 %)	0.009	-
Hydroxychloroquine, current daily dose, mean ± SD (mg/d)	271.42±106.0	-	136.12±11.5	<0.001	-
Methotrexate use: N (%)	12 (17.6 %)	28 (62.2 %)	82(59 %)	<0.001	-

**Note:** SLE: systemic lupus erythematosus.

\* Derived from one-way analysis of variance (continuous variables) or chi-square test (categorical variables).

In accordance with the guidelines outlined by the *Adult Treatment Panel of the National Cholesterol Education Program III*, in this research, metabolic syndrome was present in 48.5 % of SLE patients, 55.5 % of PsA patients, 31.4 % in RA patients, and 34.9 % in controls (p = 0.007). Its prevalence among these patients, as per the IDF criteria, was 50 %, 57.8 %, 35 %, and 38 % in SLE, AP, RA, and controls, respectively.

The comparison of metabolic syndrome components revealed a larger waist circumference in SLE patients (p = 0.001) and hypertension in PsA patients (p = 0.000). The prevalence of hypothyroidism was higher in PsA patients. Table 3 displays the detected cases of metabolic syndrome and its components in SLE, PsA, RA, and control patients.

**Table 3**

*Metabolic syndrome and its components in patients with SLE, PsA, RA and controls.*

Variables	SLE (68)	PsA (N=45)	RA (140)	Controls (123)	p-Value*
Metabolic syndrome according to NCEP: N (%) (crude prevalence)	33 (48.5 %)	25 (55.5 %)	44 (31.4 %)	43 (34.9 %)	0.007
Age-adjusted prevalence	(45.8 %)	(52.1 %)	(33.8 %)	(35.1 %)	
Metabolic Syndrome according to IDF: N (%)	34(50 %)	26 (57.8 %)	49(35 %)	47(38 %)	0.019
Age-adjusted prevalence	(48 %)	(59.5 %)	(37.7 %)	(36.7 %)	
High Waist Circumference according to NCEP: N (%)	54 (79.4 %)	32 (71.1 %)	96 (69.6 %)	65 (52.8 %)	0.001
Hypertension or Treatment: N (%)	31 (45.6 %)	28 (62.2 %)	59 (42.1 %)	32(26 %)	<0.001

**Note:** NCEP = National Cholesterol Education Program; IDF = International Diabetes Federation.

\* Derived from chi-square tests (categorical variables).

## Discussion

In this study, cross-sectional research was conducted to assess the prevalence of metabolic syndrome in patients with SLE, PsA, and RA compared to controls. The findings revealed that metabolic syndrome occurred more frequently in patients with PsA and SLE than in those with RA and the controls. Patients with AP exhibited the highest prevalence of hypertension.

The population prevalence of metabolic syndrome, according to the criteria of the *Adult Treatment Panel of the National Cholesterol Education Program III*, was 29 % in an Iranian population (35 % in women vs. 24 % in men) during the period from 2005 to 2016 (Dalvand *et al.*, 2017). In the present study, the prevalence of metabolic syndrome in controls was 34.9 %, which was slightly higher than expected. The majority of patients in all groups were women, especially those with SLE, and this was an expected outcome based on the epidemiology of these diseases. The reasons for the differences in the prevalence of metabolic syndrome in patients with rheumatic diseases compared to the general population are not entirely clear.

Contrary to Gomes *et al.* (2018), who reported a significant increase in the prevalence of metabolic syndrome in 338 patients with RA compared to 84 controls, a higher prevalence of metabolic syndrome could not be demonstrated in the 140 patients with RA in the current study. This is consistent with the results of Karvounaris *et al.* (2007) and Mok, Ko *et al.* (2011), who found a similar prevalence of metabolic syndrome in 200 patients with RA and 400 control subjects, and in 699 patients with RA and 1398 controls, respectively.

The results of this research, when comparing the rate of metabolic syndrome in patients with PsA and RA, were consistent with those of Mok, Ko *et al.* (2011) and Labitigan *et al.* (2014), but inconsistent with the results of Zonana-Nacach *et al.* (2008) in patients with SLE and RA, according to the authors' understanding and knowledge.

The relationship between the prevalence of metabolic syndrome and inflammatory rheumatic diseases appears to be complex and dependent on various factors. Some research has reported that inflammatory cytokines such as TNF $\alpha$  and interleukin 6 (IL-6) reduce insulin activity, inhibit

insulin receptor autophosphorylation, and disrupt signaling pathways leading to hyperglycemia, compensatory hyperinsulinemia, and dyslipidemia (Senn *et al.*, 2002; Gupta *et al.*, 2007). On the other hand, abdominal fat can serve as a source of cytokine production, including TNF $\alpha$ , IL-6, and adiponectin (Matsuzawa, 2007).

Chronic treatment with various medications such as glucocorticoids and hydroxychloroquine, physical activity, and concomitant disorders like hypothyroidism can contribute to changes in the incidence of hypertension, blood glucose levels, lipid profile, and visceral obesity. In this study, patients with SLE used more steroids and hydroxychloroquine (at higher doses), while methotrexate was more common in patients with PsA, as shown in Table 2. The lower LDL values in SLE patients may be due to increased use of statins and hydroxychloroquine for this condition.

Lower blood sugar levels in patients with RA could be associated with the use of hydroxychloroquine. Although steroid use was less common in psoriasis, the odds of metabolic syndrome were higher. HAQ and DAS 28 were higher in patients with PsA, which may indicate greater disability in these patients and, consequently, a decrease in their daily physical activity. Hypothyroidism was more prevalent in patients with PsA (42.2 %) and lower in those with RA (9.3 %).

The lower LDL values in patients with SLE may be due to increased use of statins and hydroxychloroquine for this condition. Lower blood sugar levels in patients with RA could be associated with the use of hydroxychloroquine. Although steroid use was less common in PsA, the odds of metabolic syndrome were higher. These findings suggest that medication regimens and their effects on various metabolic parameters may play a significant role in the development of metabolic syndrome in patients with these rheumatic diseases.

HAQ and DAS 28 were higher in patients with PsA, which may indicate greater disability in these patients and, consequently, a decrease in their daily physical activity. Hypothyroidism was more prevalent in patients with PsA (42.2 %) and lower in those with RA (9.3 %;  $p = 0.000$ ), which could indicate greater disability in these patients and, consequently, a decrease in their

daily physical activity. According to previous studies, metabolic syndrome is more prevalent in patients with PsA than in those with RA, while it follows a similar pattern in patients with SLE and RA (Zonana-Nacach *et al.*, 2008; Mok, Ko *et al.*, 2011; Özkan *et al.*, 2017). Table 4 shows some research conducted on the prevalence of metabolic syndrome.

**Table 4**

*Studies on the prevalence of metabolic syndrome in patients with rheumatologic disorders.*

Author	Patients	Average age (year)	Metabolic syndrome in patients	p-Value	Diagnostic criteria	Clinical points
Medeiros <i>et al.</i> (2016)	146 SLE 101 controls	41.7 ±12.5	45.2 % SLE 32.7 % controls	0.04	NCEP	Association of Metabolic Syndrome with Age, Duration of SLE, and Damage Index
Mok, Poon <i>et al.</i> (2010)	123 SLE 492 controls	47.9±11	16.3 % LES 9.6 % controls	0.03	NCEP	Association of Metabolic Syndrome with Coronary Atherosclerosis
Slimani <i>et al.</i> (2017)	249 RA	50.1±14.5	13.9 %	-	NCEP	Higher ESR levels in patients with metabolic syndrome.
Gomes <i>et al.</i> (2018)	338 RA 84 controls	-	51.3 % RA 21.8 % controls	0.001	NCEP	
Haroon <i>et al.</i> (2016)	283 PsA 100 controls	54.6± 12 53.7± 14	44% PsA	-	National Heart, Lung, and Blood Institute	A significant association of metabolic syndrome with more severe PsA was observed.
Bostoen <i>et al.</i> (2014)	55 PsA 49 pso		25.5 % PsA 44.9 % pso	0.037	IDF	
Zonana-Nacach <i>et al.</i> (2008)	107 RA 85 SLE	43±13 (in general)	17 % in both groups	-	NCEP	Metabolic syndrome was associated with a shorter period of treatment with methotrexate and a higher HAQ score.
Labitigan <i>et al.</i> (2014)	294 PsA 1662 RA	55.7±11.9 61.6±12.2	27 % PsA 19 % RA	0.02	NCEP, IDF, WHO	PsA was associated with higher rates of obesity, DM and hypertriglyceridemia
Mok, Ko <i>et al.</i> (2011)	109 PsA 699 RA	50.4± 10.6 53.3±12	38 % PsA 20 % RA	0.001	Updated Joint Consensus Criteria	
Özkan <i>et al.</i> (2017)	102 PsA 102 RA	44.7±11.6 47.0±11.6	40.6 % PsA 24.7 % RA	0.019	NCEP, IDF	A significantly higher prevalence of hypertriglyceridemia was found in patients with PsA

Author	Patients	Average age (year)	Metabolic syndrome in patients	p-Value	Diagnostic criteria	Clinical points
<i>Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (2001)</i>	68 SLE 140 RA 45 PsA 123 controls	42.14± 11.52 44.70±5.0 44.00± 9.8 43.30±10.5	48.5 % SLE 31.4 % RA 55.5 % PsA 34.9 % controls	0.007	NCEP, IDF	

*Note:* NCEP= National Cholesterol Education Program; IDF=International Diabetes Federation.

## Conclusions

In the current study, metabolic syndrome occurred in one third to one half of the patients. This result coincides with those obtained by several researchers in other studies, although a direct comparison is difficult, due to differences in patient selection and some parameters such as age, duration and signs of the disease; and the different modalities of immunosuppressive therapies. Considering the high prevalence of metabolic syndrome in the patients in this study, systematic screening for the components of metabolic syndrome is recommended, especially in patients with PsA and SLE.

While every effort was made to conduct this study carefully and p accurately report interpretable results; like many studies, it had some limitations. Firstly, the association between cardiovascular disease and metabolic syndrome was not assessed, which would have helped to better analyze the actual significance of detecting metabolic syndrome as a promoter of future vascular damage in patients with rheumatological disorders. However, this and other similar studies allow us to recognize the role of chronic inflammation and its contribution to metabolic syndrome and different diseases. Secondly, the sample size was relatively small, due to the difficulties associated with age and gender in patients with SLE (young women), RA (middle-aged women), and PsA (middle-aged men/women).

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### Conflict of interest

The authors declare that they have no conflict of interest.

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