Original article

Chronic low back pain in patients with systemic lupus erythematosus: prevalence and predictors of back muscle strength and its correlation with disability

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ARTICLE INFO

ABSTRACT

Objective: To determine the prevalence of Chronic Low Back Pain and predictors of Back Muscle Strength in patients with Systemic Lupus Erythematosus.

Methods: Cross-sectional study. Ninety-six ambulatory patients with lupus were selected by non-probability sampling and interviewed and tested during medical consultation. The outcomes measurements were: Point prevalence of chronic low back pain, Oswestry Disability Index, Tampa Scale of Kinesiophobia, Fatigue Severity Scale and maximal voluntary isometric contractions of handgrip and of the back muscles. Correlation coefficient and multiple linear regression were used in statistical analysis.

Results: Of the 96 individuals interviewed, 25 had chronic low back pain, indicating a point prevalence of 26% (92% women). The correlation between the Oswestry Index and maximal voluntary isometric contraction of the back muscles was $r = -0.4$, 95% CI [−0.68; −0.01] and between the maximal voluntary isometric contraction of handgrip and of the back muscles was $r = 0.72$, 95% CI [0.51; 0.88]. The regression model presented the highest value of R^2 being observed when maximal voluntary isometric contraction of the back muscles was tested with five independent variables (63%). In this model handgrip strength was the only predictive variable ($\beta = 0.61$, $p = 0.001$).

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Conclusions: The prevalence of chronic low back pain in individuals with systemic lupus erythematosus was 26%. The maximal voluntary isometric contraction of the back muscles was 63% predicted by five variables of interest, however, only the handgrip strength was a statistically significant predictive variable. The maximal voluntary isometric contraction of the back muscles presented a linear relation directly proportional to handgrip and inversely proportional to Oswestry Index i.e. stronger back muscles are associated with lower disability scores.

Lombalgia crônica em pacientes com lúpus eritematoso sistêmico: prevalência e preditores da força muscular de extensão de tronco e sua correlação com a incapacidade

R E S U M O

Palavras-chave:
Lúpus eritematoso sistêmico
Lombalgia crônica
Força muscular
Prevalência
Predição

Objetivo: Determinar a prevalência de lombalgia crônica (LBC) e os preditores de força muscular nas costas (FMC) em pacientes com lúpus eritematoso sistêmico (LES).
Métodos: Estudo transversal. Selecionaram-se 96 pacientes ambulatoriais com LES por amostragem não probabilística, entrevistados e testados durante consultas médicas. As medidas de desfecho foram: prevalência ocasional de LBC, Índice de Incapacidade de Oswestry, Escala Tampa para Cinesiofobia, Escala de Gravidade da Fadiga e contrações isométricas voluntárias máximas (CIVM) de preensão manual e dos músculos das costas. Usaram-se o coeficiente de correlação e a regressão linear múltipla na análise estatística.
Resultados: Dos 96 indivíduos entrevistados, 25 apresentavam LBC, o que indicou uma prevalência circunstancial de 26% (92% mulheres). A correlação entre o Índice de Incapacidade de Oswestry e a contração isométrica voluntária máxima dos músculos das costas foi de r = −0,4, IC 95% [−0,68; −0,01] e entre a CIVM de preensão manual e dos músculos das costas foi de r = 0,72, IC 95% [0,51; 0,88]. O modelo de regressão apresentou o maior valor de R^2 observado quando a CIVM dos músculos das costas foi testada com cinco variáveis independentes (63%). Nesse modelo, a força de preensão manual foi a única variável preditiva (ß = 0,61, p = 0,001).
Conclusões: A prevalência de LBC em indivíduos com LES foi de 26%. A CIVM dos músculos das costas foi 63% prevista por cinco variáveis de interesse. No entanto, apenas a força de preensão manual foi uma variável preditiva estatisticamente significativa. A CIVM dos músculos das costas apresentou uma relação linear diretamente proporcional à força de preensão manual e inversamente proporcional ao Índice de Incapacidade de Oswestry (ou seja, músculos das costas mais fortes estão associados a menores pontuações de incapacidade).

Introduction

Low back pain is defined by the presence of pain between the costal margin and the gluteal folds, it has a variable clinical presentation and is said to be chronic when persisting for more than three months.[1,2] Chronic low back pain (CLBP) is considered a public health problem associated with high economic costs in industrialized nations.[3,4] The direct costs of low back pain in the United States of America (USA), for example, are approximately $ 100 billion per year.[5] In Europe, the costs are two to four billion euros per year, however, there has been no evaluation of the societal costs of back pain in Brazil.[6,7]

Systemic lupus erythematosus (SLE) is a chronic inflammatory, autoimmune disease, which negatively affects multiple organs and systems and presents with periods of remission and exacerbation.[8] SLE more commonly affects young women of reproductive age, in a ratio of nine to ten women to one man.[9] The incidence of SLE in Brazil is estimated to be 8.7 cases per 100.000 people per year.[10] The etiology of SLE is unclear, however, diagnostic and management criteria are available.[11–13]

SLE is a complex disease with a variable clinical presentation inflammatory arthritis, mainly affecting the small joints of the hands and knees, is the most frequent cause of musculoskeletal pain, often preceding other manifestations of the disease.[14] CLBP is common in some inflammatory arthropathies, for example a recent study reported a prevalence of 65% of CLBP in patients with rheumatoid arthritis (RA).[15] However, there is currently no information on the prevalence of CLBP in SLE.

Recent work has reported that patients with SLE have reduced muscular strength and functional capacity compared to age and sex matched health controls.[16] One explanation for reduced muscular strength in SLE is based on the use of

corticosteroids, which can cause muscle fiber hypertrophy, leading to decreased strength and exacerbation of fatigue.[17] About 80% of those with SLE identify fatigue as the symptom that most impacts on quality of life and physical activity,[18] and there is growing consensus that back exercises are an important intervention in preventing and managing CLBP.[19] However, there has been no research that has explored how the characteristics of SLE are related to the back muscle strength in patients with SLE, who are also affected by CLBP. Therefore, this study aimed: (I) to determine the prevalence of CLBP in patients with SLE and (II) to evaluate the relationship between clinical, physical, and functional variables as predictors of the back muscle strength in patients with SLE and CLBP.

Material and methods

Subjects

This study was approved in 2014 by the Research Ethics Committee of the University who judged the study (CAAE: 27527214.7.0000.0030). Participants were recruited from the University Hospital (Rheumatology Clinic) under non-probabilistic sampling method. During consultations participants were recruited by rheumatologists, who explained the study and gained written informed consent. According to information from the Statistics Department of the Hospital, the Rheumatology Clinic has about 200 patients regularly attended by the team of clinicians and residents. Based on these figures, the following formula was used to calculate the required number of interviews for the study: $n = N*n_0/N + n_0$, where N = population size; n = sample size and n_0 = first approximation to the sample size. To establish n_0, an initial calculation was performed using the following formula: $n_0 = 1/E_0{}^2$, where $E_0{}^2$ = tolerable sampling error (5%).[20] The sample size calculation demonstrated the need to interview 40 individuals.

In order to be included in the study participants, were required to have been diagnosed with SLE by a rheumatologist, have persistent pain in the lumbar spine for more than three months and be attending the University Hospital of Rheumatology Clinic. Patients were excluded from the study if they were: pregnant, had a history of fracture and/or surgery of the lumbar spine, had a urinary tract infection in the previous three months, had a history of tumor or cancer in the lumbar spine, pelvic organs and/or gastrointestinal tract, or had an aortic aneurysm in the descending portion.

Outcome measures

During routine clinics, the physicians interviewed participants to verify the existence of CLBP, and record socio-demographic variables, life habits, the clinical features of CLBP and SLE activity. The disease activity was performed by a rheumatologist using the Systemic Lupus Erythematosus Disease Activity Index (SLEDAI), where score can range from 0 to 105 points.[21] Scores greater than eight indicate the disease is active, and values greater than or equal to 12 points indicate severe disease activity.[22] The intensity of the CLBP was evaluated using the numerical pain scale, where the patient quantifies their pain on a scale of 0 to 10, with 0 indicating "no pain" and 10 indicating "perceived maximum pain", at the time of evaluation.[23]

The other independent variables of the study were obtained through: (I) the impact of pain on activities of daily living (ADLs) using the Oswestry Disability Index questionnaire (ODI), subdivided into 10 parts. The first section of the ODI deals with the intensity of pain and other nine sections address the incapacitating effects of the pain on activities of daily living, with the final score given as a percentage and classifying the patients according to the degree of capacity[24]; (II) the fear and avoidance of movements, using the Tampa Scale of Kinesiophobia (TSK), which comprises 17 statements related to pain, to which the patient completely disagrees (1), partially disagrees (2), partially agrees (3) or completely agrees (4), the score ranges from 17 to 68 points (the higher score indicated the greater degree of kinesiophobia)[25]; (III) evaluation of related fatigue using the Fatigue Severity Scale (FSS), which consists of a questionnaire with nine questions related to physical fatigue and energy loss, the score ranges from 1 to 7, 1 indicates completely disagree and 7 completely agree (a higher score indicated the greater degree of fatigue),[26] and (IV) maximal voluntary isometric contraction (MIVC) of handgrip strength (HG) using a Jamar hydraulic dynamometer (Warrenville, Illinois), the handgrip test is used as a predictor of the general state of global strength.[27] During the MIVC of HG, the patient was requested to remain sitting on a couch without arm support, keeping their back straight, knees bent at 90 degrees, shoulder in adduction and neutral rotation, elbow flexed at 90°, with the forearm in an intermediate position between pronation and supination. The palmar grasp was standardized as the middle phalanges of the fingers.[28] The HG was performed bilaterally, but only the values of the dominant side were used for data analysis purposes.

The dependent variable was the MVIC of the back muscles, which was obtained with the use of a dorsal CROWN® dynamometer (São Paulo, Brazil), performed after the interview (questionnaires) and HG measurement. The patients stood on the marked footprints of the dynamometer platform and were requested to maintain a straight back with arms extended posteriorly behind the individual and knees extended. Participants then performed anterior flexion of the trunk; hold the handle of the dynamometer with both hands and performed the isometric extension for the evaluation of MVIC (Fig. 1). Three measurements were performed with standardized verbal commands, with a rest interval of 1 min between attempts.

The highest value of the three measurements was used for both the HG and the back muscles MVIC during statistical analysis. Three examiners performed the evaluation procedures in the following order: one responsible for the implementation of the questionnaire developed by the authors (prevalence and clinical aspects), another for the application of the scales (ODI, TSK and FSS), and the third responsible for the operationalization of the MVIC strength tests.

Fig. 1 – Maximal voluntary isometric contraction of the back muscles. Initial (left) and final (right) position of the test.

Statistical analysis

Data normality was tested using the Shapiro–Wilk test and are presented by mean and standard deviation or median and quartiles (25–75%) when the assumptions were not met. The correlation between the dependent and independent variables was performed using the Pearson correlation coefficient. Multivariate regression analysis tested the single prediction model set up to study the relationship of the dependent variable (MVIC of back muscles) with all the independent variables (age, SLEDAI, diagnostic time, intensity of low back pain, ODI, TSK, FSS and HS). The stepwise regression model was used to identify the highest R^2 for the tested model. Multicollinearity was considered present in the occurrence of tolerance $p < 0.1$ and VIF near 1. For the multiple linear regression the assumptions of residues with normal behavior in the graphical representation Q–Q Plot and in the Shapiro–Wilk test were met. Statistical significance was set at 5% and all analyses were performed with SPSS version 21.0 (Armonk, New York).

Results

From a total of 96 individuals interviewed, 37 presented with CLBP, however, 12 were excluded due to the exclusion criteria. Therefore, 25 participants took part in the study and provided data for statistical analysis, indicating a point prevalence of CLBP of 26%.

From Table 1 it can be seen that the sample was composed predominantly of women ($n = 23$; 92%), with a mean age of 43 years (SD = 13.9), most participants were employed and had high school or higher education. Table 2 demonstrates that

Table 1 – Descriptive analysis of the characteristics of the sample ($n = 25$).	
Characteristics	n (%)
Gender	
Women	23 (91.7)
Men	2 (8.3)
Employed (yes)	15 (60)
Level of education	
None	3 (12)
Elementary school	3 (12)
High school	13 (52)
Higher education	6 (24)
Physical activity (over 150 min)	8 (32)
Smoking status	
Smoker	4 (16)
Ex-smoker	5 (20)
Non-smoker	16 (64)
Current comorbidities	
Hypertension	19 (76)
Hypothyroidism	2 (8)
Dyslipidemia	5 (20)
Fibromyalgia	3 (12)
Diabetes mellitus	1 (4)
Self-evaluation of health	
Good	7 (28)
Regular	13 (52)
Bad	5 (20)

the median time since SLE diagnosis was 9 years (5–11) with a median SLEDAI score of 3.0 (0–10). The mean duration of CLBP was 7 years (SD = 6.4) with a mean pain intensity of 5.8 (SD = 2.3).

Table 2 – Descriptive analysis of the dependent and independent variables (n = 25).

Characteristic	Mean (SD) or median (25–75%)[a]	95% CI
Age	42.5 (13.6)	36.9; 48.7
SLEDAI	3 (0–10)[a]	–
Duration of SLE	9 (5–11)[a]	–
Pain	5.8 (2.3)	4.7; 6.6
ODI	20.2 (14.2)	10.3; 47.5
TSK	42 (7.4)	38.6; 45
FSS	37.4 (14.2)	32.9; 45
HS (N)	247.1 (72.9)	215; 274
MVIC (N)	367.7 (159.4)	304; 439

SLEDAI, Systemic Lupus Erythematosus Disease Activity Index; ODI, Oswestry Disability Index; TSK, Tampa Scale of Kinesiophobia; FSS, Fatigue Severity Scale; HS, Manual Handgrip Strength; MVIC, Maximum Voluntary Isometric Contraction; N, Newton.

[a] Results presented as median (25–75%).

Table 3 – Correlation between MVIC of back muscles and independent variables.

Independent variables	Dependent variable (MVIC of back muscles)	
	r	95% IC
Age	−0.19	−0.53 to 0.21
SLEDAI	−0.22	−0.55 to 0.18
Duration of SLE	−0.18	−0.53 to 0.23
Intensity of pain (END)	−0.17	−0.22 to 0.53
ODI	−0.4	−0.68 to −0.01
TSK	−0.23	−0.56 to 0.17
FSS	−0.14	−0.5 to 0.26
HS (N)	0.72	0.46 to 0.86

MVIC, Maximum Voluntary Isometric Contraction; SLEDAI, Systemic Lupus Erythematosus Disease Activity Index; END, numerical pain scale; ODI, Oswestry Disability Index; TSK, Tampa Scale of Kinesiophobia; FSS, Fatigue Severity Scale; HS, Manual Handgrip Strength.

Table 3 presents the results of the correlation analysis between the dependent and independent variables. The two correlations selected were (1) ODI and MVIC of the back muscles ($r = -0.4$), and between (2) MVIC of HG and MVIC of back muscles ($r = 0.72$).

The model tested presented statistical significance, the highest value of R^2 being observed when MVIC of the back muscles (dependent variable) was tested with five independent variables ($R^2 = 0.63$; R^2 adjusted = 0.53). In this model the

MVIC of HG was the only predictive variable with statistical significance ($p = 0.001$; $\beta = 0.61$) (Table 4).

Discussion

The present study aimed to determine the prevalence of CLBP in patients with SLE and the relationship between the MVIC of the back muscles and clinical, physical and functional variables. The results demonstrated a point prevalence of 26% of CLBP in people with SLE. These results can be compared with prevalence figures for people with rheumatoid arthritis,[15,29–31] and individuals with CLBP.[6]

Baykara et al.[15] evaluated the prevalence of low back pain in patients with RA and found a prevalence of 64.5%. Neva et al.[29] reported that the prevalence of CLBP was 19% in patients with RA, suggesting that, although common in RA, is not higher than in healthy controls (25%). However, higher rates of CLBP have been reported in RA, Kothe et al.,[30] for example, studied the impact of CLBP in patients with RA and reported a prevalence of 53.4%. Sakai et al.[31] conducted a study of radiographic images of the lumbar spine in patients with RA and determined that the prevalence of disk lesions was 45.2%, suggesting this as the origin of pain in the population described. The results found in the present study suggest that CLBP in SLE is similar to or is slightly lower than that found in RA, but highlights the need for further studies on CLBP in SLE.

Some studies which evaluated the prevalence and risk factors for the development of CLBP in young adults reported a prevalence ranging from 15% to 45%.[6] Meucci et al.[32] for example, in a systematic review found that the prevalence of CLBP may vary according to age. In individuals between 24 and 39 years the prevalence of CLBP was 4.2%, 19.6% between 20 and 59 years and 25.4% in the elderly. Garcia et al.[33] reported a 10.5% prevalence of CLBP in the general Latin American population, reaching up to 65% for more exposed to risk factors groups such as those involved in heavy manual labor, for example, sawyers, truck loaders, homemakers, and assistant nurses. Nascimento and Costa.[34] performed a systematic review of the prevalence of CLBP in Brazil, and found high rates (>50%) in adults, 13.1%–19.5% in adolescents and 4.2%–14.7% for CLBP in the general population. The results from the current study demonstrate that the prevalence of CLBP in those with SLE is greater than that found in the general population.

From the correlation analysis between MVIC of the back muscles and the independent variables, two statistically significant correlations were observed between the ODI and MVIC

Table 4 – Multivariate linear regression.

Dependent variable	Independent variable	R^2	Adjusted R^2	Standardized β	p
MVIC	SLEDAI	0.63	0.53	0.27	0.13
	ODI			0.26	0.11
	TSK			0.27	0.12
	FSS			0.21	0.20
	HS			0.61	0.01

MVIC, Maximum Voluntary Isometric Contraction; SLEDAI, Systemic Lupus Erythematosus Disease Activity Index; ODI, Oswestry Disability Index; TSK, Tampa Scale of Kinesiophobia; FSS, Fatigue Severity Scale; HS, Manual Handgrip Strength.

($r = -0.4$) and between HS and MVIC ($r = 0.72$). The results found for ODI and MVIC presented a moderate negative correlation, showing that a higher MVIC of back muscles is associated with lower functional disability related to pain. Ruiz et al.[35] demonstrated the relationship between the movement of the lumbar spine (range of motion without pain and functional range of motion), pain and disability (evaluated using the ODI) in individuals with CLBP. These authors found a positive correlation between the ODI and the intensity of low back pain (the higher the pain, the higher the reported functional disability); decreased range of motion was also associated with greater disability. Grönblad et al.[36] evaluated the correlation between the Pain Disability Index and the ODI in patients with CLBP. The authors also found a moderate positive correlation between the ODI and pain intensity. Our findings allow us to suggest that a greater MVIC of the back muscles in those with SLE results in a lower impact on activities of daily living (ODI). The finding that there was a strong positive correlation between MVIC of HG and MVIC of back muscles suggests that back muscle strength is directly proportional to HG. These finding are supported by previous work, for example Soares et al.[37] analyzed the correlation between HG, scapular and lumbar dynamometer tests in healthy subjects. These authors demonstrated a moderate positive correlation between HG and MVIC of lumbar spine ($r = 0.58$).

Regarding the regression analysis, HG was the only predictive variable with statistical significance ($p = 0.001$; $\beta = 0.61$). The regression equation can be described as follows: MVIC $= a + b{}^{*}X$, where a = a straight interception constant on the vertical axis; b = a constant representing the slope of the line; X = the variable that represents the explanation factor in the equation. Thus, MVIC of the back muscles $= 25.5 + 1.3{}^{*}247.1$; MVIC $= 346.73$ N. Therefore, in clinical practice, HG can predict MVIC of back muscles in patients with SLE. This fact is undoubtedly clinically relevant since, according to several studies, the HG is used as a predictor of the general state of global strength.[37,38] Balsamo et al.,[16] to determine the association between muscular strength and dynamic fatigue, functional performance and quality of life in patients with SLE, demonstrated that of all the independent predictive variables of 52% of dynamic muscle strength, the HG was one of the predictor variables with statistical significance ($p = 0.0027$; $R^2 = 0.22$; $\beta = 2.09$).

Demoulin et al.[39] investigated the relationship between three variables of fear related to pain (TSK, Photograph Series of Daily Activities [PHODA] and Fear Visual Analog Scale) and three specific tests of functional capacity of the spine (Finger Floor Distance, MVIC and the Sorensen test) in individuals with CLBP, and correlated with measures of pain. It was found that gender was the only predictive variable of MIVC with statistical significance ($p < 0.001$; $\beta = 0.621$), which was not verified in the present study. Keller et al.[40] investigated the variables associated with improvements in muscle strength (pain, fear and disability measured by ODI) and quantified how these variables contributed to the change in back muscle strength in patients with CLBP. The change in pain, change in fear-avoidance beliefs, change in self-efficacy for pain and treatment explained 46% of the change in muscle strength, with change in pain and treatment as significant predictors.

The current study had some methodological limitations: many participants refused to participate in the research, which may have resulted in an underestimation of the prevalence of CLBP, and in some patients, it was also not possible to determine the SLEDAI, which also generated sample loss. Finally, the results should be interpreted with caution, since the application of prediction in this type of study does not necessarily imply a cause and effect relationship.

The prevalence of CLBP in patients with SLE attending the Rheumatology Clinic at the University Hospital was 26%. The correlation analysis between the MVIC and the independent variables indicated two statistically significant correlations. There was a moderate negative correlation between ODI and MVIC and a strong positive correlation between HS and MVIC. The MVIC was 63% predicted by five variables of interest, however, only the HG strength was a statistically significant predictive variable.

Conflicts of interest

The authors declare no conflicts of interest.

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