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Estudio de caso

ARTÍCULO EN INGLÉS

## Muscular strength, bone density and body composition of a woman with systemic lupus erythematosus submitted to a resistance training program: a case report

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### ABSTRACT

**Introduction.** Physical activity can provide long-term benefits for systemic lupus erythematosus (SLE).

**Objective.** This study sought to demonstrate the effects of progressive resistance training on the muscular strength, bone mineral density (BMD) and body composition of pre-menopausal women with SLE undergoing glucocorticoid (GC) treatment.

**Materials and Methods.** This is the case report of a 43-year-old African-South American premenopausal woman with non-extensive SLE and low bone density. A six-month program with three bimonthly cycles of 70%, 80%, and 90% intensity according to the 10 maximum-repetition test was used. Dual-energy X-ray absorptiometry (DXA) was used to measure the BMD, T-scores and body composition, and indirect fluorescence was used to measure the levels of antinuclear antibodies. Student's t-test was used.

**Results.** Statistical improvement was noted in all strength exercises, including the 45° leg press ( $\Delta\% = +50\%$ ,  $p < 0.001$ ) and knee extension ( $\Delta\% = +15\%$ ,  $p = 0.003$ ) to maintain the BMD of the L<sub>2</sub>-L<sub>4</sub> lumbar ( $\Delta\% = +0.031\%$ ;  $p = 0.46$ ) as well as the trochanter ( $\Delta\% = +0.037\%$ ;  $p = 0.31$ ) and BMI ( $\Delta\% = -0.8$ ,  $p = 0.54$ ).

**Conclusion.** In this case study, the presented methodology had a positive effect on strength and contributed to the maintenance of BMD and body composition in a woman with SLE undergoing GC treatment.

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### RESUMEN

**Fuerza muscular, densidad ósea y composición corporal de una mujer con lupus eritematoso sistémico sometido a un programa de entrenamiento de resistencia**

**Introducción.** La actividad física puede proveer beneficios a largo plazo para el lupus eritematoso sistémico (LES).

**Objetivo.** Esta investigación busca demostrar los efectos del entrenamiento de resistencia progresiva sobre: la fuerza muscular, la densidad mineral ósea (DMO) y la composición corporal de una mujer premenopáusicas con LES sometido a tratamiento con glucocorticoides.

**Materiales y Métodos.** Una mujer con 43 años de edad, afrodescendiente, premenopáusicas con LES sin gravedad y baja DMO fue sometida a programa de 6 meses con 3 ciclos bimestrales de 70, 80 y 90% de intensidad, considerando un test de fuerza máxima de 10 repeticiones máximas. Se utilizó, para medir la DMO, la absorptiometría de doble energía con rayos X, evaluando los T-scores, el índice de masa corporal y la fluorescencia indirecta para medir los anticuerpos antinucleares. Para la comparación de medias de variables, se utilizó el test de la T de Student.

**Resultados.** Se observó mejora en la fuerza, incluyendo ( $\Delta\% = 50\%$ ,  $p < 0,001$ ) en la prensa de piernas de 45°, ( $\Delta\% = 15\%$ ,  $p = 0,003$ ) en la extensión de la rodilla, como el mantenimiento de la DMO de la columna lumbar L<sub>2</sub>-L<sub>4</sub> ( $\Delta\% = 0,031\%$ ,  $p = 0,46$ ) y trocánter ( $\Delta\% = 0,037\%$ ,  $p = 0,31$ ), además de mantener el índice de masa corporal ( $\Delta\% = -0,8$ ,  $p = 0,54$ ).

**Conclusión.** En este estudio de caso, se observaron efectos positivos sobre la fuerza muscular e indicios de mantenimiento de la DMO y de la composición corporal de una mujer con LES en tratamiento con glucocorticoides.

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## Introduction

Systemic lupus erythematosus (SLE) is a chronic inflammatory immune system disease of unknown etiology in which antibodies and immune complexes injure different cells and tissues<sup>1</sup>. The risk for SLE development has a genetic component that is often associated with environmental factors and lifestyle choices, such as solar radiation exposure, stress, sedentary behavior, and the use of certain medications, that tend to trigger disease manifestation<sup>2</sup>.

SLE can occur in all ethnic and age groups, and it is more severe in children and young adults despite being more frequently diagnosed in women of reproductive age<sup>3</sup>. The SLE diagnosis was established by the American College of Rheumatology in 1982 and revised in 1997<sup>4</sup>, and it is based on the presence of at least four of eleven criteria, including discoid lesions (erythematous), photosensitivity, arthritis (non-erosive with pain, swelling, and joint effusion) and abnormal titers of antinuclear antibodies (ANA)<sup>4</sup>. Although there are many criteria related to the SLE diagnosis, the positive result of ANA revealed by immunofluorescence may be indicative of the diagnosis<sup>5</sup>.

For the treatment of SLE, glucocorticoids (GC) are among the drugs used most commonly because they have an anti-inflammatory effect that reduces pain and immunosuppression, which inhibits the synthesis of autoantibodies<sup>6</sup>. However, the main adverse effects resulting from the prolonged use of GC include a reduction in bone mineral density (BMD)<sup>6</sup>. In addition, the sarcopenia is another effect that reduces muscle mass and consequently the strength with negative consequences for the functional autonomy, with an increased risk of falls<sup>7</sup>.

Most existent studies have investigated aerobic capacity<sup>8-11</sup>, and few studies have focused on the effects of resistance training (RT) in older women with SLE<sup>11</sup>.

The studies suggest that physical activity can provide long-term benefits for SLE<sup>8,10</sup> and that measures aimed at improvement through physical exercise can contribute to overall functional performance, fatigability, social stress and quality of life in individuals affected by diseases that result in bone demineralization by helping to control BMD loss<sup>8,9,11</sup>.

Among the different types of physical activities, RT has demonstrated effectiveness in treating women with low BMD through effective control of the volume and intensity of loads to favor strength and BMD increases<sup>12-14</sup>. In addition, the RT can protect against sarcopenia. This process produces important and severe effects on the functional autonomy and quality of life in older women and is the most frequent cause of disability, dependency and increased or morbi-mortality<sup>7</sup>. However, few studies related to SLE and physical activity, especially regarding RT, have been presented in the literature<sup>8</sup>. Thus, this case study aimed to demonstrate the effects of progressive RT on BMD and muscle strength in premenopausal women with SLE treated with GC.

## Materials and methods

The individual in this intra-subject study was a 43-year-old premenopausal female volunteer with normal ovulation, who was 155 cm in height and weighed 52 kg. The subject did not engage in any physical activity for four months, even though she used to practice RT and walked regularly before this period. She is an African-South American woman, whose disease was detected 15 years ago. However, she did not have extensive SLE, nor was her system compromised by

lupus. In addition, the volunteer had a history of chronic arthritis with pain, edema and photosensitivity. The patient also presented ANA 1:160 (fine speckled), which can suggest the presence of positive anti-SSA/Ro. The fact that the patient presented negative anti-DNA and anti-Sm (Smith) does not exclude the diagnosis of lupus, as the patient did not present signs or symptoms of dry mouth syndrome, which rules out the diagnosis of Sjögren's syndrome.

The volunteer had normal functional activity and carried out her daily work activities. Her treatment, prescribed by the physician in charge, was based on the daily use of 7.5 mg/day of GC and 6 mg/kg/day of hydroxychloroquine sulfate; the dose was adjusted as necessary throughout the study period. In addition, the volunteer was not taking medication for anti-conception for more than 20 years and was also not taking medications such as bisphosphonates for low BMD. However, less than 5 years prior to the study, the volunteer had begun taking vitamin D<sup>+</sup>/day (400 UI). This regimen was continued throughout the study period.

The volunteer agreed to the presentation of her case for scientific research purposes by signing an informed consent form. The project was approved by the research ethics committee at the University Castelo Branco-RJ COMEP / PROCIMH under proposal number 0171/2008.

The osteopenia diagnosis was obtained using a dual-energy X-ray absorptiometry (DXA) machine manufactured by Lunar<sup>®</sup> (USA; DPX class with a 750- $\mu$ A current, calibrated daily). A medical specialist performed the examination with the volunteer in a supine position on the equipment table with her legs supported at an immobile 30° angle. Scanning was performed in the region of the right femur and lumbar spine. The variables provided by DXA were body composition (height, mass and BMI), BMD (g/cm<sup>2</sup>) and negative *T-scores* for the lumbar spine L<sub>2</sub>-L<sub>4</sub>, femoral neck, and trochanter.

Based on the DXA, the BMD of the lumbar L<sub>2</sub>-L<sub>4</sub> was 0.904 g/cm<sup>2</sup> with a *T-score* of -2.46 standard deviations (SD). For the femoral neck, the BMD was 0.764 g/cm<sup>2</sup> with a *T-score* of -1.80 SD; for the trochanter, the BMD was 0.677 g/cm<sup>2</sup> with a *T-score* = -1.03 SD.

Because the subject had already practiced RT and did not present swollen joints or muscle soreness, the RT followed the timeline proposed by Borba-Pinheiro et al<sup>12,13</sup> using bimonthly cycles, with the 10 maximum repetition test (10RM) performed at progressive intensities. The subject performed the 10 RM test at the beginning and the end of each cycle over the six-month training period (table 1). Each training session lasted sixty minutes and was performed three times per week on alternate days.

The volunteer performed nine exercises: the 45° leg press, knee extension, hip adduction, plantar flexion, gluts, squats, elbow flexion, elbow extension, and shoulder adduction. The equipment used for the training was manufactured by Pró-Physical<sup>®</sup> (Brazil).

## Results

At the end of the six-month period, new evaluations were conducted, and the volunteer demonstrated maintenance of the BMD and *T-scores*. The absolute percentage difference was calculated by subtracting the initial test from the post-test [ $\Delta\%$  = post-test - pre-test]. Then, Student's *t*-test for BMD variables was used, as shown in table 2.

Table 3 presents the percentage improvements in muscle strength observed throughout the progressive load increase utilized in the three 10RM tests.

**Table 1**  
Periodization of Resistance Training

Six months		
Bi-months – Cycle 1	Bi-months – Cycle 2	Bi-months – Cycle 3
Intensity – 70%	Intensity – 80%	Intensity – 90%
9 exercises	9 exercises	9 exercises
3 sessions	3 sessions	3 sessions
15 – 20 repetitions	8 – 10 repetitions	5 – 7 repetitions
VME – Moderate	VME – Maximum	VME – Slow
Interval sessions – 40 sec	Interval sessions – 60 sec	Interval sessions – 60 sec
Interval exercises – 60 sec	Interval exercises – 60 sec	Interval exercises – 60 sec

VME: Velocity of movement execution. Borba-Pinheiro et al<sup>12,13</sup>.**Table 2**  
Study Variables

Variables	Pre-test	Post-test	Δ%	p-value
Mass (kg)	52.0	50.0	-2.0	0.52*
Height (cm)	155.0	155.0	0.0	1.00*
BMI (kg/m <sup>2</sup> )	21.6	20.8	-0.8	0.54*
BMD Neck of the femur (g/cm <sup>2</sup> )	0.764	0.754	-0.01	0.80*
BMD Trochanter (g/cm <sup>2</sup> )	0.677	0.711	0.03	0.31*
BMD Lumbar L <sub>2</sub> -L <sub>4</sub> (g/cm <sup>2</sup> )	0.904	0.934	0.03	0.46*
T score Neck of the Femur (SD)	-1.8	-1.88	0.08	1.00*
T score Trochanter (SD)	-1.03	-0.69	0.34	1.00*
T score L <sub>2</sub> -L <sub>4</sub> (SD)	-2.46	-2.22	0.24	1.00*

BMD: Bone Mineral Density; BMI: Body Mass Index; (\*): Student's t-test.

## Discussion

The results achieved in this case report directly demonstrate the percentage increase of muscle strength in all of the performed exercises and the maintenance of the BMD of the lumbar L<sub>2</sub>-L<sub>4</sub> and greater trochanter, although the volunteer used GC, which promotes a reduction in BMD. The low BMD of the volunteer may be attributed to the daily use of GC for the control of articular pain<sup>6</sup>.

In a similar studies, Borba-Pinheiro et al<sup>12,13</sup> report that RT planned over a 12-month period for post-menopausal women, consisting of three weekly sessions and different bimonthly intensities, was effective for increasing muscle strength and the BMD of the lumbar L<sub>2</sub>-L<sub>4</sub>, femoral neck, and greater trochanter of the volunteers compared with those engaged in other activities and the control group.

Borba-Pinheiro et al<sup>12,13</sup> emphasize that effective gains and the maintenance of muscle strength and BMD require periodized resistance training, which is corroborated by other studies<sup>13,14</sup>. In addition to the load test, the training program is based on individual biology in terms of the selection of exercises and the use of interdependent volumes and intensities to establish the number of exercises, sets, repetitions, breaks, weekly sessions and intensities that would serve each individual best<sup>4</sup>.

**Table 3**  
Strength Exercises-Variables

Exercises (kg)	Pre Test	Post 1	Post 2	Post 3	Δ% Post 1-Pre Test	Δ% Post 2-Post 1	Δ% Post 3-Post 2	Δ% Post 3-Pre Test
Leg press at 45°	160	182	196	210	22	14	14	50*
Knee extension	35	40	45	50	5	5	5	15*
Hip adduction	40	45	50	55	5	5	5	15*
Plantar flexion	45	50	60	65	5	10	5	20*
Squats	30	35	40	45	5	5	5	15*
Gluts	45	55	60	65	10	5	5	20*
Elbow flexion	4	5	6	6	1	1	0	2*
Elbow extension	30	35	35	40	5	0	5	10*
Shoulder adduction	25	30	35	40	5	5	5	15*

Δ%: Post-test-Test; (\*): p&lt;0.05 by Student's t-test.

As to the relationship between SLE and physical activity, there are few reports addressing the effects. However, Ayan and Martin<sup>8</sup> suggest that physical exercise can improve cardiovascular fitness, reduce metabolic abnormalities or fatigue and consequently contribute to an improved quality of life for individuals with this disease. The study performed by Carvalho et al<sup>9</sup> reinforces this hypothesis because it reported a significant improvement in exercise tolerance, aerobic capacity, quality of life and depression symptoms after the completion of a supervised cardiovascular training program for patients with SLE.

In another study using two groups of volunteers with SLE, one performing aerobic training and the other performing strength training with 70-80% of the maximum load with 2-3 sets of 10 repetitions at three weekly 50-minute sessions, the exercises performed by both groups were considered safe and did not aggravate the symptoms of SLE over a period of eight months<sup>11</sup>. Individuals from both groups showed improvements in fatigue, functional capacity, cardiovascular fitness, and muscle strength<sup>11</sup>. In this same study, an increase in bone turnover was noticed; however, the BMD remained unchanged in both groups.

Our work revealed that during the study period, there was an improvement in the levels of muscular strength and BMD maintenance in the volunteer. These results suggest an alternative methodology based on RT to aid in the treatment of this disease, because the approach described here could also be used for prevention and treatment strategies that protect against sarcopenia<sup>7</sup>. A recent review reinforces the findings of this study, suggesting that physical activity may have direct effects on reducing the level of systemic inflammation in chronic autoimmune diseases<sup>15</sup>.

In this review, no adverse effects due to exercise were found in patients with autoimmune disease. The fact that no adverse effects were observed can be explained by the fact that the induction of stress caused by exercise may provide physiological function alterations in the immune system that can increase the associated defense mechanisms<sup>15</sup>.

Another study showed that an increase in body composition may be associated with osteopenia and sarcopenia in women with lupus<sup>16</sup>. This

information confirms the importance of the present study because it can minimize the effects caused by disease through the possible maintenance of weight, body mass index and bone density with increasing muscle strength and, consequently, the control of sarcopenia, which is corroborated by other studies<sup>13-15</sup>.

This report suggests that the progressive RT associated with drug therapy can minimize the symptomatic autoimmune effects of SLE. In addition to increasing muscle strength, the control of BMD and can maximize these results in favor of a better quality of life for the volunteer. However, this case study also demonstrates the need for new studies of experimental and control groups to verify the effects of RT associated with the use of medication for SLE.

## Conclusion

In this case study, the presented methodology had a positive effect on strength, and it may contribute to the maintenance of BMD and the body composition of women without extensive SLE who are required to undergo GC treatment.

## Conflict of Interest

This study did not have financial support from any institution, so there are no potential conflicts of interest.

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