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ORIGINAL RESEARCH

Resistance training as a tool for changing muscle mass and frailty status in sarcopenic older women: a quasi-experimental study

Exercícios resistidos modificam a massa muscular e a classificação de fragilidade em idosas sarcopênicas: estudo quase-experimental

Los ejercicios de fuerza provocan cambios en la masa muscular y la clasificación de la fragilidad en ancianas con sarcopenia: un estudio cuasiexperimental

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ABSTRACT | Frailty and sarcopenia are geriatric syndromes highly prevalent, complex, and hard to diagnose and treat. The literature still lacks a consensus on which resistance training program is better for older people, especially when considering frailty status and sarcopenia. We aimed to evaluate the effectiveness of a progressive resistance training program on muscle mass and frailty status in older sarcopenic women. This study included 18 community-dwelling sarcopenic women aged 65 or older enrolled in the progressive resistance training program. The intervention was based on 75% of each subject's maximum repetition test (3 times/week, for 12 weeks). Before the intervention, 16.7% were frail, and 61.1% were pre-frail; after the intervention, 5.6% were frail, and 50% were pre-frail. The result shows that the intervention reduced frailty status and increased muscle mass (p=0.01). Hence, after the intervention, we observed both a decrease in frailty and a positive change in function, since the percentage of robust women increased twice (p=0.01). We conclude that the progressive resistance training program might be the best strategy to prevent frailty and sarcopenia. Therefore, we suggest using weight resistance training in daily clinical practice to improve muscle mass and decrease frailty status in sarcopenic women.

Keywords | Aged; Sarcopenia; Exercise.

RESUMO | Fragilidade e sarcopenia são consideradas síndromes geriátricas que apresentam grande prevalência e complexidade e são de difícil diagnóstico e tratamento. Ainda não existe consenso quanto ao melhor programa de exercícios resistidos, especialmente quando se considera a fragilidade e a sarcopenia. O objetivo deste estudo foi avaliar a efetividade de um programa de carga na massa muscular e na classificação de fragilidade em idosas sarcopênicas. Participaram 18 idosas sarcopênicas, com idade a partir de 65 anos, que completaram um programa de carga progressiva. A intervenção utilizou o cálculo de 75% de uma repetição máxima (1RM)

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para cada participante (3 vezes/semana, por 12 semanas). Antes da intervenção, 16,7% foram consideradas frágeis e 61,1% pré-frágeis; após, 5,6% passaram a ser consideradas frágeis e 50% pré-frágeis. Os resultados mostraram que a intervenção alterou a classificação de fragilidade e aumentou a massa muscular das idosas (p=0,01). Observou-se diminuição nos itens de classificação da fragilidade e consequente melhora no perfil funcional, havendo o aumento da porcentagem daquelas consideradas não frágeis após a intervenção (p=0,01). Conclui-se que o programa de exercício resistido progressivo é provavelmente uma das melhores estratégias para prevenir a fragilidade e a sarcopenia. Desta forma, recomenda-se o seu uso na prática clínica diária para melhorar a massa muscular e diminuir o status de fragilidade em mulheres sarcopênicas.
Descritores | Idoso; Sarcopenia; Exercício Físico.

RESUMEN | La fragilidad y la sarcopenia son síndromes geriátricos de alta prevalencia y complejidad, además de ser de difícil diagnóstico y tratamiento. Todavía no hay un consenso sobre el programa de ejercicios de fuerza más indicado, especialmente teniendo en cuenta la fragilidad y la sarcopenia. El objetivo de este estudio fue evaluar la efectividad de un programa de carga sobre la masa muscular y la clasificación de la fragilidad en ancianas con sarcopenia. Participaron 18 ancianas con sarcopenia, de más de 65 años y que completaron un programa de carga progresiva. La intervención utilizó el cálculo del 75% de repetición máxima (1RM) para cada participante (3 veces/semana, durante 12 semanas). Antes de la intervención, el 16,7% de las participantes se consideraban frágiles y el 61,1% prefrágiles; después de la intervención, el 5,6% se consideraban frágiles y el 50% prefrágiles. Los resultados mostraron que la intervención produjo cambios en la clasificación de la fragilidad y aumentó la masa muscular de las ancianas (p=0,01). Hubo una reducción en los ítems de clasificación de la fragilidad y una mejora en el perfil funcional, con un aumento del porcentaje de aquellas consideradas no frágiles después de la intervención (p=0,01). Se concluye que el programa de ejercicios de fuerza progresiva se mostró una de las mejores estrategias para prevenir la fragilidad y la sarcopenia. Por tanto, se recomienda aplicarlo en la práctica clínica cotidiana para mejorar la masa muscular y disminuir el estado de fragilidad de mujeres con sarcopenia.
Palabras clave | Anciano; Sarcopenia; Ejercicio Físico.

INTRODUCTION

Frailty and sarcopenia are considered geriatric syndromes highly prevalent and complex. Geriatric syndromes, yet not well known, are the interactions between diseases and aging on multiple systems, resulting in a wide range of signs and symptoms[1-3]. Both frailty and sarcopenia are related to disabling outcomes, such as falls and fractures, worsening mobility, activities of daily living, hospitalization, low quality of life, and death[3-6].

Some authors suggest that sarcopenia and frailty are convergent syndromes because of their connection with aging. Their definitions and assessment techniques are diversified, but the literature agrees that the key role is physical function impairment leading to mobility problems, perpetuating these conditions[7,8]. Fried et al.[5] proposed a physical phenotype of frailty based on neuroendocrine deregulation, immunological dysfunction, and sarcopenia. Their results show that muscle atrophy can trigger the frailty syndrome. However, this relation is still unestablished, and there is no consensus whether frailty is due to sarcopenia or sarcopenia is a clinical manifestation of frailty[1,8,9].

In recent years, sarcopenia definition and assessment shifted from a biomedical perspective to a wider clinical condition. Nowadays, it focuses not only on intrinsic factors that cause muscle atrophy, but also on extrinsic ones, such as lifestyle, nutrition, and associated comorbidities[6]. In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) proposed a definition and diagnosis of sarcopenia that associated muscle atrophy with low muscle strength, decreased physical performance, or both[3]. In 2018, this consensus was revised, and muscle strength came to the forefront of sarcopenia definition, as it is a better predictor of adverse outcomes compared to muscle mass[4].

Many studies confirm that the transition between frailty and sarcopenia occurs because of modifiable factors, such as body mass index, weight loss, sedentarism, low handgrip strength, and advanced impairments in daily living activities[10-12]. Because of their reversible nature, one of the major challenges nowadays is to combine both syndromes and define unique targets to treat and avoid functional incapacities. A growing consensus is that progressive resistance training is one of the best alternatives to improve lean mass and muscle strength among older people, thus preventing physical disability, especially when performed in higher volumes and as early as possible[13-15].

However, the literature still lacks a consensus on which resistance program is better for older people, especially when considering frailty and sarcopenia syndromes. Thus, we evaluated the the effectiveness of progressive resistance

training for a 12 week period, observing frailty status and muscle mass of older sarcopenic women. We hypothesize that 12 weeks of muscle strengthening at 75% load can improve muscle mass and frailty status.

METHODOLOGY

Study sample

This is a quasi-experimental study with community-dwelling older women who were assisted at a Reference Center in one of the biggest municipalities of Brazil. The patients were assigned by the clinical staff from the Reference Center according to the inclusion criteria of the study: women, aged 65 years or older; have a sarcopenia diagnosis according to the EWGSOP[3]; and who have not engaged in resistance training programs three months prior to the study. The exclusion criteria were cognitive impairment assessed by the Mini Mental State Examination with cutoff points based on Bertolucci et al.[16]; physical disabilities that could bias functional tests (sequelae of stroke, Parkinson's disease, rheumatic diseases, recent hand surgeries, cancer and/or chemotherapy treatment); and use of corticosteroids.

Data collection

Data were collected at baseline and after three months of intervention by trained physical therapist researchers. On the first day, older women were screened for sarcopenia according to the EWGSOP criteria, that is, individuals should present and association between low muscle mass and low muscle strength and/or poor physical performance[3].

Walking Speed (WS) was assessed on a four meters course and the mean of three measures was considered. Women with values >0.8m/s were assessed for strength and women with values ≤0.8m/s were assessed for muscle mass. Muscle strength was evaluated via handgrip strength (HGS) using a Jamar hand dynamometer. The mean value for the three measures on the dominant hand was collected. Values inferior to 20kgf were considered as positive for weakness[3]. Muscle mass assessment was conducted on a subsequent day by a rheumatologist, using the dual-energy x-ray absorptiometry (DXA), a Discovery W densitometer, and the software program Hologic, version 3.3.01. The women who presented low muscle mass associated with poor strength or poor muscle performance were classified as sarcopenic and, thus, were included in the study.

After that, the individuals were assessed for sociodemographic and clinical data. They were also screened for frailty according to Fried's phenotype[5], which considers: unintentional weight loss (of 4.5kg, or more than 5% of the total body weight in the last year); weakness (defined by low HGS, adjusted for sex and body mass index); exhaustion (identified by two questions of the Center for Epidemiologic Studies Depression Scale); slowness (assessed by the time spent to walk a 4.6m course, adjusted by height and sex), and low physical activity level (using the Minnesota Leisure Time Activity Questionnaire). Those participants who met three or more criteria were considered frail; one or two, pre-frail, and zero, robust individuals.

Progressive resistance training (PRT)

The PRT was administered for one hour, three times per week, for 12 weeks. The groups consisted of four to five women guided by a trained physical therapists (other than those who screened them previously). The sessions were divided in three periods: firstly, 10 minutes of lower limbs stretching exercises; then, 40 minutes of strengthening exercises using ankle weights, focusing on hips and knees muscles; lastly, 10 minutes of cooldown exercises. The knee flexion and extension exercises used 75% of the subject's maximal load and were reassessed every two weeks according to a previously published protocol[16,17]. Participants could not miss more than three consecutive sessions, or a total of nine sessions (25%), during the three months of the intervention. None of them quit the study nor reported side effects.

Statistical analysis

Descriptive analysis was used to characterize subjects' proportion or mean±standard deviation. Paired t-test was used to evaluate post-intervention changes for frailty variables (HGS, WS, unintentional weight loss, exhaustion, and sedentarism), and sarcopenia profile (muscle mass, HGS, and WS). Frailty (number of frailty variables) and sarcopenia classification were assessed by the Wilcoxon test to evaluate changes after the intervention. Statistical analyses were performed using the software SPSS, version 16.0, with a 0.05 significance level.

RESULTS

This study included 18 older sarcopenic women with a mean age of 75.11 (±3.67) years old, most (61.1%) of whom

considered themselves mixed race; also, most (83.3%) were retired. Average schooling level was 3.67 (2.59) years, and the most prevalent comorbidities were cataracts (61.1%), hypertension (55.6%), and osteoarthritis (35.3%). Regarding nutritional status, 61.1% were at risk of malnutrition according to the Mini Nutritional Assessment Questionnaire[17], and 38.9% have fallen at least once in the previous year (Table 1).

Table 1. Sociodemographic and clinical characteristics of the older sarcopenic women (n=18)

Characteristic	Number (%)
Race	
White	4 (22.2)
Mixed race	11 (61.1)
Marital status	
Married	4 (22.2)
Widowed	10 (55.6)
Comorbidities	
Cataract	11 (61.1)
Hypertension	10 (55.6)
Osteoarthritis	6 (35.3)
Labirintitis	6 (33.3)
Diabetes	2 (11.1)
Heart problems	3 (16.7)
Self-reported depression	10 (55.6)
Falls in the previous year	7 (38.9)
Nutritional status	
Under nutritional risk (MNA)	11 (61.1)

MNA: mini nutritional assessment.

At baseline, 16.7% of the sample were frail, and 61.1% were pre-frail. After the intervention, 5.6% were frail, and 50% were pre-frail. The percentage of the robust individuals doubled after PRT (p=0.01). Likewise, the number of items identifying frailty has decreased (p=0.01). Sarcopenia status changed positively as well. We also noticed a significant increase in muscle mass (p=0.01) (Table 2).

Table 2. Transition patterns between frailty and sarcopenia at baseline and 12 weeks after the progressive resistance training program

	Pre-intervention (n=18)	Post-intervention (n=18)	Paired samples test	Wilcoxon test	Power
Frail, number (%)	3 (16.7)	1 (5.6)			
Pre-frail, number (%)	11 (61.1)	9 (50)			
Robust, number (%)	4 (22.2)	8 (44.4)			
Frailty items, means (SD)	1.39 (1.14)	0.83 (0.92)	0.01*		0.81
Frailty classification				0.01*	0.85
DXA, kg/m2, means (SD)	5.49 (0.68)	6.01 (0.63)	0.01*		0.90
HGS, kgf, means (SD)	15.27 (1.14)	18.16 (0.92)	0.01*		0.49
WS, m/s, means (SD)	0.81 (0.20)	0.88 (0.22)	0.06		0.45

*Statistically significant difference after intervention; DXA: dual-energy x-ray absorptiometry; HGS: hand grip strength; WS: walking speed.

DISCUSSION

We aimed to evaluate the effectiveness of the progressive resistance training program for 12 weeks regarding improving sarcopenic older women's frailty status and muscle mass. The results show that the intervention reduced their frailty status and increased their muscle mass. Also, they corroborate the study by Cameron et al.[17] which showed a lower prevalence of frailty in individuals after the resistance training program compared to the control group. However, this difference was only found when subjects were evaluated a year after the intervention, with no differences at three months post-intervention[16]. In our study, changes in frailty profile were observed in a shorter period, probably because our subjects were almost eight years younger than the subjects from the aforementioned study (75.1 vs 83.3 years old), less affected by adverse outcomes, and at an earlier or mild stage of frailty, considering that the syndrome is directly related to aging[5,18,19]. In this case, we think that training programs can be influenced not only by the severity of the behavior but also by other factors such as age.

Transitions between frailty stages are well-reported in literature, and the pre-frail group is the most prone to change to a healthier condition[10]. Our study revealed that both pre-frail and frail individuals had improved their condition and that 50% of frail individuals became robust. In longitudinal observational studies, sedentarism is considered one of the worst components of frailty[11,12], and is probably the core and modifiable risk factor for changing this condition. In a randomized clinical trial[17], the mean number of frailty items had significantly reduced after the intervention, reinforcing that the resistance training program helps to change frailty to a better status.

Sarcopenia profiles have also changed after PRT. These findings are in accordance with some studies[13,15,17-21] that have demonstrated that performing resistance training

exercises for more than 10 weeks, 2-3 times per week, with 50–80% of one repetition maximum (1RM), and an average of 10 repetitions per set, can improve lean body mass in about 1.1kg. Similarly, our results on lean mass measurements showed a significant increase of 0.52kg after three months of the intervention. Notably, this same study found a negative association between age and muscle mass. It suggests that, although significant hypertrophy is possible in older people, the benefits of an earlier engagement in resistance training programs will produce superior improvements in lean mass, hence, a better functional capacity[15].

Furthermore, HGS significantly improved after the intervention. Some studies[15,22-24] demonstrated a correlation between HGS, mobility disability, and lower-extremity performance especially in frail older individuals. Possibly, the resistance training globally improved muscle strength, reflecting on a better HGS. Some studies[23,25] also demonstrated a correlation between HGS and lower limbs strength with poor functional performance rather than lean body mass. This studies have changed the idea that decreased muscle strength is intrinsically related to lower lean mass measures, showing that strength usually precedes muscle atrophy and, sometimes, is the first predictor of worsening profiles on function in older people[7,8].

Despite our significant results, which apply to this kind of population and study approach, this study has some limitations. Its small sample size hinders the generalization of our outcomes. However, by this methodological design one can verify the effectiveness of programs used in daily clinical practice. Our outcomes had excellent power values, strengthening our results. Future studies, including other resistance training programs, are important to corroborate our findings and to show other intervention possibilities.

CONCLUSION

In conclusion, we can state that a progressive resistance training program is probably one of the best strategies to prevent frailty and sarcopenia. Thus, we suggest using resistance training in daily clinical practice to improve strength and muscle mass in sarcopenic women.

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