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The effects of the Home-based Older People's Exercises (HOPE) protocol on functional capacity, falls risk, fear of falling, and quality of life in older Brazilian women with sarcopenia

Efeitos do protocolo Home-based Older People's Exercises (HOPE) na capacidade funcional, risco de quedas, medo de cair e qualidade de vida em idosas brasileiras com sarcopenia

Hudson Azevedo Pinheiro[1]
https ://orcid.org/0000-0003-1081-4174
Larissa de Souza Martins[2]
https ://orcid.org/0009-0001-9703-771X
Maria Paula Bastos Dias[2]
https ://orcid.org/0000-0002-8452-5124
Ruth Losada de Menezes[3]
https ://orcid.org/0000-0001-7964-8536

Abstract – This study aimed to investigate the effects of the Home-based Older People's Exercise (HOPE) program on functional capacity, falls risk, fear of falling, and quality of life in sarcopenic older women living in the Brazilian Federal District. The intervention involved 20 elderly women diagnosed with sarcopenia who participated in a 12-week exercise regimen, twice a week, focusing on functional mobility, strength, and balance. Results showed significant improvements in functional capacity, including better performance in mobility tests and increased muscle strength. Specifically, the Short Physical Performance Battery (SPPB) and handgrip strength improved, and the risk of falls, as well as the fear of falling, decreased significantly. However, no changes were observed in muscle mass. Additionally, quality of life, assessed through the EQ-5D scale, showed marked improvement. Despite the lack of muscle mass changes, the program demonstrated its efficacy in improving mobility, strength, and psychological aspects related to fall risk. The findings suggest that the HOPE protocol can be a valuable, low-cost intervention for improving the health and independence of frail, sarcopenic older adults.

Key words: Functional capacity; Older adult; Quality of life; Sarcopenia.

Resumo – *Este estudo teve como objetivo investigar os efeitos do programa Home-based Older People's Exercise (HOPE) na capacidade funcional, risco de quedas, medo de cair e qualidade de vida em idosas sarcopênicas residentes no Distrito Federal. A intervenção envolveu 20 idosas diagnosticadas com sarcopenia que participaram de um regime de exercícios de 12 semanas, duas vezes por semana, com foco em mobilidade funcional, força e equilíbrio. Os resultados mostraram melhorias significativas na capacidade funcional, incluindo melhor desempenho em testes de mobilidade e aumento da força muscular. Especificamente, o Short Physical Performance Battery (SPPB) e a força de preensão manual melhoraram, e o risco de quedas, bem como o medo de cair, diminuíram significativamente. No entanto, nenhuma alteração foi observada na massa muscular. Além disso, a qualidade de vida, avaliada por meio da escala EQ-5D, mostrou melhora acentuada. Apesar da ausência de alterações na massa muscular, o programa demonstrou sua eficácia na melhoria da mobilidade, força e aspectos psicológicos relacionados ao risco de queda. Os achados sugerem que o protocolo HOPE pode ser uma intervenção valiosa e de baixo custo para melhorar a saúde e a independência de idosos frágeis e sarcopênicos.*

Palavras-chave: *Capacidade funcional; Idoso; Qualidade de vida; Sarcopenia.*

1 Secretaria de Saúde do Distrito Federal – SES. Diretoria de Atenção Secundária – DIRASE. Superintendência Sudoeste – SRSSO. Policlínica Taguatinga 3 – GSAS3. Brasília, DF. Brasil.
2 Fundação de Ensino e Pesquisa em Ciências da Saúde. Brasília, DF. Brasil.
3 Universidade Federal de Goiás. Goiânia, GO. Brasil.

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Corresponding author
Hudson Azevedo Pinheiro.
Secretaria de Saúde do Distrito Federal – SES
SRTVN, 702, 70723-040, Brasília (DF), Brasil.
E-mail: hudsonap@gmail.com

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INTRODUCTION

Aging is accompanied by changes in physiology and body composition, with the redistribution of muscle and adipose tissue. There is a gradual loss of lean mass and an increase in the amount of body fat, which may lead to the loss of muscle strength and/or to the reduction of functional performance. This condition is called sarcopenia, a geriatric syndrome which is associated with loss of autonomy and increased risk of falls, poor quality of life, hospitalization, and death[1-4].

The literature shows that resistance training can be used as a non-pharmacological intervention to treat sarcopenic older adults. Nevertheless, access to gyms and professionals such as physical therapists and physical education teachers is limited, especially to low-income populations. These populations usually only have access to services offered in primary care health, which are mainly composed of guidance and instructions for the performance of home-based exercises, whose results are still poor[5-9].

Exercise programs for the maintenance of mobility and functional capacity are pointed out as alternatives to treat older adults (especially those over 80 years old) in clinics, long-term care institutions, or even at home, based on multimodal exercises (strengthening, mobility, and aerobic exercises). Nevertheless, performing exercises as those typical of activities of daily living (ADLs) is known to lead to greater adherence to the proposed intervention[5,10,11].

The Home-based Older People's Exercise (HOPE) program is a 12-week exercise intervention for older adults with frailty designed by Clegg *et al.* (2011) aimed at function improvement. Participants are requested to complete the exercise routine on 5 days of the week, and their performance is monitored through phone calls and/or visits by researchers. Previous research has shown important improvements in functional capacity, but effects on body composition, risk of falling, and strength is yet to be investigated as an outcome variable[12].

Falls and fear of falls are still neglected by the population and health professionals, with prevention strategies such as physical exercise and environmental adaptation being often underestimated or given due attention upon a major event involving fractures or physical disability[13].

Given the need for low-cost prevention and health promotion strategies for sarcopenic older adults, this study aimed to investigate the effects of the HOPE protocol on functional capacity, falls risk, fear of falling, and quality of life among community-dwelling sarcopenic older adults in the Brazilian Federal District.

METHODS

Study design and populations

This study was a clinical trial, with 20 older women referred to Basic Health Units in the district of Taguatinga, Brasília, Brazil.

The first inclusion criterion referred to sarcopenia as defined by the revised European Work Group of Sarcopenia in Older People (EWGSO2)[1] and independence in ADLs as assessed by the Barthel Index[14].

Exclusion criteria were neurological disease sequelae (cerebrovascular disease, Parkinsonism, etc.), moderate-to-severe cognitive deficit as assessed by the Mini-Mental State Examination (MMSE), amputation, and bedriddenness.

Physically active older adults (as assessed by the International Physical Activity Questionnaire (IPAQ) were also excluded from the study[15].

The 35 eligible older women were invited to participate in the study, out of which five refused. Thus, initially, the sample consisted of 30 elderly women. Throughout the study, 10 participants withdrew from participating in the follow-up. Finally, the sample consisted of 20 elderly women who completed all planned assessments and interventions.

This study was approved by the Research Ethics Committee of the Foundation for Education and Research in Health Sciences of the Brazilian Federal District (opinion number 1.128.355/2015). The experimental protocol was registered at the Brazilian Clinical Trials Registry (REQ 3.616).

The entire intervention program was led by a physiotherapist and three duly trained physiotherapy residents.

Intervention

The HOPE program was carried out in an adapted room in the physiotherapy outpatient clinic located at the Polyclinic in the Taguatinga region. The older women were instructed about clothing, footwear, and hydration during activities. The outpatient clinic had good lighting, ventilation, adequate flooring, and easy access to water, preserving the safety and comfort of participants. After acceptance, the Free and Informed Consent Form (TCLE) was signed, which was then followed by physical tests, clinical, and anthropometric assessments. The interventions were carried out from March/2017 to December/2017 two times a week, for 12 weeks. In total, four group exercise sessions were performed with five participants each, lasting approximately one hour with three series of 10 repetitions of each exercise.

The exercises were performed using the Timed up and Go test (TUG), according to the guidelines of the HOPE protocol. Times above 30 seconds were attributed to level 1 of training, while times between 29-20 seconds referred to level 2, and times were under 19 seconds were attributed to level 3[12]. Every four weeks, the TUG would be administered to the older women to check exercise progression. Table 1 presents the description of the HOPE protocol.

Table 1. The Home-based Older People's Exercises (HOPE)[12].

Level	Exercise	Purpose	Functional relevance
Heating	Breathing warm-up.	A preparatory exercise to increase lung capacity.	Reduce shortness of breath and improve arm mobility.
	Spine rotation.	Trunk mobility.	Washing and dressing, reaching for something on a shelf, and stair climbing.
	Trunk flexion.	Pelvis mobility.	Washing and dressing, reaching for something on a shelf.
Level 1	Armchair rise- arm strength.	Upper body strength.	Standing up from a chair, lifting/carrying household objects.
	Leg kicks.	Lower body strength.	Standing up from a chair, walking.
	Toe-heel pointing.	Lower body strength.	Walking, stair climbing.
	Raise arms with a stick.	Upper body strength and mobility and balance.	Reaching for something on a shelf, lifting/carrying household objects, washing, and dressing falls prevention.
	Seated march.	Lower body strength.	Standing from a chair, stair climbing.

Note. Exercises are included in the three levels of the HOPE program. P, progression exercise.

Table 1. Continuation...

Level	Exercise	Purpose	Functional relevance
Level 2	Armchair rise – arm and leg strength.	Upper and lower body strength.	Walking, stair climbing, standing up from a chair, lifting/carrying household objects.
	Calf raises.	Lower body strength and balance.	Walking and stair climbing.
	Legs swing back.	Lower body strength and hip mobility.	Standing up from a chair, dressing.
	Side-stepping.	Weight bearing and balance.	Falls prevention.
	Raise arms with a stick.	Upper body strength and mobility and balance.	Reaching for something on a shelf, lifting/carrying household objects, washing, and dressing falls prevention.
	Marching.	Lower body strength.	Standing from a chair, stair climbing.
Level 3	:The chair rises without hands.	Lower body strength.	Walking, stair climbing, and standing up from a chair.
	Wall press-up.	Upper body strength and mobility.	Lifting/carrying household objects, washing, and dressing.
	Single foot calf raise.	Lower body strength.	Walking and stair climbing.
	Leg back swing and side raise.	Lower body strength and hip mobility.	Standing from a chair, dressing.
	Stand on one leg.	Balance.	Falls prevention.
	Walking toe to heel.	Balance.	Falls prevention.
Cool down	Marching for 5 minutes.	Aerobic	Sustaining engagement in physical activities.

Note. Exercises are included in the three levels of the HOPE program. P, progression exercise.

Outcome variables

BIA was performed to assess muscle mass using the In Body® model 270 tetrapolar BIA device, and MM and MM/m2 were determined. Appendicular Skeletal Muscle Mass (MMEA) was defined as the sum of the muscle mass of the upper and lower limbs[16].

Functional capacity

The Short Physical Performance Battery (SPPB) is composed of three tests that assess sequentially static balance while standing, gait speed at a usual pace (three meters), and, indirectly, the muscular strength of the lower limbs through the movement of getting up from the chair and sitting down in it five consecutive times and without the assistance of the upper limbs[16].

The assessment of the muscular strength of the lower limbs was obtained through the five times sit-to-stand test (5ST), which is used in clinical practice to assess lower limb strength and endurance, as a substitute for leg muscle strength, by measuring the time required for a patient to stand up five times from a sitting position, without using their arms[17].

Usual Gait Speed (UGS) is regarded as a clinical sign of important geriatric conditions, with slowed walking speed being a strong predictor of adverse outcomes associated with risk of falls, disability, and even mortality. UGS has been assessed based on walking distance (10m), involving factors such as pace, starting point, and distances timed, excluding acceleration and deceleration[18].

The assessment of upper limb muscle strength was obtained by testing handgrip strength with a hydraulic dynamometer JAMAR®. The test was

performed three times for the dominant hand, and the average of the three measurements was used as the final result for the corresponding hand[19].

Falls risk

The simple screening test for risk of falls in the elderly questionnaire (Q22) is very simple and easy to understand by older people in the community. It is aimed at assessing the risk of falls, encompassing related risk factors such as the presence of sensory, pain, fear of falling, being able to stand on one foot or not, environmental risks, gait speed, dizziness, polypharmacy, and previous falls upon a value of <6.5 points[20].

Fear of falling

The older women's concerns about the possibility of falls during ADLs was assessed using the Falls Efficacy Scale-International (FES-I) with questions about the possibility of falling when carrying out indoor, outdoor, and social activities, with the value >31 corresponding to extreme concern regarding falls while performing specific activities[21].

Quality of life

Finally, the EuroQol five-dimensional questionnaire (EQ-5D-3L) was used to assess quality of life, a generic instrument that encompasses five health dimensions: mobility, personal care, usual activities, pain/discomfort, and anxiety/depression. The EQ5D addresses three levels of responses, generating a five-digit code to be verified in the QALY-Brazil (Quality Adjusted Life Years) valuation table, varying from 0, indicating the worst possible quality of life, to 1, indicating excellence[22].

Statistical analysis

All statistical analyses were conducted using the statistical software JAMOVI. Continuous variables were expressed as mean ±SD. Data normality was checked for normality by the Kolmogorov-Smirnov test, with the level of significance set at 5% ($p < 0.05$). Due to sample losses, sample size was estimated on the GPower software version 3.1 (GPower Software Inc., Kiel, Germany). The effect size was found to be 0.8. The Paired t-test was used to compare the results after the HOPE protocol.

RESULTS

Table 2 presents the sociodemographic characteristics, clinical aspects, and occurrence of falls in the last year for the 20 sarcopenic older women who completed the 12-week intervention, according to EWGSOP2.

Table 2. Characterization of the sarcopenic older women who completed the intervention.

Variable	Mean (DP)	n = 20	%
Age	80.3 ± 6.8		
BMI (cm/Kg^2)	23.1 ± 4.1		
Years of formal study	5.5 ± 3.7		

Note. BMI Body mass index; [c]In 2017, the Brazilian minimum wage was R$937.45. Mean (DP).

Table 2. Continuation...

Variable	Mean (DP)	n = 20	%
Presence of a partner	(Yes)	11	55
Family income	≤2 the Brazilian minimum wage[¢]	12	60
Living alone	(Yes)	02	10
History of falls (last year)	(Yes)	07	35
Polypharmacy	(Yes)	12	60
Multimorbidity	(Yes)	14	70
Hospitalization (last year)	(Yes)	04	20

Note. BMI Body mass index; [¢]In 2017, the Brazilian minimum wage was R$937.45. Mean (DP).

The HOPE protocol showed no improvements in muscle mass in sarcopenic older women; however, improvements were observed after the intervention in functional capacity, risk of falls, fear of falling, and quality of life. Table 3 shows the test comparisons.

Table 3. Comparison of pre- and post-HOPE protocol on functional capacity, risk of falls, and quality of life in sarcopenic older women.

Variable	Fase	Mean (DP)	p
Appendicular Skeletal Muscle Mass	Pre-intervention Post-intervention	13.9 ± 1.44 13.9 ± 1.08	0.89
Timed Up and Go Test	Pre-intervention Post-intervention	18.1 ± 8.41 15.5 ± 4.95	0.02*
Short Physical Performance Battery	Pre-intervention Post-intervention	6.45 ± 1.61 7.45 ± 1.54	0.001**
Hand Grip	Pre-intervention Post-intervention	16.3 ± 3.63 18.9 ± 3.08	<0.001**
Five Times Sit-to-stand Test	Pre-intervention Post-intervention	25.3 ± 9.84 21.4 ± 7.15	0.006**
Usual Speed Gait	Pre-intervention Post-intervention	0.69 ± 0.21 0.91 ± 0.33	0.002**
Q22	Pre-intervention Post-intervention	10.3 ± 2.77 7.85 ± 2.58	<0.001**
FES-I	Pre-intervention Post-intervention	30.2 ± 9.86 27.1 ± 8.07	0.02*
EQ-5D-3L	Pre-intervention Post-intervention	0.64 ± 0.13 0.78 ± 0.17	<0.001**

Note. Mean (DP); *p<0.05; **p<0.001.

DISCUSSION

This study found that a period of 12 weeks for the HOPE protocol group, with a frequency of two weekly sessions lasting an average of one hour each significantly reduced the number of falls among participants, the risk of falls and the fear of falling, as well as improvements in mobility and muscle strength that resulted in a better quality of life, despite no changes in muscle mass.

A literature review and found that reduced muscle mass alone cannot account for decreased strength or functional capacity in older adults. According to the studies, muscle quality is a more realistic measure to identify lifestyle habits and to quantify intervention effects in older adults, especially in long-lived older adults, since it is not only associated with muscle composition (structure, fiber types), metabolism, fat infiltrates, and fibrosis, but also with neural activation, which allows maintaining the required mobility for continuity of a lifestyle[23].

A systematic review compared the effects of functional and resistance training on muscle strength and the performance of ADLs. The results found

no statistically significant differences, but pointed out that functional training protocols may be more effective, especially through a systematic, active, multi-joint approach encompassing strength, coordination, and balance[24].

The individuals participating in this study underwent a progressive functional training consisting of range of motion variation, progressing from lower sitting positions to upper (standing) positions and no external load other than the one used in conventional resistance training. Nevertheless, after the intervention period, participants showed increased functional capacity.

In developing the HOPE program, Clegg et al.[12] considered how loss of mobility affects the functional capacity and quality of life of sarcopenic and frail older adults. The authors proposed a series of easily-administered exercises that can be performed at home under the indirect supervision of a health professional. In this study, sarcopenic older adults showed an increase in functional capacity after the intervention.

A study followed up pre-sarcopenic and sarcopenic older adults for six months while performing daily home-based exercises. The authors found that, despite the increase in muscle strength, body composition remained unchanged[10]. This finding agrees with our results for functional capacity; however, it disagrees with the results for body composition. This proves that the systematization of a training program with progressive load was effective for muscle mass gain, especially in the lower limbs.

A meta-analysis study established the following criteria for prescribing fall prevention exercises: challenge balance through variation of the base of support and weight shifting; measured doses of exercise (as series and repetitions); and resistance strength training (even if it is only the subject's own body resistance, only enough to achieve the proposed objective)[25]. The authors also highlight that the exercises should be performed slowly, triggering large muscle groups, either in groups or at home.

Although these recommendations focus on frailty, the HOPE protocol can also be used for the prevention of falls with a significant impact on functional performance outcomes and fear of falling.

A study addressing fear of falling among community-dwelling older Portuguese people showed that female individuals had the perception of good and moderate physical health. In addition, the symptoms of depression are predictors of fear of falling; therefore, controlling these predictors is a key aspect for promoting the independence of older people to minimize the consequences associated with the fear of falling[26].

Balance confidence was the best predictor of falling, followed by fear of falling avoidance behavior. Fall history, presence of pathology, and physical tests did not predict falling alone; therefore, participants may have had a better sense of their fall risk than they would through a test that provides a snapshot of their balance. Thus, elements related to emotional issues such as anxiety, depressive symptoms, or even social isolation must be considered[27].

Fear of falling is associated with activity restriction (barrier) and with poorer physical and cognitive functions, which may contribute highly to a diminished quality of life. In addition, many studies point to the association between fear of falling and quality of life, which appears to be independent of the conceptualization not only as by-product of falls but also as targeted interventions (physical and psychological) are likely required[28,29].

Thus, supervised group exercises like HOPE protocol can be an advantageous alternative, since low-cost strategies must be implemented to reduce the impact of low mobility and sedentary behavior in sarcopenic older people, which has become a public health problem due to population aging, aiming to reduce risk of falling and fear of falling, as well as improve quality of life.

CONCLUSION

The HOPE protocol proved to be a good non-pharmacological functional capacity training strategy by improving functional capacity (mobility and strength) and quality of life, as well as reducing the risk of falls and fear of falling in sarcopenic older women.

COMPLIANCE WITH ETHICAL STANDARDS

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Data Availability Statement

Research data is only available upon request.

Ethical approval

Ethical approval was obtained from the local Human Research Ethics Committee –1.128.355/2015 and the protocol (no. 3616) was written in accordance with the standards set by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conceived and designed experiments: HAP, RLM; Performed experiments: HAP, RLM; Analyzed data: HAP; Contributed reagents/materials/analysis tools: HAP, MPBD, LSM; Wrote the paper: HAP, MPBD, LSM.

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