

Sarcopenia and dinapenia in elderly individuals participating in a supervised exercise program¹

Sarcopenia e Dinapenia em idosos participantes de um programa supervisionado de exercício físico

Sarcopenia y Dinapenia en ancianos participantes de un programa supervisado de ejercicio físico

[Research Article

Estélio Henrique Martin Dantas²
Karollyni Bastos Andrade Dantas³
Lúcio Flávio Gomes Ribeiro da Costa⁴
Ana Lúcia Sousa Nascimento Melo⁵
David Leandro Moreno Leon⁶
Igor Santos Capela⁷
Lívia Beatriz de Aquino Cavalcante⁸
Sávio Santana da Costa⁹
Tawann Santiago Reis de Santana¹⁰

Received: September 12, 2023

Accepted: October 30, 2023

Cite as:

Dantas, E. H. M. ., Andrade Dantas, K. B., Gomes Ribeiro da Costa, L. F., Sousa Nascimento Melo, A. L., Moreno Leon, D. L., Santos Capela, I., de Aquino Cavalcante, L. B., Santana da Costa, S., & Reis de Santana, T. S. (2023). Sarcopenia y Dinapenia en ancianos participantes de un programa supervisado de ejercicio físico. *Cuerpo, Cultura Y Movimiento*, 14(1).
<https://doi.org/10.15332/2422474X.9892>

¹ Scientific research article partially funded by the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) - Funding code 001 and affiliated with the research group of the Laboratory of Human Motor Biosciences, Tiradentes University, Aracaju, Sergipe, Brazil. Research start date: January 2023; Research end date: July 2023.

² Master and Doctor's Degree Program in Health and Environment - PSA, Tiradentes University - UNIT, Aracaju, Brazil. Doctor's Degree Program in Nursing and Biosciences - PPgEnfBio, Federal University of the State of Rio de Janeiro - UNIRIO, Rio de Janeiro, Brazil. Undergraduate Medical Program at Tiradentes University - UNIT, Aracaju, Brazil. E-mail: estelio.henrique@souunit.com.br; ORCID: <https://orcid.org/0000-0003-0981-802>

³ Master and Doctor's Degree Program in Health and Environment - PSA, Tiradentes University - UNIT, Aracaju, Brazil. E-mail: karollbdantas@gmail.com; ORCID: <https://orcid.org/0000-0001-6886-6976>

⁴ Master and Doctor's Degree Program in Health and Environment - PSA, Tiradentes University - UNIT, Aracaju, Brazil. E-mail: luciojudo@hotmail.com; ORCID: <https://orcid.org/0000-0002-3437-8701>

⁵ Master and Doctor's Degree Program in Health and Environment - PSA, Tiradentes University - UNIT, Aracaju, Brazil. E-mail: mestrado_analucia@souunit.com.br; ORCID: <https://orcid.org/0009-0001-3498-6969>

⁶ Undergraduate Medical Program at Tiradentes University - UNIT, Aracaju, Brazil. E-mail: david.moreno@souunit.com.br; ORCID: <https://orcid.org/0009-0001-2975-5859>

⁷ Undergraduate Medical Program at Tiradentes University - UNIT, Aracaju, Brazil. E-mail: igor.capela@souunit.com.br; ORCID: <https://orcid.org/0009-0005-0594-0004>

⁸ Undergraduate Medical Program at Tiradentes University - UNIT, Aracaju, Brazil. E-mail: livia2003.med@gmail.com; ORCID: <https://orcid.org/0009-0005-0497-8764>

⁹ Undergraduate Medical Program at Tiradentes University - UNIT, Aracaju, Brazil. E-mail: savio.santana01@souunit.com.br; ORCID: <https://orcid.org/0009-0006-7450-9688>

¹⁰ Undergraduate Medical Program at Tiradentes University - UNIT, Aracaju, Brazil. E-mail: tawann.santiago@souunit.com.br; ORCID: <https://orcid.org/0009-0009-5072-9872>

Abstract

This study assessed the effects of a supervised exercise program on the prevention of sarcopenia and dynapenia in the elderly. 90 elderly individuals ($\bar{X} = 67.40 \pm 6.59$ years) from Primary Health Care, most of whom had chronic diseases and were on medication, participated in the study. They underwent assessments of calf circumference (CC) and muscle strength (MS) before and after 16 weeks of training in four experimental groups, with two one-hour sessions per week. Additionally, sociodemographic data were collected. The results revealed significant gains in CC ($\Delta \% = 3.94$, $p = 0.003$) and MS ($\Delta \% = 23.54$, $p = 0.0034$) after the program. These findings highlight the effectiveness of an MS training program in preventing sarcopenia and dynapenia. It can be concluded that regular physical exercise plays a significant role in improving the health and quality of life of older individuals.

Key words: aged, anthropometry, muscle strength, sarcopenia

Resumo

Este estudo avaliou os efeitos de um programa de exercício físico supervisionado na prevenção da sarcopenia e dinapenia em idosos. Participaram do estudo 90 idosos ($X = 67,40 \pm 6,59$ anos) da Atenção Primária à Saúde, a maioria com doenças crônicas e em uso de medicação. Foram realizadas avaliações da circunferência da panturrilha (CC) e da força muscular (FM) antes e após 16 semanas de treinamento em quatro grupos experimentais, com duas sessões semanais de uma hora. Adicionalmente, foram recolhidos dados sociodemográficos. Os resultados revelaram ganhos significativos na CC ($\Delta \% = 3,94$, $p = 0,003$) e na FM ($\Delta \% = 23,54$, $p = 0,0034$) após o programa. Estes resultados evidenciam a eficácia de um programa de treino de FM na prevenção da sarcopenia e da dinapenia. Conclui-se que o exercício físico regular desempenha um papel significativo na melhoria da saúde e da qualidade de vida dos indivíduos idosos.

Palavras-chave: idosos, antropometria, força muscular, sarcopenia

Resumen

Este estudio evaluó los efectos de un programa de ejercicio supervisado en la prevención de la sarcopenia y la dinapenia en ancianos. Participaron en el estudio 90 ancianos ($X = 67,40 \pm 6,59$ años) de Atención Primaria, la mayoría con enfermedades crónicas y medicados. Se les realizaron evaluaciones de la circunferencia de la

pantorrilla (CC) y de la fuerza muscular (FM) antes y después de 16 semanas de entrenamiento en cuatro grupos experimentales, con dos sesiones de una hora por semana. Además, se recogieron datos sociodemográficos. Los resultados revelaron ganancias significativas en CC ($\Delta \% = 3,94$; $p = 0,003$) y MS ($\Delta \% = 23,54$; $p = 0,0034$) tras el programa. Estos resultados ponen de manifiesto la eficacia de un programa de entrenamiento con FM para prevenir la sarcopenia y la dinapenia. Se puede concluir que el ejercicio físico regular desempeña un papel significativo en la mejora de la salud y la calidad de vida de los individuos mayores.

Palabras clave: ancianos, antropometría, fuerza muscular, sarcopenia

Introduction

Brazil has experienced a significant increase in its population aged 65 and over, over the past decade, based on the most recent data released by the Brazilian Institute of Geography and Statistics (IBGE, 2022). In 2022, this age group represented approximately 10.5% of the country's total population, in contrast to the 7.7% recorded in 2012. Additionally, the portion of the population aged 60 and over comprises approximately 15.1%. Evidencia de força; relacionar com sarcopenia e dinapenia

Numerous pieces of evidence indicate that the aging process is linked to various cardiovascular, endocrine, and neuromuscular changes. Among these, those linked to the locomotor system, notably the decrease in lean mass and muscle strength in the elderly is perhaps one of the most important (Esteve and Zuera 2021).

In this way, there is increasing discussion about the concepts of sarcopenia and dynapenia in the older population, as this leads to serious physical and psychological consequences for their quality of life over the years. Furthermore, it is important to consider sociodemographic factors that may contribute to the progression of such events (TS Alexandre and YAO Duarte, 2019). In this context, the progressive and widespread loss of lean mass and function due to natural conditions is referred to as sarcopenia, which primarily affects the elderly population (Santilli et al., 2014). Undoubtedly, it is known that this process increases with age. However physical exercise has been shown to be an excellent preventive factor, because physical training aimed at developing this physical ability has been shown to be one of the safest ways of slowing down the aging process without side effects resulting from the use of medication (Esteve and Zuera 2021).

It becomes essential, therefore, to conduct a detailed analysis of the role of physical exercise as a parameter for preventing muscle mass loss. Only in this way will the impact of this supervised active routine be observed in the assessment of the health conditions of the elderly.

On the other hand, Dynapenia is the loss of muscle strength associated with ageing, with a prevalence of over 20% in some countries (Brian and Todd, 2008). This tendency to lose muscle strength is strongly related to a high risk of falls, poor physical performance, disability and even mortality.

As a result, the importance of recurrent assessment of muscle strength (MS) in individuals over the age of 60 is evident in order to prevent the exacerbation of these risks (de Mello and Dalla Corte, 2019). Furthermore, it is possible to establish a connection between the concepts of sarcopenia and dynapenia, as the decrease in muscle mass could directly lead to a decrease in individuals' strength.

It should be pointed out that sarcopenia and dynapenia can affect the elderly population in various aspects of their lives, both physiologically, such as a decrease in functional capacity, and socially, generating additional medical care costs. Simultaneously, these impacts clearly lead to a loss of quality of life for this group of individuals. In this scenario, strength training is considered an integral part of physical conditioning for the elderly as a strategy to improve strength and muscle mass compromised by the aging process.

Given that inactivity proves to be a catalyst for physical deterioration (Thomas and Battaglia, 2019), an exercise program tailored to older individuals emerges as an essential pillar in maintaining their muscle strength over the years. This contributes to factors such as mental well-being and balance.

This research aims to shed light on the impact of a tailored and closely supervised exercise regimen in mitigating the onset and progression of sarcopenia, which involves the loss of muscle mass and function, and dynapenia, characterized by age-related reductions in muscle strength. By examining these conditions within the context of a structured exercise program, we seek to provide valuable insights into the potential benefits of such interventions for enhancing the overall well-being and functional capacity of the elderly population.

"Thus, research tends to provide information regarding the assessment parameters of sarcopenia and dynapenia, as well as the effects of continuous physical activity on these issues in different individuals in the category above 60 years of age."To address

the questions raised, the objective of this study is to investigate the effects of an individualized and supervised physical exercise program on the prevention of sarcopenia and dynapenia in elderly people.

Methodology

This is a quasi-experimental study, incorporating both pre- and post-tests, with a quantitative, cross-sectional descriptive approach. The data used in this study were obtained through assessments, standardized tests and analysis of a set of variables through statistical techniques of the MASTERFITTS project, which aims to provide supervised exercise programs for health and well-being.

Sample

The research was conducted with elderly individuals who utilize the services of Primary Health Care Units in the following neighborhoods in the city of Aracaju, Sergipe, Brazil: Aeroporto, Atalaia, Coroa do Meio, Farolândia, Inácio Barbosa, and Jardins.

After informing them about the protocols for physical assessment and intervention, they were invited to participate in the study and were asked to come to the Laboratory of Human Motor Biosciences, bringing the following documents: 1) Medical clearance with authorization to participate in physical exercises; 2) Referral from their respective Primary Health Care Units; 3) Identification documents and Individual Taxpayer Identification Number (CPF).

The inclusion criteria were as follows: being 60 years of age or older, committing to participate in the exercise program by signing the Informed Consent Form (ICF), and having the ability to perform the program. Individuals with any type of acute and/or chronic condition that would hinder exercise participation and those who did not sign the ICF were excluded.

After applying these criteria, 90 individuals participated in this study.

Ethical Precautions

The study therefore complied with national and international ethical precepts based on Resolution 466/2012 (CNS, 2012) of the National Health Council and on Declaration of Kelsinki (WHO, 2008), in order to respect ethical principles in scientific research involving human beings, as well as their dignity, privacy and well-being.

All the individuals were informed about the risks and benefits of the research and participated voluntarily by signing an informed consent form.

The research was preliminary approved by the Human Research Ethics Committee of Universidade Tiradentes on March 26, 2020, according to opinion no. 3.936.886 - CAAE: 26524719.4.0000.5371.

Evaluation procedures

After conducting preliminary procedures (participant recruitment, ethical precautions and participant safety, and stratification into groups), all study participants underwent a diagnostic evaluation, during which Muscle Strength (MS) and Calf Circumference (CC) were assessed, which are relevant for measuring dynapenia and sarcopenia, respectively.

For the assessment of MS in the elderly, the maximum repetitions test was used, lasting for 30 seconds, with added weight. The assessment was performed for both the lower and upper limbs, involving two movements: the Sit-to-Stand (ST) movement and the Elbow Flexion and Extension (EE) movement. To achieve the necessary intensity for the assessment of muscle strength, bars and weights were used as added weight, with weights of 7 kg for women and 11 kg for men. These tests are described below:

1. Sit-to-Stand (ST) Test: The test begins with the participant seated in the middle of the chair, with a straight back and feet positioned shoulder-width apart to aid in maintaining balance, with full contact on the ground. The bar should be supported on the trapezius muscles and not on the neck (it should be placed on the upper part of the deltoid). Both hands should hold the bar at a distance that varies according to each participant's characteristics, and the elbows should be flexed backward. Upon the signal to start, the participant stands up to full extension (vertical position) and returns to the reference position, the chair; however, they should not sit down, as they must maintain the movement rhythm for the entire 30 seconds or until the established pattern cannot be maintained. The chair is only for reference and safety, as the participant should not sit down to ensure the movement rhythm is maintained.

Figure 1 fits here

2. Elbow Flexion and Extension (EE) Test: In the upright position, with feet spaced shoulder-width apart and knees slightly flexed, the participant should hold the bar with arms fully extended, using a pronated grip with a width equal to or slightly wider

than the distance between the shoulders. The bar should be lifted to shoulder height by flexing the elbows and then returned to the starting position in a controlled manner for optimal movement effectiveness, while striving for maximum speed. Special attention should be paid to controlling the final phase of forearm extension to stabilize the upper arm, avoiding any swinging movements of the spine and forearm, ensuring that complete flexion is achieved (the evaluator may lightly hold the participant's biceps). It is important that the upper arm remains static during the test. The participant is encouraged to perform as many flexion and extension repetitions as possible within a time limit of 30 seconds, but always with controlled movements in both the flexion and extension phases.

Figure 2 fits here

Muscle Strength (MS) Calculation:

Muscle strength (MS) was calculated using the ST and EE tests through the following formula:

$$MS = (SC/0.85) + (EC/0.76) / 2$$

Where:

- MS: Muscle strength
- ST: Sit-to-Stand test (Strength of the lower limbs)
- EE: Elbow Flexion and Extension test (Strength of the upper limbs)

This formula combines the results of the Sit-to-Stand and Elbow Flexion and Extension tests to calculate overall muscle strength. The values obtained from these tests are divided by their respective coefficients (0.85 for SC and 0.76 for EC) and then averaged to derive the overall muscle strength score.

Calf circumference is an important parameter for assessing muscle mass in the elderly and was used in this study to evaluate the sarcopenia of the individuals.

Calf Circumference (CC) Assessment:

The measurement of calf circumference (CC) was performed on the left leg, using a non-elastic measuring tape, at its most prominent part. It's important to note that this measurement was conducted following the protocols established by The International

Society for the Advancement of Kinanthropometry (ISAK), ensuring the standardization and accuracy of data collection. Furthermore, it's worth mentioning that the CC measurement can be taken with the individual in a seated position, following the ISAK recommended guidelines to ensure result consistency (SILVA e VIEIRA, 2020).

Its evaluation will be based on the following cutoff points: > 35 cm: Normal; between 31 and 24 cm: Moderate and less than 31 cm: Severe. These cutoff values were used to categorize and assess the degree of sarcopenia.

Post-Exercise Program Assessment:

After four months from the start of the supervised exercise program, a summative assessment was conducted with the objective of comparing the collected data.

Intervention

The strength training protocol worked on by the participants was subjected to a two-week familiarization period, followed by 16 weeks of training consisting of two weekly sessions in the afternoons, divided into classes by time slot, as already specified.

The strength exercises based on the circuit of resistance exercises on machines (weight training) will be prescribed based on the OMNI-Res perceived exertion scale (Robertson et al., 2003), similar to those used in the study by Kukkonen-Harjula et al. (2007) as shown in Figure 3.

Figure 3 fits here

Levels 2 and 3 were used in the Rating of Perceived Exertion during the familiarization phase. During the 16-week training period, the load was adjusted so that participants perceive effort at levels 7 to 8 (Strong). This criterion also served as feedback for readjusting the load every two weeks.

The neuromuscular training was carried out with the following sequence of exercises: biceps-barbell, extension chair, triceps on the Cross over high pulley, flexor chair, shoulder with dumbbells, squat on the bench with washer on the chest, flying chest, leg press, front pull, plank and finally, the pelvic lift, with two minutes rest between sets (figure 4).

The strength exercises were performed at medium speed in the eccentric and concentric phases, for a period of approximately 2 seconds. The intervals between sets and between exercises should always be at least 2 minutes. The elderly people

taking part in the project performed the proposed physical exercises in a planned circuit format, which focused on strength exercises, while respecting the individuality of the participants.

Figure 4 fits here

Results

The analysis of the results allows for the classification of participants in this physical conditioning program based on these variables, which are crucial for evaluating sarcopenia and dynapenia in the elderly.

Table 1 below presents characteristics of the volunteers, including age, height, weight, and body mass index (BMI). This information provides a comprehensive overview of the physical profile of the participants, enabling a clearer understanding of the distribution of these variables within the study group.

It is possible to observe that the minimum age of the participants was 67.40, which contributes to a more detailed examination of the relationships between sarcopenia and dynapenia, which tend to increase with age. Additionally, the average BMI was 27.72, slightly above the ideal range, according to the classification of the Ministry of Health itself. These participants were subsequently evaluated with respect to the parameters of sarcopenia and dynapenia.

Table 1 fits here

Table 2 presents the socioeconomic characteristics of the patients collected through anamnesis, presented as corresponding absolute numbers and percentages.

Table 2 fits here

Sarcopenia tests were conducted using calf circumference measurements, which yielded data that were subsequently analyzed and categorized. These data are presented in Table 3, showing absolute values.

Table 3 fits here

The assessment of calf circumference was carried out, and the measurements indicated an increase in circumference attributed to the strength training regimen. This increase in calf circumference was quantified by collecting data from the participants, resulting in an average change of $\Delta \% = 3.94$, with a p-value of 0.003. It's important to note that since the mean values obtained in both the diagnostic and formative assessments exceeded 35 cm, the sample falls into the 'Normal' category, indicating the absence of sarcopenia.

When conducting dynapenia tests, data were found which, after analysis, were categorized. These data can be observed in Table 4, displaying absolute numbers.

Table 4 fits here

The muscle strength tests revealed crucial information regarding the relationship among the participants in the diagnostic and summative assessment study. It's worth noting that to obtain these data, the muscle strength formula was used, which utilized parameters such as the Sit-to-Stand Test and the Elbow Flexion and Extension Test. In this context, after data grouping, a statistically significant increase ($\Delta \% = 23.54\%$, $p = 0.0034$) in muscle performance was indicated when compared to before the training, with an average value of 19.09 for the diagnostic

and summative assessment. Therefore, the effects of the 2 training sessions per week, over a total period of 16 weeks, on the dynapenia of the participants, were clearly visible.

Discussion

Regarding the age of the participants, the prevalence of physically active older individuals can vary depending on different countries, cultures, income levels, and access to resources. In general, many studies have shown that a significant number of older adults do not engage in sufficient physical activity to reap the health benefits it can provide. According to LANZARA et al (2021), a study involving individuals aged 50 to 70 revealed that only half of the elderly participants were physically active, with the majority citing a lack of motivation as a barrier to physical activity. However, a significant percentage expressed a willingness to participate in training programs to improve their physical condition. Therefore, in line with the World Health Organization (WHO) guidelines, older adults should engage in at least 150 minutes of moderate-intensity physical activity per week. These activities, when performed regularly, have been shown to reduce the risk of falls in individuals over 65 years old (Sherrington et al., 2019). Furthermore, it's essential to note that, in addition to the physical benefits, as a measure to mitigate sarcopenia and dynapenia, physical activity also contributes to mental health, socialization, and the overall quality of life of older adults.

Self-perception is also a significant factor in an individual's quality of life. According to Lera-López et al., (2019), specifically, individuals aged 50 to 69 who engage in light to intense walking have a higher likelihood of having a better self-perceived health compared to those aged 40 to 49.

In an analysis of gender, women are less likely than men to be physically active, with only approximately 27% of women engaging in recommended levels of physical activity, according to a study by Romans MC (1996). However, based on the data collected, this trend has reversed. The gender disparity in physical activity participation can be attributed to a complex interplay of factors such as social and cultural norms, gender stereotypes, time constraints, and responsibilities. Nevertheless, it's essential to note that this disparity is not a

blanket generalization that applies to all women, as there is significant individual variation.

The relationship between marital status (single, married, or widowed) and physical activity can vary considerably based on different factors, including culture, age, level of commitment, and individual preferences. Many variables are at play, so there is no one-size-fits-all answer. Some research suggests that unmarried individuals may have more free time to dedicate to physical activities, as they may have fewer family responsibilities and commitments compared to married individuals. On the other hand, married individuals may have social and support benefits for engaging in physical activity. Couples who share common interests, such as exercise, can motivate each other to stay active. Additionally, in many cases, married couples may engage in physical activities together as part of their quality time. A study involving 3075 men and women analyzed the relationship between marital status and levels of conjugal physical activity and found that married women and men reported higher levels of exercise participation compared to single individuals. This suggests that one spouse's level of physical activity is related to the other spouse's level of physical activity. The results highlight the potential of couple-based interventions to improve participation and adherence to physical activity among older adults (Petee et al., 2016).

Regarding educational level and income, Zapata-Lamana et al., (2021) found that older women who engage in vigorous physical activity tend to have higher levels of education and income, suggesting that socioeconomic factors play a role in determining the level of physical activity among older women. The relationship between educational level, socioeconomic status, and physical activity practice by women is complex and influenced by a variety of factors. For example, women with higher levels of education often have access to more up-to-date information about the health benefits of physical activity. They may be more aware of sedentary-related chronic conditions such as diabetes, heart disease, and obesity and understand the importance of physical activity in preventing these conditions. Furthermore, a higher socioeconomic status can provide women with more resources to engage in physical activities, such as gyms, dance classes, sports equipment, and appropriate clothing. Access to these resources can increase the likelihood of incorporating physical activity into their daily routines.

Finally, based on Lim HS (2020), it was found that older women who were physically inactive had higher rates of obesity, unemployment, comorbidities, and a poor subjective perception of health compared to those who were physically active. The study emphasizes the importance of regular physical activity in maintaining health and improving the quality of life of older women. This suggests that comprehensive attention and management of lifestyle and diet quality are necessary, considering the rapid aging and high life expectancy of women.

After 16 weeks of supervised training containing a sequence of exercises (as shown in the evaluation procedures) performed at perceived muscular effort levels 7 and 8 on the OMNI-Res scale (with load adjustments made biweekly), while respecting the individuality of each participant, it was possible to observe some promising results related to the mitigation and prevention of sarcopenia and dynapenia. In Table 3, with the aim of assessing muscle loss, data related to the measurement of the left calf circumference (CC) were grouped, and the measurements indicated an increase. In Table 4, data related to muscle strength (FM) were also grouped, and a significant growth was observed. Considering these data...

...promising results concerning weight training in preventing/mitigating sarcopenia in older individuals have been identified. In this regard, these numbers corroborate, for example, the review conducted by Bao et al., (2020) - based on 22 studies involving 1,041 participants subjected to exercise programs ranging from 30 to 80 minutes of training with 1 to 5 sessions per week and durations of 6 to 36 weeks.

In this study, it was identified that resistance exercise programs not only significantly improved muscle mass, muscle strength, and physical performance in sarcopenic elderly individuals but also emerged as the most promising method for the elderly, based on the study conducted by Giallauria et al. (2016). This condition is also accelerated by various factors such as hormonal changes, sedentary lifestyle, poor nutrition, chronic diseases, and dysfunction of the nervous system.

Limitations of this study include the lack of inclusion of more health variables to be evaluated, which could contribute to the generalization of the presented data

and the characterization of the health profile of the volunteers participating in the exercise program. Therefore, it is suggested that future research includes the evaluation of additional variables.

Conclusion

In summary, the findings of this study are highly encouraging and underscore the importance of regular physical activity as a vital tool in promoting the health and well-being of the elderly. Through the implementation of a continuous physical exercise program, it was not only possible to observe significant improvements in calf circumference and muscle strength but also to highlight the effectiveness of this program in preventing two critical conditions associated with aging: sarcopenia and dynapenia.

The gains observed in calf circumference ($\Delta \% = 3.94$, $p = 0.003$) and muscle strength ($\Delta \% = 23.54\%$, $p = 0.0034$) indicate that the intervention had a positive impact on preserving muscle mass and muscle function, essential for the autonomy and quality of life of the elderly. Furthermore, the results also emphasize that this intervention not only influenced physical aspects but also had significant implications in other domains, including mental health, socialization, and the reduction of fall risks, which are crucial issues for the elderly population.

Therefore, this study strengthens the need to continue investing in personalized and supervised physical exercise programs for the elderly. By doing so, we are not only contributing to the promotion of physical health but also to the improvement of the overall quality of life and well-being of this valuable population. These findings have important implications for public health policies and clinical practices, highlighting the importance of physical activity as an effective strategy in promoting healthy aging.

References

Alexandre, T. da S., Duarte, Y. A. de O., Santos, J. L. F., & Lebrão, M. L. (2018). Prevalência e fatores associados à sarcopenia, dinapenia e sarcodinapenia em idosos residentes no Município de São Paulo - Estudo

- SABE. Revista Brasileira de Epidemiologia, 21(suppl 2).
<https://doi.org/10.1590/1980-549720180009.supl.2>
- Bao, W., Sun, Y., Zhang, T., Zou, L., Wu, X., Wang, D., & Chen, Z. (2020). Exercise Programs for Muscle Mass, Muscle Strength and Physical Performance in Older Adults with Sarcopenia: A Systematic Review and Meta-Analysis. *Aging and Disease*, 11(4), 863.
<https://doi.org/10.14336/ad.2019.1012>
- Beudart, C., Zaaria, M., Pasleau, F., Reginster, J.-Y., & Bruyère, O. (2017). Health Outcomes of Sarcopenia: A Systematic Review and Meta-Analysis. *PLOS ONE*, 12(1), e0169548.
<https://doi.org/10.1371/journal.pone.0169548>
- Brasil, A. (n.d.). População idosa no Brasil era de 10,5% em 2022, aponta IBGE. CNN Brasil. <https://www.cnnbrasil.com.br/nacional/populacao-idosa-no-brasil-era-de-105-em-2022-aponta-ibge/>
- BVS - Ministério da Saúde - Dicas em Saúde. (n.d.). [bvsmms.saude.gov.br](https://bvsmms.saude.gov.br/bvs/dicas/215_obesidade.html)
https://bvsmms.saude.gov.br/bvs/dicas/215_obesidade.html
- Castro, L. E. J., Salazar, L. T. S., & Perea, K. G. V. (2015). Programa de ejercicio físico para mejorar fuerza muscular en personas sedentarias. *Cuerpo, Cultura Y Movimiento*, 3(6), 13. <https://doi.org/10.15332/s2248-4418.2013.0006.01>
- Clark, B. C., & Manini, T. M. (2008). Sarcopenia != Dynapenia. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 63(8), 829–834. <https://doi.org/10.1093/gerona/63.8.829>
- CNS. RESOLUÇÃO Nº 466, DE 12 DE DEZEMBRO DE 2012. Conselho Nacional de Saúde. Recuperado de <https://conselho.saude.gov.br/resolucoes/2012/Reso466.pdf>
- Esteso De la Osa, Á., & León-Zarceño, E. (2022). Ejercicio físico en trastornos de ansiedad: una revisión. *Cuerpo, Cultura Y*. <https://doi.org/10.15332/2422474X.7067>
- Esteve, A., & Zueras, P. (2021). La estructura de los hogares de las personas mayores en América Latina y el Caribe. *Revista Panamericana de Salud Pública*, 45, 1–9. <https://doi.org/10.26633/RPSP.2021.115>
- Giallauria, F., Cittadini, A., Smart, N. A., & Vigorito, C. (2016). Resistance training and sarcopenia. *Monaldi Archives for Chest Disease*, 84(1-2). pp-51-53
<https://doi.org/10.4081/monaldi.2015.738>
- Hee-Sook, L., JJ., Yoo. (2020). Association between Health Indicators and Health-Related Quality of Life according to Physical Activity of Older Women. *Healthcare Journal*, 8(4), 507 1-12.
<https://doi.org/10.3390%2Fhealthcare8040507>
- Lanzara, I., Aliberti, S., & Cereda, F. (2021). Abstract submitted to: Spring Conferences of Sports Science. *Journal of Human Sport and Exercise*,

16(4proc), 21–22. <https://doi.org/10.14198/jhse.2021.16.Proc4.17> S1705-S1712. <http://dx.doi.org/10.14198/jhse.2021.16.Proc4.17>

Lera-Lopez, F., Ollo-López, A., Garrués-Irisarri, M., Cabasés, J. M., & Sánchez, E. (2018). How the relationship between physical activity and health changes with age. *European Journal of Ageing*, 16(1), 3–15. <https://doi.org/10.1007/s10433-018-0471-6>

Belza, B., & Warms, C. (2004). Physical activity and exercise in women's health. *Nursing Clinics of North America*, 39(1), pp-181–193. <https://doi.org/10.1016/j.cnur.2003.11.011>

de Mello, R. G. B., Dalla Corte, R. R., Gioscia, J., & Moriguchi, E. H. (2019). Effects of Physical Exercise Programs on Sarcopenia Management, Dynapenia, and Physical Performance in the Elderly: A Systematic Review of Randomized Clinical Trials. *Journal of Aging Research*, 2019, 1–7. <https://doi.org/10.1155/2019/1959486>

Cristina, D., Efrén, D., Valeria Andrea D'Antone, Andrea Vásquez Morales, & Parada, G. (2022). Evaluación basal integral de las condiciones de salud física y visual en adultas mayores. *Revista de Investigación*, 12(1). 1-20 <https://doi.org/10.15332/2422474x.7068>

Papadopoulou, S. K. (2020). Sarcopenia: A Contemporary Health Problem among Older Adult Populations. *Nutrients*, 12(5), 1293. 1-20 <https://doi.org/10.3390/nu12051293>

PETTEE, K. K., BRACH, J. S., KRISKA, A. M., BOUDREAU, R., RICHARDSON, C. R., COLBERT, L. H., SATTERFIELD, S., VISSER, M., HARRIS, T. B., AYONAYON, H. N., & NEWMAN, A. B. (2006). Influence of Marital Status on Physical Activity Levels among Older Adults. *Medicine & Science in Sports & Exercise*, 38(3), 541–546. <https://doi.org/10.1249/01.mss.0000191346.95244.f7>

Revista de Investigación Cuerpo, Cultura y Movimiento (2013). Cultura física, recreación, deporte, educación deporte y recreación. Recuperado de <https://revistas.usantotomas.edu.co/index.php/rccm>

Rodríguez Perdomo, L., & Barón Cuervo, J. S. (2019). Función cognitiva y composición corporal en mujeres adultas mayores. *Cuerpo, Cultura Y Movimiento*, 9(1), 45–58. <https://doi.org/10.15332/2422474x/5351>

Simão, M., Santos, Freitas, C., Ronaldo Lins Meira, & Fábio Batista Miranda. (2021). Obediencia al principio de la sobrecarga en el entrenamiento resistido y mejora de la autonomía funcional en ancianos mayores. *Revista de Investigación*, 11(2), 120–140. <https://doi.org/10.15332/2422474x.6760>

Santilli, V., Bernetti, A., Mangone, M. & Paoloni M. (2014). Clinical definition of sarcopenia. *Clin Cases Miner Bone Metab*, 11(3), 177-80. <https://pubmed.ncbi.nlm.nih.gov/25568649/>

Simão, M., Santos, Freitas, C., Ronaldo Lins Meira, & Fábio Batista Miranda. (2021). Obediencia al principio de la sobrecarga en el entrenamiento

resistido y mejora de la autonomía funcional en ancianos mayores.

Revista de Investigación, 11(2), 120–140.

<https://doi.org/10.15332/2422474x.6760>

<https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012424.pub2/full>

Silva, V. S. da, & Vieira, M. F. S. (2020). International Society for the Advancement of Kinanthropometry (ISAK) Global: international accreditation scheme of the competent anthropometrist. *Revista Brasileira de Cineantropometria & Desempenho Humano*, 22. <https://doi.org/10.1590/1980-0037.2020v22e70517>

Thomas, E., Battaglia, G., Patti, A., Brusa, J., Leonardi, V., Palma, A., & Bellafiore, M. (2019). Physical activity programs for balance and fall prevention in elderly. *Medicine*, 98(27), e16218. doi: 10.1097/MD.00000000000016218. PMID: 31277132; PMCID: PMC6635278.

World Medical Association. (2022). WMA - the World Medical Association-WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects. Wma.net; WMA - the World Medical Association-WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects. <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>

Zapata-Lamana, R., Poblete-Valderrama, F., Cigarroa, I., & Parra-Rizo, M. A. (2021). The Practice of Vigorous Physical Activity Is Related to a Higher Educational Level and Income in Older Women. *International Journal of Environmental Research and Public Health*, 18(20), 10815. <https://doi.org/10.3390/ijerph182010815>