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The Effects of 6-Month Multi-Component Exercise Intervention on Body Composition in Aged Women: A Single-Arm Experimental with Follow-Up Study

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Abstract: Multicomponent exercise programs, which combine multiple modalities such as aerobic exercises, strength training exercises, flexibility exercises, and balance exercises, can help to promote healthy aging and prevent chronic diseases in aged women. Thus, the goal of this study is to examine if a multicomponent exercise program could improve body composition in community-dwelling aged women. A 6-month single-arm quasi-experimental research was conducted using a multicomponent exercise program for older adults. The sample included 38 women with a mean age of 63.50 years (SD = 6.47 years). Body composition and anthropometric measurement was conducted from baseline (T1), after intervention (T2), and follow-Up (T3). In addition, after exercise intervention, a significant difference with moderate to large effects was reported for fat mass [η^2p = 0.374, $p < 0.001$)], bone density [η^2p = 0.374, $p < 0.05$)], percentage of water [η^2p = 0.374, $p < 0.001$)], and a metabolic equivalent task [η^2p = 0.374, $p < 0.05$]. Additionally, a significant large effect size between T1 and T2 was verified. However, body composition indicators seem to decrease below baseline levels after concluding exercise intervention (T3). Muscle mass decreased significantly after exercise intervention and mean scores were lower compared to baseline data (T1). Thus, a positive effect of the multicomponent exercise program on body composition was established in this group of community-dwelling aged women. However, the relative improvement in body fat and muscle mass were lost after the exercise program's conclusion for values below the baselines. Avoiding detraining periods is, therefore, fundamental to maintaining the normal relative body composition.

Keywords: body composition; body fat; fat-free mass; bone density; exercise

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1. Introduction

Aging is a complex process that involves physiological changes in multiple systems of the body including the immune system and body composition [1]. The immune system plays a crucial role in protecting the body against infectious agents and foreign substances, while body composition indicates the relative proportion of different tissues in the body [2]. Scientific research has shown that these three factors are intricately connected and can have profound effects on health during the aging process [3].

Sarcopenia and adiposity are the terms for the processes of muscle loss and fat growth experienced by aging persons, respectively [4]. Sarcopenia, which is the age-related loss of muscle mass and strength, can also have negative effects on the immune system [5,6]. Sarcopenia and obesity are two interrelated health issues that can have significant impacts on a person's overall well-being [2,7]. Obesity can have negative effects on the immune system, leading to chronic low-grade inflammation that can impair immune function [7,8]. Both clinical conditions are accelerated with the aging process and increase the risk of age-related health problems [9]. Additionally, sarcopenia and obesity can have a synergistic effect on immune function in older adults [10]. These changes can have serious consequences for health since they are linked to an increased risk of chronic diseases such as type 2 diabetes, cardiovascular disease, and cancer [1]. These changes in body composition have an impact on the immune system as well [11]. Sarcopenia and obesity, in particular, have been demonstrated to impair immunological function in older persons. Sarcopenia is related to a loss in immune function because muscle tissue is an important place for immune cell synthesis [12]. Adiposity, on the other hand, can cause persistent inflammation, impairing immune function and increasing the risk of infection and disease [7]. Several studies have also shown that changes in body composition can affect the distribution of immune cells in the body [4]. For example, adiposity is associated with an increase in pro-inflammatory immune cells, such as macrophages and T cells, while a loss of muscle mass is associated with a decline in regulatory immune cells, such as T regulatory cells [5]. These imbalances can contribute to chronic inflammation and an increased risk of metabolic and inflammatory diseases [13].

Physical inactivity can hasten the onset of sarcopenia, resulting in higher muscle loss in older persons. This can result in a decline in physical capacity as well as a drop in the number of immune cells within the muscles themselves, which can impair the immunological response [3,13]. Physical inactivity in elderly persons can also lead to an increase in body fat. This can contribute to sarcopenic obesity, a condition in which an individual has both decreased muscle mass and increasing body fat. Last, physical inactivity can also contribute to chronic low-grade inflammation in older adults, which can lead to a range of health problems [13]. Chronic inflammation has been linked to increased risk of heart disease, diabetes, and other chronic conditions, as well as to impaired immune function [14]. As well, long-term exercise interventions decreases chronic inflammation, improving hypoxia and reducing local inflammation in adipose tissue in addition to its effects on muscle tissue to produce muscle-derived anti-inflammatory myokines [11].

In fact, community exercise programs may be beneficial in providing the elderly with enough physical fitness to show better body composition [15]. Community exercise programs have been shown to have numerous benefits on body composition [16,17]. These programs typically involve group exercise sessions that are led by trained and experienced professionals and are designed to improve cardiovascular fitness, strength, flexibility, agility, and balance. One of the primary benefits of community exercise programs is their ability to promote weight loss and reduce body fat percentage [18]. Regular participation in these programs has also been linked to improvements in muscle mass and bone density, which can help prevent osteoporosis and other age-related conditions in aged adults [19]. Additionally, community exercise programs can improve insulin sensitivity, reduce inflammation, and lower blood pressure, which can reduce the risk of developing metabolic diseases such as type 2 diabetes and heart disease in older adults [20]. Overall, community exercise programs are an effective and accessible way to improve body composition and overall health.

The effects of exercise on body composition in aged women should be investigated because older women are at higher risk of developing age-related declines, particularly as a result of menopause in muscle mass and bone density, as well as increased body fat accumulation compared to men [9,21]. Regular exercise has been demonstrated to be a beneficial intervention for changing body composition in older women; however, further study is required to fully understand the processes underlying these benefits and to find the best exercise programs for this population [16,17]. Furthermore, studying the effects and follow-up of exercise on body composition in older women can aid in the development of methods for promoting healthy aging and improving quality of life in this population [3]. Understanding the benefits of exercise on body composition in this group is becoming increasingly important for public health policy and clinical practice, given the growing prevalence of older women in the population [3]. As a result, studying the effects of exercise on body composition in elderly women can help guide evidence-based recommendations for exercise treatments to promote healthy aging and prevent chronic diseases [1].

The primary aim of this study is to investigate the effectiveness of a multicomponent exercise program in improving body composition in community-dwelling elderly women, as measured by reliable and cost-effective methods. The hypothesis is that the exercise intervention will result in a significant improvement in body composition. Given the established age-related decline in muscle mass and increase in body fat, the secondary aim is to assess whether the benefits of the intervention could be sustained after the completion of the exercise program.

2. Materials and Methods

2.1. Design and Recruitment

This study employed a single-arm quasi-experimental design, spanning over 6 months, to investigate the effects of a multicomponent exercise program in older adults. The study included both baseline and after-analysis to assess the effectiveness of the intervention. A single-arm quasi-experimental study is a type of research design that involves a single group of participants receiving an intervention or treatment, without a comparison group. In this type of study, researchers do not randomly assign participants to different groups, but instead, they observe the effects of the intervention on the same group before and after the intervention. These types of studies are typically conducted when it is not feasible to use a randomized controlled trial design, such as when the intervention being tested is already widely used or when it would be difficult to recruit a large enough sample size. In this case, a single-arm design can still provide valuable information on the potential effects of an intervention or treatment.

The recruitment of participants for research among older populations is challenging due to limited communication channels and social isolation. To address this challenge, the study team used various communication strategies including regional journals, social media platforms, and flyers in traditional shops such as coffee shops, bakeries, and hair salons. In addition, individual invitations were made over the phone based on data from the city council of Bragança. The potential participants were fully informed about the study's goals and the voluntary nature of participation, as well as the potential risks associated with physical exercise. The study employed an inclusive approach to recruit potential participants from the community. The experimental group comprised participants who met the inclusion criteria, including being aged 65 years and above, capable of standing and walking with or without assistive equipment, not engaged in any exercise program, and living in the community. Participants with chronic neuromuscular, cardiovascular, or metabolic illnesses that could pose a danger during classes and evaluation periods were excluded. One exercise physiologists with research experience completed all the assessments, and one researcher examined the data. The first and last two weeks of the exercise protocol were dedicated to body composition and anthropometric measurement. After 6 months, an exercise physiologist measured body composition and anthropometric for follow-up analyses. The community-based program known as "+Idade +Saúde" was carried out in a gym facility at the School of Education of Bragança in Polytechnic Institute of Bragança. The research project received approval from an ethic committee (n° UID/CED/04748/2020) and adhered to the principles of the Helsinki declaration. Participants who took part in this study signed written informed consent forms.

The G*Power 3.1 (Institut für Experimentelle Psychologie, Düsseldorf, Germany) was used to calculate the required sample size, considering the following parameters: (1) statistical power = 0.95; (2) number of groups = 1; (3) number of measurements = 3; (4) correlation among repeated measure = 0.8; and (5) non-sphericity correction = 1. The calculations suggested a minimum of 24 participants for the results to be valid and reliable. The calculation of the effect was based on studies using similar protocols and designs converting reported Cohen's d effect sized into f [17,22].

2.2. Exercise Intervention

According to the American College of Sports Medicine (ACSM) [11], the exercise regimen matched the frequency, intensity, type, and time (FITT) guidelines [23,24]. The exercise intervention was scheduled for three morning sessions each week, in accordance with FITT principles. An experienced exercise physiologist with extensive training in adult and senior exercise prescription watched all sessions, offering exercise adaptations and encouragement, as well as monitoring exercise intensity with validated measures such as the talk test and Borg scale [25,26]. The exercise physiologist distributed the scales to each participant immediately after each component and at the end of each training session. Resistance, cardiorespiratory, balance, agility, and flexibility training were included in the exercise intervention, with sessions lasting 45–60 min. Exercise sessions were held on weekday mornings in a day-off-day sequence, based on the interests of the participants. Because of the large number of participants, two groups were formed for safety reasons. To provide participants with a diversity of stimuli, three unique sessions were devised and implemented. Details of the exercise protocol can be seen elsewhere [17].

During the training sessions, participants engaged in a warm-up lasting 5–8 min that included slow walking, dynamic stretching exercises, and dual-task activities. The cardiorespiratory fitness activities lasted between 15–20 min and included walking, jogging, aerodance, and dance exercises. The walking exercise involved taking steps on tippy toes, on heels, and with a knee-raising gait around a predefined circuit. Similarly, the jogging exercise was performed around a circuit, with participants increasing their hip and knee flexion with increased pace. Aerodance involved rhythm-based exercises to the beat of the music, while dance exercises were performed in pairs according to music tempo. Participants were given the opportunity to choose their preferred music. Two workouts were selected, each lasting at least 8–10 min, with one session comprising walking and aerodance activities, another session comprising jogging and dance exercises, and the third session comprising walking and dance exercises. The cardiorespiratory training sessions were structured such that participants completed different activities in each of three sessions. The intensity of these sessions began at a moderate level and increased to a moderate-to-vigorous level after 12 weeks. Resistance exercise lasted between 15 and 30 min, and involved the use of bodyweight, ankle weights, rubber bands, and dumbbell equipment. The chosen exercises targeted key muscle groups, and each session included four different exercises. In one session, participants performed chair squats, seated arm abduction and adduction, arm curls, and shoulder shrugs using dumbbells. In another session, participants performed seated single-leg extension and flexion with ankle weights, arm flexion and extension with dumbbells, and peck deck with rubber bands. Rest times between sets in the circuit ranged from 40 to 60 s. During the third session, the participants performed standing calf raises, arm curls with a shoulder press, and seated rows with dumbbells. The intensity of the resistance training was increased from light-to-moderate intensity (5–6 points on the Borg Scale) to moderate intensity (6–7 points on the Borg Scale) after eight weeks to allow for optimal adaptation and execution of the workout. The participants began with one set of 8 repetitions and gradually progressed to three sets of 12–15 repetitions. The exercise physiologist would instruct the participants to perform 3 more repetitions if they could complete 12 repetitions with light-intensity effort. For 5–8 min, the participants engaged in static and dynamic balance training using wooden sticks, softballs, and balloons. Throwing and/or catching softballs, as well as single-leg static and dynamic activities with bats and balloons, were used for balance training. To ensure safety, the exercise physiologists kept a 2 m distance between the participants while performing balance and agility exercises. At the end of each session, there was a 5 min cool-down phase that included breathing and stretching exercises. Participants repeated each stretch 3–4 times with a resting duration of 15–20 s between stretches. During the stretching exercises, the muscle was extended across the joint and held in a position of low-to-mild discomfort for 15–20 s before being released. The flexibility exercises were performed at a 1:1 ratio of active to relaxed stretching and focused on low-intensity stretching of the muscles recruited during the previous exercises.

2.3. Instruments

Height was measured using a stadiometer (SECA® 217, Hamburg, Germany). The participants stood straight with their heels together and their back against the stadiometer. The headpiece of the stadiometer was brought down to rest on the top of the participants' heads, and the height was recorded to the nearest 0.1 m. Weight was measured using a calibrated bioimpedance scale (Tanita® BC-554, Tokyo, Japan). The participants stood on the scale without shoes and with minimal clothing, and the weight was recorded to the nearest 0.1 kg. Body mass index was calculated using the standard formula: weight (kg)/height (m^2). Data reported by the bioimpedance scale included measures of weight, body fat percentage, muscle mass, hydration status, and metabolic equivalent of task which were used for the present study. Considering the bioimpedance scale, body fat percentage was estimated by analyzing the resistance and reactance of the electrical current as it passed through body tissues, with greater resistance indicating higher levels of body fat. Muscle mass was also estimated through the bioimpedance measurement, with the electrical current passing more easily through muscle tissue compared to fat tissue. Hydration status could also be estimated through bioimpedance, with greater hydration levels resulting in lower resistance to the electrical current. Bone density was estimated also using the bioimpedance scale. This scale use a technique called segmental bioelectrical impedance analysis, which measures impedance at different body segments to estimate bone mineral density. It is important to note that the accuracy and reliability of bone density measurements obtained from bioimpedance scales are not as high as those obtained through gold-standard methods such as DXA [27]. However, this indicator was considered since DXA measurements are not cost-effective. Considering that a bioimpedance scale may provide some indirect insights into bone health, and since muscle mass and bone mineral density are generally correlated, changes in muscle mass measured by a bioimpedance scale could indirectly suggest changes in bone density.

2.4. Statistical Analysis

Descriptive statistics such as mean and standard deviation were calculated. For normal data assessment, the Shapiro–Wilk test was considered. To look for variations in the dependent variables, a general linear model with repeated measures was used (data at baseline, after exercise program, and follow-up). The significance level to reject the null hypothesis was set at 5%. Sphericity assumptions were examined using Mauchly's test. When this assumption was not met, the Greenhouse–Geisser adjusted values and degrees of freedom were reported and are indicated by the presence of decimal degrees of freedom. The repeated measures analyses were followed by Bonferroni-adjusted post-hoc tests to analyze pairwise comparisons. The partial eta square effect size was calculated and the assumed reference values were as follows: "small" effect = 0.01, "medium" effect = 0.06, and "large" effect = 0.14. All data were analyzed using IBM SPSS® Statistics version 27 (IBM Corp., Armonk, NY, USA) for Windows.

3. Results

The data collected in this study are presented in Table 1, including the mean and standard deviation values. A total of 38 women were included in the exercise program after recruitment assessment and identification of potential participants, with a mean age of 63.50 years (SD = 6.47 years). Data from all 38 participants were successfully obtained at T2. However, 10 participants did not attend the follow-up assessment (T3), although there were no dropouts recorded from the exercise program. The expectation-maximization approach was used to handle missing data. Mean attendance rates were 79%, ranging from 75% to 100%. Data at baseline displayed normal distribution ($p > 0.05$).

Table 1. Mean, standard deviation, and mean comparisons across measurements.

Variable	Baseline (T1)		After Intervention (T2)		Follow-Up (T3)	
	M	SD	M	SD	M	SD
Weight (kg)	1.58	0.06	1.57	0.07	1.56	0.07
Height (m)	66.90	8.24	66.53	8.32	64.69	15.17
Body Mass Index (kg/m^2)	26.85	3.38	26.71	3.41	25.71	6.06
Fat Mass (%)	34.53	6.27	34.22	6.22	34.49	7.53
Muscle Mass (kg)	42.44	4.51	44.42	4.95	40.66	3.37
Water (%)	47.53	5.04	47.68	5.03	46.45	2.93
Bone Density (g/cm^2)	2.19	0.19	2.21	0.17	2.14	0.23
Metabolic Equivalent of Task (MET)	1302	107	1326	108	1286	104

Notes: M—mean; SD—standard deviation.

Significant improvements were observed in body composition with large effect sizes between T1 and T2. However, improvements were lost since follow-up measures indicated significant losses after exercise intervention with moderate to large effects [F (1) = 10.93, η^2p = 0.184–0.378, $p < 0.05$ to $p < 0.001$]. Muscle mass decreased significantly after exercise intervention (T3) [F (1) = 10.75, η^2p = 0.374, $p < 0.05$ to $p < 0.001$)] and mean scores were lower compared to baseline data (T1). In addition, after exercise intervention a significant difference with statistical power was reported for fat mass [F (1) = 10.75, η^2p = 0.374, $p < 0.05$ to $p < 0.001$)], bone density [F (1) = 10.75, η^2p = 0.374, $p < 0.05$)], percentage of water [F (1) = 10.75, η^2p = 0.374, $p < 0.001$)], and metabolic equivalent task [F (1) = 10.75, η^2p = 0.374, $p < 0.05$)]. All pairwise differences were reported for three assessment moments (T1 $\neq$ T2; T2 $\neq$ T3; or T1 $\neq$ T2 $\neq$ T3) (see Table 2).

Table 2. Mean comparison between measures.

Variables	F	df1	df2	*p*	η^2p	Pairwise Comparisons
Weight (kg)						
Time	10.93	1	36	<0.001	0.378	T1 $\neq$ T2; T2 $\neq$ T3
Body Mass Index (kg/m^2)						
Time	9.50	1	36	<0.001	0.345	T1 $\neq$ T2; T2 $\neq$ T3
Fat Mass (%)						
Time	9.193	1	36	<0.001	0.338	T1 $\neq$ T2; T2 $\neq$ T3
Muscle Mass (kg)						
Time	10.75	1	36	<0.001	0.374	T1 $\neq$ T2 $\neq$ T3
Water (%)						
Time	6.61	1	36	<0.05	0.269	T1 $\neq$ T2; T2 $\neq$ T3
Bone Density (g/cm^2)						
Time	4.06	1	36	<0.05	0.184	T1 $\neq$ T2; T2 $\neq$ T3
Metabolic Equivalent of Task (MET)						

Notes: F—F test results; df1—degrees of freedom; df2—degrees of freedom; *p*—significance; η^2p—partial eta-square; ns—no differences detected.

4. Discussion

The goal of this study was to examine if a multicomponent exercise program could improve body composition in community-dwelling aged women. Research results confirmed that multicomponent exercise programs have a positive effect on body composition in community-dwelling aged women, since significant improvements were observed in body composition indicators after the 6-month exercise intervention. However, the relative improvement in body fat and muscle mass were lost after the exercise program's conclusion.

Indeed, significant improvements were observed in all body composition indicators with large effect sizes ranging between T1 and T2. Concretely, the 6-month multicomponent exercise program improved body mass index, fat mass, muscle mass, percentage of water, bone density, and task metabolic equivalent for the community-dwelling aged women. These results are in line with previous studies that reported a positive effect of the multicomponent exercise in body composition outcomes [17,22]. Rodrigues et al. [22] demonstrated that a 23-week low-cost multicomponent exercise program had a positive effect on body mass index. However, Monteiro et al. [17] have not reported any significant differences in body mass index during a multicomponent training program in elderly women. In addition, Forte et al. [16] stated no differences in body mass index between pre- and post-multicomponent training program with six months of intervention. Both studies used only the body mass index, so the lack of differences may be due to the sensitivity of the method to measure other important components in body composition such as fat mass, muscle mass, percentage of water, or bone density. The BMI is a commonly used measure for assessing body composition, but it has limitations, especially when it comes to differentiating between fat mass and lean mass. BMI is only a measure of overall body weight relative to height and does not consider other important factors such as muscle mass, bone density, and hydration status. Therefore, the lack of differences between the groups in the previous studies may be partly due to the limitations of using BMI alone as a measure of body composition [9,28]. In contrast, the current research used a more comprehensive assessment of body composition based on bio impedance data, which allows for the separate measurement of fat mass, muscle mass [6], and bone density [29]. The results of this study showed that the exercise-based intervention program was effective in reducing fat mass and increasing muscle mass and bone density, indicating the importance of including more comprehensive measures of body composition in future research. Additionally, the study highlights the importance of a multi-component exercise program, which combines strength, aerobic, balance, agility, and jump training, as an effective regimen to prevent age-related functional decline in older adults [30]. The results of this study showed that the exercise-based intervention program was effective in reducing fat mass and increasing muscle mass and bone density, indicating the importance of including more comprehensive measures of body composition in future research. Additionally, the study highlights the importance of a multi-component exercise program, which combines strength, aerobic, balance, agility, and jump training, as an effective regimen to prevent age-related functional decline in older adults [6,30].

Moreover, recent studies have revealed that the improvements in body composition achieved through a six-week multi-component exercise program are not sustained over time. In fact, follow-up assessments have shown significant reductions in all body composition indicators, including a significant decrease in muscle mass scores when compared to baseline data. This highlights the importance of regular physical exercise to maintain body composition in aging individuals, as muscle mass tends to decrease with age due to the process of senescence, which is characterized by sarcopenia, increased fat mass, and low bone density [24]. While multi-component training is an effective exercise-based strategy to reduce fat mass and increase muscle mass, it should be noted that these outcomes tend to decline in a short period of time due to the aging physiological processes [24,31]. The evidence suggests that sustaining the benefits of exercise requires long-term commitment and consistent effort to maintain a healthy lifestyle. [10,32]. Furthermore, research has shown that daily physical activity alone can have a positive effect on body composition [33]. This highlights the importance of making physical activity a part of daily routine to maintain a healthy body composition. In addition to physical activity, a balanced diet with a low caloric intake is also crucial for maintaining stable body composition over time [34]. Insulin resistance, a common issue in obesity, is a reduced response to insulin in target tissues such as muscle and liver tissue [12,20]. This can lead to metabolic syndrome and hypokinetic diseases, which are known to increase the risk of metabolic cardiovascular diseases and associated morbidity and mortality [15,35]. Dysfunctional adipose tissue is also a concern in obesity, as it can lead to pro-inflammatory processes and an increase in adipocytokines such as adiponectin and pro-inflammatory tumor necrosis factor-α (TNF-α) [31]. These factors can potentiate atherosclerotic processes, endothelial dysfunction, and peripheral insulin resistance, ultimately leading to the development of cardio-metabolic pathologies such as hypercholesteremia, hyperdyslipedemia, type 2 diabetes, myocardial infarction, coronary atherosclerotic heart disease, and arterial hypertension [5,15]. It is therefore important to address obesity and its associated issues to prevent the development of these pathologies and maintain a healthy body composition.

Reduced muscle protein production is the main consequence of age-related sarcopenia, which is primarily caused by alterations in hormonal signaling and chronic low-grade inflammation. Hormones such as testosterone, growth hormone, and insulin-like growth factor-1 (IGF-1) play vital roles in muscle growth and maintenance [7,16]. In addition, mitochondrial and neuromuscular dysfunctions are frequently observed in individuals with sarcopenia. The decline in muscle energy production and motor unit connections leads to impaired muscle function, which further contributes to muscle loss and weakness [7,16]. Therefore, these age-related factors significantly impact muscle health and function, emphasizing the importance of maintaining an active lifestyle and engaging in regular physical exercise to counteract the effects of sarcopenia. In addition, obesity and sarcopenia conditions coupled with low rates of physical activity and exercise are associated with balance loss, risk of falling, and fractures [29]. It is epidemiologically a major risk for mortality in aged people [13,18,24]. Moreover, the triggered effect the impact of the binomial adipose tissue and insulin sensitivity impairment on the onset of oncological and neurodegenerative pathologies cannot be ignored [9,15]. For the following 10 years, it was predicted that both diseases will have the highest incidence, morbidity, and mortality rates [13]. Thus, researchers and practitioners should consider multi-component exercise program as a valid, affordable, and accessible strategy to maintain a proper relative body composition by avoiding chronic non-communicable diseases using this training mode as a primary exercise-based prevention [31]. However, maintaining physical exercise programs are a challenge for institutions and governments, since detraining periods in the aged population have particularly adverse effects on body composition with an increase in fat mass and a decrease in lean mass to values below the baseline [6]. However, it is important consider that individual variability in fitness level, health status, and personal preferences can impact the effectiveness and safety of the exercise program [7]. In addition, personalized physical exercise can be an effective approach for managing sarcopenia and obesity, including a regular monitoring, an adequate feedback, and a continuous nutritional support [16]. Consistency and adherence to an exercise program are crucial for achieving and maintaining the desired effects on sarcopenia and obesity [16,17].

The current evidence supports the beneficial effects of exercise on body composition. However, the study also shows that the improvements in body composition resulting from exercise programs are not maintained in the long term. This underscores the importance of continued physical activity throughout the lifespan, especially in aged individuals. Maintaining a healthy body composition is crucial for overall health, as it has direct effects on the immune system. Obesity is a well-established risk factor for a wide range of chronic diseases including type 2 diabetes, cardiovascular disease, and cancer. In contrast, a healthy body composition can help to reduce the risk of these diseases and improve overall health and well-being. When exercise is absent, individuals tend to lose all the benefits obtained thanks to the exercise. Sarcopenia age-related factors, such as alterations in hormonal signaling and chronic low-grade inflammation, can cause reductions in muscle protein production, mitochondrial and neuromuscular dysfunction, and declines in muscle energy production and motor unit connections. This can lead to impaired muscle function, which in turn can have negative effects on overall health. Overall, the evidence suggests that exercise is a crucial component of a healthy lifestyle, especially for maintaining a healthy body composition and reducing the risk of chronic diseases. People should strive to remain physically active throughout their lives, as even small amounts of regular physical activity can have significant health benefits.

Limitations, Practical Applications, and Research Agenda

This research adds useful information to the evidence base about multi-component exercise effects on body composition; however, some limitations should be considered when interpreting their results. Primary, the sample was selected by convenience and has a lack of randomization in the single-arm quasi-experimental approach. In addition, the 6-month multi-component exercise intervention is an acceptable evaluation period to measure exercise-based effects; however, it is still shorter than some previous studies. In fact, multi-component exercise can require a significant time commitment. Over time, multi-component training programs can develop a plateau in physiological and immunological effects, requiring necessary adjustments to the exercise program periodically or incorporate new exercises or techniques [17,22]. This may be challenging for individuals with busy schedules or limited time to devote to exercise [17,31]. Although the training program followed the FITT-VP guidelines [23,24], there was no individualization of the training stimulus over time, something that should be explored in future research. Furthermore, this research controls only for variables related to body composition, excluding other health-related dimensions, such as functional fitness in the forms of strength, balance, flexibility, and aerobic capacity [18,22,36]. Indeed, when the exercise stimuli are sustained over time, multi-component exercise regimens with strength training appear to increase upper and lower limb strength [18,22,36]. Future prospects should add these variables to the analysis and emphasize the analysis in the follow up, something that remains little explored in the literature. In addition, improvements in body composition should also be monitored through the potential increase in physical activity and improvement in eating habits that tend to occur in parallel with exercise programs [15]. Furthermore, well-being, psychological, and quality of life variables should be added to understand if there is any interdependence with improvements and declines over the different intervention phases [37]. Future research to evaluate the effects of a multi-component training program should use a multifactorial approach; nevertheless, the practical applicability of this procedure was mostly limited to the primary risk factor of obesity and being overweight. Although we discussed TNF-alpha as a potential mediator in the relationship between body fat and the immune system, it was not measured in the current study. Future studies should consider measuring TNF-alpha to further examine its implications in this relationship. In the present study, food intake was not measured, and thus, its role in this relationship could not be examined. Future studies should aim to measure food intake to provide a more comprehensive understanding of the relationship between body fat and the immune system.

5. Conclusions

The community-dwelling aged women showed significant improvements in body composition indicators after a 6-month exercise intervention, indicating that the multicomponent exercise program had a positive impact. Nonetheless, the relative improvements in body fat and muscle mass were not sustained after the exercise program ended, highlighting the importance of regular exercise to prevent detraining and declines in body composition measures. Overall, the multicomponent exercise program is beneficial for maintaining proper body composition, but consistent practice is critical for avoiding reductions in indexes below the baseline.

In practical terms, the findings of this study suggest that a six-month multicomponent exercise program can be an effective intervention to improve body composition in community-dwelling aged women. However, maintaining the benefits of the program requires regular practice, even after the program ends. This implies that long-term commitment and adherence to a regular exercise routine are crucial in achieving and maintaining optimal body composition levels. The results of this study also highlight the importance of ongoing monitoring and support to help individuals maintain their progress and prevent relapse. This information can be useful for researchers and practitioners involved in designing exercise interventions for older adults, particularly women, who may be at higher risk of developing age-related body composition changes.

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