Un estudio piloto sobre el miedo y el riesgo de caída: el impacto de un programa de ejercicios de componentes múltiples de 8 meses en adultos mayores que viven en la comunidad

A pilot study on fear and risk of fall: The impact of an 8-month multicomponent exercise program in community-dwelling aged adults

Um estudo piloto sobre medo e risco de queda: o impacto de um programa de exercício multicomponente de 8 meses em adultos idosos residentes na comunidade

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RESUMEN

Este estudio tuvo como objetivo examinar el impacto del efecto de un programa de ejercicio de componentes múltiples de 8 meses en adultos mayores que viven en la comunidad. Utilizamos una estrategia inclusiva para examinar la viabilidad de un programa de ejercicio de tres veces por semana. Tener más de 60 años, la capacidad de pararse y caminar con o sin equipo de asistencia, ser físicamente inactivo, autorización médica y vivir en la comunidad fueron todos los criterios de elegibilidad. Se utilizaron la prueba Timed-up and Go y la Berg Balance Scale para examinar el riesgo de caídas. Se utilizó la Fall-Efficacy Scale International para examinar el miedo a las caídas. El programa de ejercicio basado en la comunidad involucró a treinta y cinco participantes, la edad promedio fue de 67.54 años (SD = 3.81) y el 71% eran mujeres. Las tasas de asistencia variaron de 76% a 100% en promedio. Hubo una tendencia significativa hacia una mejora clínicamente importante en el timed-up and go test (t = 4.66; p < .001; d = 0.20), escala de equilibrio de Berg (t = -11.20; p < .001; d = 1.47) y escala internacional de eficacia contra caídas (t = 5.81; p < .001; d = 0.88). Este estudio ha proporcionado evidencia preliminar de que un programa de ejercicio de bajo costo basado en la comunidad de 8 meses puede ser efectivo para mejorar la agilidad, el equilibrio y disminuir el miedo a caerse en las personas mayores.

Palabras clave: miedo, caer, anciano, ejercicio, cuasi-experimental, salud.

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ABSTRACT

The objective of this study was to investigate the impact of an 8-month multicomponent exercise program in community-dwelling older adults. A comprehensive approach was employed to assess the feasibility and effectiveness of a thrice-weekly exercise intervention. Aged over 60 years, the capacity to stand and walk with or without assistive equipment, being physically inactive, medical clearance, and living in the community were all eligibility criteria. The Timed-up and Go test and Berg Balance Scale were used to examine risk of falling. The Fall-Efficacy Scale International was used to examine the fear of falling. The community-based exercise program involved thirty-five participants, the average age was 67.54 years (SD = 3.81) and 71% were female. At-tendance rates ranged from 76% to 100% on average. There was a significant trend toward a clinically important improvement in the timed-up and go test (t = 4.66; p < .001; d = 0.20), berg balance scale (t = -11.20; p < .001; d = 1.47) and fall-efficacy scale international (t = 5.81; p < .001; d = 0.88). This study has provided preliminary evidence that an 8-month community-based low-cost exercise program may be effective in improving agility, balance, and decreasing fear of falling in older people.

Keywords: fear, fall, older, exercise, quasi-experimental, health.

RESUMO

Este estudo teve como objetivo examinar o impacto do efeito de um programa de exercício multicomponente de 8 meses em idosos residentes na comunidade. Usamos uma estratégia inclusiva para examinar a viabilidade de um programa de exercícios três vezes por semana. Idade acima de 60 anos, capacidade de ficar em pé e andar com ou sem equipamento auxiliar, ser inativo fisicamente, ter autorização médica e morar na comunidade foram todos os critérios de elegibilidade. O teste Timed-up and Go e a Escala de Equilíbrio de Berg foram usados para examinar o risco de queda. A Fall-Efficacy Scale International foi utilizada para examinar o medo de cair. O programa de exercícios comunitários envolveu trinta e cinco participantes, a idade média foi de 67,54 anos (DP = 3.81) e 71% eram do sexo feminino. As taxas de adesão variaram de 76% a 100%, em média. Houve uma tendência significativa para uma melhora clinicamente importante no timed-up and go test (t = 4.66; p < .001; d = 0.20), escala de equilíbrio de Berg (t = -11.20; p < .001; d = 1.47) e escala de eficácia de queda internacional (t = 5.81; p < 0.001; d = 0.88). Este estudo forneceu evidências preliminares de que um programa de exercícios de baixo custo baseado na comunidade de 8 meses pode ser eficaz para melhorar a agilidade, o equilíbrio e diminuir o medo de cair em idosos.

Palavras-chave: medo, cair, idosos, exercício, quase-experimental, saúde.

INTRODUCTION

Aging is a pervasive demographic phenomenon that is unfolding worldwide, as the global population expands, and life expectancy rises. Projections by the United Nations (2020) indicate a substantial increase in the number of individuals aged 60 and over, with estimates surpassing 2.1 billion by 2050, more than double the figure of 962 million in 2017. Furthermore, the proportion of older adults within the overall population is also expected to rise from 12% in 2017 to 22% in 2050, underscoring the significant demographic shift towards an aging population. In developed countries, the aging of the population is more advanced. The proportion of older adults in these countries is expected to be higher than in developing countries. The aging of the population has significant implications for health care, social security, and the economy. As people age, they are more likely to develop chronic health conditions that require ongoing medical treatment and support. Additionally, older adults are more likely to rely on social security and pension systems, which can place a strain on government finances (Samuel et al.,

2021). Overall, the aging of the population is a major demographic trend that is expected to continue in the coming decades, and it will have significant implications for society, governments, and economies.

Aging refers to the process of growing older, which is characterized by physical, mental, and social changes that occur over time (Beard & Bloom, 2015). Aging is a complex and multidimensional process that is influenced by both genetic and environmental factors. From a biological perspective, aging is characterized by a gradual decline in the function of various organ systems and an increased susceptibility to disease (Barzilai et al., 2018). Age-related cognitive decline is a well-established phenomenon, often accompanied by social changes such as retirement, bereavement, and modifications in living arrangements (Donovan & Blazer, 2020).

Sarcopenia, the age-related decline in muscle mass and strength (Walston, 2012), is a prevalent condition among older adults, with estimates suggesting that up to 50% of individuals over the age of 80 may be affected (Faulkner et al., 2007). This condition is associated with increased risks of falls, disability, frailty, and morbidity. Various factors, including reduced physical activity, hormonal changes, and inflammation, contribute to the development of sarcopenia (Priego et al., 2021). Furthermore, sarcopenia has been identified as a significant risk factor for falls in older adults, in addition to its association with chronic diseases like diabetes and heart disease (Rodrigues et al., 2022). The loss of muscle mass with aging can compromise balance maintenance and hinder the performance of everyday activities, thus increasing the likelihood of falls. Moreover, sarcopenia is also associated with decreased strength and power, which can further impede tasks such as rising from a chair or climbing stairs. Falls are a serious concern in older adults as they can result in injuries such as fractures, head trauma, or even fatality (Iamtrakul et al., 2021; Rubenstein, 2006) even more during (Jung et al., 2023) and after COVID-19 (Briguglio et al., 2020). Therefore, it is crucial to identify and address potential fall risks to prevent injuries or fatalities (Soh, 2022). The fear of falling is a common concern among older adults, characterized by a heightened sense of apprehension regarding falls and their consequences (Smith et al., 2018). This fear can negatively impact quality of life, mobility, and engagement in physical activities, thereby increasing the risk of falls. Several factors, including a history of falls, fear of injury, and loss of confidence in maintaining balance, can contribute to the fear of falling (Schoene et al., 2019).

The prevention and treatment of sarcopenia, as well as the mitigation of falls and fear of falling, are crucial for maintaining function and independence in older adults (Rodrigues et al., 2022). To effectively manage the fear of falling, a key strategy is to focus on fall prevention through regular exercise aimed at increasing muscle mass and strength (García-Hermoso et al., 2020; Marques et al., 2022). Multicomponent exercise programs, which integrate various types of exercises to target multiple aspects of physical fitness, have been identified as an effective intervention for preventing and treating sarcopenia (Chang et al., 2023) and increasing well-being (Figueira et al., 2021; Oliveira et al., 2021). These programs typically encompass cardiovascular exercise, strength training, balance, agility, and flexibility exercises. The advantage of multicomponent exercise programs lies in their ability to address diverse components of physical fitness, including muscle strength, cardiovascular fitness, balance, and flexibility (Rodrigues et al., 2022). This comprehensive approach can contribute to overall improvement in physical function, reduction in falls risk, and enhancement of quality of life.

Multicomponent exercise programs can be effectively implemented in community settings, such as senior centers, community centers, or higher educational institutions, to facilitate regular exercise participation among older adults in a convenient, accessible, and socially engaging environment (Monteiro et al., 2022). These programs are tailored to the unique needs and abilities of older participants, and modifications can be made accordingly. The social aspect of community-based multicomponent exercise programs can foster a sense of community and belonging, which is particularly beneficial for older adults who may experience isolation or mobility limitations.

Certified instructors with expertise in working with older adults lead community-based multicomponent exercise programs and are equipped to provide personalized modifications and adaptations to

accommodate individual needs (Rodrigues et al., 2021; Rodrigues et al., 2022). Some programs also incorporate assessments and monitoring to track progress and adhere to exercise prescription guidelines for necessary adjustments (Nelson et al., 2007). By engaging in these multicomponent exercise programs, older adults can effectively sustain physical activity levels, preserve physical function, and enhance their overall health and well-being, while mitigating fear and risk of falls.

There are several limitations in the existing literature on falls risk in older adults. Many studies examining falls risk are cross-sectional in nature, collecting data at a single time point, which precludes the establishment of cause-and-effect relationships as pointed out by Marques et al. (2022). Additionally, numerous studies investigating fall prevention strategies are short-term interventions, and their long-term effectiveness remains poorly understood (Phelan et al., 2016). Challenges are also encountered in recruiting older adults with specific characteristics, such as limited physical fitness, which may limit the generalizability of findings (Sullivan-Marx et al., 2011). Furthermore, multicomponent exercise programs can be costly, time-consuming, and require significant investments in equipment and facilities. Some studies are conducted on a short-term basis and lack long-term follow-up to comprehensively evaluate the effectiveness of multicomponent exercise programs (Rodrigues et al., 2022). These factors collectively restrict the generalizability of findings to a larger population.

The potential novelty of a multicomponent exercise program for community-dwelling older adults lies in its ability to comprehensively address multiple facets of physical and cognitive health that contribute to falls risk and fear of falling. Fear of falling and risk of falling are distinct concepts related to falls in older adults. Fear of falling pertains to the psychological concern or anxiety experienced by individuals regarding the possibility of falling. This fear may arise from previous falls, physical impairments, or perceived lack of control over balance and mobility. On the other hand, risk of falling refers to an objective assessment of the likelihood of an individual experiencing a fall. This assessment considers factors such as age, health conditions, medication use, and physical function to determine the probability of a fall occurrence. While exercise

programs have been shown to improve physical function and reduce the risk of chronic diseases in older adults, a multicomponent approach has the potential to offer additional benefits by addressing the psychological aspect of fear of falling. Moreover, the program may potentially improve cognitive function by incorporating activities that challenge memory and executive function. The impact of such a multicomponent exercise program on fear of falling in community-dwelling older adults could have important implications for reducing healthcare costs and improving outcomes in this population (Marques et al., 2022; Samuel et al., 2021). Furthermore, investigating the impact of a multicomponent exercise program on fear of falling may provide valuable insights into the most effective strategies for addressing this concern in older adults, potentially leading to the development of more targeted interventions in the future with a focus on the psychological aspect of falls.

The aim of this study was to evaluate the effects of a low-cost multicomponent exercise intervention on reducing falls risk and fear of falling in community-dwelling older adults. Valid and reliable measures of balance and associated fear of falling were utilized. It was anticipated that the exercise intervention would have a significant and positive impact on agility, balance, and self-confidence in community-dwelling older individuals.

METHODS

Design and Participants

This quasi-experimental study spanned a duration of 8 months and aimed to investigate the effects of a multicomponent exercise program in the elderly population, with pre- and post-analysis conducted (Ato et al., 2013). The evaluations were carried out by two exercise physiologists with extensive research experience, and one researcher analyzed the data in a blinded manner. The first and last two weeks of the study were dedicated to functional fitness testing and measurement of fear and risk of falling. The community-based multicomponent exercise program, known as +idade+saúde, was conducted at the School of Education of Bragança in Bragança, within a gym facility. Ethical approval was obtained from the Life Quality Research Center with reference number UID/CED/04748/2020, and the study adhered to the principles of the Helsinki Declaration as outlined by

the World Medical Association (2013). Written informed consent forms were signed by all participants who took part in this study.

Instruments

All measurements were taken by a single evaluator at two time points: baseline and after an 8-month exercise program. The assessments were conducted in a standardized circuit, with consistent conditions maintained throughout the testing period. On the day of testing, subjects underwent an 8–10-minute warm-up led by an exercise physiologist prior to completing all outcome measurements.

Weight was measured with a digital bioimpedance scale (Tanita BC-50, Illinois, USA) while participants wore light clothing and were without shoes, before breakfast. Height was evaluated using a digital scale with an attached stadiometer (SECA®, Chino, USA), with the measurement taken between the vertex and the ground's reference plane. Body Mass Index (BMI) was calculated using the formula: BMI = weight (kg) / height^2 (m). Weight, height, and BMI will be reported for transparency.

To estimate the risk of falls, the timed up-and-go test (Rikli & Jones, 2013) was employed. This test measures the time taken to rise from a seated position, walk 2.44 meters, turn, and return to a seated position, with the time recorded to the nearest 1/10th of a second. Participants performed the timed up-and-go test twice, following a demonstration by the researcher, and the best attempt was used to define the risk of falling.

The Berg Balance Scale (1989) is a well-established functional measurement used to assess balance and fall risk. It comprises 14 items that evaluate the ability to maintain balance both statically and during dynamic tasks. The assessment takes 10-20 minutes to complete and is scored on a scale of 0-4 for each item, resulting in a total score ranging from 0-56. The Berg Balance Scale is widely utilized due to its proven reliability, validity, and functional nature (Mancini & Horak, 2010).

The Falls Efficacy Scale International (Yardley et al., 2005) is a 16-item measure of fear of falling, assessing concerns related to falling during various social and physical activities, using a four-point rating scale. This instrument was developed based on a comprehensive review of fear of falling, self-efficacy, and balance confidence questionnaires. It has been validated for use in older adults and demonstrates good reliability and validity (Delbaere et al., 2010).

Attendance rates for both groups were calculated by dividing the number of exercise sessions completed by each participant by the total number of sessions scheduled (3 sessions per week x 24 weeks = 72 sessions). Additionally, researchers documented potential falls, emergency room visits, hospitalizations, and length of stay for further analysis.

Data Collection

The Soper (Soper, 2022) calculator was employed in this study to determine the required sample size, taking into consideration the following parameters: an anticipated effect size of d = 0.8 based on previous research (Sherrington et al., 2020), a significance level (α) of 0.05, and a statistical power of 0.95. Based on the calculated results, a minimum sample size of 35 participants was determined to be necessary to achieve valid and reliable results. Furthermore, the sample size in this study was larger compared to other studies utilizing similar protocols and designs, as reported by Rodrigues et al. (2022).

Recruiting participants for community-based programs can pose challenges due to various factors. One limitation is the difficulty in reaching the target population, particularly in the case of community-based programs targeting specific groups such as the elderly, who may be hard to contact. Another limitation is the lack of trust and awareness of research studies among the target population, with concerns about confidentiality, understanding of the study, and mistrust of researchers potentially hindering participation. Additionally, low literacy levels, language barriers, and mobility issues may also impede the ability to effectively recruit individuals from the community.

In this study, we utilized a probability sampling method to recruit potential participants. Flyers were created to engage individuals in the exercise program, and contacts were made through local social media groups, referrals, and invitations by the

county state. The study objectives, voluntary nature of participation, and potential risks of physical injury were thoroughly explained to potential participants. An inclusive approach was adopted to maximize recruitment from the community. All participants who met the inclusion criteria and voluntarily chose to participate were assigned to the community-based exercise program.

For the sake of research objectivity and participant safety, inclusion criteria entailed individuals aged 50 years or older who were capable and willing to provide informed consent, able to communicate and ambulate with or without personal/technical assistance, not currently engaged in any other exercise program, and living in the community. Chronic neuromuscular, cardiovascular, or metabolic conditions that could pose a danger or safety risk during the exercise sessions or evaluation periods were thoroughly evaluated, and individuals who did not meet these criteria were excluded from participation for safety reasons. Participants were required to attend all three-week exercise sessions as well as the evaluation periods. They were advised to continue with their normal physical activities outside the program, such as gardening or household tasks. Any co-existing diseases or issues associated with the intervention were managed in accordance with standard medical practices and documented as adverse events.

Exclusion criteria included attending less than 75% of the sessions and/or missing more than 10 consecutive sessions, as well as having any factors that would hinder the performance of the physical training program or the testing procedures, as determined by the attending exercise physiologist. These factors included, but were not limited to, recent myocardial infarction within the past 3 months, unstable angina pectoris, uncontrolled arrhythmia, unstable cardiovascular disease or other unstable medical conditions, uncontrolled arterial hypertension, recent pulmonary thromboembolism, pending entry into an institution, and unwillingness to comply with the study requirements.

Community-based exercise program

The exercise program in this study adhered to the Frequency, Intensity, Type, and Time (FITT) guidelines as outlined by the American College of Sports Medicine (ACSM, 2021), based on previous research by Garber et al. (2011) and Nelson et al. (2007). The program consisted of three morning sessions per week, each lasting 45-60 minutes, and included various types of exercises such as resistance training, cardiorespiratory exercises, balance training, agility exercises, and flexibility training. All exercise sessions were supervised by a qualified exercise physiologist with expertise in exercise prescription for adults and seniors, who provided guidance and motivation.

The timing of the exercise sessions was scheduled according to the preferences of the participants, with options for weekday mornings at either 9 AM to 10 AM or 10 AM to 11 AM, in a day-off-day sequence. For safety reasons, two groups were formed due to the relatively large number of participants (n = 35), and all participants performed the same exercises with adjustments made as necessary. To ensure diversity in the exercise stimuli, three unique sessions were developed and implemented.

To monitor exercise intensity, the talk test and the 10-point Borg Perceived Exertion Scale were used, which are widely accepted and validated measures for this purpose (Borg, 1998; Reed & Pipe, 2014). The talk test allows for the determination of three levels of exercise intensity: i) during low-intensity exercise, individuals should be able to speak comfortably without shortness of breath or excessive effort; ii) during moderate-intensity exercise, individuals should be able to speak in full sentences with occasional breaths between phrases, and breathing rate will increase, but conversation can be maintained without gasping for air; and iii) during high-intensity exercise, individuals should not be able to speak in full sentences and may require frequent breaths between words, with rapid breathing and a high level of exertion. The Borg Perceived Exertion Scale was used to anchor perceived effort, with statements provided for each item, ranging from "hardly any exertion" for a score of 1 to "feels almost impossible to keep going" for a score of 10. The exercise physiologist administered the scale to each participant immediately after each exercise component and at the end of each session.

The training sessions consisted of a structured regimen of activities, designed to improve various aspects of physical fitness. These activities were

carefully selected and conducted in a systematic manner to ensure their effectiveness. The training sessions were conducted over a period of 8 weeks and included the following components: a) Warm-up Phase: The warm-up phase commenced with 5-8 minutes of slow walking, followed by light-intensity dynamic stretching exercises. Dynamic stretching exercises involved controlled movements that aimed to increase the range of motion of the major joints; b) Cardiorespiratory Fitness Phase: The cardiorespiratory fitness phase consisted of 15-20 minutes of moderate-intensity activities such as walking, jogging, aerodance, or dance. The intensity of the exercises was gradually increased from a rating of 6 (moderate-intensity) on the perceived exertion scale to scores of 7 and 8 (moderate-to-vigorous) on the Borg Scale after 8 weeks of training. The Borg Scale is a widely used tool to measure perceived exertion during exercise, with higher scores indicating higher levels of effort; c) Resistance Training Phase: The resistance training phase involved 15-30 minutes of exercises using bodyweight, rubber bands, dumbbells, ankle weights, and other equipment. Participants performed three sets of resistance exercises in a circuit format, with rest durations between sets ranging from 40 to 60 seconds. The exercises were targeted towards important muscular groups, including shoulder abductors/adductors, elbow flexors/extensors, pectoral/back, and knee flexors/extensors muscles. The intensity of the resistance training was gradually increased from a rating of 6 (moderate-intensity) on the perceived exertion scale to scores of 7 and 8 (moderate-to-vigorous) on the Borg Scale after 8 weeks of training. Participants started with a single set of 8 repetitions and progressed to three sets of 12-15 repetitions; d) Balance Training Phase: The balance training phase included 5-8 minutes of static and dynamic balance training using wooden sticks, softballs, and balloons. Safety measures were implemented to ensure appropriate distance between participants to minimize risks during the exercises; e) Cool-down Phase: Each training session concluded with a 5-minute cool-down period that included breathing and stretching exercises. Participants performed each stretch twice, and static stretching was employed, which involves extending the muscle across the joint and holding it in a position of low-to-mild discomfort for 15-20 seconds before releasing it. For additional details regarding the exercise program, refer to the work of Rodrigues et al. (2023) as cited elsewhere.

Statistical analysis

Data analysis was conducted using IBM SPSS STATISTICS version 27 (Chicago, USA) for Windows. Descriptive statistics were calculated to provide a summary of the data, and skewness and kurtosis estimates were performed to assess the statistical significance of deviations from the normal distribution. According to Cohen's (1988) criteria, a score of less than |2.00| was considered indicative of a normal distribution. To investigate potential variations in the dependent variables, a paired sample-repeated measure analysis was employed, comparing data at baseline and after the exercise program. Cohen's d effect size was calculated to determine the magnitude of the differences between time points, with thresholds for small, medium, and large effects set at 0.2, 0.5, and 0.8, respectively. The significance level for rejecting the null hypothesis was established at 5% for all statistical tests, in accordance with standard scientific practices.

RESULTS

The study flow diagram, depicted in Figure 1, illustrates the progression of the community-based exercise program involving thirty-five participants, with an average age of 67.54 years (SD = 3.81), of which 71% were female. The mean weight was 68.91kg (SD = 8.64) and mean height was 1.61m (SD = 0.07). Attendance rates for the program were consistently high, ranging from 76% to 100% on average. Baseline data exhibited a normal distribution, as shown in Table 1. Notably, no dropouts were observed from the community-based exercise program, although missing values at random were identified. To address this, we utilized the expectation-maximization method to handle missing data. Attendance rates remained consistently high, ranging from 78% to 100% on average. Analysis of the timed-up and go test, risk of fall, and fear of falling revealed a statistically significant trend towards clinically significant improvement (p < 0.001), with medium to large effect sizes ranging from d = 0.20 to d = 1.47, respectively.

Figure 1

Study flow diagram
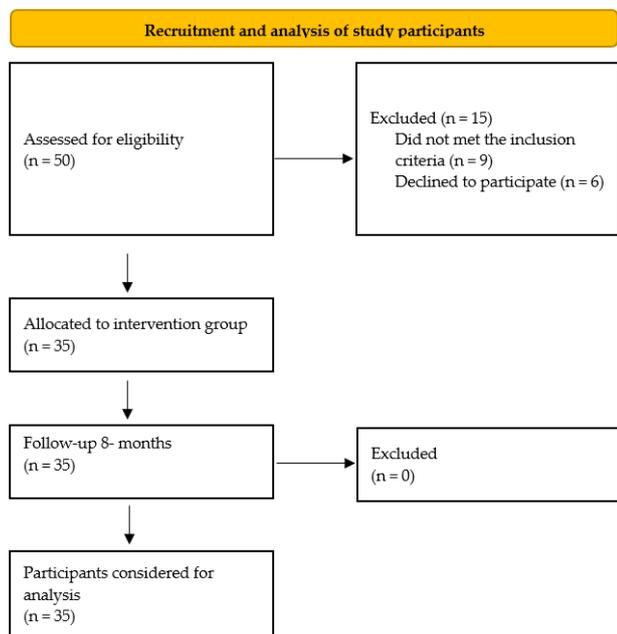
Table 1

Mean differences between time points in all outcomes.

Measure	Units	Baseline				After				Δ	t	p	d
		M	SD	S	K	M	SD	S	K				
Body Mass Index	kg/m²	26.69	3.12	.62	.34	26.53	3.16	.62	.34	.16	5.33	<0.001	.05
Timed-Up-and-Go	Seconds	4.63	.83	1.24	1.19	4.46	.87	.63	1.59	.18	4.66	<0.001	.20
Berg Balance Scale	Score	47.26	2.74	-.62	-.16	50.51	1.50	-1.13	1.33	-3.26	-11.20	<0.001	1.47
Fall Efficacy Scale	Score	19.66	5.16	-1.15	1.39	16.00	2.89	-1.28	1.22	3.66	5.81	<0.001	.88

Notes: M = Mean; SD = Standard-Deviation; S = Skewness; K = Kurtosis; Δ = changes; *t* = t-test; *p* = significance level; *d* = effect size.

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Regarding the incidence of falls and fall-related injuries, the exercise intervention administered by the exercise physiologists did not result in any reported falls. However, outside of the fitness program, participants self-reported a total of two falls. Notably, there were no recorded emergencies or hospitalizations stemming from falls or fall-related injuries throughout the duration of the study.

DISCUSSION

The objective of this study was to investigate the impact of a community-based multicomponent exercise intervention, utilizing low-cost equipment, on agility and balance in older individuals, with the goal of reducing the risk and fear of falls. Our findings demonstrate that an 8-month exercise intervention, consisting of low-to-moderate intensity resistance, cardiorespiratory, balance, agility, and flexibility training exercises performed three times per week, yields significant benefits and can effectively counteract the functional decline associated with aging, as well as reduce the risk and fear of falls. Thus, our results support the original hypothesis that the exercise intervention has a positive and significant effect on agility and balance in community-dwelling older adults.

Notably, in comparison to traditional strength and/or cardiorespiratory training that often involves high-cost machines, our participants were able to achieve significant gains in agility and balance with minimal investment in equipment. Specifically, the results indicate that the exercise intervention had a positive effect on agility, as evidenced by the timed-up and go test. The statistical significance of the results, with a p-value less than 0.001, suggests that the observed improvement can be attributed to the efficacy of the exercise program. The medium effect size of d = 0.20 further indicates a moderate effect on mobility. These findings are consistent with previous literature that has also utilized the timed-up and go test as a measure of mobility in various populations, including older adults (Monteiro et al., 2022; Phelan et al., 2016; Rodrigues et al., 2022). Moreover, several studies have reported the reliability and validity of the timed-up and go test as a measure of mobility in older adults (Rodrigues, Domingos, et al., 2022; Rubenstein, 2006; Smith et al., 2018). For instance, a randomized controlled trial by Ashburn et al. (2007) demonstrated significant improvements in the timed-

up and go test in older adults with Parkinson's disease following a home-based exercise program. Similarly, Kang et al. (2015) found that a multicomponent exercise program was effective in improving agility and balance in elderly individuals. Overall, our findings highlight the effectiveness of a community-based multicomponent exercise intervention, utilizing low-cost equipment, in enhancing agility and balance in older individuals, and suggest that this approach can be a feasible and cost-effective strategy for addressing functional decline and reducing the risk of falls in community-dwelling older adults.

The significant differences over time that were observed in the Berg Balance Scale suggest that the intervention was effective at decreasing risk of falling by improving their levels of balance and agility. Existing literature has shown that regular exercise can increase physical fitness in older people (American College of Sports Medicine, 2009; 2021), and experimental studies have confirmed this assumption and meta-analytic studies provide evidence on the effects on balance (Sherrington et al., 2020; Zhao et al., 2019). We support these statements, and our findings are consistent with earlier research on the impact of exercise on risk of fall (Marques et al., 2022; Ng et al., 2019). The increase in balance could be attributed to the increase in muscle strength. Even though we did not measure force production, exercise helps to strengthen the muscles, especially those in the legs and core, which are crucial for maintaining good balance (García-Hermoso et al., 2020). Strong muscles provide stability and support, making it easier to maintain balance while standing, walking, or performing other physical activities. In addition, exercise could also help to improve coordination and flexibility, both of which are essential for improved balance. Coordination refers to the ability to use different parts of the body together smoothly and efficiently, while flexibility refers to the range of motion in joints. By improving both coordination and flexibility, aged adults may move more easily and smoothly, reducing the risk of falls (Phelan et al., 2016).

The present exercise program appears to have a significant effect equal to prior studies employing high-cost equipment training regimens in health-related physical fitness (Monteiro et al., 2022; Teodoro et al., 2019). Specifically, current exercise

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pro-gram was able to decrease fear of falling assessed using the Falls Efficacy Scale – Inter-national measure. Current results support the findings of previous studies on fear of falling (Kendrick et al., 2014; Kumar et al., 2016) that looked at exercise interventions and found that exercise can improve health-related indicators in community-dwelling older persons increasing their confidence to perform daily task with efficacy and low perceptions of fear of falling. While the applicability of our program demonstrated equal results in terms of fear of falling compared to previous studies using other exercise programs (Ángeles et al., 2022; Kwok & Pua, 2016), further testing is required. Exercise programs considering cognitive aspects may be of relevance in this population. While it was not assessed, there is evidence that cognitive capacity may be related to risk of falling and fear of falling. In older adults, the link between cognitive ability, fear of falling, and balance skill is complex. Age-related cognitive decline can have a negative impact on balance skills, leading to a fear of falling (Wang et al., 2022). Further-more, fear of falling can contribute to impaired balance skills by limiting physical exercise and becoming less physically active (Silva Tavares et al., 2020). According to research, old-er persons with greater cognitive capacities have better balance and are less prone to fall (Hadjistavropoulos et al., 2012). Interventions such as cognitive training and physical exercise have also been demonstrated to improve balance ability and reduce fear of falling in older persons (Wang et al., 2022).

The findings of the present study indicate a significant improvement in mobility among the study population, suggesting a positive effect of the exercise program on mobility, which is a crucial outcome in reducing the risk and fear of falling. Notably, the observed gains in mobility were consistent with those reported in a recent review on resistance training (Lopez et al., 2021). The older adults in our study were able to increase their muscle strength, but not their agility, through an 8-month exercise program that incorporated concurrent training with and without repetitions to failure, as demonstrated in a previous study by Teodoro et al. (2019). In our exercise program, the elderly participants engaged in a multicomponent training approach that targeted various physical fitness capacities according to exercise intensity, without reaching perceived muscle failure. Consequently,

while there are established links between physical activity and improved muscle strength and power in older adults (Ramsey et al., 2021), our intensity-controlled multicomponent exercise program may be particularly effective in enhancing mobility and agility, which are known risk factors for falling. Recent meta-analyses by Borges-Machado et al. (2021) and Li et al. (2023) further support the effectiveness of multicomponent exercise programs in improving different aspects of health-related physical fitness that are associated with fear of falling.

Given the growing body of evidence highlighting exercise as a major predictor of positive health outcomes in older adults, researchers have increasingly focused on developing and evaluating multicomponent interventions aimed at reducing the risk of falling and fall-related injuries (Forte et al., 2021; Rodrigues, Amaro, et al., 2022), as well as fear of falling (Wetherell et al., 2018). Experimental research has demonstrated short-term benefits of exercise programs, but the long-term implications of such interventions are of paramount importance, as the ultimate goal of community-based exercise programs should be to promote sustained exercise participation beyond the duration of the intervention (Forte et al., 2021; Rodrigues, Amaro, et al., 2022). In our program, we were able to enhance agility, balance, and autonomy among older adults by combining a multicomponent exercise program with low-cost equipment, and no falls were reported in relation to the intervention. However, participants did report falls outside of the program, which were attributed to external factors such as slippery floors (n = 2), and no fall-related injuries were reported.

Several possible explanations may account for the success of our intervention. The community-based exercise program with an inclusive approach, as implemented in our study, may have been appealing to older adults who have a preference for remaining in their homes, as documented in previous studies (Forte et al., 2021; Rodrigues et al., 2022). Moreover, the dynamics of large group exercise sessions may have contributed to positive feedback and reinforcement, potentially enhancing adherence and commitment to the exercise program.

While the present study provides valuable insights, it is important to acknowledge its limitations. This study was conducted as a single-arm pilot study without a control group, driven by the specific purpose of the research. Consequently, further investigation employing experimental designs with control groups is warranted to validate the findings, as it cannot be guaranteed that the observed improvements in agility and reduction in falls and fear of falling will translate into long-term outcomes. Additionally, the detraining effect of the exercise protocol was not assessed in this study, and future research should collect data during the mid-intervention phase to monitor progress throughout the training program. Further research is needed to assess the efficacy of the intervention, including detraining assessment equivalent to the intervention period. While the absence of a control group limits the evaluation of the exercise program's benefits on functional fitness, this study provides preliminary evidence of the potential health-related benefits of an exercise program. However, it should be noted that this study has the advantage of novelty. We also recommend collecting demographic data, such as socioeconomic status, time since retirement, and levels of physical activity, which could moderate the effects of the exercise intervention.

CONCLUSION

The studied showed that a community-based exercise program is essential for maintaining physical and mental health and can help reduce the risk and fear of falls, particularly in older adults. Regular physical exercise supervised by an exercise physiologist can help improve balance, agility, and confidence thus reducing the risk of falling and fear of falling. These findings suggest that the exercise program for aged adults that is inclusive and community-based can be effective in producing health-related benefits, as well as cost-effective and simple to deploy for all older adult populations compared to traditional resistance and cardiorespiratory exercise protocols.

Regular exercise has numerous benefits for older adults, including a reduced risk of falling and a decrease in fear of falling. These benefits can have a significant impact on an individual's quality of life, allowing them to maintain their independence and mobility for longer. It is important to measure both risk-related factors in older adults, as the risk of falling and fear of falling are closely related but distinct phenomena. By assessing both factors, healthcare professionals can develop tailored exercise programs that address an individual's specific needs and reduce their risk of falling while improving their confidence and overall well-being (Rodrigues et al., 2018; Rodrigues et al., 2020). Ultimately, promoting exercise as a means of reducing the risk of falling and fear of falling is an important step in improving the health and quality of life of older adults.

PRACTICAL APPLICATIONS

Based on the results, it is evident that exercise plays a crucial role in preventing the fear of falling among older adults in the community. To consider these results in practical terms and promote exercise as a preventive factor, there are several factors to account. First, establish community-based exercise programs that specifically target older adults. These programs should be inclusive, accessible, and tailored to address the needs and abilities of the participants. Second, ensure that the exercise programs are supervised by qualified exercise physiologists or trained professionals who can guide older adults in performing exercises safely and effectively. Supervision also helps in monitoring progress and making appropriate adjustments to the exercise routines. Third, design exercise programs that incorporate various elements such as balance training, strength exercises, flexibility training, and aerobic activities. A multidimensional approach helps target different aspects of physical fitness and enhances overall fall prevention. Last, foster a sense of community and social support within the exercise programs. Encourage participants to engage in group activities, fostering social connections and reducing feelings of isolation. This can contribute to the overall well-being of older adults and help alleviate the fear of falling.

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