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ARTIGO DE REVISÃO

Benefícios do treinamento com pesos para aptidão física de idosos

Strength training benefits on the physical fitness of elderly individuals

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RESUMO

O objetivo desta revisão é elucidar os benefícios do treinamento com pesos (TP) sobre quatro componentes da aptidão física (AF) fundamentais para a qualidade de vida de idosos: força, flexibilidade, equilíbrio e resistência aeróbia. Foi realizada pesquisa bibliográfica nas bases de dados PUBMED e LILACS. Foram selecionados estudos que incluíam no título os descritores: strength training, resistance training, strength, balance, flexibility, power, aerobic, older e elderly. Modificações na força muscular são observadas após poucas semanas de TP. Essa melhoria pode auxiliar não só na independência dos idosos, mas também na diminuição da incidência de quedas. Além disso, a prática sistematizada do TP promove melhoria na flexibilidade e na resistência aeróbia de idosos. As modificações no equilíbrio, após programas de TP, ainda não estão bem esclarecidas na literatura. Desta forma, o TP consiste numa importante ferramenta para a melhoria da AF de idosos, haja vista que promove adaptações na força muscular, flexibilidade e na resistência aeróbia.

PALAVRAS-CHAVE

envelhecimento, treinamento resistido, treinamento de força, equilíbrio, flexibilidade, resistência aeróbia

ABSTRACT

The objective of this review is to assess the benefits of strength training (ST) over four very important components of physical fitness (PF) of the elderly: strength, flexibility, balance and aerobic resistance. A literature search was carried out through PUBMED and LILACS. Articles which included the following words in their titles were selected: strength training, resistance training, strength, balance, flexibility, power, aerobic, older, and elderly. Strength modifications can be observed after a few weeks of ST. This improvement can help the elderly not only by providing independence, but also by reducing the incidence of falls. Moreover, the systematic practice of ST by the elderly promotes better flexibility and aerobic resistance. Balance modifications after ST programs have not been well established in the literature. Thus, ST is an important resource for the improvement of PF in the elderly, as it promotes adaptations in muscular strength, flexibility and aerobic resistance.

KEY-WORDS

aging, resistance training, strength training, balance, flexibility, aerobic power

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Introduction

In the last decades, the number of elderly individuals has increased significantly, currently reaching an unprecedented number of individuals. According to data from the United Nations Population Fund (UNFPA)[1], there were around 204 million elderly individuals in 1950, worldwide. In 1998, almost 5 decades later, this number had increased to 579 million individuals. The estimates regarding the number of elderly individuals in 2050 indicate a population of approximately 1.9 billion people.

The UNFPA[1] estimates that, in 2050, life expectancy in developed countries will be approximately 87.5 years for males and 92.5 for females (compared to 70.6 and 78.4 yrs, respectively, in 1998), whereas, in the developing countries, it will be 82 yrs for males and 86 yrs for females, i.e., 21 years more than the current life expectancy, which is 62.1 and 65.2 yrs, respectively.

Information from the Brazilian Health Ministry2 suggest that, in 2025 Brazil will be the 6th country with the largest elderly population in the world. It is believed that, until 2020, the elderly population in the country will increase around 175%, which corresponds, in absolute figures, to approximately 28 million people.

The causes for the increase in the elderly population worldwide are multifactorial. However, one must mention the decrease in the birth rates[3], the result of social alterations that occurred from the 60's on, and affected women's jobs, education and marriage, and promoted deep alterations in the demographic pyramid.

Although the growth of the world's elderly population is an important indication of quality of life improvement, it is well known that the aging process is associated to several significant physical skill losses, which culminate, inevitably, in the decline of the functional capacity and independence of the elderly individual4.

However, a large part of these impairments is associated to the decreased size and/or number of muscular fibers, i.e., sarcopenia5. In a longitudinal study carried out by Hughes et al.[6], it was observed that the aging process results in the reduction of approximately 2% of the fat-free mass by decade, concomitantly with an increase of 7.5% of fat mass.

The American College of Sports Medicine (ACSM) 7 states that sarcopenia is main factor responsible for the reduction of the elderly's functional capacity, as it causes decreased muscular strength, balance, flexibility and aerobic resistance. These alterations, in turn, make it difficult to perform simple tasks present in the elderly individuals' daily life, such as walking, climbing stairs and carrying small objects.

Studies performed by Baumgartner et al.[8] confirm these data. The results of this study indicated, in a New Mexico population, a prevalence of sarcopenia of 13-24% in individuals younger than 70 years and 50% in those older than 80 years. Additionally, the authors observed that sarcopenia was associated with a 3- to 4-fold decrease in the functional capacity, regardless of age, sex, ethnicity, socioeconomic level, chronic diseases and health habits.

Strength training benefits for elderly individuals

The increase of the elderly population worldwide has called the attention of health professionals for the creation of strategies that can contribute, especially, to the prevention and reduction of sarcopenia.

One of the intervention methods that has shown great effectiveness in maintaining and increasing muscle mass, and, consequently, improving physical fitness (PF) and independence of the elderly is strength training (ST). According to the reports by the ACSM[7,9], the systematic practice of ST by elderly individuals can promote increased strength, muscle mass and flexibility.

According to Hunter et al.[10], if a single exercise type must be chosen to promote improvement in the functional capacity of the elderly, ST seems to be the best option, when compared to aerobic training. This option is based on the observation that the main daily activities present in the elderly individual's life, involve skills that are improved during ST practice.

However, it is important to mention that the adaptations promoted by any type of training are closely related to the specific training model performed. Thus, when the training is carried out with high intensity and 60-90 sec rest intervals, modifications in strength and muscle mass are the main changes observed.

On the other hand, a ST program with a large volume and short rest intervals results in body fat decrease[9].

Hence, the aims of a ST program, specifically designed for the elderly, must be directed mainly at improving PF and quality of life, i.e., it must be structured in order to promote improvement in the independence and functional capacity of the elderly.

Considering all that, the present study will discuss the adaptive responses obtained through the systematic practice of ST in four fundamental physical skills for quality of life improvement of the elderly: strength, flexibility, balance and aerobic capacity.

Material and methods

A literature review was carried out in PUBMED and LILACS databases. In order to locate the studies, the following descriptors were used: "strength training", "resistance training", "strength", "balance", "flexibility", "power", "aerobic", "older" and "elderly". Only studies that carried out an intervention process by ST and observed the responses regarding strength, flexibility, balance or aerobic resistance were selected. Due to the large number of studies that assessed strength alterations, five of them were randomly included. All studies that assessed the skills of flexibility, balance and aerobic resistance were included. Libraries of the city of São Paulo were searched as well as the "SIBI" electronic database to acquire the full text of the studies. The studies of which the full texts were not available were excluded.

Muscular strength

Muscular strength can de defined as the capacity of the skeletal muscle to generate tension, whereas power is the result of the product strength X velocity. These two capacities are evident in most daily tasks of the elderly, and, consequently, are crucial for the independence and quality of life of elderly individuals[11]. Additionally, the lack of muscular strength in the elderly population seems to be the main factor responsible for falls among the elderly[12].

Muscular strength and power are extremely affected by aging, and can undergo a reduction of 60% in 50 years. Frontera et al. 13 observed, in their longitudinal study of elderly individuals, an annual decline in strength between 2 and 2.5% for lower limbs. Similarly, Harries and Bassey14 observed a reduction of 15% by decade in muscular strength during the sixth and seventh decade of life, and a more marked decline, of around 30%, at older ages.

The causes of decreased muscular strength and power that occur with aging are not associated to the decreased muscle mass, only. Other aspects, such as neural and environmental ones, for instance, also have great influence on this process. According to Porter et al.[15], the mechanisms involved in the decrease of strength during the aging process can be divided in three large groups: 1- muscular: muscular atrophy, alteration in muscular contractility or enzymatic level; 2- neurological: decrease in the number of motor units, changes in the nervous system or endocrine alterations; and 3- environmental: level of physical activity, bad nutritional status or the presence of illnesses.

After short periods of ST, significant changes in muscular strength are observed in adults, children and the elderly[16,17,18]. These alterations can be attributed mainly to the neural adaptations, i.e., higher muscular activation, better recruitment of muscular fibers, higher frequency of motor unit discharges and decrease of the co-activation of muscles that are antagonist to movement[19]. Campbell et al.[20] assessed the evolution of muscular strength in 12 elderly individuals (8 men and 4 women), aged 56 to 80 years. After 12 weeks of ST, significant increases in muscular strength were observed at the supine exercises (30%), leg flexion (92%), low rowing (24%), right and left leg extension (64% and 65%, respectively).

Hakkinen et al.[21] observed, after 12 weeks of unilateral or bilateral ST in men and women older than 70 years, significant increases in the maximum strength, measured by the maximum one-repetition value (1RM).

These results were also observed by Barbosa et al.[18], who submitted a group of 11 elderly women to a 10-week ST program and observed significant increases in muscular strength (25.9% and 49.1% for triceps and calf muscles, respectively) and the hand grip strength of both hands (3% to 17%).

Seeking to correlate the modifications in muscular strength and independence in the elderly, Brandon et al.22 submitted 43 individuals, whose mean age was 72 years, to a 16-week ST program. The results indicated an increase of 51.7% in the maximum strength of the lower limbs, concomitantly with significant improvements in tasks such as getting up from a chair, walking and returning to the initial position, and the task of getting up from a sitting position on the floor.

Similarly, Cavani et al.[23] investigated the effect of a 6-week ST program of moderate intensity (a series of 12-15 maximum repetitions), associated to stretching exercises in 15 elderly individuals. The authors observed significant improvement in muscular resistance and performance of tasks such as sitting down and getting up from a chair.

Flexibility

Flexibility is the range of motion capacity of one or multiple joints in performing specific tasks[7]. Brown and Miller[24] observed a progressive reduction in hip flexibility of around 23% in 304 women, aged 20 to 70 years.

These results are relevant as the performance of this skill is related to the performance of daily tasks by the elderly. Some examples are the findings by Badley et al.[25], who observed in 95 individuals aged 28 to 84 years, the association between the flexibility of different movements with the performance of daily tasks. The results indicated that the deambulation capacity was significantly correlated with the knee extension movement; the capacity to bend towards the floor was correlated to the hip flexion movement; and the skills that required hand and arm use were correlated with the movement of upper limb extension.

The range of motion (ROM) of joint movements is related to morphological modifications in the muscles, bones, and conjunctive tissue structures and functions[26]. According to Magnusson[27], the decrease in ROM caused by aging can be related to the mechanical and biochemical alterations in joint cartilage, ligaments and tendons, which consist of nonelastic conjunctive tissue.

Barbosa et al.[28] carried out a study with 1,656 elderly individuals in the city of São Paulo, aiming at verifying the influence of age on strength and flexibility. The individuals were distributed among three groups: 60-69 yrs, 70-79 yrs and ≥ 80 yrs. The results indicated that the older the individuals were, the lower the strength and flexibility were.

In addition to age, gender and level of physical activity are factors that directly influence flexibility. Individuals with a higher level of physical activity present a higher ROM[29]. Regarding gender, most studies indicate that women present higher levels of flexibility when compared to men[30,31].

Girouard and Hurley 32 performed a study with 31 elderly individuals aged 50 to 74 years, distributed in three groups. The first group, with 14 individuals, participated in a ST program 3 times a week for 10 weeks; the program consisted of warming up on a stationary bicycle, and 10 minutes of static stretching, before and after ST. The second group, with 10 individuals, trained flexibility exercises only, for the same period of time, with static stretching exercises that lasted 30 seconds per series. The thirds group, with 7 individuals, did not undergo any training. Flexibility was measured through a goniometer. The results indicated a significant increase in shoulder flexion and abduction in the first group after the training period. Similarly, the second group presented increment of flexibility in the shoulder abduction and hip flexion movements;

however, the second group presented a favorable difference regarding shoulder abduction movement, only.

Barbosa et al.[33] observed an increment in flexibility (9% to 21%) at the sit-and-reach test after a 10-week ST program, applied to elderly women, without the inclusion of stretching exercises to the training program. According to the authors, the main mechanism responsible for the increased flexibility with ST is related to the decrease of muscle and fascia rigidity. Additionally, Cyrino et al.[34] reported that the increased flexibility after a ST program occurs more markedly in individuals with a low level of training. Thus, in sedentary individuals, the practice of ST is an important tool for improving flexibility.

Balance

Balance is the capacity of maintaining a stable posture, statically as well as in movement. With the aging process, there is a progressive decrease in balance, which is directly related to the elevated incidence of falls observed in the elderly population[35]. According to Hobeika 36, 65% of the individuals older than 60 yrs frequently suffer dizziness or balance loss and all individuals in this age range present some form of lack of balance.

The loss of balance results from a generalized functional deterioration. Initially, the lack of balance is sporadic and manifest when the reflexes cannot attend to the environment modifications, such as a slippery surface. At the most advanced periods of deterioration of the neural, sensorial and skeletal muscle systems, the lack of balance occurs frequently during everyday activities. In this phase, the performance of independent daily activities becomes difficult and the probability of a fall markedly increases.

The analysis of static balance is an important tool, able to identify the limitations in movement control, in addition to being useful in the determination of the risk of falls in elderly individuals. Cornillon et al.[38] observed, in 300 elderly women, the relation between the performance at the static balance test and the incidence of falls. The results showed that most elderly women with better performance at the static balance test had the lowest number of falls within a one-year period. The authors concluded that the performance at the test of static balance had a direct relation with the number of falls in elderly individuals.

Although the incidence of falls is related to the decrease of strength, muscular power and balance, it is yet to be clarified in literature whether there is a relation among these physical skills, as few studies have observed improvement in balance after ST.

Bellew et al.[39] observed the effect of a 12-week low-volume ST program on muscular strength and balance in elderly men and women. The postural oscillation was assessed through the use of a balance platform, with the individual standing, under four conditions: open eyes with the platform stable, closed eyes with the platform stable, open eyes with the platform unstable and closed eyes with the platform unstable. The results showed that, despite the significant increases in the muscular strength of men and women, there was no alteration in balance for either sex. Additionally, in me, there was an increase of 37% in the mediolateral oscillation. The authors attributed these results to the low volume of ST (five exercises with only one series) and the specificity of the movements that were trained, which did not include standing exercises.

In fact, the specificity of the ST program seems to be directly related to balance modifications. Studies that adopted exercises with weights in sitting position and/or using a chair to support the back, did not observe significant alterations in balance after the St program[39,40]. Thus, it is recommended that, to improve the balance through ST programs, it is necessary to use exercises that involve the active maintenance of postural stability. However, more efficient results are observed when the ST program is performed concomitantly with the specific balance training[41,42].

Aerobic resistance

Aerobic resistance is the capacity of the cardiovascular and respiratory system to supply the muscular work together with the metabolic system, being the energy supplied mainly by fats[43]. After the third decade of life, there is a reduction of 0.5 to 3.5% per year in the aerobic power[44].

The reduction in the aerobic power that occurs with aging is due to two main aspects: the decrease in the heart's ejection capacity and the reduction in the amount of muscular mass[45]. Thus, some authors believe that, after a ST program, the increase in muscular mass would promote improvement in the aerobic power46 and the performance of submaximum exercises[47].

The results shown in literature are extremely controversial. Frontera et al.[46], after submitting healthy elderly individuals aged 60-72 yrs to a 12-week high intensity ST program, observed significant increases of 5% at VO2 max, measured in a cycle ergometer. The results observed by Hagerman et al.[48], who employed walking, corroborated these findings. In this study, the effect of a 16-week high-intensity ST program was observed on the VO2 max in 9 elderly individuals, measured at the walking test. The results showed significant increases in VO2 max, without significant alterations in the maximum cardiac frequency and arterial pressure.

On the other hand, Kallinen et al. 49 did not observe significant alterations in the VO2 max of elderly women aged 76 and 78 after an 18-week ST program. However, there were increases in the relative VO2 peak, i.e., when analyzed by kilogram of body weight. Although the presence of modifications in aerobic power is not a consensus in the literature, other overall adaptations to ST can be beneficial to the cardiorespiratory system of the elderly.

Ades et al.[50] observed, after a 12-week ST program, significant improvements in walking time at 80% of VO2 max of around 38% in elderly women aged 65 to 78 yrs, without alterations in the VO2 max. The results also showed that the improvement in the walking time was significantly related to the increase in muscular strength.

Similarly, Izquierdo et al.[51] observed, after 8 weeks of intermittent ST, significant reductions in blood lactate levels and after 16 weeks, improvement in the work load at the cycle ergometer. Hepple et al.[52], in a study of elderly individuals, showed more marked modifications in the ratio of capillaries per fiber after 8 weeks of

ST followed by 8 weeks of aerobic training, which were superior to the group that trained 16 weeks aerobically.

According to Frontera et al.[46], the improvement in oxygen use after ST, measured at the stress test in a cycle ergometer, occurred almost exclusively at muscular level. This hypothesis seems to be true when considering study results that did not show significant modifications at VO2 max, but observed alterations in the aerobic performance.

Additionally, most results that observed improvement in VO2 max, are not significant when analyzed in relative terms (VO2 max per kg of body weight).

Conclusions

The practice of ST is an important tool to improve PF in elderly individuals, independence and, consequently, quality of life in this population. Increases in muscular strength and power, important for the maintenance of independence, and for the reduction of falls among the elderly, can be observed after a few weeks of ST program. Additionally, improvement in the flexibility and aerobic resistance levels have also been observed after ST by elderly individuals. Among the physical skills that are important for health, balance modifications after ST are yet to be clarified in literature. However, further studies to investigate the effect of ST on this skill must be carried out, as aspects such as the position and stability of the exercises seem to influence the balance modifications after the training program. Additionally, it is worth mentioning that prescribing ST programs to the elderly must be done after a careful medical assessment, preventing secondary injuries, which are common in this population.

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