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International Journal of Geriatrics and Gerontology

Review Article

de Resende-Neto AG Int J Geriatr Gerontol 3: 117.
DOI: 10.29011/2577-0748.100017

Effects of Functional Training on Body Composition, Physical Fitness, Cognitive Status and Cardiovascular Health in the Older People

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Citation: de Resende-Neto AG (2019) Effects of Functional Training on Body Composition, Physical Fitness, Cognitive Status and Cardiovascular Health in the Older People. Int J Geriatr Gerontol 3: 117. DOI: 10.29011/2577-0748.100017

Received Date: 15 August, 2019; **Accepted Date:** 26 August, 2019; **Published Date:** 03 September, 2019

Abstract

The Functional training (FT) has gained prominence and attracted a large number of supporters with the basic premise of providing improvement in the human psychobiological system through the application of multisegmental and multiplanar exercises aimed at improving movement ability and increased neuromuscular efficiency for daily tasks. However, the efficacy of FT to mitigate the deleterious effects of the aging process is not well established in the scientific community. Therefore, the objective of the present review is to analyze the information available in the literature so far about the possible effects of FT on body composition, physical fitness, cognitive status and cardiovascular health in older people. The search for information was performed on the electronic databases MEDLINE, BioMed Central, SciELO, Scholar Google and Sport Discus. The selected works were published during the period from 1990 to 2019. The results suggest that FT seems to be a safe, inexpensive and interesting alternative for physical training for the elderly, with positive impact on muscle mass, muscle strength and power, cardiorespiratory capacity, flexibility, balance, cognition and cardiovascular health.

Keywords: Aging; Functionality; Neuromuscular Training; Quality of Life

Introduction

Aging reflects a set of neuromuscular, metabolic and cardiovascular changes that cause gradual disability in the performance of daily activities and increased incidence of chronic diseases, resulting in increased physical dependence and frailty, often associated with increased malnutrition, falls and infectious processes [1]. Additionally, sedentary behavior accompanied by overweight accelerate this natural physical decline, increasing the difficulties to perform daily tasks of low complexity and eventually leading to premature death [2]. Among the different strategies adopted to mitigate the deleterious effects of senescence and sedentary lifestyle, the systematized practice of strength training is the main non-pharmacological intervention, capable of promoting numerous favorable adaptations to health and quality of life [3]. Thus, given the great concern of health professionals, different methods of physical training have been tested in search of multisystem adaptations that can effectively reduce negative changes arising from the aging process [4].

In this perspective, the search for methods that mainly aim at anti-aging benefits has become increasing, prioritizing the principle of specificity and also the development of muscular strength in an integrated and balanced way with other components of physical fitness at sufficient levels to enable the execution of daily tasks satisfactorily and safely. Being the Functional Training (FT) considered by many the most efficient in the adaptive responses to the human functionality [5]. This method focuses on multiple, complex and dynamic movements and incorporates variations to increase neuromuscular performance of individual [6]. Thus, FT improves physical fitness for daily activities through a protocol where the exercises performed require movement patterns similar to those performed on a daily basis. Some trials show these programs have positive effects on functional performance and may be sustained for up to 6 months after completion of training [7,8]. Most studies use a systematization that divides the FT session into sets with different types of exercises to minimize adaptive competition. Being the set first commonly intended for mobility activities for the main joints required in daily activities. Second, activities organized in circuits that require agility, coordination and muscle power. Third, multisegmental exercises that require muscle strength and refer to functional actions of squatting, pulling, pushing, and transporting objects, as well as exercise that stimulate stabilizing muscles of the spine. And fourth, intermittent cardio metabolic activities [7-9]. However, the benefits of this protocol are not well known in the elderly population, there is an

absence of investigations comparing FT with traditional methods, hindering a robust analysis between the protocols used and the effects found. Thus, the purpose of this manuscript is to discuss the main adaptations of functional training on body composition, physical fitness, cognitive status and cardiovascular health in older people.

Methodological Procedures

From April to July 2019, information about the FT was searched in the following databases: MEDLINE, Scholar Google, SciELO, LILACS and SportDiscus. The FT programs were considered those that used multiarticular exercises with transfer to daily activities, whose training sessions comprised more than two components of physical fitness. The following combined keywords were used in the search for the desired information: "functional training", "multi-component exercise", "exercises for activities of daily living", "dual task exercises", "elderly" and "older people". As inclusion criteria, articles should be written in English, Spanish or Portuguese and mention the effects of FT on any component of physical fitness in older people.

Benefits of Functional Training on Body Composition, Physical Fitness, Cognitive Status and Cardiovascular Health in Older People

The Functional Training (FT) for the elderly is characterized as a program of general conditioning physical exercises that aims to provide the broadest physiological adaptation. Thus, it intends to promote the optimization of all physical qualities (muscle strength and power, coordination, agility, balance, cardiorespiratory endurance and flexibility), and prepare participants to perform essential movements (pulling, pushing, carrying, jumping, spinning, crouching and raise) with maximum efficiency, ensuring the improvement of functional fitness and excellent neuromuscular and metabolic responses through a systematization in which the multicomponent stimulus in specific movements for daily activities is prioritized. The expected result of this type of training is to improve fitness, decrease body weight, improve muscle quality, reduce the incidence of chronic degenerative diseases and promote increased sociability and adherence to the program through collective activities where socialization is also valued. In this context, knowing that FT can promote minimization of the deleterious effects of the aging process, it is described below the main adaptations that have been reported in the studies selected to compose this manuscript, to know: the effects of FT on body composition, strength and muscle power, cardiorespiratory capacity, dynamic balance, flexibility, cognition and cardiovascular health.

Effect on Body Composition

It is believed that the FT can generate important changes in body composition, such as those observed in other exercise models, because it is a physical effort that follows the same biological and methodological principles of conventional strength training, can thus, promote a high basal caloric expenditure and generate positive stimuli on protein synthesis and hormonal release, favorable conditions for muscle mass gain and reduction of fat deposits [10,11]. In this sense, Cadore, et al. [12] identified significant increases in quadriceps total cross-sectional area with low fat infiltration and high muscle density after 12 weeks of intervention in frail older adults using a combination of strength exercises performed at maximum concentric speed, balance and gait. Neves, et al. [13] found significant reductions in body weight and total fat after eight weeks of FT in sedentary older women. Similarly, Cress, et al. [14] found increases in cross-sectional area of all muscle fiber types following a program of aerobic and resistance exercise (up and down stairs, push and pull). Finally, Sobrero, et al. [15] found decreased fat percentage, increased muscle mass, accompanied by better performance on agility, strength and muscle power tests after six weeks of functional circuit training in inactive women. Thus, the results of the studies presented above indicate that FT can assist in the hypertrophic process and in reducing body fat in older people.

Effect on Muscle Strength

The adaptations in muscle strength caused by FT can be justified by classically evidenced neuromuscular changes, deriving from the specificity of strength training, such as muscle cell hypertrophy, increased motor unit recruitment and spinal cord moto neuron excitability [16]. Moreover, this method works by interacting and integrating body structures into specific muscle actions for daily activities, promoting greater muscle activation, better neuromuscular coordination and better energy availability, which are adaptations observed in free weight exercises [17,18].

Thus, Cadore, et al. [12] found significant increases in maximum dynamic and isometric strength and muscle power using a combination of strength, balance and gait exercises for 12 weeks in 24 nonagenarian. Feitosa-Neta, et al. [19], from the application of a systematized FT protocol consisting of mobility exercises, circuits with strength and power exercises in specific movement patterns for daily needs and intermittent high intensity activities, observed significant increases (+14% to 24%) in strength, muscle power and quality of life in relation to the control group. However, the most important aspect is that muscle strength gains through regular functional exercise practice can better assist in the performance of activities daily in the elderly [7]. Krebs, et al. [20], in a six-week study in disabled older women who performed functional or strength training with elastic bands, found that both groups significantly improved lower limb strength. However, the group that performed exercises according to the FT proposal presented higher gait speed, higher maximal knee torque and better dynamic balance and coordination during daily tasks.

Similar results were reported by De Vreede, et al. [21] that found greater gains in the functional capacity in subjects trained in daily life-based exercise compared to those trained in conventional exercise. Therefore, the results of the described studies indicate that FT seems to provide an increase in muscle strength levels accompanied by a more expressive improvement in functionality.

Effect on Muscle Power

Skeletal muscle power can be defined as the product of the force or torque of a contraction and its application speed. This variable is associated with dynamic balance and postural oscillation, and may help to reduce the incidence of falls and bone fractures, besides providing greater independence in daily activities [22]. Thus, Bassey, et al. [23] identified positive and significant correlations (r = 0.65-0.88) of lower limb power with performance measures (sitting and rising, climbing stairs and walking) in nonagenarians, suggesting lower limb power as a variable that deserves attention in interventions with physical exercise. The functional exercise performed at maximum concentric speed can increase muscle power and improve functional capacity in senile by increasing type II fiber activation and spinal cord alpha motoneuron excitability, decreasing antagonist muscle coactivation, and improving inter and intramuscle coordination [24].

Ramirez-Campillo, et al. [25] observed after 12 weeks of intervention that high-speed exercise programs induce significant changes in muscle power and the ability to perform functional tasks in sedentary older women. Compared the effects of functional and traditional exercise, both at high intensity and high speed on the functional performance of 63 active older people, Lohne-Seiler, et al. [26] found a significant performance improvement in the object lifting test in both groups. However, only the group that performed the functional exercises improved their performance in the sitting and rising chair test.

Effect on Cardiorespiratory Capacity

The metabolic characteristic of interval activities commonly performed at the end of the session, associated with the circuited dynamic character of the main FT exercise sets, may increase cardiorespiratory resistance by providing central adaptations such as increased pulmonary oxygen diffusion, maximum cardiac output and affinity between oxygen and hemoglobin. And peripheral adaptations such as increased muscle glycogen, myoglobin content, capillarization, mitochondrial volume and density, and the activity of oxidative enzymes such as citrate synthase. Causing changes in oxygen transport and utilization mechanisms, such as increased muscle cell oxidative capacity, increased glycogen and phosphate degradation, and better utilization of intramuscular triglyceride [27]. Frontera, et al. [28], after combined application of aerobic and resistance exercise in a circuit, observed VO2max improvement, accompanied by a 15% increase in the amount of capillaries per fiber and a 38% increase in citrate synthase enzyme activity, thus suggesting some responses adaptive of exercise protocols with functional characteristics. Whitehurst, et al. [29] observed increases of 7.4% in cardiorespiratory capacity after 12 weeks of circuit training with functional exercises, and Resende-Neto, et al. [30] reported an 8% improvement this variable in physically active older women undergoing a high-intensity functional exercise program. Given the studies described above, it seems that the metabolic characteristics of circuit training, including high intensity interval exercises, may favor important increases in cardiorespiratory capacity in older people.

Effect on Dynamic Balance

The loss of dynamic balance is one of the main factors that prevent older people from performing their functional activities correctly and with confidence, and is closely related to the increased risk of falls and fractures [31]. The instability and change of direction of the exercises applied in the FT can stimulate proprioceptive receptors present in the body, which improve the development of synesthetic awareness and postural control, as well as activate more central muscles of the body, aiding in the development effective of agility and dynamic balance [32,33]. Thus, Giné-Garriga, et al. [34] demonstrated after 12 weeks of circuit FT 17% improvement in dynamic balance, and Karóczi et al. [35] showed improvement in the order of 27%; both in relation to a control group that performs traditional activities.

Recently, Resende-Neto, et al. [30] with 12 weeks of FT consisting of mobility exercises, circuits with strength and power exercises in movement patterns specific to daily needs and intermittent high intensity activities noted a 27.2% increase in agility / dynamic balance regarding the control group. In this same perspective, Distefano, et al. [36] conclude that programs that incorporate flexibility, agility, balance, plyometric and resistance exercises performed at high speed in their sessions are more effective than traditional training in improving functional performance measurements, highlighting the need for multicomponent stimulation for multisystem adaptations.

In addition, it is worth mentioning that reductions in muscle strength can also affect balance-related postural mechanisms. The neuromuscular complexity of functional exercises can improve muscle synergy and increase motor unit recruitment and, consequently, body stabilization. Accompanied by positive adaptations in lower limb muscle strength, Whitehurst, et al. [29] found a 12.9% improvement in dynamic balance and Milton, et al. [37,38] observed a 13% improvement this variable when compared with a group that performed conventional activities. Therefore, FT also seems to be effective in improving dynamic balance in older people.

Effect on Range of Motion

Adequate levels of flexibility favor better execution of daily movements and may reduce the risk of injury in the elderly [38]. In contrast, reduced flexibility in hip flexion, knee extension and glenohumeral mobility movements are, respectively, correlated with declining ability to bend to the ground, decreased walking ability and limited use hands and arms for daily life activities [39]. Given the systematized proposals of FT, it is believed that greater flexibility or range of motion can be obtained with the dynamic stretching exercises (joint mobility) applied in the first set of the session. Moreover, adaptations in flexibility are commonly observed also in strength training, when composed of multiarticular exercises performed with full range of motion, thus being complemented and guaranteed by other sets of the session, through mechanisms such as joint stiffness reduction and increased muscle elasticity [38,40]. In this context, Milton, et al. [37] when comparing an intervention group with functional exercises to a

control group that performed conventional activities, showed a 43% superior improvement in shoulder mobility and Whitehurst, et al. [29] reported a 14% increase in flexibility in the elderly after 12 weeks of functional exercise. The results of these studies indicate that FT can improve joint mobility in older people.

Effect on Cognitive Capacity

Cognitive disorders affect about 20% of the elderly and the most prevalent are dementia, depression and Alzheimer's disease, affecting 14%, 10% and 10% of senile, respectively. Functional strength training programs can improve mood, reduce moments of confusion and feelings of anger, reduce anxiety and tension, improve sleep quality, vigor and awareness [41].

The stimulation of different components of physical fitness and the collective character of many activities, together with the high variability and complexity of the movement patterns required in the functional circuits, make it difficult to reproduce the exercises, representing a constant cognitive challenge, being the main justifications for improvement in mental health in elderly individuals, having as possible physiological mechanisms stimulation the expression of genes that act in the process of brain plasticity, the increase of neurotrophic factors and IGF-1 levels, the facilitation of synaptogenesis, improvement in the vascularization, decrease in systemic inflammation and reduction of abnormal protein deposits [42].

Law, et al. [43] found significant differences in general cognitive functions, memory, executive function, functional status, and everyday problem-solving ability in individuals who performed functional exercises compared to a group that performed conventional cognitive activities after ten weeks of intervention in the elderly with mild cognitive impairment. It is noteworthy that the observed changes were maintained over six months after the end the training. Thus, it can be concluded that FT programs can contribute to the improvement of cognitive capacity in older people.

Effect on Cardiovascular Health

Identifying the acute and subacute hemodynamic changes of a physical training session is essential to ensure cardiovascular safety and suggest the application of a particular method to promote benefits on this system. Although FT is widely used in clinical practice, few studies have investigated its effects on hemodynamic parameters. In the study conducted by Botelho, et al. [44] analyzed hemodynamic responses (double-product, systolic and diastolic blood pressure) in 24 untrained women undergoing a FT session. Results revealed a decrease in systolic (after 20 min) and diastolic (after 10 min) blood pressure. Corroborating this finding, Lima, et al. [45] submitted 14 normotensive young men (23 ± 2 years) and 15 pre-hypertensive elderly (68 ± 4 years) to a circuit FT session and, as expected, the results showed increased double-product during the session, however, within the limits of cardiovascular safety (maximum of~23,000 for the elderly). Systolic blood pressure showed a significant reduction after exercise, regardless of age and resting blood pressure level. Already the diastolic reduced only in the elderly.

Several mechanisms may be involved in the improvement of exercise-induced autonomic modulation, including an improvement in endothelial response in nitric oxide production, promoting greater vagal stimulation and lower renin concentration. These factors together lead to a lower amount of angiotensin II, which, through a bidirectional pathway, reduces its inhibitory effect on the vagus nerve [46]. In conclusion, FT seems safe and efficient in improving cardiovascular health in hypertensive young and elderly.

Final Considerations

Based on the results of the reviewed studies, FT appears to be a safe, inexpensive, and interesting alternative for elderly physical training, with a positive impact on muscle mass, muscle strength and power, cardiorespiratory endurance, flexibility, balance, cognition and health cardiovascular, recommending its implementation in health promotion programs in this population, specifically.

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