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Review Article

Prescription of the Functional Strength Training for Older People: A Brief Review

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ABSTRACT

Aging is associated with a variety of multisystem changes that influence decreased neuromuscular fitness levels. Such losses decrease physiological resilience and increase vulnerability to chronic diseases. As such, treatment strategies are necessary for health promotion and well-being in older people. Seeking to meet this need, functional strength training is an intervention often used to improve muscle strength and morphology. However, evidence-based dose-response relationships with key physical training variables (e.g. intensity, volume, speed of movement, frequency and adhesion strategies) are unclear in the scientific literature. Thus, the purpose of this update is to provide an overview of current investigations and to suggest recommendations for the application of functional strength training to elderly. Taking into consideration the conditions of analysis, it may be suggested that a properly designed training program for the elderly should include a functional approach, working with two to three sets in one to two exercises per muscle group, reaching intensities of 70%-85% of one repetition maximum in body movements that resemble daily activities, 2 to 3 weekly sessions, including strength exercises performed at maximum concentric speed also with moderate intensities (40%-60% of one repetition maximum) and having as a basic premise neuromuscular adaptations.

Keywords: Aging; Strength training; Physical function; Activities of daily living

INTRODUCTION

Given the unwanted physical consequences of aging, prevention strategies are necessary to promote a healthy and independent life. Among contributors to senility, physical inactivity is an avoidable factor. Neuromuscular stimulation with functional strength training (FT) has been consistently demonstrated as a viable and effective way to combat muscle weakness and physical fragility by attenuating intramuscular fat infiltration, improving physical performance, improving muscle quality, bone density, health metabolic and insulin sensitivity, quality of life, psychological well-being and reduced risk of falls and fractures in older people [1,2]. In addition, FT can improve the metabolic capacity of skeletal muscle by improving glucose homeostasis, preventing intramuscular lipid accumulation, increasing glycolytic enzyme capacity, increasing amino acid uptake and protein synthesis, and increasing anabolism in this population [3].

However, before thinking about the benefits or periodization of FT, it is essential to know about the classic and main variables of strength training, for better adaptability of practitioners, efficiency of methods and minimization of the potential for exercise injury. Moreover, recent investigations have shown that the effects of physical training depend primarily on the stimulus given and not on the method applied [4], because, due to the high responsiveness and neuromuscular adaptive capacity of the elderly, it is a fact that any program will have some benefit [5]. From this perspective, it will be discussed below how to manipulate training variables to make it more secure, specific and efficient for senile.

Initially one needs to differentiate “movement” from “exercise”. Exercises are body movements that are performed to improve physical fitness, so any body "movement" can only be considered an "exercise" when the variables of its selection, application and execution (dose) are integrated into the context of the training program, attending appropriate and evidenced criteria to achieve sufficient stimuli to improve or restore physical health [6].

It is noteworthy that this update is designed for independent older

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and differs from individualized programs, in which the possibilities of adjusting the variables are maximized. Thus, was taken into consideration the orientation for collective activities, which require average stimulus values and determination of specific objectives for the elderly population in general, taking into consideration the same safety, efficacy and functionality criteria.

Thus, exercise prescription is complex, and despite the innumerable ways of controlling the internal (e.g. exertion perception, heart rate) and external (e.g. Repetitions, Kg) load of training, there are many manipulative components: exercise selection, number of sets and repetitions, recovery time between sets and sessions, range and quality of movement, execution speed, density, volume and intensity, weekly frequency and balance of different stimuli. This without taking into account the any manipulable variables, which are some of the principles of sports training, such as biological individuality.

With attention to all these variables, the regular practice of FT is capable of promoting numerous favorable adaptations to health and quality of life, having particular evidences in the improvement of physical capacities related to daily activities and structural alterations [7,8]. In a systematic review analyzing the effectiveness of different exercise protocols, 70% of the included studies showed reduced incidence of falls, 54% showed improved gait ability, 80% reported increased balance, and 70% increased muscle strength [9], showing that well-prescribed exercise is the true elixir of life for the elderly. Wake up to life, exercise is the medicine!

MATERIAL AND METHODS

Using a practical approach, sought to integrate scientific evidence and professional experience to develop recommendations for prescribing of the FT for older people. The main steps involved: (a) gathering information, (b) evaluating the quality of studies and (c) integrating evidence with practical aspects. Because the evidence was drawn from a variety of research-based methodologies, no single approach was ideally suited to assessing the strength of all existing scientific evidence. Thus, this update presents a critical review of the major published papers, taking into consideration the following inclusion criteria: (a) Full article (not just a summary), (b) Peer-reviewed manuscript, (c) Years of publication (2005-2019), (d) Published in English, Portuguese and Spanish (e) Study subjects 60 years of age and older, (f) Random assignment to intervention groups, (g) Presence of control group (h) Use of validated measurement method of results.

Training intensity

Intensity is most often represented by the percentage of a maximum effort. A recent positioning suggests loads between 70 and 85% of 1RM (one repetition maximum) as ideal for greater neuromuscular adaptations in the elderly [3]. However, studies comparing the effects of moderate (50%) and high loads (80% of 1RM) have not shown statistically significant differences in the increase in maximum dynamic force when volume is equalized [10,11]. However, when comparing low (30%) and high loads (70%-80% of 1RM), Ogasawara et al. [12] and Jenkins et al. [13] showed greater effectiveness of FT at high intensity in maximum dynamic strength gains, but the same magnitude of effects on increasing muscle mass. Corroborating this last finding, Ozaki et al. [14] stated that mechanical and metabolic stress has the same hypertrophic potential, if volume is normalized with repetitions until failure. Finally, Lasevicius et al. [15] add that loads from until 20% of 1RM are inefficient for any neuromuscular adaptation, thus establishing a lower limit for intensity to be applied.

Despite the importance of the findings cited for understanding the outcomes, it is noteworthy that most exercises suggested for the elderly are performed with the practitioner's own body weight, making it impossible to apply 1RM tests [16]. In addition, there are contraindications to the use of this test to prescribe o FT because of its low applicability due to the periodic adjustments necessary to maintain the intensity in adequate progression and for not being uniform in relation to the number of maximum repetitions possible in each percentage of 1RM for different exercises [17].

In this sense, it seems that the best way to measure the training load for the elderly is by using repetition interval. Baechle and Earle [18] suggest that an interval of execution between 8 and 12 maximum repetitions per exercise is the ideal intensity for simultaneous gains in muscle mass, strength, power and muscle endurance.

However, training to failure generates greater muscle damage, requiring a longer recovery time (approximately 72 hours), especially in the elderly population, which naturally has low anabolic capacity [19]. In addition, Nevez et al. [20] found that repetitions to concentric failure do not promote higher neuromuscular performance (maximal dynamic force, power and activation threshold) and muscle hypertrophy. The authors suggest that training volume is more important for hypertrophy than repetition until failure. This result is in accordance with the meta-analysis published by Davies et al. [21], showing that in situations in which the volume is equalized, whether or not to go to the concentric failure has little relevance, but when not equalized, this limit may have deleterious effects on neuromuscular performance, as it has a negative role in recovery between sets and training sessions. Thus, as a way to identify fatigue and maintain the desired range of repetitions it is suggested to adopt as a criterion the loss of speed or quality of movement, together with the application of effort perception scales.

In summary, in individuals over 60 years of age, the intensity of FT should reach 70%-85% of 1RM (06-12 submaximal repetitions) to optimize neuromuscular gains. Changes in morphology and functional performance can also be achieved at moderate intensities (50%-70% of 1RM or 12-15 submaximal repetitions).

Training volume

Volume refers to the total amount of weight lifted during a training session. More specifically, it refers to the sum of the total number of sets multiplied by the number of repetitions per series multiplied by the weight lifted for each repetition. Thus, the present subsection will provide evidence regarding the most effective number of sets per exercise, repetitions and time under tension to optimize muscle strength and hypertrophy in older people [3].

In the early stages of training, the number of exercises does not appear to be the primary variable responsible for increased muscle strength in sedentary individuals. Regarding the number of series, although Radaelli et al. [22] have shown similar results in quadriceps thickness and muscle strength in older women who performed one or three sets per exercise during 12 weeks of intervention, in periods longer than this, performing three sets seems to be more effective. A recent meta-analysis with 25 randomized and controlled trials showed a greater dose-response relationship in muscle strength with

2-3 sets of 7-9 repetitions per exercise [23]. Krieger [24] points out that performing one set per exercise/muscle group is insufficient to generate important adaptations in strength and hypertrophy. And Wernbom et al. [25] from a brief review show that performing 2-6 sets for each large muscle group per session or approximately 08-12 sets per week is sufficient to ensure optimal neuromuscular adaptations.

In summary, since intensity and volume are inversely manipulated and according to the indication of 50-85% of 1RM, it is recommended to use four sets per session for the main muscle groups or 08-12 sets per week depending on the physical condition of the elderly. The number of repetitions is dependent on the intensity (i.e. the load) used and should be adjusted considering that repetitions to failure are not necessary to optimize neuromuscular adaptations.

Movement speed

Evidence from 44 studies demonstrates a superior association of muscle power with functional performance when compared with muscle strength in the elderly [26]. Interestingly, Perry et al. [27] found that older adults with a history of falls show lower power in the lower limbs.

Studies have also shown that training at maximum concentric speed at moderate and high intensities induces similar neuromuscular and functional adaptations in the elderly [28]. This can be explained because muscle performance at high speeds increases the recruitment threshold of motor units composed of type II muscle fibers. In addition, force is the product of displaced mass and acceleration, even at moderate intensities, performing repetitions at a higher velocity considerably increases the resulting force, and since the velocity of motion is inversely associated with relative intensity, it can be considered a direct indicator of training intensity [3]. In addition, lower training volumes have been reported to be associated with greater improvements in muscle power [29].

Therefore, since muscle power is a variable that deserves attention in interventions with physical exercise, especially in this population, it is suggested to perform repetitions at maximum concentric speed in loads ranging from 40% to 80% of 1RM [30]. Specifically, in FT it is recommended for activities that require coordination and agility, moderate intensities between 12-16 repetitions or 40 and 60% of the practitioner's maximum neuromuscular capacity. In specific exercises for developing muscle strength between 08-12 repetitions or 70% and 85% of 1RM, with all movements intentionally performed at maximum concentric speed (1-2 seconds in the concentric phase and 3-4 seconds in the eccentric) and series interruption when this speed drops to 3 seconds in the concentric phase due to fatigue.

Finally, due to disagreements in the literature about the magnitude of FT induced neuromuscular effects at maximum concentric velocity at moderate and high intensities, both types of stimuli are recommended and should be combined over periodization.

Weekly frequency

Frequency represents the number of training sessions per muscle group performed per week. The vast majority of studies analyzing the influence of weekly frequency on body composition and functional performance in the elderly suggest 2-3 sessions per week [25,31]. Borde et al. [23] showed a higher dose/response ratio of interventions with two weekly sessions. Corroborating these findings, Ferrari et al. [32] concluded that anaerobic and aerobic exercises performed in two weekly sessions promote identical adaptations in muscle power and quality when compared to the same training program performed three times a week in the elderly. Schoenfeld et al. [33] show that having a single weekly session or three can achieve similar results as long as the workload is equalized.

However, higher volumes or intensities in a single session may result in a greater need for recovery from trained muscle grouping, which will result in lower weekly training frequency [19,34]. Thus, to apply the ideal dose of the FT for the elderly, 2-3 sessions per week are suggested, depending on the physical condition of the practitioner.

Adhesion strategies

The best dose of exercise is the one the practitioner likes to take. In this sense, it is important to understand that adhesion related to training denotes approval or admiration and satisfaction for performing a certain activity and/or being part of a group. There are several factors that influence in this regard as intrinsic and extrinsic motivation, which is influenced by the coach's ability to relate to the elderly, the physical environment, the training method, as well as the potential to promote pleasure through social interaction and health benefits [35].

In this perspective, some strategies that increase the adhesion in the physical training program will be presented below.

- Respect, before starting the session, a minimum of 5 to 10 min of interaction between practitioners;
- Always treat in a loving, friendly and caring manner;
- Always give positive feedback on the results obtained with the practice, emphasizing the benefits and purpose of the training program;
- Respect skill and comfort levels by setting realistic challenges and goals;
- Serve all practitioners equally, without preferences;
- Praise and commuicate whenever possible. e.g. "How was your weekend?".
- Provide physical support that gives security to the practitioner in performing the activities, when necessary;
- Hold one event per month. e.g. breakfast, dance class and walks.
- Offer gifts to those who bring a friend to training;
- Post daily messages or motivational images on social networks;
- Use songs that conceive joy and energy.

Thus, participants are less likely to abandon the activity due to lack of motivation, boredom or lack of knowledge of the benefits that exercise promotes health.

CONCLUSION

The purpose of this update is to provide an overview of the current literature of the FT variables for older adults, and to suggest evidence-based recommendations. Current research has shown that combating muscle disuse through FT can be a powerful intervention to reduce negative changes arising due to aging,

especially when administered the right dose of intensity, volume, speed of movement, weekly frequency, and adhesion strategies.

Thus, the results presented suggest that a properly designed training program for the elderly should include a structured and functional approach, working with 2 to 3 sets in 1 to 2 exercises per muscle group, reaching 70%-85% 1RM intensities in body movements that resemble daily activities, 2 to 3 weekly sessions, including strength exercises performed at maximum concentric speed also with moderate intensities (40%-60% of 1RM) and having as a basic premise neuromuscular adaptations.

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