111 - RESISTANCE TRAINING IN THE ELDERLY: A REVIEW OF TRAINING INTENSITY

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INTRODUCTION

There is consensus amongst researchers that a loss of strength occurs in the ageing process, mainly resulting from factors such as reduced levels of physical activity, inappropriate diet, illnesses, hormone reduction and biological ageing itself (FIATARONE et al, 1990; MATSUDO, 2001; SHEPHARD, 2003). All of these factors lead to loss of muscle mass in the elderly, a process known as sarcopenia, which often leads to loss of strength. With this process, there is an impact on functional ability which can lead the elderly individual to a loss of self-sufficiency and also to the development of some pathologies deriving from their frailty (CHANDLER et al., 1998; FARINATTI, 2008; PETERSON et al., 2010).

Frailty in old people has been defined as the loss of physiological reserves that leads to a decline in physical performance and functional independence. This frailty becomes more prevalent with age, however it is no longer considered to be an inevitable consequence of ageing, bearing in mind that some causal factors are reversible, such as the loss of strength, for example, which can be minimized or even reversed with physical exercise and, more specifically, by resistance training (CHANDLER et al., 1998; FIATARONE et al., 1990).

Resistance training is recommended by both national and international health organizations such as the American College of Sports Medicine (ACSM), and is directed towards various sectors of the population such as teens, adults, elderly and people with chronic illnesses, mainly with the aim of improving and maintaining health and quality of life (KRAEMER; RATAMESS, 2004).

Despite these recommendations, there is still some controversy over the intensity to which an elderly individual should be subjected in order to obtain the benefits from strength training directed towards maintaining health and improving quality of life.

Accordingly, the aim of this study is to compare, by means of a review of the bibliography, the effects on the elderly of different intensities of resistance training on strength gain.

METHODOLOGY

The articles used for this bibliographical review were selected from the databanks of Lilacs, Medline and Scielo. This study was conducted between December 2009 and July 2010. The terminology used for the research includes: elderly, strength training, resistance training, intensity of training.

LOAD INTENSITY IN STRENGTH TRAINING

Intensity of load in strength training signifies the resistance against which the movements proposed in the training are carried out (HÄKKINEN et al., 1998; KRAEMER; RATAMESS, 2004).

High intensity is recognized by Evans (1999), as that which approximates to or results in muscle fatigue after the movement has been performed between 8 and 12 times. It has also been seen as the most effective in improving strength at all ages. A load that can be lifted 20 times or more will improve muscle strength but will not result in large gains in strength or muscle mass. The higher the load, the lower the number of repetitions until fatigue sets in and the greater the intensity. In this regard, the exact number of repetitions is not so important. For an individual to get optimum benefit from strength training, it is not sufficient merely to carry out the proposed movements. The organization of the program and the application of scientific principles will guarantee the effectiveness of this training (BARBANTI; TRICOLI; UGRINOWITSCH, 2004).

Four of the six meta-analysis studies of Silva; Farinatti (2007), which compared high and low intensities, found significant differences. The elderly who trained at high intensity obtained an average strength gain of around 55.6%, while in those studies where the elderly trained at low intensity, there was a strength gain of 39.9% on average, demonstrating the importance of variable intensity for the efficiency of the program. High loads were, for the most part, set at around 80% of 1RM. There is evidence that such loads provide a significantly higher strength gain in old people when compared to training with low intensity loads.

High intensity loads also seem to have more significant effects in terms of both neural and hypertrophic adaptations, which are the pathways known for strength gain (HÄKKINEN et al., 1998).

Accordingly, Table 1 summarizes the information gathered in the articles researched, highlighting the regimes and the results obtained.

TABLE 1. COMPARISON OF STRENGTH GAIN IN DIFFERENT TRAINING REGIMES

n and sex	Age	Regime	↑ Strength	Volume	Reference
n: 10 6F/4M	Ave. 90.2	3X8 at 80% of 1RM	174% right leg 180% left leg	3X per week 8 weeks	Fiatarone, 1990
n: 100 50F/50M	Over 64	(No description) Home-program for lower limbs.	10 to 16%	3X per week 10 weeks	Chandler et al. 1998
n: 100 No description	60 to 72	80% of 1RM	227% knee flexors 107% knee extensors	3X per week	Evans, 1999
n: 19F * 19 Leg Press 17 Supine	Over 60	2X10 RM 1' interval	60% Leg Press 62% Supine	2X per week 12 weeks	Trancoso; Farinatti, 2002
n: 18 11M/7F	65-75	5X5 RM** Unilateral extension of knees	M: 27% F: 29%	3X per week 9 weeks	Martel et al., 2006

n: 30F	Ave. 61.1	2X from 10 to 12 RM 2' interval	Knee extension: 36.5% Knee flexion: 34.3% Elbow extension: 13.7% Elbow flexion: 16.3%	3X per week 12 weeks	Silva et al., 2006
n: 18 7F/11M	65-79	1 series till fatigue at 75% of 1RM (10 to 15 repetitions)	*** G1: 43.8% G2: 52%	G1: 1X per week G2: 2X per week	DiFrancisco-Donoghue; Werner; Douris, 2007
n: 65 F **** TG1: n=20 TG2: n=12	60-80	4X8 at 10 repetitions 75-80% of 1RM (Explosive)	TG1: 28.1% TG2: 21.5%	2X per week 12 weeks	Caserotti et al., 2008
n: 6M	80-86	3X10 at 70% of 1RM 2' interval	41%	3X per week 12 weeks	Slivka; Raue; Hollon, 2008
n: 6F	85	3X10 70-75% of 1RM 2' interval	26%	3X per week 12 weeks	Roue; Slivka; Minchev, 2009 m

*Two people were unable to carry out the exercise in supine erect due to joint problems. **The first series consisted of 5 repetitions at 50% of 1RM, at 2nd of 5 repetitions at 5RM, in the 3rd it was necessary to perform repetitions with 5RM until fatigue, so the subject quickly reduced the load in order to carry out one or two extra repetitions. The process was repeated until 10 repetitions were reached. In the 4th, the same process as before was conducted up to 15 repetitions. In the 5th, up to 20 repetitions. *** Greatest strength gains observed amongst the regime exercises were with Chest Fly. **** TG1: average age of 62.7; TG2: average age of 81.8.

From the table it can be seen that a large number of exercise regimes have been used in literature, to check the effectiveness of resistance training in the elderly population. In studies where the loads used were 80% of 1RM, strength gains were greater (FIATARONE et al, 1990; EVANS, 1999).

In all of the research studies analyzed, there were positive results in terms of strength, though they were less significant when the load was lower. In all of them, however, the authors reported the benefits which this type of training brought when the realization of routine daily activities was evaluated using physical/ functional testing.

In the study where the least significant result in strength gain is found, Chandler et al. (1998), resistance was employed with the use of elastic bands and the weight of the body itself. No load measurement was taken using the percentage of 1RM, however the load was increased progressively through the use of stronger elastic bands. Even with low intensity training, the authors report increments in strength that produced effects in the realization of routine daily activities. However, the authors stress that, in untrained subjects, strength gains tend to be greater and this was indeed the case with the subjects in this study. They were all elderly and frail, that is to say they had impediments relating to the realization of routine daily activities (FARINATTI, 2008; KAMEN; KNIGHT, 2004; KRAEMER; RATAMESS, 2004)

All the exercise regimes brought benefits to the elderly individuals, but the most effective were those that made use of higher loads.

STRENGTH GAIN AND NEURAL ADAPTATIONS

A number of authors report gains in neural function, which relates to the capacity of activation, recruitment and/or discharge frequency of motor units. They also report an increase in the area of the transverse section as a result of the strength training (KAMEN; KNIGHT, 2004 HÄKKINEN et al., 1998; NARICI et al., 2004; ONAMBÉLÉ-PEARSON; BREEN; STEWART; 2010; PETERSON et al., 2010)

The already acknowledged decline in strength and muscle power that comes with ageing may be partially caused by the reduction in the maximum voluntary activation of the agonist muscle of the movement in question, which can be proved by the decline in the discharge rate of the motor units, which is inversely proportional to the increase in age, as quoted in Kamen; Knight, (2004), in addition to the increase in the coactivation of the muscles that are antagonists to the muscle action, mainly in multi-joint movements, as mentioned in Häkkinen et al., (2001). Bearing in mind the neural loss that occurs with advancing age, strength training that optimizes strength gain due to neural adaptations may contribute to the total strength gain in the elderly, as such adaptations do not stop occurring in this population as a consequence of ageing. Caserotti et al., (2008), reported in his study that strength training with high loads, 75% to 80% of 1RM, with intentional maximum acceleration of movement (power training), may result in an excellent combination for muscular hypertrophy and neural adaptation.

Kamen; Knight, (2004); Häkkinen et al., (1998) believe there is a specific motor unit recruitment pattern when training with high or near maximum loads which does not occur with light to moderate loads. The activity of the motor units increases with fatigue, which makes it important to bring the musculature to this state during training in order to obtain optimal strength gains.

Light loads, such as 45% to 50% of 1RM or less, can increase the strength in untrained individuals. In trained people, higher loads become necessary for better results. Hakkinen et al., 1985, as mentioned in Kraemer; Ratamess, (2004), believe that loads greater than 80% to 85% of 1RM are necessary in order to obtain additional strength gains due to the neural adaptations (KAMEN; KNIGHT, 2004; KRAEMER; RATAMESS, 2004)

It is important to stress that, with ageing, one does not lose the capacity to adapt to the stimuli offered by strength training; the neural and morphological adaptations are similar to those in young adults. The difference is more likely to be the absolute amount of strength gain (HÄKKINEN et al., 2001; NEWTON et al., 2002). With this in mind, the remarks of Kraemer et al., (1996) apud Silva; Farinatti, (2007), provoke interest when they say that the recruitment of motor units with the high intensity of neural work, can enable underutilized muscle fibers to be trained. Setting this information against the reduction in the level of physical activity presented by the elderly, high loads may capacitate muscle fibers that were neglected through disuse.

The majority of authors researched agree with the need to use high loads for optimum gains in neural adaptation, generally in excess of 70% of 1RM. It appears that the execution of a movement at high speed may optimize such adaptations. It is clear that the idea that all old people should perform strength training using light to moderate loads is far too generalized, since the best results in terms of strength gain seem to be linked to training with high loads, but the importance cannot be discounted of considering the biological individuality of the subject in question, or in other words, not all individuals will have the capacity or need to use more intense loads.

DISCUSSION

The objective of the present study was to compare, by means of a review of bibliography, the effects of high and

moderate intensities of resistance training in strength gain in the elderly.

Some reluctance can be noted on the part of Physical Education professionals to prescribe resistance training for the elderly population. This occurs based on the conception that injuries could result from excess loads, which is related to the idea that, due to their frailty, elderly individuals should not train with high intensities. This reluctance, however, could lead to the individual not attaining the expected results since optimum strength gain will mainly depend on the intensity of training. Amongst the studies researched in this review, the majority encountered results where strength gains are greater when the intensity of training is high.

When an elderly individual undergoes proper adaptation to resistance training, the risk of injury is lower (KRAEMER; RATAMESS, 2004). So it is important to respect the pace of learning and the time required for physiological adaptation. This is because the pace of learning becomes slower with age but this factor can be offset by increasing adaptation time and also adopting a simpler approach that leads to a reduction in the learning of elements peripheral to the realization of a task, such that for an old person to learn all the details of the execution of the exercise, the time should be increased (SHEPHARD, 2003). Once this period has passed, the elderly subject becomes fit to raise the load gradually until he/she reaches an intensity considered to be high enough to cause adaptations associated with increased strength.

The work researched in this review used different resistance training regimes in an attempt to discover what would bring greater benefits to the elderly.

A tendency can be seen towards more significant results with traditional high-intensity strength training, although those who worked with lower intensities also obtained positive results, albeit not as significant.

Accordingly it may be concluded that:

The practicing of strength-related exercises is extremely important for the elderly, since it enhances their physical capacity, increases their quality of life due to the improvement in realizing routine daily activities and reduces the risk of osteo-muscular injury.

The recommendations of the authors for adaptation to resistance training for the elderly are similar to those recommended for any individual, though it is believed a longer period of time is required in this phase for this population, since the pace of learning becomes slower due, for example, to the gaps in short-term memory, amongst other factors. (SHEPHARD, 2003)

Training loads should be progressively increased, more slowly than with adults, but may reach higher and higher intensities depending on the condition of the elderly subject.

High loads produce better strength gain results than do low loads and are considered to be more effective for strength training in the elderly, and by taking adequate precautions, the risk of injury is slight. None of the research used in this review reported injuries to any individual on account of the use of high loads, showing that training, when conducted properly, has a low probability of injury resulting from this kind of intervention. All forms of training are important and relevant for the improvement in strength and functional capacity in the elderly, it is just a question of evaluating the best moment to be introduced to the training program.

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RESISTANCE TRAINING IN THE ELDERLY: A REVIEW OF TRAINING INTENSITY

ABSTRACT

The loss of strength and function in the elderly has already been widely discussed in literature. Resistance training has been seen as a way of preventing or even reversing this situation. On the other hand, the area is notorious for the difficulty in prescribing the load intensity that is appropriate for the results to be effective. The aim of this study was to compare the effects of different intensities of resistance training with strength gain in the elderly. The methodology consisted of a review of the bibliography. The articles used were chosen from the following data banks: Lilacs, Medline and Scielo. The research was conducted between December 2009 and July 2010. The terms used in the study are as follows: elderly, strength training, resistance training, intensity of training. It was concluded that progressions in load and training should be carried out more slowly due to the greater difficulty in learning the proposed movements and dynamics, however, it was the higher loads that produced the most significant strength gains, so bearing in mind that ageing does not imply that it is impossible to adapt to the training, the increase in intensity becomes important in obtaining more effective results. Strength training injuries did not occur in any of the studies, which demonstrates the safety of training when conducted properly.

KEYWORDS: elderly subjects/ intensity of training/ strength training

ENTRAINEMENT RESISTE POUR LES PERSONNES AGEES: UNE REVISION SUR L'INTENSITE D'ENTRAINEMENT

RESUME

La perte de la force et de la fonctionnalité, est déjà un suject très discuté dans la littérature. L' entrainement est vu comme une façon de prévention ou même de réversion dans ce-cas. Cependant la difficulté de prescription de l'intensité de charge appropriée pour que les résultats soient efficaces. L' objectif de cette étude, était faire la comparaison des effets des différentes intensités d'entraînement résisté pour les bénéfices de forces, des personnes âgées. La méthodologie a été faite sur une révision bibliographique et les articles ont été sélectionnés dans les bases de donnés de Lilacs, Scielo et Medline. Cette recherche a été réalisée entre les mois de décembre 2009 et juillet 2010. Les mots-clés utilisés dans la recherche ont été: "elderly, strenght training, resistance training, intensity of training". La conclusion est que les progressions de charges et de l'entrainement doivent être plus lentes, en fonction d'une plus grande difficulté de l'apprentissage du mouvement et des dynamiques proposés, mais les charges élevées ont été celles qui produisaient des bénéfices plus expressifs en force; donc, le vieillissement n'amène pas une impossibilité d'adaptation ou d'entrainement, l'augmentation de l'intensité est importante pour obtenir des résultats efficaces. Dans aucune des recherches, il n'y a eu d'accidents à cause de l'entrainement de force, ce qui montre la sécurité de l'entrainement lorsqu' il est réalisé de façon adéquate.

MOTS-CLÉS: personnes âgées / intensité de l'entraînement / l'entraînement en résistance

ENTRENAMIENTO DE RESISTENCIA EN ANCIANOS: UNA REVISIÓN DE LA INTENSIDAD DEL ENTRENAMIENTO

RESUMEN

La pérdida de fuerza y función en los ancianos es ampliamente discutido en la literatura. El entrenamiento de resistencia se ha visto como una manera de prevenir o incluso revertir esta situación. Sin embargo, es notoria la dificultad para encontrar la zona de prescripción de la intensidad de carga adecuado para que los resultados sean efectivos. El objetivo de este estudio fue comparar, a través de una revisión de la literatura, los efectos de diferentes intensidades de entrenamiento de resistencia sobre las ganancias de fuerza en los adultos mayores. La metodología consistió en una revisión de la literatura. Artículos usados para esta revisión fueron seleccionados sobre la base de datos www.pubmed.com y www.bireme.com.br www.scielo.br. Esta encuesta fue realizada entre los meses de diciembre de 2009 y julio de 2010. Las palabras clave utilizadas en la investigación fueron: elderly, strength training, resistance training, intensity of training. La conclusión fue que la progresión de las cargas de entrenamiento debe ser más lenta debido a la mayor dificultad en el aprendizaje de los movimientos y dinámica propuestos, sin embargo, las altas cargas que produce ganancias significativas en la fuerza, entonces, dado que la el envejecimiento no trae la imposibilidad de adaptación al entrenamiento, el aumento de la intensidad llega a ser importante para obtener resultados efectivos. En ninguno de los estudios fue la lesión debido al entrenamiento de fuerza, que muestra el entrenamiento de seguridad cuando se realiza correctamente.

PALABRAS CLAVE: entrenamiento de fuerza / ancianos / intensidad de entrenamiento

TREINAMENTO RESISTIDO EM IDOSOS: UMA REVISÃO SOBRE A INTENSIDADE DE TREINO

RESUMO

A perda de força e funcionalidade no idoso já é amplamente discutida na literatura. O treinamento resistido tem sido visto como uma forma de prevenção ou até reversão desse quadro. Porém, é notória na área a dificuldade de prescrição da intensidade de carga adequada para que os resultados sejam eficazes. O objetivo deste estudo foi comparar os efeitos de diferentes intensidades do treinamento resistido no ganho de força em idosos. A metodologia consistiu em uma revisão bibliográfica. Os artigos utilizados foram selecionados nas seguintes bases de dados: Lilacs, Medline e Scielo. Esta pesquisa foi

realizada entre os meses de dezembro de 2009 e julho de 2010. Os termos utilizados para a pesquisa foram: elderly, strength training, resistance training, intensity of training. A conclusão foi que as progressões das cargas e do treinamento devem ser mais lentas devido a uma maior dificuldade de aprendizado dos movimentos e dinâmicas propostos, porém, as cargas elevadas foram a que produziram ganhos mais expressivos em força, então, tendo em vista que o envelhecimento não traz impossibilidade de adaptação ao treinamento, o aumento da intensidade torna-se importante para resultados eficazes. Em nenhuma das pesquisas ocorreu lesão devido ao treinamento de força, o que mostra a segurança do treinamento quando realizada de maneira adequada.

PALAVRAS CHAVE: idosos/intensidade de treino/treinamento de força