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LETTER TO EDITOR

Improving muscular strength and hypertrophy: are we following the right scientific way?

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Improvement in muscular strength is necessary for the majority of individuals, whether for health promotion or to increase performance in sports. Prescription of resistance training can vary significantly in volume and intensity in accordance with the characteristics of the subjects. In this sense, several athletes need to train at their maximum individual intensity; while hypertensive patients should train with low loads to avoid unnecessary cardiovascular stress. For healthy adults, the recommendations for resistance training for increasing muscular strength and muscle mass basically follow a consensual model, which involves 1-3 sets per exercise/muscle group, 8-12 repetitions, 60-80% of one-maximal repetition (1RM), and a 1-3 min rest interval[1]. The resistance training prescription following this general recommendation is relatively easy, safe and can be apply to the most of healthy adults.

However, several studies have attempted to identify routines to maximize strength/muscle mass gains by manipulating sets, repetitions, load, and rest interval values. On the other hand, the combinations between sets, repetitions, load, and rest interval results in different possibilities of training routines; and different training routines can result in different effects in strength and/or hypertrophy. In this sense, meta-analysis studies have also been performed to integrate the results of the original studies and, through statistical treatment, to identify the variables, and their respective values, that can most influence the increase in muscular strength and/or muscle mass.

Regarding the number of sets, Schoenfeld et al.[2] showed that ≥10 sets per week per muscle group would have the greatest effect on hypertrophy. However, the authors failed to identify an optimum number of sets to maximize the hypertrophy. On the other

hand, the performance of a large number of sets above the individual adaptive capacity may increase the chance of overtraining or injuries.

For each set, it is necessary to perform a number of repetitions. Depending on the load being carried out, it is common for repetitions to be performed until exhaustion or near exhaustion. In this context, Davies et al.[3] analyzed the effects of repetitions failure or non-failure on muscular strength. Although the authors identified an advantage of up to 1.3% for the non-failure repetition model, this value is too small to characterize a relevant difference in practical applications. Thus, it appears that performing repetitions to failure and non-failure have similar effects on increasing muscular strength.

Considering that multiple sets should be performed and that repetitions should be performed to values near fatigue, the rest interval between sets is an important variable in the prescription of resistance training in order to avoid excessive fatigue during the training. Recently, Grgic et al.[4] showed that untrained subjects (sedentary or without previous experience in resistance training) could maximize muscular strength with rest intervals between 0.5-2 min; while resistance-trained subjects would need more than 2 min rest intervals between sets. This association between the rest interval and training status may have a direct relation to the load, since untrained subjects usually use a relatively lower load than resistance-trained subjects. Consequently, with low load, untrained subjects need a shorter rest time than resistance-trained subjects, even when performing repetitions near fatigue. However, the authors also concluded that strength gains could be achieved at intervals of less than 1 min for both resistance-trained and untrained subjects. In other words, since there is no lower or upper limit of rest interval, the chances of varying the recovery interval are very large.

Regarding the load, an elegant study compared two intensities (30 and 80% 1RM) in strength and muscle mass responses after 10 weeks of knee extension[5]. The sample performed 3 sets with repetitions failure and the data showed that the intensity of 80% 1RM provided greater improvement in 1RM strength. This result can be explained by the intensity of 80% 1RM being very close to the 1RM test (100% 1RM). On the other hand, there was no difference in isokinetic torque and maximal voluntary isometric contraction. Protein synthesis was also similar in both intensities, suggesting that muscle hypertrophy does not depend on the load when repetitions are performed to failure.

Researches, professionals and practitioners of resistance training expect that scientific literature provide consistent data (i.e., as precise as possible) related to training prescription. Nevertheless, in some cases, the literature failed or the scientific data are not very accurate, and the training prescription can vary widely. In this context, considering the results of the cited studies in the present manuscript, the load can be low, moderate, or high. Regardless of the load chosen, repetitions should be performed until exhaustion or near exhaustion. The exercises and series should be repeated so that there is a weekly sum of at least 10 sets per muscle group; and the rest interval between sets should be sufficient for the realization of another set. Then, it is possible to think that an auto-suggested training model could have significant results in both strength and hypertrophy. Auto-suggested training is understood as when the individual selects the training variables as a function of individual sensations, such as motivation and/or rating of perceived exertion.

It is important to mention that this conclusion was based on the results of scientific studies published in journals with high impact factor in the sports science

area. The main limitation of these studies is the resistance training variables (i.e., sets, repetitions, load, rest interval, frequency etc.), which must be analyzed together when meta-analysis were performed (not separately). For this reason, further studies should be carried out to integrate the effect of different variables in the same mathematical model.

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