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Exercise prescription thru the T1RM test in trained men

Original Article

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Abstract: This article aims to determine whether the prescription of exercise at 80% of 1RM is related to the stimulus zone, as advocated by the literature for the strength work and muscle hypertrophy. The studied group of 25 (25 ± 6.1) trained subjects male. The 1RM test by prediction of Baechle was applied in straight bench press, with squat with bar, and front pulley. After an interval of 48 hours, were performed the same exercises with the maximum possible number of repetitions at 80% of 1RM until concentric failure. The average values were obtained as nine to the supine, 10 to high pulley, and 20 for the squat. With these results, we conclude that the prescription of exercises for the strength training and muscle hypertrophy, based on the 1RM percentage, does not seem the most appropriate mean to control the intensity in the squat exercise. In contrast, in the supine and in the pulley the stimulus appears to be sufficient to maintain the stimulus zone, as quoted in the literature.

Keywords: Strength, Muscular hypertrophy, 1RM test.

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RESUMO

Prescrição de exercícios através do teste de T1 RM em homens treinados

Este artigo teve como objetivo verificar se a prescrição de exercícios a 80% de 1RM está relacionada com a zona de estímulo, conforme preconizado pela literatura para o trabalho de força e hipertrofia muscular. O grupo estudado foi de 25 indivíduos (25 ± 6,1) treinados do sexo masculino. O teste de 1RM por previsão de Baechle foi aplicado nos exercícios supino reto, agachamento com barra, e puxada pela frente. Após um intervalo de 48 horas, foram realizados os mesmos exercícios com o número máximo de repetições possíveis a 80% de 1RM até a falha concêntrica. Os valores médios obtidos foram de nove para o supino, 10 para a puxada alta, e 20 para o agachamento. Com estes resultados, podemos concluir que a prescrição de exercícios para o treinamento de força e hipertrofia muscular, tendo como base o percentual de 1RM, não parece ser o meio mais apropriado para controlar a intensidade no exercício agachamento. Em contraposição, no supino e puxada o estímulo parece ser suficiente para manter a zona de estímulo conforme citado pela literatura.

Palavras-chave - Força; hipertrofia muscular; teste de 1RM.

RESUMEN

Prescripción de ejercicios a través del test de 1RM en hombres entrenados

Este artículo tuvo como objetivo verificar si el fallo muscular de ejercicios al 80% de 1 RM se relaciona con la zona de estímulo de acuerdo al preconizado por la literatura para el trabajo de fuerza y hipertrofia muscular. El grupo estudiado fue de 25 individuos (25 ± 6,1 años) entrenados del sexo masculino. El test de 1 RM por previsión de "Baechle" fue aplicado en los ejercicios *press de banca*, sentadillas con barra y tirada por el frente. Después de un intervalo de 48 horas fueran realizados los mismos ejercicios con el numero máximo de repeticiones posibles el 80% de 1 RM hasta la imperfección concéntrica. Los valores medios obtenidos fueran de nueve para el *press de banca*, diez para la tirada alta y veinte para las sentadillas. Con estos resultados podemos concluir que el fallo muscular de ejercicios para el entrenamiento de fuerza y hipertrofia muscular teniendo como base el porcentaje de 1 RM, no parece ser el medio más adecuado para controlar la intensidad en el ejercicio de sentadillas. En contraposición en el *press de banca* y tirada parece de ser lo bastante para guardar la zona de estimulación según lo citado por la literatura.

Palabras clave: Fuerza, Hipertrofia Muscular, Test de 1 RM.

INTRODUCTION

The practice of resistance exercises has aroused the interest of an immeasurable number of practitioners, whether as a form of prevention, health promotion, esthetic reasons and recreation. Currently, the ER have become a way to improve the form and fitness of athletes and non-athletes recommended by the American College of Sports Medicine (ACSM 2002). The popularity of ER it is growing, due to many polls that show the benefits of strength training for performance and health (SIMÃO, 2003). However, they require an understanding of definitions, principles and methods to prescript a routine of ER, so that the Physical Education professional has sufficient basis that enable it to adjust, interpret and judge what fundaments and force training laws will be adapted to the needs of its practitioners.

The training routine planned and implemented correctly result in exercises that systematically organized, develop the power, through an adjustment to the overload, because among the components of force training, the intensity or load used in a specific exercise is one of the most important variables (FLECK; KRAEMER, 1997). It can be defined in many ways, but the most commonly used are the absolute (weight used in the equipment or bar), and the relative, expressed as a percentage of a maximum repetition (% 1RM) (SIMÃO, 2003). In scientific experiments, the % 1RM is widely used due to the accessibility (BAECHLE; EARLE, 2000), either as a muscle strength measure diagnosis, or as a parameter to prescript and monitor a determined exercise (MACDONAUGH; DAVIES, 1984). However, it seems to have little practicality in daily use by the periodic adjustment required for the intensity so that the training intensity is not diminished (FLECK; KRAEMER, 1997). The effort intensity reported in the literature to gain strength and hypertrophy is always over than 60%, and usually in most scientific works to 80% of 1RM, so the number of repetitions varies between six to 12 RM (ACSM, 2002). KOMI, 2003.

This article has the objective to check whether the prescription of exercises at 80% of 1RM is related to the stimulus area, as advocated by the literature to the strength work and muscle hypertrophy in exercises that require the participation of large muscle groups, as supine with horizontal bar, pushdowns and front pull in the high pulley.

METHODS AND MATERIALS

25 trained man were evaluated, aged between 18 and 38 years old (25 ± 6.1), body weight between 55 and 106 kg (74.83 ± 15.1) and stature between 161 and 197 cm (174± 6.6). All subjects examined were physically active and has practiced ER at least three times a week. Before data collecting, all volunteers responded negatively to the items of the questionnaire PAR-Q, and signed an agreement term.

After collecting anthropometric data, the 1RM was realized in supine horizontal exercises, pull downs with bar, and front pull with high footprint supined, in order to determine the maximum load in a complete movement execution.

Objecting to reduce the error margin in the 1RM test, the following strategies were adopted:

1. Instructions were established before the standardized test, so that the evaluated were aware of the whole routine that involved the data collection;

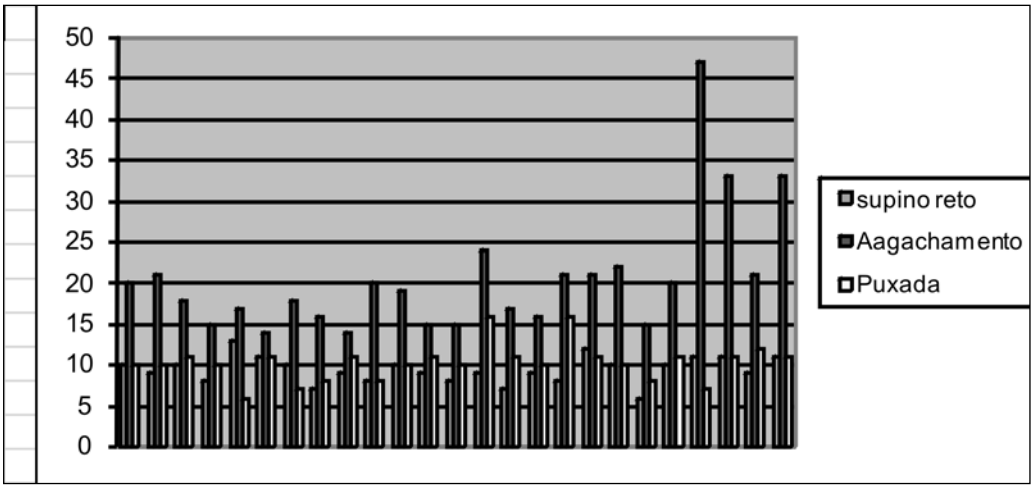

Figure 1 – Average individual repetition

2. The measured was instructed about the technical exercise execution, including doing it sometimes without load. The subject performed a number of repetitions needed to feel safe in the exercise execution;

3. The evaluator was alert to the position adopted by evaluated at the time of measurement. Small changes in the joints positioning involved in the movement could trigger other muscles, leading to wrong interpretations of the obtained scores;

4. The weights, the iron bar, used in the rings of the equipment were checked in previously calibrated balance;

5. The tests were conducted always at the same time for the same individual.

To establish that the load generated greater muscle strength and the maximum load in the 1RM test, FISIOMAC brand equipment was used, Nexus line (supine horizontal chair, high pulley with load in form of plates weighing 5 kg each, support pull downs cage type). The used bar weighted 12 kg with 180 cm length and rings that goes from one to 20 kg FUNDIMIC brand.

According Baechle and Earle (2000), the 1RM test must include the following steps:

1. Instruct the individual to warm up with lighter weights from five to 10 repetitions;

2. Provide a minute's interval;

3. Estimate a heating load that can let the individual conduct from three to five repetitions, and after that heat, add loads of 4-9 kg for upper members and 14-18 kg for the lower members;

4. After this procedure, give 2 two minute interval;

5. Estimate loads so that the individual complete from two to three repetitions, and after that procedure, add loads of 4-9 kg for upper members and 14-18 kg for the lower members;

6. Give from two to four minutes of interval;

7. Make an addition of loads: 4-9 kg for upper members and 14-18 kg for the lower members;

8. Constantly stimulate the individual;

9. If the individual was successful, provide from two to four minutes interval and back to step number 7;

10. If the individual fails, give two to four minutes interval and reduce the load subtracting from 2-4 kg or 2.5-5% for upper members and 7-9 kg or 5-10% for the lower members, and then back to step number 8;

11. Continue increasing or subtracting load until individual performs a movement without the full capacity to make the second repetition.

After 48 hours of obtaining the maximum loads on the 1RM test, individuals were subjected to a further session of evaluation. On this interval between the sessions, the practice of any exercise that could affect the reliability of the data wasn't permitted. On the second day, the evaluated should do the most possible repetitions with 80% of the cargo obtained in the 1RM test in the same sort of exercises that were made in the 1RM test. The interval between exercises, after obtaining the maximum number of repetitions, was 10 minutes to a complete restoration. If the evaluated felt not capable of doing them, more resting time was allowed.

Data analysis was performed in a descriptive way, in order to compare the number of repetitions performed to 80% of 1RM as recommended by literature as the ideal for gains in strength and muscle hypertrophy (BAECHLE; EARLE, 2000).

RESULTS

Table 1- Descriptive data of average number of repetitions

	Repetitions at 80% 1RM				
	N	Average	DP	Min.	Max.
Supine	25	09	01	06	13
Pull downs	25	20	07	13	47
Pull ups	25	10	02	06	16

Figure 1 shows the number of possible repetitions for each exercise for the same individual. The average obtained repetition was 9 (± 1) for the horizontal supine, 20 (± 7) for the pull down and 10 (± 2) to the front pull.

Table 1 shows the differences between the average number of repetitions for each possible exercise possible on the same individual.

DISCUSSION

It's known that even today professionals from both gym and researchers use percentage of 1RM to prescribe force training. They also predetermine the intensity of training through 60 to 80% 1RM for strength of hypertrophy (SIMAO, 2003). Performance studies for different intensities in percentage terms of 1RM can help clarify the behavior of different muscle groups and different conditioning levels, determining the optimal number of repetitions for each determined goal (Pereira, 2001).

According Baechle and Earle (2000), loads with 80% of 1RM were previously seen as a limitation related primarily to gains in strength and hypertrophy. However, on the data obtained in this study, was observed that the prescription of loads in pull downs exercises through the 1RM test, presents a high number of repetitions (20 ±} 7) with the predominance of the force resistance development over force to hypertrophy. In contrast, the average repetitions obtained in the horizontal supine (9 ±} 1) and the front supined pull (10 ±} 2) has stayed inside the stimulus zone set as great for gains in strength and hypertrophy (BAECHLE; EARLE, 2000).

Hoeger et al. (1990) found as a result a number of repetitions to 80% 1RM in men trained to the concentric failure, very similar to the ones verified in this study, such as: leg press 19 (±}9), supine 12 (±}3), back pull 12 (±}4) repetitions. The leg press exercises back pull differ from our specific exercises because we use the pull downs front pulls with supined hands, but due to a similarity of muscle groups and joints involved can show close results, including the standards diversions. In our research, we only studied trained men, but as Simon et al. (2002) the 1RM test in trained women also seems to be failed when prescribing the number of repetitions. In this study six exercises were observed, three for the lower members and three for the higher. The leg press and obtained approximately a 21 (±} 8) and 8 (±} 3) average repetition, which corroborated the data found by Hoeger et al. (1990).

Hoeger et al. (1987, 1990) and Simon et al. (2002) showed that the number of repetitions can vary significantly in different exercises for the same percentage of 1RM due to the joint characteristics involved, muscle groups size, and practitioner state of training. This indicates that the method used to determine loads given in a training program must overcome the percentage of 1RM, considering other variables involved. The results of this study tend to confirm these propositions once that were observed a high number of repetitions for pull downs, 80% of 1RM. Contrary to that, for the supine and pull up, our data seem to reproduce the results cited in the literature for the prescription of strength and hypertrophy (ACSM 2002).

Our research didn't promote speed control, but it seems that it was important at certain times. A high speed was printed right on the first repetitions and, with the introduction of fatigue, reduced considerably until exercise interruption. Apparently, in direct relation to the difficulty of enforcement due to peripheral fatigue, the speed of movement has become smaller, which, in a general way, has altered the time of tension. This can be seen by examining the differences found in the average number of repetitions and the standart diversion. As for the tension time, a speed movement previously given result in similar tension times for the same exercise. Several are the findings that indicate the speed of movement as a player in the variable gain in strength (WESTCOTT et al. , 2001) making it possible to be changed according to the situation. For example, low acceleration contractions should be implemented to increase strength production (KOMI, 2003). Increasing the strength in low speed is a property related to the speed muscles and tension, and may even bring the advantage of reducing the inhibition of the Golgi's Tendinous Body (EDSTROM; GRIMBY, 1986). On the other hand, a fast execution speed may result in different motor units recruitment adaptations, and, consequently, specific strength gain (BEHM; SALE, 1993; COELHO et al. , 2002). Speed variations can also cause specific stimulation for different contraction modes. The lack of specific information prevents precise recommendations about what is the best execution speed for neural or hypertrofic earnings (SIMAO et al. , 2001a; SIMAO et al. , 2001b). Because this study has a great internal validity and low external validity, it is suggested that the research should be conducted on isocinetic machines in order to control the angular velocity and thus compare with our results.

The relationship between the percentage of 1RM and the number of repetitions that can be performed varies with the amount of muscle mass necessary to execute the exercise. The exercises for larger muscle groups need very high percentage of 1RM to keep them in the maximum repetition muscle strength area (FLECK; KRAEMER, 1997). However, when discussing the issue of training volume for the same percentage of load, literature says that major muscle groups support a greater number of repetitions when compared to small groups (HOEGER et al. , 1990; SIMAO et al. , 2002). Our findings ratify the literature, because the average repetition was higher in the following sequence: pull downs, pulls and supine.

Another reason which leads us to question the results and data obtained by Simon et al. (2002) and Hoeger et al. (1987, 1990) is the reliability of the instruments used in the measurements, which are essential for a researcher to ensure the quality and

the meaning of data from a research, such as determining the impact of a training program (Pereira, 2001). The existence of few controlled studies on the reliability of the tests of strength / muscle endurance in to dynamic equipment suggests that quality is checked prior to the completion of work using these methods, in a way to guarantee the quality of results for the exercises and samples (Pereira, 2001). Rikli et al. (1996) recommended an adaptation period to the test, in addition to the completion of two tests, using the results of the second when dealing with an aging population. Therefore, based on the need to reduce the error of the measurements and on the few studies available, it should be recommended that the subjects participate in some sessions of adjustment before carrying out tests. However, there seems to be no indication of the appropriate number of sessions needed to achieve an appropriate adjustment (Pereira, 2001). Perhaps these inferences have interfered in our results, because the assessed were trained in exercises with weights, but did not have practice in 1RM tests.

Beyond that, several factors may have interfered in our results, among which we can highlight the execution speed, motion range, neural activation ability, postural stability, coordination learning, modulating afferent, antagonist activity reduction, motivation, and type of muscle fibers involved (ZHOU, 2000).

CONCLUSION

The prediction of 1RM from the test itself has a small reliability, validity and reliability power, particularly on untrained individuals. The training prescription based on a number of repetitions, assuming that this number represents a percentage of 1RM, was not supported by the results of this research making it close to other studies proposed HOEGER et al. , 1987, 1990; (Pereira et al. , 2001; SIMAO et al. , 2002). The difference between exercises indicates that the same number of repetitions may represent different intensities for different muscle groups.

Therefore, we can say that there are many variables that influence the implementation of the 1RM test, as practicality and applicability of the measurements, and that people react differently to the same training program. This way, the prediction may not be widespread, based on the percentage of load carried, may be the best prediction of loads by submaximum tests.

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