Influence of different protocols of warm-up for the capacity of developing maximum load on the 1RM test

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Abstract: Theoretically the need of the accomplishment of a heating exists before the resisted exercises (ER), however little it is known about their different protocols and his/her influence before the accomplishment of ER. The objective of this study was to verify the influence of the specific heating (Ae), of flexibility heating (Af) and aerobic heating (Ar) before the development of maximum loads in 15 individuals (age 22 ± 3) seemingly healthy. The test of a maximum repetition was accomplished (1RM) in the leg-press exercise and the answer of the different types of heating was compared through ANOVA with verification post-hoc of Tukey (p <0,05). The tests allowed to order the results of the maximum load in the following way: Ae = 134,5 ± 26,6; Air = 131,3 ± 27,4; Af = 129,9 ± 28,3. In conclusion, in 60% of the individuals, Ae was the protocol that made possible the largest load mobilization; even with such predominance the comparison was not significant when compared to the three variables in ANOVA. In 20% the Air was the protocol of largest efficiency and Af was responsible for the best acting in only 6,6% of the appraised ones. He/she is still due to stand out, that the not load differentiation happened in 13,4% of the appraised ones, these tends at least two answers of identical in value.

Keywords - Heating. Maximum load. 1RM Test. Resistance training. Strength Training.

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RESUMEN

Influencia de los diferentes protocolos de calentamiento en la capacidad de desarrollar carga máxima en el test de 1RM

La necesidad de la realización de una calefacción ocurre teóricamente antes de los ejercicios resistidos (ER), no obstante poco él se sabe sobre sus diversos protocolos y su influencia antes de la realización de ER. El objetivo de este estudio fue para verificar la influencia de la calefacción específica (Ae), de la calefacción de la flexibilidad (Af) y de la calefacción aeróbica (Ar) antes del desarrollo de cargas máximas en 15 individuos (± de la edad 22.3) aparentemente sanos. La prueba de una repetición máxima fue lograda (el 1RM) en leg-press ejercicio y la respuesta de los diversos tipos de calefacción fue comparada con ANOVA y la verificación post-hoc de Tukey (p<0.05). Las pruebas que permitimos para pedir los resultados de la carga máxima de la manera siguiente: Ae = 134.5 ± 26.6; Ar = 131.3 ± 27.4; Af = 129.9 ± 28.3. En conclusión, en el 60% de los individuos, Ae era el protocolo que hizo posible la movilización más grande de la carga; incluso con tal predominio la comparación no era significativa cuando estaba comparada a las tres variables en ANOVA. En el 20% el aire era el protocolo de una eficacia más grande y el Af era responsable de mejor actuar del solamente 6.6% valorados. El/Ella todavía debe estar parado hacia fuera, eso que no la diferenciación de la carga sucedió en el 13.4% valoradas, estos tienden por lo menos a dos respuestas de idéntico en valor.

Palabras clave – Calentamiento. Carga máxima. Prueba de el 1RM. Ejercicios resistidos, Entrenamiento de la Fuerza.

INTRODUCTION

There is a myriad of myths which concern different warm-up strategies for resisted exercises resisted exercises (RE). Normally, different volumes and intensities are utilized in strength training aiming to increase it, as well as causing alterations in the composition corporal, in the motor performance and muscular hypertrophy muscular (Simão, 2003). This training seems to contribute for the gradual evolution of users physical capacities for RE (SIMÃO et al., 2001). In order to optimize this training, several warm-up techniques which, to some extent, are carried out empirically, for few are investigations relating to the types of exercises which should be incorporated before a training sessions, or even before carrying out tests which estimate maximum load (Simão et al., 2003).

Usually, warm-up types are applied aiming to allow the more active organism working as a whole, besides preventing injuries, even being questionable evidences, depending on several intervening variables (Simão et al., 2003). It is observed that, at fitness centers, it is generally used three types of warm-up as follows: specific warm-up using movements which will be subsequently applied; flexibility exercises with different methodological variables, which seem to be important in the pre-exercise promoting some increase, however, some studies question such assertion (Smith, 1994; Viveiros & Simão, 2001), and aerobic exercises, which tend to increase body temperature, allowing greater velocity of chemical reactions in the human being body (Robergs & Roberts, 2002).

The exam of evolution of load can be estimated by means of several tests. And the test of maximum repetition (1RM) is widely used, as it makes use of maximum weight lifting possible in only one complete, so as to estimate in the various muscular groupings (Baechle, Earle, 2001).

From these considerations, it is observed that the number of researches related to maximum strength with warm-up through flexibility and aerobic warm-up is restricted, what raises questions of how individuals should be prepared for a training session and even for the test accomplishment, for instance, the 1RM test. In this manner, the aim of this study was to verify the maximum load for the 1RM test after the application of specific warm-up, aerobic warm-up and warm-up carried out with flexibility exercises.

MATERIALS AND METHODS

The sample consisted of 15 individuals of both sexes (12 women and 3 men), aged, on average, 22.2 years (± 3.5), stature 163.4 cm (± 6.70), and mean weight 56.1 (± 9.81). The individuals participated in the study freely and voluntarily and answered the items of PAR-Q questionnaire negatively, and signed a document of consentment, according to the Regulation no. 196/96 of the National Health Council of Brazil. For the evaluation of 1RM, it was used movement in the leg-press exercise by means of Life Fitness equipment. Aiming to reduce the margin of error, the following strategies were adopted:

1) Standardized instructions were offered to the respondents before the test, so that individuals were aware of the whole routine concerned for the data collection;

2) The individuals were oriented about the technique for the exercise accomplishment;
3) The evaluator was attentive to the chosen position at the moment of the measure. Small variations in the positioning of the involved articulations were able to use other groups of muscles, distancing the specific focus of the survey, allowing erroneous interpretations for the obtained scores;

4) It was established a fixed position for the feet, avoiding then differentiation in the angulation of ankle, for the three tests;

5) For greater accuracy, individuals were not aware of endurance load during the procedure.

For a better movement description, the following steps were taken: initial position and concentric phase.

**Initial position**. In decubitus dorsal, trunk and articulations acetabulum. Femural discreetly flexed, extended knees and ankles with light plantar flexion. The feet were on a support platform, shoulders in horizontal flexion and flexed ankles at sufficient angulation, letting the individuals hold onto handgrip specific for the equipment.

**Concentric phase**. All the extension of inferior limbs were carried out until the initial position.

The 1RM test was conducted two minutes after warm-up and the initial weight was proposed by a previously trained evaluator. During the 1RM trials, the interval was established between from 2 to 5 minutes. The test was interrupted at the moment in which the individuals were not able to carry out a complete movement or when there were voluntary concentric failures. Consequently, the obtained maximum load was validated in the last complete accomplishment.

Three types of warm-ups were proposed, as they are widely used at fitness centers: aerobic warm-up (Aw), specific warm-up (Sw) e warm-up de flexibilidad (Fw).

The Aw was carried out on Reebok bicycle, especially used for indoor cycling. After attaining the ideal zone of training (target zone), the individuals remained in this step during 10 minutes. It was used the formula FCT = [(FCM . FCR) x %Tint] + FCR (Karvonen, 1957), with intensity between 60% to 80% of HCmax. Each individual’s HCmax was based upon Karvonen’s formula (1957). It is still noteworthy that a bicycle and Polar MZ1 frequencymeter, were used in the test, the same for all participants. The saddle height was defined according to the association of lower anterosuperior iliac spine and the distance from the saddle to the handlebar adjusted to the base in the trunk flexion at approximately 30° degrees.

The Sw comprised of 20 repetitions, with a comfortable load and amplitudes similar to the ones used in the test RE. It is worth observing that Sw test was carried out in the same equipment for 1RM test.

The Fw was carried out by means of six stretching exercises of the flexibility test (ARAUJO, 1987). In every exercise, the individuals would stretch up to the ache subjective threshold, remaining in the same position for 10 seconds. A description of exercises and sequence of accomplishments follows below:

1. Movement III (Knee flexion)
   Position: laid down in ventral decubitus, with extended arms, flexed knee in front of the body, in which the evaluator will try to bend it gradually to the ache threshold.

2. Movement VI (Hip extension)
   Position: laid down in ventral decubitus, with extended arms, flexed knee in front of the body, in which the researcher will try to bend the hip gradually to the ache threshold.

3. Movement V (Hip flexion)
   Position: laid down in dorsal decubitus, with extended arms, flexed knee over the head, one of the legs extended while the other one is flexed, trying to put the thigh on the thorax.

4. Movement I (Dorsal flexion)
   Position: seated, with extended knees. It is conducted the dorsal flexion unilaterally, in which the researcher will try to flex gradually to the ache threshold.

5. Movement IX (Trunk flexion)
   Position: seated, with extended knees, ankles in anatomic position, the hip will be flexed until the ache threshold.

6. Movement VII (Hip adduction)
   Position: seated with trunk and hip well-leant-against at a wall, while one of the legs is extended and the other is semi-flexed (approximately 90°), carrying out a movement of hip adduction.

The individuals were subjected to a three-day battery of tests, with a 48-hour interval for recovery. In every day, it was conducted a type of warm-up, highlighting that the individuals were placed in three groups with different sequence, so that it was avoided any act of contamination in the sample (cf. Table 1).

An ANOVA of entry was used with a post-hoc examination of Tukey, adopting statistical significance p<0.05. The data were treated using a StatisticaR 5.5 software (Statsoft, USA).

**RESULTS**

It was not verified significant difference, irrespective of the type of warm-up used in the capacity of developing maximum load, as can be observed in the load means: Sw = 134.5 ± 26.6; Aw = 131.3 ± 27.4; Fw = 129.9 ± 28.3. However, in 60% of the individuals, the Sw was the protocol which allowed a greater load change; even with such predominance, the comparasion was not

<table>
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<tr>
<th>GROUP 1</th>
<th>DAY1</th>
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<tr>
<td>Aw</td>
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<td>GROUP 2</td>
<td>Fw</td>
<td>Aw</td>
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<td>GROUP 3</td>
<td>Sw</td>
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**Table 1 - Different warm-up sequencies**
significant when compared the three variables in ANOVA. In 20% of individuals, the Aw protocol was the most efficient, and the Fw protocol was responsible for a better performance in only 6.6% of the individuals. It is also important to highlight that the non-differentiation of load occurred in 13.4% of the individuals. And thus, at least, there were two identical responses in number.

DISCUSSION

The proposal of the study is to carry out an analysis on a known theme, however there is little scientific evidence. Three warm-up types were used of the accomplishment of 1RM test (aerobic warm-up, specific warm-up and stretchings), questioning in which of these there might have better results, accepting that previous warm-up allows a faster adaptation to stress (Robergs, Roberts, 2002). Our study sought to verify the main types of active warm-ups in the literature and which are widely used at fitness centers and physical education centers. The results, despite being non-significant, seem to corroborate with Robergs, Roberts (2002). This fact demonstrates that general warm-ups, such stretchings and exercises, which involve the body in fullness, may provide some benefits, but they are not effective in the RE as for specific warm-ups (Simão et al., 2003), as in our results, 60% of assessed individuals obtained greater results with this type of warm-up.

The specific warm-up increases the coordination capacity, triggers a blood redistribution and increase of muscular irrigation, for it guarantees oxygen supply, favoring the muscular metabolism (Sweet, 2001). In a study proposed by SIMAON et al. (2003), two forms of warm-up in the 1RM test were compared, in the exercise horizontal supine. It was utilized the specific warm-up and the method of proprioceptive neuromuscular facilitation (PNF) in the shoulder-humerus articulation. Generally speaking, the obtained results indicated that there is no significant influence of the type of warm-up in the maximum loads obtained. In conclusion to this study, SIMAON et al. (2003) agree on proposing that when a previous warm-up possess a low volume seem that there is no significant differentiation between the types of warm-up in the tests and maximum loads. The obtained results in the current study seem to corroborate with this assertion, as our warm-up by means of stretching possesses a low volume and intensity, as well the specific warm-up itself. Also the variability of some physiological and methodological aspects may have favored the non-significance of the data collected, within which we can highlight the velocity of accomplishment, capacity of neural activation, posture stabilization, afferent modulation, activity reduction of the antagonist, motivation, muscular fiber type involved (Simão et al., 2001; Lynch et al., 1999; Zhou, 2000). Nonetheless, the studies are scarce and methodologically limited, which related specific warm-up and RE.

In relation to previous flexibility exercises to RE, one can mention Tricoli & Paulo's study (2002), in which it was investigated the acute effect of static stretching exercises in the performance of maximum strength. In this experiment, 11 male individuals were subjected to a 1RM test under two conditions, with and without stretching exercise. The text consisted of a complete series of exercises of knee extension and flexion using the leg-press equipment. The group who carried out stretching exercises obtained significantly lower (p<0.05) for the 1RM test than for the group who carried out exercises without stretching, i.e., the static stretching caused some performance drop of maximum strength. It was not possible to statistically confirm these results in our study, however only 6.6% of the evaluated individuals obtained better results when carried out stretching before the RE. It is important to highlight that there is a great difference in warm-up volume implemented in Tricoli & Paulo's study (2002). The total duration of stretching was 20 minutes, whereas in our study six adapted exercises of flexibility test were applied (Araujo, 1987). For this, the individuals would stretch until the ache threshold, remaining in the same position for 10 seconds, having a total volume of six proposed exercises. Similar to our study, Simão et al. (2003) applied a low volume of warm-up in the FNP as three static supports of six seconds each. They also obtained significant differences in maximum loads, when compared to specific warm-up.

According Fowles et al. (2001), it was observed some reduction in the capacity to develop maximum voluntary strength after approximately a 33-minute stretching, and it was still verified that this effect perdures for 1 hour. It is interesting to observe in this study that stretching exercises as warm-up may interfere in the results of maximum loads. A hypothesis which should be taken into consideration in it and in Simao fs et al. (2003) are the possible plastic alterations did not occur, both in the elastic components of soft tissues and muscular fascia. This induces to more permanent alterations in their lengths. On the other hand, maybe these modifications allow that the sarcomere reaches its optimum length, allowing to develop maximum tension. In the same train of thought, another important aspect is that stretching exercises are capable of changing viscoelastic properties of the muscle-tendon unit, shortening the passive tension and unit rigidity (Kubo et al., 2001; Viveiros, Simão, 2001). According WILSON et al.s study (1994), a more malleable muscle-tendon system might undergo a rapid period of length diminishing, with the absence of overload, until the elastic components of system were adjusted enough for the transmission of strength, putting a contractile component in a less variable position in terms of strength production in the curves of strength-length and strength-velocity. Finally, the decrease in the activation of motor units can be responsible for the drop in the maximum strength capacity after stretching exercises (Fowles et
was no significant reduction in the performance for the 1RM test, press exercise, with different types of applied warm-ups. As there were able to perform greater workload in the 1RM test after the aerobic warm-up. We also observed that 20% of the individuals were able to perform greater workload in the 1RM test after the aerobic warm-up.

**CONCLUSION**

As a conclusion, based upon our results, there we no statistically significant differences for performance in the 1RM test for the leg-press exercise, with different types of applied warm-ups. As there was no significant reduction in the performance for the 1RM test, it is suggested that the test be carried out according to the aim, methods and individuals adaptation. Even so, our groups allows inferring that, upon carrying out a test of maximum workload, the best way to warming up is probably the specific warm-up, once 60% of individuals obtained better performance using the maximum workload. It is also important to add that in the original proposal, in the 1RM test, proposed by Berger (1963) and adapted by Baechle & Earle (2000), the previous warm-up to the maximum workload test is the specific warm-up, without reference to other forms of warm-up.

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