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Original

The effect of static passive stretching on a bench press, in one maximum repetition test performance, is independent of the level of flexibility

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ABSTRACT

Objective: The aim of this study was to investigate at different levels of flexibility the influence of static passive stretching on bench press one maximum repetition test.

Method: Eleven men (26.09 ± 4.2 years, 81.69 ± 13.94 kg, 1.70 ± 0.05 m) were evaluated in flexibility using Flexitest and goniometry test classified according to their flexibility levels (small and upper middle levels) and joint range of motion (deficit levels), as well as performed the one maximum repetition test in the following experimental protocols: without previous stretching and with stretching 10, 20 and 60 seconds before the test.

Results: The results indicate that 64% demonstrated a low level of flexibility and 36% with a higher average level. In both, there was no significant difference in load: A0s (72.43 ± 21.10Kg vs 66.25 ± 19.02Kg); A10s (72.29 ± 20.25Kg vs 67.25 ± 20.35Kg); A20s (73.43 ± 20.78Kg vs 67.75 ± 18.23Kg) and A60s (73.29 ± 19.35Kg vs 68 ± 19.25Kg). ANOVA for repeated measures showed that no significantly different the maximum strength between groups the protocols of static passive stretching tested.

Conclusion: It was concluded that passive static stretching times lower than 60 seconds, in accordance with the current recommendations, do not interfere in the neuromuscular performance of men in the one maximum repetition test, in the bench press independent of their level of flexibility.

Keywords: Muscle Stretching Exercises; Resistance Training; Range of Motion; Articular.

El efecto del estiramiento pasivo estático en la prensa de banco, en el rendimiento del test de una repetición máxima, es independiente del nivel de flexibilidad

RESUMEN

Objetivo: El objetivo de este estudio fue investigar, a diferentes niveles de flexibilidad, la influencia del estiramiento pasivo estático en el test de una repetición máxima de la prensa de banca.

Método: la flexibilidad de once hombres (26.09 ± 4.2 años, 81.69 ± 13.94 kg, 1.70 ± 0.05 m) fue evaluada usando la prueba de Flexitest y goniometría y clasificada de acuerdo a sus niveles de flexibilidad (niveles bajo y medio superior) y rango de movimiento articular (niveles de déficit), además de realizar la prueba una repetición máxima con los siguientes protocolos experimentales: sin estiramiento previo y con estiramiento 10, 20 y 60 segundos antes de la prueba.

Resultados: Los resultados indican que el 64% demostrado un bajo nivel de flexibilidad y el 36% con un nivel promedio más alto. En ambos, no hubo diferencia significativa en la carga: A0s (72.43 ± 21.10Kg vs 66.25 ± 19.02Kg); A10s (72.29 ± 20.25Kg vs 67.25 ± 20.35Kg); A20s (73.43 ± 20.78Kg vs 67.75 ± 18.23Kg) y A60s (73.29 ± 19.35Kg vs 68 ± 19.25Kg). El test ANOVA, para medidas repetidas, no mostró diferencias significativas en la fuerza máxima entre los grupos, con los diferentes protocolos de estiramiento pasivo estático testados.

Conclusión: se concluyó que los tiempos de estiramiento estático pasivo inferiores a 60 segundos, de acuerdo con las recomendaciones actuales, no interfieren en el rendimiento neuromuscular de la prensa de banca de los hombres, en la prueba de una repetición máxima, independientemente de su nivel de flexibilidad.

Palabras clave: Ejercicios de Estiramiento Muscular; Entrenamiento Fuerza; Rango de Movimiento; Articular.

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O efeito do alongamento estático passivo, no supino no teste de uma repetição máxima, é independente do nível de flexibilidade

RESUMO

Objetivo: O objetivo deste estudo foi investigar em diferentes níveis de flexibilidade a influência do alongamento estático passivo no supino no teste de uma repetição máxima.

Método: Onze homens (26.09 ± 4.2 anos, 81.69 ± 13.94 kg, 1.70 ± 0.05 m) foram avaliados quanto à flexibilidade usando o Flexiteste e a goniometria classificados de acordo com seus níveis de flexibilidade (níveis médio e baixo) e amplitude de movimento articular (níveis de déficit), bem como realizou o teste de uma repetição máxima nos seguintes protocolos experimentais: sem alongamento prévio e com alongamento 10, 20 e 60 segundos antes do teste.

Resultados: Os resultados indicam que 64% demonstraram um baixo nível de flexibilidade e 36% com um nível médio mais alto. Em ambos, não houve diferença significativa na carga: A0s (72.43 ± 21.10 Kg vs 66.25 ± 19.02 Kg); A10s (72.29 ± 20.25 kg vs 67.25 ± 20.35 kg); A20s (73.43 ± 20.78 kg vs 67.75 ± 18.23 kg) e A60s (73.29 ± 19.35 kg vs 68 ± 19.25 kg). A ANOVA para medidas repetidas mostrou que não houve diferença significativa entre a força máxima entre os grupos e os protocolos de alongamento estático passivo testados.

Conclusão: Concluiu-se que tempos de alongamento estático passivo inferiores a 60 segundos, de acordo com as recomendações atuais, não interferem no desempenho neuromuscular dos homens no teste de uma repetição máxima, no supino independente do seu nível de flexibilidade.

Palavras-chave: Exercícios de Alongamento Muscular; Treinamento de Resistência; Amplitude de Movimento; Articular.

Introduction

Different heating techniques are used in the resistance training routine as a preparatory procedure to potentiate the development of maximum loads,¹ among them: specific heating with movements similar to the main; Muscular stretching exercises and aerobic exercise.²

Muscle stretching exercises are often used in the warm-up routine in a resistance training session to increase amplitude and improve athletic performance.³ Although stretching be frequently used and the focus of numerous scientific investigations^{4,5} there is still no consensus on its potential interference in the generation of force, once the possibilities of duration and intensity of the applied stimuli present different combinations.⁶

In general, in the scientific literature, it is observed that investigations with passive stretches with durations longer than 30 seconds interfere with muscle properties, reducing strength generation, while those below this time seem to exhibit opposite behavior.⁷ Some authors observed a decrease in strength when muscle stretching was performed before resistance exercise, as decreases in muscle strength and power were observed. Static muscle stretches lasting up to 60 seconds can be used in pre-exercise routines without risk of significant reductions in performance of force-dependent tasks.⁸

Therefore, Souza and Penoni,⁹ already stated that the decrease in strength and power induced by muscle stretching is attributed to the deterioration of the neurological response, as well as changes in the muscle-tendon unit (UMT). The authors also state that loose elastic components in series and in parallel can cause an electromechanical delay, delaying the period between the cross bridges in the myofilament, in addition to the tension exerted by UMT in the skeletal system.

However, in these investigations the level of flexibility or joint range of motion was not considered for the effect that stretching has on strength. In this regard, is important to clarify the use of this technique during a resistance training session, enabling professionals involved in the prescription of this type of training to be more critical in the preparation of the exercises training programs.

The aim of this study was to investigate at different levels of flexibility the influence of static passive stretching on bench press on test of a 1 maximum repetition (1-RM).

Method

Eleven sport sciences male students healthy (age 26.09 ± 4.2 years, body mass 81.69 ± 13.94 kg, height 1.70 ± 0.05 m) were recruited for this study for convenience. They regularly practiced recreational resistance training for the past six months, at least three times a week, lasting 60 minutes per session; previous

bench press experience. For this, these individuals declared that they did not present musculoskeletal injuries that could affect the performance of the test, in addition to not using anabolic steroid medications or substances that could interfere with the generation of muscle strength at the time of the research. The study was approved by the local ethics committee (2.028.925) of the State University of Ceará.

First, an anamnesis was applied to collect data related to the participants and anthropometric evaluation with measures of height, weight,¹⁰ for characterization of samples and classification of shoulder flexibility levels through the application of Goniometry¹¹ (medial and lateral rotation) through the goniometer pendular (Sanny®) and Flexitest¹² (shoulder extension and abduction; posterior shoulder extension; posterior adduction from the 180° abduction in the shoulder). The subjects performed two familiarization sessions on the bench press to ensure an adequate technique during the experimental protocols.

After, the participants performed the 1-RM tests following the recommendations of the Protocol described by Heyward,¹³ to verify the maximum strength capacity achieved in the horizontal bench press exercise in the guided machine (Jones model Freedom Strength Training System®). The execution begins with the participant in dorsal decubitus, with the hip joints and knees flexed, parallel lower limbs and feet supported. The positioning of the hands in the bar was standardized according to the performance of the eccentric phase, angle of 90° formed between the arm and forearm, with arm parallel to the ground. The grip was performed with the thumb underneath the bar. In the eccentric phase, the initial position was from extended elbows and horizontal flexion of shoulders to form an angle of 90° between the arm and forearm with flexion of the elbows. To finalize the movement, the horizontal flexion of the shoulders and the complete extension of the elbows were considered.¹⁴

The intervention conditions were without stretching (A0) and with stretching, in the period of 10 seconds (A10), 20 seconds (A20) and 60 seconds (A60) before the 1-RM test. The passive and static stretching was performed with horizontal shoulder abduction until the maximum articular amplitude of the movement limited by the pain threshold, maintaining this position during the determined times.

To minimize interferences, each participant was randomly submitted to tests on the intervention days, which an interval of 72 hours. During the test stages, all study participants were instructed not to perform any type of exercise involving the joints and musculature required in the tests.

Descriptive data are presented as means, standard deviation and relative frequency. The normal distribution of the data was confirmed by the Shapiro-Wilk test ($p < 0.05$). After, to verify the difference between the loads found in the force protocols, were used two-way repeated measures ANOVA confirmed by the

Bonferroni test. For data analysis the program used was the Statistical Package for the Social Sciences (SPSS) version 17.0.

Results

The mean and standard deviation values found in Flexiteste and Goniometry were similar, considering their evaluation components, as shown in [Table 1](#).

Table 1. Mean values, standard deviations, minimum and maximum for the variables related to the flexibility of the evaluated.

Flexiteste	Mean ± SD	Minimum	Maximum
Posterior Shoulder Abduction	1.36 ± 0.81	0	3
Shoulder Horizontal Abduction	1.45 ± 0.93	0	3
Shoulder extension	1.82 ± 0.87	1	3
Flexiindex (summation)	4.64 ± 2.34	2	8
Goniometry (Glenohumeral Mobility)	Mean ± SD	Minimum	Maximum
Right Medial rotation (internal)	59.82° ± 17.07	20°	85°
Left Medial rotation (internal)	62.45° ± 18.45	20°	95°
Right Lateral rotation (external)	73.18° ± 22.83	30°	100°
Left Lateral rotation (external)	72.73° ± 22.18	30°	90°

Source: Own authorship. SD: standard deviations.

The results of maximum muscle strength achieved in the 1-RM tests was not influenced by the stretching times studied, that is, the loads (kg) recorded in the 1-RM tests of groups A0s, A10s, A20s and A60s remained unchanged independent of the individual's level of flexibility, as shown in [Table 2](#).

Discussion

Based on these data, the main conclusion of our study is that performing a passive stretching of 60 seconds or less, with horizontal shoulder abduction movement in the warm-up before the horizontal bench press, does not interfere with the maximum dynamic strength performance.

In this study, the low stretching volumes tested did not significantly interfere with the strength performance in the horizontal bench press in recreationally trained youngsters. Even in individuals with low flexibility, passive acute stretching did not change strength levels.

These results reinforce the body of evidence that reinforce a dose response effect between the amount of stretching employed and its effects on strength,¹⁵ in which static stretching routines with reduced volumes (e.g., 2x30s; 3x15s; 6x10s) has been shown to have no negative effect on the strength of the horizontal bench press and may sharply increase the range of motion of the shoulder girdle.¹⁶⁻¹⁸ However, routines with high stretching volume (e.g., 16min) have a greater deleterious effect on the performance of the dynamic strength of upper members of young men.¹² This tendency is also observed in the lower members, with

the high intensity and short duration static stretching protocol decreasing the peak strength.²⁰

Although the stretching volume has been shown to interfere differently in performance, controversies are pointed out in the literature about the effect of static stretching on strength performance. Simic, Sarabon and Markovic,²¹ in a meta-analysis review, showed a likely negative effect of static stretching lasting 46 to 90sec per muscle group on maximal strength (about 5.6%), with greater impact on isometric strength than in the dynamics.

Neural and structural factors related to the involved muscle group, high volume and strong intensity of stretching exercises have been discussed by De Souza and Penoni,⁹ Ebadi and Çetin²² to understand the possible causes of loss of strength after stretching. It is appointed that neural mechanisms (central fatigue) would be involved in the reduction of muscle strength when it is preceded by long-lasting static stretching. When there is a decrease in performance in routines with shorter duration, this seems to be related to structural factors, such as the reduction in the passive stiffness of the muscle-tendon unit.^{9,24}

The characteristics of the stretching exercise used in this study with low volume (only one series; times less than or equal to 60sec) and moderate intensity (pain threshold) may explain the non-influence of previous stretching on strength. It can be assumed that even in individuals with less muscular flexibility and probably greater passive stiffness, the volumes used did not cause a reduction in the stiffness of the muscle-tendon unit and, consequently, of its specific tension, not compromising the capacity to generate force.

The absence of changes in performance in the studied times (A0s, A10s, A20s, A60s) can also be attributed to the amount of muscles involved in stretching and strength exercises, as in the study by Gonçalves et al.²⁵ and Lopes et al.²⁶ when performing shoulder abduction movement in the extensive static stretching protocol, they also did not identify interference in the performance of the repetitions and loads of presses in the bench press. The same authors report that possible changes in synergic muscles potentiate the mechanical action of the triceps brachii, compensating for a possible strength deficit caused by the reduction of motor unit recruitment in the horizontal shoulder abductors.

It is highlighted that there are numerous possibilities of prescribing volume and intensity of stretching exercises in the heating routines related to muscular strength performance. Further investigations on the subject with stretching protocols involving different muscle groups and different types of stretching (dynamic, active, proprioceptive neuromuscular facilitation) are necessary and relevant to the scientific field as they may broaden and clarify the influence of stretching on muscle strength performance in low volumes contributing to planning and prescription of exercises.

Table 2. Load values (kg) after each stretching period (0sec, 10sec, 20sec and 60sec), sorted by flexibility level in both tests used.

Flexiteste	n (%)	Load (Kg)			
		A0s	A10s	A20s	A60s
Small level	7 (64%)	72.43 ± 21.10	72.29 ± 20.25	73.43 ± 20.78	73.29 ± 19.35
Upper Middle Level	4 (36%)	66.25 ± 19.02	67.25 ± 20.35	67.75 ± 18.23	68 ± 19.25
Goniometry (Glenohumeral Mobility)	n (%)	A0s	A10s	A20s	A60s
Right Medial rotation (internal)					
Deficit > 10%	10 (91%)	71.20 ± 20.39	71.30 ± 20.24	72.30 ± 19.92	72.30 ± 19.24
Deficit < 10%	1 (9%)	60 ± 0	62 ± 0	62 ± 0	62 ± 0
Left Medial rotation (internal)					
Deficit > 10%	10 (91%)	69.10 ± 20.35	69.50 ± 20.18	70.50 ± 19.96	70.50 ± 19.28
Deficit < 10%	1 (9%)	81 ± 0	80 ± 0	80 ± 0	80 ± 0
Right Lateral rotation (external)					
Deficit > 10%	6 (55%)	75.92 ± 19.20	76.50 ± 18.20	77.67 ± 18.57	76.33 ± 17.77
Deficit < 10%	5 (45%)	63.30 ± 19.85	63.20 ± 20.18	63.80 ± 18.85	65.40 ± 19.51
Left Lateral rotation (external)					
Deficit > 10%	5 (45%)	69.60 ± 25.14	70 ± 24.29	71.60 ± 25.12	71 ± 23.19
Deficit < 10%	6 (55%)	70.67 ± 16.27	70.83 ± 16.76	71.17 ± 15.13	71.67 ± 15.97

A0s: no stretching period; A10s: after 10 seconds of stretching; A20s: after 20 seconds of stretching; A60s: after 60 seconds of stretching. Source: Own authorship.

The study has some limitations that must be considered. The sample this study was small and include only young men, the results being specific to this public. For greater reliability of the results, the sample size and power must be considered. In addition, the individual's difficulty in remaining in the research stands out, because, although the size and power of the sample can be calculated, the individuals initially recruited were unable to complete the stages of the study, especially the four experimental strength conditions and stretching. Another limitation was not to measure the range of motion of the participants after applying static stretching, which restricts the verification of the stretching effect.

The practical implications of this study indicate that the maximum performance of dynamic strength in the bench press of the recreational practitioner will not be interfered with when performing passive static stretching for up to 60 seconds, even if his levels of shoulder flexibility are not optimal.

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