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ORGINAL ARTICLE

The Effect of Duration and Type of Rest Interval between Sets with Low and Moderate Intensities on the Volume of Bench Press in Untrained Men

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Abstract

According to the few studies in active rest interval between the resistance exercises sets, it can't be explicitly commented about the effect of it on performance in consecutive sets. Purpose**:** The purpose of the current study was to compare different active and passive rest interval durations (3 and 4 minutes) on the numbers of repetition of bench press with 50 and 75 percent of 1RM in untrained men during a workout. 15 college-aged men (age: 21.7±2.17 years, height: 174±5.98 cm, weight: 71.36±36 kg, body mass index: 23.44±3.19 Kg/m^2) were studied during nine weeks. During each testing session, the bench press was performed with a 3 or 4- minute rest interval between sets. The exercises volume was defined as the total number of repetitions completed over 3-sets in each session; and active rest was included dynamic stretching exercises. Results**:** In two intensities of 50 and 75% 1RM and in two times of 3 and 4 minutes, active rest between bench press sets in comparison with passive rest increased significantly exercise volume ($P\leq0/05$). Also, no significant difference was observed in active rest between 3 and 4 minutes, but there was a significant difference in passive rest ($P\leq0/05$). Conclusion: The findings of the current study indicate that using active rest and dynamic stretching exercises between bench press sets in comparison with passive rest will increase more repetitions in an exercise session.

Key Words: Active and passive rest interval, resistance exercise, bench press, training volume, untrained men

Introduction

The increase of overall body power and strength constitutes main part of exercise programs that are designed for improving physical fitness and performance. Using resistance exercises is the best way to achieve these goals (Kraemer et al., 2002). Resistance exercises, widely recommended by society's Public health organizations such as American College of Sports Medicine and American Heart Association to most people including healthy adolescents, youth, adults and aged people (Celes et al., 2009). Designing an appropriate program is the most important factor for achieving resistance exercise goals in each age and levels of physical fitness (Kraemer et al., 2004). In order to maintain participants' health and more efficient exercises, it is necessary to consider effective factor in designing exercises such as the intensity and volume of exercise, number of sessions, number of sets and repetitions in each session, speed

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of repetitions, resting time and type between sets and exercise sets and sessions (De Salles et al., 2009). Some studies have shown performing several consecutive sets significantly increases the exercise efficiency rather than an single set (Rhea et al., 2002; Richmond & Godard., 2004). On the other hand, rest intervals between sets is a determinant factor in effectiveness of resistance exercises which must be controlled by researchers, coaches and athletes. Sufficient rest between exercise sets is critical because it delays the side effects of fatigue, accelerates recovery process and offers to do more works during exercise session [Rahimi., 2005; Richmond, S.R., & Godard]. Traditionally the American College of Sports Medicine (ACSM) recommended a training program with rest intervals of 1 to 2 minutes between multiple sets for beginners and intermediate individuals in the resistance exercise (ACSM., 2009). However, there is no consensus in the literature that 1 min or 2 min rest intervals is adequate for maintaining volume during multiple sets in individuals with little or no experience with resistance exercise. In this line, some studies that examine untrained individuals and those with low physical fitness showed that these amount of the rest between sets are not enough (Celes et al., 2005; Pincivero et al., 1998). Pincivero et al. demonstrated that a 160-second rest interval was superior to a 40-second rest interval for producing isokinetic strength increases in the quadriceps and hamstrings (Pincivero et al.., 1997). Likewise, Richmond & Godard demonstrated that a 3-minute rest interval was superior to 90-second and 30-second rest intervals for producing strength increases in the free-weight squat exercise (Richmond & Godard., 2004). They concluded that longer rest intervals allowed for the maintenance of training intensity, which led to greater strength increases. Some studies suggested rest intervals shouldn't be less than 3 minutes when the exercise goal is performing certain number of repetitions during consecutive sets (De Salles et al., 2009; Willardson & Burkett., 2006). Also, 90 to 95 percent of the consumed ATP[1] during intensive and tedious activities is reproduced first three minutes after activity (Young et al., 2004). Using active recovery and stretching exercises between exercise sets is one of the useful methods to overcome exercise-related fatigue. But it has not been studied so far. Most researchers just examined the effect of rest interval on the performance. In the few studies administered for this purpose, the effect of massage (Caruso & Coday., 2008) and pedaling with low intensity (Corder., 2000) has been examined. The effects of stretching on physical fitness and strength production have not been established. Some Researcher have suggested that stretching increases, but others suggests that it decreases, strength capacity (Franco et al., 2008).To the best of our knowledge there is one study analyzing the influence of interest stretching on exercise performance, even though it is usual to see lifters performing stretching between consecutive resistance training sets, both in sport- or recreational-related facilities (Garcia-lopez et al., 2010; Kraemer et al., 2002). The effect of three different activities (doing static stretching, Ballistic activities and no stretching) between two consecutive sets and the speed of doing bench press activities was examined in the mentioned study and there were no difference among these three methods. Despite this, authors suggested that it should not be used static stretching between the sets, rather ballistic stretching activities should be replaced. some studies have reported performance declines after doing static stretching activities (Evetovich et al., 2003; Robinson et al., 1995; Willardson & Burkett., 2006b). Performance loss after ballistic stretch has also been reported (Nelson & Kokkonen). Therefore unlike Garcia-Lopez et. al.,

[1]- Adenosine Triphosphate

current study has used dynamic stretch rather than ballistic and static activities. Moreover, set numbers has increased from two to three sets so activity-related fatigue and the effect of the doing stretching movements on repetition number loss tendency become clearly visible. Unlike previous researches that only investigated effect of rest interval on ability to maintain the number of repetitions ha been studied, in the present study, the effect of the combination of rest duration and stretching on the performance was studied. Also the effect of intensity changes was investigated.

Methods

Experimental Approach to the Problem

Stretching between sets and exercises is a common practice among Participants in the resistance training, but its effects on the number of repetitions during consecutive sets are unknown. This study was undertaken to examine the role of interset active and passive rest interval on the number of the repetition during the 3 bench-press sets to failure with a submaximal load (50 and 75% of the 1 repetition maximum) (Garcia-lopez et al., 2010). Active and passive recovery included doing dynamic stretching between bench press sets and stationary rest, respectively. Data collection took place over a period of 9 weeks. College students participate in the study. Four sessions were held in the first week. In the first session the protocol was explained for subjects, and then they were required to sign a consent form in accordance with human subject regulations (Willardson & Burkett., 2006b). The second and third sessions were held to teach the exercise protocol (Garcia-lopez et al., 2010). In fourth session one repetition maximum (1RM) for the bench press exercise was determined for each subject using standardized procedures (Sewall & Lander., 1991). During each of the next 8 testing sessions, 3 sets of the bench press were performed at 50 and 75% of 1RM, leading to failure and allowing a 3 and 4-minute resting period between sets. During such a resting period, 1 of the 2 treatments designed was performed: Dynamic stretching (DS) and no stretching (NS). A counterbalance procedure was used to determine the treatment for each testing session (Garcia-lopez et al., 2010).

Subjects

Fifteen healthy college students volunteered for the study (The subjects' Mean±SD age, height, body mass, and BMI were 21.7±2.17 years, 174±5.98 cm, body mass 71.36±1.03 kg, and body mass index (BMI) 23.44±3.19 Kg/m2 respectively). Subjects were physically active, but at the time of the study and from 2 months before, none were engaged in any regular or organized stretching and/or resistance training program. Prior to data collection subjects were informed of the requirements associated with participation and provided written informed consent. Moreover, subjects did not allow their sleeping, and eating, habits to change throughout study participation.

Procedures

Data collection took place over a period of 9 weeks. The first week consisted of four sessions. In the first session, instructions regarding preparation for the 1RM testing and proper form and bench press technique were given to each participant. Then they signed informed consent to participate in the test. The second and third sessions were taught the correct way to implement protocol, and During the Fourth experimental session, 1RM for the bench press was determined. During each of the next 8 testing sessions, 3 sets of the bench press with 50 and 75 percent of 1RM were performed to failure, allowing a 3 and 4 minute resting period between sets. During such a resting period, 1 of the 2 treatments designed was performed: DS or NS. A counterbalance procedure was used to determine the treatment for each testing session. Testing sessions were carried out

the same day of the week at the same time of the day in all cases (Garcia-lopez et al., 2010). Warm-up sets were performed prior to each bench press session. For the 50% test condition, subjects performed 2 warm-up set at 30 and 50% of the goal resistance for 8 to 10 repetitions. For the 75% test condition, subjects performed 2 warm-up sets; the first with 50% of the goal resistance and the second with 60% of the goal resistance, for 8 to 10 repetitions each (Marek et al., 2005; Willardson & Burkett., 2005).

Maximal Strength Measurement

To calculate one maximum repetition, subjects warmed up for 5 minutes at first. Then, they performed two low-intensity bench presses. It was considered one minute rest between sets. The 1RM bench press was assessed using a previously established protocol (Stone & O'Bryant., 1987). Briefly, after a light warm-up on the bench press using a Smith machine, subjects attempted to lift a progressively increasing load, allowing 3 minutes of resting periods between attempts. The 1RM value was obtained using as few attempts as possible (5 attempts as maximum). For bench-press repetitions, subjects lowered the bar until the chest was touched lightly, approximately 3 cm superior to the xiphoid process (Wagner et al., 1992). The elbows were extended equally with the head, hips, and feet remaining in contact with the floor throughout the lift. No bouncing or arching of the back was allowed. Bench-press technique and settings were maintained throughout the whole experimental phase (Garcia-lopez et al., 2010).the maximum weight for each subject was calculated using formula (maximum weight=1.0278-(weight÷0.0278×repetition numbers).

Dynamic stretching

In this study, four main muscles involved in the bench press (Right pectoralis major, Left pectoralis major, Right triceps brachii, Left triceps brachii) were stretched dynamically in two consecutive sessions. For 4 minutes rest, each muscle was stretched for 25 seconds in every session, so next muscle was stretched after 5 seconds rest. Thus, each muscle was stretched twice and overall for 50 seconds. For 3 minutes rest, subjects acted like the previous method, but the time declined from 25 seconds to 17 seconds (Garcia-lopez et al., 2010).

Statistical Analysis

Descriptive statistics methods (mean, SD) were used to describe demographic characteristics of the participants and Kolmogorov – Smirnov test was used to check for normal distribution of the variables. Also, dependent t-test was used to compare the results of two sessions. All statistical calculations were performed through SPSS statistical software version 16 and diagrams were plotted with Excel 2010 version. The significance level for all tests was considered less than $P \leq 0/05$.

Results

The results of this study showed in untrained people who have a weight training history, in two intensities 50 and 75 maximum peak power and for two rest interval 3 and 4 minutes between sets, Using active rest (doing dynamic stretching activities) between bench press sets rather passive rest significantly will increase the number of repetitions (diagrams 1 and 2). Moreover, in both exercise intensities and active rest between 3 and 4 minutes, there was no significant difference in terms of training volume. But in passive recovery, 3 minutes in comparison with4 minutes will significantly reduce the number of iterations. In brief, in these subjects in both exercise intensities and for 3 and 4 minutes, active rest between bench press sets significantly increases the volume of exercise than passive rest. But if these people are using passive rest between sets, they should choose 4 minutes time to prevent a decline in the number of

repetitions. Since there was no significant difference in active rest between 3 and 4 minutes, 3 minutes will be enough to keep the training volume. The results of this study showed that in active and passive rest and for both times and training intensity, the number of bench press repetitions reduced significantly from first set to third set. But this reduction amount in active rest has been less than passive rest. Also in active rest, number of repetitionsfor3 or 4minutes within three sets declined to the same extent. But in passive rest, repetition numbers loss increased significantly in three minutes than four minutes. Overall, the findings of this study support the idea that use of dynamic stretching exercises between weight training set improves the performance.

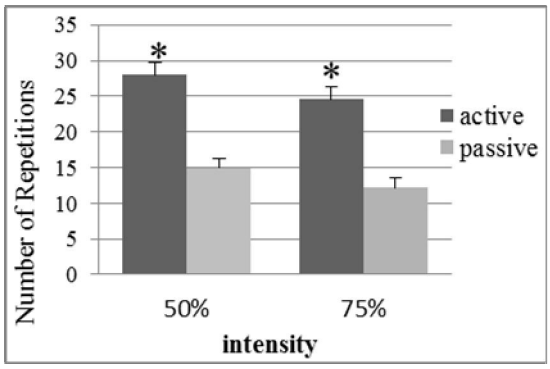

Figure 1: Comparison the effect of 3 minutes active and passive rest interval on the mean of bench press repetitions in 50 and 75 percent of 1RM

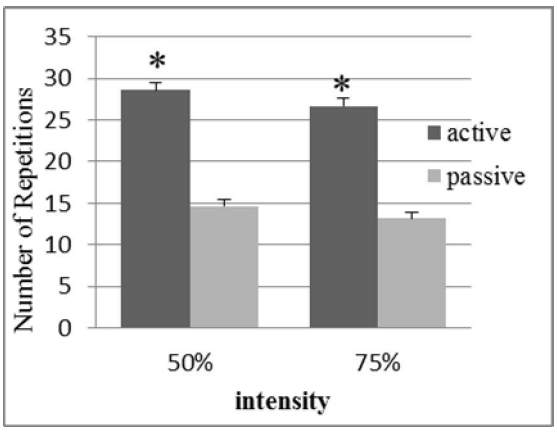

Figure 2: Comparison effect of 4 minutes active and passive rest interval on the mean of bench press repetitions in 50 and 75 percent of 1RM.

Discussion and Conclusion

The goal of this study was to compare the effects of duration (3 and 4 minutes) and types (active vs. passive) of between set rest with different intensities (50 and 75 percent 1RM) on bench press volume (number of repetitions) in untrained men. Rest duration changes among sets are one of the common methods among participants of resistance trainings to achieve pre designed goals. On the other hand, many studies have suggested that active rest between exercise sets cause better excretion of metabolites and therefore, higher acceleration of energy resource recovery process. So, subject will be able to perform their desired activities during several consecutive sets properly. The results of current study showed for both 50% and 75% of 1RM loads and for both 3 and 4 minutes, use of active rest (performing dynamic stretching activities between bench press sets) rather than passive rest would significantly lead to more repetitions in an exercise session. Also, in active rest and in both exercise intensities there was no significant difference in the number of repetitions between 3 and 4 minutes, but in passive recovery, 4 minutes rest significantly increased training volume rather than 3 minutes rest. there was no significant difference in the number of repetitions between3 and 4minutes, but the difference between two rest times became significant in passive rest and 4 minutes rest significantly increased training volume rather 3 minutes rest. So far, few studies have examined the effects of dynamic stretching activities on resistance training performance. Most of these studies have examined the effect of stretching activities during warm-up period before exercise initiation on the performance. Yet, almost in all these studies have been reported improvement of athletic performance after doing dynamic stretching activities (Beedle et al., 2008; Torres et al., 2008). In a similar study conducted by Garcia-Lopezet al., to assess the effects of activity

type between sets on the speed of doing bench press exercise, 25 students performed the bench press twice quickly up to failure. 4 minutes rest was considered between sets. Tests were administered on three non-consecutive sessions and they were performing one of these activities (ballistic stretching, static stretching or no stretching) in the rest time between sets. The results of above study indicated that activity type changes among sets have not significantly influenced bench press speed loss and repetition numbers in second sets. Also it was demonstrated that static stretching should be avoided among the sets or ballistic stretching should be replaced if the absolute speed of activity is considered. Active stretching was also followed better results than static stretching or passive rest; however, this difference was not significant (Garcia-lopez et al., 2010). It is probably for the lack of difference in the number of exercise frequent sets because only two sets of bench press was used in the mentioned study that may not be enough to cause fatigue or may be chosen due to stretching activities. As mentioned before, ballistic and static stretching may cause damage and performance loss. Unlike the study of Garcia-Lopez et al. except using male subjects, set numbers in current study increased from two to three with 3 and 4 minutes rest duration with intensity of 50 and 75% 1RM was considered and activity speed was controlled. Moreover, due to more dynamic stretches advantages other stretching methods; the dynamic stretching was used to execute active rest intervals between exercise periods. Dynamic stretching led to increased core body temperature, increased deep muscle temperature, stimulation of the nervous system, reduction in filament's sliding friction during muscle contraction, reduction in blood and muscle lactate accumulation, rise in dilation of blood vessels within the muscles and thus better oxygen supply to the muscles and possibility of reduction in muscle damage risk (Behm et al., 2003). Increasing in average range of joint motion with dynamic stretching exercises may increase athletic performance with developing balance and coordination raising the function of neuromuscular portion (Faigenbaum et al., 2005). Researchers have also suggested that improvement seen after dynamic stretching activities may be the result of specific movement patterns of practice in dynamic stretching activities; and this hypothesis was also supported that dynamic stretching activities may allow muscles to make a normal contraction that finally results in improvement of power production (Fletcher & Anness., 2007). According to available reports on athletic performance improvement, it is concluded that dynamic stretching activities improve performance of people who recreationally doing resistance exercise (Yamaguchi et al., 2005). Performance improvement due to dynamic stretch is attributed to several factors including increased muscle temperature (Thacker et al., 2004), similarity of the exercise motion pattern (Fletcher et al., 2007) and rise in muscle contractile force and amount of force developed following an active contraction (PAP) (Marek et al., 2005). Eventually, it be proposed that due to active rest and dynamic stretch nature, substrate delivery, waste Metabolites removal, conduction of nerve impulses and muscular contractile force production increase during successive periods. This would lead to faster recovery of energy sources in the rest duration and performance loss rather than passive rest. This research suggests that dynamic stretching activities on target muscular groups and stretching activity similar to motion pattern of exercise improves exercise. According to Fletcher and Jones' definition, dynamic stretching is controlled displacement along the active range of motion for each joint (Fletcher & Jones., 2004). In the other words, dynamic stretching activities include joint's active motion throughout the range of motion

without any stop and moving up to the end point (Weerapong et al., 2004). Willardson and Burkett (2006) investigated the effect of different rest intervals on the ability of sustainability the number of bench press repetitions over 5 consecutive sets with heavy vs. Low loads, and observed that 3 minutes compared with 1 and 2 minutes significantly enhanced this ability. Moreover, they did not observed any difference in ability of sustain the repetitions number between loads (Thacker et al., 2004). Mirzaei et al. (2008) investigated effect of 3 different rest intervals (90, 150 and 240s) with 60 and 90 percent of 1RM on sustainability of bench press repetition over 4 consecutive sets. For each load, significant decline in repetition occurred between first and fourth set and the sustainability of repetitions was different between loads. A significant difference in the sustainability of repetitions occurred between all rest conditions, and 240-second resting between sets resulted in sustainability greater total repetitions vs. 90s and 150s resting between sets (Mirzaei et al., 2008a). In another study they obtained similar result about similar rest intervals on leg press, but also they did not find significant differences between 60 and 90 percent of 1RM in squat (Mirzaei et al., 2008b). In the present study unlike Willardson et al. the sustainability of repetitions was significantly different between loads, and despite mirzaei et al. Study that total number and sustainability of repetitions was significantly greater in heavy loads, this presses occured in low intensity.

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