The Effect of Different Rest Intervals on the Sustainability of Squat and Bench Press Repetitions in Karate Men

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Abstract: The purpose of this study was to compare the effect of three different rest intervals on the sustainability of squat and bench press on consecutive sets at 90% with 1RM (1 repetition maximum)-loads. Design and methods: Fifteen karate men were chosen to participate in this study (age of 22/3 ± 2/1 years; height 172/6 ± 3/6 cm; weight 67/8 ± 5/2 kg). All subjects performed 7 sessions of squat & bench press with 48 h intervals. At the first session, 1RM was measured. During the rest 6 sessions, athletes performed 4 times squat & bench press with 90% (1RM) at each session, one of three different rest intervals (60, 180, 225 seconds) were used randomly between sets. Number of repetitions performed & repetition sustainability between different rest intervals were recorded. Results with Boneferoni method showed that each three different rest intervals caused decline in repetitions in squat & bench press. The repetition decline was significant in the bench press and squat. Repetition sustainability in 225 s in compare to 60 & 180 s was more significant. Repetition sustainability also was higher in 180 s in compare to 60 s. On basis of findings from this study, we can recommend for best performance in bench press & squat, rest intervals of 225 s, to maintain consecutive repetitions.

Key words: Rest interval, sustainability of repetition, recovery, fatigue.

1. Introduction

Nowadays, one of the main concerns of the best trainers and athletes is quick return to an original state after each match or exercise and preparing for next match that has made the researchers carry out studies about optimum time for recovery in exercise and competitions in recent years. Since last few years up to now sport performances have greatly improved. The performance level which was something dreamy in past, it looks common place and usual now and the number of athletes who are able to gain wonderful results, have been increased. What is the reason for these wonderful improvements? It is not easy to answer these questions. One of the reasons is that the sport is interesting and exciting and also high motivation which can ensure performing difficult and long term activities for a long time. Sport training has been improved in terms of cooperating with sport experts and scientists, on the other hand some parts of these differences is as a result of performing resistance exercise, specially those which are done with weights. Resistance exercises are planned as a necessary part of body fitness program for athlete in different fields, in order to increase the power resistance and muscular tension. Several studies have been conducted on performing exercise with weights like extra load principal, exercise character and increased resistance. Enough documents have been presented about kind, proper load, number repetitions and turns in exercise planning with weights. But researchers could not have gained to definite results about recovery time and resting period among exercise turns yet. The results which exercise especially those with weights could be planned. Here, resting interval or
recovery time among activities is one of main successful factors in an exercise program. Recovery period or return to original state includes the time intervals between the end of an activity or a hard activity and the beginning of the next activity. During this period, some different metabolism occur in body which aims at recovery of lost phosphagene, glycogen resources, removing lactic acid and surplus material arising from body metabolism. Recovery period is a time dependant trend which can remove the tiredness caused by doing exercises. Tiredness arising from doing exercise is a multifactor process and its kind depends on intensity of contraction, character of involved moving units and other factors. Despite of carrying out several studies about reasons of tiredness, no one could offer a comprehensive scientifically explanation about the trend of tiredness creation yet. Its reason can be this fact that tiredness is special compared to the done activity in question. Because of close relationship between tiredness and recovery period, rest time among intervals and exercise turns are of high importance. The conducted researches show that the ability to maintain the repetition in successive turns depends on quantity of resting among turns with fix work load. So it has been suggested that there should be enough revive among turns of resistance exercise, in order to maintain the number of repetitions in successive turns at maximum level. The recovery time and resting intervals among exercise turns with different loads with isokinetic machines and free weights have been studied continuously. Which results of these studies are not sometime similar to each other?

Wier [10] conducted a research called “the effect of resting among repetition in bench press” 1, 3, 5 and 10 min revive intervals were used in four treatment groups in this study. No meaningful difference was observed in ability of successful repetition of bench press based on revive period among turns and long term or short term recovery period did not have any effects on ability of involved muscles in running the test. Kraemer [4] investigated the effect of 1, 3 min resting between two exercise turns on the all of the done repetitions in foot and bench press movements in 3 successive turns with 10 repetitions at maximum in professional football players. The results of their studies show that every sport trainee can do 10 repetitions fully when using a 3 min resting among exercise turns but using a 1 min resting among turns causes a meaningful reduction in all of done repetitions. Matozak [5] investigated the effect of three 1, 3, 5 min resting intervals among exercise turns on ability of maximum doing of a repetition in two squat movements. Willardson [11] considering effect of three 1, 2, 5 minute resting intervals among exercise turns on the rate of exercise carried out in bench press movement and squat with 8 repetitions at maximum showed that the rate of exercise carried out in turns with a 5 minute resting interval is more than that of with 1, 2 resting intervals. In the study, Willardson and Burkett [12] considered the effect of three 1, 2, 3 min resting intervals among exercise turns on the performance of bench press movement with 50% and 80% of loads of a maximum repetition. The results revealed that bench press movement performance in turns with a 3 min resting interval has been better than that of 1, 2 min resting intervals. No meaningful difference was observed between ability of maintenance of repetition in two different weights either. Researchers could not offer proper suggestion about recovery period among turns of resistance exercise according to gained results, yet and they are going to answer this question: How long is a complete recovery time for a muscle and which resting turns used in researches is more proper for resistance exercise? So, present research is going to study the effect of different resting intervals on ability of maintain repetitions of squat & bench press in Karate athletes.

2. Methods

(1) Society and statistical sampling the present study is all of Guilan selective Karate team and Damash club, they were 40 persons on the other hand
15 persons of the research who practiced with weights for 2 to 3 years.

(2) Running method & information collecting in first session, the athletes filled out the medical information question. Athletes’ individual features were recorded in special sheets. Then they got familiar with protocol running process. After they warmed out for 15 minutes, their maximum repetition was determined using this formula: $1\text{RM} = \text{Weight}/(1 - 0.02 \times \text{Repetition})$.

Ninety percent of which were calculated for squat & bench press exercise until arbitrary tiredness with inactive resting successions during next 6 sessions, the trainees did bench press or squat movements to warm themselves they ran 10 bench press movements or squat with weight of 50% of a maximum repetition and for bench press or squat with 90% of a maximum repetition until they got so tired. One of the 60, 180, 225 seconds resting successions was randomly used for each person in each session. Because of inactivating of resting successions and creating similar situations, the trainees were asked to sit on the bench after finishing running each exercise turn and the number of carried out repetitions in each turn was recorded for each person.

3. Results & Research Findings

The mean & standard deviation related to number of repetitions in each turn were shown using resting successions in Tables 1-3. Findings showed that all of three 60, 180, 225 seconds resting successions caused reduction in number of repetitions in successive turns and it showed that there was meaningful difference between ability of maintaining repetition in bench press movement & squat in successive turns.

4. Discussion

In weight training when exercise turns accompanied with continuous contractions lead to muscular tiredness and reduction in performance. Collecting H+, inorganic phosphate (P$_2$O$_4$) & phosphocreatine incomplete recovery are of key factors in muscle performance reduction. The ability of recovery in neuro-muscular activity, the tension of active muscles metabolism hemostats is a time-dependant process [1-3]. That is why the importance of a muscular resting period is

![Fig. 1](image) Number of repetitions in turns 1, 2, 3, 4 bench press with rest intervals 60, 180, 225 second with 90% loads with 1RM.
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Fig. 2 Number of repetitions in turns 1, 2, 3, 4 squat with rest intervals 60, 180, 225 second with 90% loads with 1RM.

Table 1 Mean and standard deviation number of repetitions in turns 1, 2, 3, 4 bench press with rest intervals 60, 180, 225 second with 90% load with 1RM.

<table>
<thead>
<tr>
<th>Mean ± SD (Load 90%)</th>
<th>Rest intervals Load</th>
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</thead>
<tbody>
<tr>
<td>Set 4</td>
<td>Set 3</td>
</tr>
<tr>
<td>1.0 ± 2.3</td>
<td>1.1 ± 2.7</td>
</tr>
<tr>
<td>2.0 ± 4.1</td>
<td>1.6 ± 5.7</td>
</tr>
<tr>
<td>1.7 ± 5.1</td>
<td>1.8 ± 5.8</td>
</tr>
</tbody>
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Table 2 Mean and standard deviation number of repetitions in turns 1, 2, 3, 4 squat with rest intervals 60, 180, 225 s with 90% load with 1RM.

<table>
<thead>
<tr>
<th>Mean ± SD (Load 90%)</th>
<th>Rest intervals Load</th>
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<tbody>
<tr>
<td>Set 4</td>
<td>Set 3</td>
</tr>
<tr>
<td>1.8 ± 2.2</td>
<td>2.5 ± 3.9</td>
</tr>
<tr>
<td>2.2 ± 3.9</td>
<td>2.9 ± 4.8</td>
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<tr>
<td>2.2 ± 4.4</td>
<td>2.8 ± 5.9</td>
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</tbody>
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Table 3 Sustainability bench press and squat movement in three rest intervals 60, 180, 225 second with 90% load with 1RM.

<table>
<thead>
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<th></th>
<th>P</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>Bench press</td>
<td>0.004</td>
<td>4.278</td>
<td>2</td>
<td>10.689</td>
</tr>
<tr>
<td>Squat</td>
<td>0.005</td>
<td>3.991</td>
<td>2</td>
<td>17.489</td>
</tr>
</tbody>
</table>

Emphasized after each exercise. It is necessary to get enough rest successions among exercise turns with weights, in order to free and remanding harmful effects of tiredness and facilitating muscle recovery in scientific aspects. So it is suggested to consider enough recovery time among resistance exercise turns, in order to allow maximum number of possible repetitions in successive turns. The ability of maintaining repetition in exercises with medium power and fix work load leads to increase exercise load and following muscular power increasing. It seems that resting succession changes among exercise turns with weights play an important role in increasing of resistance & muscular power. The results of present research showed that three 60, 180, 225 s resting successions has affected squat and bench press exercise running negatively an on the other hand the number of repetitions in successive turns has been reduced using all of 60, 180, 225 s resting successions. There is also a meaningful difference in bench press movement & squat in terms of ability of maintenance repetition in successive turns.

Richmond and Willardson, et al. [8, 14] showed that there was meaningful difference among ability of maintaining repetitions in bench press exercise in successive turns using different resting successions and the number of repetitions has not been maintained in successive turns which agree with present research results. The findings of this part of study disagree with Kramer’s study results. Kramer [4] showed that the number of repetitions has been carried out completely in 3 turns with a 3 min resting interval. This is because of possible difference in trainees situations. Kramer’s treatment groups were football players who got accustomed to exercise and they could possibly do the maximum possible repetitions using short resting time. The trainees had exercised very little in these situations and most of their exercises have been done in phosphagen and anaerobic glycolysis. Other part of findings showed that there is a meaningful difference in ability of maintaining repetition among 60, 180 and 225 s resting successions and ability of maintenance repetition using a 225 s resting succession in bench press exercise & squat has been better compared to other resting successions. In comparing state, in present study, reduction rate of number of repetition in carrying out bench press & squat exercise has been less in a 225 s resting succession compared to that of 180 and 60 s. On the other hand, carrying out bench press and squat
exercises have been affected less and two 60 s and 180 s resting successions have affected running bench press & squat exercises greatly so that the number of repetitions reduced more and did not provide enough chance for muscular energy recovery. According to present findings, one can conclude that doing exercise with a 225 s resting succession has been better a more complete compared to two other resting successions and its running changed very little. The result of this part of study agrees with those of Richmond [8] who showed that running bench press exercise with a 5 m resting succession among exercise turns is better and more complete compared to 1 min and 3 min ones. Willardson and Burkett [11] showed that running bench press exercise and squat with a 5 m resting succession among exercise turns are better and more complete compared to 1 min and 2 min resting successions. Willardson and Burkertt [13] showed that performance of bench press exercise with a 2 min resting time is better than 30 s and 60 s ones, and Mirzaee, et. al. [6] showed that performance of bench press exercise with a 240 s resting interval is better and more complete than two 90 s and 150 s resting successions. In resistance exercises when lifting weight below maximum level, first of all slow-contraction fibers are asked to produce forces. These fibers show some aspects of physiologic tiredness little by little in the next part of activity, rapid contractile myofibrils are asked to produce enough forces for overcoming the resistance. Moving process will be stopped when the ability of all muscular fibers will be reduced because of tiredness. Slow contraction need less time for recovery which is because of their oxidative character but since rapid contraction fibers rely on anaerobic glycolysis to produce energy on the other hard exercises lead to H⁺ collection pH reduction and lactic acid collection in these fibers so these fibers need longer time. H⁺ increasing and the acidity of the course cause to reduction of calcium amount in myofibril that this process delay induced connection step in calcium & troponin integration on the other hand increased H⁺ stops, the activity of phosphofructokinase (anaerobic glycogen enzyme) & makes glycolysis path slow and also prevents producing ATP (adenosine three phosphate ) to ensure the contraction energy [1-3]. The necessary time for taking H⁺ and lactate to out of contracting muscle is ranging from 4 min to 10 min. In present study, a 225 second resting may remove muscle from H⁺ and lactic acid also increase the maintenance of repetitions. The present study disagrees with the findings of Matozak, et al. studies [5] showed that there are not any meaningful differences in the ability of successful doing a maximum repetition in two turns with 1, 3, 5 min resting successions in squat exercise. Weir [10] showed that 1, 3, 5 or 10 min resting successions do not affect the ability of successful repetitition in two turns with maximum weight in bench press exercise. The reasons of facing two different study results are likely related to using maximum weight rate as resistance in research. In training weight program, lifting a weight in one turn with 100% maximum repetition needs one minute for recovery. When the weight in question is in maximum level, the muscles use phosphocreatine to ensure the energy. Phosphocreatine resource recovery is done very quickly and more than half of these resources will be recovered in 30 s. The studies which considered increased power in resistance exercises enjoyed longer resting intervals. Pincivero et. al. [7] showed that a 160 s resting time between isokinetic exercise turns showed increased power in hamstring and quadriceps femoris more than 40 s one. Robinson [9] showed that a 3 min resting among exercise turns in squat exercise showed increased power compared to 30 s and 90 s resting. The results of these two studies showed that longer resting time led to maintain the exercise with determined intensity and more increased power.

5. Conclusions

Regarding the result of present study, one can conclude that a 225 s resting session is used in exercise turns for running bench press and squat exercises with maximum level of repetition, in order
that repetitions will be maintained in higher level in successive turns.

**References**


