# Comparison of 3 Different Rest times in Resistance Training Plan of Footballers Maximum Power in Leg Squat and Bench Press

Abuzar Mohamadimofrad[1], Dr. Masoud Nikbakht[2], Dr. Abdolhamid Habibi[2], Dr. Saeed Shakerian[3]

[1.] MSc of physical education and sport sciences, Shaid Chamran University, Ahvaz, Iran
[2.] Associate professor of physical education and sport sciences, faculty member of Shaid Chamran University, Ahvaz, Iran
[3.] Assistant professor of physical education and sport sciences, faculty member of Shaid Chamran University, Ahvaz, Iran

**Abstract:** The aim of this study is to compare different rest times in squat and bench press performance and to calculate footballers' maximum power. 40 male footballer volunteers with BMI=22.79 were invited to the study. The athletes put in groups C 1; n = 10, C 2; n = 10, C 3; n = 10 and C 4; n = 10. 8 weeks training with an intensity of 70% 1RM was started; each session included warm-up and 4 sets of squat and 4 sets of bench press. Rest time between sets for the four groups: C1, S=45; C2, S=90; C3, S=180; and C4 a combination of the three. The result with respect to $P<0.05$ showed that strength program with different relaxation times increases 1RM, but there was no significant difference between the groups.

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## 1. Introduction

Resistance training has been recognized as an essential component of a comprehensive fitness program for individuals with diverse fitness goals (1).Several training variables should be considered when prescribing a resistance exercise program(1). Manipulation of training variables such as intensity, volume, frequency, repetition velocity, and rest between sets is dependent on the specific goals of the individual (1.2.3.4). The manipulation of training variables as mentioned above is determined by the goals of the program and the needs of the individual. Mistakes in any of these variables in the progression of a program could theoretically result in an overtraining syndrome, therefore the manipulation of these variables must be correct done(5.4).Training volume is a summation of the total number of repetitions performed during a training session multiplied by the resistance used. Training volume has been shown to affect neural (6.7), hypertrophy (8.4), metabolic (9), and hormonal (10.11.12) responses and subsequent adaptations to resistance training. The amount of rest between sets has been considered an important factor that can be manipulated to fit the goal of a program this factor significantly effects the metabolic (13), hormonal (15.14.11) and cardiovascular (16), responses to an acute bout during resistance exercise, as well as performance of subsequent sets (4)and training adaptations (17.18).the length of rest interval must be sufficient to recover energy sources (i.e., adenosine triphosphate [ATP] and phosphocreatine), clear fatigue-producing substances (i.e., hydrogen ions), and restore force production ( 1).when training for increased strength, longer rest periods of 2 and 5 minutes have been recommended to allow for greater recovery and maintenance of training intensity (3.19.20). Previous studies have shown that the amount of rest between sets has a significant effect on the total volume completed during a workout, which may affect subsequent strength adaptations (18).A primary area of concern within the scope of proper resistance training is the amount of rest between sets of exercises (21). The rest or recovery periods between sets is the period of time between the ends of a workout and starting the next, so that the physiological status of individual will be normal before the action. Although training variables such as intensity and volume have been researched most frequently in determining muscular adaptations, relatively little research has been conducted on the optimal rest interval between sets. According to researchers' different opinions about the recovery time, the research shows that different rest times will result in the opinion diversity about the right time to get maximum power. Michael ( 2001)No differences were observed in ground reaction forces among 15, 30, and 60-second rest trials for any of the jumps (1–10) Also, ground reaction forces did not differ among jumps 1–10 within groups (15,30, or 60 seconds.)(22).Vilason and Barket (2006) concluded that the short break between courses will increase muscular endurance and rest for 2 minutes is offered as the optimum rest gap (23). Lopez et al (2007) in

their study concluded that when the purpose of exercise is more power and recurrence to have a high speed, short breaks can be problematic (24).In the researches, due to the less weeks of training, the effects of nerve - muscle were measured mostly. In this study, with more weeks of training, it is tried to investigate the hypertrophic effect involved in max power, too. According to various conducted researches and the results obtained, it is hoped that the research findings can be an ideal and applicable guide for athletes and coaches.

**Method:**

This is a quasi-experimental and practical study. Research population includes Gachsaran Oil Industry hopes and adults' football teams who participated in the exercise after filling the medical and consent forms. Their mean age was 173.62 and mean BMI = 22.79 .The 40 people attended in the test were purposefully divided into four groups: C1; n = 10 with BMI = 22.55, $C_2$; n = 10 with BMI = 23.22, $C_3$; n = 10 with BMI = 22.87 and $C_4$; n = 10 with BMI = 22.54. In this study, a digital scale, a stadiometer, a 20 kg standard Olympic bar, free weights of 1.25, 2.5, 10, 15 and 20 kg, squat, bench press and a chronometer were used. The method of putting people into groups was obtained based on subjects' 1RM measurement from the following formula:

$$1RM = \frac{load\ weigth\ (weigth)}{1-0.02\ (repeation)}$$

After measuring the max power, athletes were grouped in this way: first person (with the highest 1RM) was put in Group 1, second in Group 2, third in Group 3, fourth in Group 4, fifth in Group 4, sixth in Group 3, seventh in Group2, eighth in Group 1 and it continued to fortieth person. Then the four groups of 10 people were included in three groups of 45, 90, and 180-second and a combined group for training with 3 times rest interval. The training included warm-up and four sets of 8 bench presses and after 5 minutes of rest, four sets of 8 squats. Training started at 70% 1RM and every two weeks 5% weights were added to the weights (25). Total duration of training was 8 weeks and total training sessions were 24 sessions. Each session was 48 hours after the other. Totally, the maximum power of subjects was measured 3 times at first, twelfth and twenty-fourth sessions. The first twelve sessions reflected nervous - muscular effects and the next twelve training hypertrophy.

In this study, repeated measures method was (Repeated Measures) used to statistical analysis of differences between groups in the first, twelfth and twenty-fourth sessions and inter-group differences in the level of $p < 0.05$ using SPSS version 16.

**Results**

In Table 1, the mean BMI, height and weight of different study groups are shown. Mean height is 173.62, weight 68.69 and BMI = 22.79

Table1: Mean body mass index, weight and height of subjects

| Groups | 45s | 90s | 180s | Combined Group | Total |
|---|---|---|---|---|---|
| BMI (kg/m2) | 22.55 | 23.22 | 22.87 | 22.54 | 22.79 |
| Height (cm) | 173.30 | 174.56 | 173.44 | 173.21 | 173.62 |
| Weight (kg) | 67.72 | 70.75 | 68.79 | 67.79 | 68.69 |

Table 2: inter-group differences in subjects' max power in squat motion at 45, 90,180 s and combined rest times

| Groups | 1RM | Type III Sum Of Squares | *df* | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 45s Group | Inter Group Changes (Sessions)<br>Error | 724412.641<br>20.707 | 1<br>9 | 724412.641<br>2.301 | 3.149E5 | .001 |
| 90s Group | Inter Group Changes (Sessions)<br>Error | 727396.151<br>104.420 | 1<br>9 | 727396.151<br>11.602 | 6.269E4 | .001 |
| 180s Group | Inter Group Changes (Sessions)<br>Error | 739313.008<br>64.697 | 1<br>9 | 739313.008<br>7.189 | 1.028E5 | .001 |
| Combined Group | Inter Group Changes (Sessions)<br>Error | 743579.674<br>85.014 | 1<br>9 | 743579.674<br>9.446 | 7.872E4 | .001 |

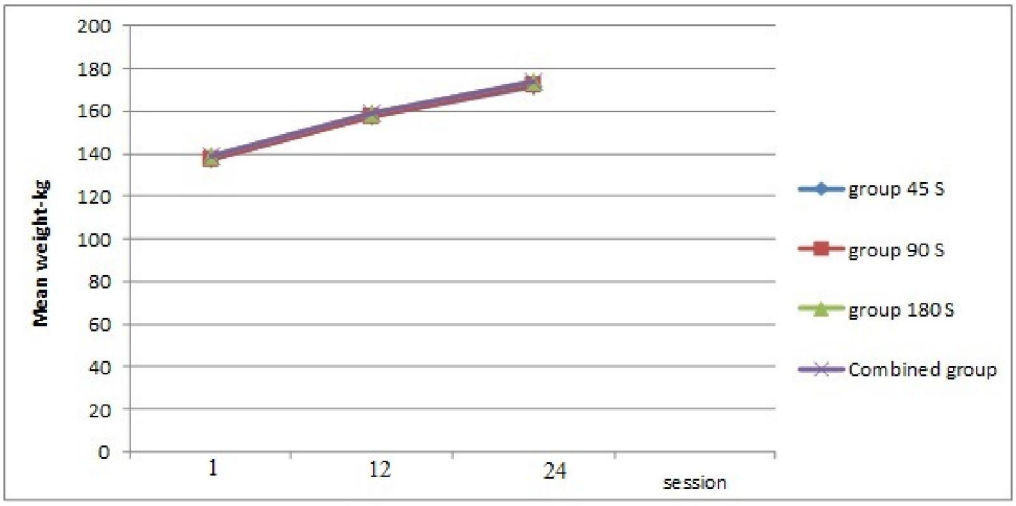
Table3: Inter-group differences in subjects' maximum power in the bench press at 45, 90,180 s and combined rest times

| Groups | 1RM | Type III Sum of Squares | *df* | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 45s Group | Inter Group Changes (Sessions)<br>Error | 214467.839<br>170.818 | 1<br>9 | 214467.839<br>18.980 | 1.130E4 | .001 |
| 90s Group | Inter Group Changes (Sessions)<br>Error | 217933.110<br>392.162 | 1<br>9 | 217933.110<br>43.574 | 5.002E3 | .001 |
| 180s Group | Inter Group Changes (Sessions)<br>Error | 229554.519<br>61.698 | 1<br>9 | 229554.519<br>6.855 | 3.349E4 | .001 |
| Combined Group | Inter Group Changes (Sessions)<br>Error | 217141.176<br>413.840 | 1<br>9 | 217141.176<br>45.982 | 4.722E3 | .001 |

According to Table (4), at the level of p <0.05, there is no significant differences between groups. It can be concluded that the squat motion progress is almost identical for different groups.

Table 4: Intergroup differences in subjects' maximum power in the squat at 45, 90,180 s and combined rest times

| | | Sum of Squares | *df* | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| First session | Between Groups | 20.044 | 3 | 6.681 | 1.211 | .320 |
| | Within Groups | 198.554 | 36 | 5.515 | | |
| | Total | 218.599 | 39 | | | |
| Twelfth session | Between Groups | 24.819 | 3 | 8.273 | 2.695 | .060 |
| | Within Groups | 110.525 | 36 | 3.070 | | |
| | Total | 135.344 | 39 | | | |
| Twenty fourth session | Between Groups | 46.938 | 3 | 15.646 | 2.660 | .063 |
| | Within Groups | 211.734 | 36 | 5.882 | | |
| | Total | 258.672 | 39 | | | |



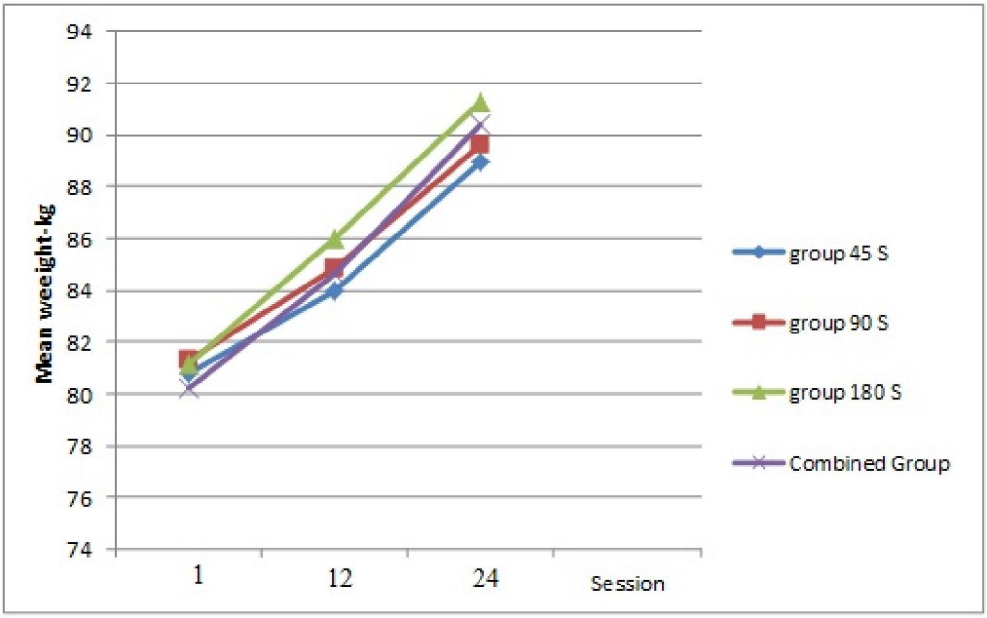

Graph (1) shows the four groups progress in squat

According to Figure 1, we can conclude that in footballer subjects whose legs are more active during exercise and their leg muscles are prepared, different rest times have no effects on progress and the progress of each group is the same.

According to Table (5), at the level of p <0.05, there is no significant differences between groups. It can be concluded that the bench press progress is almost identical for different groups.

Table 5: Inter-group differences in subjects' maximum power in bench press at 45, 90,180 s and combined rest times

| | | Sum of Squares | *df* | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| First session | Between Groups | 49.063 | 3 | 16.354 | 2.278 | .096 |
| | Within Groups | 258.469 | 36 | 7.180 | | |
| | Total | 307.532 | 39 | | | |
| Twelfth session | Between Groups | 52.418 | 3 | 17.473 | 2.206 | .104 |
| | Within Groups | 285.205 | 36 | 7.922 | | |
| | Total | 337.623 | 39 | | | |
| Twenty fourth session | Between Groups | 63.244 | 3 | 21.081 | 1.278 | .297 |
| | Within Groups | 593.828 | 36 | 16.495 | | |
| | Total | 657.072 | 39 | | | |




Graph (2) showed the four groups improvement in bench press.

According to Figure 2, we can conclude that footballer subjects need more rest in rest time due to less use of hand muscles and less preparedness in that part and more time cause further progress in their power.

According to Table 2 and p <0.05, different rest times increase max power in squat. According to Table 3 and p <0.05, different rest times increase max power in bench press. According to Table 4 and p <0.05, different rest times increase max power in squat, but there is no differences between the groups. According to Table 5 and p <0.05, different rest times increase max power in bench press, but there is no differences between the groups. According to Figure 1 and 2 it can be concluded that the muscles that are smaller and less prepared need more rest between sets to continue practicing and improve training power.

**Discussion**

In this study, three passive recovery periods (rest periods of 45, 90,180 seconds), and 70% 1RM of one maximum repetition were considered as independent variables. According to study, practice separately with rest periods of 45, 90, 180s, and combined one between bench press and leg squat with 1RM of 70% have an effect on maximum power and enhance it. The increase in the maximum power was statistically significant. These findings are in agreement with those studies done by Willardson and Burkett (2006) that investigated the effects of rest interval of 1, 2 and 3 minutes between practice sessions on the bench press with 50 to 80% 1RM of one maximum repetition. With regard to the findings of this study, recovered energy during exercise was enough in each rest period to increase max power and using any rest times, practitioners can observe their

progress in the max power. According to the findings, there are no differences between the rest periods of 45, 90, 180 seconds and combined one in exercise cycle of leg squat and bench press with the 70% 1RM on max power during 12 and 24 sessions. Although there are differences between different groups, the differences are not statistically significant.

This result is not consistent with the results of Willardson and Burkett (2006) study which investigated the effects of three rest times of 1, 2 and 3 minutes between sessions of training on the bench press with 50 to 80% of one repetition maximum (1) and also with Lopez et al (2007) study which investigated the effects of resistance training with short and long rest intervals between exercises on elbow flexor muscle fatigue by performing a resistance training to fatigue border (24); but it was consistent with the results of Michael et al (2001) which investigated the effects of different rest intervals on the height of the press and the reaction power during depth jump from pre-determined heights (22) and Ahtiainen et al (2005) who investigated the short and long rest periods between courses in hypertrophy resistance exercise and its impact on power, size, and hormonal adaptation in male athletes (26) and with TácitoPSouza-Junior et al (2011) who reviewed the subject of "Strength and hypertrophy responses to constant and decreasing rest intervals in trained men using creatine supplementation" (27). They found that both groups demonstrated significant increases in back squat and bench press maximal strength, knee extensor and flexor isokinetic peak torque, and upper arm and right thigh CSA from pre-to post-training ($p \leq 0.0001$); however, there were no significant differences between groups for any of these variables (27).

According to the results of this study, the reason for lack of differences between the groups regarding the use of different rest times between periods of exercise is subjects' consistency with exercise method and assigned rest times for them. People who engage in bodybuilding exercises are able to withstand the effects of fatigue. It is possible because of fitness to exercise (high workload with short rest periods). These adaptations may include increased capillary walls, the normal density of cells, and the ability to avoid and direct H ions out of the muscle (28). Facing athletes with loads beyond their ability with short rest intervals will cause reducing their abilities to adapt new loads. Generally, incompatibility of the present findings with past research findings can be for many different reasons. These factors can be subjects' fitness level, their specific field of sports, nutrition, psychosocial factors, duration of training, testing, gender and age.

**Conclusion:**

The results obtained from the test groups and their comparisons shows that 12 and 24 sessions of training using rest times of 45, 90, 180s and combined one in leg squat and bench press increases maximum power. Although there are differences in this progress comparing different research groups, but these differences are not significant. In the previous research, some differences have been observed in progress between periods of rest, but as noted, the research had only considered short-term training courses (maximum 12 sessions). These training sessions state nervous effects more. In this study, after 12 sessions of training, some differences were observed between groups, but their level was not significant. This is possibly due to subjects' features.

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