ACUTE RESPONSE OF 3 VERSUS 5 MINUTES REST INTERVAL AFTER SQUAT EXERCISE ON STANDING BROAD JUMP DISTANCE AND LEG PEAK FORCE OUTPUT

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ABSTRACT

The aim of this study is to investigate acute responses of 3 minutes versus 5 minutes rest interval during squat exercise on standing broad jump distance and leg peak force output. Second to this, comparison was also made between the 3 minutes and 5 minutes rest interval. Twenty-five recreationally active participants were recruited for this study. Participants randomly attended two testing sessions, where either 3 or 5 minutes rest interval between set was prescribed in the session. In both sessions, participants performed two set of four repetitions of squat exercise at 80% of one repetition maximum. Standing broad jump were performed on a force platform before and after the squat exercise. The results of this study indicated that there was no significant difference between the 3 minutes and 5 minutes rest interval group on standing broad jump distance. However, there was significant difference in the post test between the 3 minutes rest interval group versus the 5 minutes rest interval group. Meanwhile, for the leg peak force output, there were no significant differences between the 3 and 5 minutes rest interval group. There were also no significant differences between the 3 minutes rest interval group versus 5 minutes rest interval group on leg peak force output. It can be concluded that for recreational males lifting four repetitions of squat with either 3 or 5 minutes rest interval between sets for strength and power protocol resulted the same performance in standing broad jump distance and leg peak force output. For practitioners, this study has indicated that using any of the two durations as rest interval between sets during strength training produce similar effect. But this only on assessed variables, and may have different effect on other training variables such as metabolic based variables or hormonal based variables.

RESPON AKUT JEDA REHAT 3 MINIT VERSUS 5 MINIT SELEPAS SENAMAN *SQUAT* KE ATAS JARAK LOMPAT JAUH BERDIRI DAN PENGHASILAN DAYA MAKSIMA KAKI

ABSTRAK

Tujuan kajian ini adalah untuk mengkaji respon akut jeda rehat 3 dan 5 minit ke atas jarak lompat jauh berdiri dan penghasilan daya maksima kaki. Perbandingan juga dibuat di antara kedua-dua jeda rehat tersebut. Dua puluh lima pelajar lelaki aktif telah direkrut secara sukarela untuk kajian ini. Peserta menghadiri dua sesi ujian secara rawak dimana 3 atau 5 minit jeda rehat diberikan dalam sesi ujian tersebut. Dalam kedua-dua sesi, peserta melakukan senaman *squat* sebanyak dua set dengan empat ulangan pada 80% daripada satu ulangan maksimun dengan dua jeda rehat yang berbeza. Lompat jauh berdiri dilakukan sebelum dan selepas senaman *squat* di atas pelantar daya. Jarak lompat jauh berdiri dan daya maksima kaki dinilai sebelum dan selepas senaman. Hasil kajian ini menunjukkan tidak terdapat perbezaan yang signifikan dalam ujian pra dan pasca bagi kumpulan jeda rehat 3 minit dan 5 minit dalam ujian lompat jauh berdiri. Walau bagaimanapun terdapat perbezaan yang signifikan dalam ujian pasca antara kumpulan jeda rehat 3 minit versus jeda rehat 5 minit. Tidak terdapat juga perbezaan yang signifikan dalam ujian pra dan pasca bagi kumpulan jeda rehat 3 dan 5 minit bagi penghasilan daya maksima kaki. Malah, tidak terdapat perbezaan yang signifikan dalam ujian pra dan pasca di antara jeda rehat kumpulan 3 minit versus jeda rehat 5 minit bagi penghasilan daya maksima kaki tersebut. Kesimpulannya bagi lelaki yang aktif secara rekreasi, angkatan bebanan *squat* sebanyak empat ulangan dengan samada jeda rehat 3 atau 5 minit antara set menghasilkan prestasi lompat jauh berdiri dan penghasilan daya maksima kaki yang sama. Untuk pengamal, kajian ini menunjukkan penggunaan salah satu durasi jeda rehat antara set sewaktu latihan bebanan menghasilkan kesan yang sama. Tetapi ini hanya terhadap pembolehubah yang telah dinilai, dan mungkin mempunyai kesan yang berbeza terhadap pembolehubah latihan yang lain seperti pembolehubah berteraskan metabolik atau pembolehubah berteraskan hormonal.

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LIST OF ABBREVIATION

UPSI	= Universiti Pendidikan Sultan Idris
RI	= Rest Interval
ACSM	= American College of SPORTS Medicine
1 RM	= Repetition Maximum
ATP-PC	= Adenosine Triphosphate Phosphocreatine
SR	= Short Rest
LR	= Long Rest
CMJ	= Countermovement
RFD	= Rate of Force Development
SBJ	= Standing Broad Jump
Kg	= Kilogram
BMI	= Body Mass Index
SPSS	= Statistical Package for Social Science
SD	= Standard Deviation
Sig.	= Significance
PAP	= Post-activation potentiation
m	= Meter
n	= Newton

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Time for recovery between sets and exercises can be defined as rest period, inter-set or rest interval and is one of the few variables that can be manipulated when designed resistance training programs (Willardson, 2006). RI between sets in resistance training depends on the goal of the training program based on sports and games of the athletes. Coaches must be careful while selecting rest interval in strength training because application of precise RI can help enhance the effectiveness of the strength training.The total of rest interval between sets can influence the hormonal, metabolic, and immune responses during strength and power workouts.

Power performance entirely dependent on metabolism energy (phosphagen system). RI between sets during power and strength training should enable the replenishment of muscle phosphocreatine (PCr) which requires a minimum of 4 minute recovery (De Salles, Simao, Miranda, da Silva Novaes, Lemos, & Willardson, 2009). If RI not sufficient enough to restore the replenishment of phosphocreatine (PCr), the energy system will switch to the glycolytic system. When the load of the strength training is less than 90% of 1RM , 3-5 minutes RI is important to maintain the volume of the training without lowering the intensity of training. Muscle power acute can be maintained by using rest interval 3-5 minutes between sets as compared to 1 minute rest interval between sets.

The amount of RI between sets which are very related to the training volume, the higher the volume of the training, the longer the rest interval requires between sets. For example, workout for muscular strength with 4 RM load needed longer period of rest between sets compared to workout for muscular endurance in which lighter 15RM loads are performed (De Salles et al, 2009). Although the relationship between the goals of the training and the duration of the rest period, not all resistance training programs should be utilized similar rest period. It is important that coaches know the right rest RI based on the relative volume output and the total of muscle mass involved in each workout.

Rest interval between sets is essential in the resistance training. This is because, the muscles fatigue very quickly due to the stress on the anaerobic metabolism. Muscle fatigue period depends on the intensity of the training or the percentage of the load lifted. Haas, Bishop, Dawson, Goodman, and Edge (2007), indicated that most of the strength

training started at the 30% - 100% intensity of 1RM. RI between sets allow to rebuild the blood flow and oxygen delivery which enables replenishment of phosphocreatine, intramuscular and muscle recovery.

1.2 PROBLEM STATEMENT

Physical preparation contributed in enhancing the athletes performance in any type of sports and games. Coaches often emphasize on volume, intensity and number of sets and repetition in strength training. RI between sets are often seen as less important variables in the strength training though it can give a great impact in the training. The American College of SPORTS Medicine (ACSM) position suggested that power training should compose 3 to 6 repetitions ranging from 0 to 60% of one repetition maximun (1RM) with high muscle action velocity (ACSM, 2009). The ACSM also suggested that RI of at least 2 to 3 minute between sets for core workouts and 1 to 2 minutes for hypertrophy and local muscle endurance training.

However, this suggestion was based on a consent of panel members from ACSM that was also based only on the research done by Abdessemed, Duche, Hautier, Poumarat, and Bedu, in 1999. Thus based on the previous studies the influences of different RI on strength, power and force is still highly debate. Thus, since to the limited number of scientific information on acute response of rest interval on lower-body power training, the reason of the current research was to compared 3 minute versus 5 minute RI between sets

after squat exercise on standing board jump distance and leg peak force output in active men.

In addition, athletes can know the precise RI to be applied in the strength training based on the training program goal. All the information can help coaches to determined the optimal RI and match athletes accordingly through accurate examination and records charge. As a conclusion, this study provided the foundation basic for future research would be to manipulate other variables in resistance training and the influence with the rest intervals between sets. The length of the rest RIl between sets was based on the training program goal.

1.3 PURPOSE OF STUDY

The purpose of this research are:

a) To determine acute response of 3 minutes RI in pre and post test after squat exercise on standing board jump distance among male students strength and conditioning class Sultan Idris Education University (UPSI).

b) To determine acute response of 3 minutes RI in pre and post test after squat exercise on leg peak maximum output among male students strength and conditioning class Sultan Idris Education University (UPSI).

c) To determine acute response of 5 minutes RIl in pre and post test after squat exercise on standing board jump distance among male students strength and conditioning class Sultan Idris Education University (UPSI).

d) To determine acute response of 5 minutes RI in pre and post test after squat exercise on leg peak maximum output among male students strength and conditioning class Sultan Idris Education University (UPSI).

e) To compare standing board jump distance between 3 minutes versus 5 minutes RI after squat exercise among male students students strength and conditioning class Sultan Idris Education University (UPSI).

f) To compare leg peak maximum output between 3 minutes versus 5 minutes RI after squat exercise among male students students strength and conditioning class Sultan Idris Education University (UPSI).

1.4 RESEARCH QUESTIONS

This study was addressed to these research questions:

a) What will be the acute response of 3 minute RI in pre and post test after squat exercise on standing board jump distance among male students strength and conditioning class Sultan Idris Education University (UPSI).

b) What will be the acute response of 3 minute RI in pre and post test after squat exercise on leg peak maximum output among male students strength and conditioning class Sultan Idris Education University (UPSI).

c) What will be the acute response of 3 minute RI in pre and post test after squat exercise on standing broad jump distance among male students strength and conditioning class Sultan Idris Education University (UPSI).

d) What will be the acute response of 5 minute RI in pre and post test after squat exercise on leg peak force output among male students strength and conditioning class Sultan Idris Education University (UPSI).

e) Will there be a significant differences on standing board jump distance between 3 minutes versus 5 minutes RI after squat exercise among male students students strength and conditioning class Sultan Idris Education University (UPSI).

f) Will there be a significant differences on leg peak maximum output between 3 minutes versus 5 minutes RI after squat exercise among male students students strength and conditioning class Sultan Idris Education University (UPSI).

1.5 SIGNIFICANCE OF STUDY

All coaches knew that rest interval between set in resistance training is important that influence both acute responses and chronic adaptations to resistance exercises. Beside that RI must be sufficient enough to allow for replenishment of phosphocreatine stores and consistency in movement mechanics, but also short enough to take benefit of the heightened neural activation that lead to enhancement of power production (De Salles et al, 2009). Choosing the appropriate RI in resistance training can be a challenging responsibility for a coach who engaged with several and vary athletes thus this study is significance due to this reason.

1.6 LIMITATIONS AND DELIMITATIONS OF THE STUDY

1.6.1 Limitations

It was beyond the researcher’s capabilities to control subjects daily nutritional intake, lifestyles and participants passion during the intervention.

1.6.2 Delimitations

The findings of this study was delimited to 25 males, aged between 20-24 years old with 22.04 ± 2.79kg body mass index (BMI) no serious lower limb and spine injury for the past 2 years or have no implant or under recovery from any injury and have strength training background of at least 6 months as recommended by Willardson and Burkett, 2005. The results of this research were not being applicable to the other groups of people with different characteristics.

1.7 OPERATIONAL OF TERMS

1.7.1 Back Squat with Barbell (Half Squat)

Exercise in which a person squats (thigh at parallel 90° to the floor) and then returns to an erect position while holding a barbell at the back of the shoulders.

1.7.2 Force Plate

A force plate which measure ground reaction forces involved in human movement as a participants stands, steps, or jumps on it (Haugland, 2013). Details of the force plate as

indicated in chapter 3.

1.8.3 Power

Power is the ability to exert maximal force within the shorter time possible or defined as the amount of work performed per unit of time (Harman, 1993).

1.8.9 Standing broad jump

Also called the standing long jump horizontal jump to the front of the participants as far as possible with technique as described in chapter 3.

1.8.10 Force

For the purpose of this study, force that cause the movement as measured and recorded by the force platform used.

1.8.11 Active men

Active men age above 18 years old and below 30 years old with at least 3 times a week of at least 30 minutes per session of physical activity.

CHAPTER 2

LITERATURE REVIEW

2.1 BACKGROUND

Rest interval aim of training session typically the determinant for length or duration of rest in between sets, used by athletes (Kraemer, & Ratamess, 2005). The principles of rest interval between set in resistance training is equal to cardiovascular training. High intensity training required a long rest between sets as compared to low intensity training. Rest interval is determined based on the training goals that individual wants to achieved during the workout. Recovery from exercise training is an important component in the overall training program and is crucial for optimal performance and improvements. Rest interval during training is crucial to ensure that athletes are capable of training consistently without result in overtraining (Bishop, Jones, & Woods, 2008).

Coaches uses different approach to find the best recovery process for athletes. The concept of physiological recovery is important to design the optimal training program. In the meantime, individual diversity exists in the recovery process as a result of training status (trained versus untrained), fatigue factors, and the ability for someone to address the physical, emotional and psychological (Willardson & Burkett, 2005).

2.2 Principles of rest interval

In order to determine how long to rest between sets of exercise in a workout session, one must know the energy source being utilized. For bouts of high-intensity exercise of less than 30 s in duration, the primary energy sources are Adenosine Triphosphate (ATP) and Creatine Phosphate which are stored in the muscles. Intense training can deplete these phosphagen stores in 15 second. It takes about 2.5 to 3 minutes to replenish the phosphagen stores needed for the next set of high-intensity effort. Athletes who involved in sports that emphasize high intensity and short term activities required 3-5 minutes rest interval between sets in the strength / power training (ACSM, 2009).

The strength training designed for this athletes focus on high intensity, lower repetition and fast movement in a short period. This protocol is applicable to athletes interested in gaining strength and power but not necessarily interested in intensive muscular hypertrophy or relative endurance. Another good reason use this rest interval when combined with heavy load training, appears to produce greater levels of testosterone

in the strength when combining large muscle group workouts in their training. As we know high levels of testosterone contributes to more strength. Table 1 shown the recommended rest period lengths for strength, power, hypertrophy and muscular endurance programs.

Table 2.1 :

Rest period duration assignments based on the training goal

Training goal	Rest period length
Strength	2-5 minutes
Power Single-effort event Multiple-effort event	2-5 minutes
Hypertrophy	30 seconds-1.5 minutes
Muscular endurance	≤30 seconds

Source: de Salles, Simao, Miranda, da Silva Novaes, Lemos, & Willardson (2009).

2.3 Effect of rest interval length on muscular strength and power adaptations

Richmond and Godard (2004), findings shown that total of rest may be of some importance in determination of lifting performance total volume workout, or both when multiple sets are prescribed. In this study, 28 men lifted 2 sets of the bench press at 75% of their 1 repetition maximum (1RM) to volitional fatigue. The study consisted 3 separate testing session where 1, 3, or 5 minutes rest interval between sets were used. Regardless all the rest interval, there was a compelling decline in the amount of repetitions lifted

between the second. During the second set with the 3- and 5-minute rest interval, there were no significant differences in volume output (repetitions 3 weight) , however the entire volume output when using 1-minute rest period was significantly less compared to both 3- and 5-minute rest interval. The data demonstrated that participants were inadequate to fully restore from fatigue during the first and second sets of maximum strength workout, at all rest interval. However, participants were able to sustain work output of 8–12 repetitions and maintain the entire volume output per set with as shorter as 3 minutes rest between sets in strength workout.

In 2005, Willardson and Burkett compared bench press total work output over 5 sets with load of 50% versus 80% of 1-RM, and 1, 2, or 3 minute rest interval between sets. A continuous decrease in the repetitions existed regardless rest interval between the second through the fifth set, but the 3 minutes rest interval showed lesser reduction than 1 or 2 minutes rest between sets. The amount work performed in the training is a great stimulus to increase strength, the extra repetitions is achieved when 3 minutes rest between sets may be well valuation the additional rest interval

Kraemer and Ratamess (2005), study found differences in total volume of training with 3- versus 1-minute rest intervals. During the testing sessions, all participants were successfully completed the same volume training which is 10 repetitions with 10 RM loads for 3 sets when 3-min rest interval were utilized for the leg press and bench press. Nonetheless, repetitions increasingly decreased from 10, 8 and 7 when the rest interval was reduced to 1 minute respectively. Kraemer and Ratamess (2005), suggested that