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ESTABLISHING AN OPTIMAL RECOVERY TIME BETWEEN REPEATED MAXIMAL STRENGTH SETS ON THE SQUAT AND BENCH PRESS
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ACKNOWLEDGEMENTS

I would like to thank the following people:

Dr Michael G. Hughes for his constant support and advice throughout the last year.

My subjects for their time and efforts.

My friends for all their support, in particular Jonathan George who dedicated much of his valuable time to helping me.

My family for their love, support and belief.
ABSTRACT
The purpose of the present research study was to identify and refine through testing the optimum recovery time between repeated maximal strength sets using the squat and bench press exercises. This study was conducted due to a paucity of data on the optimal inter-set rest duration in the strength and conditioning literature (Hill-Haas., 2007).

Seven male (n= 7) subjects from the University of Wales Institute Cardiff agreed to participate in the study (mean ± SD for age = 21.9 years ± 0.9, body mass = 93.2 kg ± 7.5). Subjects completed 4 repeated sets at their individual 4 RM load across 4 different interset recovery times, 30 seconds, 60 seconds, 90 seconds and 180 seconds. The total number of repetitions completed per set at each recovery period was recorded. Sustainability of repetitions was analysed across all recovery periods for both the squat and bench press.

The study concluded that a relationship existed between the number of repetitions completed at each rest interval on both the bench press and the squat (p<0.05). It was found that the shorter the rest interval between repeated maximal sets, the fewer the mean number of repetitions completed across all 7 subjects. The 180 second rest period between sets allowed for the most recovery and resultantly the highest number of successfully completed repetitions in both exercises. At the 30 second rest interval a statistical significant difference occurred (p=0.21) in the number of repetitions completed in the squat and bench press. The squat was found to be more sustainable across all rest periods than the bench press. The findings were consistent with previous research and the
lower sustainability of repetitions at the shorter recovery periods were attributed to the inability to sufficiently recover from both metabolic and neural fatigue. The findings are of use to strength and conditioning coaches and athletes, who are consistently seeking techniques to optimise adaptations and consequently strength performance. They are also of use to the general public who practice resistance training, they provide general guidelines of recovery for popular exercises.
CHAPTER ONE: INTRODUCTION

1.0 Introduction

Strength has been highlighted as the most important of all biomotor abilities for overall fitness and a prerequisite for the development of many other abilities such as speed, agility and power (Everett, 2007). Strength refers to the skeletal muscle’s ability to contract and exert a force against a resistance (Hazeldine, 1985). More recently strength has been defined by McArdle et al. (2006) as the maximum force, torque, or tension generated by any specific muscle or muscle group. There are many different types and methods of assessing strength. Strength- endurance can be described in both static and dynamic terms. Static strength is the ability to maintain a fixed joint position for a period of time. Whereas, dynamic strength refers to the muscles’ ability to resist fatigue and continually contract in order to sustain a maximal or sub-maximal force for duration of time (Everett, 2007). Maximal strength refers to the muscles ability to overcome maximal resistance, such as a one rep maximum. Absolute strength has been defined by Clegg (1995) as the capacity to produce a large overall force measured in absolute terms kilograms (kg) or Newtons (N). True absolute strength would only be possible in the absence of protective and inhibitory mechanisms, thus is gauged more as an estimated potential quotient (Everett, 2007). Alternatively strength can be expressed as relative, where the maximal force production is related to the body mass, load divided by the body mass, to give a relative value which is a more accurate and fair reflection of strength. Strength is transferable and maximal strength is at the core of strength
development, any increases in maximal strength will transfer to some degree to all types of strength (Everett. 2007). According to McArdle et al. (2006) the most commonly used methods to assess muscular strength are; cable tensiometry, dynamometry, one-repetition maximum (1-RM) and computer-assisted electromechanical and isokinetic determinations.

Strength training has increased markedly in popularity over the last decade and not only amongst the athletic population looking to further enhance performance but also in the general public with individuals looking to improve their physique (Hannie et al., 1995). A large proportion of the active population engage in resistance training as part of their job, their profession, for recreational purposes, rehabilitative reasons and many others (Willardson & Burkett, 2006a). Power underpins successful performance in numerous athletic activities, thus training protocols that optimize strength are of significant value to strength and conditioning coaches and athletes (Lawton et al., 2006). In some sports such as weightlifting strength is virtually the sole determinant of performance. In other sports such as rugby and American football strength is a key determinant but must be coupled with other abilities. Strength training now forms part of most athlete’s training programmes regardless of the sport, the specific sport will inevitably control the intensity and frequency of strength training with regard to how critical it is to performance. For these specific and general reasons it is important to know how to optimize strength gains.
Resistance training programmes are usually designed to stimulate improvements in muscular strength, muscular power, muscular hypertrophy or muscular endurance (Willardson & Burkett., 2006b). Manipulation of specific training variables determines the degree to which these characteristics of strength are increased and the manipulation is dictated by the goal orientation of the individual (Willardson & Burkett., 2006a). The key training variables according to Willardson and Burkett (2006b) are mode of exercise, intensity, volume, frequency, repetition velocity and rest period between sets. Effective strength training utilizes the training variables and principles of training to optimize the stress on the muscle in order to achieve the desired response. The principle of specificity, as noted by Willardson and Burkett (2006b), dictates that the type of muscular adaptation is a direct result of the specific training stimulus applied. Specificity combines with the principle of overload which reflects the percentage of maximum strength a pre-fatigued muscle can exert relative to the 1-RM. Muscular overload is often referred to as training intensity and is quantified as a percentage of the 1-RM and represents the most important principle in determining strength development (McArdle et al., 2006). General muscular strength training requires a load between 85%-100% of the 1 RM typically for between 1 and 6 reps of 1-4 ‘working’ sets (excluding warm up sets) depending on the individual, level and sustainability of the event (Bompa. 1999).
A key and generally overlooked area of focus when designing a proper resistance program is rest duration between sets (Richmond & Goddard, 2004). Recovery is not only essential between sets of performance but also over the entire routine. It is directly related to intensity and volume and must be prescribed accordingly (Everett, 2007). Jeffreys (2005) states that when designing any program it must be understood that only when athletes are able to optimally balance training intensity and subsequent recovery that optimal performance can be achieved. Recovery must be proactive and an integral part of the training program. Recovery has been defined by Jeffrey’s (2005) as an:

“inter-and intra-individual multilevel process in time for the re-establishment of performance abilities”

Optimal rest strategies are dependent upon the individual and the nature of the training, and are influenced by the type of fatigue, current training and non-training levels of stress and their ability to cope with the stressors. Fatigue has been evaluated as a complex phenomenon and a result of both central and peripheral factors (Meeusen et al., 2006). Sale (2002) states that at any point in time the skeletal muscle’s ability to perform is affected by its contractile history and the obvious effect of contractile history is fatigue which inhibits performance. Fatigue can be described as an exercise-induced reduction in maximal force generating capacity and recovery from fatigue involves two stages (Jeffreys, 2005). Short-term recovery involves the re-establishment of performance
parameters such as phosphocreatine (PC) and glycogen stores which takes place during the recovery time between sets, highlighting the importance of inter-set recovery duration. Long-term recovery relates to neural and metabolic processes that take longer to rejuvenate and most importantly the development of the athlete’s tolerance to physiological, psychological and emotional stressors (Jeffreys, 2005). In order to achieve optimal recovery the process needs to encompass techniques specifically tailored to the individual and the goal orientation and systematically integrate them into the training program. If the recovery process is inadequate and muscles are not fully recovered they are unable to maintain training intensity and strength gains are hindered. Continued insufficient recovery can lead to exhaustion and ultimately overtraining.

Resistance training programmes are designed to stimulate improvements which are the result of underlying adaptations. An adaptation is referred to as the way in which the body adjusts to a repeated stimulus (McArdle et al., 2006). Adaptations can occur in both the nervous system and the muscular system. Neural adaptations include increased central nervous system activation, lowered inhibitory reflexes and improved motor unit recruitment and synchronization. Muscular adaptations encompass both structural changes to the musculature and metabolic and cellular adaptations. Adaptations include increased myofibril size, increased amounts of contractile proteins, increased strength of connective tissue, increased intramuscular fuel stores, increased bone mineral content and increased enzyme concentrations (Bompa. 1999).
As stated by Hill-Haas (2007) there is paucity of data on the optimal inter-set rest duration. Therefore the purpose of the investigation is to identify and refine through testing the optimum recovery time between repeated maximal strength sets using the squat and bench press exercises. The squat and bench press exercises have been selected due to their popularity in resistance training programmes and the fact that they are primary exercises used to evaluate strength globally (Ware et al., 1995). Furthermore it aims to establish any relationships between the musculature of the upper and lower body with regard to recovery duration and performance parameters. The findings of the investigation aim to provide further insight into the most effective methods of improving strength gains through strength and conditioning training.
CHAPTER THREE: METHODOLOGY

3.0 Experimental Approach to the Problem

To examine the effects of four differing interset recovery intervals, 30 seconds, 60 seconds, 90 seconds and 180 seconds on 4 repeated sets at 4 RM on squat and bench press performance with the view to establishing an optimal recovery time.

3.1 Subjects

Seven male (n= 7) students from the University of Wales Institute Cardiff agreed to participate in the study (mean ± SD for age = 21.9 years ± 0.9, body mass = 93.2 kg ± 7.5). Subjects were required to have at least 6 months resistance training experience due to the maximal nature of testing. Participants were required to be in good health and free from injury and illness in order to participate in the study. Health status of participants was ascertained through the completion of a Physical Activity Readiness Questionnaire (PARQ) (Woods et al., 2004; Willardson & Burkett 2006a; Miranda et al., 2007) (Appendix A). Participants were also required to complete an informed consent form prior to their involvement in the study in accordance with human subject regulations (Matuszak et al., 2003; Richmond & Goddard 2004; Woods et al., 2004; Willardson & Burkett 2006a) (Appendix B) and made aware they have the right to withdraw from the investigation at any time if they wish to and their names would remain confidential. Subjects were permitted to continue with their individual training routine around testing with the following exceptions; 1) Subjects were asked not to perform leg or chest workouts within 24 hours prior to testing and 2)
subjects were asked not to take part in training prior to or after testing (Willardson & Burkett 2006a). Creatine supplementation was prohibited and subjects reporting use during the time of the study were not eligible and excluded (Rhea et al., 2002). The use of sports beverages and food consumption during training was also prohibited.

3.2 Initial Testing
An initial meeting was held with the eligible participants in order to record their descriptive characteristics such as age and weight. The protocol used to establish the 4 RM was also described to each subject. The protocol for establishing the 4 RM was a manipulation of the reference standard protocol used by Matuszak et al. (2003) to determine 1 RM. A series of four repetitions completed with a progressively heavier load until the subject can no longer lift complete 4 repetitions, this load was their 4 RM. This method was adopted as opposed to using methods which derive 4 RM values from a 1 RM as it enables subjects to familiarise themselves with the equipment and provides a practical representation and replication of the multiple set testing protocol. Subjects were then asked to calculate their individual 4 RM in their own time so as not to place excessive time constraints on them. Individual 4 RM data can be seen in appendix 1. Following this the four recovery intervals were randomized so as to eradicate ‘order effect’ and ‘learning effect’. Subjects were made aware of the sequence of the rest intervals prior to the initiation of the first set of the first bout.
3. 3 Equipment
Subject’s weights were calculated pre-testing using digital weighing scales (SECA, Model 770, Vogel & Halke Hamburg, Germany). A hand held stop watch (Cranlea, Birmingham, UK) was used to time the interset rest periods. The testing was completed on a Smith Machine (Nova fitness, Radstock, UK) for both the squat and bench press protocol. A weight belt was used by all subjects when squatting.

3. 4 Testing Procedure
Due to the volume of testing in each protocol and participant time constraints testing was conducted over the course of two days. Subjects completed testing for the squat and bench press on separate days and the rest interval sequence was randomized for both the squat and bench press. Two time slots were allocated to each subject in which there testing would be carried out in the physiology laboratory at UWIC. The subjects were advised not to eat within 2 hours of testing to make sure they were hydrated.

Masamoto et al. (2003) suggest that several minutes of low-moderate intensity exercise followed by various stretching techniques help the performer prepare for the upcoming exercise. It is also duly noted that warming up increases flexibility, reduces injury incidence and enhances performance (Masamoto et al., 2003). In accordance with this subjects were advised to warm up on the Monark cycle ergometers (Monark Exercise, Sweden). Following this subjects were required to perform 2 warm up sets at 50% and 75% (Matuszak et al., 2003) of their individual 4 RM on the Smith Machine (Nova fitness, Radstock, UK) to prime the
specific muscle groups and to familiarise themselves with the equipment and range of motion. Individuals were then able to perform individual stretches of their choice. This warm up protocol was carried out by each subject before both the squat and bench press protocol. The number of successfully completed repetitions in each of the 4 sets at each of 4 rest intervals for the bench press and the squat were recorded for further analysis.

Subjects were provided with water throughout the testing period. Subjects received verbal encouragement from assisting personnel unless the performer was opposed to it (Ware et al., 1995). “Psyching-up”, which refers to self-directed cognitive methods designed to enhance performance were allowed by subjects (Tod et al., 2005).

3.5 Squat Protocol

All squat testing took place on the Smith Machine (Nova fitness, Radstock, UK). The subject positioned themselves under the bar with the bar aligned across the middle portion of the trapezius and posterior to the deltoid (Figure 2). The scapula was retracted to help stabilise the thoracic spine and the hands grasped the bar at a comfortable point (Ware et al., 1995). Two spotters were positioned either side of the machine to assist in re-racking of the bar upon completion of the repetitions and to ensure correct technique was used, for example, hyperextending the lumbar spine (Willardson & Burkett. 2006a). Subjects wore a support belt to assist in correct technique and prevent injury. Upon setting the feet the subject lifted the bar from the rack and began to lower the bar through
flexion at the knee joint until the bottom of the thighs were parallel to the floor. This was observed and judged by the referee a method previously used by Ware et al. (1995). When the bottom of the thigh was parallel to the floor the referee provided a verbal signal and the subject ascended (Matuszak et al., 2003), this represented a full repetition. The squat assesses the strength of hip extensors (glutes, hamstrings, and hip adductors), knee extensors (quadriceps) and spinal extensors (Everett, 2007). Upon completion of 4 consecutive repetitions the bar was hooked back in the rack. If the full range of motion was not executed in the repetition it was excluded and the rep had to be completed again. Failure to complete the first set of 4 reps at 4RM resulted in termination and re-calculation of the load. If the subject was able to complete the 4 maximal repetitions and more on the first set of the testing then the load was adjusted by 2.5kg on the squat as suggested by Willardson and Burkett. 2006b. Rest intervals were timed using a hand held stop watch (Cranlea, Birmingham, UK) and a passive recovery period was implemented due to the findings of Hannie et al. (1995) who revealed that subjects participating in an active rest interval increased the number of repetitions performed. Ten seconds prior to the end of the rest interval the subject positioned themselves under the bar ready to begin on time.
3.6 Bench Press Protocol
The subjects positioned themselves supine on the bench and gripped the bar approximately 20-30 cm greater than shoulder width with arms extended (Ware et al., 1995). The scapula were slightly retracted and the elbows were positioned out and wrists straight, a technique previously outlined by Everett (2007). With the assistance of spotters, as with the squat, the bar was raised off the rack and slowly lowered through flexion at the elbow joint until the bar touched the chest in line with the nipples (Tod et al., 2005). From this position the bar was raised using the musculature of the chest until the arms were fully extended again, constituting a full repetition (Figure 3). Spotters were present for each repetition in case of momentary failure and the referee made sure correct technique was maintained, for example, making sure the subject’s buttocks remained in contact

Figure 2: Free body diagram of traditional squatting position
with the bench at all times and that the bar was not bounced off the chest (Ware et al., 1995). The bench press assesses the strength of the chest, anterior deltoid and triceps (Everett, 2007). As with the squat, if the subject fails to complete 4 repetitions the load must be re-calculated. If the subject is unable to complete the 4 maximal repetitions and more on the first set of the testing then the load was adjusted by 1.5kg as proposed by Willardson and Burkett (2006b).

![Figure 3: Phases of the barbell bench press motion – (A) Ready position, (B) Downward phase, (C) Ascending phase](image)

3.7 Statistical Analyses
The data was tested for normality using the Kolmogorov–Smirnov test (K-S test).

The Kolmogorov–Smirnov test indicated that the data was not normal. Following this Spearman’s rank correlation coefficient, a non-parametric measure of correlation, was applied to the data to establish a relationship between the number of repetitions completed on the squat and bench press. Kruskal-Wallis non-parametric ANOVA was carried out on the data to establish differences between all interset rest intervals for both exercises. A Wilcoxon signed-rank test
(non-parametric alternative to the paired t-test) was then carried out to identify where these differences lie. The statistical significance value was set at $p<0.05$, making the statistical power of the study strong. A theoretical optimal recovery time was calculated using the y-intersect value in the equation for the line of best fit ($y = mx + c$) from individual subject graphs (Appendix C).
CHAPTER FOUR: RESULTS

4.1 Relationship Between Bench Press and Squat
The main finding from the present research study was that the shorter the rest interval between repeated maximal sets, the fewer the mean number of repetitions completed across 7 subjects (Figure 4). Figure 4 demonstrates that 180 seconds rest between sets allows for the most recovery and resultantly the highest number of successfully completed repetitions in both exercises. Spearman’s rank correlation coefficient revealed that there was a relationship between the number of repetitions completed at each rest interval on both the bench press and the squat (p<0.05), as is evidenced in figure 4.

![Bar chart](image)

Figure 4: Bar chart representing the mean number of repetitions completed per set across 7 subjects at each interset rest interval.
4.2 Differences Across Rest Intervals

Figure 4 illustrates that as the rest interval between sets is increased there is a progressive increase in the number of repetitions completed. The progressive increase is more evident in the bench press, where at the 30 second rest interval on average just below 3 repetitions were completed per set, in comparison to just under 4 repetitions at the 180 second rest interval. In contrast, the squat illustrated a minimal difference in the number of repetitions completed at the longest rest intervals (90 and 180 seconds).

Kruskal-Wallis ANOVA test revealed that there were significant differences (p<0.05) in the number of successful repetitions completed between the bench press and squat across all rest conditions. However, the test did not accentuate which rest interval(s) were responsible for the significant difference. The Wilcoxon signed-rank test revealed a statistically significant difference (p<0.05) at the shortest rest interval (30 seconds) (Table 2). This statistical significance is depicted in Figure 4.

Table 2: Results from the Wilcoxon signed-rank test

<table>
<thead>
<tr>
<th></th>
<th>Squat30 - Bench30</th>
<th>Squat60 - Bench60</th>
<th>Squat90 - Bench90</th>
<th>Squat180 - Bench180</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>-2.309(a)</td>
<td>-.632(a)</td>
<td>-1.327(a)</td>
<td>-.447(a)</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.021</td>
<td>.527</td>
<td>.185</td>
<td>.655</td>
</tr>
</tbody>
</table>

At the 30 second rest interval a statistical significant difference occurred (p=0.21) in the number of repetitions completed in the squat and bench press. The least significant difference (p=0.655) i.e. the most similar in terms of number of
repetitions completed, occurred at the longest rest interval (180 seconds). An interesting finding was revealed at the 90 second rest interval. A greater difference in the number of repetitions completed between exercises was observed at the 90 second rest interval (p=0.185) in comparison to the 60 second rest interval (p=0.527). This is also illustrated in figure 1.

4. 3 Theoretical Optimal Recovery Times

Table 3: Theoretical Optimal Recovery Times (seconds) across all subjects, including calculated means for the bench press and squat.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Squat</th>
<th>Bench Press</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>195</td>
<td>314</td>
</tr>
<tr>
<td>B</td>
<td>191</td>
<td>163</td>
</tr>
<tr>
<td>C</td>
<td>206</td>
<td>167</td>
</tr>
<tr>
<td>D</td>
<td>163</td>
<td>234</td>
</tr>
<tr>
<td>E</td>
<td>177</td>
<td>152</td>
</tr>
<tr>
<td>F</td>
<td>151</td>
<td>173</td>
</tr>
<tr>
<td>G</td>
<td>156</td>
<td>181</td>
</tr>
<tr>
<td>Mean</td>
<td>177</td>
<td>198</td>
</tr>
</tbody>
</table>

The amount of time theoretically required for subjects to successfully complete 4 sets of 4 repetitions (16 repetitions) is presented in table 3. The mean across all subjects suggests that the bench press requires a longer rest period between sets (198 seconds) in comparison to the squat (177 seconds) to sufficiently recover. However, the table reveals large inter-subject variability with some
subjects, for example subject E, demonstrating the need for a longer recovery time on the squat (177 seconds) than on the bench press (152 seconds). This is illustrated in figure 5 where subject E optimally recovers on the bench press prior to the squat.

**Figure 5:** Variability in Subject E - Bench Press and Squat results


APPENDICES
Appendix A: Physical Activity Readiness Questionnaire (PAR-Q)

Physical Activity Readiness Questionnaire (PAR-Q)

Please circle the answers to the following questions:

1. Has your doctor ever said you have a heart condition and that you should only do physical activity recommended by a doctor?
   - Yes / No

2. Do you feel pains in the chest when you do physical activity?
   - Yes / No

3. In the past month have you had chest pain when you were not doing physical activity?
   - Yes / No

4. Do you lose your balance because of dizziness or do you ever lose consciousness?
   - Yes / No

5. Do you have a bone or joint problem that could be made worse by physical activity?
   - Yes / No

6. Is your doctor currently prescribing drugs for blood pressure or a heart condition?
   - Yes / No

7. Do you currently have any muscle, tendon or ligament damage that is aggravated or susceptible to further damage as a result of physical activity?
   - Yes / No

8. Do you know of any other reason why you should not do physical activity?
   - Yes / No
If you have answered yes to any of these questions, please add details below. Similarly, if there are any situations which will prevent you from exercising write them here

Signed..........................................................................................Date.............................................
Appendix B: Informed Consent Form

**UWIC PARTICIPANT CONSENT FORM**

**UWIC Ethics Protocol Number:** APPROVED

**Participant name or Study ID Number:**

**Title of Project:** Establishing an optimal recovery time between repeated maximal strength sets on the squat and bench press

**Name of Researcher:** JAMIE HARRIS

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**Research Investigation Information**

Subjects will be asked to perform a series of repeated multiple maximal strength sets on both the Smith machine bench press and Smith machine squat. Subjects will perform 4 sets of 4 repetitions at their pre-determined 4 repetition maximums (4RM) with 4 varying inter-set recovery times on the squat and bench press. Subjects will receive an ample warm up period where 2 warm up sets at 50% 4RM and 70% 4RM must be undertaken to prepare the specific muscles.
Subjects will have experienced spotters that will spot through each repetition of each set to ensure correct technique and safety is maintained. Subjects will squat and bench to an angle of 90° at the knee and elbow joints respectively. Following completion of the 4 sets a recovery time of 5 minutes will be allowed before the 2 warm up sets of the next exercise commence (the bench press). The 4 designated recovery times for the squat and bench press are; 30 seconds, 60 seconds, 90 seconds 180 seconds. Subjects will receive verbal motivation throughout the testing and will be informed as the rest period time elapses. Upon completion of the testing subjects will receive a 5 minute recovery period.

Testing Requirements

Subjects are asked to adhere to the following in order to be viable for the study;

- To not have consumed alcohol 48hrs prior to testing
- To not be taking any performance enhancing supplements with the exception of protein
- Ensure you are hydrated prior to and for the duration of testing
- To not have consumed food within 2hours prior to testing
- Ensure you are of good health on the day of testing
➢ To wear comfortable clothing that does not restrict motion and to wear proper sports trainers with sufficient ankle support

Participant to complete this section: Please initial each box.

1. I confirm that I have read and understand the information sheet dated ......................... for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my relationship with UWIC, or my legal rights, being affected.

3. I understand that relevant sections of any of research notes and data collected during the study may be looked at by responsible individuals from UWIC for monitoring purposes, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.
4. I agree to take part in the above study.

_______________________________________ ___________________
Signature of Participant:..............................................................................

Date............................................................................................................

_______________________________________ ___________________
Name of person taking consent: .................................................................

Date............................................................................................................

_______________________________________ ___________________
Signature of person taking consent
Appendix C: Theoretical optimal recovery time graphs for each subject

C.1 Subject A

C.2 Subject B
### Subject C

- **Equations:**
  - Linear (Bench): $y = 0.0333x + 10.5$
  - Linear (Squat): $y = 0.0262x + 10.643$

### Subject D

- **Equations:**
  - Linear (Bench): $y = 0.0167x + 12.25$
  - Linear (Squat): $y = 0.031x + 10.964$
C. 7 Subject G

\[ y = 0.0429x + 8.3929 \]

\[ y = 0.019x + 13.036 \]