Acute Cardiovascular Response and Perception of Effort Between the Super Slow and Gold Standard Resistance Training Protocols

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Acute Cardiovascular Response and Perception of Effort Between the Super Slow and Gold Standard Resistance Training Protocols

A Thesis
Presented to
The Faculty of the Department of Physical Education and Recreation
Western Kentucky University
Bowling Green, KY

In Partial Fulfillment
Of The Requirements for the Degree
Master of Science in Physical Education

By
Phillip Jason Wickwire

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Acute Cardiovascular Response and Perception of Effort Between the Super Slow and Gold Standard Resistance Training Protocols

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Director of Thesis

Date

Dean, Graduate Studies and Research
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Acute Cardiovascular Response and Perception of Effort During the Super Slow and 
Gold Standard Training Protocols

Phillip Jason Wickwire July 2003 57 pages

Directed by: Dr. John McLester

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Super Slow training was proposed by Ken Hutchins in a book entitled Super Slow: The Ultimate Exercise Protocol (1992). Since then Super Slow training has been proposed to improve strength more effectively than traditional resistance training and improve cardiovascular measures above aerobic exercise. However, whether this type of training is safe for the older, possibly hypertensive population to which it is being targeted is questionable. To help provide an answer to this question the purpose of this study was to measure blood pressure, heart rate (HR), and ratings of perceived exertion (RPE) while performing the Super Slow resistance training protocol (SS) and compare those measures to the “Gold Standard” slow resistance training protocol (GS). The elbow flexion and knee extension exercise were incorporated for this investigation. The subjects completed three separate testing sessions. Session 1 consisted of obtaining a 1 repetition maximum on the above mentioned exercises and a familiarization trial for SS. The SS trial consisted of three sets of each exercise. Each set consisted of a 10 second concentric phase and a 5 second eccentric phase. HR was monitored using an Acumen HR monitor (Acumen Inc., Sterling, VA). Blood pressure measurements were obtained using an Omron wrist blood pressure monitor (Omron Healthcare Inc., Vernon Hills, IL).
Measurements were taken after set 1, 2, and 3 and 2 minutes post set 3. Measurements were also taken prior to set 2 and 3. RPE’s differentiated to the active musculature were obtained three times per set. GS was administered in the same manner as SS with the exception of speed of movement, resistance, and number of repetitions accomplished. Each set during GS consisted of a 2 second concentric phase and a 4 second eccentric phase. Values were analyzed using repeated measures ANOVA for between and within group comparisons for HR, blood pressure, and RPE. When ANOVA indicated a significant difference, a Bonferroni post hoc procedure was used to detect specific differences between the variables in different trials. Results were considered significant at p ≤ .05. The results showed systolic blood pressure was lower than the resting measurement during the elbow flexion exercise and higher than the resting measurement during the knee extension exercise within trials. Diastolic blood pressure did not change significantly within trials through either protocol. HR was greater during GS as compared to SS for both exercises. RPE was also greater during GS as compared to SS for both exercises. In conclusion, even though systolic blood pressure was greater within SS and GS, a comparison of these protocols showed minimal differences in BP responses suggesting either would be appropriate for the individual to whom strength training is not contraindicated. This assumption is also considering these same results would be seen in the hypertensive populations. However, it should be individualized because different people have differing blood pressure responses. Also, consideration should be given to resistance because of the greater HR and RPE response elicited by GS.
Chapter 1

Introduction

“Super Slow” training is a type of resistance training copyrighted by Ken Hutchins (1992). In his book entitled Super Slow: The Ultimate Exercise Protocol, Super Slow training is defined as performing the concentric phase of a weight training exercise for ten seconds and performing the eccentric phase for five seconds. Since publishing the book in 1992, little research has examined the efficacy of this program.

One study was conducted by Westcott et. al (2001). The primary purpose was to determine if the Super Slow training protocol produced benefits exceeding that of the gold standard protocol with respect to strength enhancement over ten weeks of training. In the study by Westcott (2001) the gold standard protocol involved a four second concentric phase and a two second eccentric phase. The results of this experiment showed that the subjects using the Super Slow protocol made significantly greater gains in strength than subjects using the gold standard protocol. However, as the author mentioned, future research is warranted to determine the effects of this training protocol on blood pressure. Blood pressure was measured in a study conducted by Frazier et. al (2003). However, the goal of this investigation was to compare the effects of super slow training with traditional aerobic exercise (sixteen weeks of training) on resting blood pressure. Acute blood pressure response was not measured. To date there have been no investigations involving the measurements of the acute cardiovascular and perceptual responses to Super Slow resistance training. The acute cardiovascular response to Super Slow resistance training is an important variable to consider because of the population that is being targeted with this protocol (middle aged to elderly individuals). These individuals may be at greater risk for hypertension, which if worsened by a particular
training regimen could contribute to potentially more serious problems such as acute cardiovascular events.

Therefore, the purpose of this study was to measure the acute cardiovascular response (heart rate and blood pressure) and initial perception of effort while performing resistance-training exercises using the Super Slow training protocol versus the gold standard training protocol.

**Statement of Problem**

One of the goals of this study was to further the research as regards Super Slow training to determine the safety of prescribing this type of exercise compared to a more traditional training regimen. This investigation may lead to future research examining older populations that could possibly be hypertensive and to all possibly hypertensive populations that are being targeted. In this study cardiovascular variables of blood pressure, heart rate, and ratings of perceived exertion were measured while subjects performed the Super Slow and gold standard resistance training protocols.

**Significance of the Study**

There has been very little research directed toward Super Slow resistance training. There has been an even smaller number of experiments conducted as regards the cardiovascular responses to Super Slow training. Therefore, it is pertinent to know what effect this training protocol has on acute blood pressure and heart rate responses. These cardiovascular measures are especially important to the older populations that are being targeted with this protocol. It is extremely important to know the effects of Super Slow training for the potentially hypertensive individuals to which this training protocol may be prescribed. Although not as important, it is also valuable information for the general population as well.
**Hypothesis**

The research hypothesis of this investigation was that Super Slow resistance training would elicit a significantly greater cardiovascular response and a greater rating of perceived exertion (RPE) than Gold Standard resistance training. The null hypothesis was that there would be no significant difference in the cardiovascular response and rating of perceived exertion between Super Slow training compared to gold standard training. The rationale for the research hypothesis was a potentially greater ischemic response during Super Slow training. Ischemia is the lack of blood flow to the muscle. It was hypothesized that because of the longer contraction time of the muscle in each phase, that ischemia would possibly reach a greater level. If ischemia is indeed greater during the Super Slow protocol it could generate a greater cardiovascular response and a greater RPE. Another reason for the research hypothesis was the possibility of increased pain during the Super Slow training. Pain stimulates an increase in adrenaline release consequently magnifying the cardiovascular response. If Super Slow training induced a greater pain response, the cardiovascular response could be greater as well. Also, this increase in pain may contribute to a greater response in RPE.

**Delimitations**

This study was limited to the twenty subjects who were all residents of the Western Kentucky area. This investigation is also limited to the age of the participants. Most of the subjects were college aged males and females. This age category could pose a problem because it is not indicative of the population that is being targeted with Super Slow training. Another possible delimitation of this study is the Omron wrist blood pressure monitor that was used. The validation of the wrist blood pressure device is not known.
Limitations

Several aspects of this study could potentially limit its validity. These aspects include but are not limited to the following:

1. The researchers cannot ensure that each subject gave his or her full effort.
2. It is the researcher’s opinion that using the Preston Center may have been a potential problem because of the large number of people that use the facility. If several people were using the weight training equipment at the Preston Center at the time of data collection then an excessive time frame between exercises could occur while waiting for other individuals to finish with the equipment.
3. Estimation of the correct resistance for each protocol could have potentially limited this investigation.

Assumptions

It was the assumption of the researchers involved in this study that the potential obstacles mentioned in the limitations section would not pose a major threat to the validity and reliability of the results.

Definition of Terms

1. Volume – the amount of repetitions and sets accomplished in a given amount of time
2. Frequency – the number of resistance training sessions achieved in a given amount of time
3. Intensity – the amount of weight lifted during a resistance training exercise
4. **Ratings of Perceived Exertion (RPE)** – a numerical rating of exercise intensity based upon an individual’s subjective feelings of physical stress, effort, and fatigue

5. **Concentric** – this term refers to the phase of a resistance training exercise in which the muscle fibers are shortening

6. **Eccentric** – this term refers to the phase of a resistance training exercise in which the muscle fibers are lengthening
Chapter 2

Review of Related Literature

Introduction

It has been hypothesized by Hutchins et. al. (1992) that Super Slow training is superior to normal speed training as regards many variables. However, supporting research is limited. Since the publishing of Hutchins’ book *Super Slow: The Ultimate Exercise Protocol* (1992), a few experiments have been administered to determine the efficacy of this type of training. Super Slow training is proposed to produce superior results in muscular strength. Two researchers have since studied the usefulness of Super Slow training on improving strength. However, conflicting results were found.

One of the experiments that measured strength gains in response to Super Slow training was conducted by Westcott et. al. (2001). His investigation consisted of subjects recruited through the South Shore YMCA in Quincy, Massachusetts. There were a total of 147 participants (46 males and 101 females). The mean age of the subjects was 53.6 and none had any prior history of resistance training. The subjects were separated into two groups. One group trained with the Super Slow protocol, which consisted of a 10 second concentric phase and a 5 second eccentric phase. The second group trained with a regular speed training protocol (gold standard), which consisted of a 2 second concentric phase and a 4 second eccentric phase. All aspects of the 2 training programs were identical except for the speed of contraction and number of repetitions. The basic difference between groups was the time spent in the concentric phase. Each group used the same time (4 seconds) on the eccentric phase of each movement. The participants trained using 1 set per exercise, 2 to 3 times per week for a period of 8 to 10 weeks. The results showed that the Super Slow trainees gained about 50% more strength than did the
regular-speed trainees \((p<0.001)\); thus, according to Westcott et. al. (2001) Super Slow training was superior to regular speed training for improving strength in previously untrained subjects.

Another experiment found conflicting results. Popper et. al. (2000) examined twenty-one experienced weight trainers for 10 weeks. The subjects were split into 2 groups: a Super Slow training (SST) group and a traditional speed training (TST) group. Both groups completed 1 upper-body workout per week. Each workout consisted of 4 exercises, with 6 repetitions per exercise. The author stated that the TST group performed each repetition to a three second count. Therefore, it is unknown the exact amount of time that was spent in the concentric and eccentric phases. The results showed that the SST group showed no significant improvements in strength. Conversely, the TST group displayed a significant increase in upper-body strength in bench press (13.6%) and lat pull-down (13.6%). Thus, on the basis of these findings, it was suggested that SST was not effective for further enhancing muscular strength in resistance trained subjects.

What caused the opposing results of these two studies? The most convincing explanation for the differing results of these two studies is simply that Westcott (2001) used untrained subjects and Popper (2000) used trained subjects. Any type of training program would be expected to improve strength when using untrained subjects. This statement is true because when one begins a resistance training program most of the strength gains are due to neural adaptations, which occur quicker and more rapidly than muscle hypertrophy (Powers and Howley, 2001). Therefore, any training administered to untrained subjects will typically generate positive results. However, in the later stages of training, neural adaptations enhancing strength peak. Therefore, the muscle must
hypertrophy in order to gain strength (Powers and Howley, 2001). Thus for a trained subject to see continuing improvements, a greater stimulus than Super Slow training may be necessary. Also, it should be kept in mind that Westcott et. al. (2001) used subjects with a mean age of 53.6. This population is the one that is being targeted with Super Slow training, thereby possibly having an effect on the outcome of the study.

Another variable where Super Slow training is hypothesized to show superior results is in the improvement of resting blood pressure. According to its founder (Hutchins, 1992), a certified Super Slow program will improve measures of cardiac function at rest including systolic blood pressure, diastolic blood pressure, and mean arterial pressure. In a study by Frazier et. al. (2003), this theory was put to the test. In this experiment thirty-nine college-age males volunteered to be randomly assigned to one of three groups. The three groups were traditional exercise (TE), Super Slow (SS), and a control group (C). Traditional exercise in this investigation consisted of aerobic exercises following the guidelines of the 1998 American College of Sports Medicine (ACSM) position statement. The SS group engaged in a certified Super Slow protocol supervised by a certified Super Slow trainer. The two exercise groups completed sixteen weeks of supervised training based on group assignment with the control group performing normal daily activities. Both training programs were progressive in both volume and intensity. Resting blood pressure was measured via auscultation before and after sixteen weeks of training. The results showed no changes in pre systolic blood pressure, but a significant difference was found between post systolic blood pressure (pre TE = 120.27 mmhg, post TE = 114.64 mmhg; pre SS = 120.86 mmhg, post SS = 120.62 mmhg; pre C = 120.93 mmhg, pre C = 121.38 mmhg). Also, changes in diastolic blood pressure were statistically significant between groups (TE = 70.93 mmhg versus 65.85...
mmHg; SS = 71.27 mmHg versus 75.08 mmHg; C = 74.27 mmHg versus 71.23 mmHg).

Therefore, these measures of cardiac function suggest Super Slow training does not improve resting systolic, diastolic, or mean arterial pressure compared to traditional aerobic exercise. However, whether these results would apply to the older population is unknown. The subjects in this study were younger and normotensive. If this same experiment were conducted in older or hypertensive subjects, it could be speculated that similar results might be found. However, would the difference in pre and post resting blood pressure measures in a similar training study be large enough to make a difference in health related outcomes for these populations? Unfortunately, there is no definite way to know unless similar experiments were conducted on an older or hypertensive population.

To our knowledge these are the only studies that have measured the variables of strength and blood pressure in response to Super Slow training. Obviously investigations on the effects of Super Slow training are sparse. Therefore, more research is warranted to fully understand this type of resistance training. Westcott et al. (2001) stated in his investigation of Super Slow training that there were other potential risks for certain populations when very slow repetition training is used. For example, he did not measure and compare acute blood pressure responses between the training protocols. Therefore, in this study we measured the acute cardiovascular response to Super Slow training versus a gold standard training protocol for the typical slow resistance training routine.

Similar studies have been done using normal resistance training protocols. One of these experiments was conducted by Roltsch et al. (2001). The purpose was to see if the dramatic increase in blood pressure that occurs during weight training persists after the session is completed. The subjects involved in this investigation were sedentary (5 men
and 6 women), resistance-trained (6 men and 6 women), and endurance-trained (4 men and 6 women) volunteers. All were between the ages of 18 and 25. Also, all of the participants were normotensive. Two 24-hour ambulatory blood pressure recordings were made on each subject, one after two sets of resistive exercise on twelve weight machines and one after 48 hours without prior exercise. The results showed that systolic, diastolic, and mean arterial blood pressure and heart rate were not different in the hours after, and for up to 24 hours after, the single resistive exercise session compared with the control day. There also was no difference in the ambulatory blood pressure or heart rate response after the single session of resistive exercise based on the training status of the subjects. Therefore, the elevated blood pressure that occurs during resistive exercise does not persist in the 24 hours after acute resistive exercise in sedentary, resistance-trained, or endurance-trained, normotensive men and women.

A related study was conducted by Gilders et. al. (1991). The purpose of this study was to determine whether conventional resistance training alters 24-hour ambulatory and manually determined casual blood pressure of normotensive women. Seven women between the ages of 21 and 25 trained two days per week for twenty weeks. The results showed that the average values for 24 hour ambulatory blood pressure were not different before and after training. These results indicated that resistance training, which increases muscular strength, muscle fiber area, and lean body mass, does not alter ambulatory or casual blood pressure. Thus, the concern that conventional resistance training may chronically elevate blood pressure does not appear warranted, at least in normotensive women.

Even with this information from the above studies regarding normal speed resistance training, a question still lingers. Will the acute cardiovascular effects from
traditional training be seen when using the Super Slow training protocol? As mentioned earlier, it was hypothesized that Super Slow training would elicit a greater acute cardiovascular response (heart rate and systolic blood pressure) than normal slow training. The rationale for these hypotheses was greater ischemia and a higher pain stimulus. Therefore, if these two factors were indeed greater during the Super Slow resistance training protocol as compared to the normal slow speed resistance training protocol, then it is possible that this study will have differing results than the above studies measuring acute blood pressure following a normal resistance training protocol.
Chapter 3

Methodology

Subjects

Twenty subjects (11 men and 9 women), mainly recruited from various physical education classes, participated in this study. Table 1 describes the physical characteristics of the subjects. Signed, written informed consent was obtained from each subject before his or her participation in the experiment. Following data collection, subjects’ names were blacked out and were replaced with a code number. Hard copies of coded data were stored in the Physical Education office of Dr. John McLester. Approval was obtained for this study through the Western Kentucky University Human Subjects Review Board.

Instruments

The forms that were used in this study included an informed consent form, American College of Sports Medicine (ACSM, 2000) risk stratification form, and a training questionnaire. The ACSM risk stratification form was used to determine if the potential subjects were eligible to participate in this study based on their health history. The training questionnaire was used to establish if the participants could be classified as trained or untrained.

The equipment used to measure cardiovascular variables were an Omron wrist blood pressure monitor (Omron Healthcare Inc., Vernon Hills, IL) and an Acumen heart rate monitor (Acumen Inc., Sterling, VA). A Paramount (Paramount Fitness Corp., Los Angeles, CA) knee extension and elbow flexion machine were used for this experiment. Also, the Borg category ratings of perceived exertion (RPE) and the Omni category
ratings of perceived exertion (RPE) were used to measure how difficult each exercise felt to the subject in the active muscles.

**Procedures**

The investigation consisted of three separate sessions that were completed for each subject in a span of no longer than eight days. All sessions were conducted at the weight room of the Western Kentucky Preston Health and Activities Center. Each session was administered as follows:

**Session 1**

Upon arrival to the Preston Center subjects completed the informed consent form, ACSM risk stratification form, and the training questionnaire. Next, the participants were measured for their height, weight, body composition (electrical bioimpedance), resting blood pressure, and resting heart rate.

The foremost reason for having the subjects come in initially was to measure them for their 1 repetition maximum (1RM). This procedure was accomplished by using the guidelines set forth by the ACSM’s Guidelines for Exercise Testing and Prescription: Sixth Edition (2000). The two lifts that were used for this investigation were the elbow flexion and the knee extension exercise.

Finally, after completion of the 1RM test the subjects completed a familiarization trial. This trial was necessary because subjects are typically unfamiliar with the Super Slow training technique. The Super Slow protocol (SS) consisted of a 10 second concentric phase and a 4 second eccentric phase. The gold standard protocol (GS) consisted of a 2 second concentric phase and a 4 second eccentric phase. The trials were counterbalanced to eliminate any possible training effect. The exercises used were also counterbalanced to reduce the likelihood of an order effect.
Super Slow Trial

Initially, the subjects’ resting blood pressure and resting heart rate were measured. Next, the subjects began the resistance training aspect of the investigation on either the elbow flexion or knee extension exercise. The participants performed 3 sets of each exercise with 3 to 5 minutes of rest between each set and 5 to 8 minutes of rest between each exercise. During the Super Slow protocol, the subjects completed 4 to 6 repetitions per set (Table 2) at a weight set at 40% of the individuals’ 1RM as determined during session 1. The individual repetitions were timed to ensure subjects adhered to the protocol. The total time taken to complete each set was recorded. Heart rate was recorded every 5 seconds with the Acumen heart rate monitor. The intervals used include the following: peak heart rate of set 1, 2, and 3 (P1, P2, and P3) and the minimums post set 1, 2, and 3 (Po1, Po2, and Po3). Blood pressure was taken after each set was completed (P1, P2 and P3), 1 minute before starting set two and three (Pr2 and Pr3) of each exercise, and 2 minutes after completion of the final set (2MP3) of each exercise. Rating of perceived exertion was taken at a beginning point (T1), a mid point (T2), and near failure (T3) of each set with the Borg’s Category Ratings of Perceived Exertion and the Omni Resistance Exercise Scale of Perceived Exertion.

Gold Standard Trial

The gold standard protocol session was administered in the same manner as the “Super Slow” session. The exception was the amount of weight used, the amount of repetitions accomplished, and the amount of time spent in the concentric and eccentric phases. The resistance was set at 65% of the individuals’ 1RM. Because of the greater speed of the movement during this protocol more repetitions were possible; thus, the
participants were able to reach a range of 7 to 10 repetitions per set (Table 3). All other aspects of the investigation were kept the same as the previous session.

**Design and Analysis**

Values were analyzed using SPSS for windows statistical program (v. 10.0). Repeated measures ANOVA was used for between and within trial comparisons ("Super Slow" versus gold standard) for systolic blood pressure, diastolic blood pressure, heart rate, and RPE. When ANOVA indicated a significant difference, a Bonferroni post hoc procedure was used to detect specific differences between the variables in different trials. Results were considered significant at p<0.05.

**Pilot Study**

Pilot work was administered on four different subjects to help determine correct intensities for the two protocols.
Chapter 4

Presentation of Results and Analyses

Subjects

Physical characteristics are presented in Table 1

Table 1
Subjects’ Physical Characteristics (n = 20)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>24.65</td>
<td>3.47</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>174.07</td>
<td>9.88</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>73.18</td>
<td>16.53</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>16.56</td>
<td>4.82</td>
</tr>
<tr>
<td>RBP – Systolic (mmHg)</td>
<td>115.85</td>
<td>10.04</td>
</tr>
<tr>
<td>RBP – Diastolic (mmHg)</td>
<td>73.00</td>
<td>8.75</td>
</tr>
<tr>
<td>Resting Heart Rate</td>
<td>70.60</td>
<td>10.62</td>
</tr>
<tr>
<td>1RM – Knee Extension (kg)</td>
<td>94.46</td>
<td>34.07</td>
</tr>
<tr>
<td>1RM – Bicep Curl (kg)</td>
<td>53.41</td>
<td>27.22</td>
</tr>
</tbody>
</table>
The number of repetitions completed per set during the Super Slow protocol is presented in Table 2. The number of repetitions completed per set during the Gold Standard trial is presented in Table 3.

<table>
<thead>
<tr>
<th></th>
<th>Super Slow</th>
<th></th>
<th>Gold Standard</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>EF Set 1</td>
<td>7.45</td>
<td>1.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EF Set 2</td>
<td>5.83</td>
<td>1.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EF Set 3</td>
<td>5.00</td>
<td>1.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KE Set 1</td>
<td>5.85</td>
<td>1.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KE Set 2</td>
<td>4.60</td>
<td>.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KE Set 3</td>
<td>4.33</td>
<td>.83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EF = Elbow Flexion
KE = Knee Extension
There were no significant differences found in systolic blood pressure between SS and GS for EF or KE (p > .05).

**Systolic BP - KE**
**SS vs GS**

**Systolic BP - EF**
**SS vs GS**
There were no significant differences found in diastolic blood pressure between SS and GS for EF or KE (p > .05).

**Diastolic BP - EF**

SS vs GS

**Diastolic BP - KE**

SS vs GS
There was a significant change in systolic blood pressure (SBP) during the elbow flexion exercise (EF) within trials overtime ($p = .02$). A significant difference occurred between the resting measure ($122.55 \pm 11.46$) and post set 1 ($114.70 \pm 14.96$, $p = .006$) and between the resting measure and post set 3 ($114.48 \pm 16.39$, $p = .042$).
There was a significant change in SBP during the knee extension exercise (KE) within groups over time (p = .016). The significant differences occurred between resting (122.55 ± 11.46) and post set 2 (133.75 ± 19.28, *p = .001) and between resting and prior to set 3 (130.8 ± 17.78, *p = .014). Differences were approaching significance between resting and post set 3 (130.23 ± 18.72, p = .059).
There were no significant differences in diastolic blood pressure (DBP) during the EF exercise within groups overtime ($p = .885$).
There were no significant differences in DBP during the KE exercise within
groups over time ($p = .081$).
KE elicited a significantly greater SBP response as compared to EF (p = .048) during the SS protocol. The significant differences occurred at prior to set 2 (EF=115.6 ± 16.15, KE=134.0 ± 17.56, *p = .043) and post set 2 (EF=116.6 ± 14.94, KE=136.15 ± 20.92, *p = .001) between EF and KE. SBP measure post set 2 (EF=117.05 ± 15.37, KE=130.8 ± 22.16, p = .056) was approaching significance between EF and KE.
KE elicited a significantly greater SBP response as compared to EF (p = .029) during the GS protocol. The significant differences occurred prior to set 3 (EF=113.65 ± 13.23, KE=130.1 ± 16.28, *p = .013), post set 3(EF=111.9 ± 17.37, KE=129.65 ± 15.09, *p = .000), and 2 minutes post set 3(EF=115.15 ± 14.06, KE=127.05 ± 16.09, *p = .023). It is worth noting that even though the measurement at post set 2 (EF=115.35 ± 18.66, KE=131.35 ± 17.7, p = .086) was not statistically significant it is of practical significance.

GS - Systolic BP
EF vs KE

![Graph showing systolic blood pressure comparison between EF and KE](image-url)
There were no significant differences between EF and KE for DBP during SS (p = .449) and GS (p = .344).
GS elicited a significantly greater peak heart rate (PHR) response over SS while performing EF (p = .000). The significant difference occurred for PHR during set 1 (SS=130.55 ± 18.4, GS=144.05 ± 18.86, *p = .02). SS and GS elicited a significantly greater minimum heart rate (MHR; Po1, Po2, and Po3) as compared to the resting value while performing EF (p = .003). Thus, heart rate never reached resting levels between sets.
GS elicited a significantly greater peak heart rate (PHR) response over SS while performing KE (p = .000). The significant difference occurred for PHR during set 1 (SS=125.55 ± 22.53, GS=138.5 ± 16.48, *p = .023) and during set 2 (SS=133.05 ± 24.11, GS=144.8 ± 17.14, *p = .037). SS and GS elicited a significantly greater MHR (Po1, Po2, and Po3) as compared to the resting value while performing KE (p = .002). Thus, heart rate never reached resting levels between sets.

Heart Rate - KE
SS vs GS

![Bar chart showing heart rate comparison between SS and GS during rest and various stages of exercise, with asterisks indicating significant differences.](chart.png)
Overall EF elicited a significantly greater heart rate response than KE during SS (p = .000) and GS (p = .000). However, no significant differences between sets were found at specific time points.
GS elicited a significantly greater rating of perceived exertion on the Borg scale (BRPE) than SS for EF ($p = .030$). The significant differences occurred at T2 (SS=$12.6 \pm 2.46$, GS=$15.95 \pm 1.93$, *$p = .006$) and T3 (SS=$16.85 \pm 1.84$, GS=$18.65 \pm 1.84$, *$p = .033$) for set 1, T1 (SS=$11.8 \pm 2.04$, GS=$13.9 \pm 2.5$, *$p = .027$) and T2 (SS=$15.1 \pm 2.05$, GS=$17.0 \pm 2.03$, *$p = .019$) for set 2, and T3 (SS=$18.1 \pm 1.48$, GS=$19.5 \pm 1.24$, *$p = .015$) for set 3.
GS elicited a significantly greater BRPE than SS for KE (p = .004). The significant difference occurred at T2 (SS = 13.8 ± 1.82, GS = 16.15 ± 1.9, *p = .002) for set 1.
GS elicited a significantly greater rating of perceived exertion on the Omni scale (ORPE) than SS for EF ($p = .009$). The significant differences occurred at T1 (SS=3.65 ± 1.46, GS=5.45 ± 1.32, *$p = .046$), T2 (SS=4.85 ± 1.79, GS=7.55 ± 1.39, *$p = .000$), and T3 (SS=7.9 ± 1.25, GS=9.15 ± 1.14, *$p = .019$) for set 1. For set 2 the differences occurred at T1 (SS=4.65 ± 1.35, GS=6.15 ± 1.57, *$p = .000$) and T2 (SS=6.8 ± 1.28, GS=8.15 ± 1.35, *$p = .006$). For set 3 the differences occurred at T3 (SS=8.8 ± 1.36, GS=9.65 ± .67, *$p = .010$).

**Omni RPE - EF**

SS vs GS

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<table>
<thead>
<tr>
<th>Set</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T1</th>
<th>T2</th>
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</tr>
</tbody>
</table>

Set 1 Set 2 Set 3

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* denotes significant differences ($p < .05$).
GS elicited a significantly greater ORPE than SS for KE (p = .005). The significant differences occurred at T1 (SS=4.1 ± .97, GS=5.25 ± .85, *p = .023) and T2 (SS=5.7 ± 1.26, GS=7.35 ± 1.04, *p = .000) for set 1.


**Discussion of Results**

**Blood Pressure**

As determined by the results of this study there were no significant differences in systolic blood pressure (SBP) and diastolic blood pressure (DBP) between the Super Slow protocol (SS) and the gold standard protocol (GS). Therefore, regarding SBP and DBP, it would be safe to prescribe these training regimens to normotensive populations. Assuming similar results would be found when using hypertensive subjects, prescription of these regimens would also be safe in this group. However, this population was not used for this experiment. Thus, no definite conclusions can be made with respect to hypertensive populations. However because SBP and DBP were not different between protocols, it can be concluded that neither regimen presents a greater danger than the other with respect to acute blood pressure response.

Also, according to the results of this experiment, while performing the elbow flexion (EF) exercise, SBP decreased significantly from the resting value while using the SS and the GS over time. However, while performing the knee extension exercise (KE), the systolic blood pressure response significantly increased above the resting value. A possible explanation for the decrease in SBP during EF could be the subject experienced a vasodilation immediately after cessation of the exercise. It is not known from this experiment what happens to blood pressure during the exercise, but it is hypothesized that the subject experiences a large increase in SBP. However, upon completion of the exercise and relaxation of the muscles being used, SBP may decrease possibly because of vasodilation. Another possible explanation of the lower elbow flexion SBP measures could be from using the wrist blood pressure monitor. It is not know what the effect of elbow flexion exercises will have on the validity of the wrist blood pressure device. As
expected, there was no significant difference observed over time with SS and GS combined in DBP. It was also observed that KE elicited a greater response in SBP during SS and GS as compared to EF. Therefore, according to the findings of this study, it may be prudent to closely monitor the overall intensity prescribed for hypertensive populations on knee extensor exercises regardless of the type of training regimen used. However, these populations were not used during this study; therefore definite conclusions cannot be drawn. Although the difference was found to be significant, the increase was not great enough to be of concern. It merely depends on the individual for whom the exercise is being prescribed because different people have differing blood pressure responses.

**Heart Rate**

The results of this study showed that GS brought about a significantly greater response in heart rate (HR) when compared to SS for both exercises. This response could have been brought about by the greater resistance used during GS. It was thought that by increasing the resistance and the speed of GS that the overall intensity would equal the decreased resistance and speed of SS. However, the greater resistance must have played a role in the greater HR response by GS. Also, the increased number of repetitions per set could have played a role in the greater HR brought about by GS.

**RPE**

Two different rating of perceived exertion scales were used for this investigation. The scales used were the Borg scale (BRPE) and Omni scale (ORPE). Subjects perceived GS as more difficult than SS at each time point. It was initially hypothesized that SS would elicit a greater pain response (RPE) thereby eliciting a greater HR response. However, the results contradicted this hypothesis. GS brought about a greater
RPE or pain response than did SS. Pain causes an increase in adrenaline release. The increase in adrenaline will then cause an increase in the cardiovascular response (HR). Since GS brought about a greater RPE, then it can be assumed that the pain response was higher. Therefore, the greater response in HR brought on by GS could possibly be attributed to its greater RPE. The initial goal prior to starting this study was to equate overall intensity by decreasing the resistance and repetitions of SS and increasing the resistance and repetitions of GS. However, it appears that the greater resistance during GS had an effect on the overall perception of pain, which could have had lead to an increase in adrenaline release. The increased perception of pain and increased adrenaline release could have ultimately contributed to an increase in HR. All of these variables combined possibly had an effect on the greater RPE experienced during GS.

**Rate Pressure Product**

Rate pressure product (RPP) can be determined by multiplying HR by systolic blood pressure. Both of these measures were taken during this investigation. Therefore, some assumptions can be made. According to Howley and Franks et. al. (1997), RPP is indicative of the oxygen requirement of the heart during exercise. Thus, factors that increase HR and systolic blood pressure can increase the oxygen requirement of the heart. In this experiment elbow flexion elicited a lower systolic blood pressure than the resting value, and knee extension brought about a higher systolic blood pressure than the resting value during both protocols. Because GS elicited a significantly greater HR than SS, RPP could be greater while performing knee extensions during GS, causing a greater oxygen demand on the heart. Conversely, since systolic blood pressure was significantly lower during elbow flexion as compared to knee extension RPP would be lower -- thus, not placing as great an oxygen need on the heart. SS did not produce as great a HR as
GS. Therefore, RPP would probably be lower during SS. Finally, RPP should be given consideration when prescribing exercise to hypertensive populations. As regards this study, the greatest concern with RPP would be while performing knee extension during GS. As heart rate and systolic blood pressure go down in SS while performing elbow flexion, RPP becomes a lesser problem. However, it should be kept in mind that this variable was not measured because of the mismatched time points at which HR and blood pressure were measured. Thus, no definite conclusions can be made.
Chapter 5

Summary of Study

This study examined the acute cardiovascular response (heart rate and blood pressure) and initial perception of effort while performing resistance-training exercises using the Super Slow training protocol versus the gold standard training protocol. To date very little research has been conducted on Super Slow training. However, it is still being suggested for older populations that are at a greater risk for hypertension. Westcott et. al. (2001) investigated the strength response while using this type of training with the older population. He found that Super Slow training does elicit a greater improvement in strength as compared to a normal slow speed training protocol. On the other hand, Popper et. al. (2001) found that Super Slow training was not superior to normal slow speed training for improving strength in experienced weight trainers. Therefore, dealing with untrained subjects may have been the reason for Westcott’s et. al. (2001) results. This outcome leads to the conclusion that a greater stimulus may be needed in resistance-trained individuals to bring about greater improvements in strength. Another study involving Super Slow training compared this training protocol to traditional aerobic exercise to compare the improvements in resting blood pressure between the two groups over time (Frazier, 2003). It has been hypothesized that Super Slow training could improve cardiovascular measures, such as blood pressure, to a greater degree than aerobic exercise. However, according to the results reported by Frazier et. al. (2003), traditional aerobic exercise generated greater improvements in resting blood pressure as compared to Super Slow training.

These few studies that have been conducted on the effects of Super Slow training on different variables all serve a great purpose. However, even if this type of training is
superior in improving strength and/or blood pressure, is it safe for the older populations? Can this possibly hypertensive population perform this resistance training protocol without fear of adversely affecting their cardiovascular system? We measured blood pressure, heart rate, and rate of perceived exertion in subjects performing the Super Slow protocol and the gold standard. The safety of SS training appears similar to that of GS for normotensive males and females.

**Conclusion**

In conclusion, even though systolic blood pressure was greater versus rest over time within the Super Slow and gold standard protocols, it is probably still safe to prescribe Super Slow training to hypertensive populations. This statement can be made because even though the differences in systolic blood pressure were significant they were still arguably not great enough to significantly increase the risk for acute cardiovascular events. However, some people have a greater response in blood pressure than others while performing resistance-training exercises. Therefore, the individual and his/her unique response in blood pressure should be kept in mind when prescribing the Super Slow protocol or gold standard protocol. Some individuals may be less tolerant than others. However, hypertensive subjects were not recruited for this study. Therefore, definite conclusions regarding this population cannot be made.

As regards heart rate, the gold standard protocol showed a greater response. Rate of perceived exertion coincided with this rise in heart rate. It appears that the greater resistance in the gold standard protocol elicited a higher degree of pain and therefore a greater heart rate. This rise in heart rate could be an important factor to consider. While generally of less concern with healthy, young, normotensive subjects, it may be a greater
concern when dealing with older populations. This variable could be especially true when prescribing weight training programs to individuals with cardiovascular problems.

**Recommendations for Further Study**

Throughout this investigation references have been made to older populations that could be at a higher risk for being hypertensive. Therefore, future investigations are warranted using this population and other populations at risk for hypertension. If possible, this experiment should be administered again using subjects with cardiovascular problems to see if similar results are found. Also, blood pressure could not be measured throughout the performance of the exercises. In future studies, it would be very valuable to constantly monitor blood pressure throughout each trial.
APPENDICES
APPENDIX A

APPROVAL LETTER FROM

HUMAN SUBJECTS REVIEW BOARD
WESTERN KENTUCKY UNIVERSITY
Human Subjects Review Board
Office of Sponsored Programs
104 Foundation Building
270-745-4652; Fax 270-745-4211
E-mail: Phillip.Myers@Wku.Edu

In future correspondence please refer to HS03-062, March 13, 2003

Phillip Wickwire
372 Pascoe Blvd., Apt. 15
Bowling Green, KY 42101

Dear Phillip:

Your research project, “Acute Cardiovascular Response and Perception of Effort During the “Super Slow” and Gold Standard Training Protocols,” was reviewed by the HSRB and it has been determined that risks to subjects are: (1) minimized and reasonable; and that (2) research procedures are consistent with a sound research design and do not expose the subjects to unnecessary risk. Reviewers determined that: (1) benefits to subjects are considered along with the importance of the topic and that outcomes are reasonable; (2) selection of subjects is equitable; and (3) the purposes of the research and the research setting is amenable to subjects’ welfare and producing desired outcomes; that indications of coercion or prejudice are absent, and that participation is clearly voluntary.

1. In addition, the IRB found that: (1) signed informed consent will be obtained from all subjects. (2) Provision is made for collecting, using and storing data in a manner that protects the safety and privacy of the subjects and the confidentiality of the data. (3) Appropriate safeguards are included to protect the rights and welfare of the subjects.

   a. Your research therefore meets the criteria of Full Board Review and is Approved.

2. Please note that the institution is not responsible for any actions regarding this protocol before approval. If you expand the project at a later date to use other instruments please re-apply. Copies of your request for human subjects review, your application, and this approval, are maintained in the Office of Sponsored Programs at the above address. Please report any changes to this approved protocol to this office. A Continuing Review protocol will be sent to you in the future to determine the status of the project.

Sincerely,

Phillip E. Myers, Ph.D.
Director, OSP and
Human Protections Administrator

cc: Human Subjects File Wickwire HS03-062
cc: Dr. John McLester
APPENDIX B

SCREENING TOOLS
Informed Consent Statement

Project Title: Acute Cardiovascular Response and Perception of Effort During the “Super Slow” and Gold Standard Training Protocols

The purposes of this research are to compare your heart rate and blood pressure during 2 types of strength training exercise. How hard the exercise feels to you will also be measured.

Requirements: As a volunteer in this research project you will be asked to do the following:
1. Complete forms allowing testers to determine the safety of your participation
2. Have your height, weight, body fat, blood pressure and heart rate measured
3. Complete forms on the type and amount of exercise you do and whether you take nutritional supplements
4. Complete 3 separate strength training sessions as follows:
   a. Determine how much weight you can lift a single time with your arms (bicep curls) and your legs (knee extensions) – this is called a “1 rep max” (1RM)
   b. Perform 3 sets of arm exercise and leg exercise in an extremely slow and controlled way. (weight will be based on your “1 rep max” for each exercise)
   c. Perform the same exercise routine – 3 sets of arm and leg exercise – using normal speed movements (weight will be based on your “1 rep max” for each exercise) During both b and c the tester will use a watch to ensure you are performing the exercises at the right speed and using the correct form.

YOU SHOULD NOT PARTICIPATE IF YOU:
1. ARE TRYING TO CONCEIVE CHILDREN
2. YOU ARE TAKING DRUGS (PRESCRIPTION OR ANY OTHER)
3. HAVE A FAMILY HISTORY OF HEART, VASCULAR, OR KIDNEY DISEASE.
4. ALSO, YOU CAN NOT PARTICIPATE IF YOU ARE NOT 18 OR OLDER

All sessions will be completed at the Health and Fitness lab and fitness room at the Preston Center. The 3 exercise trials will be completed on 3 separate days within 1 week and will be as follows:

Session 1 – Determine “1 Rep Max” for legs and arms:

At the beginning of session 1 you will be measured for descriptive data (age, height, weight, and percent body fat). Percent body fat will be estimated by measuring skinfold thickness at your chest, abdomen, and thigh. This process requires testers to pinch your skin and use a small device to measure how thick the pinched skin is. Your heart rate at rest will be measured using a small strap similar to a belt that will be worn around your chest. Blood pressure will also be measured at rest, using a wrist blood pressure monitor.

Next, you will be measured for your 1 Rep Max (1RM). A 1RM is a test to determine the maximal amount of weight that you can lift one time. The procedure will be as follows:
- You will lift a light load as a warm-up
- The amount you then try to lift will be increased by 5 - 10 pounds (depending on the level of difficulty), after each successful lift
- When you attempt a weight that you cannot lift, the trial will be stopped
- Your 1RM will be the weight of the last successful lift

This will be completed for arm exercise (bicep curls) and leg exercise (knee extension)

After completing the 1RM tests and a brief rest you will then complete a trial to practice for the next 2 sessions. This will require you to complete 1 – 3 sets of arm exercise and 1 – 3 sets of leg exercise with an easy weight.

Session 2 – “Super Slow” Speed Training:
- You will perform 3 sets of arm exercise and 3 sets of leg exercise with 2 minutes of rest between each set. You will rest 5 minutes between arm and leg exercises.
- You will complete 4 – 6 repetitions per set at a weight set at 85% of your 1RM
- Each repetition will be timed to ensure you are lifting at the correct “SUPER SLOW” speed
Blood pressure will be taken after each set and after 5 minutes of rest between arm and leg exercise.
Perception of effort will be taken at 15 and 30 seconds into each set and at the completion of each set. This requires you to tell the tester how hard the exercise feels as you lift based on a numbered scale.

Session 3 – Gold Standard Training:
- You will perform 3 sets of arm exercise and 3 sets of leg exercise with 2 minutes of rest between each set. You will rest 5 minutes between arm and leg exercises.
- Each repetition will be timed to ensure you are lifting at the correct gold standard speed.
- You will complete 8 – 12 repetitions per set at a weight set at 75% of your 1RM.
- Blood pressure will be taken after each set and after 5 minutes of rest between arm and leg exercise.
- Perception of effort will be taken at 15 and 30 seconds into each set and at the completion of each set. This requires you to tell the tester how hard the exercise feels as you lift based on a numbered scale.

Discomfort and Risks:
Potential risks to your health and well-being because of your participation include 1) cardiovascular injury (heart attack, stroke, death), 2) severe acute fatigue especially in your arms and legs, 3) lightheadedness, dizziness, nausea, 4) all other possible risks associated with physical exertion and exercise. To avoid some of these risks you should never hold your breath. You should always maintain a normal breathing pattern. You should also expect to experience the following:

- Extreme muscle soreness 1 – 2 days after each session
- Temporary increase in blood pressure
- Temporary increase in heart rate
- Mild to severe fatigue may occur depending on your overall fitness level

The American College of Sport Medicine (2000) suggests the following regarding the potential for risk/injury as the result of participating in an exercise test of this nature:

<table>
<thead>
<tr>
<th>Risk Description</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of Death during or immediately after</td>
<td>&lt;0.01% (1 in 10,000)</td>
</tr>
<tr>
<td>Risk of Heart Attack during or immediately after</td>
<td>&lt;0.04% (4 in 10,000)</td>
</tr>
<tr>
<td>Risk of Hospitalization as a result of testing</td>
<td>&lt;0.2% (2 in 1,000)</td>
</tr>
</tbody>
</table>

The researchers of this investigation are certified by the American Red Cross in cardiopulmonary resuscitation.

Benefits
The benefits that you will receive from participating will include personal information gathered on you throughout the study. Some specific examples include: 1) Body Fat Percentage, 2) Blood pressure at rest and during strength training protocols, 3) Heart rate at rest and during strength training protocols, 4) Advice from a certified personal trainer in resistance training methods.

Confidentiality:
Following data collection, your name will be blanked out and will be replaced with a code number. Hard copies of coded data will be stored in the Physical Education office (locked in Dr. McLeod’s office - 312 Smith Stadium). The data will be kept secure in this manner for a minimum of 3 years after project completion.

Refusal/Withdrawal:
Refusal to participate in this study will have no effect on any future services you may be entitled to from the University. If you agree to participate in this study you are free to withdraw at any time with no penalty. This project is a Masters thesis (of Jason Wickwire). If you would like to contact the faculty advisor (Dr. John McLeod, please feel free to do so. [(270) 745-6042 or john.mclester@wku.edu]. If you are not comfortable contacting Mr. Wickwire or Dr. McLeod, you may also contact Dr. Phil Myers in Sponsored Programs (270) 745-4652.
You understand also that it is not possible to identify all potential risks in an experimental procedure, and you believe that reasonable safeguards have been taken to minimize both the known and potential but unknown risks.

Signature of Participant _______________________________ Date __________

Witness _______________________________ Date __________

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY THE WESTERN KENTUCKY UNIVERSITY HUMAN SUBJECTS REVIEW BOARD. Dr. Phillip E. Myers, Human Protections Administrator: TELEPHONE: (270) 745-4652
SESSION 1
DESCRIPTIVE DATA & TRAINING QUESTIONNAIRE

Subject Name ____________________________ Subject # _____ Date ______

1. Age ________ RBP ________ 1RM Knee Ext. ________

2. Gender ________ RHR ________ 1RM Bicep Curl ________

3. Height ________

4. Weight ________

5. Body Composition

   a. Skinfolds:
      Female: Tricep ________ Male: Chest ________
      Iliac ________ Ab ________
      Thigh ________ Thigh ________
      Sum ________ Sum ________

      Body Fat % ________

   Years experience (weight training) ________ Average frequency ________

   Average number of reps ________ Average number of sets ________

   Free-weights or machines (most often) ________ Type? ________

   Personal goal of this exercise ________ Competitions? ________

   Other forms of exercise ________ Frequency ________ Duration ________

   Other forms of exercise ________ Frequency ________ Duration ________

   Years of the above ________ Competitions? ________

   Personal goal of this exercise ________

   Sports participation? ________

   Supplementation ________ How long? ________

   Would you classify yourself as a “sprinter” or “endurance” athlete by nature? ________

   Do you feel stronger or weaker after a weekend off? ________

   How often do you get sore from exercise? ________
What type of exercise causes the most frequent soreness?

How long does the soreness usually last?

How many days off does it take for you to begin to feel weaker or "out of shape"?
Please mark a response for each item below. If you do not fully understand a question, ask the individual administering the test to clarify.

SECTION 1:
Mark all the following that pertain to you.

Yes No
1. Family history of Heart Disease. Heart complications in father or male first-degree relative before age 55 or before 65 in female first-degree relative

Yes No
2. Current smoker or quit less than 6 months ago

Yes No
3. Hypertension. Resting systolic blood pressure > 140 or diastolic > 90 or currently taking medication for high blood pressure.

Yes No
4. High cholesterol. Total cholesterol > 200 or HDL < 35 or currently taking medication to lower cholesterol. (If LDL is known use > 130)

Yes No
5. Diabetes or impaired fasting glucose. Fasting glucose > 110

Yes No
6. Obesity. BMI > 30 kg/m² or waist > 100 cm (39 inches)

Yes No
7. Sedentary lifestyle. Not participating in regular exercise program.

SECTION 2:
Do you experience any of the following?

Yes No
1. Pain, discomfort in the chest, neck, jaw, arms, or other areas that may be indicative of a heart problem

Yes No
2. Shortness of breath at rest or with mild exertion

Yes No
3. Dizziness or faintness

Yes No
4. Labored breathing especially at night

Yes No
5. Swelling, especially at or near the ankles

Yes No
6. Sever pain in the legs during exertion that goes away with rest

Yes No
7. Fluttering of the heart or rapid heart rate for no apparent reason

Yes No
8. Known heart murmur (mitral valve prolapse, etc)

Are there ANY reasons you know of that you should not perform physical activity?

After completing both sides of this form, submit to the individual administering the test.
APPENDIX C

DATA COLLECTION SHEETS
“SUPER SLOW” PROTOCOL

Subject Name ______________________ Subject # _____ Date __________

RBP _____  RHR _____  40% 1RM _____

BICEP CURL

RPE

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<tr>
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<td>Set 1</td>
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<tr>
<td>Omni RPE (20 sec)</td>
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Cardiovascular Measures

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<td>BP 2min Post 3rd Set</td>
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Set Times

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KNEE EXTENSION

RPE

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Cardiovascular Measures

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Set Times

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# GOLD STANDARD PROTOCOL

Subject Name ___________________________  Subject # _______  Date _________

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<th>RHR</th>
<th>65% 1RM</th>
</tr>
</thead>
<tbody>
<tr>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
</tbody>
</table>

## BICEP CURL

### RPE
- Borg RPE (20 sec) Set 1 ______ Set 2 ______ Set 3 ______
- Omni RPE (20 sec) Set 1 ______ Set 2 ______ Set 3 ______
- Borg RPE (40 sec) Set 1 ______ Set 2 ______ Set 3 ______
- Omni RPE (40 sec) Set 1 ______ Set 2 ______ Set 3 ______
- Borg RPE (NF) Set 1 ______ Set 2 ______ Set 3 ______
- Omni RPE (NF) Set 1 ______ Set 2 ______ Set 3 ______

### Cardiovascular Measures
- BP Prior 1<sup>st</sup> Set ______ BP Prior 3<sup>rd</sup> set ______ HR ______
- BP Post 1<sup>st</sup> Set ______ BP Post 3<sup>rd</sup> set ______ HR ______
- BP Prior 2<sup>nd</sup> Set ______ BP 2min Post 3<sup>rd</sup> Set ______ HR ______
- BP Post 2<sup>nd</sup> Set ______ HR ______

### Set Times
- Start Time Set 1 ______ Set 2 ______ Set 3 ______
- End Time Set 1 ______ Set 2 ______ Set 3 ______
- Total Time Set 1 ______ Set 2 ______ Set 3 ______

## KNEE EXTENSION

### RPE
- Borg RPE (20 sec) Set 1 ______ Set 2 ______ Set 3 ______
- Omni RPE (20 sec) Set 1 ______ Set 2 ______ Set 3 ______
- Borg RPE (40 sec) Set 1 ______ Set 2 ______ Set 3 ______
- Omni RPE (40 sec) Set 1 ______ Set 2 ______ Set 3 ______
- Borg RPE (NF) Set 1 ______ Set 2 ______ Set 3 ______
- Omni RPE (NF) Set 1 ______ Set 2 ______ Set 3 ______

### Cardiovascular Measures
- BP Prior 1<sup>st</sup> Set ______ BP Prior 3<sup>rd</sup> set ______ HR ______
- BP Post 1<sup>st</sup> Set ______ BP Post 3<sup>rd</sup> set ______ HR ______
- BP Prior 2<sup>nd</sup> Set ______ BP 2min Post 3<sup>rd</sup> Set ______ HR ______
- BP Post 2<sup>nd</sup> Set ______ HR ______

### Set Times
- Start Time Set 1 ______ Set 2 ______ Set 3 ______
- End Time Set 1 ______ Set 2 ______ Set 3 ______
- Total Time Set 1 ______ Set 2 ______ Set 3 ______
APPENDIX D

BORG’S CATEGORY RATINGS OF PERCEIVED EXERTION SCALE

AND

THE OMNI RESISTANCE EXERCISE SCALE OF PERCEIVED EXERTION
RPE

6
7 Very, very light
8
9 Very light
10
11 Fairly light
12
13 Somewhat Hard
14
15 Hard
16
17 Very Hard
18
19 Very, Very hard
20
FIGURE 1—OMNI-Resistance Exercise Scale (OMNI-RES) of perceived exertion.
Bibliography


