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Effects of Caffeine on Muscular Strength

Scott Wilson
Western Kentucky University

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EFFECTS OF CAFFEINE ON MUSCULAR STRENGTH

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

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

By
Scott Alan Wilson

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EFFECTS OF CAFFEINE ON MUSCULAR STRENGTH

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Director of Thesis

Dean, Graduate Studies and Research  Date
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Caffeine is the most widely consumed drug in the world. Research has suggested that caffeine can enhance aerobic performance. However, its benefits in the resistance training world are not fully understood. Due to caffeine’s ability to alter pain perception and the onset of peripheral fatigue it may positively affect performance. This study examined the effects of caffeine on muscular strength, determined by the number of successfully completed reps at 85% of 1RM bench press. Fifteen recreationally trained males were tested for their 1RM on bench press. Subjects completed 3 randomized, double blind trials at 85% of their 1RM to failure after receiving caffeine, a placebo, or no treatment. Successful reps were recorded. Data was analyzed using a within group ANOVA (p = 0.05) to compare the differences in reps between trials. No significant differences were found between trials; however the mean number of reps completed was greater for the caffeine vs. placebo trials (7.27 vs. 7.2), suggesting no negative effect occurred as well. Further research is needed utilizing more complete training bouts and lower intensity/higher repetition training.
Chapter One

Introduction

A steady increase in the popularity of strength training has constituted the rise of the use of both legal and illegal ergogenic aids. This rise has occurred at all training levels, from the recreational to the professional athlete, in an attempt to find any possible edge. However, a forgotten and legal ergogenic aid is caffeine. Caffeine is the most commonly consumed drug in the world (Antonio, 2004, Paluska, 2003). Caffeine researchers have reported of its abilities to affect stimulatory receptors in the central nervous system, as well as affect metabolic receptors in peripheral tissues such as skeletal muscles (Antonio, 2004). Other proposed effects of caffeine are the ability to influence psychological states, alter pain perception, decrease fatigue, and elevate mood.

Researchers have suggested that one possible effect of caffeine is its ability to enhance aerobic performance (Costill et al., 1978; Erickson et al., 1987; Bell et al., 2003). Suggested reasons for these increases in performance were an increase in catecholamines and an increase in free fatty acid mobilization. Researchers imply that these changes may result in glycogen sparing, which in turn would create a boost in aerobic performance.

While the majority of caffeine-related research has been done in the endurance training world, a huge gap remains to its possible benefits as an untapped aid in the strength world (i.e., resistance training). One accepted benefit is its effects on peripheral fatigue (James et al. 2003). Peripheral fatigue is primarily due to a combination of impaired calcium release from the sarcoplasmic reticulum (SR) and reduced calcium sensitivity of myofibrils (James et al. 2003). Caffeine is thought to delay the onset of fatigue and increase muscle force by opening calcium channels in the SR and increasing
intracellular calcium concentration, yet a small portion of force could also be attributed to an increased sensitivity of calcium by the myofibrils (James et al. 2004).

Other accepted benefits of caffeine are its effects on the central nervous system and associated increased mental alertness (Sinclair and Geiger, 2000). Due to caffeine’s direct stimulation of the central nervous system it could be proposed that it might have a positive effect on anaerobic performance possibly through augmented acetyl choline function and/or altered pain perception (Sinclair and Geiger, 2000). Along with these direct stimulatory effects of caffeine on the central nervous system and because of its reported positive effect on RPE (Costill et al. 1978; Cole et al. 1996) it is reasonable to assume that caffeine supplementation may show some ergogenic benefits with forms of anaerobic exercise (i.e., resistance training).

Statement of the Problem

This study examined the effects of caffeine on muscular strength ~1 hour after supplementation. Caffeine’s effect was determined through the performance, in number of reps, at 85% of 1RM bench press.

Hypotheses

Caffeine will produce acute improvements in muscular strength, thus improving performance. Performance improvements will be determined by increasing the amount of successfully completed reps.

Significance of the Study

Caffeine’s ergogenic properties are not a recent phenomenon. Research has suggested its potential for at least thirty years dating back to 1978 (Costill et al.) with the majority of this research done on aerobic performance. However the research evidence on
anaerobic performance is limited and inconclusive by comparison, specifically regarding resistance training. Nevertheless, because of caffeine’s direct stimulatory effects on the central nervous system and its ability to alter pain perception (Sinclair and Geiger, 2000) it could be proposed that it may have positive effects on performance of resistance training. If research could provide evidence of caffeine’s potential benefits, it could present strength athletes with a safe, effective, and legal ergogenic aid.

**Limitations**

The study was limited to

Subjects complied with a maintenance workout program during the course of the study.

Subjects maintained current diet.

Error associated with all measurement procedures for determining 1RM and body composition. To insure reliability, the investigator conducted all measures.

Subjects’ motivation.

**Delimitations**

This study was delimited to

30 healthy, recreationally trained, male subjects, aged 18 – 25.

The investigator performing all measures.

The investigator supervising each session.

Body compositions being determined by skinfold measurement.

**Assumptions**

The assumptions of the study were that

All subjects performed to their maximal effort during all trials.
All subjects complied with researcher’s request to not perform other forms of resistance training.

Measurements and instruments are assumed to be valid and reliable.

Subjects will not use other ergogenic aids during this study.

**Definition of Terms**

- Ergogenic aid – a substance, application, or procedure that improves performance.

- Strength training – The process of regularly exerting muscular force against a load in an attempt to increase muscular strength.

- Recreationally trained – Minimum of 5 hours strength training per week for at least 6 weeks.

- 1RM – The maximum amount of weight an individual can successfully lift one time.
Chapter Two

Review of Literature

Caffeine is a safe and effective ergogenic aid (Antonio, 2004). Research has shown that caffeine can elicit ergogenic properties ranging from increased mental alertness and elevated mood to increasing athletic performance (Paluska, 2003). However, the majority of this research on athletic performance has primarily been done utilizing aerobic/endurance activities.

It has been well documented that caffeine significantly enhances aerobic and endurance exercise performance (Costill et al. 1978; Erickson et al. 1987; Bell et al. 2003). Studies suggest reasons for improvement in performance as an increase in catecholamines and an increase in free fatty acid mobilization. These studies concur that these benefits may result in glycogen sparing which in turn would boost aerobic performance.

Glycogen sparing, on the other hand, is not likely to affect short duration or anaerobic performance. However, other physiological effects of caffeine permit a reasonable argument that anaerobic exercise could be influenced by caffeine supplementation. One such effect is caffeine’s direct stimulation of the central nervous system (Sinclair and Geiger, 2000). Due to these plausible effects it could be proposed that caffeine might have a positive effect on anaerobic performance possibly through augmented acetyl choline function and/or alerted pain perception.

Jacobson et al. (1992) suggested that caffeine can favorably affect some strength parameters in highly resistance-trained males. In this study, 20 intercollegiate Division I varsity football players, performed computerized testing, to determine caffeine’s effect on
the strength and power of the knee extensors and flexors. Subjects’ daily caffeine intake was determined by a questionnaire with the mean being 72mg per day. Results from this study showed a significant difference in the amount of peak torque of both knee extension and flexion. The attributed effects in this study to the increase in performance were (1) rapid release of calcium ions from the sarcoplasmic reticulum; (2) decreased rate of calcium ion uptake; (3) increase in the calcium ion permeability of the sarcolemma; and (4) increased intracellular cyclic adenosine 5’ monophosphate levels. Jacobson (1992) also noted that differences in subject fiber type, motivation and caffeine sensitivity need to be elucidated.

James et al. (2004) suggested effects of fatigue on force and power output is reversed by exposure to caffeine in the skeletal muscle of mice. This study suggests the reasons for the effects are due to caffeine’s ability to diminish peripheral fatigue. James (2004) concurs caffeine improves muscular force generation through the opening of calcium channels in the sarcoplasmic reticulum, thus increasing the amount on intracellular calcium. James (2004) also suggested that the plasma concentrations found when caffeine is used to enhance performance in human athletes might not directly affect the contractile performance of fatigued skeletal muscle.

Caffeine research has also reported positive effects on Rating of Perceived Exertion (RPE). One such study was Costill et al. 1978. In this study 9 competitive cyclists exercised until exhaustion on a bicycle erogometer at 80% of Vo2 max. Subjects completed 2 trials. One trial was performed 1 hour after ingesting decaffeinated coffee (Placebo), while the second trial required subjects to consume caffeinated coffee containing 330mg of caffeine 1 hour before exercise. Subjects on average rated their
effort during the caffeinated trail significantly easier, based on RPE, than the demands of the decaffeinated trials.

Cole et al. (1996) reported similar RPE findings. Cole investigated caffeine’s effect on work output at various levels of perceived exertion during cycling exercise. Subjects completed 6 trials 1 hr after consuming either 6mg/kg caffeine (3 trials) or a placebo (3 trials). Each trial consisted of subjects cycling for 10 minutes at 3 different perceived RPE levels, level 9 for the first 10 min, level 12 for the second 10 min., and level 15 for the final 10 min. Subjects performed a significantly greater work output during the caffeine trial (277.8±26.1 kj) versus placebo trial (246.7±21.5 kj).

In each of these studies RPE was lower at a given work rate during aerobic exercise. A reasonable assumption based on these suggestions is that a lower RPE would lead subjects to feeling less fatigued and possibly enhancing their performance during anaerobic bouts as well.

However, in studies by Greer et al. 1998, Powers et al. 1983, and Bell et al. 1998, no positive or negative effect on anaerobic performance (i.e., Wingate maximal anaerobic power test) has been demonstrated. On the other hand, one author has reported contradictory findings to these results. Anselme et al. (1992) administrated a single dose of 250 mg caffeine to subjects before performing a Wingate test. This study used a dosage not relative to the subjects’ bodyweight as had the previous studies. Nevertheless, Anselme found that caffeine supplementation significantly increased maximal anaerobic power compared to a placebo.

Results of caffeine studies on anaerobic performance tend to agree with Greer et al. (1998) in not showing a benefit. Yet, because of the direct stimulatory effects on the
central nervous system, its reported benefits on peripheral fatigue, and because of its reported positive effects on RPE it is still reasonable to assume that caffeine supplementation may show some ergogenic benefits with other forms of anaerobic exercise (i.e., resistance training).
Chapter Three

Methodology

Experimental Design

By design, this study attempted to expose any increases in muscular strength ~1-hour after a caffeine supplementation. The independent variable is the caffeine supplementation and the dependent variable is the number of completed reps at 85% of a 1RM bench press. This study was a randomized, placebo controlled, double-blind, counterbalanced study. Subjects were randomly selected to determine order of trials. All trials were ordered in a counterbalanced fashion, alternating groups between caffeine, placebo, and no treatment for each test sequence.

Subjects

To investigate the possible ergogenic effects of caffeine on muscular strength, fifteen healthy males provided written consent to participate in this study. All procedures were approved by the Human Subjects Review Board of Western Kentucky University. Subjects were classified as recreationally trained, defined as having participated in resistance training for a minimum of 5 hours a week for at least 6 weeks and classified as “low risk” according to America College of Sports Medicine (2000).

Session A: Determination of a 1RM

Subjects first completed an informed consent along with a health status and resistance training questionnaires. Subjects’ descriptive data was then collected and a 1RM established.

Subjects’ height and weight were measured using a Health-O-Meter Scale model 402KL. Body composition was assessed using a 3-site skin-fold method (chest,
abdomen, thigh) according to the ACSM standards using a Lange Skinfold Caliper Model 68902. Waist-To-Hip Ratios were determined per ACSM guidelines using a Body Tape Measure 85410, and Grip Strength was assessed using a hand held TAKEI KIKI KOGYO Dynamometer in accordance with the Canadian Standardized Test of Fitness Operations Manual (3rd ed.).

The 1RM testing was conducted in accordance with the guidelines established by the NSCA. (Earle et al. 1999) (Appendix F) Subjects were allowed to self-select their grip to increase practicality. Subjects performed a familiarization trial with minimal resistance prior to testing ensure they knew exactly how the exercise was expected to be done.

**Sessions B, C, & D**

Sessions B was performed 72 hours after session A. Sessions C and D followed in accordance at 72 hours after the previous session. (McLester et al. 2003) Each trial consisted of a warm up at 50% of their 1RM followed by 3 minutes of rest before performing 85% of their 1RM to failure. Sessions B through D were performed in a randomized, counterbalanced method.

**Caffeine Trial**

Caffeine supplementation was administered in a double blind, placebo controlled method. Each subject received a dosage of caffeine relative to his bodyweight. Doses were equal to ~6 milligrams of caffeine per kilogram of bodyweight as described in the dosage chart (Appendix G). (Greer at al. 1998; Hunter et al. 2002; Tarnopolsky et al. 2000) Caffeine was administered ~1-hour before performing 85% of their maximal capacity to failure. Both placebo and caffeine were administered in pill form that
matched in appearance and taste. In both trials the participants received the sugar to negate any possible effects it could have had on performance. The number of reps completed were recorded and analyzed in comparison to their placebo and no treatment trials in order to determine an ergogenic effect.

**Placebo Trial**

The placebo trial was conducted in the same manner as the caffeine trial. In the Placebo trial subjects received the same number of sugar pills as needed to attain the appropriate dose of caffeine. Subjects then waited ~1-hour before performing 85% of their maximal capacity to failure. The number of successfully complete reps was recorded.

**No Treatment Trial**

In the No Treatment trial subjects came in and received nothing before performing their trial. Subjects were not required to wait the 1 hour period before completing their lift.

**Statistical Analysis**

Comparisons between the trials were made using a within group ANOVA to compare the differences in successfully completed repetitions between testing trials. Alpha level was set at $p = 0.05$. 
Chapter Four

Results

Subjects’ descriptive statistics are displayed in Table 1. All subjects had currently been participating in a resistance training program for a minimum of 6 weeks. Performance characteristics are presented in Table 2. ANOVA revealed no significant difference (p = 0.413) in the number of reps completed with caffeine supplementation compared to the placebo and no treatment groups, suggesting that no ergogenic effect was present.
Chapter Five

Discussion

The purpose of the current study was to compare the difference in the number of reps completed at 85% of a 1RM bench press with caffeine supplementation to a placebo trial and a no treatment trial.

Previous research has shown caffeine to elicit an ergogenic or performance boosting effect in aerobic exercise through increases of catecholamines and free fatty acid mobilization. (Costill et al., 1978; Erickson et al., 1987; Bell et al., 2003) Researchers concluded that these effects may result in glycogen sparing which in turn would boost aerobic performance. However, caffeine research on anaerobic performance is far from being as complete; furthermore, caffeine research on resistance training is still in its very early stages and not completely understood.

In this study it was hypothesized that caffeine would create an acute increase in muscular strength allowing the subjects to complete a greater number of successful repetitions. Previous research had suggested caffeine’s potential ability to positively affect peripheral fatigue (James et al. 2003) and its ability to alter pain perception (Sinclair and Geiger, 2000; Kalmar and Cafarelli, 2004) leading to this hypothesis.

James et al. (2003) state that the effects of peripheral fatigue normally occur due to a combination of impaired calcium release from the sarcoplasmic reticulum and reduced myofibrillar calcium sensitivity. However, research has stated that fatigue can happen under many conditions. (Kalmar and Cafarelli, 2004) Kalmar and Cafarelli (2004) state that in many circumstances fatigue or the termination of exercise is a voluntary act that occurs because of pain and discomfort. While both Kalmar and
Cafarelli (2004) and Sinclair and Geiger (2003) report of caffeine’s ability to alter pain perception, Kalmar and Cafarelli (2004) state that caffeine’s effects on pain induced reductions in motor unit firing rates have not yet been explored.

The current study showed no significant difference in performance at 85% of 1RM bench press with caffeine supplementation versus a placebo. (p = .413) However, the study also suggests that caffeine does not demonstrate any negative effects on bench press performance. This conclusion is reached since the mean numbers of reps completed was slightly greater for the caffeine trial (7.3 reps) compared to the placebo (6.93 reps) and no treatment trials (7.2 reps).

While the current study used an intensity of 85% of 1RM, peripheral fatigue is normally associated with training at a lower intensity (percentage of 1RM) and higher repetitions. Performance in these situations is usually affected due to the “burn” or pain that is commonly felt when performing such exercise. The intensity in the current study may have been too great to experience such effects leading to other causes of muscular failure, before peripheral fatigue had begun to transpire. For this reason subjects may have not been able to fully use caffeine for its proposed benefits.

**Conclusion**

The results of this study suggest that supplementing with caffeine has no significant effect on bench press performance at 85% of a 1RM. These findings were equivocal to a similar study in which Wickwire et al. (2006) suggested that caffeine had no effect on bench press performance performing a 10 repetition max. Though the study showed no significant benefit it did provide more knowledge of the ergogenic effects of caffeine and that some may benefit from caffeine supplementation as an ergogenic aid.
Future research should seek to determine caffeine’s effect in a training program of higher volumes, multiple sets, and complete weight training sessions. Further research should also include training at a lower intensity/higher repetition range that may result in peripheral fatigue as more of the associated mechanism for failure.
Appendix A
Table 1: Subjects’ Descriptive Characteristics (N=15)

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Max</th>
<th>M ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>19</td>
<td>24</td>
<td>21.13 ± 1.46</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>170.2</td>
<td>186.7</td>
<td>177.63 ± 5.4</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>72.5</td>
<td>142.95</td>
<td>84.35 ± 17.2</td>
</tr>
<tr>
<td>Body fat %</td>
<td>3.5</td>
<td>24</td>
<td>11.7 ± 5.5</td>
</tr>
<tr>
<td>Bench Press Max</td>
<td>168</td>
<td>309</td>
<td>240.47 ± 45.22</td>
</tr>
<tr>
<td>85% Bench Press Max</td>
<td>142.8</td>
<td>262.65</td>
<td>204.4 ± 38.43</td>
</tr>
</tbody>
</table>
Appendix B
Table 2: Subjects’ Performance Characteristics (# of reps completed)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>M ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Treatment</td>
<td>7.2 ± 1.37</td>
</tr>
<tr>
<td>Placebo</td>
<td>6.93 ± 1.03</td>
</tr>
<tr>
<td>Caffeine</td>
<td>7.27 ± 1.28</td>
</tr>
</tbody>
</table>

p = .413
Appendix C
INFORMED CONSENT DOCUMENT

Project Title: Effects of Caffeine on Muscular Strength

Investigator: Scott Wilson, Im/Rec, 745-6535

You are being asked to participate in a project conducted through Western Kentucky University. The University requires that you give your signed agreement to participate in this project.

The investigator will explain to you in detail the purpose of the project, the procedures to be used, and the potential benefits and possible risks of participation. You may ask him/her any questions you have to help you understand the project. A basic explanation of the project is written below. Please read this explanation and discuss with the researcher any questions you may have.

If you then decide to participate in the project, please sign on the last page of this form in the presence of the person who explained the project to you. You should be given a copy of this form to keep.

Purpose of the study:
The purpose of this study is to determine the effects of caffeine on muscular strength ~ 1 -hour after supplementation, through the performance, in number of reps, at 85% of a 1RM bench press.

Requirements: As a volunteer in this research project you will be asked to do the following:

1) Perform 4 lab sessions allowing at least 72 hours of rest between each session. Lab sessions B, C, and D will be counterbalanced and randomized.

Session A
Descriptive data will be collected and subjects will be tested for a 1RM Bench Press

Session B, C, & D
Subjects will perform one of these three trials each session. Subjects will either perform a no treatment trial consisting of performing 85% of their maximal bench press to failure or subjects will consume caffeine or a placebo (sugar) ~ 1 -hour before performing 85% of their maximal bench press to failure.

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 - YOU HAVE ANY MUSCULAR OR SKELETAL PROBLEM(S)

During all exercise sessions you will also be asked to tell testers a number for how difficult the exercise feels. Also, you should expect to experience, increased heart rate, possible lightheadedness, sore muscles and other uncomfortable symptoms associated with maximal physical exertion.

1) At the beginning of your first exercise session you will be measured for descriptive data (age, height, weight, and percent body fat). Percent body fat will be estimated by measuring skin fold thickness at your chest, abdomen, and thigh. This process requires testers to pinch your skin and use a small device to measure the thickness of the pinched skin.

2) Prior to participation you MUST complete a questionnaire tool for classifying your level of risk, and the informed consent. These forms will be used to evaluate the safety of your participation as well as your willingness to participate. Any questions you may have about your participation or the forms you complete are welcomed and will be answered to your satisfaction. If these forms indicate it may not be safe for you to participate, the information will be confidential; however, you will not be allowed to continue.

**Risks Due to Participation**
Potential risks to your health and well-being because of your participation include 1) cardiovascular injury (heart attack, stroke, death), 2) severe acute fatigue, 3) lightheadedness, dizziness, nausea, 4) muscle soreness, 5) all other possible risks associated with physical exertion and exercise.

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

- Risk of Death during or immediately after: < 0.01% (1 in 10,000)
- Risk of heart attack during or immediately after: < 0.04% (4 in 10,000)
- Risk of hospitalization as a result of testing: < 0.2% (2 in 1,000)

*Because your health history and current lifestyle habits have been evaluated prior to your participation, and because of the nature (resistance training) of the exercise in this study, your risk is likely lower than those described above.

**Safety of Participation**
We will take every precaution to ensure your safety. It is very important that you fully disclose anything that would increase your risk for exercise. **IT IS IMPORTANT THAT YOU DO NOT CONSUME HEAVY FOODS FOR APPROXIMATELY 3 HOURS PRIOR TO EACH LAB SESSION. DRINK PLENTY OF FLUIDS AND AVOID**
ALCOHOL FOR 24 HOURS BEFORE PARTICIPATING IN THE EXERCISE TRIALS. ALSO, YOU SHOULD REPORT TO THE LAB EACH TIME WELL-RESTED (NO STRENUOUS EXERCISE FOR 48 - 72 HOURS PRIOR TO THE LAB SESSION). Also, do not 1) take medication of any kind; 2) consume any caffeine the days when you are participating.

IF YOU FEEL ILL AT ANY TIME DURING, BEFORE OR AFTER THIS STUDY LET THE INVESTIGATORS KNOW IMMEDIATELY!! IF YOU ARE TRYING TO CONCEIVE CHILDREN, YOU SHOULD NOT PARTICIPATE IN THE STUDY!!

Benefits of Participation
Benefits to subjects will include their 1RM. From this data, subjects can construct a well-designed and effective resistance-training protocol to meet their specific goals. The information may also serve as pre-test data to monitor effectiveness of their program. The study will provide a 1RM Testing Protocol for future use. Also the project will extend the knowledge regarding the ergogenic effects of caffeine.

Right to Withdraw
It is your right to withdraw from the study at any point in time with no penalty. Withdrawing from the study will not adversely affect you in any manner. Refusal to participate in this study will have no effect on any future services you may be entitled to from the University. You should also understand that the investigator might ask you to withdraw from the study.

Privacy
All data will be completely confidential. Your participation in the study will not be recognized nor will any personal information about you be made public. Only the primary investigator will have access to any personal information throughout the study. Should data be presented it will only be presented as group data and individual results will NOT be reported.

Voluntary Consent
If you fully understand what will be asked of you (should you decide to participate), please read and sign the following statement:

I understand that my participation is strictly voluntary and that I am free to withdraw my consent and discontinue participation at any time without penalty or prejudice. I also understand that my confidentiality will be protected and that my name will not be associated with the study results. I have been given the right to ask and have answered any questions that I may have regarding this research. I also understand that any other questions that I may have regarding this research or any procedure may be addressed to Dr. Scott Lyons in the Department of Physical Education and Recreation (745-6035). If you are uncomfortable contacting Dr. Lyons in the Physical Education Department, you may contact Dr. Phillip Myers in the Office of Sponsored Programs (745-4652) who is a
member of the Western Kentucky University Review Board for the Protection of Human Subjects. I have read and understand the above.

Name (please print):

____________________________________________________________

Signature: ___________________________________________ Date:

________________________________________________________

Address: ____________________________________________ Telephone #: __________________
Witness ____________________________ Date: ________________

(Consent form continued)

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.

_________________________________________________________ Date

Signature of Participant

Witness

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
Appendix D
Resistance Training and Supplement Questionnaire

Name: __________________________

Please fill in the following blanks:

1.) I resistance train _____ hours per week.

2.) I train my upper body _____ hours per week.

3.) I train my lower body _____ hours per week.

4.) I have been consistently resistance training for _________ weeks.

Comments: __________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

Please complete the following statements:

1. My training program consist of: _____ total sets for each muscle.
   I perform _____ exercises for each muscle.
   My Rep Range is _____ repetitions per set.

Other comments about your resistance training program?

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

Please list any and all supplements that you are currently taking or have taken in the last month? (I.e. protein, creatine, NOXPLODE)

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________
Appendix E
Health Status
QUESTIONNAIRE
(All information is confidential and is necessary to ensure your safety)

NAME:______________________ DATE:__________
D.O.B.______________________ AGE:___
SEX:___

HEALTH QUESTIONS
(All responses are confidential and used solely to ensure your safety and well-being during your appointments with the fitness professional).

PLEASE ANSWER YES OR NO.

___ Do you have a personal history of coronary or atherosclerotic disease?

___ Any personal history of metabolic disease i.e.: (thyroid)?

___ Do you have diabetes? If so, longer than 15 years? ____
    Or less than 15 years? ____ If so, do you take insulin? ____

************************************************************************
*************************
Have you ever experienced pain or discomfort in your chest during exercise?

___ Any unaccustomed shortness of breath? If so, when? _________________

___ Any dizziness or fainting? If so, when? ____________________________

___ Any breathing difficulties at night? _____ or in cold weather _____ or with exercise?

___ Any rapid throbbing or fluttering of the heart? If so, when?

_____________________________________

___ Any ankle edema (swelling of the ankles)?

___ Any severe pain in the leg muscles during walking/jogging?

___ Do you have a known heart murmur?
Have you ever been told you have high blood pressure? If so, when (High BP is over 140/90).

Do you know your cholesterol? Has it ever been over 240 mg/dl?

Do you have any family history (blood relatives) of cardiac or pulmonary disease prior to age 55?

Do you suffer from frequent heartburn or upset stomach?

GENERAL QUESTIONS

What are your present health goals?

What would you like to know more about?

Are you exercising now?

How often and what are you doing?

Are you on any medications of any kind?

If so, which ones and for what?

Have you had any operations?

If so, for what and when?

Do you smoke? If not, did you ever, regularly?

If you did ever, when did you quit for good?

Do you have or have you had any back, knee or other orthopedic ailments or injuries that may affect your exercise prescription? If so, explain in detail and how is it now?
Were you in any high school or college athletic teams? __________
Which sports and for how long?
Appendix F
NSCA’s 1RM Protocol
Earle et al 1999

1. Instruct the athlete to warm up with a light resistance that easily allows 5 – 10 repetitions.

2. Provide a 1 – min rest period

3. Estimate a warm up load that will allow the athlete to complete 3 – 5 repetitions by adding
   a. 10 – 20 lb or 5% - 10% for upper body exercise or
   b. 30 – 40 lb or 10% - 20% for lower body exercise

4. Provide a 2 – min rest period

5. Estimate a conservative near maximal load that will allow the athlete to complete 2 – 3 repetitions by adding
   a. 10 – 20 lb or 5% - 10% for upper body exercise or
   b. 30 – 40 lb or 10% - 20% for lower body exercise

6. Provide a 2 – 4 min rest period

7. Make a load increase
   a. 10 – 20 lb or 5% - 10% for upper body exercise or
   b. 30 – 40 lb or 10% - 20% for lower body exercise

8. Instruct the athlete to attempt a 1RM

9. If the athlete was successful, provide a 2 – 4 min rest period and go back to step 7.

   If the athlete failed, provide a 2 – 4 min rest period, decrease the load by subtracting
a. 5 – 10 lb or 5% - 10% for upper body exercise or

b. 15 – 20 lb or 10% - 20% for lower body exercise

AND then go back to step 8.
Appendix G
## Caffeine Dosage Chart

<table>
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<th>Body Weight (kg)</th>
<th>Dosage of caffeine (mg)</th>
<th>Average cups of coffee</th>
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References


