UNIVERSITY OF WISCONSIN-LA CROSSE

Graduate Studies

LONG TERM EFFECTS OF PRE-WORKOUT SUPPLEMENTATION ON CLINICAL HEALTH MARKERS IN RECREATIONALLY ACTIVE FEMALES

A Manuscript Style Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science

Brooke E. Zajac

College of Science and Health
Clinical Exercise Physiology

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LONG TERM EFFECTS OF PRE-WORKOUT SUPPLEMENTATION ON CLINICAL HEALTH MARKERS IN RECREATIONALLY ACTIVE FEMALES

By Brooke Zajac

We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Master of Science in Clinical Exercise Physiology

The candidate has completed the oral defense of the thesis.

Andrew Jagim, Ph.D. Thesis Committee Chairperson	4/21/17 Date
Clayton Camic, Ph.D. Thesis Committee Member	4/21/17 Date
Carl Foster, Ph.D. Thesis Committee Member	4/21/17 Date

Thesis accepted

Steven Simpson, Ph.D. Graduate Studies Director	5/11/17 Date

ABSTRACT

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Consuming a multi-ingredient pre-workout supplement (MIPS) to enhance physical capabilities has become increasingly popular. However, limited data is available regarding the long-term safety of consuming such products. Therefore, the purpose of this study was to examine the effects of pre-workout supplementation on health measurements in recreationally active females. Subjects reported to the laboratory for baseline and identical post-data measurements which included blood pressure, heart rate, and blood lipids. They were then randomly assigned to ingest one serving of the pre-workout supplement or placebo daily during a 7-week period. All subjects also completed a standardized strength training program 3 times per week and were provided dietary recommendations. No significant group x time interactions were observed for heart rate ($p = 0.43$), systolic blood pressure ($p = 0.18$), diastolic blood pressure ($p = 0.20$), high density lipoproteins ($p = 0.92$), low density lipoproteins ($p = 0.93$), triglycerides ($p = 0.96$), or total cholesterol ($p = 0.99$). There was a significant main effect for time observed for diastolic blood pressure which decreased over the course of the study ($p \leq 0.001$). Ingesting a MIPS for 7 weeks does not appear to negatively influence clinical markers of health in active females.

ACKNOWLEDGMENTS

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I would also like to thank my amazing parents for their continued love and support throughout my educational career. You both have always pushed me to be the best person that I can be and I cannot thank you both enough for the opportunities you have given me throughout my life thus far.

TABLE OF CONTENTS

PAGE

LIST OF TABLES

LIST OF APPENDICES

INTRODUCTION

According to the National Institutes of Health (2011), a dietary supplement is defined by Congress in the Dietary Supplement Health and Education Act (DSHEA) of 1994 as a product that is intended to supplement the diet, contains one or more dietary ingredients, is intended to be taken by mouth as a pill, capsule, tablet, or liquid, and is labeled on the front panel as being a dietary supplement. A particular category of dietary supplements, multi-ingredient pre workout supplements (MIPS) are a type of supplement that is a proprietary blend of multiple ingredients (Eudy et al., 2013), and are purported to enhance physical capabilities when ingested prior to exercise. Common ingredients in MIPS often include caffeine, beta-alanine, creatine, L-carnitine, and branched chain amino acids (Mueller, & Hingst, 2013).

Each of the ingredients in a MIPS has different theoretical mechanisms of action, from a physiological standpoint. For example, caffeine is a common stimulant used in supplements to prolong exercise endurance and delay fatigue while allowing athletes to train at a greater power output (Graham, 2001), whereas beta- alanine supplementation has been show to delay time to exhaustion and increase ventilatory threshold (Culbertson, Kreider, Greenwood, & Cooke, 2010). It is possible that the combination of these ingredients and other common in MIPS may provide a synergistic benefit on exercise performance. Although MIPS's are widely used, there are limited data available regarding the safety of consuming the supplement. Specifically, it is not clearly understood how ingesting a MIPS influences clinical health markers such as blood

pressure (BP), blood lipids, and heart rate (HR). However, there is some research that has investigated the safety of energy drinks which are often similar in nature, particularly in regards to the caffeine content and in their ability to enhance physical performance. A recent meta-analysis examining the effects of acute ingestion of an energy drink showed that blood pressure measurements were affected, with significant increases in both systolic and diastolic blood pressure parameters from baseline testing after ingestion (Shah et al., 2016). Another study that examined the affect effects of an energy drink in females found that after two and three hours of ingesting the energy drink average systolic blood pressure was increased (Rashti et al., 2009). In addition, Campell et al. (2016) examined the acute effects of a multi-ingredient thermogenic supplement on hemodynamic variables at 60, 120, and 180 minutes post-consumption. Results showed that heart rate was not significantly affected although blood pressure increased (Campell et al., 2016). To the best of our knowledge the safety of long term supplementation in females consuming a MIPS has not been thoroughly explored.

Therefore, the purpose of this study was to observe the long-term effects of ingesting a multi-ingredient pre-workout supplement for seven weeks on clinical health measurements in recreationally active females in conjunction with a standardized exercise program. It was hypothesized that ingesting the supplement Fitmiss™ Ignite™ would cause no significant differences in blood pressure, heart rate, and blood lipids. The results of this longitudinal study allowed identification of the effects of a MIPS in recreationally active females in terms of clinical health.

METHODS

Experiment Design

This study utilized a double-blind, placebo-controlled between subjects design. Before beginning, all subjects attended a familiarization session where the details of the study were explained in detail. Before baseline testing all subjects were asked to fast for eight hours and abstain from any exercise 24 hours before testing. The subjects were assessed for baseline measures of blood pressure and heart rate, and then provided a blood sample in order to analyze baseline cholesterol levels. Subjects were then randomly assigned to one of two groups: either to receive one serving per day of the multi-ingredient pre-workout supplement (MIPS) or placebo (PL). Subjects also participated in a seven week resistance training program while following dietary guideline recommendations. Subjects returned to the lab for the same protocols for post-data collection.

Subjects

Twenty-nine recreationally active females were recruited to participate in this study. However, seven removed themselves from the study due to time conflicts. Subjects were required to complete a questionnaire about their medical history so that those with any medical contraindications to exercise would be excluded from participating in the study. Recreationally active was defined as being physically active 1-2 times per week and have done so for >6 months prior to the study beginning. Subjects were also required to be between the ages of 18-30 and not classified as obese (BMI: <30 kg/m^2).

Contraindications included: any metabolic disorder including known electrolyte abnormalities; heart disease, arrhythmias, diabetes or thyroid disease; a history of hypertension, hepatorenal, musculoskeletal, autoimmune, or neurologic disease; or if they were taking thyroid, anti-hyperlipidemic, hypoglycemic, anti-hypertensive or anti-inflammatory medications. Subjects who were pregnant or breast-feeding were also eliminated. Subjects that were taking birth control medications were asked to consistently take their medication for the duration of the study. If subjects were not taking any contraceptives they were asked to refrain from taking any for the duration of the study. Participants that had taken any ergogenic aids within 3 weeks prior to the beginning of the study were excluded. Subjects that met the eligibility criteria were informed of the requirements of the study and signed informed consent statements in compliance with the Human Subjects Guidelines of the University of Wisconsin – La Crosse and the American College of Sports Medicine.

Testing Procedures

Clinical Health Testing

Baseline blood pressure, heart rate, and blood lipids were taken using standard clinical procedures. Subjects were first asked to remain in the seated position for ten minutes prior to taking and recording all measurements. Blood pressure was taken using an American Diagnostic Corporation ADCUFF (Hauppauge, NY). Heart rate was measured using an Allegiance Oxi-reader (McGaw Park, IL). After HR and BP were taken, blood samples were provided in order to analyze blood lipids. The finger that blood was sampled from was sterilized using an alcohol wipe to avoid contamination. Once the finger was sterilized a Unistik 2 (Marietta, GA) blood sampling device was

used to withdraw blood. Blood lipids, including high-density lipoprotein (HDL-C), low-density lipoprotein (LDL-C), total cholesterol (TC) and triglyceride levels were analyzed using an Alere™ (Waltham, MA) analyzer. Controls were run daily according to the manufacturer instructions. Optics checks and calibration protocols were completed between each subject.

Other Testing Procedures

Weight and height were obtained using a Healthometer (Telstar LLC, Bridgeview, IL) scale.

Dietary Intake

Daily caloric intake was based on the following equation and given to the subjects before the study began as previously used by Layman et al. (2005):

Daily Caloric Intake = (1.3* [10 x weight (kg) + 6.25 x height (cm) – 5 x age (yrs.) – 161]) – 300 kcals

Participants were asked to reduce their caloric intake by 300 kcals per day in order to elicit moderate weight loss. Subjects were asked to make sure they were ingesting all of their macronutrients targets per day and to consume 1.8 grams of protein per kilogram of bodyweight as higher protein intakes have been found to be beneficial during weight loss interventions (Layman et al., 2005). Subjects were instructed to record daily dietary consumption using a commercially available nutritional analysis program (MyFitnessPal, Inc.). With the online program they were able to input what they were eating and receive immediate feedback regarding their daily target values for total energy and macronutrient targets to make necessary adjustments. Daily dietary consumption was monitored weekly and recorded to ensure the subjects were in compliance with the program requirements.

Supplementation

Subjects were randomly assigned to one of two groups to ingest one serving of a placebo of similar taste and texture or the supplement (MusclePharm Fitmiss™ Ignite™), daily. They were assigned to consume one serving of their provided supplement 30 minutes before exercising on training days or one serving of the supplement before breakfast on recovery days.

Side Effect Assessment and Mood State Questionnaire

Subjects were provided with weekly questionnaires on how they tolerated the supplement and to report any side-effects they may have had. On the questionnaire there was a question asking if they took their provided supplement that day in order to monitor participant's adherence to the supplementation protocol, and a question asking if they completed their resistance training program that week as well. Subjects were also asked to assess feelings on energy, fatigue, focus, and desire to complete tasks using a 5-pt Likert scale as previously used by Jagim et al. (2016).

Training

Subjects completed three sessions of a resistance training program per week for a total of seven weeks. They were provided with full body multi-joint exercises that included a variety of different modes and equipment. The equipment that was used included: kettlebells, plate-loaded machines, Olympic bars and plates, dumbbells, medicine balls, and resistance bands. Each of the training sessions took approximately 60-minutes to complete. Two of the days were primarily gym-based workouts and the third day was designed to be an at home workout to allow for more variability and time-flexibility. Gym-based sessions included eight different moderate intensity exercises.

Exercises were designed to be completed in three different sets with short rest periods in between, each set containing eight to twelve repetitions. In order to progress throughout the weeks more weight/resistance was added to the subjects work load. Subjects were instructed to add more weight/resistance after each week that made the last two repetitions difficult but not impossible to complete. At home workouts similarly included eight different moderate intensity exercises that were done in three sets of eight to twelve repetitions with short rest period in between but used body weight as resistance. Subjects kept track of their progression and work-out sessions on a spread sheet that was provided to them and turned in to the researcher at the end of the study to monitor adherence.

STATISTICAL ANALYSIS

Data collected was analyzed using SPSS Statistical Software (SPSS Inc., Chicago, IL). A one way analysis of variance (ANOVA) was used to compare baseline demographics. Any differences at baseline between groups were adjusted using analysis of co-variance (ANCOVA) using pre testing measurements as the covariate. Markers of clinical health were analyzed using a two-way (group x time) ANOVA mixed factorial to compare differences between groups. An independent t-test was used to analyze resistance training data and find differences between volumes. Data were considered statistically significant with probability of a type I error was $p < 0.05$.

RESULTS

Descriptive Statistics

Table 1 presents a summary of baseline demographics.

Table 1. Initial Descriptive Statistics of Both Groups (mean ± SD)

	MIPS	PL	*p* value
Age (years)	20.3 ± 1.5	19.6 ± 0.8	0.20
Height (cm)	66.9 ± 2.0	66.9 ± 2.3	0.96
Weight (kg)	67.8 ± 7.5	66.3 ± 9.5	0.70

Heart Rate and Blood Pressure

No significant group x time interaction was observed for heart rate ($p = 0.43$), systolic blood pressure ($p = 0.18$), or diastolic blood pressure ($p = 0.20$). However, a significant main effect for diastolic blood pressure ($p = 0.00$) was detected, indicating that overall both groups together had a significant decrease in diastolic blood pressure from pre to post testing. Diastolic blood pressure significantly decreased over the course of a seven week span as seen in Table 2.

Table 2. Heart Rate (beats per minute) and Blood Pressure (mmHg) Results (mean ± SD)

	Pre-testing	Post-testing	Δ	*p* value
HR				
MIPS	83.4 ± 15.8	84.6 ± 17.9	+1.2	T: 0.21
PL	77.0 ± 10.0	81.7 ± 16.3	+4.7	GxT: 0.43
Systolic BP				
MIPS	114.7 ± 10.4	108.4 ± 11.8	-6.3	T: 0.06
PL	109.6 ± 7.1	108.4 ± 5.7	-1.2	GxT: 0.18
Diastolic BP				
MIPS	71.3 ± 9.5	63.6 ± 7.0	-7.7	T: 0.00*
PL	67.4 ± 6.1	63.8 ± 6.9	-3.6	GxT: 0.20

*Denotes statistically different from pre-testing ($p<.05$)

Blood Lipid Panel

Subjects with triglyceride levels less than 45 mg/dl did not register on the blood panel, therefore not providing a low-density lipoprotein measurement either. In order to compensate subjects who had a triglyceride measurement lower than 45 mg/dl (n = 5) were given at a set point of exactly 45 mg/dl in order to derive LDL's using the Friedewald equation, which has been validated by Tremblay et al. (2004). The following equation was used: ([LDL-C= (TC) – (HDL-C) - ([TG]/5)).

A significant difference in triglycerides was observed at baseline, as a result pre-testing measurements were used as a covariate to compare differences in triglycerides over time. An analysis of co-variance was used to analyze differences in triglycerides. No

significant group by time interaction or main effect was observed for any of the blood lipid panel measurements as seen in Table 3.

Table 3. Blood Lipid Panel Results in mg/dl (mean ± SD)

	Pre-testing	Post-testing	Δ	*p* value
Triglycerides				
MIPS	60.6 ± 31.6	73.9 ± 20.6	+13.3	T: 0.25
PL	95.9 ± 28.5	99.9 ± 57.2	+4.0	GxT: 0.96
LDL-C				
MIPS	77.9 ± 26.0	78.6 ± 30.6	-0.7	T: 0.90
PL	83.7 ± 27.5	83.8 ± 31.3	+0.1	GxT: 0.93
HDL-C				
MIPS	59.4 ± 19.1	62.6 ± 19.5	+3.2	T: 0.16
PL	54.8 ± 14.6	57.5 ± 13.1	+2.7	GxT: 0.92
TC				
MIPS	152.0 ± 33.5	156.0 ± 38.4	+4.0	T: 0.36
PL	157.4 ± 24.6	161.3 ± 34.4	+3.9	GxT: 0.99

Questionnaire

No significant group x time interaction was observed on the weekly questionnaire for feelings of energy ($p = 0.12$), fatigue ($p = 0.12$), focus ($p = 0.29$), or a desire to complete tasks ($p = 0.73$).

Reported Side Affects

The side effects that were most commonly reported included being "itchy" (n = 3), and having "tingly lips" (n = 3). This was reported by subjects that were assigned to the MIPS but there were no common side effects reported by the placebo group.

Training

In order to analyze adherence to the resistance training program subjects mean training volume was calculated. This volume was found by multiplying repetitions x weight x sets, these numbers were added up per day per week. An independent t-test found no significant differences over time between groups as seen below in Table 4.

Table 4. Mean Training Volume in Kilograms (mean $\pm$ SD)

	MIPS	PL	*p* value
Week 1	7,338.1 $\pm$ 1,336.8	9,029.9 $\pm$ 2,629.6	0.10
Week 3	8,067.6 $\pm$ 1,799.5	8,248.8 $\pm$ 2,213.6	0.85
Week 7	7,520.1 $\pm$ 1,407.5	7,410.3 $\pm$ 1,980.3	0.89

Nutrition Logs

The compliance rate for subjects following their daily and weekly nutrition recommendations was set at 75%, meaning subjects had to be within' 75% of their mean calorie intake recommendation for at least five of the seven weeks. Due to non-compliance three subjects were removed from the study and their data was discarded. No

significant group by time interaction ($p = 0.08$) or main effect ($p = 0.21$) was observed as seen below in Table 5.

Table 5. Mean Caloric Dietary Intake (mean ± SD)

	Recommended	Week 1	Week 3	Week 7
MIPS	1,606.8 ± 119.6	1,736.8 ± 276.3	1,598.8 ± 252.3	1,508.7 ± 257.3
PL	1,637.4 ± 135.9	1,465.1 ± 196.0	1,547.3 ± 254.8	1,489.6 ± 223.2

DISCUSSION

The purpose of this study was to examine the long-term effects of a multi-ingredient pre-workout supplement on clinical health measurements in recreationally active females. Clinical health measurements were defined as blood pressure, heart rate, and blood lipids such as HDL-C, LDL-C, TC, and triglycerides. The main finding of this study was that there were no significant differences observed between the multi-ingredient pre-workout supplement and the placebo in any of the variables measured. While findings from this study suggest that there is a decrease in diastolic blood pressure over seven weeks, it does not appear to otherwise influence any of the other clinical health markers measured.

These results are similar to those from a long term study completed over a period of 28 days by Vogel et al. (2015) that found no changes in hematological markers, BP, or HR in females that ingested the same supplement. Vogel et al. (2015) concluded that ingesting MusclePharm Fitmiss™ Ignite™ is apparently safe to take within recommended dosage guidelines. Kendall et al. (2014) also tested a MIPS that contained caffeine and beta-alanine and similarly found no negative side effects or altering of clinical markers throughout the duration of the study, 28 days, in recreationally active males.

Significant reductions in diastolic blood pressure can come from different physiological factors. The females in this study were all previously active before the start

of the study but exercising more frequently and consistently has been shown to lower blood pressure measurements (Whelton, Chin, Xin, & He, 2002). The mechanism that is thought to help lower blood pressure is by reducing hormones that cause arterioles to constrict, in other words reducing the amount of total peripheral resistance that blood pressure has to work against (Duncan et al., 1985). Secondary, diet and weight loss have been shown to significantly reduce blood pressure parameters (Stevens et al., 2001). The caloric intake equation that was used to give subjects their daily calorie recommendation has been shown to stimulate weight loss (Layman et al., 2005).

A small sample size was a limitation of this study due to participants not adhering to the program and guidelines. Another long term study is needed to exam the effects of a MIPS in females with a larger sample size to reinforce the results found from this study.

This study supports the hypothesis that ingesting a multi-ingredient pre-workout supplement has no negative side effects and causes no differences in blood pressure, heart rate, and blood lipids over a long duration of seven weeks when compared to a placebo. Results from this study indicate that supplementing with a multi-ingredient pre-workout supplement has no adverse side effects or implications on clinical health measurements in active females.

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APPENDIX A

INFORMED CONSENT

INFORMED CONSENT
University of Wisconsin- La Crosse

Protocol Title: Long-term effects of MusclePharm Fitmiss™ Ignite™ supplementation on clinical health measurements, resting energy expenditure, body composition, and training adaptations in recreationally active females

I, _____ volunteer to participate in a research study being conducted by the University of Wisconsin – La Crosse.

1. Purpose and Procedures

- The purpose of this study is to determine the long-term effects of supplementation of MusclePharm Fitmiss Ignite on clinical health measurements, resting energy expenditure, body composition, and training adaptations in recreationally active females.
- My participation will require me to:
    - Follow a high-intensity resistance training program for 8 weeks
    - Consume 1 serving of placebo or Fitmiss Ignite 30 minutes prior to each training session and following breakfast on recovery dates
    - Complete two identical testing sessions (approximately 1 hour long), one pre and one post the training period of 8 weeks. Testing will be held in the Human Performance Lab in Mitchell Hall. Both testing sessions will be completed after fasting for 8 hours and refraining from exercise 24 hours prior to testing. The testing session will include:
        - Height and weight measurements
        - Resting Energy Expenditure and Respiratory Exchange Ratio: laying still for 20 minutes under a metabolic hood.
        - Body composition: sitting still for an air displacement test in the BodPod
        - Resting clinical health measurements including: blood pressure, heart rate, and a finger prick for a blood lipid panel
        - A dynamic warm-up followed by performance tests including: countermovement vertical jump, 1 RM bench press, 1 RM hip sled/leg press, 75% 1 RM bench press to failure, and 75% 1 RM hip sled/leg press to failure.
    - Reduce my caloric intake by 300 kcals to elicit moderate weight loss
    - Submit 4-day dietary logs at baseline, 4 weeks, and 8 weeks. Day-to-day nutritional logs will be performed using a free commercially available software (MyFitnessPal)
- Research will be conducted by Anna Nelson, Brooke Zajac, and Kaela Hoecherl, who are Clinical Exercise Physiology Graduate Students, under the direction of Dr. Andrew Jagim of the Department of Exercise and Sport Science.

2. Potential Risks

- I may experience muscle fatigue and soreness and possibly musculoskeletal injuries from participating in the high intensity resistance training program
- I may experience mild side-effects (dizziness, nausea, etc.) from supplementation but I will be given a weekly questionnaire on how well I tolerate supplementation and to report any side-effects.
- I understand that the risk of serious or life threatening complications is very low in apparently healthy adults.
- Testing will be stopped immediately if there are any complications or adverse side effects appear.

3. Benefits

- As a participant in this study, I will learn my own resting energy expenditure and body composition levels and how my body responds to exercise in terms of blood pressure, heart rate, and lipid levels.
- I have the potential of seeing healthy weight loss.
- I have the opportunity to participate in research to better the knowledge of exercise, sport science, and nutrition.

4. Rights & Confidentiality

- My participation is voluntary. I can choose to discontinue my involvement in the study for any reasons without penalty.
- The results of this study may be published in scientific literature or presented at professional meetings using grouped data only and my personal data will be kept confidential.

I have read the information provided on this consent form in it entirety. I have been informed of the purpose and procedures, potential risks and benefits, and my rights and confidentiality. I have asked any questions that concern me on this study and received clear answers.

If I have any future questions I will contact Anna Nelson, Brooke Zajac, or Kaela Hoecherl, Clinical Exercise Physiology Graduate Students at nelson.anna@uwlax.edu (651-402-3275), zajac.brooke@uwlax.edu (262-945-4304), hoecherl.kaela@uwlax.edu (262-945-1548) or I may also contact Dr. Andrew Jagim, study supervisor, at 608-785-6538 (office) or at ajagim@uwlax.edu. Questions regarding the protection of human subjects may be addressed to the UW-La Crosse Institutional Review Board for the Protection of Human Subjects at 608-785-8124 or irb@uwlax.edu.

Participant: _____
Date: _____

Researcher: _____
Date: _____

APPENDIX B

MEDICAL HISTORY QUESTIONNAIRE

MEDICAL HISTORY QUESTIONNAIRE

Medical History Inventory

Directions. The purpose of this questionnaire is to enable the staff of the Laboratory to evaluate your health and fitness status. Please answer the following questions to the best of your knowledge. All information given is CONFIDENTIAL as described in the Informed Consent Statement.

Name: _____ Age _____ Date of Birth_____

Name and Address of Your Physician:_____

MEDICAL HISTORY

Do you have or have you ever had any of the following conditions? (Please write the date when you had the condition in the blank).

____Heart murmur, clicks, or other cardiac findings?
____Asthma/breathingdifficulty?
____ Frequent extra, skipped, or rapid heartbeats?
____Chest Pain of Angina (with or without exertion)?
____High cholesterol?
____Diagnosed high blood pressure?
____Heart attack or any cardiac surgery?
____Leg cramps (during exercise)?
____Chronic swollen ankles?
____Varicose veins?
____Frequent dizziness/fainting?
____Muscle or joint problems?
____High blood sugar/diabetes?
____Thyroid Disease?
____Low testosterone/hypogonadism?
____Glaucoma?
____Bleeding Disorders
____Bronchitis/Chest Cold?
____Cancer, Melanoma, or Suspected Skin Lesions?
____Stroke or Blood Clots?
____Emphysema/lung disease?
____Epilepsy/seizures?
____Rheumatic fever?
____Scarlet fever?
____Ulcers?
____Pneumonia?
____Anemias?
____Liver or kidney disease?
____Autoimmune disease?
____Nerve disease?
____Psychological Disorders?

Do you have or have you been diagnosed with any other medical condition not listed?
_____
_____

Please provide any additional comments/explanations of your current or past medical history.
_____
_____

Please list any recent surgery (i.e., type, dates etc.).

_____
_____

List all prescribed/non-prescription medications and nutritional supplements you have taken in the last 3 weeks.

_____
_____

What was the date of your last complete medical exam?

_____
_____

Do you know of any medical problem that might make it dangerous or unwise for you to participate in this study? (including strength and maximal exercise tests) . If yes, please explain:

_____
_____
_____

Recommendation for Participation (for Staff use only):

____ No exclusion criteria presented. Subject is *cleared* to participate in the study.
____ Exclusion criteria is/are present. Subject is *not cleared* to participate in the study.

Signed: _____ Date: _____

APPENDIX C

PERSONAL INFORMATION

PERSONAL INFORMATION WORKSHEET

Personal Information

Name: _____

Cell Phone: (___) _____ E-mail address: _____

Birth date: _____ / _____ / _____ Age: _____ Height: _____ Weight: _____

Exercise History/Activity Questionnaire

1. Describe your typical occupational activities.

2. Describe your typical recreational activities

3. Describe any exercise training that you routinely participate.

4. How many days per week do you exercise/participate in these activities?

5. How many hours per week do you train?

6. How long (years/months) have you been consistently training?

APPENDIX D

RESISTANCE TRAINING PROGRAM

Name:					Week #1									
Exercise														
Warm Up		**Day 1**					**Day 2**					**Day 3**		
5-10 Minutes (Bike, etc)		Set	Set	Set			Set	Set	Set			Set	Set	Set
Chest Press	Weight				Shoulder Press	Weight				Pushups	Weight			
(Machine)	Reps	10	10	10	(Dumbbell)	Reps	10	10	10	(Knees, if need be	Reps	10	10	10
Sumo Squat	Weight				Leg Press	Weight				Walking Lunges	Weight			
(Dumbbell)	Reps	12	12	12	(Machine)	Reps	10	10	10	(Bodyweight)	Reps	10	10	10
Lat Pulldown	Weight				Straight Leg	Weight				Calf Raises	Weight			
(Machine (Back)	Reps	10	10	10	Deadlift	Reps	10	10	10	(Bodyweight)	Reps	12	12	12
Alternate Lunges	Weight				Row (Machine)	Weight				Step Ups	Weight			
(Body weight)	Reps	12	12	12	Back	Reps	12	12	12	(Bodyweight)	Reps	10	10	10
Dumbell Row	Weight				Reverse Lunges	Weight				Supermans	Weight			
(Dumbbell)	Reps	12	12	12	Bodyweight	Reps	10/sid	10/sid	10/side	(Bodyweight)	Reps	12	12	12
Mountain Climber					Planks					High Plank				
(Dumbbell)	Reps	30 sec	30 sec	30 sec	Bodyweight	Reps	45 sec	45 sec	45 sec	(Bodyweight)	Reps	45 sec	45 sec	45 sec
Tricep Push Down	Weight				Thrusters	Weight				Tricep Dips	Weight			
(Rope/Pulley)	Reps	10	10	10	(Dumbbell)	Reps	10	10	10	(from chair)	Reps	10	10	10
Hamstrings	Weight				Upright Row	Weight				Squats	Weight			
(Machine)	Reps	10	10	10	(Dumbbell)	Reps	10	10	10	(Bodyweight)	Reps	12	12	12
Cool Down														
~For this first week do a warm up set of each exercise to test out the weight you should be using.														
~Choose a weight that makes the last 1-2 reps difficult but not impossible to complete.														
Notes: To document any changes or what you were feeling about the workout. Note if it was to easy or hard or if you had any pain.														

Name:					Week #2									
Exercise														
Warm Up		**Day 1**					**Day 2**					**Day 3**		
5-10 Minutes (Bike, etc)		Set	Set	Set			Set	Set	Set			Set	Set	Set
Pullups	Weight				Walking Lunges	Weight				Mountain Climb	Weight			
(Bands if needed)	Reps	4	4	4	(Dumbell)	Reps	10	10	10	(bodyweight)	Reps	30 sec	30 sec	30 sec
Back Squat	Weight				Bear Crawl					V Pushups	Weight			
(Barbell)	Reps	10	10	10	Bodyweight	Distanc	50 ft	50 ft	50 ft	(bodyweight)	Reps	10	10	10
Bench Press	Weight				Pushups	Weight	10	10	10	Sumo Squat	Weight			
(Barbell)	Reps	10	10	10	(Bodyweight)	Reps				(bodyweight)	Reps	12	12	12
Deadlift	Weight				Burpess	Weight				Deadlift	Weight			
(Barbell)	Reps	12	12	12	(Bodyweight)	Reps	10	10	10	(hold light weight)	Reps	12	12	12
1-Arm Overhead P	Weight				Side Lunge	Weight				Wide Pushups	Weight			
(Dumbbell) Knees	Reps	10	10	10	(Dumbell)	Reps	8	8	8	(bodyweight)	Reps	10	10	10
Farmers Walk	Weight				Renegade Row	Weight				Glute Bridge	Weight			
(Dumbbell)	Reps	50 ft	50 ft	50 ft	(Dumbell)	Reps	6	6	6	(bodyweight)	Reps	12	12	12
Landmine	Weight				Thruster	Weight				Side Lunges	Weight			
(Barbell)	Reps	10	10	10	(Dumbell)	Reps	10	10	10	(bodyweight)	Reps	10	10	10
1-Arm DB Row	Weight				Plank					V Up Crunches	Weight			
(Machine)	Reps	10	10	10	(Bodyweight)	Reps	60 sec	60 sec	60 sec	(bodyweight)	Reps	10	10	10
Cool Down					*The colored (paired) exercises are to be done									
					in a superset fashion. Go from the first exercise									
					immediately to the second.									
Notes: To document any changes or what you were feeling about the workout. Note if it was to easy or hard or if you had any pain.														

Name:					Week #3									
Exercise														
Warm Up		**Day 1**					**Day 2**					**Day 3**		
5-10 Minutes (Bike, etc)		Set	Set	Set			Set	Set	Set			Set	Set	Set
Chest Press	Weight				Shoulder Press	Weight				Decline Pushups	Weight			
(Machine)	Reps	8	8	8	(Dumbbell)	Reps	8	8	8	(Feet on Stair)	Reps	8	8	8
Sumo Squat	Weight				Leg Press	Weight				Curtsy Lunge	Weight			
(Dumbbell)	Reps	10	10	10	(Machine)	Reps	8	8	8	(bodyweight)	Reps	10	10	10
Lat Pulldown	Weight				Straight Leg	Weight				Tricep Dips	Weight			
(Machine (Back)	Reps	8	8	8	Deadlift	Reps	8	8	8	(from stair)	Reps	10	10	10
Alternate Lunges	Weight				Row (Machine)	Weight				Toe Touch Crunch	Weight			
(Body weight)	Reps	8	8	8	Back	Reps	10	10	10	(bodyweight)	Reps	12	12	12
Dumbell Row	Weight				Reverse Lunges	Weight				Single Leg Squats	Weight			
(Dumbbell)	Reps	10	10	10	Dumbells	Reps	10/sid	10/sid	10/side	(bodyweight)	Reps	10	10	10
Mountain Climber					Planks					High Planks				
Body Weight	Reps	30 sec	30 sec	30 sec	Bodyweight	Reps	45 sec	45 sec	45 sec	(bodyweight)	Reps	45 sec	45 sec	45 sec
Tricep Push Down	Weight				Thrusters	Weight				Calf Raises	Weight			
(Rope/Pulley)	Reps	10	10	10	(Dumbbell)	Reps	8	8	8	(Bodyweight)	Reps	12	12	12
Hamstrings	Weight				Upright Row	Weight				Bird Dogs	Weight			
(Machine)	Reps	10	10	10	(Dumbbell)	Reps	10	10	10	(bodyweight)	Reps	12	12	12
Cool Down														
~For this first week do a warm up set of each exercise to test out the weight you should be using.														
~Choose a weight that makes the last 1-2 reps difficult but not impossible to complete.														
Notes: To document any changes or what you were feeling about the workout. Note if it was to easy or hard or if you had any pain.														

Name:					Week #4									
Exercise														
Warm Up		**Day 1**					**Day 2**					**Day 3**		
5-10 Minutes (Bike, etc)		Set	Set	Set			Set	Set	Set			Set	Set	Set
Pullups	Weight				Walking Lunges	Weight				Clock Lunges	Weight			
(Bands if needed)	Reps	4	4	4	(Dumbell)	Reps	8	8	8	(bodyweight)	Reps	4	4	4
Back Squat	Weight				Bear Crawl	BW				V Pushups	Weight			
(Barbell)	Reps	10	10	10	Bodyweight	Distanc	50 ft	50 ft	50 ft	(bodyweight)	Reps	12	12	12
Bench Press	Weight				Pushups	Weight	12	12	12	Donkey Kicks	Weight			
(Barbell)	Reps	10	10	10	(Bodyweight)	Reps				(bodyweight)	Reps	12	12	12
Deadlift	Weight				Burpees	BW				Step Ups	Weight			
(Barbell)	Reps	12	12	12	(Bodyweight)	Reps	12	12	12	(bodyweight)	Reps	12	12	12
1-Arm Overhead P	Weight				Side Lunge	Weight				Side Plank	Weight			
(Dumbbell) Knees	Reps	10	10	10	(Dumbell)	Reps	6	6	6	(bodyweight)	Reps	30 sec	30 sec	30 sec
Farmers Walk	Weight				Renegade Row	Weight				Wall Sit	Weight			
(Dumbbell)	Reps	50 ft	50 ft	50 ft	(Dumbell)	Reps	8	8	8	(bodyweight)	Reps	30 sec	30 sec	30 sec
Landmine	Weight				Thruster	Weight				Narrow Pushups	Weight			
(Barbell)	Reps	10	10	10	(Dumbell)	Reps	8	8	8	(bodyweight)	Reps	10	10	10
1-Arm DB Row	Weight				Plank	Weight				SL Deadlift	Weight			
(Machine)	Reps	10	10	10	(Bodyweight)	Reps	60 sec	60 sec	60 sec	(bodyweight)	Reps	12	12	12
Cool Down					*The colored (paired) exercises are to be done									
					in a superset fashion. Go from the first exercise									
					immediately to the second.									
Notes: To document any changes or what you were feeling about the workout. Note if it was to easy or hard or if you had any pain.														

Name: _____					Week #5									
Exercise														
Warm Up		**Day 1**					**Day 2**					**Day 3**		
5-10 Minutes (Bike, etc)		Set	Set	Set			Set	Set	Set			Set	Set	Set
Chest Press	Weight				Shoulder Press	Weight				Pushups	Weight			
(Machine)	Reps	8	8	8	(Dumbbell)	Reps	8	8	8	(Knees, if need be	Reps	12	12	12
Sumo Squat	Weight				Leg Press	Weight				Walking Lunges	Weight			
(Dumbbell)	Reps	10	10	10	(Machine)	Reps	8	8	8	(Bodyweight)	Reps	12	12	12
Lat Pulldown	Weight				Straight Leg	Weight				Calf Raises	Weight			
(Machine (Back)	Reps	8	8	8	Deadlift	Reps	8	8	8	(Bodyweight)	Reps	14	14	14
Alternate Lunges	Weight				Row (Machine)	Weight				Step Ups	Weight			
(Body weight)	Reps	14	14	14	Back	Reps	10	10	10	(Bodyweight)	Reps	12	12	12
Dumbell Row	Weight				Reverse Lunges	Weight				Supermans	Weight			
(Dumbbell)	Reps	10	10	10	Bodyweight	Reps	12/sid	12/sid	12/side	(Bodyweight)	Reps	14	14	14
Mountain Climber					Planks					High Plank				
(Dumbbell)	Reps	20 sec	20 sec	20 sec	Bodyweight	Reps	60 sec	60 sec	60 sec	(Bodyweight)	Reps	60 sec	60 sec	60 sec
Tricep Push Down	Weight				Thrusters	Weight				Tricep Dips	Weight			
(Rope/Pulley)	Reps	8	8	8	(Dumbbell)	Reps	8	8	8	(from chair)	Reps	12	12	12
Hamstrings	Weight				Upright Row	Weight				Squats	Weight			
(Machine)	Reps	8	8	8	(Dumbbell)	Reps	8	8	8	(Bodyweight)	Reps	14	14	14
Cool Down														
~For this first week do a warm up set of each exercise to test out the weight you should be using.														
~Choose a weight that makes the last 1-2 reps difficult but not impossible to complete.														
Notes: To document any changes or what you were feeling about the workout. Note if it was to easy or hard or if you had any pain.														

Name: _____					Week #6									
Exercise														
Warm Up		**Day 1**					**Day 2**					**Day 3**		
5-10 Minutes (Bike, etc)		Set	Set	Set			Set	Set	Set			Set	Set	Set
Pullups	Weight				Walking Lunges	Weight				Mountain Climb	Weight			
(Bands if needed)	Reps	6	6	6	(Dumbell)	Reps	8	8	8	(bodyweight)	Reps	45 sec	45 sec	45 sec
Back Squat	Weight				Bear Crawl					V Pushups	Weight			
(Barbell)	Reps	8	8	8	Bodyweight	Distanc	75 ft	75 ft	75 ft	(bodyweight)	Reps	12	12	12
Bench Press	Weight				Pushups	Weight	12	12	12	Sumo Squat	Weight			
(Barbell)	Reps	8	8	8	(Bodyweight)	Reps				(bodyweight)	Reps	14	14	14
Deadlift	Weight				Burpess	Weight				Deadlift	Weight			
(Barbell)	Reps	10	10	10	(Bodyweight)	Reps	12	12	12	(hold light weight)	Reps	14	14	14
1-Arm Overhead P	Weight				Side Lunge	Weight				Wide Pushups	Weight			
(Dumbbell) Knees	Reps	8	8	8	(Dumbell)	Reps	6	6	6	(bodyweight)	Reps	12	12	12
Farmers Walk	Weight				Renegade Row	Weight				Glute Bridge	Weight			
(Dumbbell)	Reps	50 ft	50 ft	50 ft	(Dumbell)	Reps	6	6	6	(bodyweight)	Reps	14	14	14
Landmine	Weight				Thruster	Weight				Side Lunges	Weight			
(Barbell)	Reps	8	8	8	(Dumbell)	Reps	8	8	8	(bodyweight)	Reps	12	12	12
1-Arm DB Row	Weight				Plank					V Up Crunches	Weight			
(Machine)	Reps	8	8	8	(Bodyweight)	Reps	75 sec	75 sec	75 sec	(bodyweight)	Reps	12	12	12
Cool Down					*The colored (paired) exercises are to be done									
					in a superset fashion. Go from the first exercise									
					immediately to the second.									
Notes: To document any changes or what you were feeling about the workout. Note if it was to easy or hard or if you had any pain.														

Name:					Week #7									
Exercise														
Warm Up		**Day 1**					**Day 2**					**Day 3**		
5-10 Minutes (Bike, etc)		Set	Set	Set			Set	Set	Set			Set	Set	Set
Chest Press	Weight				Shoulder Press	Weight				Decline Pushups	Weight			
(Machine)	Reps	6	6	6	(Dumbbell)	Reps	6	6	6	(Feet on Stair)	Reps	10	10	10
Sumo Squat	Weight				Leg Press	Weight				Curtsy Lunge	Weight			
(Dumbbell)	Reps	8	8	8	(Machine)	Reps	6	6	6	(bodyweight)	Reps	12	12	12
Lat Pulldown	Weight				Straight Leg	Weight				Tricep Dips	Weight			
(Machine (Back)	Reps	6	6	6	Deadlift	Reps	6	6	6	(from stair)	Reps	12	12	12
Alternate Lunges	Weight				Row (Machine)	Weight				Toe Touch Crunch	Weight			
(Body weight)	Reps	6	6	6	Back	Reps	8	8	8	(bodyweight)	Reps	14	14	14
Dumbell Row	Weight				Reverse Lunges	Weight				Single Leg Squats	Weight			
(Dumbbell)	Reps	8	8	8	Dumbells	Reps	10/sid	10/sid	10/side	(bodyweight)	Reps	12	12	12
Mountain Climber					Planks					High Planks				
Body Weight	Reps	45 sec	45 sec	45 sec	Bodyweight	Reps	75 sec	75 sec	75 sec	(bodyweight)	Reps	60 sec	60 sec	60 sec
Tricep Push Down	Weight				Thrusters	Weight				Calf Raises	Weight			
(Rope/Pulley)	Reps	8	8	8	(Dumbbell)	Reps	6	6	6	(Bodyweight)	Reps	14	14	14
Hamstrings	Weight				Upright Row	Weight				Bird Dogs	Weight			
(Machine)	Reps	8	8	8	(Dumbbell)	Reps	8	8	8	(bodyweight)	Reps	14	14	14
Cool Down														
~For this first week do a warm up set of each exercise to test out the weight you should be using.														
~Choose a weight that makes the last 1-2 reps difficult but not impossible to complete.														
Notes: To document any changes or what you were feeling about the workout. Note if it was to easy or hard or if you had any pain.														

APPENDIX F

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The purpose of this paper is to review the literature pertaining to the ingredients in a multi-ingredient pre-workout supplement and the effects it has on performance and other resting clinical health measurements such as blood pressure, heart rate, and blood lipids. Other variables that might have an effect on clinical health measurements will also be reviewed.

History of Dietary Supplements

In ancient times it is has been said that athletes and soldiers would consume specific animal parts in order to obtain the agility, speed, and strength that was associated with that specific animal (Applegate & Grivetti, 1997). This is one of the first times recorded in history that consuming a supplement, in this case animal parts, was used to enhance performance. Fast forward a couple thousand years and we now understand the physiological processes ergogenic aids have on the human body.

According to the National Institutes of Health (2011), a dietary supplement is defined by Congress in the Dietary Supplement Health and Education Act (DSHEA) of 1994 as a product that is intended to supplement the diet, contains one or more dietary ingredients, is intended to be taken by mouth as a pill, capsule, tablet, or liquid, and is labeled on the front panel as being a dietary supplement. Prior to this act passing by Congress in 1994, laws on dietary supplements were much stricter. The Food and Drug Administration (FDA) regulated all dietary supplements and they only included essential nutrients such as vitamins, minerals and proteins (Kimpel, 2000). After DSHEA was passed in 1994, there are currently no provisions stating that the FDA has to approve dietary supplements for safety before consumption (National Institutes of Health, 2011).

"Once a dietary supplement is marketed, [the] FDA has to prove that the product is not safe in order to restrict its use or remove it from the market" (National Institutes of Health, 2011).

Multi-ingredient Pre-workout Supplements

Consuming a multi-ingredient pre-workout supplement to enhance exercise performance is a common practice. A survey conducted among college athletes at a Division I university showed that 89% of athletes were using nutritional supplements, and 73% of those athletes were taking the supplement in the form of an energy drink (Froiland, Koszweski, Hingst, & Kopecky, 2004). Commercially available pre-workout products usually contain a proprietary blend of multiple ingredients (Eudy et al., 2013). Each of the ingredients serve a different purpose; some are made to delay fatigue during exercise while others are made to lower fat mass and increase muscular mass/strength. Some of most commonly used ingredients that are in pre-workout supplements include caffeine, beta-alanine, creatine, L-carnitine, and branched chain amino acids.

Caffeine

Caffeine is a stimulant used in supplements to increase endurance and delay fatigue, while letting athletes train at greater power output (Graham, 2001). The International Society of Sports Nutrition supports the use of caffeine at low to moderate doses (3-6 mg/kg) (Goldstein et al., 2010). They state that caffeine has multiple ergogenic properties including: enhancing alertness, sustaining maximal endurance, and is beneficial for high intensity exercise (Goldstein et al., 2010). The use of caffeine as an ergogenic aid is most effective if taken one hour prior to exercise. This allows for it to be

metabolized by the liver and flow into the bloodstream and allows plasma concentrations to reach maximum level (Graham, 2001).

Beta-Alanine

Beta- alanine (BA) is also a highly researched ingredient that is found in most pre-workout supplements. According to a recent meta-analysis, BA is an essential amino acid and has been shown to have beneficial effects on ventilatory threshold and time to exhaustion (Culbertson, Kreider, Greenwood, & Cooke, 2010). According to Culbertson et al. (2010), BA increases levels of muscle carnosine in skeletal muscle. Muscle carnosine is known to act as a physiological buffer and reduces the acidity in active muscles during high intensity exercise (Culbertson et al., 2010). This not only helps with the accumulation of lactic acid but also with the accumulation of hydrogen ions (Culbertson et al., 2010). Reducing the acidity of muscles during exercise is thought to delay muscle fatigue.

Creatine

Creatine is found in the muscle as phosphocreatine (PC). As muscles are working during exercise PC is depleted in order to defend the muscle adenosine triphosphate (ATP) concentration (Kreider et al., 1998). Kredier et al. (1998) states that there have been many speculations that ingesting a creatine supplement may allow for a greater amount of PC to be available and this is turn will allow faster re-synthesis to ATP for energy. A study that tested the addition of creatine as a supplement found that there was increased gains in fat-free mass, lifting volume, and sprint performances during intense resistance and agility training (Kreider et al., 1998). Creatine ingestion also has been

shown to increase the availability of total creatine concentrations in the muscle during high intensity performance (Culbertson, Kreider, Greenwood, & Cooke, 2010).

L-Carnitine

L-Carnitine is an amino acid that has been widely researched in animals such as mice, rats, and fish. L-Carnitine (LC) is the bioactive form of carnitine and has been shown to increase energy expenditure and fatty acid oxidation (Kim, Pan, Lee, & Kim, 2015). Kim, Pan, Lee, and Kim (2015) found that administering LC to mice and having them train 3 days a week on a treadmill promotes fat oxidation while sparing muscle glycogen during longs bouts of exercise, which resulted in an enhanced endurance capacity. While there are other studies that show success with the consumption of LC in animals there is little research on how it affects humans.

Branched-Chain Amino Acids

Branched-chain amino acids (BCAA) have little to do with performance and more to do with recovery from exercise. It has been shown that BCAA supplementation is beneficial for decreasing exercise-induced muscle damage (Negro, Giardina, Marzani, & Marzatico, 2008). Muscle damage will develop into delayed onset muscle soreness (Negro, Giardina, Marzani, & Marzatico, 2008).

The safety of consuming a multi-ingredient pre-workout supplement (PWS) is still debated. Dietary supplements are not regulated by the FDA. This means that ingredients are not regulated and in turn are not tested for purity (Eudy et al., 2013). According to Eudy et al. (2013), since PWS are not verified by the FDA, the labels of the supplement might not tell all of the ingredients. It has also been reported the supplements cause adverse effects. These effects include: stomach distress, arrhythmias, increased

blood pressure, and potential effects on blood lipids and blood glucose (Eudy et al., 2013). However, a recent study found contradictory results. Vogel, Joy, Falcone, Mosman, Kim, and Moon (2015) found that consuming a PWS containing BA, caffeine, L-carnitine, and BCAA's caused no abnormal changes or side effects.

Effects of PWS on Clinical Health Measurements

In relation to my study resting clinical health measurements are represented as blood pressure, heart rate, and blood lipids/triglycerides. Blood lipids include high-density lipoproteins (HDL-C) and low-density lipoproteins (LDL-C); added together with triglycerides these make-up the total cholesterol level. Ingesting a PWS has been shown to have effects on these particular variables.

Blood pressure can be broken down into systolic blood pressure (SBP) and diastolic blood pressure (DBP). A meta-analysis researching how consuming an energy drink affects blood pressure showed that both SBP and DBP were greatly affected (Shah et al., 2016). According to Shah et al. (2016), both measurements of blood pressure increased significantly. The largest change was seen in SBP when the energy drink contained over 200 mg of caffeine (Shah et al., 2016). Caution should be taken with hypertensive or pre-hypertensive individuals when considering the use of a pre-workout supplement (Campbell et al., 2016).

Heart rate is often looked at during studies as a resting vital sign. Studies that compared baseline testing and post-data testing when consuming a PWS show no significant changes in heart rate (Vogel, Joy, Falcone, Mosman, Kim, & Moon, 2015). Campbell et al. (2016) measured heart rate after acutely ingesting a thermogenic supplement every hour on the hour and found there were no significant changes.

Cholesterol levels have more variability. Waggner, Robison, Ackerman, and Davis (2015) found that after just 3 exercise sessions in obese young adults there were significant changes in HDL-C, LDL-C, and triglycerides. They found that the level of HDL-C increased while the level of LDL-C decreased. They also found that triglycerides decreased by 29 percent.

Other Variables Effecting Clinical Health Measurements

There are numerous variables that can affect BP, HR, and blood lipids other than ingesting a PWS. There is much variability that can contribute to a person having hyper/hypo-tension. Mayo Clinic Staff (February 2016) states that factors that can affect blood pressure include: pain medications, antidepressants, birth control medications, caffeine, decongestants, herbal supplements, stimulants, overweight, sedentary lifestyle, smoking, dietary salt intake, stress, and more. Pain medications include anti-inflammatories including Advil (ibuprofen) and Aleve. Caffeine will raise blood pressure when more than 200-300 mg's are consumed (Mayo Clinic Staff, February 2016).

According to the American Heart Association (2015), heart rate can be affected by medications, air temperature, body position, body size, emotions, and arrhythmias. Air temperature affects HR. When temperature is high; the heart tends to pump more blood so the HR increases (American Heart Association, 2015). Body position affects HR. When going from sitting to standing in a short amount of time (American Heart Association, 2015). Emotions can increase HR if there are overwhelming feelings of stress or anxiousness (American Heart Association, 2015).

The National Heart, Lung, and Blood Institute (2016) found that there are multiple factors that can also influence blood lipid levels such as diet, physical activity

and weight, family history, and age/sex. Diet, physical activity, and weight are all factors that can be controlled, whereas family history, age, and gender are variables that cannot be controlled. When more saturated fats are introduced into the diet, the levels of LDL-C increase. The same happens to those who are overweight and sedentary (National Heart, Lung, and Blood Institute, 2016). Family history is hereditary, so if high blood cholesterol runs in the family one is more likely to get it. Also, as we age the levels of LDL-C rises and once females reach the age of menopause their LDL-C levels are most likely higher than males (National Heart, Lung, and Blood Institute, 2016).

Resistance Training

According to the American College of Sports Medicine's (ACSM) *Guidelines for Exercise Testing and Prescription* (2014), resistance training should exercise each major muscle group 2-3 days out of the week. Sets and repetitions will vary depending on the individual but the recommendation to improve muscular strength and mass includes completing 2-4 sets with 8-12 repetitions in each set (American College of Sports Medicine & Pescatello, 2014). Resistance exercises can incorporate multiple types including free weights, stacked machines, and resistance bands (ACSM & Pescatello, 2014). These exercises should also be multi-joint in order to work more than one muscle group at a time (ACSM & Pescatello, 2014).

There are numerous benefits to resistance training besides improving muscular strength and muscular mass. Winett and Carpinelli (2001) found that resistance training adds to the maintenance of activities of daily living while also works to prevent osteoporosis, sarcopenia, lower-back pain, and many other disabilities. Weight lifting

may also positively affect risk factors such as insulin resistance, resting metabolic rate, glucose metabolism, blood pressure, and body fat (Winett & Carpinelli, 2001).

Some of the ingredients in a PWS are intended to increase muscular strength. Some of these ingredients include beta-alanine, taurine, and creatine. Data shows that consuming a PWS only ten minutes prior to exercise enhances performance by significantly increasing the number of repetitions performed in comparison to the placebo (Gonzalez, Walsh, Ratamess, Kang & Hoffman, 2011).

CONCLUSION

In conclusion, there is a need for more information concerning on how a PWS effects clinical health measurements. There is too much variability from the results of research that has already been done and no concrete understanding of what happens. Similarly, more research needs to be done concerning on how consuming a PWS effects females. In most cases PWS's are associated with males. Consequently, there is little research on how females are affected from ingesting a dietary supplement and an abundance of research on how it influences males. A long-term study needs to be completed to observe how females respond in terms of clinical health measurements to a pre-workout supplement during a resistance training program.

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