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The Acute Effects of Shred Matrix on Hemodynamic Responses, Substrate
Utilization, Endurance, Arterial Compliance, and Body Water Distribution

By

Samuel Rice Buchanan

A Thesis Presented to the Graduate Faculty of the College of Education in
Partial Fulfillment of the Requirements for the Degree of
Master of Science in Exercise Science
In the Field of Health and Human Performance

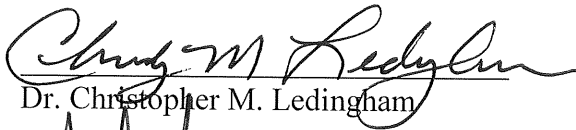
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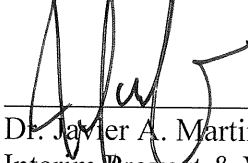
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JULY 15, 2015

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Dedication and Acknowledgement

This thesis is dedicated to my parents, John and Melinda Buchanan, who have always supported me in my many endeavors. All of my best qualities, and perhaps a few of my worst, were instilled by them. I wouldn't be who I am today without them.

I would like to thank Dr. Murat Karabulut, who has been the best mentor a mentee could hope for. He has continuously provided an admirable example to follow, guidance when it was needed, and pushed me to better myself as both a student and researcher. Dr. Christopher Ledingham also has my thanks for many years of quality education and support. His classes provided the knowledge and structure for writing a thesis and have been invaluable thus far. I would also like to thank Dr. Saraswathy Nair for serving on my research committee and providing valuable assistance.

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Abstract

Supplement manufacturers are widely unregulated and are only held accountable for products if their supplement is shown to cause harm. To take advantage, some manufacturers use false or sensationalized claims that have little or no scientific backing. Due to the lack of testing for many supplements, this study will seek to determine multiple effects of the weight loss supplement, Shred Matrix.

PURPOSE: The purpose of this study was to 1) examine the acute effects of the weight loss aid, Shred Matrix, on hemodynamic responses, substrate utilization, endurance, arterial compliance, and body water distribution; 2) To investigate the differences between athletes and non-athletes on the previously stated measures.

METHODS: 31 subjects underwent a randomized, double-blind, crossover design study and were given a placebo or Shred Matrix on two separate days. Baseline measures of all variables were assessed prior to exercise. During exercise, each subject ran on a treadmill at 80% VO₂ Max until volitional fatigue. While running, HR, VO₂, and respiratory exchange ratio were continuously monitored. Immediately post-exercise, arterial elasticity was measured at 0, 10, 20, and 40 minutes. Body fluid analyses were performed at 5 and 30 minutes post-exercise. PWV was measured at 5, 15, 25, and 35 minutes post-exercise.

RESULTS: Significant condition differences existed for ECF in non-athlete males ($p=.023$). Carotid to radial PWV was significant ($p=.01$). There was a significant condition*time interaction with Shred Matrix having a higher PWV for the carotid to femoral segment ($p=.003$) and the femoral to distal segment ($p=.018$). LAE was significantly lower for Shred Matrix ($p=.003$). SBP was conditionally higher ($p=.001$), as was DBP ($p=.003$), MAP ($p=.001$), and PP ($p=.035$). There were significant

condition*time interactions for PR ($p=.001$) and SV ($p=.016$). VR was conditionally significant ($p=.05$). RER while running was significantly higher ($p=.034$) with Shred Matrix. Only female non-athletes ran longer on Shred Matrix ($p=.033$).

CONCLUSION: Shred Matrix caused multiple negative effects in hemodynamics and arterial compliance. Consumers should educate themselves before purchasing supplements and visit with a physician to determine any preexisting conditions that might be cause for concern.

KEYWORDS: Shred Matrix, supplement, weight-loss

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CHAPTER I

INTRODUCTION

By law, dietary supplement manufacturers are not required to receive Food and Drug Administration (FDA) approval before producing or selling a dietary product. This means that manufacturers are able to introduce substances into their products without labeling or including dosage sizes. Companies are also able to invent false or sensationalized claims as long as their disclaimer reads, “these statements have not been evaluated by the FDA.” Their only obligation is to register the product and report instances of adverse effects. The policy is reactionary; action against a harmful supplement is not taken unless catastrophic events happen to draw attention to a harmful product or ingredient (FDA, 2015).

A well-known incident of an ingredient in supplements being harmful is ephedrine in the early 2000s. A report published by the FDA in 2003 performed a meta-analysis over ephedrine and ephedrine-containing products. Their results found a modest increase in fat loss, but a two to three fold increase for the risk of nausea, vomiting, psychiatric symptoms, autonomic hyperactivity, and palpitations. There were also reports of a total of five deaths from the ingredient (Shekelle, Morton, Maglione, et al. 2003). Consequently, the FDA banned ephedrine four months later.

With over 1500 establishments that manufacture dietary supplements (Karns, 2000) there is a need for products and ingredients to be tested to substantiate claims of efficacy. Companies that possess research backing their products will have more credibility for consumers. They will also provide evidence for new findings that may allow ingredients to treat diseases where medication is ineffective or unwanted.

Study Purpose

The purpose of this study was to 1) examine the acute effects of the weight loss aid, Shred Matrix, on hemodynamic responses (i.e., heart rate, blood pressure, stroke volume, and ejection time), substrate utilization, endurance, arterial compliance, pulse wave velocity, and body water distribution; 2) To investigate the differences between athletes and non-athletes on the previously stated measures.

Research Questions

1. Was there a significant increase in fat metabolism when the weight loss aid, Shred Matrix, if consumed prior to exercise?
2. What were the changes in exercise HR, exercise diastolic and systolic BP?
3. Was there a significant effect on stroke volume?
4. Was there a significant effect on ejection time?
5. Was there an increase in exercise endurance?
6. Was there a change in arterial compliance?
7. Was there a significant effect on pulse wave velocity?
8. Was there a change in intracellular and/or extracellular body water?

Hypotheses

1. There was a greater amount of fat metabolism with Shred matrix during exercise.
2. Shred Matrix resulted in lower increases in HR, diastolic and systolic blood pressures at different time points compared to placebo.
3. There was a significant increase in stroke volume.
4. There was an increase in cardiac ejection time.
5. Shred Matrix resulted in increased time to exhaustion.

6. There was an increase in large and small arterial elasticity.
7. There was a decrease in pulse wave velocity.
8. There was an increase in extracellular water.

Significance of the Study

The Dietary Supplement Health and Education Act of 1994 (DSHEA) defines dietary supplements as “products that, among other things, are intended for ingestion to supplement the diet, labeled as dietary supplements, and not represented as conventional foods or as a sole items of a meal or diet” (Dietary Supplement Health and Education Act of 1994). Under the DSHEA, supplements are generally considered as being safe and the Food and Drug Administration (FDA) has no authority to regulate the market unless a product has been shown to be dangerous to the public. Supplement manufacturers are not required to provide evidence for claims so long as there is no claim that a product can “treat, prevent, or cure” a disease (GAO-10-662T). With such a large amount of freedom given to manufacturers, there is a need for more research into supplementation to provide accountability for businesses creating these supplements and to educate consumers on the effectiveness of their purchases.

Shred Matrix claims to be a weight loss supplement and mood enhancer designed specifically for athletes. There are several active ingredients contained within the supplement that have been previously studied and shown to support those claims. It is important that this study observe the effects of Shred Matrix on heart rate, blood pressure, substrate utilization, endurance, arterial compliance, stroke volume, ejection time, and body water distribution to determine if their claims are substantiated and to add to the body of knowledge concerning the ingredients listed.

Delimitations

1. Since arterial elasticity is affected by age, only males and females between the ages of 18-40 were allowed to participate in the study.
2. Individuals suffering from diseases that prevent subjection to maximal testing were excluded. These included hypertension, metabolic, and cardiovascular diseases.
3. Individuals suffering from disabilities that prevented maximal testing were excluded. These included joint injuries or chronic pain.
4. Individuals who were currently or took ergogenic aids other than caffeine within the previously 30 days before testing were excluded.
5. Subjects were required to be adequately hydrated before testing.

Limitations

1. The study might not be representative of the population due to all participants being volunteers and not being randomly sampled.
2. Health history and medical information were gathered through self-report.
3. Participants were asked to refrain from ingesting caffeine, alcohol, or engaging in intense exercise for at least 24 hours before testing, but diet and activity were not monitored.

Assumptions

1. Subjects performed each maximal test and volitional fatigue test to the best of their ability.
2. Subjects arrived fasted and adequately rested on testing days.
3. Accurate health history and medical information were provided.

4. The equipment used was reliable and provided accurate information for each testing session.

Operational Definitions

Athlete: Having a VO_{2MAX} (ml/kg/min) deemed “excellent” according to age for females and males as determined by either the greatest measure gathered by metabolic cart or time to exhaustion during the Bruce Protocol (Nunes, 2005).

Non-athlete: Having a VO_{2MAX} (ml/kg/min) deemed less than “excellent” according to age for females and males as determined by either the greatest measure gathered by metabolic cart or time to exhaustion during the Bruce Protocol (Nunes, 2005).

Hydration: Hydration status was deemed adequate when urine specific gravity measured 1.010 and lower as determined by a clinical urine refractometer (Case et al., 2000).

PAR-Q: PAR-Q (Physical activity readiness questionnaire) is a screening tool that is designed to determine whether a subject may perform the exercise in a safe and risk free manner.

Ergogenic Aid: are any external influences that can be determined to enhance performance in high-intensity exercises.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study was to 1) examine the acute effects of the weight loss aid, Shred Matrix, on hemodynamic responses (heart rate, blood pressure, stroke volume, ejection time) substrate utilization, endurance, arterial compliance, pulse wave velocity and body water distribution; 2) To investigate the differences between athletes and non-athletes on the previously stated measures.

Unlike weight loss supplements tailored to be taken by a sedentary and obese population, Shred Matrix claims to be “a weight loss system designed for athletes.” According to the manufacturers this is achieved through an eight stage approach consisting of: Stages 1 and 2 increase energy and ramp up metabolism. Stages 3 and 4 crush hunger. Stage 5 balances mood and enhances well-being. Stage 6 maintains sharp mental focus without jitters. Stage 7 eliminates excess water. Stage 8 contains a trademarked Sugar Stop TM and enzyme aid matrix.

Ingredients Affecting Body Fluid

Weight loss is also obtained from this supplement through loss of water. There are two ingredients that are listed in Shred Matrix that have been associated with water loss, uva ursi leaf and dandelion root. The American Medical Association classifies both dandelion root and uva ursi leaf as diuretics to increase body fluid loss (Miller, 1998).

Uva Ursi Leaf

Uva ursi is most commonly used as a natural remedy to treat urinary tract infections. However on review cited a study done in animals where uva ursi acted as a

diuretic without impacting potassium or sodium levels (Head, 2008). No human studies for uva ursi's effects on body fluid were discovered while reviewing literature.

Dandelion Root

A study was designed by Clare et al. (2009) to determine the diuretic effects of dandelion root on 28 females aged 18-65. The trials took place over a 4 day period where subjects monitored their fluid intake and urine excretion with or without the supplement. The results showed a significant increase in urination following dosages of dandelion root with a decrease near baseline levels the day following supplementation. The authors revealed that the test was not blinded, there were a small number of subjects, fluid input was self-monitored, there was no correction for water from food, and limited baseline values for urine output. Despite the limitations, the authors felt the results warranted further investigation into the natural diuretic, dandelion root (Clare, Conroy, & Spelman, 2009).

Ingredients Affecting Hemodynamics

Shred Matrix contains ingredients that both positively and negatively affect hemodynamics. This may lead to either higher central pressures, lower, or they may be cancelled out and remain unchanged.

Garlic

Garlic has been shown to lower blood pressure in hypertensive subjects. Seventy-nine subjects took part in a 12-week double-blind, randomized, placebo-controlled parallel trial. Subjects were split between four groups, 3 varying garlic groups and one placebo group. The results of the study showed that garlic supplementation was superior to placebo in lowering systolic blood pressure in subjects with hypertension in the higher dosage groups (Ried, Frank, & Stocks, 2013).

In trained cyclists, there was no significant difference found in blood pressure under hypoxic conditions. Nine healthy subjects underwent 7 days of garlic supplementation, a 7 day washout period, and then another 7 day supplementation period with maximal testing pre and after each supplementation period. All exercise testing was done on cycle ergometers. Treatments were applied in a randomized, single-blind, crossover fashion. The results of the study concluded that under hypoxic conditions in trained cyclists, there was no significant decrease in SBP or DBP (Morris, Beloni, & Wheeler, 2013).

Caffeine

Caffeine is one of the primary ingredients listed in Shred Matrix. In 2004, the World Anti-Doping Agency removed caffeine from its list of banned substances, and more than 60 peer-reviewed articles have been published on caffeine and its role in sport performance enhancement (Desbrow & Leveritt, 2007). Caffeine has been shown to increase systolic and diastolic blood pressure through increases in peripheral vascular resistance at rest. One study performed on young, healthy, normotensive men volunteered to take part in a double-blind cross-over study. Subjects came in on two different days separated by at least 48 hours. They were randomly assigned either 3.3 mg/kg caffeine or a placebo and rested for 40 minutes. Afterwards, subjects performed multiple 3 minute cycling stages of increasing intensity. After one hour of rest, subjects performed maximal cycling testing. Results showed increases in systolic and diastolic blood pressure and also increases in peripheral vascular resistance. The authors speculate that caffeine inhibited the adenosine receptor responsible for vasodilation. The resultant vasoconstriction caused increases in central pressure (Sung, Lovallo, Pincomb, & Wilson, 1990).

Another study observed the hemodynamic responses to caffeine at rest. Fifteen males, aged 20-35 years were blinded and received either caffeinated or a placebo beverage. Every ten minutes measures were taken, up to 40 minutes post ingestion, while subjects remained in a semi-recumbent position. Results showed significant increases in systolic and diastolic pressure and increased systemic vascular resistance (Pincomb et al., 1985).

Ingredients Affecting Arterial Elasticity

Turmeric

Turmeric is derived from the plant *Curcuma longa* and has many potential health benefits, including potential increases in arterial elasticity. One of the few studies observing turmeric's effects on arterial elasticity measured differences between 51 postmenopausal women separated into four groups. The four groups consisted of two exercise groups, one of which also received turmeric, and two non-exercise groups, one of which received turmeric. The four groups ingested 150mg of turmeric or a placebo each day for 8 weeks and the exercise groups were given an aerobic workout plan. The results of the experiment showed positive increases in carotid arterial elasticity for all groups except the non-exercise placebo group. Turmeric only supplementation showed positive effects similar to the exercise only group, and combined exercise and turmeric demonstrated the greatest increases in carotid arterial compliance (Akazawa et al., 2013).

Caffeine

Caffeine's effects on hemodynamic may also relate to changes in arterial elasticity. Seven healthy subjects ingested either 250mg of caffeine through coffee or drank decaffeinated coffee on two different days divided by at least one week. After ingestion, subjects were observed for 90 minutes in the supine position with carotid to

femoral pulse wave velocity measurements taken every 30 minutes. Results showed acute increases in vascular stiffness, even after adjustment for blood pressures (Mahmud & Feely, 2001).

Ingredients Affecting Endurance

There is a relationship between endurance activities and fat oxidation. The ability to perform for longer periods of time at a given intensity means that more fat is being burned to meet energy demands. As a weight loss supplement, Shred Matrix contains ingredients that have been shown to increase endurance, and thus burn more fat and lower body mass. The ability to utilize more fat comes in part from a sparing of glucose. A negative fat balance can also be had by maintaining steady insulin levels after ingestion of carbohydrates to avoid storing glucose in adipose tissue. Utilizing both approaches from the ingredients in the product allow fat to be utilized more as an energy source and have less fat stored.

Caffeine

Caffeine has previously been shown to improve performance by promoting plasma free fatty acid (FFA) mobilization and sparing muscle glycogen (Spriet et al., 1992), however later studies credit better performance to increases in central nervous system (CNS) stimulation and muscle recruitment (Cox et al., 2002)

Aside from reported physiological effects of caffeine, there may be a psychological component to increasing endurance performance (Marcora, Staiano, & Manning, 2009). Adenosine, a neurotransmitter, is responsible for inhibiting excitatory neurotransmitters leading to reduced arousal, increased sleep, and feelings of fatigue. During the day or throughout exercise, adenosine levels progressively increase until fatigue or exhaustion sets in. Researchers speculate that adenosine may be partially

responsible for fatigue in endurance exercise (Davis et al., 2003). Caffeine directly inhibits adenosine receptors and may explain in part why ingestion of caffeine leads to increases in exercise duration (Cox et al., 2002). Research on rats has already shown that low doses of caffeine inhibit adenosine and was responsible for longer exercise durations until exhaustion (Davis et al., 2003).

Eleutherococcus senticosus

Eleutherococcus senticosus (ES) is a shrub native to forests in Russia, China, Japan, and Korea. The active ingredients in ES are known as eleutherosides. The plants and its derivatives are normally safe, but diarrhea and insomnia have been reported as possible side effects (Kuo, 2010).

Nice recreationally trained college males were given either 800mg/d of ES or a placebo during an 8 week randomized, double-blind, placebo-controlled with a crossover design study to determine its effects on endurance capacity, cardiovascular functions, and metabolism. Pre and post-test values were measured on a bicycle ergometer at 75% VO₂ peak. The results of the study showed a 12% increase in VO₂ peak, endurance time increased 23%, and max HR increased 4%. The authors attributed the positive endurance results to a shift of burning more fatty acids as a fuel instead of glucose (Kuo, 2010).

Biotin and Chromium

The essential trace mineral, chromium, was identified over 40 years ago as being a part of lipid and carbohydrate metabolism. Since then, there have been multiple studies, both animal and human, that demonstrate the efficacy of chromium supplementation for type 2 diabetes (Albarracin, Fuqua, Evans, & Goldfine, 2008). Biotin is part of the B vitamin group, specifically B₇. It is water soluble and plays a role in carbohydrate and lipid metabolism. Biotin affects metabolism by stimulating genes that affect glycaemic

control in the pancreas and liver. It also suppresses phosphoenolpyruvate carboxykinase, which is one of the enzymes involved in gluconeogenesis. This suppression will inhibit new glucose molecule formation, thus maintaining lower blood glucose levels (Albarracin et al., 2008).

Four hundred and forty-seven subjects with type 2 diabetes and $HbA_{1c} \geq 7$ were divided into an experiment or control group for 90 days. HbA_{1c} refers to the amount of hemoglobin that is combined with blood glucose to become glycated. Each group received either biotin with chromium picolinate or a placebo. The results of the study showed a significant improvement in fasting blood glucose levels and HbA_{1c} , especially when HbA_{1c} levels pretest were ≥ 10 (Albarracin et al., 2008).

Biotin has been studied extensively in diabetic animals. "In genetically diabetic KK mice and in Otsuka Long Evans Tokushima Fatty (OLETF) rats, biotin treatment lowered postprandial glucose concentration and improved tolerance to glucose." This means that biotin supplementation may lower glucose absorption, thus lowering insulin response and preventing excess carbohydrate from being stored as fat (Fernandez-Mejia, 2005).

Capsaicin

Capsaicin is the component generally found in cayenne pepper and is responsible for its hot and spicy flavor. Its use has been studied with results indicating that both energy expenditure and fat oxidation increased (Ahuja, Robertson, Geraghty, & Ball, 2006). Other studies suggest that capsaicin may be used to lower blood glucose by increasing insulin levels in healthy human subjects (Dömötör, Szolcsányi, & Mózsik, 2006). At this time there were no studies found investigating the effects of capsaicin on diabetic humans.

Eight male mice, aged one week, were fed a high fat diet for a total of 20 weeks. They were divided at week 10 into an experiment and control group. The experimental group was administered capsaicin with their high fat diet while the control continued to receive only the high fat diet. The group receiving capsaicin had significantly lower levels of insulin and glucose 60 minutes after ingesting glucose. The results showed that capsaicin protected against glucose intolerance in obese mice (Kang et al., 2010).

Twelve healthy volunteers participated in a crossover study designed to test the effects of capsaicin on blood glucose levels. Baseline levels of insulin and fasted blood glucose were taken. Subjects were then administered 75g of glucose followed by 5g of either capsaicin or a placebo. With capsaicin ingestion, lower blood glucose levels were observed at 30 and 45 minutes post ingestion. Insulin levels were higher than the placebo group during the time period. Afterwards, insulin levels dropped back to basal levels for the experimental group while insulin levels continuously decreased below basal levels in the control (Weerapan Khovidhunkit, 2009).

Dömötör et al. studied fourteen healthy human subjects. Each subject was self-controlled and was administered 75mg of glucose orally either with or without capsaicin. Blood glucose, insulin, and glucagon levels were measured every 15 minutes for 4 hours. The study found that capsaicin was responsible for an initial increase in insulin levels which demonstrated an increase in absorption. Glucagon levels also increased independently from insulin. The authors speculated that capsaicin was responsible for stimulating afferent nerves responsible for glucagon synthesis (Dömötör et al., 2006).

Gymnema Sylvestre

Gymnema sylvestre is a plant that acts to improve blood glucose levels in two ways. First, it acts to stimulate insulin secretion (Al-Romaiyan et al., 2010). Second, it

suppresses glucose absorption in the small intestine. This will cause a slower rise in blood glucose and can become easier to control (Kurian, Manjusha, Nair, Varghese, & Padikkala, 2014).

Banaba Extract

Banaba is touted as being an insulin mimetic, meaning it acts in the way that insulin does to decrease blood glucose. It has primarily been used in folk medicine in Southeast Asia to treat diabetes. According to some studies, it may also be beneficial in controlling hyperlipidemia and act as an anti-inflammatory (Miura, Takagi, & Ishida, 2012).

Subjects with mild diabetes were recruited to perform a randomized, double-blind study for 6 months to determine the effectiveness of Banaba extract and other components on blood glucose. The results showed no significant difference in blood glucose homeostasis. However, the researchers did find that there was a decrease in biomarkers that signal inflammation. The author speculated there may not have been a significant difference in blood glucose levels due to the multiple herbs in their cocktail interfering with each other (Kim et al., 2012).

Six-week-old mice were fed a high fat diet for 9 weeks, with the experimental mice receiving corosolic acid, derived from Banaba leaves, and the control receiving only the high fat diet. Mice receiving the corosolic acid had 10% less body weight than the control. Plasma glucose was 23% lower for the experimental group, and insulin was also lower by 41%. This suggested that the corosolic acid mice had higher insulin sensitivity. The lower weight was explained through activation of the peroxisome proliferator-activated receptor (PPAR), which is responsible for gene expression that affects lipid

metabolism. PPAR activation from corosolic acid would lead to higher level of fat oxidation (Yamada et al., 2008).

Twelve subject, 7 males and 5 females, were recruited to test the efficacy of Banaba extract on blood glucose. Fasting blood glucose was measured, followed by a 540kcal meal consisting of 100% starch. Plasma glucose levels were then measured at 30, 60, and 120 minutes after ingestion. For the next two weeks, Banaba extract was administered orally every morning. No changes in plasma glucose were reported, however there was an improvement in BMI (Tsuchibe, Kataumi, Mori, & Mori, 2006).

Turmeric

Along with increasing arterial elasticity mentioned earlier, turmeric has also been found to possess antioxidant and antimutagenic capabilities, while also inhibiting glucosidase enzymes (Gupta et al., 2013). Alpha and beta glucosidase are responsible for breaking down compound carbohydrates into simpler sugars that will lead to high blood glucose levels. Inhibiting these enzymes will cause blood glucose to rise at a slower rate and be easier to manage (Lekshmi, Arimboor, Indulekha, & Nirmala Menon, 2012).

Type 2 diabetic subjects participated in a randomized, double-blind, and placebo controlled study to determine the efficacy of turmeric on proteinuria, serum transforming growth factor, tumor necrosis factor, and urinary levels of interleukin-8. The primary results of the study are beyond the scope of this review, but the researchers also observed fasted plasma glucose and 2 hours postprandial blood glucose. They found no significant difference for either category (Khajehdehi et al., 2011).

Genetically diabetic mice were divided into 3 groups of 5 mice each by body weight and blood glucose. The control was fed the basal diet only, while the two experimental groups were fed turmeric either .2 or 1g/100g of the diet. After 4 weeks

blood samples were obtained. The control group saw a significant rise in blood glucose after 4 weeks of feeding while both experimental groups stayed the same. This led the authors to speculate that turmeric supplementation may lead to preventing type 2 diabetes (Kuroda et al., 2005).

Fourteen healthy subjects in a crossover trial ingested 75g of glucose together with either 6g of Curcumin longa or a placebo. Blood samples were taken using finger prick to measure glucose and insulin levels at 15, 30, 45, 60, 90, and 120 minutes. The results of the study concluded that there was no significant difference in plasma glucose from an acute dose of Curcumin longa. However, the study show significance in insulin levels after 30 minutes postprandial up to 1 hour. The author speculated that Curcumin longa may stimulate beta cells in the pancreas to release more insulin (Wickenberg, Ingemansson, & Hlebowicz, 2010).

Conclusion

This review brings to light some potential conflicting ingredients in Shred matrix. Caffeine can cause increases in central pressures and arterial stiffness, and also improve aerobic endurance (Mahmud & Feely, 2001; Pincomb et al., 1985; Sung et al., 1990). Garlic has been shown to decrease blood pressure through vasodilation, which may or may not offset caffeine's vasoconstriction (Ried et al., 2013). Turmeric's positive effects on arterial elasticity may also be negated by stiffening caused by caffeine in an acute dosage of Shred Matrix.

Simply because an ingredient is listed on the label of a product, it does not mean that the ingredient will cause any affect. Also, the proprietary blend posted on some supplement labels means that manufacturers do not have to disclose the amount of

ingredient contained within the product. Studies such as this will help determine various effects of supplements and provide speculation as to the causes observed.

CHAPTER III

METHODS

The purpose of this study was to 1) examine the acute effects of the weight loss aid, Shred Matrix, on hemodynamic responses (i.e., heart rate, blood pressure, stroke volume, and ejection time), substrate utilization, endurance, arterial compliance, pulse wave velocity, and body water distribution; 2) To investigate the differences between athletes and non-athletes on the previously stated measures.

Subjects

Fifteen male and sixteen female participants between the ages of 18 and 40 years were recruited for this study. The length of testing for each subject was one 60 minute introduction session and two experimental sessions that lasted approximately 150 minutes each, for a total of 6 hours.

Inclusion Criteria

1. Subjects must have been between 18-40 years of age.
2. Subjects must not have had hypertension, cardiovascular disease, any metabolic disease, chronic pain, or joint problems.
3. Subjects must not have been taking any other ergogenic aid, with the exception of caffeine, for the previous 30 days.

Exclusion Criteria

1. Subjects that were taking medication for hypertension.
2. Subjects that were taking medication for cardiovascular disease.

3. Subjects that were suffering from chronic pain.
4. Subjects were suffering from joint injuries in the lower extremities.
5. Subjects were currently or within the previous 30 days had consumed another ergogenic aid other than caffeine.

Recruitment

Subjects were recruited from The University of Texas at Brownsville, Texas Southmost College and the surrounding community by fliers and word of mouth. Participation in this study was voluntary and subjects were allowed to withdraw at any time.

Experimental Protocol

The first day included filling out paperwork and familiarization of testing protocols. Paperwork consisted of signing an informed consent form, completing the physical activity readiness questionnaire (PAR-Q), and a health status questionnaire. After completing paperwork, anthropometric measures that included height, weight, resting heart rate (HR), and resting blood pressure (BP) were assessed and recorded. Subjects then performed the Bruce Protocol. Testing consisted of running on a treadmill, with increasing speeds and incline, until exhaustion. Subjects were fitted with a mask for the metabolic cart, and gas exchange, perceived exertion, and heart rate were monitored continuously by the metabolic cart while performing VO₂ Max testing.

For the two experimental protocols, participants were required to be fasted for at least 8 hours prior to testing. Sessions were randomized and either a placebo or Shred Matrix (MusclePharm Corp., Denver, CO, USA) were given on two separate days with at least 48 hours between each session. Upon arriving, subjects were required to give a urine sample measured by Clinical Urine Refractometer 300005 (SPER Scientific, Scottsdale,

AZ, USA) to determine hydration levels. If inadequately hydrated, subjects were instructed to drink water to reach proper hydration. Urine samples were continuously collected every 20 minutes until subjects were deemed hydrated according to preset standards. The subjects' HR and BP were assessed prior to the start of exercise. Intracellular and extracellular body fluids were analyzed via Hydra ECF/ICF Model 4200 Bio-Impedance Spectrum Analyzer (Xitron Technologies, Inc., San Diego, CA, USA). Baseline arterial compliance, left ventricular ejection time and fraction were recorded via the HDI/PulseWave CR-2000TM Research Cardio Vascular Profiling System (Hypertension Diagnostic, Inc., Eagan, Minnesota, USA). Baseline pulse wave velocity was also recorded prior to exercise via SphygmoCor® CPV Pulse Wave Analyzer (AtCor Medical, Itasca, IL, USA). During exercise, each subject exercised until volitional fatigue on a treadmill at 80% predicted VO₂ Max. Immediately post exercise, arterial elasticity was measured at 0, 10, 20, and 40 minutes. Body fluid analyses were performed at 5 and 30 minutes post-exercise. Pulse wave velocity was measured at 5, 15, 25, and 35 minutes post-exercise. During testing, heart rate, VO₂, and RER was continuously monitored. Calibration of all the equipment was performed regularly according to instructions provided by the manufacturers.

VO₂MAX

Participants were required to wear a breathing mask that was connected to the MOXUS Modular VO₂ System (AEI Technologies, Inc., Pittsburgh, PA, USA) through a mask and breathing tubes. Inspired oxygen and expired carbon dioxide was collected by the metabolic cart computer and analysis and calculations of energy expenditure and oxygen consumption was recorded by the software. Heart rate was assessed by wearing a

Polar Heart Rate Monitor FT7 Series (Polar Electro Inc., Lake Success, NY, USA) and recorded in the data collection sheet.

Bruce Protocol

The Bruce Protocol consisted of multiple stages of increasing speeds and inclines until maximal exertion was reached. The metabolic cart recorded the exchange of gases inhaled and expired to indirectly determine how much oxygen was consumed.

Table 1. Bruce Protocol

Stage	Minutes	% grade	km/h	MPH
1	3	10	2.7	1.7
2	6	12	4.0	2.5
3	9	14	5.4	3.4
4	12	16	6.7	4.2
5	15	18	8.0	5.0
6	18	20	8.8	5.5
7	21	22	9.6	6.0

Bioelectrical Impedance

Intracellular and extracellular fluid values were determined using the Xitron 4200 Bio-Impedance Spectrum Analyzer. Subjects were placed in the supine position with arms held comfortably abducted from their bodies by roughly 15 degrees and legs separated comfortably. Electrodes were placed on the subjects' left wrist and ankle.

Hydration

Hydration status was measured using the SPER Scientific Clinical Urine refractometer. The device required 1-3 drops of a urine sample placed on a lens. The device was then pointed at a light source and the level of refraction caused by the sample was recorded.

Pulse Wave Analysis, Stroke Volume, and Ejection Time

Arterial compliance, stroke volume, and left ventricular ejection time were measured using the HDI/PulseWave CR-2000™ Research Cardio Vascular Profiling System. Subjects lay supine with their arms held comfortably abducted from their bodies by roughly 15 degrees and legs separated comfortably. The wrist was supported while measurements were being taken using the radial artery near the right hand wrist.

Pulse Wave Velocity

Pulse wave velocity was measured by the SphygmoCor® Pulse Wave Analyzer. The subject had segmental measures taken with a segmometer (RealMet BCN, Barcelona, Spain) from the right carotid to right radial artery, the carotid to the right femoral artery, and also from the right femoral to the dorsalis pedis. Leads for ECG were placed at the top and bottom of the sternum and at the bottom of the rib cage near the midaxillary line.

Statistical Analysis

A 3-way analysis of variance (ANOVA) (CONDITION [Placebo vs. Supplement] x TIME [varied depending on the variables] x CATEGORY [Male Athlete vs. Female Athlete vs. Male Non-Athlete vs. Female Non-Athlete]) with repeated measures and pairwise Bonferroni-adjusted estimated marginal means was used to see if significant differences existed for analyzed variables. All repeated measures data was checked with Mauchly's Test of Sphericity. Where significant condition main effects were revealed, the origin of effects was determined by paired *t*-tests. An alpha of 0.05 was used to determine statistical significance and data was analyzed using SPSS 22.0 (IBM

Corporation, New York, NY, USA) and Microsoft Excel 2013 for Windows (Redmond, WA, USA).

CHAPTER IV

RESULTS

The purpose of this study was to 1) examine the acute effects of the weight loss aid, Shred Matrix, on hemodynamic responses (i.e., heart rate, blood pressure, stroke volume, and ejection time), substrate utilization, endurance, arterial compliance, pulse wave velocity, and body water distribution; 2) To investigate the differences between athletes and non-athletes on the previously stated measures.

Subject Characteristics

The study tested 31 subjects, including 15 athletes (age= 22.6 (3.1)) and 16 non-athletes (age= 22.6 (3.9)) participants. Table 1 displays anthropometric measures of the study population. Subjects were recruited from the University of Texas at Brownsville campus, Texas Southmost College, and surrounding community.

Table 2. Anthropometric Data of Participants

Variables	Athlete Male (n=7)	Athlete Female (n=8)	Non-Athlete Male (n=8)	Non-Athlete Female (n=8)	Combined Cohort (n=31)
Age (yr)	23.57 (\pm 3.7)	21.75 (\pm 2.0)	23.13 (\pm 4.1)	22 (\pm 3.9)	22.6 (3.5)
Height (cm)	174.29 (\pm 4.7)	161.63 (\pm 5.8)	179.25 (\pm 6.7)	158.25 (\pm 4.2)	168.16 (10.3)
Weight (kg)	73.86 (\pm 9.0)	56.63 (\pm 7.0)	88.38 (\pm 9.6)	61.13 (\pm 12.2)	69.87 (15.7)
VO ₂ MAX (ml/kg/min)	54.71 (\pm 7.1)	52.45 (\pm 8.6)	40.08 (\pm 5.4)	36.15 (\pm 3.8)	45.54 (10.1)

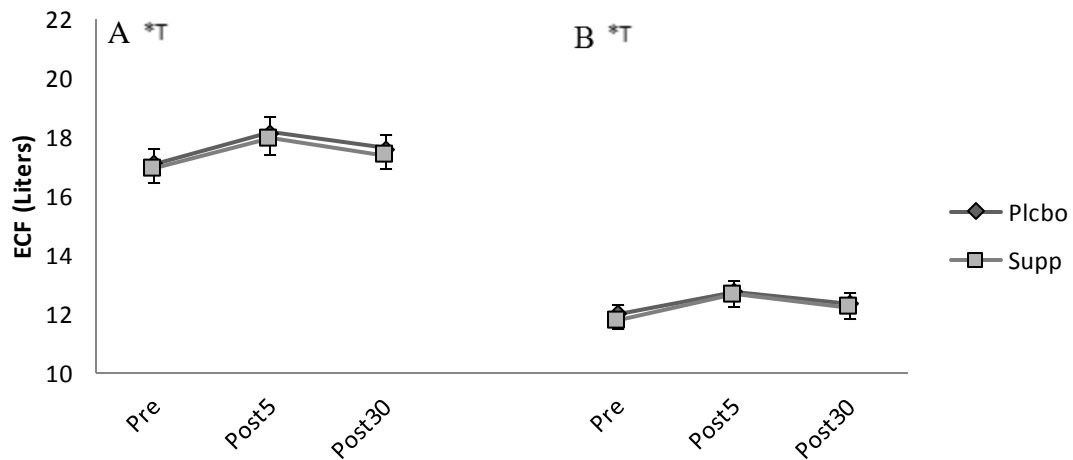
Values are reported as means (SD).

Body Water

Figures 1-2 show effects of exercise with and without supplement on athletes' and non-athletes' extracellular fluid. Except for condition main effect, categories (male

athlete vs. male non-athlete vs. female athlete vs. female non-athlete) were statistically similar ($p > .05$) for all effects and interactions and were reported together. Repeated measures ANOVA found significant condition ($p = .012$) and time ($p < .001$) main effects. Condition significance was determined by paired t -tests to originate in male non-athletes at Post5 ($p = .023$) and Post30 ($p = .009$). For time, Pre was significantly different from Post5 ($p < .001$) and Post30 ($p < .001$). Post5 was significantly different from Post30 ($p < .001$).

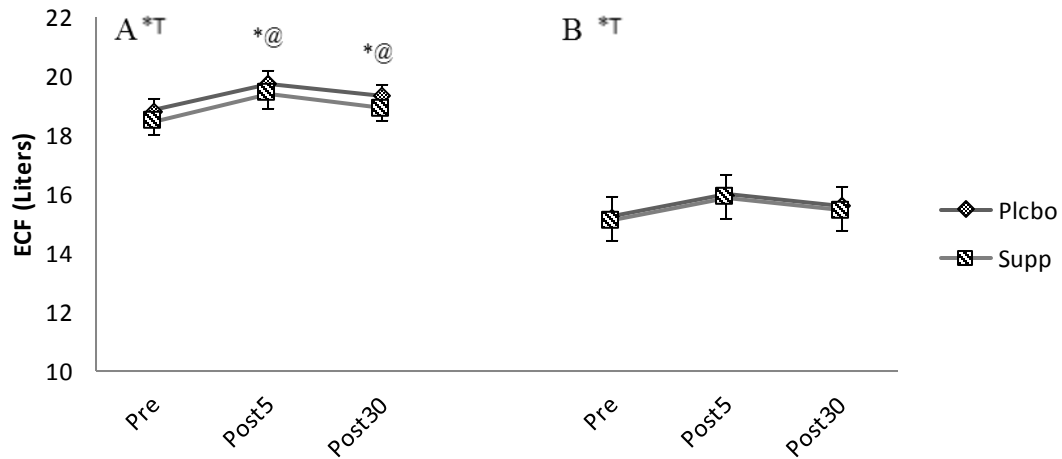
Figure 1. Athlete Extracellular Fluid.



A= Males (N=7), B= Females (N=8)

*T Significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 2. Non-Athlete Extracellular Fluid.

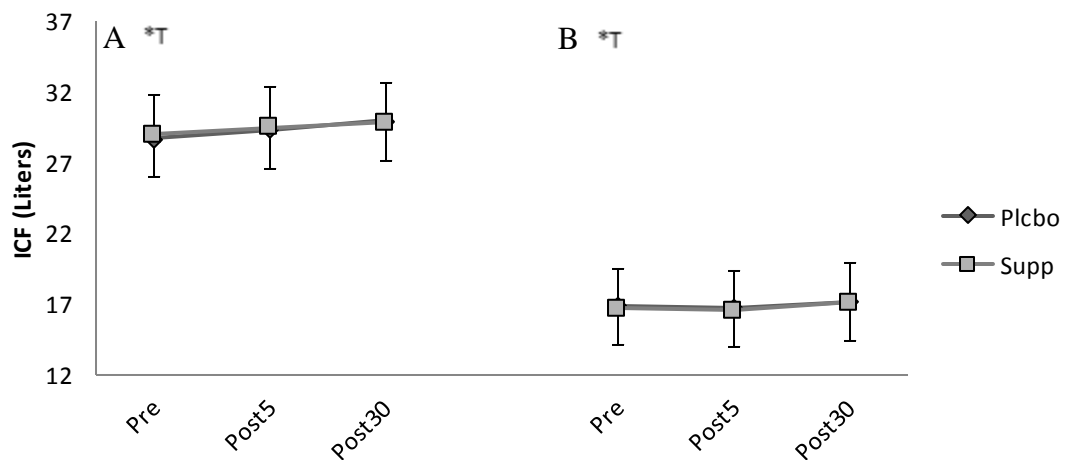


A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for males at Post5 ($p=.023$) and Post30 ($p=.009$). *T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 3 shows effects of exercise with and without supplement on athletes' intracellular fluid. Repeated measures ANOVA detected a significant time ($p<.001$) effect. For time, Pre was significantly different from Post30 ($p<.001$). Post5 was significantly different from Post30 ($p<.001$).

Figure 3. Athlete Intracellular Fluid.

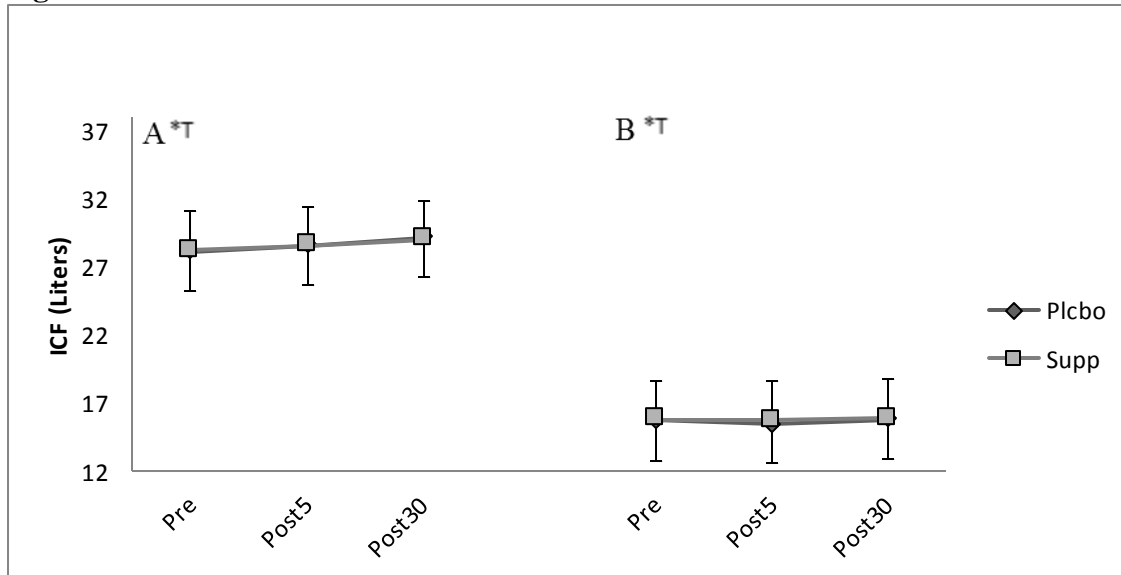


A= Males (N=7), B= Females (N=8)

*T Significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 4 shows effects of exercise with and without supplement on non-athlete intracellular fluid. Repeated measures ANOVA showed significance for the time ($p < .001$) main effect. For time, Pre was significantly different from Post30 ($p < .001$). Post5 was significantly different from Post30 ($p < .001$).

Figure 4. Non-Athlete Intracellular Fluid.

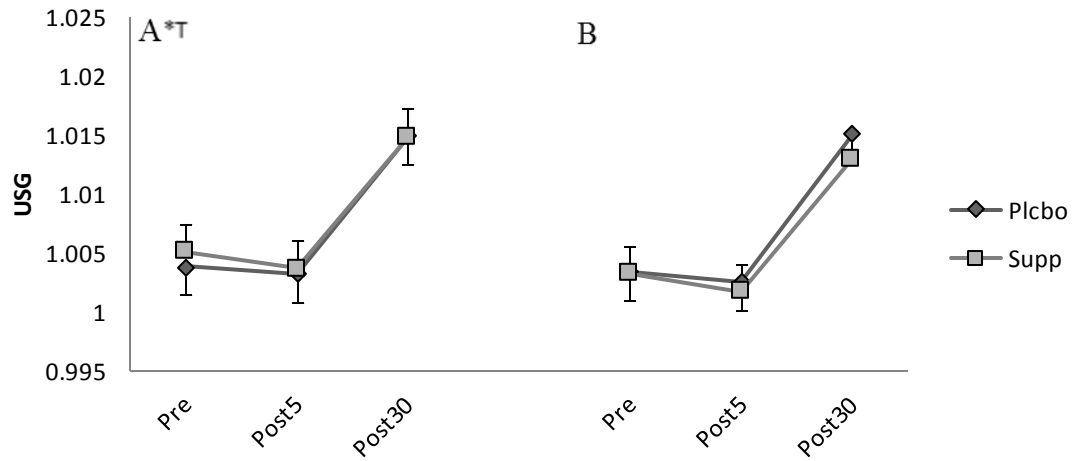


A= Males (N=7), B= Females (N=8)

*T Significant time difference ($p < .001$). Values reported as mean \pm SE.

Figures 5-6 shows effects of exercise with and without supplement on athlete and non-athlete urine specific gravity. Categories were statistically similar ($p > .05$) for all effects and interactions; therefore, they were reported together. Repeated measures ANOVA showed significant time ($p < .001$) differences. For time, Pre was significantly different from Post5 ($p = .009$) and Post30 ($p < .001$). Post5 was significantly different from Post30 ($p < .001$).

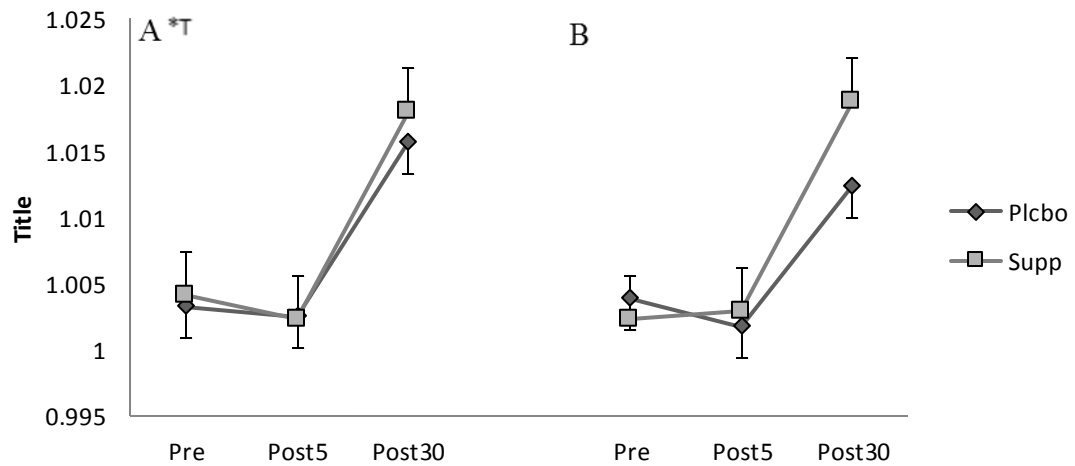
Figure 5. Athlete Urine Specific Gravity.



A= Males (N=7), B= Females (N=7)

*T Significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 6. Non-Athlete Urine Specific Gravity.



A= Males (N=8), B= Females (N=8)

*T Significant time difference ($p < .001$). Values reported as mean \pm SE.

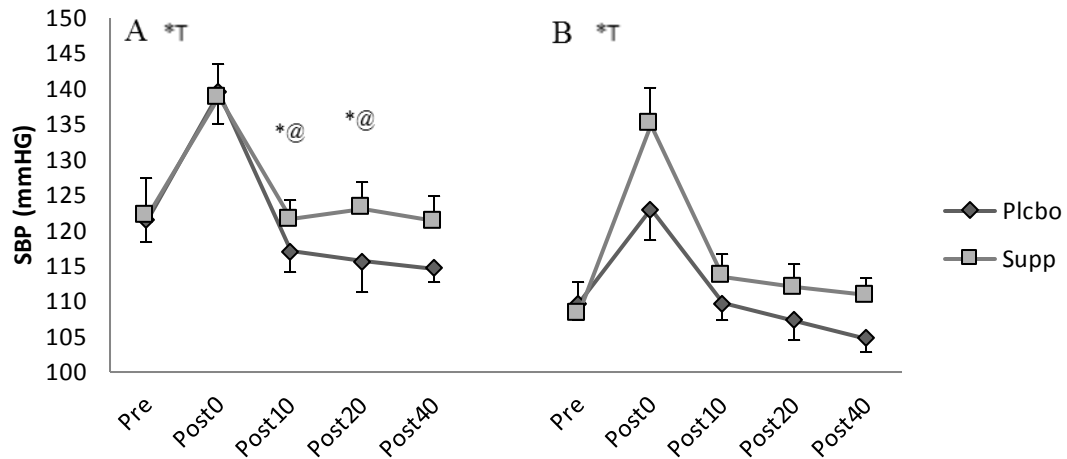
Hemodynamic Responses

Figures 7-8 show effects of exercise with and without supplement on athlete and non-athlete systolic blood pressure. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and were reported together.

Repeated measures ANOVA showed significant condition ($p = .001$) and time ($p < .001$)

main effects, and a trend for condition*time interaction ($p=.067$). For condition, paired t -tests showed significance originated for male athletes at Post10 ($p=.047$) and Post20 ($p=.01$). For time, pre was significantly different from Post0 ($p<.001$) and Post40 ($p=.038$). Post0 was significantly different from Post10 ($p<.001$) and Post20 ($p<.001$).

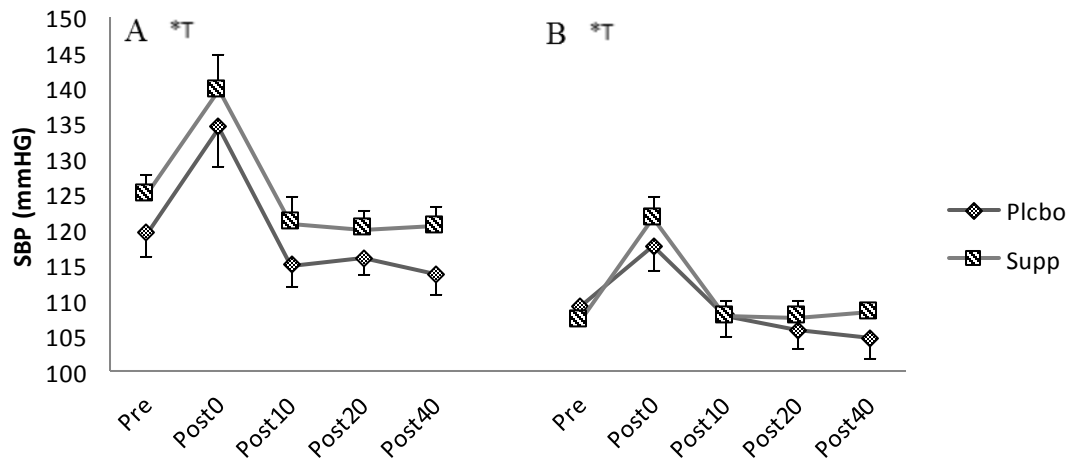
Figure 7. Athlete Systolic Blood Pressure



A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for males at Post10 ($p=.047$) and Post20 ($p=.01$). *T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 8. Non-Athlete Systolic Blood Pressure

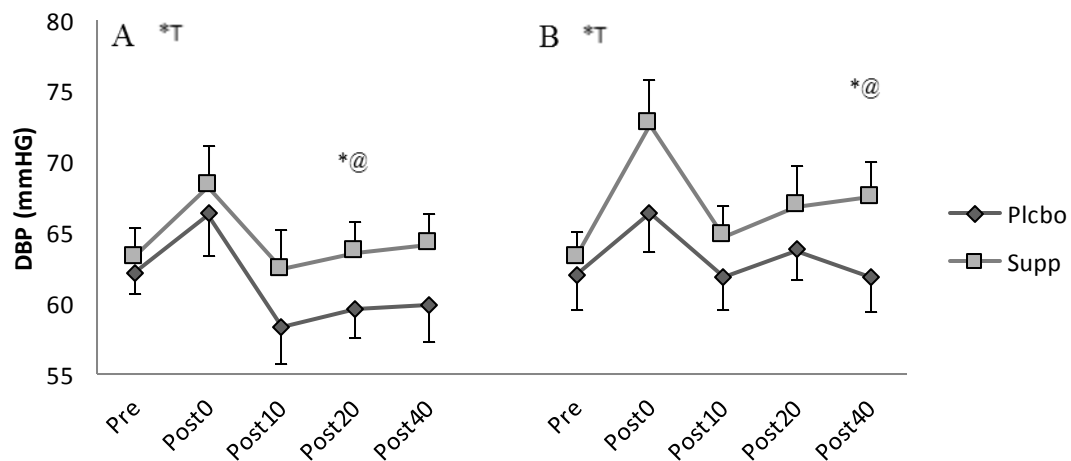


A= Males (N=7), B= Females (N=8)

*T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figures 9-10 show effects of exercise with and without supplement on athlete and non-athlete diastolic blood pressure. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and were reported together. Repeated measures ANOVA showed main effects for condition ($p = .003$) and time ($p < .001$), and a significant interaction for time*category ($p = .042$). For condition, paired t -tests showed significance originated for male athletes at Post20 ($p = .035$) and for female athletes at Post40 ($p = .021$). For time, Pre was significantly different from Post0 ($p = .003$). Post0 was significantly different from Post10 ($p < .001$), Post20 ($p < .001$), and Post40 ($p < .001$).

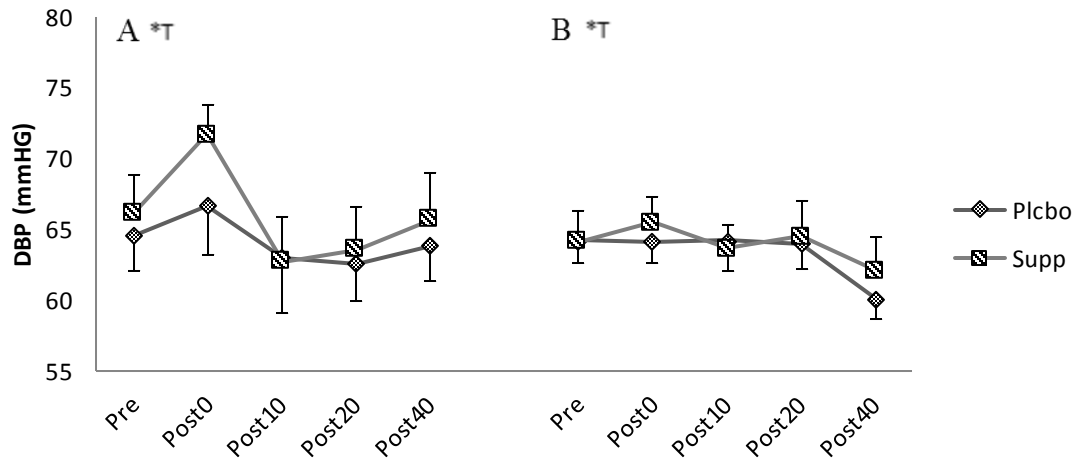
Figure 9. Athlete Diastolic Blood Pressure



A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for males at Post20 ($p = .035$) and females at Post40 ($p = .021$). *T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 10. Non-Athlete Diastolic Blood Pressure

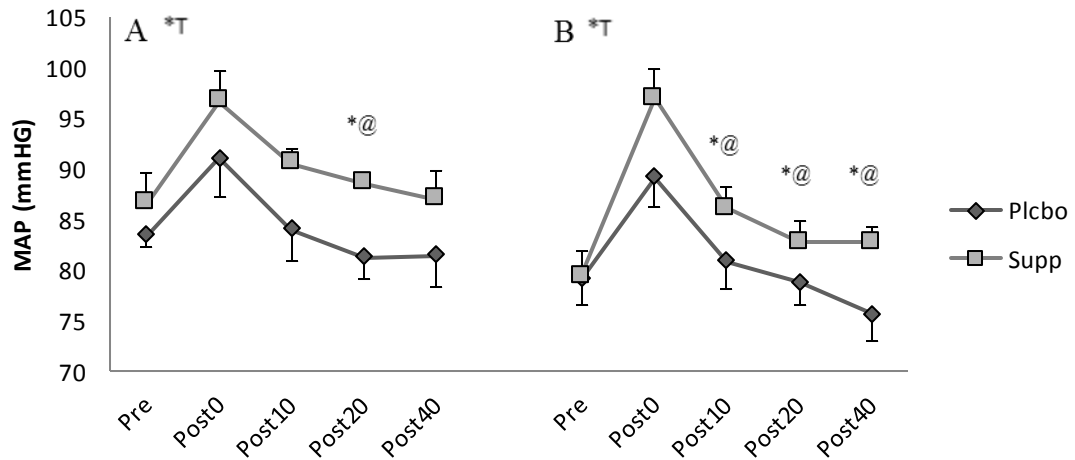


A= Males (N=7), B= Females (N=8)

*T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figures 11-12 show effects of exercise with and without supplement on athlete and non-athlete mean arterial pressure. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and were reported together. Repeated measures ANOVA showed significant main effects for condition ($p = .001$) and time ($p < .001$), and a trend for condition*category ($p = .061$) interaction. For condition, paired t -tests showed significance originated in male athletes at Post20 ($p = .046$), female athletes at Post10 ($p = .037$) Post20 ($p = .048$) and Post40 ($p = .029$), and in male non-athlete at Post10 ($p = .014$) and Post20 ($p = .044$). For time, Pre was significantly different from Post0 ($p < .001$). Post0 was significantly different from Post10 ($p < .001$), Post20 ($p < .001$), and Post40 ($p < .001$). Post 10 was significantly different from Post20 ($p = .043$) and Post40 ($p = .024$).

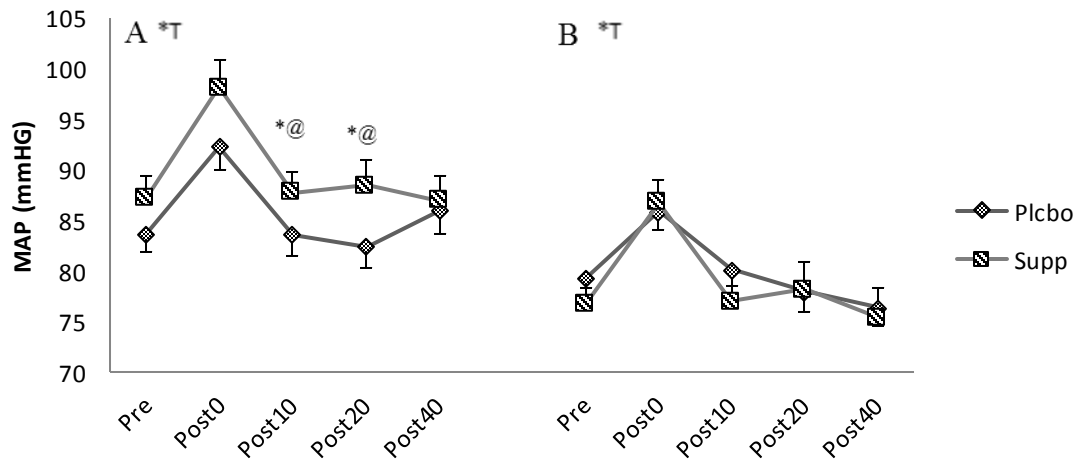
Figure 11. Athlete Mean Arterial Pressure



A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for males at Post20 ($p=.046$) and females at Post10 ($p=.037$) Post20 ($p=.048$) and Post40 ($p=.029$). *T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 12. Non-Athlete Mean Arterial Pressure

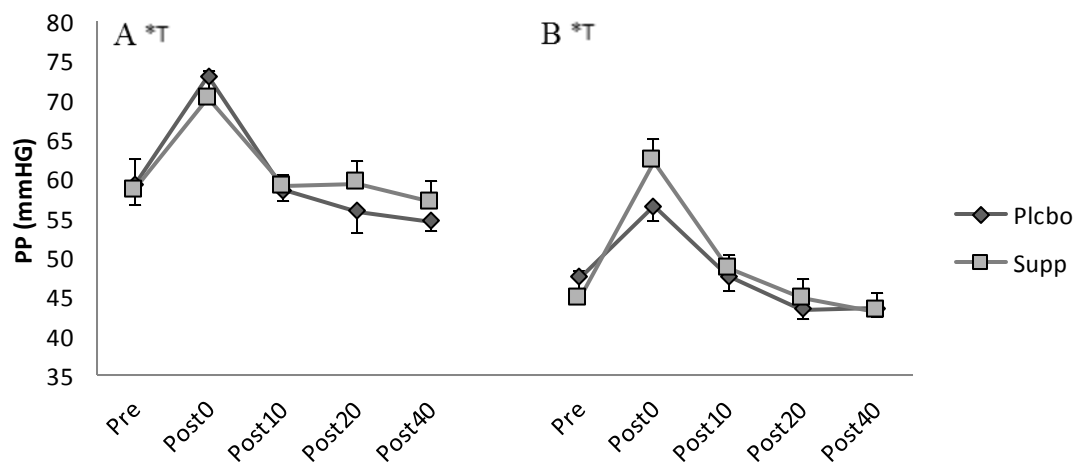


A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for males at Post10 ($p=.014$) and Post20 ($p=.044$). *T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figures 13-14 shows effects of exercise with and without supplement on athlete and non-athlete pulse pressure. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and were reported together. Repeated measures ANOVA showed significant condition ($p = .035$) and time ($p < .001$) main effects. For condition, paired t -tests showed significance originated in male non-athletes at Post40 ($p = .011$). For time, Pre was significantly different from Post0 ($p < .001$). Post0 was significantly different from Post10 ($p < .001$), Post20 ($p < .001$), and Post40 ($p < .001$).

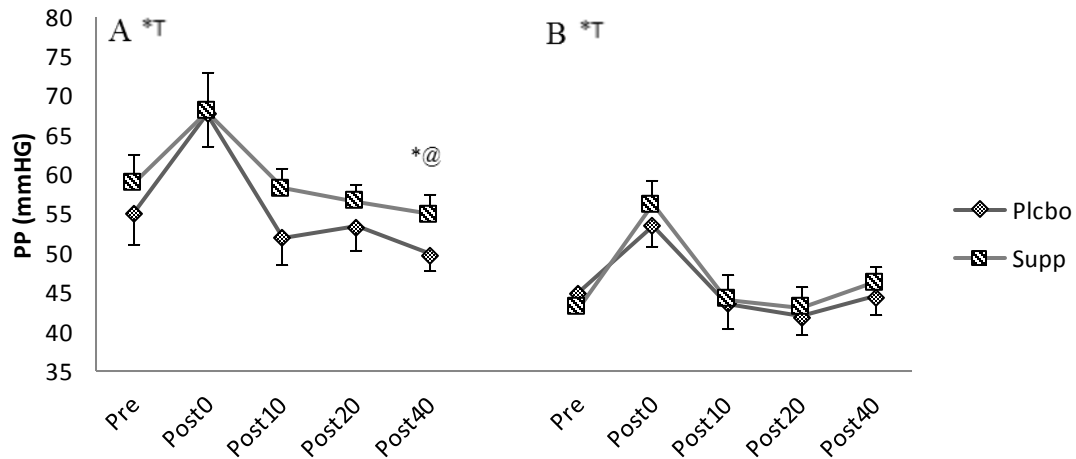
Figure 13. Athlete Pulse Pressure



A= Males (N=7), B= Females (N=8)

*T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 14. Non-Athlete Pulse Pressure

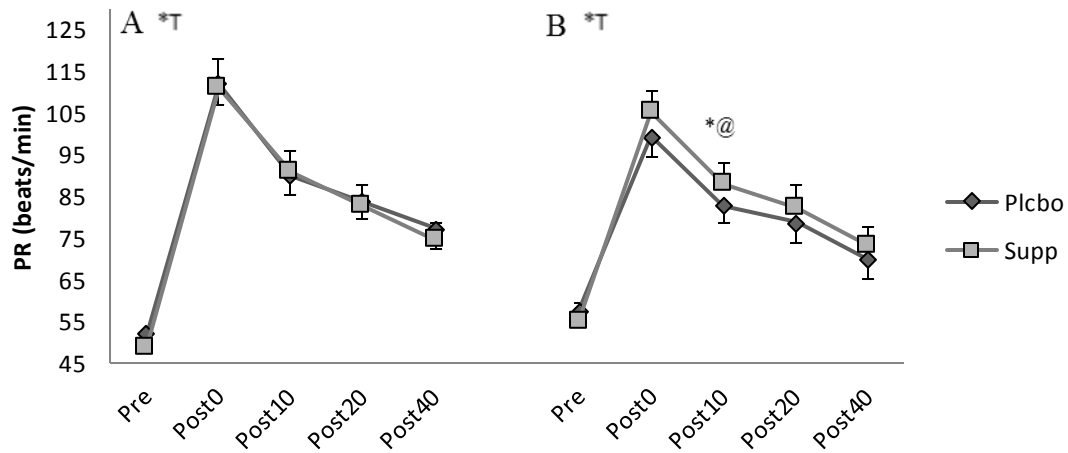


A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for males at Post40 ($p=.011$) *T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 15 shows effects of exercise with and without supplement on athlete pulse rate. Repeated measures ANOVA showed significant interactions for condition*time ($p=.001$), condition*category ($p=.009$), time*category ($p=.001$), and significant condition ($p=.001$) and time ($p<.001$) main effects. Both athlete groups had lower exercise heart rates for each time point compared to their non-athlete counterparts. For condition, paired t -tests showed significance originated in female athletes at Post10 ($p=.038$). For time, Pre was significantly different from Post0 ($p<.001$), Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post0 was significantly different from Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post10 was significantly different from Post20 ($p<.001$) and Post40 ($p<.001$). Post 20 was significantly different from Post40 ($p<.001$).

Figure 15. Athlete Pulse Rate

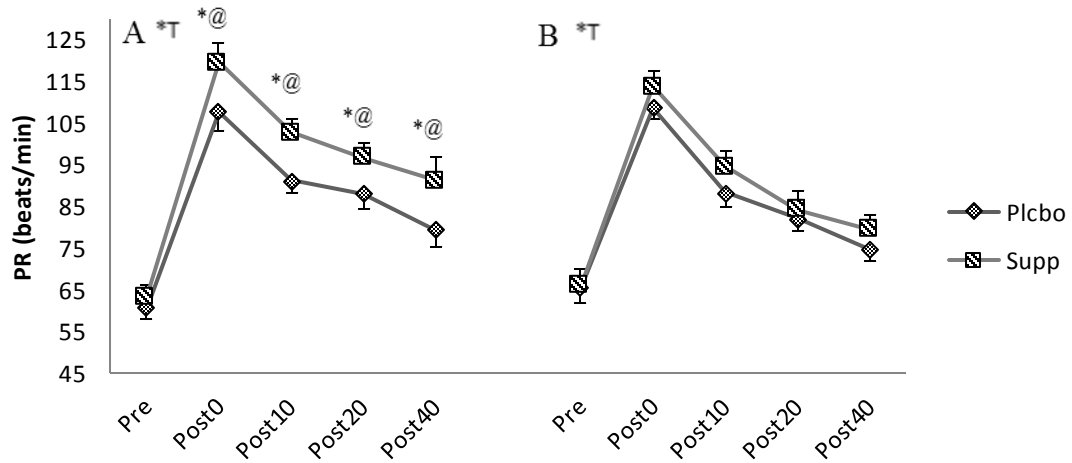


A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for females at Post10 ($p=.038$). *T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 16 shows effects of exercise with and without supplement on non-athlete pulse rate. Repeated measures ANOVA showed significant interactions for condition*time ($p=.001$), condition*category ($p=.009$), time*category ($p=.001$), and significant main effects for condition ($p=.001$) and time ($p<.001$). For condition, paired t -tests showed significance originated in male non-athletes at Post0 ($p=.014$), Post10 ($p<.001$), Post20 ($p=.004$), and Post40 ($p=.009$). For time, Pre was significantly different from Post0 ($p<.001$), Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post0 was significantly different from Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post10 was significantly different from Post20 ($p<.001$) and Post40 ($p<.001$). Post 20 was significantly different from Post40 ($p<.001$).

Figure 16. Non-Athlete Pulse Rate

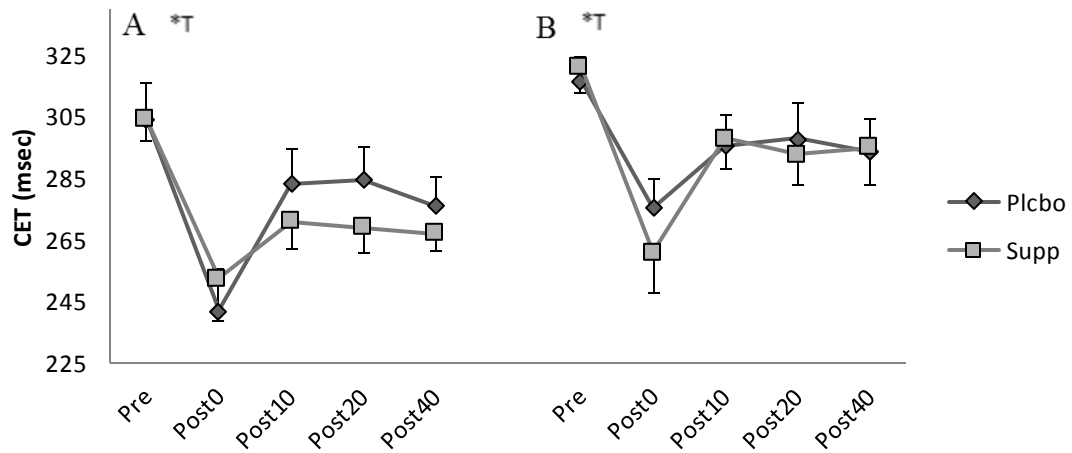


A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for males at Post0 ($p=.014$), Post10 ($p<.001$), Post20 ($p=.004$), and Post40 ($p=.009$). *T significant time difference ($p<.001$). Values reported as mean \pm SE.

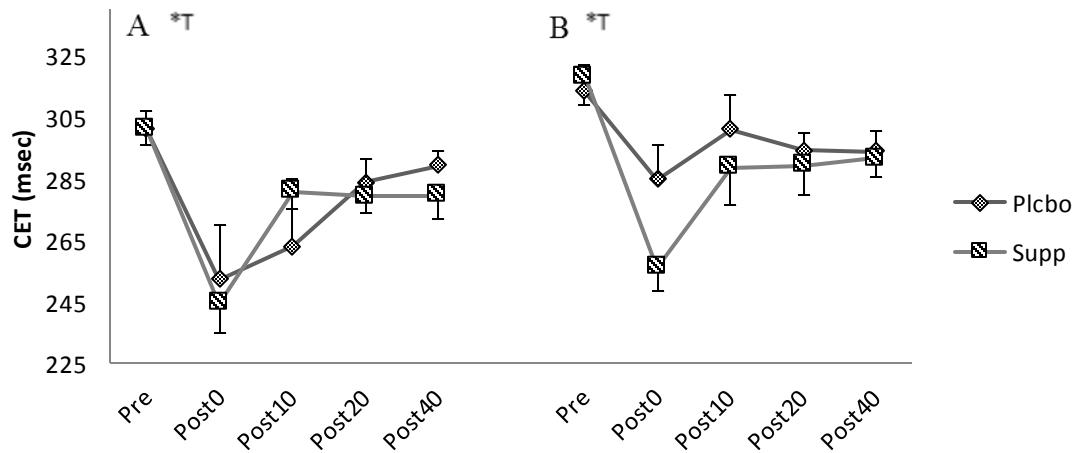
Figures 17-18 show effects of exercise with and without supplement on athlete and non-athlete cardiac ejection time. Categories were statistically similar ($p>.05$) for all effects and interactions and were reported together. Repeated measures ANOVA showed a significant time ($p<.001$) main effect. For time, Pre was significantly different from Post0 ($p<.001$), Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post0 was significantly different from Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$).

Figure 17. Athlete Cardiac Ejection Time



A= Males (N=7), B= Females (N=8)
 *T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 18. Non-Athlete Cardiac Ejection Time

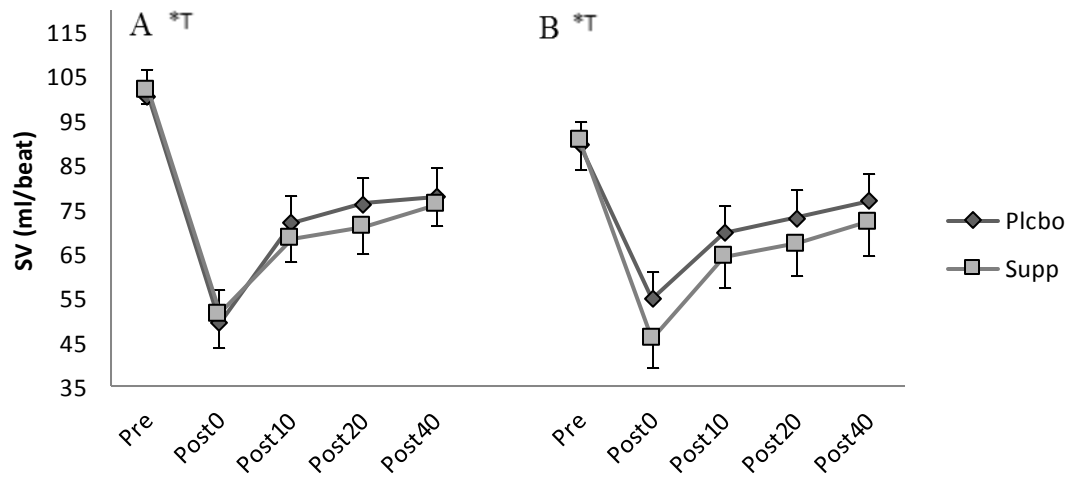


A= Males (N=7), B= Females (N=8)
 *T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figures 19-20 show effects of exercise with and without supplement on athlete and non-athlete stroke volume. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and are reported together. Repeated measures ANOVA showed a significant condition*time interaction ($p = .016$), condition main effect ($p = .033$), and time main effect ($p < .001$). For condition, paired t -

tests showed significance originated in non-athlete females at Post0 ($p=.012$). For time, Pre was significantly different from Post0 ($p<.001$), Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post0 was significantly different from Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post10 was significantly different from Post20 ($p<.001$) and Post40 ($p<.001$). Post 20 was significantly different from Post40 ($p<.001$).

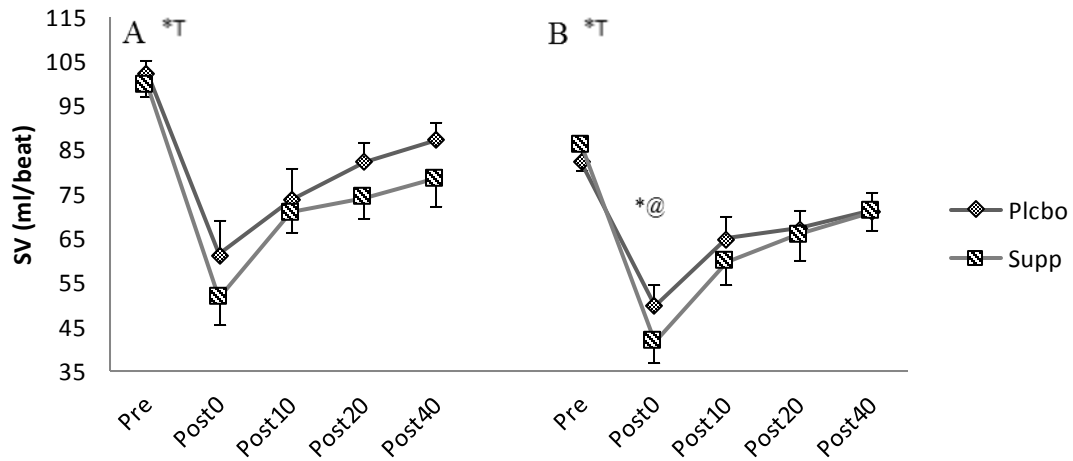
Figure 19. Athlete Stroke Volume



A= Males (N=7), B= Females (N=8)

*T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 20. Non-Athlete Stroke Volume

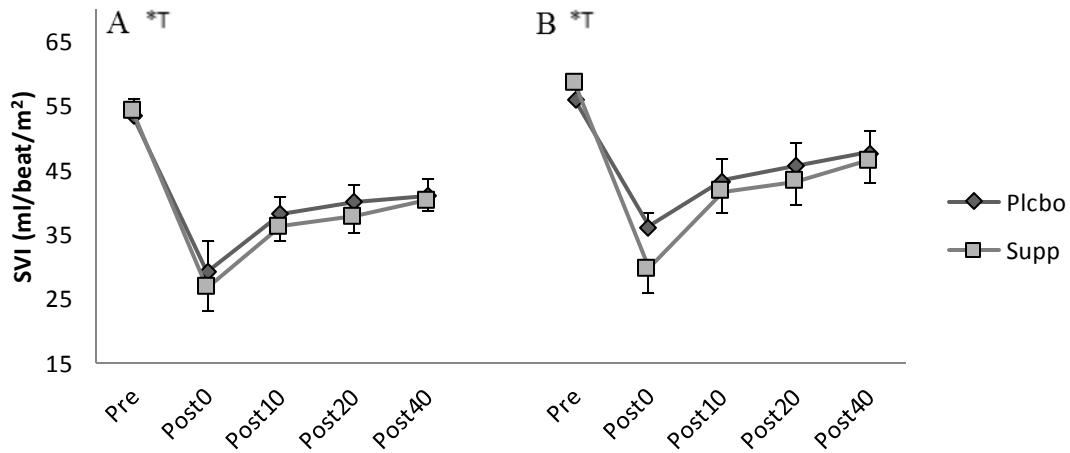


A= Males (N=7), B= Females (N=8)

*@ Condition difference for females at Post0 ($p=.012$). *T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figures 21-22 show effects of exercise with and without supplement on athlete and non-athlete stroke volume index. Except for condition main effect, categories were statistically similar ($p>.05$) for all effects and interactions and are reported together. Repeated measures ANOVA showed a significant condition*time ($p=.001$) interaction, and condition ($p=.007$) and time ($p<.001$) main effects. For condition, paired t -tests showed significance originated in non-athlete females at Post0 ($p=.013$). For time, Pre was significantly different from Post0 ($p<.001$), Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post0 was significantly different from Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post10 was significantly different from Post20 ($p<.001$) and Post40 ($p<.001$). Post 20 was significantly different from Post40 ($p=.001$).

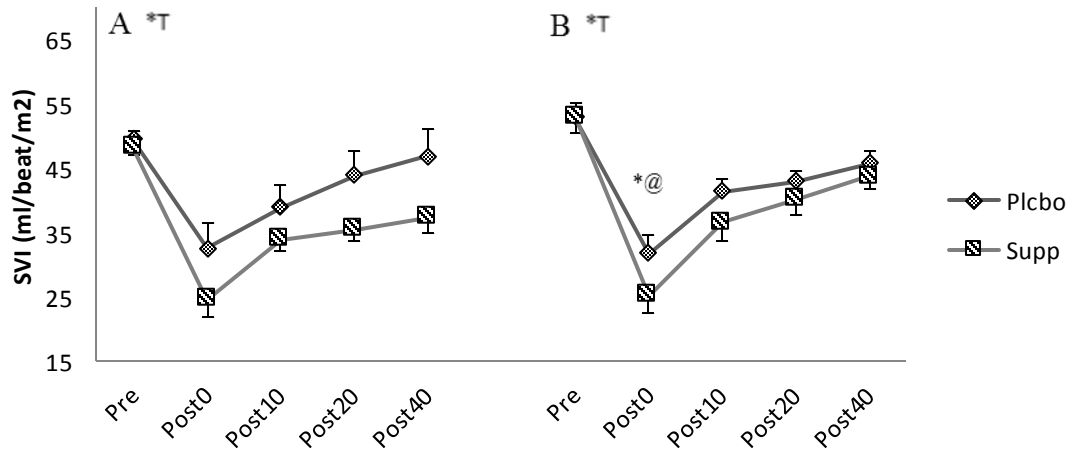
Figure 21. Athlete Stroke Volume Index



A= Males (N=7), B= Females (N=8)

*T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 22. Non-Athlete Stroke Volume Index



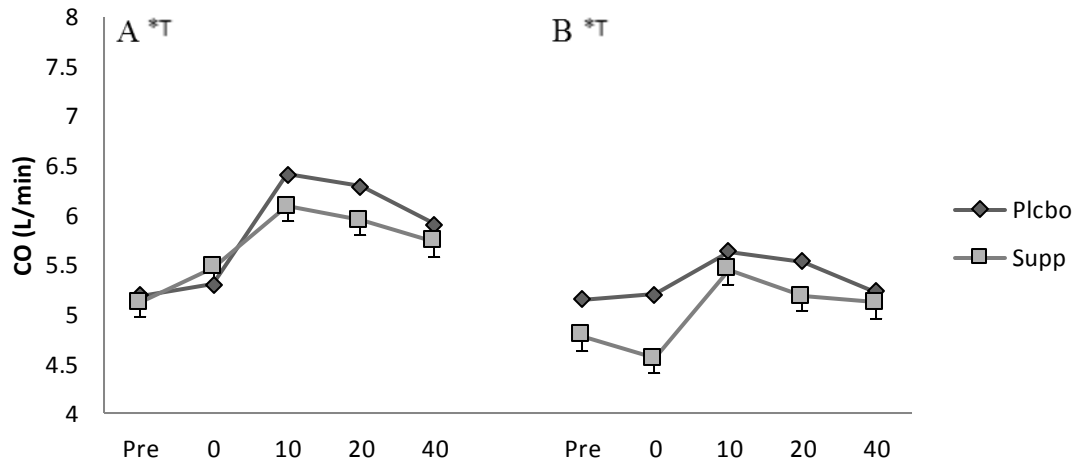
A= Males (N=7), B= Females (N=8)

*@ Condition difference for females at Post0 ($p = .013$). *T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figures 23-24 shows effects of exercise with and without supplement on athlete and non-athlete cardiac output. Categories were statistically similar ($p > .05$) for all effects and interactions and are reported together. Repeated measures ANOVA showed a significant main effect for time ($p < .001$) and a trend for condition*time ($p = .081$) interaction. For time, Pre was significantly different from Post10 ($p < .001$), Post20

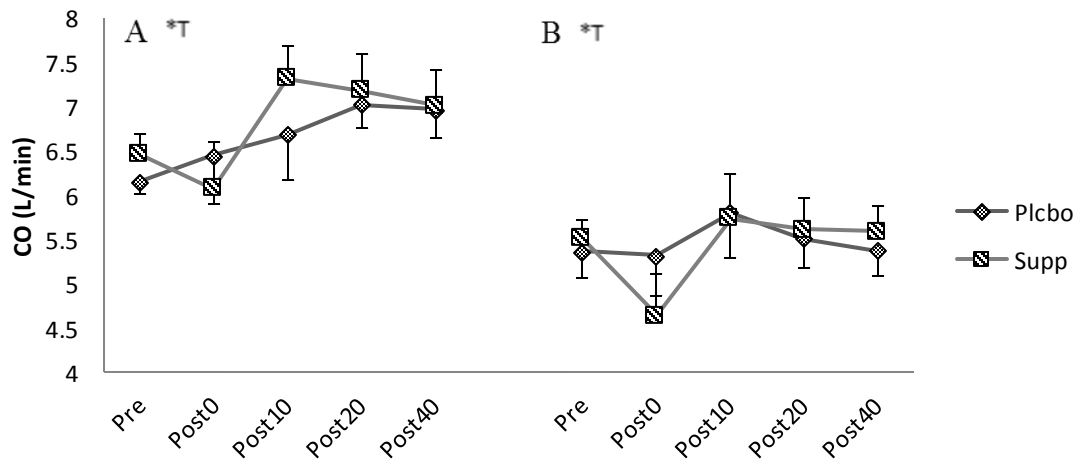
($p < .001$), and Post40 ($p = .001$). Post0 was significantly different from Post10 ($p < .001$) and Post20 ($p = .003$). Post 20 was significantly different from Post40 ($p = .006$).

Figure 23. Athlete Cardiac Output



A= Males (N=7), B= Females (N=8)
 *T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 24. Non-Athlete Cardiac Output

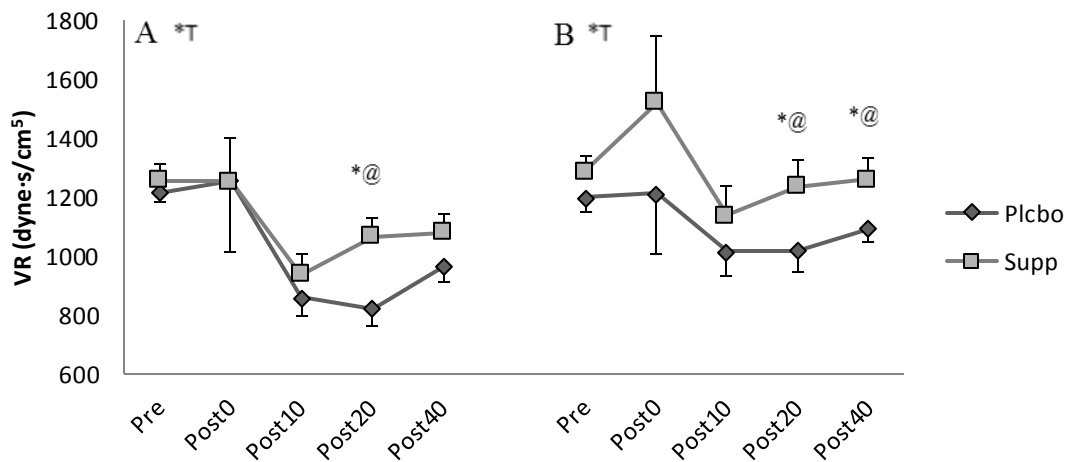


A= Males (N=7), B= Females (N=8)
 *T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figures 25-26 show effects of exercise with and without supplement on athlete and non-athlete vascular resistance. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and were reported together.

Repeated measures ANOVA showed significant condition ($p=.05$) and time ($p<.001$) main effects. For condition, paired t -tests showed significance originated in male athletes at Post 20 ($p=.017$) and female athletes at Post20 ($p=.018$) and Post40 ($p=.032$). For time, Pre was significantly different from Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p<.001$). Post0 was significantly different from Post10 ($p=.008$) and Post20 ($p=.035$).

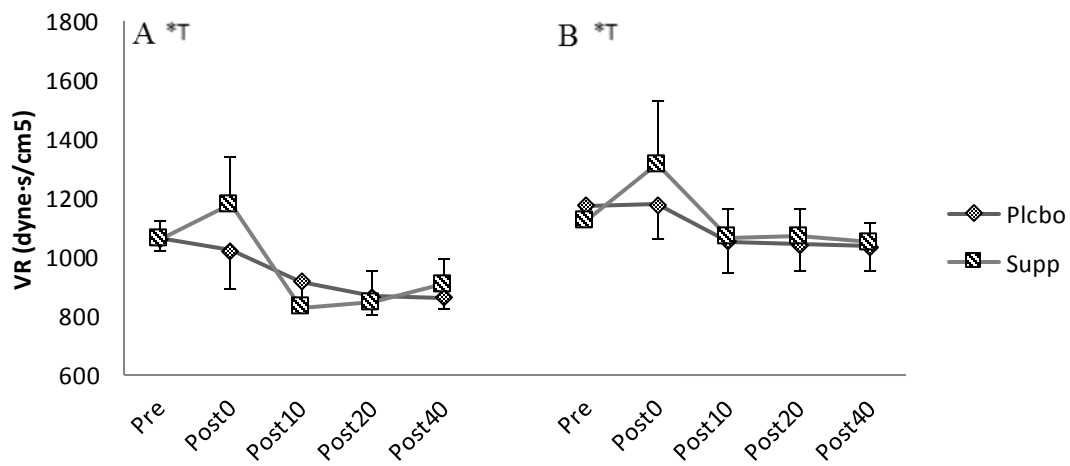
Figure 25. Athlete Vascular Resistance



A= Males (N=7), B= Females (N=8)

*@ Significant condition difference for males at Post 20 ($p=.017$) and females at Post20 ($p=.018$) and Post40 ($p=.032$). *T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 26. Non-Athlete Vascular Resistance

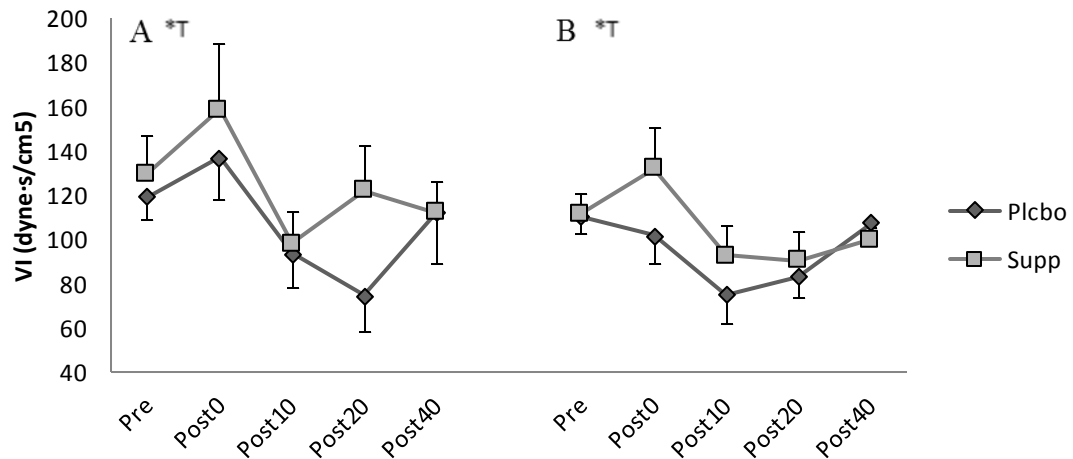


A= Males (N=7), B= Females (N=8)

*T significant time difference ($p<.001$). Values reported as mean \pm SE.

Figures 27-28 show effects of exercise with and without supplement on athlete and non-athlete vascular impedance. Categories were statistically similar ($p > .05$) for all effects and interactions and were reported together. Repeated measures ANOVA showed a significant time ($p < .001$) main effect and a trend for condition ($p = .076$) main effect. For time, Pre was significantly different from Post10 ($p < .001$), Post20 ($p < .001$), and Post40 ($p = .014$). Post0 was significantly different from Post10 ($p < .001$) and Post20 ($p = .003$). Post10 was significantly different from Post40 ($p = .042$).

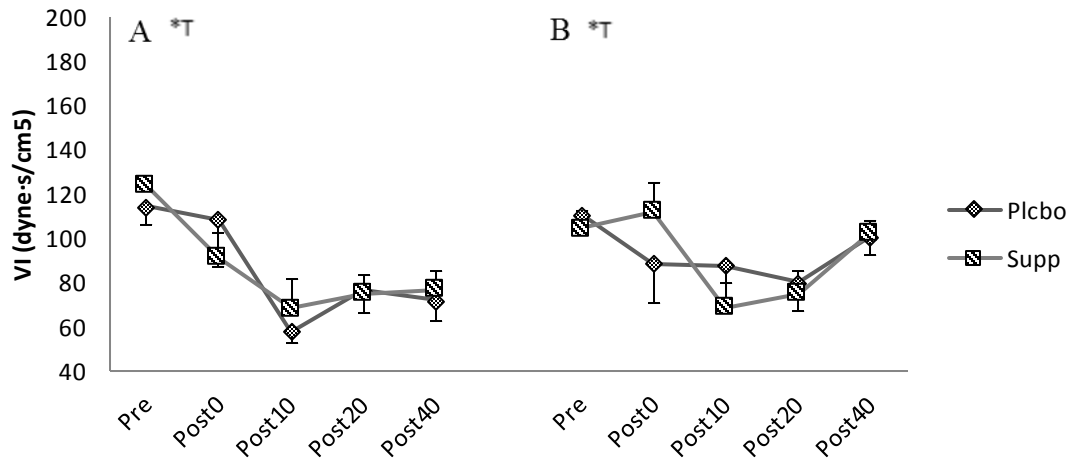
Figure 27. Athlete Vascular Impedance



A= Males (N=7), B= Females (N=8)

*T significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 28. Non-Athlete Vascular Impedance



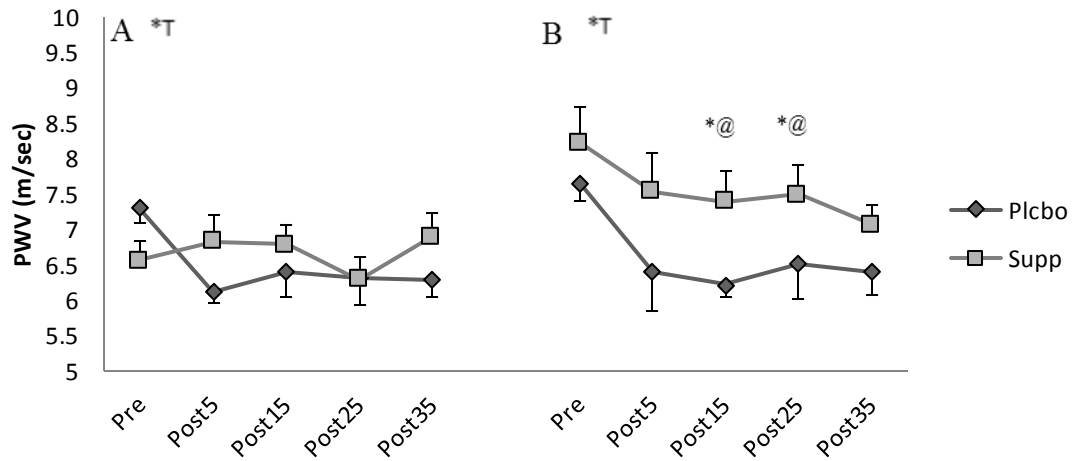
A= Males (N=7), B= Females (N=8)

*T significant time difference ($p < .001$). Values reported as mean \pm SE.

Arterial Compliance

Figures 29-30 show effects of exercise with and without supplement on athlete and non-athlete pulse wave velocity from the carotid to radial artery. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and were reported together. Repeated measures ANOVA showed significant condition ($p = .01$) and time ($p < .001$) main effects. For condition, paired t -test analysis showed significance originated in female athletes at Post15 ($p = .032$) and Post25 ($p = .019$). For time, Pre was significantly different from Post10 ($p = .004$), Post20 ($p = .008$), and Post40 ($p = .017$).

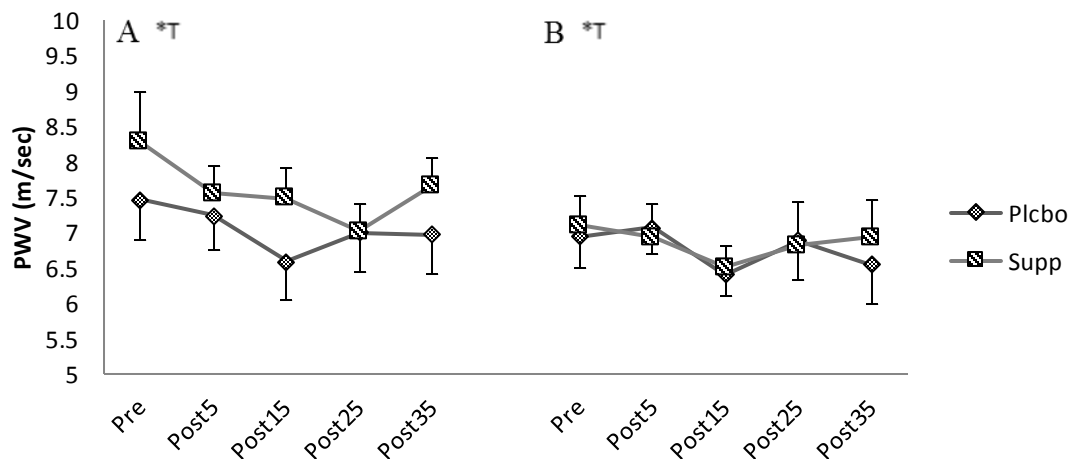
Figure 29. Athlete Pulse Wave Velocity- Carotid to Radial



A= Males (N=7), B= Females (N=7)

*@ Significant condition difference for females at Post15 ($p=.032$) and Post25 ($p=.019$). *T Significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 30. Non-Athlete Pulse Wave Velocity- Carotid to Radial



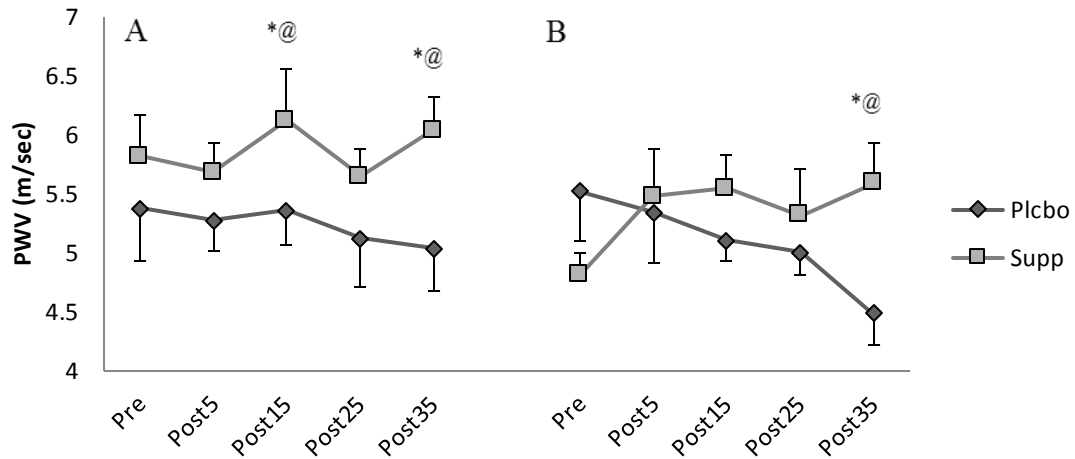
A= Males (N=8), B= Females (N=7)

*T Significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 31 shows effects of exercise with and without supplement on athlete pulse wave velocity from the carotid to femoral segment. Repeated measures ANOVA showed a significant condition*time ($p=.01$) and condition*category ($p=.038$) interaction. There was also a significant condition ($p=.003$) main effect. Paired t -test analysis showed

condition significance originated in male athletes at Post15 ($p=.027$) and Post35 ($p=.005$) and in female athletes at Post35 ($p=.016$).

Figure 31. Athlete Pulse Wave Velocity- Carotid to Femoral

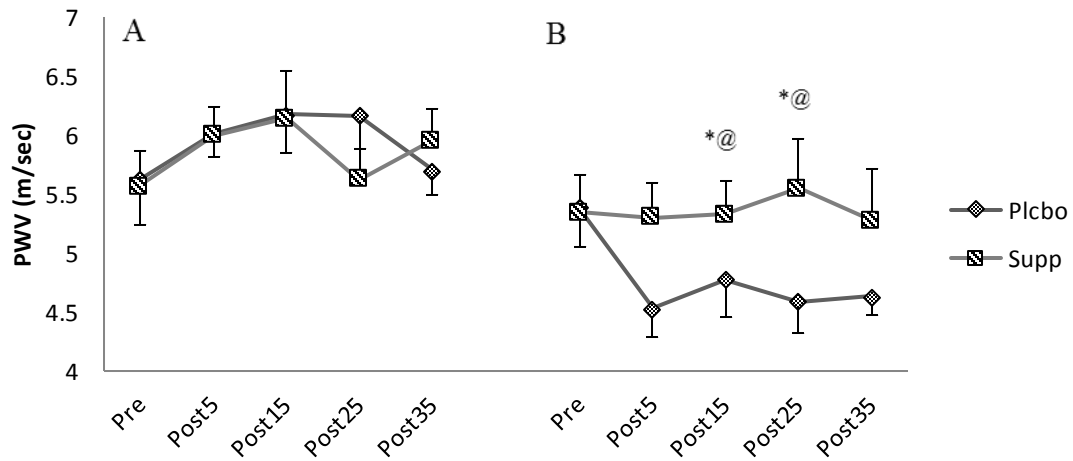


A= Males (N=7), B= Females (N=6)

*@ Significant condition difference for males at Post 15 ($p=.027$) and Post35 ($p=.005$) and for females at Post35 ($p=.016$). Values reported as mean \pm SE.

Figure 32 shows effects of exercise with and without supplement on non-athlete pulse wave velocity from the carotid to femoral segment. Repeated measures ANOVA showed a significant condition*time ($p=.01$) and condition*category ($p=.038$) interaction. There was also a significant main effect for condition ($p=.003$). Paired t -test analysis showed condition significance originated in female non-athletes at Post15 ($p=.016$) and Post25 ($p=.03$). There was no significant condition effect found for male non-athletes.

Figure 32. Non-Athlete Pulse Wave Velocity- Carotid-Femoral

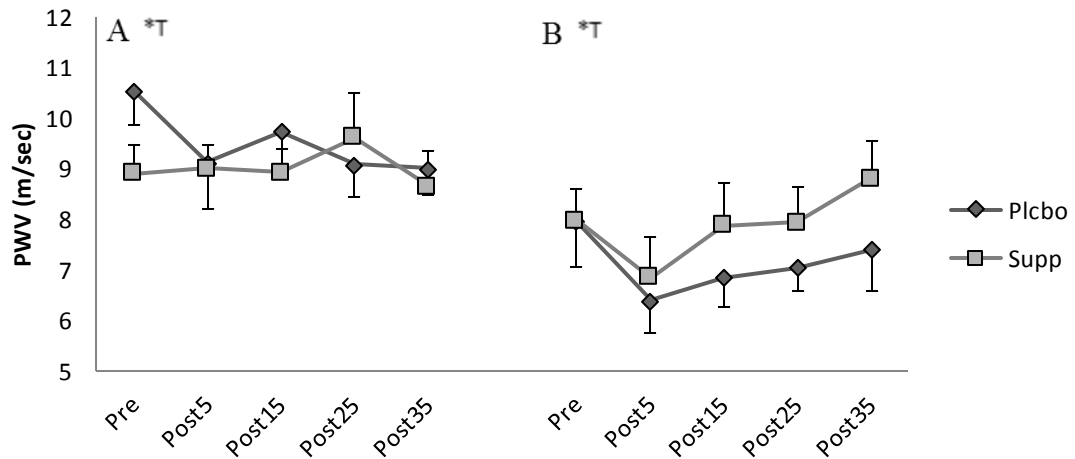


A= Males (N=8), B= Females (N=7)

*@ Significant condition difference for females at Post15 ($p=.016$) and Post25 ($p=.03$). Values reported as mean \pm SE.

Figures 33-34 show effects of exercise with and without supplement on athlete and non-athlete pulse wave velocity from the femoral to distal segment. Categories were statistically similar ($p>.05$) for all effects and interactions and were reported together. Repeated measures ANOVA showed a significant condition*time ($p=.018$) interaction. There was also a significant time ($p<.001$) main effect. For time, Pre was significantly different from Post0 ($p<.001$), Post10 ($p=.001$), and Post20 ($p=.006$). Post0 was significantly different from Post20 ($p=.009$), and Post40 ($p=.046$).

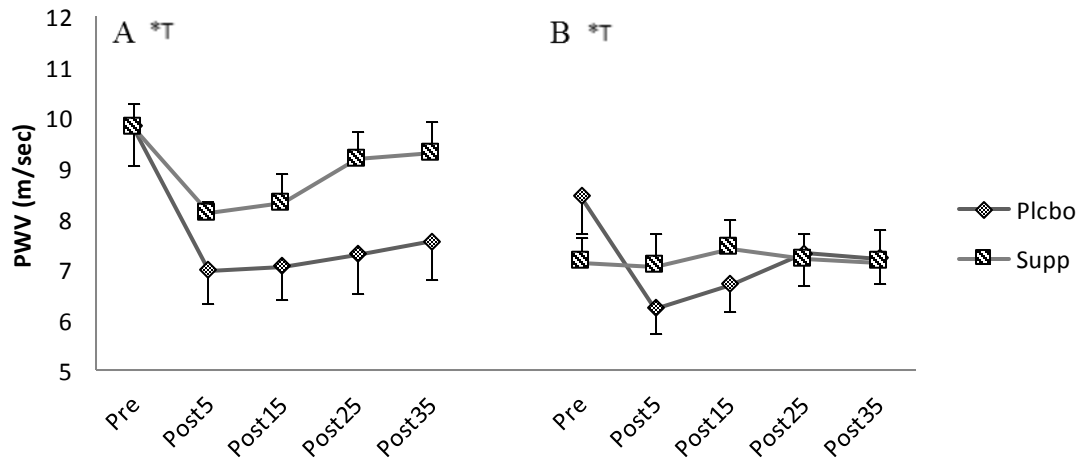
Figure 33. Athlete Pulse Wave Velocity- Femoral to Distal



A= Males (N=7), B= Females (N=7)

*T Significant time difference ($p < .001$). Values reported as mean \pm SE.

Figure 34. Non-Athlete Pulse Wave Velocity- Femoral to Distal



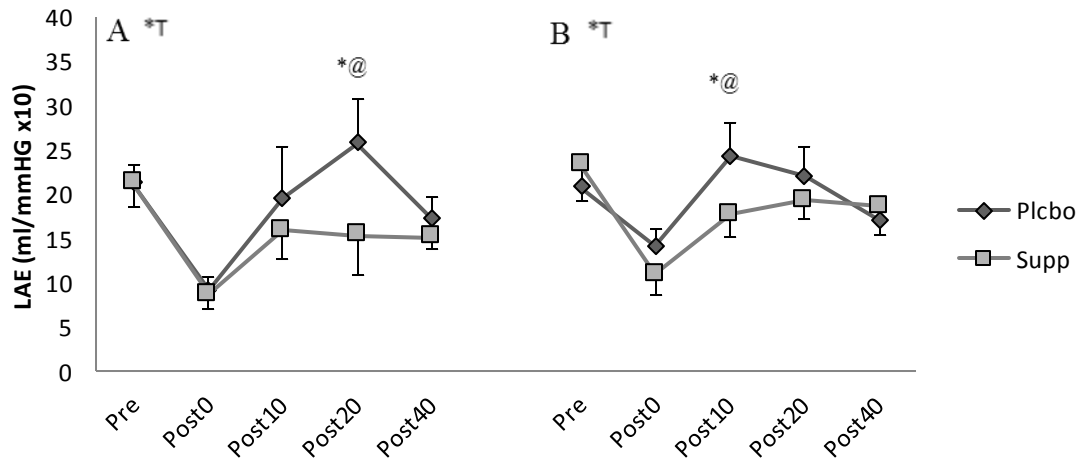
A= Males (N=8), B= Females (N=7)

*@ Significant condition difference for males at Post25 ($p = .021$) and Post35 ($p = .01$). *T Significant time difference ($p < .001$). Values reported as mean \pm SE.

Figures 35-36 show effects of exercise with and without supplement on athlete and non-athlete large arterial elasticity. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and are reported together. Repeated measures ANOVA showed significant condition ($p = .003$) and time ($p < .001$) main effects. There was also a trend for condition*time ($p = .096$) interaction. For

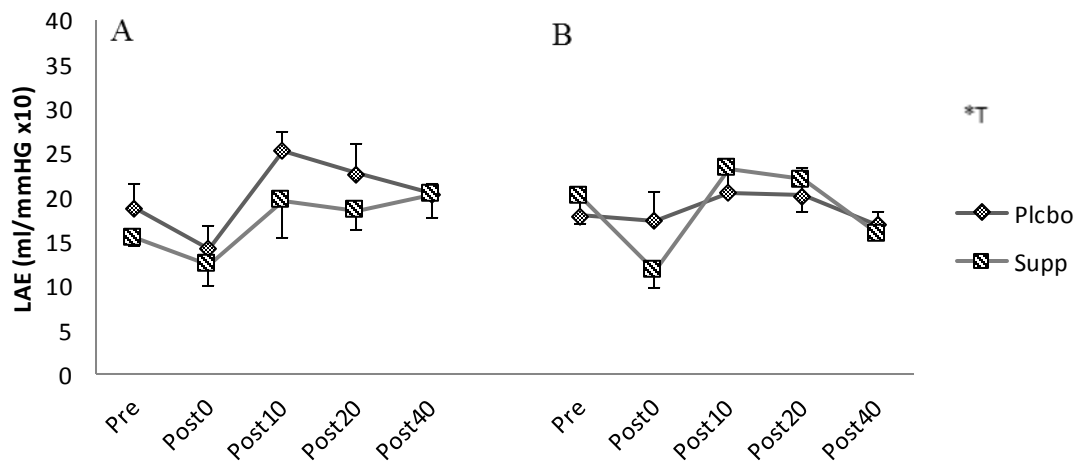
condition, paired *t*-test analysis showed significance originated in male athletes at Post20 ($p=.05$) and in female athletes at Post10 ($p=.012$). For time, Pre was significantly different from Post0 ($p=.001$). Post0 was significantly different from Post10 ($p<.001$), Post20 ($p<.001$), and Post40 ($p=.001$).

Figure 35. Athlete Large Arterial Elasticity



A= Males (N=7), B= Females (N=8)
 *@ Significant condition difference for males at Post20 ($p=.05$) and females at Post10 ($p=.012$).
 *T Significant time difference ($p<.001$). Values reported as mean \pm SE.

Figure 36. Non-Athlete Large Arterial Elasticity

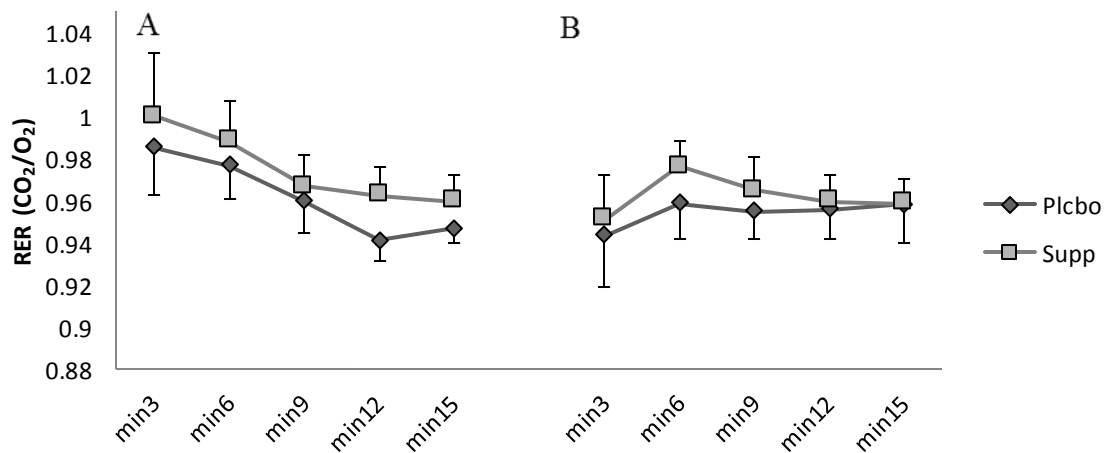


A= Males (N=6), B= Females (N=7)
 *T Significant time difference ($p<.001$). Values reported as mean \pm SE.

Substrate Utilization

Figures 37-38 show effects of exercise with and without supplement on athlete and non-athlete respiratory exchange ratio. Except for condition main effect, categories were statistically similar ($p > .05$) for all effects and interactions and are reported together. Repeated measures ANOVA showed significant condition ($p = .034$) time ($p = .001$) main effects through 15 minutes of treadmill running. VO_2 and heart for the same time length was not statistically significant for condition. For condition, paired t -test analysis showed significance originated in male non-athletes at min3 ($p = .003$), min6 ($p = .03$), min9 ($p = .025$), and min12 ($p = .025$). For time, Post0 was significantly different from Post10 ($p < .001$), Post20 ($p = .001$), and Post40 ($p = .001$).

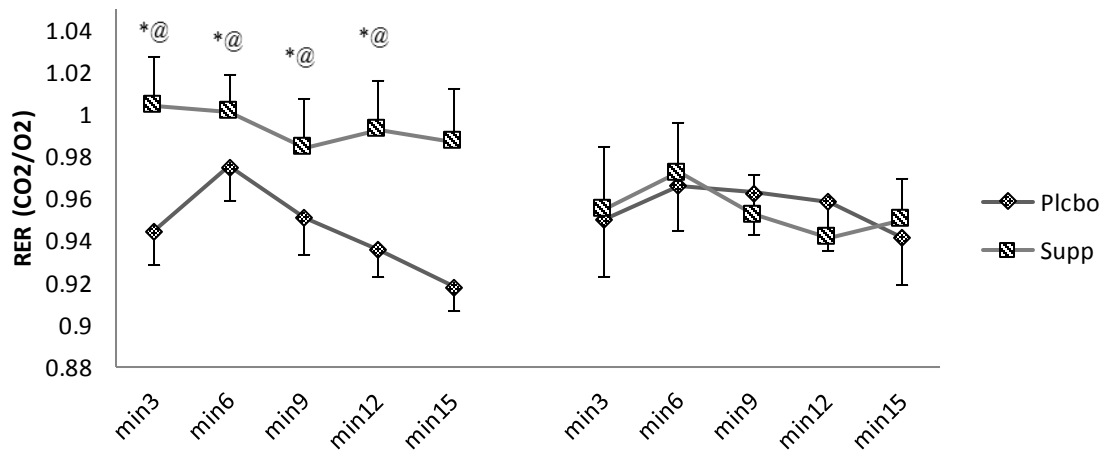
Figure 37. Athlete Respiratory Exchange Ratio



A= Males (N=7), B= Females (N=7)

*T significant time difference ($p = .001$). Values reported as mean \pm SE.

Figure 38. Non-Athlete Respiratory Exchange Ratio



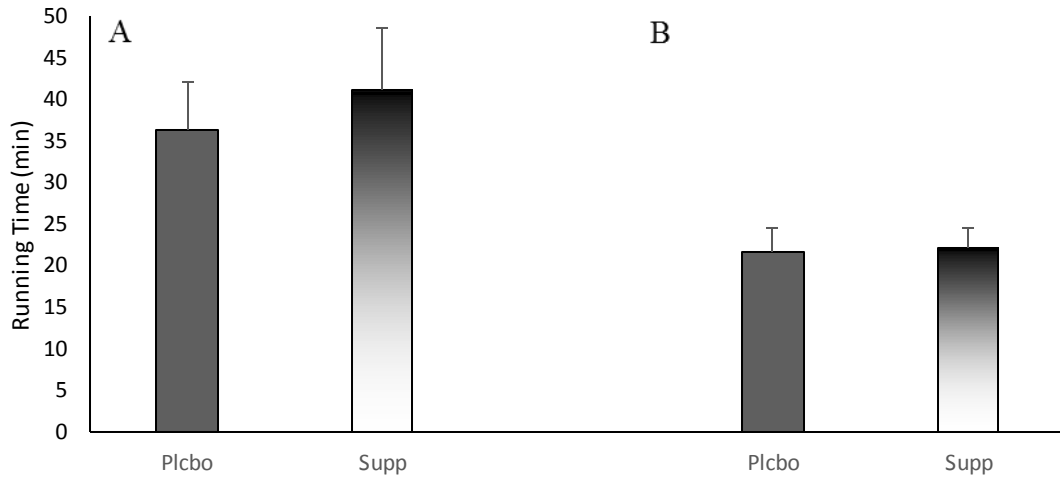
A= Males (N=5), B= Females (N=6)

*@ Significant condition difference for males at min3 ($p=.003$), min6 ($p=.03$), min9 ($p=.025$), and min12 ($p=.025$). *T significant time difference ($p=.001$). Values reported as mean \pm SE.

Endurance

Figure 39 shows athlete running times with and without supplement to volitional fatigue. Male athletes ran 36.47 (± 15.83) minutes on the placebo and 41.28 (± 20.99) minutes on the supplement. Female athletes ran 21.71 (± 2.95) minutes on the placebo and 22.1 minutes (± 2.49) on the supplement.

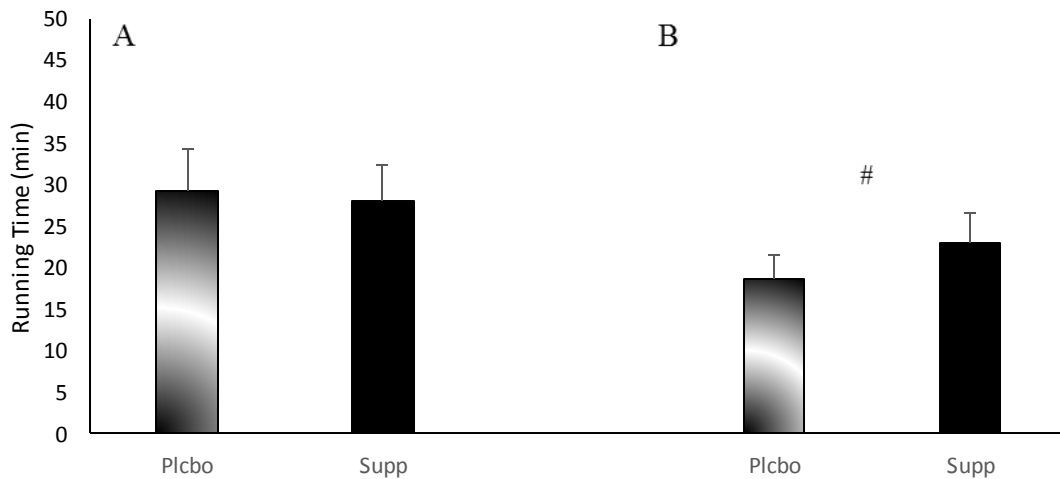
Figure 39. Athlete Running Time



A= Males (N=7), B= Females (N=8)
Values reported as mean \pm SE.

Figure 40 shows non-athlete running times of exercise with and without supplement to volitional fatigue. There was a significant difference for running time to volitional fatigue for female non-athletes ($p=.033$). Male non-athletes ran 29.27 (± 4.76) on the placebo and 28 (± 4.01) minutes on the supplement. Female non-athletes ran 23.64 (± 2.94) minutes on the placebo and 25.31 (± 2.67) minutes on the supplement.

Figure 40. Non-Athlete Running Time



A= Males (N=7), B= Females (N=8)
Significant time to volitional fatigue for females ($p=.033$). Values reported as mean \pm SE.

CHAPTER V

DISCUSSION

The purpose of this study was to 1) examine the acute effects of the weight loss aid, Shred Matrix, on hemodynamic responses (i.e., heart rate, blood pressure, stroke volume, and ejection time), substrate utilization, endurance, arterial compliance, pulse wave velocity, and body water distribution; 2) To investigate the differences between athletes and non-athletes on the previously stated measures.

Body Water

There were no significant differences between conditions for the combined cohort or for any individual group for urine specific gravity. Based on these results, it can be assumed that hydration did not play a role for hemodynamic responses or performance for running time to exhaustion.

Extracellular fluid differences for the supplement condition in male non-athletes were also not a barrier to performance. While post exercise ECF levels were lower in the supplement condition, they did not drop below pre-exercise values. Intracellular fluids for the same group and condition also did not drop below the pre-exercise levels, indicating that there was no drop in total body water from sweating that would cause a decrease in performance in relation to the placebo condition (Case et al., 2000).

Though the supplement contains the diuretics dandelion root and uva ursi leaf, an acute dosage did not appear to have any measurable effect on hydration or total body water, though the male non-athletes showed lower ECF during the supplement condition.

Had the supplement caused an acute effect through diuresis, there should have been a lowering of blood pressure from lower systemic blood volume, however none was found.

Caffeine has also been found in some instances to be a mild diuretic. However, the literature suggests that the diuresis is similar to that caused by drinking plain water. The reported effects indicate there is no evidence for enough water loss from caffeine to cause any decreases in performance (Armstrong, 2002).

Hemodynamic Responses

There were significant differences in blood pressures between conditions post-exercise. The condition*time interaction showed that the increase in systolic blood pressure was directly related to the taking of the supplement. This finding is similar to another study that observed the effects of caffeine supplementation on exercise, consisting of submaximal, followed by maximal cycling. The authors speculated that the increase in systolic and diastolic pressure was caused by increases in vascular resistance from peripheral vasoconstriction. The vasoconstriction was caused by caffeine's antagonist effects on the vasodilator, adenosine, and epinephrine's activation of alpha-1 receptors in the smooth muscle of the arteries (Pincomb et al., 1985; Sung et al., 1990). Evidence that caffeine is the cause for increases in central pressures in this study is furthered supported by significant increases in vascular resistance, diastolic blood pressure, mean arterial pressure, pulse pressure, pulse rate and decreased stroke volume.

Another study evaluating the effects of a thermogenic supplement during and after exercise found increases in heart rate, systolic blood pressure, and diastolic blood pressure. Subjects (13 women, 15 men) ingested a supplement containing caffeine, capsaicin, and other ingredients, rested for approximately 50 minutes, and then walked on a treadmill at a self-selected pace for an hour. Though the study did not have subjects

exercise at vigorous intensity, heart was significantly elevated above resting values, allowing similar effects to occur post-exercise compared to the current study (Ryan et al., 2009).

Condition*time interactions were observed for pulse rate and stroke volume, but there was no significant difference in total cardiac output between conditions. Higher pulse rates for the supplement condition led to a decreased stroke volume from shorter duration left ventricular filling. The placebo condition showed slower heart rates with larger stroke volumes.

It appears that garlic had no effect on blood pressure in this study. This was either due to an ineffectively low dosage, interference from caffeine, subject sampling from a non-hypertensive population, or varied combinations of the three. For athletes, results of the current study coincide with the study performed by Morris et al. (2013) that found no significant differences in blood pressures in athletes cycling under hypoxic conditions. The other study mentioned previously, by Ried et al. (2013), concerning garlic, showed significant decreases in blood pressure. However, the subjects in the study were considered hypertensive. In the current study, all subjects were normotensive or prehypertensive.

Arterial Compliance

Both pulse wave velocity and arterial elasticity measures showed an increase in stiffness of the large arteries above the placebo condition. This evidence is supported by the previously mentioned article by Mahmud and Feely (Mahmud & Feely, 2001). While their study did not observe subjects during or post-exercise, negative changes in pulse wave velocity at rest caused by caffeine are a plausible indication that the same effects can be observed from exercise.

Another study performed on young and healthy males and females also showed increases in arterial stiffness with increases in pulse wave velocity after ingestion of caffeine. In their study, 8 males and eight females ingested 80mg of caffeinated or decaffeinated coffee on separate visits. Subjects were then monitored at rest and measurements were taken every thirty minutes for two hours. Diastolic blood pressure was also found to be higher in the caffeine condition (Karatzis et al., 2005).

An acute dosage of turmeric from the supplement did not have an effect on post-exercise arterial stiffness outcomes. There was either not enough turmeric in the dosage to see a response, caffeine masked any benefits derived, or it may take a longitudinal study to observe the same positive effects seen from the study by Akazawa et al (2013).

Substrate Utilization

The supplement caused a significantly higher respiratory exchange ratio through the first 15 minutes of exercise, especially in male non-athletes. Due to loss of statistical power for groups after 15 minutes, no further time points were included. The higher RER indicates that a higher rate of glycolysis was being used to meet energy demands (Powers & Howley, 2009, pp. 59-60).

Eleutherococcus senticosus (ES) has been previously shown to increase endurance in recreationally trained men participating in an 8 week training study (Kuo, 2010). The current study containing ES contradicts those findings. However, the previously mentioned study was a training study, not acute, they performed cycling exercise at 75% VO_2 , and the supplement did not include other ingredients that may interfere.

Other ingredients that affect blood glucose, including capsaicin, gymnema sylvestre, and banaba extract were mentioned in the literature review. These ingredients

have been previously found to affect how carbohydrate is absorbed and the effects on insulin response (Al-Romaiyan et al., 2010; Dömötör et al., 2006; Fernandez-Mejia, 2005; Kang et al., 2010; Kurian et al., 2014; Tsuchibe et al., 2006; Weerapan Khovidhunkit, 2009). Because this study required that subjects be fasted for participation, there was no measurable effect these ingredients had on their intended purposes.

Endurance

Overall, there were no significant differences between the supplement and placebo conditions. Female non-athletes alone showed significantly longer time to volitional fatigue. Graham and Spriet (1995) have previously shown that various dosages of caffeine affect well-trained endurance athletes differently depending on the dosage. In their study, subjects ingested a placebo, 3 mg/kg, 6 mg/kg, or 9 mg/kg of caffeine. After a period of rest, subjects ran at 85% of their VO_{2MAX} until volitional fatigue. The times to exhaustion varied between groups, but only the 3 and 6 mg/kg trial lasted significantly longer. A notable finding from the study is that only the 9 mg/kg trial had significant increases in plasma FFA and glycerol with the greatest effect on epinephrine. This should have correlated to higher FFA use and glycogen sparing, but time to exhaustion indicated that it was not the most effective condition (Graham & Spriet, 1995).

In the current study, the dosage of supplement was uniform for all subjects, meaning caffeine ingestion was relatively different for individuals and between groups. The supplement in the current study contained 217.5 mg of caffeine per serving according to its label. This equated to male athletes receiving an average of 2.94 mg/kg, female athletes 3.84 mg/kg, male non-athletes 2.46 mg/kg, and female non-athletes ingested 3.56 mg/kg of caffeine. Dosages appear to be similar for all groups in the current study. However, it has also been shown that tolerance to habitual caffeine use can affect

treadmill running time to exhaustion at a similar intensity of 75% V_{O2} max (Fisher, McMurray, Berry, Mar, & Forsythe, 1986). The members of the female non-athlete group might consume less caffeine daily compared to the other groups, showing less tolerance, and resulting in an increased time to exhaustion. This is a possible explanation as to why the group was the only one to last significantly longer.

CONCLUSION

The purpose of this study was to 1) examine the acute effects of the weight loss aid, Shred Matrix, on hemodynamic responses (i.e., heart rate, blood pressure, stroke volume, and ejection time), substrate utilization, endurance, arterial compliance, pulse wave velocity, and body water distribution; 2) To investigate the differences between athletes and non-athletes on the previously stated measures. This study asked: Was there a significant increase in fat metabolism when the weight loss aid, Shred Matrix, is consumed prior to exercise? What were the changes in exercise HR, exercise diastolic and systolic BP? Was there a significant effect on stroke volume? Was there a significant effect on ejection time? Was there an increase in exercise endurance? Was there a change in arterial compliance? Was there a significant effect on pulse wave velocity? Was there a change in intracellular and/or extracellular body water?

Research Hypothesis 1. There was a greater amount of fat metabolism with Shred matrix during exercise.

The results of the present study did not support this hypothesis. It was hypothesized that caffeine would mobilize more fatty acids from adipose tissue and spare

glycogen stores. However, RER values, especially in male non-athletes, indicated an increased use of carbohydrate during the first 15 minutes of treadmill running at 80% of VO_{2MAX} .

Research Hypothesis 2. Shred Matrix resulted in lower increases in HR, diastolic and systolic blood pressures at different time points compared to placebo.

The results of the present study did not support this hypothesis. Based on a study by McClaran and Wetter (2007), we hypothesized that caffeine would cause a lower heart rate response during sub-maximal exercise. However, Shred Matrix resulted in no significant difference during exercise for heart rate.

Due to garlic's vasodilation capabilities reported in a previously mentioned study, we hypothesized that peripheral vascular resistance would be lower with the supplement. Lower resistance would bring about lower blood pressures. Pulse rate, SBP, and DBP were all higher post-exercise for Shred Matrix compared to the placebo at different time points.

Research Hypothesis 3. There was a significant increase in stroke volume.

The results of the present study did not support this hypothesis. It was hypothesized that the expected lower heart rate would leave more time for left ventricular filling and result in increased stroke during systole with the supplement condition. However, stroke volume was lower post-exercise compared to the placebo.

Research Hypothesis 4. There was an increase in cardiac ejection time.

The evidence gathered in the present study did not support the hypothesis. With the expected lower heart and longer stroke volume, it was expected that cardiac ejection time would last longer with the supplement. However, the present study did not find any significant changes in CET.

Research Hypothesis 5. Shred Matrix resulted in increased time to exhaustion.

The results of the present study did not support this hypothesis. The hypothesized increase in fat metabolism and subsequent glycogen sparing would potentially allow subjects to continue running for a longer duration. Overall mean time to exhaustion was higher for Shred Matrix, but was only significant for female non-athletes.

Research Hypothesis 6. There was an increase in large and small arterial elasticity.

The results of the present study did not support this hypothesis. With the hypothesized decrease in vascular resistance, there would be a decrease in central and peripheral pressures, allowing increased arterial compliance. However, shred matrix caused decreases in large arterial elasticity and no changes for small arterial elasticity compared to the placebo.

Research Hypothesis 7. There was a decrease in pulse wave velocity.

The results of the present study did not support this hypothesis. Hypothesized decreases in vascular resistance and increased arterial elasticity would also cause lower wave reflections, placing less strain on the heart, and result in decreased pulse wave

velocity (Nichols et al., 2008). Shred matrix caused an increase in pulse wave velocity compared to the placebo.

Research Hypothesis 8. There was an increase in extracellular water.

The results of the present study did not support this hypothesis. It was hypothesized that with the presence of potassium aspartate, there was a possibility of a fluid shift from extracellular to intracellular fluid. Non-athlete males were the only group to undergo significant changes in extracellular fluid. The ECF for male non-athletes was lower than the placebo.

This study observed acute negative effects for multiple variables. These included higher blood pressures, lower arterial elasticity, and increased pulse wave velocity post-exercise during days where Shred Matrix was ingested compared to a placebo. These measures indicate an increased risk for a possible cardiovascular event (Mahmud & Feely, 2001; Papaioannou, Karatzi, Karatzis, Papamichael, & Lekakis, 2005).

Simply because a weight loss supplement is marketed for athletes does not mean it is recommended to take. The term “athlete” encompasses a vast array of sports requiring different energy demands. In the present study where higher intensities of aerobic running were used, athletes did not statistically perform better while on the supplement. Furthermore, if chronic use does cause a measurable diuretic effect, the loss of water could have a negative effect on athletic performance and can even become a safety concern (Case et al., 2000).

Both athletes and non-athletes should educate themselves before purchasing supplements to determine both effectiveness and potential harmful effects. Also,

conversing with a physician may help determine if a supplement is safe or if a preexisting condition exists that makes taking a supplement contraindicated.

To ameliorate caffeine's negative effects on hemodynamics and arterial compliance, supplement manufacturers should look into reformulating products in an effort to offset those negative effects. For example, the current supplement could be modified to use more garlic and turmeric in relation to caffeine to improve vasodilation and arterial elasticity.

It is recommended that future studies involving weight loss supplements containing ingredients affecting carbohydrate absorption incorporate carbohydrate feeding so that insulin effects can be measured in addition to performance. Long-term studies can also be conducted testing products containing diuretics and their effects on both athletic performance and cardiovascular health.

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APPENDICES

Appendix A. List of Abbreviations

Appendix B. Recruitment Flyer

Appendix C. Informed Consent





Appendix D. PAR-Q

Appendix E. IRB Approval Letter

Appendix F. Data Collection Sheet

Appendix A. List of Abbreviations

ANOVA	-Analysis of Variance
CET	-Cardiac Ejection Time
CNS	-Central Nervous System
CO	-Cardiac Output
DBP	-Diastolic Blood Pressure
ECF	-Extracellular Fluid
ES	-Eleutherococcus senticosus
FDA	-Food and Drug Administration
FFA	-Free Fatty Acid
HR	-Heart Rate
ICF	-Intracellular Fluid
LAE	-Large Arterial Elasticity
MAP	-Mean Arterial Pressure
PAR-Q	-Physical Activity Readiness Questionnaire
PP	-Pulse Pressure
PPAR	-Peroxisome Proliferator-Activated Receptor
PR	-Pulse Rate
PWV	-Pulse Wave Velocity
RER	-Respiratory Exchange Ration
SAE	-Small Arterial Elasticity
SBP	-Systolic Blood Pressure
SV	-Stroke Volume
SVI	-Stroke Volume Index
USG	-Urine Specific Gravity
VI	-Vascular Impedance
VR	-Vascular Resistance

	
	
ATTENTION	
\$ Participants Needed \$	
MALES AND FEMALES BETWEEN 18 AND 40 YEARS OLD	
<p>The Health and Human Performance Department would like to invite you to participate in a research study at The University of Texas at Brownsville to assess the acute effects of the weight loss aid, Shred Matrix, on hemodynamic responses, substrate utilization, endurance, arterial compliance, body water distribution, and hydration status. Males and females between the ages of 18 and 40 years are encouraged to call Samuel Buchanan at (940) 389-4807 or e-mail Samuel.Buchanan40@utb.edu, or contact Dr. Murat Karabulut at 882-7236 or e-mail Murat.Karabulut@utb.edu. The total time requirement for completion of the study is 3 visits for a total of approximately 4.5 hours. Compensation for time spent completing the study will be \$20 in the form of a gift card.</p>	
Samuel Buchanan <small>Samuel.Buchanan40@utb.edu</small> 940-389-4807	PLEASE CONTACT: Dr. Murat Karabulut <small>Murat.Karabulut@utb.edu</small> 956-882-7236

Appendix C. Informed Consent

**University of Texas at Brownsville
Institutional Review Board
Informed Consent to Participate in a Research Study**

Project Title: The Acute Effects of Shred Matrix on Hemodynamic Responses, Substrate Utilization, Endurance, Arterial Compliance, Body Water Distribution, and Hydration Status
Principle Investigator: Dr. Murat Karabulut
Co-Investigator: Samuel Buchanan
Department: Health and Human Performance

You are invited to participate in a study as part of testing the acute effects of the weight loss supplement, Shred Matrix, on hemodynamic responses, substrate utilization, endurance, arterial compliance, and body water distribution. The research will be conducted by Dr. Murat Karabulut and Samuel Buchanan at the laboratory in the department of Health and Human Performance.

You were selected as a potential participant because you are a healthy male or female between the ages of 18-40 who are able to perform exercise without risk to health. Limitations for participation include high blood pressure, injuries to the lower extremities that impair running, pregnancy, individuals younger than 18 or older than 40, or any health restrictions that may cause risk to health (determined by PAR-Q).

Purpose of the Research Study

The purposes of the study are to examine: 1) hemodynamic responses, substrate utilization, endurance, arterial compliance, body water distribution, and hydration status; 2) To investigate the differences between genders on the previously stated measures.

Number of Participants

20 males and 20 females, aged 18-40, will participate in this study.

Procedures

On the first day, the participants will fill out questionnaires and will be familiarized with the study procedures before starting the exercise sessions. Following initial screening (PAR-Q and health questionnaire) and familiarization, anthropometric measures that include resting heart rate (RHR), blood pressure (BP), height, and weight will be performed. Subjects will perform the Bruce Protocol on a treadmill. Testing consists of running on a treadmill, with increasing speeds and incline, until exhaustion. Subjects will be fitted with a mask for the metabolic cart, gas exchange, rate of perceived exertion, and heart rate will be monitored continuously by metabolic cart machine while performing VO₂ Max testing and endurance exercise on a treadmill. Participants will arrive at the lab fasted on two separate days to complete the testing sessions.

Participants will be required to show up at least 8-hours fasted during two separate randomized sessions. The subject will be given either Shred Matrix, or receive a placebo. The subject's HR and BP will be assessed prior to the start of the exercise. Intracellular and extracellular body fluids will be analyzed via bioelectrical impedance equipment. Hydration status will be measured by a clinical urine refractometer. Baseline arterial elasticity, ejection fraction, stroke volume, and pulse wave velocity will

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also be recorded prior to exercise via pulse wave analysis, Sphygmocor®, and bioelectrical impedance. Hydration status will be determined by a clinical urine refractometer. During the two different testing days, each subject will exercise until exhaustion on a treadmill at 80% VO2 Max, once with Shred Matrix and once with a placebo. Immediately post exercise, arterial elasticity will be measured at 0, 10, 20, and 40 minutes. Body fluid analyses will be performed at 4, 14, and 30 minutes post-exercise. Hydration status will be determined at 3 and 31 minutes. Pulse wave velocity will be measured at 5, 15, 25, and 35 minutes post-exercise. During testing, heart rate and rate of perceived exertion will be continuously monitored.

Time Commitment

The study will require approximately 4 hours broken down into the following test sessions:

- 1) On the first session (approximately 60 min), the initial screening and questionnaires will be completed (10-15 min). After completion of the paperwork; RHR, BP, height, and weight will be performed. Participants will complete familiarization by being introduced to study procedures and then complete a VO2 Max test using the Bruce Protocol.
- 2) During the next two visits, participants will ingest three pills, either the supplement or placebo, wait 30 minutes, and perform the exercise protocol. Participants will perform both exercise conditions on different days separated by at least 48 hrs. The total time required to complete the sessions is approximately 105 minutes each.

This study has the following risks:

You understand there are minimal risks to healthy individuals when performing any of the requirements for this project. However, even though these standard protocols have been approved at numerous other institutions and will be performed by qualified and trained personnel, you should be aware of the following:

Physical Risks

- a) You may experience slight, temporary discomfort while performing the Bruce Protocol and the testing protocols due to elevated heart rate and lactate accumulation which may signal a burning feeling in the working muscles.
- b) There is a possibility of temporary muscles soreness occurring 24-48 hours after testing which could be the result of the protocols.
- c) To reduce the risk of allergic reactions, Shred Matrix has been formulated to no traces of milk, egg, shellfish, fish, tree nut, peanut or soybeans. However, there may be slight increases in heart rate above baseline values and minor loss of water from the diuretic components.

Benefits of Participation

There is a \$20 incentive in the form of a gift card for participation and completion of the study. In addition, personal knowledge of your aerobic capacity and arterial health will be obtained which may be useful when determining appropriate cardiovascular regimens. Data will also help researchers understand in more detail the effects of certain weight loss supplements and their ingredients.

Injury

In case of injury or illness resulting from this study, emergency medical services will be contacted. However, you or your insurance provider may be expected to cover payments for your treatment. The University of Texas at Brownsville has no set funds to compensate you in the event of an injury.

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Confidentiality

In published reports, there will be no information included that will make it possible to identify you without your permission. Research records will be stored securely for 3 years after completion of the study and only approved researchers will have access to the records. There are organizations that may inspect and/or copy your research records for quality assurance and data analysis. These organizations include Murat Karabulut and the University of Texas at Brownsville Institutional Review Board.

Costs

There is no cost for study participation.

Compensation

As an incentive to participate in the study, you will be compensated for your time with a \$20 gift card upon completion. An incentive of a gift card may be offered to students who participate as trainees. The IRS requires the reporting of taxable income paid to non-US Citizens, non-Legal Permanent Residents, regardless of the amount paid. It is the responsibility of the participant to file any tax paperwork.

Rights

Refusal to participate will involve the loss of the \$20 incentive to which you are otherwise entitled to upon completion. You can discontinue participation at any time with the loss of \$20 to which you are otherwise entitled.

Voluntary Nature of the Study

Participation in this study is strictly voluntary. If you decline to participate, you will not be penalized or lose benefits or services unrelated to the study. If you decide to participate, you may decline to answer any question and may choose to withdraw at any time.

Waivers of Elements of Confidentiality

Your name will not be linked with your responses unless you specifically agree to be identified. Please select one of the following options:

_____ I consent to being quoted directly.

_____ I do not consent to being quoted directly.

Contacts and Questions

You should feel free to ask questions now or any time during the study. If you have any questions, you can contact Samuel Buchanan at Samuel.Buchanan40@utb.edu (956) 882-8293 or Dr. Murat Karabulut at Murat.Karabulut@utb.edu (956) 882-6509.

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You are voluntarily making a decision whether or not to participate. Your signature indicates that, having read and understood the information provided above, you have decided to participate. You will be given a copy of this information to keep for your records. If you are not given a copy of this consent form, please request one.

Statement of Consent

I have read the above information. I have asked questions and have received satisfactory answers. I consent to participate in the study.

Signature

Date

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Appendix D. PAR-Q

Physical Activity Readiness
Questionnaire - PAR-Q
(revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
<input type="checkbox"/>	<input type="checkbox"/>	1. Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?
<input type="checkbox"/>	<input type="checkbox"/>	2. Do you feel pain in your chest when you do physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	3. In the past month, have you had chest pain when you were not doing physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	4. Do you lose your balance because of dizziness or do you ever lose consciousness?
<input type="checkbox"/>	<input type="checkbox"/>	5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
<input type="checkbox"/>	<input type="checkbox"/>	7. Do you know of <u>any other reason</u> why you should not do physical activity?

If
you
answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever — wait until you feel better; or
- if you are or may be pregnant — talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____

DATE _____

SIGNATURE OF PARENT
or GUARDIAN (for participants under the age of majority) _____

WITNESS _____

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.



© Canadian Society for Exercise Physiology www.csep.ca/forms

Appendix E. IRB Approval Letter



Research Integrity and Compliance
The University of Texas at Brownsville

Matthew Johnson, Ph.D.
IRB Chair

March 9, 2015

Dr. Murat Karabulut
The University of Texas at Brownsville
One West University Blvd.
Brownsville, Texas 78520
RE: IRB-HS Approval

Study Title: "The Acute Effects of Shred Matrix on
Hemodynamic Responses, Substrate Utilization,
Endurance, Arterial Compliance, Body Water
Distribution and Hydration Status"

Approval Type:

- Full Board Review
 Designated Member Review
 Continuing Review
 Change request/Modification/Amendment
 Exempt Category
 Expedited Category 1 and 4

Approval Period:

Start Date: March 9, 2015

End Date: March 8, 2016

Protocol #: 2015-011-IRB

Dear Dr. Karabulut,

In accordance with Federal Regulations for review of research protocols the Institutional Review Board – Human Subjects of The University of Texas at Brownsville has reviewed your study as requested.

The IRB-HS grants its approval for this project contingent on compliance with the following items. You may make as many copies of the stamped consent form as are necessary for your activity. All consent forms MUST bear the UTB IRB stamp indicating approval.

Responsibilities of the Principal Investigator also include:

- Inform the IRB-HS in writing immediately of any emergent problems or proposed changes.
- Do not proceed with the research until any problems have been resolved and the IRB-HS have reviewed and approved any changes.
- Report any significant findings that become known in the course of the research that might affect the willingness of the subjects to take part.
- Protect the confidentiality of all personally identifiable information collected.
- Submit for review and approval by the IRB-HS all modifications to the protocol or consent form(s) prior to implementation of any change(s).
- Submit an activity/progress report regarding research activities to the IRB-HS on no less than an annual basis or as directed by the IRB-HS through the Continuing Review Form.
- Notify the IRB-HS when study has been completed through submission of a Project Completion Report.

Should you have any questions or need any further information concerning this document please feel free to contact me at (956) 882-8888 or via email at Matthew.Johnson@utb.edu.

Sincerely yours,

Matthew Johnson, Ph.D.

Matthew Johnson, Ph.D.
IRB – Chair

One West University Blvd. • BRHP 2.210 • Brownsville, Texas 78520 • 956-882-7731 • research.compliance@utb.edu

Appendix F. Data Collection Sheet

Subject Name: _____ Number: _____ Ht: _____ Wt: _____

	USG	Carotid	Radial	Femoral	Distal
Day 1	_____				
Pre:	_____				
Post 0:	_____				
Post 30:	_____				
Day 2	_____				
Pre:	_____				
Post 0:	_____				
Post 30:	_____				