EFFECTS OF CAFFEINE AND

CARBOYHDRATE INGESTION ON

RATINGS OF PERCEIVED EXERTION

IN FEMALE CYCLISTS

By

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TABLE OF CONTENTS

LIST OF TABLES

Table Page

CHAPTER I

INTRODUCTION

Worldwide, the bicycle is the most commonly used vehicle for transportation (Forrester, 1993). However, cycling is not solely an effective form of transportation. It is a form of aerobic exercise that is low weight bearing and requires little skill by the user. These attributes combined make cycling a safe and preferable form of exercise for many people. Additionally, a study carried out for the British Department of Transport found that even a small amount of cycling, four miles five days per week, led to a seventeen percent increase in cardiovascular fitness in participants (Fentem, 1994).

Generally, when not being used for transportation, cycling is competitive or recreational. Shortly after the introduction of bicycles, competitions developed independently in many parts of the world. Large races became popular during the 1890s, with events across Europe, the U.S., and Japan. Presently, competitive cyclists participate in either road races, off road (sometimes referred to as mountain biking) or track racing (Union Cycliste International, 2003). Recreational cycling may include all of the aforementioned events, however indoor cycling is also added to the list. Indoor cycling is a form of exercise that involves the use of a stationary bicycle. In recent years, indoor cycling classes have gained popularity. In these classes, exercisers use stationary bicycles and set goals based on their heart rate (Smith, Davison, Balmer, Bird, 2001).

Regardless if the exerciser is attending indoor group cycling, or is a world-class road racer, there is usually a common thread that involves the use of some form of ergogenic aid. The two most commonly used supplements are caffeine and carbohydrates (Paluska, 2003). Caffeine and carbohydrates are considered ergogenic because when used before exercise they can enhance exercise performance. Caffeine is the worlds most widely used drug, and can be found in the blood streams of the elite athletes and recreational exercisers. At least 80% of American's ingest an average of 200mg of caffeine daily (Paluska, 2003). It has been found that caffeine inhibits adenosine receptors thus having an increased effect on metabolic activity, myocardial oxygen consumption and coronary blood flow (Doherty & Smith, 2005). A more recent study theorizes that caffeine stimulates adrenalin secretion, resulting in the mobilization of free fatty acids- an important fuel for muscles. This increase in fat utilization decreases carbohydrate utilization, thus delaying glycogen depletion (Juhn, 2003). The literature is consistent in showing that carbohydrate ingestion can delay fatigue in a variety of exercise protocols by maintaining blood glucose and in some cases sparing muscle glycogen levels, both important sources of energy for working muscles (Backhouse, Bishop, Biddle, & Williams, 2005).

With the knowledge of the physiological benefits of both carbohydrates and caffeine, many researchers have begun to study the effects of these substances on ratings of perceived exertion (RPE) in test subjects (Doherty & Smith, 2005). RPE is a subjective measure of how hard a person feels their body is working during exercise. It is based on the physiological cues a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating, and muscle fatigue as well as psychological cues (Backhouse, Bishop, Biddle, & Williams, 2005). The harder an athlete feels they are working, the higher the RPE. The basis behind using the RPE scale in tandem with carbohydrates and caffeine is to determine if ingesting these substances has an effect on how hard an athlete "feels" he or she is working.

It has consistently been found that both caffeine and carbohydrate use can cause a decrease in RPE levels in prolonged (>30 minutes at 60-80% of V02 max) cardiovascular activity (Timmons, Bar-Or, 2003). However, there has been little research done to directly examine which of the two accounts for a greater decrease in RPE. As the reviewed literature in Chapter II of this study suggests, comparisons from various studies can be made in an attempt to discern which has a greater effect, but since distinctions in designs present differences in the variables, a direct comparison can not be made

Statement of the Problem

As previously cited in the introduction, both carbohydrates and caffeine produce preferential effects on performance during prolonged (>30 minutes at 60-80% of V02 max) cardiovascular exercise. Unfortunately, there are not many studies in which the researchers make a direct comparison between the two, determining which supplementation method provides the athletes with a lower feeling of exertion for a set duration of time. In addition, there are no studies that test the effects of carbohydrate and caffeine supplementation on RPE in female cyclists only.

Purpose of the Study

The purpose of this study is to examine the influence of carbohydrate and caffeine ingestion on RPE in female cyclist during prolonged exercise. This study will differentiate the effects of carbohydrate and caffeine treatments and determine which is most advantageous to a cyclist performing prolonged cycling exercise.

Significance of the Study

The results of this study will be applicable to the training of recreational cyclists. Carbohydrates and caffeine are two of the most readily available and easily attainable forms of ergogenic aids; they are not only inexpensive but are known to have minimal side effects. Understanding the results of this study will help athletes determine which of these very popular aids will most benefit their training programs.

Assumptions

The following assumptions were made:

1. The subjects were honest and accurate when completing the criteria questionnaire
2. The subjects followed all the instructions in reference to dietary restrictions prior to participation in the study.
3. The subjects understood the purpose and use of the RPE scale after it was explained to them.
4. The subjects accurately reported their RPE during their participation in the study.

Limitations of the Study

The research may be limited by the following:

1. Limited sample size, only 11 participants were available for participation.
2. Attrition, two participants were unable to complete the study.

Delimitations

1. Multiple treatment interference, having more than one treatment and meeting, may have affected the behavior of the participants.
2. Treatment diffusion, the participants ability to hear other participants RPE during the experiment may have effected the accurate reporting of the RPE.
3. Subjects were limited to individuals who indicated that they were currently recreational cyclist, according to given measurements.

Hypotheses

The following hypotheses were investigated:

Ho1: There will be no significant difference among the carbohydrate, caffeine and placebo treatments, with respect to their effects on RPE scores.

Definition of Terms

Blood Glucose: The main energy or fuel for the body obtained from food or made by the liver. Glucose is carried through the bloodstream to provide energy to all of the body's living cells. Also called glucose, dextrose or blood sugar (Gropper, Smith, Groff, 2005).

Blood lactate concentration: Lactate is a normal intermediary metabolite and is present at low levels (< 1.5 mmol/L) in the blood of healthy individuals. Main lactate sources in healthy individuals are the red blood cells, the skin, and the central nervous system. Circulating lactate is eliminated by extraction and further metabolism, mainly in the liver, kidneys, and myocardium (Gropper, 2005).

Borg Ratings of Perceived Exertion: Gunnar Borg developed the Borg RPE Scale as a means to produce estimates of exertion that would be comparable across people and across tasks. A high correlation exists between a person's perceived exertion rating times 10 and the actual heart rate during physical activity. For example, if a person's RPE is 12, then 12 x 10 = 120; so the heart rate should be approximately 120 beats per minute (Backhouse, 2005).

Caffeine: An organic compound found in foods such as chocolate, coffee, cola nuts and tea. Caffeine stimulates the nervous system, kidneys and heart, causes the release of insulin in the body and dilates the blood vessels (Paluska, 2003).

Carbohydrates: Sugars and starches that are the most efficient source of food energy. Stored in the muscle and liver as glycogen and in the blood as glucose (Gropper, 2005).

Cardiovascular Exercise (Aerobic Exercise): Any activity that uses large muscle groups, can be maintained continuously, and is rhythmic in nature (American College of Sports Medicine, 2000).

Cycling: Cycling is a recreation, a sport, and a means of transport across land. It involves riding a bicycle indoors (stationary) or outside and is accepted as means of cardiovascular exercise (Union Cycliste International, 2003).

Dextrose: Commonly known as corn sugar and grape sugar. Naturally occurring form of glucose (Gropper, 2005)**.**

Ergogenic: Enhancing physical performance (Merriam Webster Online Dictionary, 2007).

Free fatty acids: Free fatty acids are an important source of fuel for many tissues since they can yield relatively large quantities of energy (Gropper, 2005).

Heart Rate Monitor: A heart rate monitor is a device that allows a user to monitor their heart rate while exercising. It consists of two elements, a chest strap and a wrist receiver (Smith, Davison, Balmer, Bird, 2001).

Heart Rate Reserve: The difference between resting heart rate and maximum heart rate. Method used to calculate exercise heart rate at a given percentage training intensity, also known as the Karvonen Method (ACSM, 2000).

Maximal Heart Rate*:* The fastest heart rate possible under normal maximal exercise conditions (ACSM, 2000).

Muscle Glycogen: Stored form of glucose found in the muscles (Gropper, 2005).

CHAPTER II

REVIEW OF LITERATURE

Introduction

There have been numerous articles published that have investigated the effects of carbohydrate and caffeine supplementation on exercise (Paluska, 2003). However, this literature review will reference articles that specifically investigated the effects caffeine and carbohydrate supplementation on cyclists and cycling performance. In addition to the investigation of the effects of supplementation on cyclists, the literature review will introduce studies that investigated the effects of the two supplements on ratings of perceived exertion. This review of the literature is specifically broken down into five sections: caffeine and cycling, carbohydrates and cycling, carbohydrates and RPE, caffeine and RPE and finally caffeine and carbohydrate combination and RPE.

The purpose of this review of the literature is to introduce the results of previous studies which have investigated the effects carbohydrate and caffeine supplementation.

Caffeine and Cycling

There are three major theories explaining the ergogenic effect of caffeine during exercise. The first proposes a direct effect of caffeine on skeletal muscle performance. The second theory is an explanation that involves an increase in fat oxidation and a reduction in carbohydrate oxidation and the third will be discussed later in the document (Graham, Spriet, 1996). Though there is no unified position on how caffeine elicits its effects, strength of evidence of caffeine's ergogenic potential is strong, particularly in aerobic activity (Juhn, 2003). This section will reference four studies with varying protocols that all support the theory that caffeine has an ergogenic effect on exercise performance in cyclists.

In a double blind, crossover study, Kovacs et al. investigated fifteen well-trained male tri-athletes and cyclists in a one hour cycling time trial at 75% of V02 max. Three different dosages of caffeine were consumed: 145mg, 230mg an 328mg. Even in the lowest dose there was improvement in time trial performance. (Kovacs, Stegen, Brouns, 1998). The previous study showed that caffeine is effective in a one hour timed trial. The following studies will demonstrate the affects of caffeine when used by cyclist to exhaustion. In a study by Greer, Friars and Graham, eight men cycled at 80% maximum oxygen consumption to exhaustion, ninety minutes after ingesting either a placebo or caffeine. All eight subjects rode 22% longer on average after caffeine ingestion. A similar study was conducted by Costill with mirrored results. Cyclists ingested 330 mg of caffeine one hour prior to cycling to exhaustion at 80% of maximal oxygen consumption. The participants improved performance from 75 minutes in the placebo condition to 96 minutes following caffeine ingestion (Costill, Dalsky, Fink, 1978). The last study cited is slightly different, in that it tested the ingestion of a higher dose of caffeine. The study examined whether a high dose improved running and cycling performance. Seven trained runners completed two trials running to exhaustion and two trials cycling to exhaustion. Subjects ingested either placebo or caffeine 1 hour prior. Endurance times were increased ($P < 0.05$) after caffeine ingestion during running and cycling. The data showed that caffeine in high doses (9mg/kg) increases endurance performance during both running and cycling (Graham & Spriet, 1996).

Despite different protocols, the literature researched to this point supports the theory that caffeine produces at least some ergogenic effect on cycling performance.

Carbohydrates and Cycling

It is generally recognized that a decrease in carbohydrate availability can lead to the development of fatigue during prolonged exercise (El-Sayed, Maclaren, Rattu, 1997). During prolonged exercise, blood glucose and intramuscular glycogen are the two main sources of carbohydrate utilization by the active muscles. Studies have demonstrated that that fatigue can be delayed and performance improved by the ingestion carbohydrates during prolonged exercise. The literature cited below will discuss the affects on carbohydrate utilization while cycling (El-Sayed, Maclaren, Rattu, 1997).

The majority of research on this subject has been investigated by a small group of researchers: Andrew Coggan, Edward Coyle, Mark Hemmert, and John Ivy. This section will investigate three of their studies demonstrating dissimilar protocols but similar results. In the first study, seven cyclists exercised at 70% of maximal oxygen uptake until fatigue on three occasions. After resting for twenty minutes the subjects attempted to continue exercise either after ingesting a placebo, glucose polymers or when glucose was infused intravenously. Glucose polymers (maltodextrins) were used because it has been proposed that due to their lower osmolalities they would be a preferable solution to ingest during exercise (El-Sayed, Maclaren, Rattu, 1997). The results indicate that glucose polymers were effective, however not as effective as intravenous infusion. Time to fatigue was significantly longer during the glucose polymer ingestion (26 +/- 4 minutes; $P < 0.05$) or glucose infusion (43 +/- 5 minutes; $P< 0.01$) compared with the placebo (Coggan & Coyle, 1987). Prior to this study, Coyle et. al conducted an experiment that investigated muscle glycogen utilization during prolonged strenuous exercise when fed carbohydrates (Coyle, Coggan, Hemmert, Ivy 1986). This study also included seven endurance-trained cyclists exercising at 70% of maximal oxygen uptake until fatigue. They received a placebo treatment and a glucose polymer solution while exercising. All seven subjects showed improvements in performance which ranged from 21 minutes to 149 minutes when fed carbohydrates (Coyle et. al, 1986). In 1989, Coggan and Coyle conducted yet another study. This time the purpose of the study was to determine if a single carbohydrate feeding could rapidly restore and maintain plasma glucose availability late in exercise. Six trained cyclists were instructed to cycle at 70% of maximal oxygen uptake and after 135 minutes of exercise they were fed either a placebo or glucose polymer. Exercise time to fatigue was 21% longer during the carbohydrate ingestion trail.

There has not been much research done on cycling and carbohydrate utilization in recent years. However, based on the available data it can be deduced that carbohydrate feeding before and/or during exercise can affect performance.

Carbohydrates and RPE

There have been numerous studies investigating the effects of carbohydrate ingestion on RPE (Utter, et al. 1999 and Backhouse, Bishop, Biddle, & Williams, 2005). Their results have not been as consistent as those that have investigated the effects of caffeine; however, the majority of the literature suggests that carbohydrate ingestion has a positive effect (lower scores) on RPE. The literature reviewed in this study addresses two experiments with different designs that show decreases in RPE with carbohydrate ingestion in respect to control groups. Included in the review is an experiment that does not support the previously established norm.

Utter, et al. (1999) and Backhouse, Bishop, Biddle, & Williams,(2005) conducted separate studies whose results both reported decreased levels in RPE when compared to the placebo control group. In one of the experiments nine endurance trained males ingested either water or a carbohydrate solution during 15 minute increments during 90 minute cycling sessions. Subjects were asked how hard they felt they working (RPE) and what they were feeling (pleasure or displeasure) as the cycling session progressed. The results of the study showed that with carbohydrate ingestion ratings of perceived exertion that were slightly lower at every interval in comparison to placebo, with the greatest difference at 75 minutes into the cycling sessions. On a side note, there were greater feelings of pleasure associated with the carbohydrate ingestion (Backhouse, Bishop, Biddle, & Williams, 2005). The Utter, et al. (1999) study was a double-blind, placebo-controlled study that was designed to determine the influence of exercise mode, and 6% carbohydrate versus placebo beverage ingestion, on ratings of perceived exertion and hormonal regulation for 2.5 hours of high intensity running or cycling. The participants were male and female tri-athletes that were instructed to either run or cycle during one of their four test sessions. These subjects were given Gatorade and/or a placebo drink (containing similar sodium and potassium levels) every 15 minutes throughout the exercise session. The results of this study showed that a significantly ($P<0.05$) lower RPE overall ending value was found for the cycling plus carbohydrate session versus the cycling plus placebo test session. The last study investigated RPE during prolonged cycling with and without carbohydrate ingestion in boys and men (Timmons & Bar-or, 2003). This design assigned 10 boy and 10 men to 60 minutes of cycling on two occasions after receiving a carbohydrate drink or a flavored water drink. Like the previous study, this was a double blind counterbalanced design. With this study there was no significant effect on RPE or the ratio of RPE to heart rate during exercise in either the group of men or boys.

Caffeine and RPE

The premise behind the ergogenic effect of carbohydrate is that the prevention of glucose depletion will prevent premature fatigue during exercise (Backhouse, Bishop, Biddle, & Williams, 2005). Unlike carbohydrate supplementation, caffeine's mechanism may not totally be due to fatigue prevention, but an alteration of the participant's perceptual response to exercise and energy expenditure. The third theory mentioned earlier in the caffeine and cycling section suggests that caffeine has a direct effect on some portion of the central nervous system affecting effort perception. Athletes will feel as though the exercise is less difficult at the same intensity when supplementing with caffeine (Doherty & Smith, 2005). Doherty and Smith (2005) conducted a meta-analytical study that assessed the effects of caffeine on RPE, comparing over twenty different studies that investigated some variation of the topic. The experiments referenced in this meta-analysis were laboratory-based, double blinded, placebo controlled studies published in peer reviewed journals. The mean RPE score from each study was used for analysis and the effectiveness of caffeine ingestion on RPE was quantified by calculating effect size as well as relative percent of change from the placebo. When RPE during constant load exercise was considered the RPE change in comparison to placebo was approximately 6% lower ($P<.05$). The studies that failed to detect statistically significant changes in the perceptual response to exercise following caffeine ingestion, suffered from low subject sample size (Doherty & Smith, 2005).

Caffeine and Carbohydrate Combination and RPE

After reviewing the available literature on caffeine, carbohydrates and RPE, it would seems as though the most logical way to capitalize on their apparent benefits would be to combine the two while performing prolonged exercise. Surprisingly, some studies have shown that there are no additional benefits associated with combining the two. One study even showed an unfavorable effect as a result of this combination.

In an experiment by O'Conner (1993), the effects of caffeine ingestion and carbohydrate loading were examined on seven trained male cyclists during 90 minutes of cycle ergometry. O'Conner (1993) found that when the caffeine alone and carbohydrate and caffeine combination treatments were compared, there were no statistically significant differences found in glucose, lactate, heart rate, oxygen uptake or RPE. Giles and MacLaren (1984) investigated the effects of caffeine, used separately and in combination with glucose on, blood lactate, blood glucose, plasma fatty-free acids, respiratory exchange ratio, V02 and most importantly, RPE during an extended treadmill run. Subjects received treatments of caffeine 60 minutes prior to exercise, glucose 30 minutes prior to exercise and during exercise, caffeine 60 minutes prior to exercise and glucose 30 minutes prior to exercise, and a placebo treatment. Results of their study showed that subjects were found to perceive exercise as significantly easier with caffeine alone and significantly more difficult with the combination of glucose and caffeine.

There was not much research investigating the affects of the combination of caffeine and carbohydrates on rating of perceived exertion. The available research does not show that the combination produces favorable effects in respect to perceived exertion. This would be an interesting area to investigate further.

Summary

The evidence provided by this literature review strongly supports the theories that caffeine and carbohydrate supplementation can have an ergogenic effect on cycling exercise (Kovacs, Stegen, Brouns, 1998, Coyle, Coggan, Hemmert, Ivy 1986). However, the same cannot be said about the two supplements in respect to RPE. As shown in the reviewed literature, support for the ergogenic effect of carbohydrate utilization on RPE scores is not as strong when compared to the consistency of results associated with the ergogenic effects of caffeine utilization and RPE scores (Doherty & Smith, 2005, Timmons & Bar-or, 2003). This review also demonstrates a lack of significant benefit when combining carbohydrate and caffeine supplementation (O’Conner, 1993). By reviewing this literature alone, one could conclude that caffeine supplementation provides a more reliable effect of decreased feelings of exertion. Additionally, one may also conclude that both caffeine and carbohydrate will produce ergogenic effects when exercising.

CHAPTER III

METHODOLOGY

Introduction

This chapter details the methodology utilized in the completion of the study. It describes the selection of the subjects and the instruments and procedures used. Prior to the recruitment of subjects this methodology was approved by the Institutional Review Board at Oklahoma State University, included in Appendix E.

Selection of Subjects

Fifteen 18 to 30 year old apparently healthy female recreational cyclists were recruited for the study. The subjects were recruited from cycling aerobics classes held at the Campus Recreational Center. At the end of the classes the participants were briefed on the purpose of the study and the types of subjects needed. In addition, the investigator visited undergraduate health promotion classes, briefly explained the study and asked for volunteers. The recruiting process reached three predominately female, twenty person cycling classes as well as four health promotion classes. The script used to speak to the classes is shown in Appendix B. The interested members of the classes were contacted by phone or email and were invited to the preliminary meeting.

To be eligible for participation the subjects had to be female recreational cyclists with no previous history of diabetes, were neither pregnant, nor planning to become pregnant during the duration of the study and had no allergies associated with caffeine consumption. Recreational cyclists for this study were defined as athletes who cycle indoors or outdoors at least two days per week for approximately one hour or longer and have done so consistently for at least three months.

This sample size and distribution was preferential because it added to the generalizability of the study. Preceding studies with similar designs have had a mean sample size of 9.6 +/- 2.5 with females being underrepresented. Subject age and gender were selected based on a meta- analysis encompassing a multitude of studies with a similar research design (Doherty & Smith, 2004). The average age range based on these studies is 20 to 35 years of age. As stated earlier, the majority of the related studies had a disproportionate number of male subjects. This experimental design only included female subjects since there is a lack of information pertaining to that specific population.

Initially, eighteen females signed up to participate in the study. Seven of the potential subjects were not included in the study due to schedule or criteria conflicts. Thus the final sample included eleven female participants. Each subject was asked to participate in three days of data collection and two of the subjects were only able to complete two of the three days. A total of nine subjects completed the entire study.

Site selection

The A.B Harrison Human Performance Lab at Oklahoma State University was selected as the site for the preliminary meeting and the initial portion of the test session. All cycling occurred at the designated cycling area at Campus Recreation Center at Oklahoma State University.

Instruments

The equipment and supplies used for the study included the Borg's (6-20) rating of perceived exertion scale, the Multisports Enduro Cycle ENC-360 and the *Polar* heart rate monitors. The participants received a thorough explanation of the purpose of the instruments and how they would be used during preliminary and test sessions.

<u>Borg's Scale of Perceived Exertion</u>

The most widely used instrument to measure perceived exertion or exercise intensity is Borg's rating of perceived exertion scale. The Borg RPE scale was initially developed as a proxy indicator of exercise intensity in physical rehabilitation. The Borg scale used in this study was the 15 point scale, starting with the number 6 and ending with the number twenty. Point 6 is the equivalent of sitting down doing nothing, 9 is like walking gently, 13 a steady exercising pace and 19/20 the hardest exercise possible. The Borg scale is a relatively straight forward testing measure that has been shown to be understood by a broad age range, starting at adolescence (Chen, Fan & Moe, 2002). A meta-analytical study was published to establish whether the Borg scale is a valid measure of exercise intensity. The most relevant evidence of the validity of the RPE scale is criterion-related. Criterion-related describes the empirical relationship between RPE and physiological measures that reflect exercise intensity. The most common physiological variables are heart rate, blood lactate concentration, and oxygen uptake. The study found that there is a degree of inconsistency and different variables can affect the validity of the RPE score as a measure of exercise intensity but it supports the use of RPE scores as a means of assessing exercise effort, with the proviso that certain situations or subjects may lessen their validity.

MultiSports Enduro Cycle ENC-360

MultiSports Enduro Cycle ENC-360 was the model of bicycle used in the study. This is a 143 pound bicycle with a 45 lb. flywheel. The indoor bicycle has an adjustable seat and handles to accommodate the various heights of the subjects. Other features include self-leveling pedals with toe straps an emergency brake and portability wheels are located on the front of the bike for easy mobility. In addition, the resistance can be manipulated to achieve desirable workloads. The Colvin Recreation Center provided for the use of fifteen of the bicycles for the duration of the study. The subjects were briefed on how to adjust the bicycles during the test session.

Polar Heart Rate Monitor

The *Polar* FS1 heart rate monitor consists of a chest transmitter and a wrist display. The chest transmitter is adjusted with an elastic strap ensure contact with the skin. Once the wrist display is turned on by pressing the activation button, the heart rate will appear on the display screen. These devises were used in the fashion instructed by the manufacturer. Each subject received a *Polar* heart rate monitor to wear while participating in the cycling portion of the test session (Polar USA, 2007).

Design

The design used in this study was a quantitative single-subject experimental design. Specifically it is an alternating treatment or counter balanced design. The alternating treatments design involves the alteration of treatments for a single subject. This design is preferential because each subject served as her own control and experienced three treatments.

Preliminary Session

During the preliminary meeting the subjects received a through explanation of the experiment and the expectations of the subjects during the experiment. The subjects were told to eat as they normally would but to replicate their meals on days prior to the experiment. They were also instructed to abstain from caffeine ingestion 24 hours before the experiment and to avoid strenuous exercises on the day prior to the experiment. It was reiterated to the subjects that their participation was voluntary and that the benefits associated with their participation only included gaining information about the possible benefits of glucose and caffeine ingestion during cycling. Next, there was an explanation of the Borg's 6-20 RPE Scale, which can be viewed in Appendix D.   The potential participants were told the following: "This scale is a method that allows us to know how hard you feel you are working, and we will show it to you from time to time during the exercise test. There is no right or wrong answers, but you must point to one of the numbers on the list: 6 is the lightest possible effort you can think of and 20 is the hardest possible effort. Some of the numbers have words beside them, which are to help you remember what the number means." After RPE was explained the subjects were asked to complete an informed consent. The informed consent explained the purpose of the study, stated that it was voluntary and absolved Oklahoma State University from any liability in the event of an accident or injury. The informed consent can be viewed in Appendix A. The potential participants then completed a criteria questionnaire, which included questions to determine their status as a recreational cyclist and the specificities of their current caffeine use. The questionnaire also included questions about their health, specifically whether they were pregnant or planning to become pregnant, diabetic or had any caffeine or carbohydrate allergies. The criteria questionnaire can be view in Appendix C. The criteria questionnaires were reviewed and all potential participants that met the criteria were invented to participate in the study on the following day.

Test Sessions

For the three test sessions the subjects arrived at the lab on a Monday morning after an overnight fast and a 24 hour abstinence from caffeine. The subjects indicated that they had avoided intensive exercise for the day prior to the testing and all other exercise for at least 12-15 hours. After the subjects sat quietly for 5 minutes their resting heart rates were attained. Next, the cyclists consumed either 200mg of caffeine (one No Doz ® tablet) mixed with twelve ounces of Crystal Light®, 15g of glucose mixed with twelve ounces of Crystal Light ® or a placebo which included only twelve ounces of Crystal Light® by its self. The placebo treatment and caffeine treatment contained an additional 5g of Sweet'N Low®. The Sweet'N Low® was added to replicate the taste of sweetness displayed in glucose treatment; 5g of Sweet'N Low® is equivalent in taste to 15g of sugar. The treatment containing glucose was supplemented with 15g of powdered glucose. Powdered dextrose was used and can be found at health stores; it has a thirty minute absorption rate and an average serving size of 4g. The National Athletic Training Association recommends the ingestion of 6% (approximately 15g) carbohydrate solution prior to exercise (Casa, et al., 2000). The quantity of glucose was selected based on this recommendation in addition to the fact that 15g is the average serving size in most sports drinks. The treatment containing caffeine was supplemented with a single dose, one 200mg tablet, of the over the counter caffeine treatment No Doz ®. The tablet was crushed with a mortar and pestle and added to the Crystal Light ® the morning of the experiment before the subjects arrived.

After ingesting the specified treatment the subjects were asked to sit for 30 minutes to allow for the absorption of the treatment. During the sitting period the predicted maximal heart rate and heart rate reserve for each the participants was attained. Subjects were then told to apply the polar heart rate monitor band around their chest. The output watch was attached to the bicycle but the screen was hidden from the participants. Once the sitting period ended each subject was given 24 ounces of water to drink throughout their cycling session. They were then taken to the designated cycling area in the Colvin Recreation Center. The subjects made the appropriate adjustments to the handle bars and seat height of the bicycles and then mounted their bicycle. The subjects were told to adjust their seats to the height that would allow one leg to fully extend with the heel placed on the pedal at its lowest point. When the instep of the foot was on the pedal, this allows for 5 degrees of flexion at the knee. Also, they were told to adjust the handlebars so that they were able to reach them easily with a slight bend in the elbow. The subjects were instructed to maintain the same adjustments throughout the duration of the study. During this time they were briefed on the RPE scale once more. Following the briefing subjects complete a 5 minute warm up, during which the resistance on the bicycle was adjusted until subjects reach 50% of predicted maximal heart rates. The predicted maximal heart rate was determined by subtracting the participant's age from 220 and multiplying that number by the desired percentage, in this case 50%. A predicted maximal heart rate for a 20 year old female is illustrated in the following example: 220-20 (age) = 200 x .50 = 100 beats per minute. The warm up was lower intensity and intended to prepare the participants for the cycling session. After the five minute warm up the subjects attained a speed that maintained 65% of their heart rate reserve. Heart rate reserve was determined by subtracting the participant's age by 220 to achieve the maximal heart rate; the resting heart rate was then subtracted from the maximal to establish the heart rate reserve. Multiplying the heart rate reserve by the desired percentage (65%) and adding the resting heart rate back to the equation yielded the target heart rate percent. Heart rate reserve for a 20 year old female is illustrated in the following example: 220-20 (age) = 200 -75 (resting HR) = 125 x .65 = 81.25 + 75 (resting HR) = 156.25 or 156 beats per minute. The heart rate reserve equation yields heart rates that will place the participants in the vigorous intensity workout zone. This zone is preferred because it most accurately replicates the intensity of an indoor cycling class.

The purpose of this study was to establish the effects of glucose and caffeine on perceived exertion. Consequently, every five minutes for 45 minutes, the subjects were asked how hard they felt they are working based on the RPE scale. In addition, heart rate was notated at the five minute intervals to serve as a base of comparison during the data analysis. Throughout the cycling the subjects were individually cued to speed up or slow down to ensure they stayed within five beats of their target heart rate reserve. At the end of 45 minutes the subjects were instructed to reduce speed and resistance and cool down for five minutes. During the cool down the participants were instructed to reduce their cycling speed and continue to do so until they achieved 40% of their predicted maximal heart rate. The preparer of the study established the heart rate reserve values. On the first day of the study, the subjects were given their heart rate reserve values before they began to cycle. For a 20-year-old female, this can be represented in the following example: 220-20 = 200 x .40 = 80 bpm. The subjects repeated the same steps Wednesday and Friday morning. The only difference with each day was the change in the treatment they received. Since this was a counterbalanced design all groups received all treatments, glucose, caffeine, or placebo, but in a different order on a Monday, Wednesday and Friday.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

This study was designed to investigate the effects of caffeine and carbohydrate supplementation on ratings of perceived exertion in female cyclists. Female cyclists from Oklahoma State University were recruited and subsequently participated in the three day study. Each participant served as their own control group receiving, a caffeine treatment, carbohydrate treatment, or placebo on each day of the study. After each participant, received one of the three treatments they rested for 30 minutes to allow for complete absorption, and were then asked to cycle for forty-five minutes. During the cycling each participant was asked to report her RPE at each five minute interval. The protocol was replicated on three alternating days (Monday, Wednesday and Friday) until each participant received all treatments. Chapter IV first restates the hypothesis for this study and then reveals the results of the study. Chapter IV is concluded with a discussion of these results.

Hypothesis

One hypothesis was tested during this study to determine if there would be any differences in RPE scores among participants ingesting caffeine, carbohydrates or plain water (placebo). This hypothesis was tested using a simple analysis of variance (ANOVA).

Results

Group means and standard deviations for each of the treatments at the corresponding interval are displayed in Table 1. Additional tables displaying the estimated marginal means of group, time, group by time and the grand mean are also listed. This information, in conjunction with the tests of within-subject effects (Table 2) show that there were no significant differences in RPE scores of the caffeine treatment groups and the carbohydrate treatment groups.

Ho: There will be no significant difference between the carbohydrate and caffeine treatments. The null hypothesis is accepted.

Table-1 Group Means and Statistics

Treatments	Time (minutes)	Mean RPE	Std. Deviation	N
Placebo	5	13.00	1.183	11
	10	13.27	1.104	11
	15	13.55	1.036	11
	20	13.91	1.300	11
	25	13.82	1.250	11
	30	13.64	1.362	11
	35	13.18	1.471	11
	40	13.73	1.618	11
	45	13.36	1.286	11
Glucose	5	12.91	1.578	11
	10	13.18	1.601	11
	15	13.55	1.864	11
	20	13.73	1.794	11
	25	13.91	1.921	11
	30	13.82	1.722	11
	35	13.91	2.212	11
	40	13.73	1.794	11
	45	14.09	2.119	11
Caffeine	5	12.73	1.272	11
	10	12.82	.982	11
	15	12.91	1.136	11
	20	12.64	1.629	11
	25	13.09	1.868	11
	30	13.27	1.555	11
	35	13.36	1.748	11
	40	13.27	1.902	11
	45	13.00	1.612	11

Table-2 Tests of Within-Subjects Effects

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig
Group	21.879	1.996	10.959	1.311	.292
Error (group)	166.936	19.964	8.362		
Time	16.121	1.291	12.492	1.425	.264
Error (time)	113.138	12.905	8.767		
Group * Time	10.788	5.194	2.077	1.504	.203
Error (group*time)	71.731	51.937	1.381		

Estimated Marginal Means

Table-3 Grand Mean

		95% Confidence Interval	
Mean RPE	**St. Error**	**Lower Bound**	**Upper Bound**
13.384	.332	12.644	14.124

Table-4 Group

			95% Confidence Interval	
Group	**Mean RPE**	**St. Error**	**Lower Bound**	**UPPER BOUND**
Placebo	13.495	.310	12.805	14.185
Glucose	13.646	.501	12.530	14.763
Caffeine	13.010	.391	12.139	13.881

Table-5 Time

			95% Confidence Interval	
Time (minutes)	**Mean RPE**	**St. Error**	**Lower bound**	**Upper bound**
5	12.879	.289	12.235	13.522
10	13.091	.225	12.589	13.593
15	13.333	.302	12.662	14.005
20	13.424	.343	12.661	14.188
25	13.606	.404	12.706	14.506
30	13.576	.374	12.743	14.408
35	13.485	.470	12.438	14.532
40	13.576	.509	12.442	14.709
45	13.485	.459	12.462	14.508

Table 6 Group * Time

			95% Confidence Interval		
Group	**Time (minutes)**	**Mean RPE**	**St. Error**	**Lower bound**	**Upper bound**
Placebo	5	13.000	.357	12.205	13.795
	10	13.273	.333	12.531	14.014
	15	13.545	.312	12.850	14.241
	20	13.909	.392	13.036	14.783
	25	13.818	.377	12.978	14.658
	30	13.636	.411	12.721	14.551
	35	13.182	.444	12.194	14.170
	40	13.727	.488	12.640	14.814
	45	13.364	.388	12.499	14.228
Glucose	5	12.909	.476	11.849	13.969
	10	13.182	.483	12.106	14.257
	15	13.545	.562	12.294	14.797
	20	13.727	.541	12.522	14.932
	25	13.909	.579	12.618	15.200
	30	13.818	.519	12.662	14.975
	35	13.909	.667	12.423	15.395
	40	13.727	.541	12.522	14.932
	45	14.091	.639	12.667	15.515
Caffeine	5	12.727	.384	11.873	13.582
	10	12.818	.296	12.159	13.478
	15	12.909	.343	12.146	13.672
	20	12.636	.491	11.542	13.731
	25	13.091	.563	11.836	14.346
	30	13.273	.469	12.228	14.317
	35	13.364	.527	12.189	14.538
	40	13.273	.574	11.995	14.551
	45	13.000	.486	11.917	14.083

Discussion of Results

This study investigated the effects of caffeine and carbohydrate supplementation on RPE in female recreational cyclist. The ANOVA analysis evaluated the differences in RPE between each treatment group, at each time interval, and the RPE in each treatment group at each time interval. The results from each analysis are discussed in the following sections. Chapter IV is concluded by comparing the present research to the literature and discussing the implications.

Group

There were three different groups analyzed in the study. Of the three groups, two represented a treatment and one represented the placebo. The participants in this study served as there own control so each received a caffeine treatment, carbohydrate treatment and the placebo. Each participant received a different treatment on each day of the study, with no more than four participants receiving the same treatment on the same day. The mean RPE of the caffeine, carbohydrate, and placebo groups were analyzed and there was no significant difference in RPE between the treatment groups or the control group. These results indicate that the caffeine and carbohydrate supplementation have no more effect on than ingesting similar amounts of water. Additionally, the results also indicate that caffeine ingestion is no more advantageous than carbohydrate or placebo ingestion thirty minutes before forty-five minutes of moderate intensity cycling.

Time

The cycling portion of the study started with a five minute warm-up that was immediately followed by forty-five minutes of cycling at 65% of the heart rate reserve of each of the participants. During the forty-five minutes of cycling the subjects were asked to report their RPE every five minutes, a total of nine five minute intervals. This protocol was repeated three times, resulting in three sets of data. The mean RPE for all groups at each time interval was calculated and analyzed by ANOVA and it was determined that there was not any significant difference in RPE at any of the time intervals.

Group * Time

The group by time section investigated differences in RPE in each treatment group at each time interval. The results from this section are a direct response to the hypothesis of the study, stating rather there would be change in the RPE scores after the ingestion of the caffeine treatment. As noted in the results section, there were no significant differences detected among any of the treatment groups at any time interval. The results from this analysis suggest: 1) the duration of the cycling should have been extended 2) treatment dosage should have been increased or 3) females do not respond positively to caffeine and carbohydrate supplementation with respect to RPE.

Comparison of Present Study to the Literature

The findings of the present study do not coincide with the majority of existing literature (Graham, Spriet, 1996). Based on the available literature it can be inferred that the inconsistency may be attributed to treatment dosage, cycling duration or possible gender difference. In the aforementioned literature, investigating the effects of carbohydrates on RPE the quantity of carbohydrate solution distributed to the participants was determined by the weight of each participant (Utter, et al. 1999). Also, the supplementation was rationed out in 15 minute intervals (Timmons, 2003, Backhouse, Bishop, Biddle, & Williams, 2005, Utter, 1996). A similar protocol was used in an experiment studying the effects of glucose feeding on RPE (Burgess, Robertson, Davis, Norris, 1990). The caffeine dosages were not administered in intervals however they, like the carbohydrate treatment, were administered based on the subject weight (Doherty, Smith, 2005).

A consistent difference found in the literature investigated carbohydrate supplementation as well caffeine supplementation was cycle duration. In the Doherty and Smith meta- analysis addressing the effects of caffeine supplementation on RPE, all but one study had a cycling duration time of one hour or longer. Additionally, in the study by Burgess, Robertson, Davis, Norris, there were no significant changes in RPE under carbohydrate supplementation until the sixty minute interval. It can be implied from the literature, that the treatment distribution, cycling duration and gender differences, may have affected the results of the present study.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Introduction

Chapter V first summarizes the purpose and methodology of the present study. Next, the findings are discussed specifically in reference to the initial hypothesis. The conclusions that have been drawn based on the results of this study are discussed. Finally, the chapter is concluded with recommendations for future research.

Summary of the Purpose and Methodology

The purpose of the study was to examine the influence of carbohydrate and caffeine ingestion on ratings of perceived exertion in recreational female cyclists during prolonged exercise. This study was to differentiate the effects of carbohydrate and caffeine treatments to determine which is most advantageous to female recreational cyclists performing prolonged cycling exercise. Approximately fifteen female cyclists from Oklahoma State University were recruited from indoor cycling classes to participate in the study. Eleven cyclists volunteered and nine completed the study. A week prior to the study the participants completed a criteria questionnaire and were familiarized with the protocol of the study. On three alternating occasions for forty-five minutes in the morning the participants rode a cycle ergometer at 65% of their heart rate reserve. While cycling the participants were asked to report their RPE every five minutes for the entire forty-five minutes. Each day of the study the participants received either a placebo, caffeine treatment or a carbohydrate treatment.

Summary of Findings

The following hypothesis was tested.

Ho1: There will be no significant difference among the carbohydrate, caffeine, and placebo treatments and their effects on RPE scores.

Conclusions

Within the limitations of the study, the following conclusions were reached:

1. Caffeine ingestion is no more advantageous in reference to RPE than carbohydrate ingestion before forty-five minutes of moderate intensity cycling for female cyclists.
2. Carbohydrate ingestion is no more advantageous in reference to RPE than caffeine ingestion before forty-five minutes of moderate intensity cycling for female cyclists.
3. Neither carbohydrate nor caffeine ingestion are more advantageous in reference to RPE than water before forty-five minutes of moderate intensity cycling for female cyclist.

Recommendations for Future Research

1. Similar studies need to be conducted to examine the comparison caffeine and carbohydrate treatments on RPE with a longer cycling duration.

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APPENDIX A

INFORMED CONSENT

INFORMED CONSENT

Effects of Caffeine and Carbohydrate Ingestion on RPE in Female Cyclist

Investigators:
Desiree Brown
Dr. Kulling

The purpose of the study is to examine the influence of carbohydrate and caffeine ingestion on ratings of perceived exertion (RPE) in recreational cyclists during prolonged exercise. This study will differentiate the effects of carbohydrate and caffeine treatments to determine which is most advantageous to cyclist performing prolonged cycling exercise. You have been asked to participate in this study because you are a female recreational cyclist.

Procedures.

You will be expected to arrive for the experiment on a Monday at 6:30 am. It will be requested that you do not eat breakfast before your arrival and abstain from caffeine 24 hours before the experiment. Also during the week of the experiment you will need to replicate the meals eaten on days immediately prior to the experiment. When you arrive you will be asked to drink a regular grape flavored drink, grape flavored drink containing caffeine or one containing a glucose solution. After ingestion of the grape beverage you will be asked to sit for 30 minutes to allow for digestion. You will be given 20 ounces of water that can be ingested throughout the cycling.

You will then be given a rate monitor to wear. This will consist of a strap that goes around your upper torso under your shirt. You will not be able to see the output monitor while cycling. After putting on the heart rate monitor you will be asked to adjust your bicycle to your desired specifications. After these adjustments you will be briefed on the RPE scale once more.

You will then mount your bike and warm up for five minutes at 50% of you predicted maximal heart rate. Resistance on the bicycle will be set for you in efforts to have you reach 65% of your heart rate reserve. After the five minute warm up you will attain a speed that will maintain 65% of your heart rate reserve. Every five minutes for 45 minutes you will be asked how hard you feel you are working based on the RPE scale. At the end of 45 minutes you will be instructed to reduce speed and resistance until you reach 40% of your predicted maximal heart rate, this time will serve as the cool down. During the warm up, cycle session and cool down will be informed when have achieved the specified heart rate. This same protocol will be repeated at the same time on Wednesday and Friday morning.

Risks of Participation:

If you are pregnant are or are planning to become pregnant you will not be permitted to participate in the study; please inform the primary investigator if either apply. In addition, if you have been previously diagnosed as a diabetic you will not be permitted to participate. There are always potential risks associated with exercise. With this experiment there is a potential risk for possible injury while using the stationary bicycles. To minimize risk their will first aid and CPR trained personnel available during the experiment. Side effects associated with the ingestion of glucose and artificial sweeteners are uncommon. Those people that are allergic or sensitive may experience skin rashes/flushing, gastro intestinal agitation, muscle aches, headaches, hungry or lethargy. If you are diabetic and can not ingest the quantity of glucose required for the experiment please notify the primary investigator. Side effects associated with caffeine intake may include nausea and jitters.

Benefits:
The benefit if this study will be to learn if frequently ingested substances can effect your personal exercise performance.

Confidentiality:
The data collected from this experiment will be in the possession of the primary investigator. The hard copies of the data will be stored in a file cabinet in the locked office of the primary investigator. An electronic copy saved to a flash drive will also be in the possession of the primary investigator. This data will be kept for at least one year, upon time disposal all data will be shredded and electronically erased.

The records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify you by name. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records. It is possible that the consent process and data collection will be observed by research oversight staff responsible for safeguarding the rights and wellbeing of people who participate in research.

Compensation:
There will be no compensation given for participation in this research study.

Any question can be directed to
Desiree Brown, 309-532-2409 or DesireeBrown82@yahoo
Dr. Kulling, Frank.A.Kulling@okstate.edu.

IRB contact:
If you have questions about the research and your rights as a research volunteer, you may contact Dr. Sue C. Jacobs, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-1676 or irb@okstate.edu.

Participant Rights:
I understand that my participation is voluntary and I can discontinue the research activity at any time without reprisal or penalty.

Signatures:
I have read and fully understand the consent form. I sign it freely and voluntarily. A copy of
this form has been given to me.

______________________ ______________

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant
sign it.

______________________ ______________

Signature of Researcher Date

APPENDIX B

SCRIPT

Script

The cyclists were informed that I was seeking volunteers for an upcoming research study that investigating the effects of carbohydrate and caffeine ingestion on the performance of female recreational cyclists. The study would include only 20 participants, all of which must be considered recreations cyclist: those who cycle for at least one hour, two or more days per week for the last three months. If more than 20 potential participants volunteered and met all of the criteria, then each participant would be assigned a number, the numbers would then be randomly selected from a pool until 20 subjects were attained. They were informed that if they were pregnant or planning to become pregnant during the duration of the study then they would not be permitted to participate. In addition, the subjects would be told that if they were diabetic that they will not be permitted to participate. The subjects were then informed that the study would take place in the same cycling area as the class they were just completing. After that the cyclists were informed that the experiment would require them to ride on three separate occasions at 65% of their heart rate reserve, a Monday, Wednesday, Friday, at 7:30am, for 45 minutes. They would ride at this 65% heart rate reserve because it would mimic the intensity of an indoor cycling class. Heart rate reserve would then be explained, if you are a 20 year old female we will calculate 220-20 (age) = 200 -75 (resting HR) = 125 x .65 = 81.25 + 75 (resting HR) = 156.25 or 156 beats per minute. So for a twenty year old female heart rate reserve would be approximately 156 beats per minute. Lastly the cyclists were informed that part of the study includes ingesting a carbohydrate solution containing less carbohydrates than one slice of bread and a caffeine solution the equivalent of less than two cups of coffee. Anyone interested were instructed to write down their names and contact information on a sign up sheet that was provided for them. They were told that they would not be compensated and they will not be identified by name in the study.

APPENDIX C

CRITERIA QUESTIONNARE

Criteria Questionnaire

1. Please list your contact information. (Name, Age, Phone Number, Email Address)

2. How often do you ingest caffeine? How many times per day? How many days per week? Examples: coffee, tea, soda, energy drinks

3. If you do ingest caffeine what is the quantity? (One cup: 8oz, one can of soda: 12oz, one bottle of soda: 20oz)

4. According to the scale provided would you consider yourself a caffeine consumer?

   Caffeine Consumer: ingesting an equivalent of 6 ounces of coffee (one cup), or 2 cans of soda or caffeine containing supplements on more than two days per week.

5. Do you have any allergies or negative side effects associated with caffeine ingestion?

6. Are you opposed to consuming caffeine?

7. Do you have any allergies or have you experienced negative side effects associated with the ingestion of artificial sweeteners?

8. Are you opposed to consuming artificial sweeteners?

9. Do you have any allergies or have you experienced negative side effects associated with the ingestion of glucose?

10. Are you opposed to consuming glucose?

11. How many times per week do you attend spin class?

12. Do you ever cycle outside continuously for over 45 minutes? If so how often?

13. For how long have you been cycling consistently (2 or more days per week for an hour or more)?

14. Are you pregnant or intending to become pregnant in the near future?

15. Are you diabetic?

APPENDIX D

INSTRUCITIONS FOR BORG RATINGS

OF PERCEIVED EXERTION SCALE

Instructions for Borg Rating of Perceived Exertion (RPE) Scale

While engaging in physical activity, we want you to rate your perception of exertion. This feeling should reflect how heavy and strenuous the exercise feels to you, combining all sensations and feelings of physical stress, effort, and fatigue. Do not concern yourself with any one factor such as leg pain or shortness of breath, but try to focus on your total feeling of exertion.

Look at the rating scale below while you are engaging in an activity; it ranges from 6 to 20, where 6 means "no exertion at all" and 20 means "maximal exertion." Choose the number from below that best describes your level of exertion. This will give you a good idea of the intensity level of your activity, and you can use this information to speed up or slow down your movements to reach your desired range.

Try to appraise your feeling of exertion as honestly as possible, without thinking about what the actual physical load is. Your own feeling of effort and exertion is important, not how it compares to other people's. Look at the scales and the expressions and then give a number.

6 No exertion at all

7
Extremely light (7.5)
8

9 Very light

10

11 Light

12

13 Somewhat hard

14

15 Hard (heavy)

16

17 Very hard

18

19 Extremely hard

20 Maximal exertion

9 corresponds to "very light" exercise. For a healthy person, it is like walking slowly at his or her own pace for some minutes

13 on the scale is "somewhat hard" exercise, but it still feels OK to continue.

17 "very hard" is very strenuous. A healthy person can still go on, but he or she really has to push him- or herself. It feels very heavy, and the person is very tired.

19 on the scale is an extremely strenuous exercise level. For most people this is the most strenuous exercise they have ever experienced.

Borg RPE scale

APPENDIX E

INSTITUTIONAL REVIEW BOARD

APPROVAL LETTER

Oklahoma State University Institutional Review Board

Date:	Friday, February 02, 2007
IRB Application No	ED06201
Proposal Title:	Effects of Caffeine and Carbohydrate Ingestion on RPE in Female Cyclist

Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved Protocol Expires: 2/1/2008

Principal
Investigator(s)

Desiree Brown 1807 N. Hartford Apt. 1118 Stillwater, OK 74075	Frank Kulling 188 Colvin Center Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☑ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Sue C Jacobs

Sue C. Jacobs, Chair
Institutional Review Board

VITA

Desiree Elaine Brown

Candidate for the Degree of

Master of Science

Thesis: EFFECTS OF CAFFEINE AND CARBOYHYDRATE INGESTION ON RATINGS OF PERCEIVED EXERTION IN FEMALE CYCLISTS

Major Field: Health and Human Performance

Biographical:

Personal Data: Born in Killeen, Texas on September 17, 1982, the daughter of Donnis and Edwin Blount.

Education: Graduated from Duncan High School, Duncan, Oklahoma in May of 2000; received Bachelor of Science degree in Athletic Training from Oklahoma State University, Stillwater, Oklahoma in May of 2004; completed requirements for the Master of Science degree in Health and Human Performance at Oklahoma State University, Stillwater, Oklahoma in May 2007.

Experience: Adjunct Professor teaching Health Promotion in the Workplace and Wellness, Oklahoma City University, Oklahoma City, Oklahoma (2007); Graduate Assistant, Seretean Wellness Center, Stillwater, Oklahoma (2005-2007); Exercise Specialist, Ponca City Medical Center, Ponca City, Oklahoma; Exercise Specialist (2005-2007); Graduate Teaching Assistant teaching First Aid and CPR, Oklahoma State University, Stillwater, Oklahoma (2005-2006); Fitness Specialist, Total Rehab, Stillwater, Oklahoma (2005-2006); Corporate Wellness Coordinator, Tulsa, Oklahoma (2004-2005).

Name: Desiree Elaine Brown Date of Degree: May, 2007

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: EFFECTS OF CAFFEINE AND CARBOYHYDRATE INGESTION ON RATINGS OF PERCEIVED EXERTION IN FEMALE CYCLISTS

Pages in Study: 55 Candidate for the Degree of Master of Science

Major Field: Health and Human Performance

Scope and Method of Study: The purpose of the study was to examine the influence of carbohydrate and caffeine ingestion on ratings of perceived exertion in recreational female cyclists during prolonged exercise. This study was to differentiate the effects of carbohydrate and caffeine treatments to determine which is most advantageous to female recreational cyclists performing prolonged cycling exercise. Approximately fifteen female cyclists from Oklahoma State University were recruited from indoor cycling classes to participate in the study. Eleven cyclists volunteered and nine completed the study. A week prior to the study the participants completed a criteria questionnaire and were familiarized with the protocol of the study. On three alternating occasions for forty-five minutes in the morning the participants rode a cycle ergometer at 65% of their heart rate reserve. While cycling the participants were asked to report their RPE every five minutes for the entire forty-five minutes. Each day of the study the participants received either a placebo, caffeine treatment or a carbohydrate treatment.

Findings and Conclusions: The ANOVA analysis evaluated the differences in RPE between each treatment group, at each time interval, and the RPE in each treatment group at each time interval. This information showed that there were no significant differences in RPE scores of the caffeine treatment groups and the carbohydrate treatment groups at any time intervals.

ADVISER'S APPROVAL: Dr. Frank Kulling