Spring 5-4-2017

Relationship between breakfast and basketball shooting accuracy

Dimitrije Cabarkapa
James Madison University

Relationship Between Breakfast and Basketball Shooting Accuracy

Dimitrije Cabarkapa

A thesis submitted to the Graduate Faculty of

JAMES MADISON UNIVERSITY

In

Partial Fulfillment of the Requirements

for the degree of

Masters of Science

Concentration Nutrition and Physical Activity

May 2017

FACULTY COMMITTEE:

Committee Chair: Jeremy D. Akers, PhD, RDN

Committee Members/Readers:

Danielle M. Torisky, PhD, RDN

Elizabeth S. Edwards, PhD

Acknowledgments:

To begin, I would like to thank Dr. Jeremy Akers for his help and endless support during this project. Throughout my undergraduate and graduate career, he was always there to support me and he is one of the main reasons why I was able to choose the right steps to be at the point where I am right now.

I would also like to thank Dr. Daniele Torisky and Dr. Liz Edwards for their help, patience and overall assistance with my thesis project.

I appreciate JMU men's and women's basketball staff and players, who during the intense summer school and workout schedule, found time to volunteer their time and participate as a subject in my study.

I would like to thank Jaclyn Latvis for assisting and helping me during the process of data collection.

I appreciate assistant basketball Coach Mike Deane who has supported me through the last five years on the basketball court as well as in the classroom. He helped and guided me to the right resources for assistance and encouragement throughout my time at James Madison University.

I would like to acknowledge the JMU athletic community's generosity, for their scholarship and their willingness to allow my 5th year opportunity to further my education and give me the opportunity to complete my master's program.

Lastly, I would like to thank my family, who has always been with me and supported me throughout my life.

Table of Contents

List of Tables

List of Figures

Abstract:

Purpose: The purpose of this study was to determine if collegiate and recreational basketball players shooting accuracy improved after consumption of breakfast (BF) compared to no-breakfast (No-BF).

Methods: 24 male and female collegiate and recreational basketball players completed a three-week intervention study with a cross-over design. Subjects were randomly assigned to a four-day BF or No-BF treatment starting on Monday and completed testing that included a free-throw drill and timed 2-point and 3-point drills on day four. Treatment switched the following Monday. Food intake records were collected during each treatment phase.

Results: There was no difference between BF and No-BF treatments in amount of shots taken and percentage of shots made during the free-throw, 2-point and 3-point drills. In addition, no difference was observed between BF and No-BF treatment when the number of shots taken during 2-point and 3-point drill was combined. There was a significant difference observed between BF and No-BF in mean percentage of shots made during the free throw, 2-point and 3-point drill combined, (BF= 59.2 ± 6.8, No-BF= 48.3±5.4, p-value < 0.001).

Conclusion: Despite the finding that mean shooting percentage was improved when the free-throw, 2-point and 3-point drill were combined, the main finding of the study was that breakfast consumption did not show significant improvement in basketball shooting accuracy when free throw, 2-point and 3-point basketball shooting drills were observed separately.

Chapter I

Introduction

Breakfast is defined as a meal that breaks the overnight fast and has the most important role in replenishing glycogen stores (Affenito, 2007; Mahoney, Taylor, Kanarek, & Samuel, 2005). The amount of food eaten during breakfast represents approximately 15-20 percent of total daily macronutrient intake for children and adults (O'Neil et al., 2014).

A well-balanced diet, starting with a nutritious meal in the morning, can be a significant performance enhancement tool that provides essential nutrients needed for the body to function properly (Ruxton & Kirk, 1997). Basketball is a popular team sport where energy mainly comes from anaerobic metabolism (Williams & Rollo, 2015). In order to make a high percentage of free throws, field goals and three point shots, the player needs high levels of fatigue resistance, cognitive function and positive mood (Pojskić, Šeparović, & Užičanin, 2011; Williams & Rollo, 2015). A high carbohydrate diet before and after exercise can increase glycogen stores from 11-17 percent, which leads to an increase in fatigue resistance (Pojskić et al., 2011; Williams & Rollo, 2015). In addition, breakfast consumption can increase cognitive performance (Mahoney et al., 2005). Current research reveals that increasing glycogen storage with breakfast consumption can improve memory, increase alertness and increase accuracy on a variety of cognitive tests (Clayton & James, 2015; Mahoney, 2005; Cooper et al., 2015). Furthermore, researchers have shown that daily breakfast consumption resulted in an

increased positive emotional state of an athlete's mood and decreased levels of stress (O'Neil et al., 2014; Veasey, Haskell-Ramsay, Kennedy, Tiplady, & Stevenson, 2015).

Basketball players are required to maintain high intensity short repetitive series of sprints, jumps and lateral movements (Nigg, Whitting, Tomaras, Davis, & Nigg, 2015). Players desire to shoot at a high percentage while minimizing body fatigue.

In conclusion, multiple research have been conducted on the relationships between breakfast and how it improves cognitive function, performance and mood. To the researcher's knowledge, there are no studies that have observed the potential effect of breakfast consumption on basketball players shooting accuracy. The purpose of this study is to determine if basketball shooting accuracy in men and women college basketball players improves after four consecutive days of breakfast consumption.

Review of Literature

Breakfast is often referred to as the most important meal of the day, but it is also the meal that is most often missed (Affenito, 2007; Mahoney et al., 2005). Breakfast is defined as a meal that breaks the overnight fast and has the most important role in replenishing glycogen stores (O'Neil et al., 2014). The amount of food eaten during breakfast represents 15-20% of total daily macronutrient intake and this proportion is usually similar between children and adults (O'Neil et al., 2014).

There are multiple research studies reporting reasons why people skip breakfast (Dykstra et al., 2016). The most common reported reasons for skipping breakfast include not being hungry, lack of planning, lack of time and trying to prevent weight gain (Affenito, 2007; O'Neil et al., 2014; Vanelli et al., 2005). Other reasons that affect breakfast skipping include parental influence, education level, income level and availability to food (Affenito, 2007).

Parental Influence:

Many studies report that parents act as role models for healthy breakfast eating (O'Neil et al., 2014; Videon & Manning, 2003). Research revealed that 22 percent of the elementary school children did not eat breakfast before coming to school (Mahoney et al., 2005). In households where the parents were present around kids during the mealtime, the quality of breakfast consumed, including healthy food choices, was higher and the nutrient intake was significantly better (Videon & Manning, 2003). Moreover, a study that conducted in Netherlands on middle school children revealed that child breakfast

consumption is significantly affected by home environment; children with higher parent involvement had higher breakfast consumption (DeJong, van Lenthe, van der Horst, & Oenema, 2009). The education of parents as a child's role model can be the first step that would increase the portion of people eating breakfast in the morning (DeJong et al., 2009).

Education:

Dietary habits are learned during childhood and maintained throughout life, so it is important to educate children about proper nutrition habits that involve breakfast eating patterns from a young age (Aranceta, Serra-Majem, Ribas, & Pérez-Rodrigo, 2001). Children from families with higher educational levels tend to have proper energy intakes during breakfast which includes nutrients as milk, cereal and fruit intake (Aranceta et al., 2001). This indicated that education may play role in improvement healthy eating including breakfast consumption. Researchers found that athletes who have a higher educational level compared to other athletes had a higher percentage of cases where breakfast was eaten on a daily basis (Musaiger & Ragheb, 1994). The education of children coming from families from lower social class can be beneficial in improvement in their diet and proper breakfast eating patterns (Ruxton & Kirk, 1996). Research that was conducted on multiethnic woman, infants and children showed that online or in-person education improved breakfast eating patterns (Au, Whaley, Rosen, Meza, & Ritchie, 2015). Furthermore, education about importance of breakfast consumption showed improvement in the overall behavior of children (Au et al., 2015). We can

assume that there is a potential relationship between education and breakfast eating habits.

Income level and availability of food:

Research conducted on 821 school children presented that students with low household supervision had higher chances of skipping breakfast with no significant differences between race age and ethnicity (Dykstra et al., 2016). Children coming from low-income families tend to have poorer nutrition, including a higher intake of fat and lack of mid-day snacks compared to families with a higher income (Ruxton & Kirk, 1996). Researchers found that 31 percent of students from low-income families regularly skipped breakfast compared to 22 percent of students from families with a higher income (O'Dea & Caputi, 2001). Based on this we can assume that there is a potential relationship between breakfast consumption and household income to be able to provide breakfast. The researchers also found that children from lower socio-economic classes lack nutritional education advices from family members (O'Dea & Caputi, 2001). Only 20 percent of children from low-income families reported that they consumed breakfast and, of that percentage, eight percent of them stated that they had candy or soda for the breakfast (Dykstra et al., 2016).

A well-balanced diet, starting with a healthy meal in the morning, can be a significant performance enhancement by acting on the physical and cognitive abilities, mood and overall emotional state (Veasey et al., 2015, O'Neil et al., 2014, Mahoney et al., 2005, Benton & Brock, 2010). Basketball is a type of physical activity that requires

extra energy sources, which can be obtained through a healthy and well balanced diet (Nikić, Jakovljević, Pedišic, Venus, & Šatalic, 2014). Breakfast plays important part of the overall individual's diet by providing some of the necessary micro and macronutrients that body needs to function properly (Ruxton & Kirk, 1997). Our body is able to utilize energy by metabolizing macronutrients into adenosine-triphosphate (ATP) which can be produced in two different ways: aerobically and anaerobically (Williams & Rollo, 2015). Basketball is a popular team sport based on short, quick and repetitive stop-and-go intervals. Levels of concentration and focus have to be very high in order to make a high percentage of free throws, field goals and three point shots, which are the main factors identifying a winner or loser of the basketball game (Pojskić et al., 2011; Williams & Rollo, 2015).

Performance:

The energy needed to shoot a basketball mainly comes from anaerobic metabolism, while energy for cognitive and physiological functions, including energy for the heart and other organs, comes from the aerobic metabolism (Williams & Rollo, 2015). A high carbohydrate diet before and after exercise can increase glycogen stores as a source of ATP as energy and aid in shooting a basketball (Williams & Rollo, 2015). Carbohydrates such as grains, fruits and vegetables provide required energy while proteins such as eggs, lean meat and legumes can be essential sources of vitamins and minerals (O'Neil et al., 2014). It is recommended that breakfast should be composed of carbohydrate-rich foods combined with foods that contain a significant amount of protein (O'Neil et al., 2014). Researchers found that during afternoon performance athletes who

consumed breakfast received a nine percent increase in sport performance compared to athletes who did not consume breakfast, while athletes who skipped breakfast but ate *ad libitum* lunch had a four to five percent decrease in sport performance compared when both meals were consumed (Clayton & James, 2015). In another study, after soccer matches, players who consumed low carbohydrate meals before exercise covered less ground compared to players that were consuming a high carbohydrate diet (Williams & Rollo, 2015). High carbohydrate breakfasts can increase glycogen energy stores from 11-17 percent, which may enhance basketball performance (Clayton & James, 2015). Research conducted on men's basketball players showed that the caloric intake of the basketball players was 20 percent higher compared to non-athletes (Nikić, Jakovljević, Pedišic, Venus, & Šatalic, 2014). Basketball players are recommended to consume more than 6 g/kg/day of carbohydrates and 1.7 g/kg/day of proteins (Nikić et al., 2014). Eating breakfast can play a significant role as a meal that can help in providing necessary nutrients. Based on this we can assume that well-balanced breakfast consumption can lead to increase in basketball performance.

The amount and choice of food that athletes consume can play a potential role in the improvement of basketball shooting performance by decreasing fatigue levels and increasing energy storages (Williams & Rollo, 2015). Researchers found that the best time to take a pre-exercise meal is four to six hours before exercise to help increase muscle glycogen levels (Sherman, Jacobs, & Leenders, 1998). Food with a high glycemic index consumed three hours before exercise can increase glycogen storage by approximately 11-15 percent (Williams & Rollo, 2015). This can lead to a decrease in fatigue levels because basketball players will be able to perform the same motion for

longer periods of time. In contrast, foods with a low glycemic index are better than foods with a higher glycemic index for cognitive function because they are able to stabilize the glucose supply during longer periods of time (Komiyama et al., 2016). Breakfast meals with lower glycemic index can slow down digestion and sustain longer release of glucose from the carbohydrate source (Cooper, Bandelow, Nute, Morris, & Nevill, 2015; Mahoney et al., 2005). Research found that any kind of breakfast will increase cognitive performance; however there are no studies conducted to identify what types of breakfasts should be consumed to improve specific parts of cognitive performance (Mahoney et al., 2005).

Cognitive ability:

Besides the potential effect of breakfast on increased fatigue resistance, research conducted on 13,858 active soldiers (average age = 28) showed that proper nutrition and hydration through "HET-(healthy eating test)" scores resulted in an increase in physical fitness tests scores and higher social and emotional scores (Purvis, Lentino, Jackson, Murphy, & Deuster, 2013). It is necessary that a basketball player during competition have high emotional control to be able to focus on the specific target on the rim (Pojskić et al., 2011). Body movement of shooting the basketball at high accuracy percentages requires mental and cognitive endurance (Pojskić et al., 2011). Glucose is the preferred energy source that the brain can use (Cooper, Bandelow, & Nevill, 2011; Mahoney et al., 2005). Various research have been conducted on relationships between breakfast consumption that leads to increase glucose storage and cognitive function in children/adolescents (Cooper et al., 2011; Komiyama et al., 2016; Mahoney et al., 2005;

O'Neil et al., 2014; Veasey, Gonzalez, Kennedy, Haskell, & Stevenson, 2013). A variety of studies have shown that higher glucose levels can improve memory and performance on cognitive tests (Clayton, Barutcu, Machin, Stensel, & James, 2015; Cooper et al., 2011; Vanelli et al., 2005). Research found that when breakfast was consumed within an elementary school, children's performance on tests that required logical reasoning and problem solving were enhanced (Mahoney et al., 2005; O'Neil et al., 2014). "Stroop test" and "Visual search test" are used to measure cognitive function (Cooper et al., 2011). "Stroop test" measures the frontal lobe function as ability of the body to suppress automated response, while "Visual search test" has a purpose to test quickness of response to respond to a specific stimulus (Cooper et al., 2011). Among the subjects performing "Stroop test" and "Visual search test", reaction time and accuracy were both decreased when subjects skipped breakfast. This can be caused by lower glucose levels which is a preferable source of energy that can lead to lower test scores especially for the higher demanding cognitive tests (Cooper et al., 2011). In contrast, researchers found that subjects who consumed low glycemic index foods combined with exercise improved reaction times of "Stroop test" with accuracy of "Visual search test" unchanged (Cooper et al., 2015). Not only the consumption of carbohydrates can have an impact on performance on cognitive tests, proteins consumed during breakfast can increase tyrosine levels in the body (Mahoney et al., 2005). Tyrosine can potentially play an important role in increasing alertness that can be related with improvement in cognitive performance (Mahoney et al., 2005).

Mood, Fatigue and Emotional State:

Besides the requirement of high cognitive function, an athlete's mood can play a significant role in performance, which can potentially improve with proper breakfast intake (O'Neil et al., 2014; Veasey et al., 2015). Breakfast consumption is related to improvement in memory and mood, which can increase academic and psychological performance (Mahoney et al., 2005; O'Neil et al., 2014). A low tiredness level and a high self-reported energy levels were observed when breakfast was consumed in the morning (Cooper et al., 2011). A study completed on more than 600 males and females identified that after the consumption of breakfast, the individuals' moods were enhanced while stress levels were decreased (Benton & Brock, 2010). The difference between males and females observed that higher carbohydrate intake was needed to effect better moods in males, whereas females required a higher protein intake (Benton & Brock, 2010). In addition, moods were not changed after consumption of foods with low or high glycemic index (Cooper et al., 2015). Fatigue ratings were significantly higher when breakfast omission was combined with exercise, compared to when breakfast was consumed combined with exercise (Cooper et al., 2011).

Given the combination of all potential positive effects that breakfast can have on an individual, it is logical for athletes to consume breakfast on an everyday basis in order to enhance their physical, psychological, and cognitive abilities. In sports such as basketball, this can have a potential positive impact on performance. Basketball players are required to maintain high intensity, short repetitive series of sprints, jumps and lateral movements (Nigg et al., 2015). Most basketball players want to be able to shoot at a high

percentage while their bodies are fighting with fatigue. There is insufficient research that can be related to basketball drills that are equivalent to the level of the basketball game. It was difficult to find studies that provided valid and repetitive basketball drills that combined shooting basketball ability with game-like running patterns. Basketball players spend a majority of the game above 85 percent of their VO2 max (Pojskić et al., 2011). Stationary shooting drills are not a proper representative of the shots that a player will shoot during the game. Shooting drills that reflect game-like situations, tested on men's basketball players, can potentially be used for shooting accuracy testing with high validity (Pojskić et al., 2011). Every drill is based on measuring different types of shooting accuracy, but all statistically showed similar purpose. This data allows the usage of certain drills presented in this study to be used as an appropriate test of basketball shooting accuracy (Pojskić et al., 2011).

In conclusion, multiple research studies have examined the relationships between breakfast and cognitive function, performance and mood. To the researchers' knowledge, there was no research conducted that observed the potential effect of breakfast consumption on basketball shooting accuracy. Consumption of breakfast will be combined with specific validated basketball drills as a good representative of a basketball players cognitive function, mood and fatigue status.

Purpose:

The purpose of this study is to determine if basketball shooting accuracy during certain designed basketball drills of men and women college basketball players is improved after consumption of breakfast, compared to breakfast omission in men and women college and recreational basketball players, during a three-week intervention.

Hypothesis:

It is hypothesized that basketball shooting percentage will improve when the subjects are provided with a breakfast before shooting workout compared to breakfast omission following the three-week intervention.

Assumptions:

In this study it is assumed that athletes are taking proper care of their bodies, will continue to maintain their proper nutrition during the day, will continue recovery programs with a certified athletic trainer, and maintain the proper amount of sleep between seven to eight hours/night.

Chapter II

Methodology

Participants

The study will be conducted at James Madison University, Virginia. Elite woman and men's Division-1 collegiate and recreational basketball players will be recruited to participate in a three-week crossover designed study. Subjects will be recruited through meetings with coaches and players from both teams. The researcher will explain the study design and informed consent during a team meeting and after answering questions, all athletes interested in participating will sign the consent form. The inclusion criterion of this study includes playing at the college varsity and recreational basketball levels with no current injuries. In addition, subjects with a medical history of cardiovascular problems, diabetes (type 1 and type 2) or any other kind of metabolic disease will be excluded from this study. All study procedures were approved by the University's Institutional Review Board.

Study Design

Exercise Protocol:

The study is going to be conducted on college basketball players during the off-season training period. The off-season training period is mainly focused on player's skill development. Workouts are performed at the same indoor facility at the James Madison Convocation Center. They are approximately one hour long and they are usually done individually. Off-season workouts are composed of 30-minute basketball shooting drills,

which includes free-throw shooting, with another 30 minutes of rebounding and ball-handling drills. Basketball players are required to participate in workouts at least four days per week, Monday to Thursday. The study is going to be conducted over the period of three weeks, starting with a pre-testing procedure. The pre-testing procedure is based on a five to seven minute warm up, which depends on each individual player's routine preferred warm up, and three shooting basketball drills. The shooting basketball drills have been validated for shooting accuracy and fatigue (Pojskić et al., 2011).

Free Throw Drill: The free-throw shooting drill is designed to test shooting accuracy without a fatigue component. The subject will shoot three sets of 10 free-throws (4.57m) with a three-minute break between the sets.

Two-Point Drill: The two-point shooting drill is designed to test shooting accuracy with a fatigue component from five different spots marked with plastic cones during the time period of 60 seconds. The player will start at the cone numbered "1" under the basket and run to the cone numbered "2" at the right corner where he/she will receive the ball from the passer and will shoot. After the shot, the player will return back to cone numbered "1" and run to the cone numbered "3" at the "45-degree spot" where he/she will receive the ball from the passer and will shoot. There will be five shooting stations. All cones are positioned exactly five meters away from the rim (right corner, right 45 degrees, center, left 45 degrees and left corner). The pattern of the drills will repeat in both directions until the 60 seconds runs out.

Three-Point Drill: The three-point shooting drill is designed to test shooting accuracy with a fatigue component in the same pattern as the second drill, except the cones where the subjects are shooting from are positioned on a three-point line (6.325m).

Every basketball drill requires a rebounder who will help an athlete to preserve energy and focus mainly on the shooting motion (Pojskić et al., 2011). The same testing procedure is going to be done each week on Thursday morning. The three basketball drills are going to be used as a measurement tool for basketball shooting accuracy with high validity. Subjects will randomly be selected into two groups. The first week is designed as familiarization week and pre-testing week, where the subject will not be exposed to any intervention. In a randomized crossover fashion Group 1 will perform basketball shooting drills during the second week without breakfast consumption, while Group 2 will consume a specially designed breakfast. During the third week of the intervention both groups will switch the treatment (no breakfast/breakfast).

Diet Protocol:

The breakfast consumption/omission is going to be maintained from Monday morning until Thursday morning. Subjects should keep the same diet pattern as their typical diet routine, including *ad libitum* eating patterns during meals. In addition, subjects will be trained on how to complete proper diet records including meal timing, portion size and type of preparation. Any kind of food and fluid consumption must be recorded by the subject. Furthermore, any kind of additional physical activity, medication and supplement used by the subject must also be reported. The breakfast that subjects are instructed to consume should be mostly composed of carbohydrates with smaller amounts of protein. The amount of macronutrients provided during breakfast will be specifically determined by the weight of the subject. Based on ISSN guidelines, the breakfast that the subject will consume is composed of 0.75-1.2 grams/kg of carbohydrates, 0.2-0.3

grams/kg of protein and a small percent of fat content (Kreider et al., 2010). Subjects will be provided with detailed list of appropriate breakfast options that will meet their specific criteria.

Measurement

Exercise Protocol:

A stopwatch will be used to measure the time for the athlete to perform a specific basketball shooting drill. The number of shots during the specific drill will be expressed as a percent that represents the number of shots that subject made divided by number of overall attempts. To be able to collect proper data, the subjects will perform the drills individually at a specific set time in order to decrease any kind of distraction caused by other players on the court.

It is important to notice that two different basketball sizes will be used in this research because the size of basketball is different between men and women's basketball. The air pressure in the basketball will constant. Women's basketball players will perform the shooting drills with a size six basketball, while the men's basketball players will perform the shooting drills with a size 7 basketball.

Diet protocol:

The food intake records will start on Monday of the pre-testing week. The diet records will be based on time period from Monday morning until Thursday morning during each week of the study. Data records are going to be collected on Thursday morning before the workouts. Nutritional Data System for Research (NDSR) will be used

to analyze all food intake records, which will serve as an approximate estimate of calories the athletes consume during each day.

Statistical Analysis:

In order to determine the difference in accuracy or mean percentage of shots the subject made during the free throw, 2-point and 3-point shooting drills separately, a one-way ANOVA for the repeated measurements will be used. The same statistical analysis will be used to analyze the fatigue component of the research only including 2-point and 3-point shooting drills. The difference between the mean numbers of shots that subject attempted during free throw, 2-point drill and 3-point drill separately will be observed during the Pre-T, No-BF and BF week. In addition, by using multivariate analysis of variance (MANOVA), we will observe the difference in percentage of shoots that subject will make combining the free throw, 2-point and 3-point drills between different treatments. It will also be used to examine fatigue and compare the mean number of shots attempted during the 2-point and 3-point drills combined. For both statistical analyses, the statistical significance will be set at p-value ≤ 0.05. The SPSS Statistics program, Version 23 for Windows will be used.

Chapter III: Manuscript

Abstract:

Purpose: The purpose of this study was to determine if collegiate and recreational basketball players shooting accuracy improved after consumption of breakfast (BF) compared to no-breakfast (No-BF).

Methods: 24 male and female collegiate and recreational basketball players completed a three-week intervention study with a crossover design. Subjects were randomly assigned to a four-day BF or No-BF treatment starting on Monday and completed testing that included a free-throw drill and timed 2-point and 3-point drills on day four. Treatment switched the following Monday. Food intake records were collected during each treatment phase.

Results: There was no difference between BF and No-BF treatments in amount of shots taken and percentage of shots made during free-throw, 2-point and 3-point drills. In addition, no difference was observed between BF and No-BF treatment when the number of shots taken during 2-point and 3-point drill was combined. There was a significant difference observed between BF and No-BF in mean percentage of shots made during the free throw, 2-point and 3-point drill combined, (BF= 59.2±6.8, No-BF= 48.3±5.4, p-value < 0.001).

Conclusion: Despite the finding that mean shooting percentage was improved when the free-throw, 2-point and 3-point drill were combined, the main finding of the study was that breakfast consumption did not show significant improvement in basketball shooting accuracy when free throw, 2-point and 3-point basketball shooting drills were observed separately.

Introduction

Breakfast is defined as a meal that breaks an overnight fast and has the most important role in replenishing glycogen stores (Affenito, 2007; Mahoney et al., 2005). The amount of food eaten during breakfast should represent approximately 15-20 percent of total daily macronutrient intake for children and adults (O'Neil et al., 2014). Breakfast is one of the most significant factors that influence children performance in school (Fulford, Varley-Campbell, & Williams, 2016).

Basketball players desire to make a high percentage of their shots while minimizing body fatigue. A well-balanced diet, starting with a nutritious meal in the morning, can be a significant performance enhancement tool that provides essential nutrients needed for the body to function properly (Ruxton & Kirk, 1997). A high carbohydrate diet before and after exercise can increase glycogen stores from 11-17 percent, which leads to an improved fatigue resistance (Pojskić et al., 2011; Williams & Rollo, 2015). Basketball is a popular team sport in which energy mainly comes from anaerobic metabolism (Williams & Rollo, 2015). Basketball players are required to maintain high intensity, short repetitive series of sprints, jumps and lateral movements (Nigg et al., 2015). Consumption of breakfast after an overnight fast can increase time to exhaustion and decrease fatigue levels by replenishing glycogen stores (Williams & Lamb, 2008). In order to make a high percentage of free throws and field goals, the player needs high levels of fatigue resistance, cognitive function and overall positive mood (Pojskić et al., 2011; Williams & Rollo, 2015).

A well balanced diet combined with proper practice and mental training was one of the main factors that considerably improved learning and performance of the beginner basketball players for the free throw shooting (Janvier et al., 2016). In addition, breakfast consumption can increase cognitive performance, which can possibly lead to improvement in basketball shooting performance (Mahoney et al., 2005; Mishra, 2016). Research reveals that increasing glycogen storage with breakfast consumption can improve memory, increase alertness and increase accuracy on a variety of cognitive tests (Clayton & James, 2015; Mahoney, 2005; Cooper et al., 2015). Even when the overall improvement in cognitive performance was not observed, breakfast consumption resulted in increased cerebral activity that can be related to increase availability of glucose (Fulford et al., 2016). When child performance was observed during different aspects of cognitive ability, it was found that breakfast had positive impact on cognitive performance, especially for the children coming from a low socio economic class (Ptomey et al., 2016). In addition, breakfast that included higher levels of complex carbohydrates was associated with improved scores on cognitive tests in elementary school children (Ptomey et al., 2016). Researchers have shown that daily breakfast consumption resulted in a positive increase of an athlete's mood and decrease in stress levels (O'Neil et al., 2014; Veasey et al., 2015).

In conclusion, various research studies have examined the relationships between breakfast and cognitive function, performance and mood. To the researchers' knowledge, there are no studies which have observed the potential effect of breakfast consumption on basketball shooting accuracy. The purpose of this study was to determine if basketball

shooting accuracy in men and women college basketball players improves after four consecutive days of breakfast consumption.

Methods

Participants

Male and female Division-1 collegiate and recreational basketball players were recruited to participate in a three-week crossover design study. Subjects were recruited through meetings with coaches and players from both teams (Appendix A). The researcher explained the study design and facilitated consent during team meetings. The inclusion criteria included playing Division-1 college varsity and/or recreational basketball players with no current injuries. In addition, subjects with a medical history of cardiovascular problems, diabetes (type 1 and type 2) or any other kind of metabolic disease were excluded from this study. James Madison University's Institutional Review Board approved all study procedures.

Study Design

Subjects were randomly selected into two groups and participated in the study for three weeks. The first week was designed as familiarization week and pre-testing week were subjects were not exposed to any intervention. After pretesting, subjects were randomized in a cross-over fashion were Group 1 performed basketball shooting drills the second week without breakfast consumption, while Group 2 consumed a specially designed breakfast for four days. Both groups switched the treatments (no breakfast/breakfast) during the third week of the intervention. Four-day food intake

records were collected and testing procedures were done each week on Thursday at the same individualized time. There were three basketball drills used as a measurement tool for basketball shooting accuracy and fatigue.

The study was conducted during the off-season training period were the training focus is on player's skill development. Off-season workouts were composed of a 30-minute basketball shooting drills and 30-minute of rebounding and ball-handling drills. Division-1 men and women basketball players were required to participate in workouts at least four days per week, Monday to Thursday. Recreational basketball players continued weekly basketball workout routine. Individual workouts were performed at the same indoor facility at the James Madison Convocation Center. The pre-testing procedure was based on a five to seven minute warm up, which depends on each player's routine preferred warm up, and three shooting basketball drills. Previous research validated the selected shooting basketball drills for shooting accuracy and fatigue (Pojskić et al., 2011).

Exercise Protocol:

All shooting drill procedures were kept consistent in order to eliminate any possible bias. All subjects performed the drills individually at similar times each week. In order to decrease any distractions, no other players were allowed on the court. Every basketball drill had a rebounder to preserve subject's energy and focus mainly on the shooting motion (Pojskić et al., 2011). During every shooting drill and treatment, subjects had the same rebounder. The lead researcher managed time using a stopwatch and also recording subjects shooting data (Appendix B). A single basketball was used during every shooting drill with an extra basketball placed under the basket in the case of long

rebounds. The basketballs were set at the standardized air pressure provided by James Madison University Basketball Equipment Staff. A standardized basketball size was used for female and male subjects. Male subjects used basketball size "7", while female subjects used basketball size "6". The number of shots during the specific drill is expressed as a percent that represents the number of shots that subject made divided by number of overall attempts.

Free Throw Drill: The free-throw shooting drill was designed to test shooting accuracy without a fatigue component. The subject shot three sets of 10 free-throws (4.57m) with a three-minute break between each sets.

Two-Point Drill: The two-point shooting drill was designed to test shooting accuracy and fatigue. The subject shot from five different spots within the 3-point line marked with plastic cones during the allotted 60 seconds time period. The player started at the cone numbered "1" under the basket and ran to the cone numbered "2" at the right corner where he/she received the ball from the passer and shoot. After the shot, the player returned back to cone numbered "1" and run to the cone numbered "3" at the "45-degree spot" where he/she received the ball from the passer and shoot. There were five shooting stations. All cones were positioned exactly five meters away from the rim (right corner, right 45 degrees, center, left 45 degrees and left corner). The pattern of the drills were repeating in both directions until the 60 seconds ran out (Appendix B).

Three-Point Drill: The three-point drill started three minutes after ending the two-point shooting drill. The three-point shooting drill was designed to test shooting accuracy and fatigue in the same pattern as the 2-point drill, except the cones where the subjects were shooting from are positioned on a three-point line (6.325m) (Appendix B).

Diet protocol:

Food intake records were collected for four days during each of the treatments phases (Monday-Thursday). All subjects were instructed on proper food recording techniques at the beginning of the study and all food intake records were reviewed by the lead researcher and subject when completed (Appendix C). Additional physical activity, medication and supplement used by the subject had to be reported. Nutritional Data System for Research (Minneapolis, MN) was used to analyze all food intake records and food intake records were randomly reviewed by a Registered Dietitian for quality assurance measures.

The breakfast consumption/omission was maintained from Monday morning until Thursday morning. Subjects should keep the same diet pattern as their typical diet routine, including *ad libitum* eating patterns during meals. The breakfast that subjects were instructed to consume was specifically determined by the weight of the subject, based on ISSN guidelines, 0.75-1.2 grams/kg of carbohydrates, 0.2-0.3 grams/kg of protein and a small percent of fat content (Kreider et al., 2010). Subjects were provided with detailed list of appropriate breakfast options that will meet their specific criteria (Appendix D).

Statistical Analysis:

All statistical analyses were performed using SPSS version 23 (SPSS, Inc. Chicago, IL, USA). All data are presented as mean ± SD. Significance was set a priori with an alpha of 0.05. The difference in mean percentage of shots (accuracy) made during

the free throw, 2-point and 3-point shooting drills were analyzed using a One-way Repeated Measures of Variance (RM-ANOVA). One-way RM-ANOVA was used to analyze how many shots subject completed in 60 seconds (fatigue) during the 2-point and 3-point shooting drills. Multivariate Analysis of Variance (MANOVA) was used to analyze differences in combined accuracy (free throw, 2-point and 3-point drills) and combined fatigue (2-point and 3-point) between different treatments. All data was tested to see if assumptions were met. Shapiro-Wilk test was used to determine normal distribution and Mauchly's test was used for sphericity. Bonferroni correlation was used to adjust confidence intervals.

Results:

Participation

Twenty-six (17 Division-1, 9 recreational) basketball players volunteered with 24 subjects completing all testing (18 males, 6 females). Two Division-1 male subjects dropped out due to lack of time and illness unassociated with the study (Figure 1).

Accuracy

Free throw, 2-point and 3-point drill combined

The percentage of shots made revealed significant differences between all three weeks. The mean percentage of shots made during the Pre-T week was significantly higher compared to No-BF and BF week. (Pre-T=78.4±27.0, No-BF=48.3±25.8, BF=59.2±32.4, all p-values < 0.05). In addition, mean percentage of shots made was higher for BF week compared to No-BF week (BF=59.2±32.4, No-BF=48.3±25.8, p-value < 0.001) (Figure 2).

Free throw

There was no significance difference observed between the mean percentage of shots made during the BF week compared to No-BF week (BF=79.9±12.9, No-BF=75.0±18.3, p-value=0.253). In contrast, there was a significant difference observed between the mean percentage of shots made between Pre-T week and No-BF (Pre-T=80.3±12.9, No-BF=75.0±18.3, p-value=0.039) (Figure 3).

2-point drill

There was no significant difference in percentage of shots made between Pre-T, No-BF and BF week (Pre-T=60.7±21.8, No-BF=56.4±22.8, BF=60.6±17.1, all p-values=1.000) during the 2-point drill (Figure 4).

3-point drill

There was no significant difference observed in the percentage of the 3-point shots made between Pre-T week and No-BF week and Pre-T week and BF (Pre-T=50.4±20.9, No-BF=43.5±21.6, BF=51.0±21.6, all p-values > 0.05). Furthermore, no statistically significant difference was observed between No-BF week and BF week (No-BF=43.5±21.6, BF=51.0±21.6, p-value=0.947) (Figure 5).

Fatigue

2-point and 3-point drill combined

There was a significant increase in the mean number of shots taken from the Pre-T week to BF week (Pre-T=10.1±1.68, BF=10.6±1.61, p-value=0.032). There was no significant difference observed between No-BF week and BF week and No-BF week and Pre-T (No-BF=10.3±1.87, BF=10.6±1.61, p-value=0.113), (No-BF=10.3±1.87, Pre-T=10.1±1.68, p-value=1.000) (Figure 6).

2-point drill

There was a significant difference observed between the mean number of 2-point shots attempted during the Pre-T week and BF week (Pre-T=11.0±0.95, BF=11.5±1.02,

p-value=0.045). However, the mean number of 2-point shots taken was not significant between the No-BF week and BF week and No-BF week and Pre-T testing procedure, (No-BF=11.1±1.08, BF=11.5±1.02, p-value=0.264), (No-BF=11.1±1.08, Pre-T=11.0±0.95, p-value=1.000) (Figure 7).

3-point drill

There was no difference observed between BF and No-BF for the mean number of 3-point shots taken, (BF=11.5±1.02, No-BF=11.1±1.08, p-value=0.264). Furthermore, significant differences were observed between two periods: Pre-T week and BF week (Pre-T=9.3±1.05, BF=11.5±1.02, p-value < 0.001) along with Pre-T week and No-BF week (Pre-T=9.3±1.05, No-BF=11.1±1.08, p-value < 0.001) (Figure 8).

Dietary Data

Based on the subject's schedules and the "Convocation Center" basketball floor availability, we were not able to schedule shooting testing on Thursday of each week at the same time. The amount of food that subjects consumed until their scheduled time was not the same every week (morning session vs evening session). In order to improve validity of our study we needed to exclude the fourth day of the dietary records and analyze complete three-day food intake records.

Amount of carbohydrates consumed for breakfast during the BF week

The average consumption of carbohydrates for breakfast during the BF week was 226.8.2±76.4 grams (Monday= 211.0±99.4 grams, Tuesday= 255.9±106.8 grams, Wednesday= 213.1±92.4 grams) (Table 1). During the three-day period of the BF week, Monday through Wednesday, 17 subjects consumed under the recommended amounts of carbohydrates during breakfast at least one of the three days. In addition, 6 subjects did not consume the recommended amount of carbohydrate during all three days (Table 4).

Daily average carbohydrate consumption (Monday –Wednesday)

The overall average of carbohydrates that subjects consumed during the Pre-T week was higher compared to amount of carbohydrate that subject consumed during the BF week and No-BF week, (Pre-T=267.0±137.0 grams, No-BF=185.0±67.2 grams and BF=226.0±76.4 grams, respectively) (Table 1). Six subjects had higher carbohydrate consumption during the No-BF week compared to BF week. When compared in order, starting with the Pre-T week – No-BF week – BF week, five subjects had a constant decrease in daily average amount of carbohydrates consumed (Figure 9).

Daily average calorie consumption (Monday – Wednesday)

The overall three-day average of calories that subjects consumed during the Pre-T week was much higher than amount of calories the subject consumed during the BF week and No-BF week, (Pre-T= 2168.2±801.2 kcal, No-BF= 1594.4±409.7 kcal and BF= 1978.7±605.7 kcal, respectively) (Table 2). Eight subjects had a higher consumption of calories during the No-BF week compared to the BF week. Furthermore, 7 subjects had a

constant decrease in average calorie consumption starting with Pre-T week – No-BF week – BF week (Figure 9).

Amount of protein consumed for breakfast during the BF week

The average consumption of protein for breakfast during the BF week was 96.6±35.8 grams (Monday= 91.3±47.9 grams, Tuesday= 106.8±42.1 grams, Wednesday= 91.5±38.1 grams) (Table 3). During the three-day period of the BF week, Monday through Wednesday, 17 subjects did not consume recommended amount of protein during the breakfast at least one of the three days. In addition, 8 subjects did not consume the recommended amount of protein during all three days (Table 5).

Daily average protein consumption (Monday – Wednesday)

The overall average of protein that subjects consumed during the Pre-T week was higher compared to amount of protein that subjects consumed during BF week and No-BF week, (Pre-T= 98.8±33.5 grams, No-BF= 74.8±20.3 grams and BF= 96.6±35.8 grams, respectively) (Table 3). Starting with the Pre-T week – No-BF week – BF week, 7 subjects had a constant decrease in daily average protein consumption (Figure 9).

Discussion

The purpose of this study was to determine if basketball shooting accuracy of male and female collegiate basketball players was improved after consumption of breakfast compared to breakfast omission during a three-week intervention. One of the most important factors that influence outcome of the basketball game is the accuracy of the shots made (Pojskić et al., 2011). In order to make a high percentage of free throws and field goals, the player needs high levels of fatigue resistance and cognitive function (Pojskić et al., 2011; Williams & Rollo, 2015). The present study observed that accuracy, measured by number of shots made, significantly increased when subjects were assigned to a standardized breakfast meal. All other measures of accuracy and fatigue were not significantly different when consuming a standardized breakfast.

Based on our dietary data, subjects consumed higher amount of carbohydrates during the Pre-T week compared to BF and higher amount of carbohydrates during the BF week compared to No-BF week. Researchers found that fatigue could have significant negative effect on basketball performance and cognitive abilities during performance (Pojskić et al., 2011). Higher intake of carbohydrates will increase individuals' glycogen stores, which is also associated with increased sport performance by lowering fatigue levels and increasing positive mood (Veasey et al., 2015; Williams & Rollo, 2015). Our data agrees with the previously found research, which shows that higher average intake of carbohydrates and protein during the Pre-T week compared to BF and No-BF week could be a possible result for better shooting performance. Knowing that breakfast omission is related to decrease in muscle glycogen which can lead to decrease in athletic

performance, this can be a possible reason why the amount of shots that subject attempted was higher during the Pre-T week was higher compared to BF week. Previously completed research found that the total work completed during the exercise performance test during the breakfast week was 4.5% greater compared to no-breakfast week (Clayton et al., 2015). In the present study, inability of the subject to follow the specifically designed research protocols and obtain a high-recommended carbohydrate consumption during the BF week could have possibly had a negative impact on shooting performance (Table 4).

As it was mentioned earlier, healthy eating patterns do not only include breakfast consumption and proper hydration, they are also related to individual motivation, mood and overall spirit (Purvis et al., 2013). It is known that blood glucose is the main source of the energy for the brain, which can be increased, with a higher consumption of carbohydrates (Komiyama et al., 2016). Knowing that shooting the basketball requires higher levels of concentration, not being able to consume the same amount of macronutrients through the period of three-weeks could possibly affect mental status of the subject which could lead to a decrease in shooting percentage (Komiyama et al., 2016). By using the "Stroop test" as measure of cognitive ability, previous research showed that response times on the test were improved after breakfast consumption (Veasey et al., 2013). Previous research also showed improvement in cognitive performance and decrease in amount of errors made on cognitive tests after breakfast consumption (Hoyland, Dye, & Lawton, 2009). Even when cognitive performance was not enhanced after breakfast consumption, the cerebral activity was higher compared to breakfast omission (Fulford et al., 2016). We expected that subjects would consume

higher amount of macronutrients during the BF week compared to No-BF week and Pre-T week. Based on previously found research, we assumed that breakfast would positively influence cognitive performance, which would lead toward improvement in basketball shooting performance. When the free-throw, 2-point and 3-point shooting drills were observed separately, we were unable to observe differences between BF and No-BF week. Our data does not agree with previously found research, which suggests that accuracy on cognitive ability tests during rest was higher with breakfast consumption compared to breakfast omission (Veasey et al., 2013). Decrease in carbohydrate consumption could have negatively affected the shooting ability of the subjects by diminishing their cognitive ability.

The inability to observe the difference between BF and No-BF in any of the drills that we performed in our study can possibly be explained by the inability of subjects to consume recommended amount of calories and macronutrients. It was found that basketball shooting practice combined with mental training and proper diet led to improvement in free throw shooting of the Congolese beginner basketball players (Janvier et al., 2016). Even though studies showed that breakfast consumption is associated with improvement in academic performance and improvement in cognitive function of the children and adolescents, our data did not show that breakfast consumption by improving the cognitive performance would have a positive impact on shooting performance (Affenito, 2007; Cooper et al., 2011; Komiyama et al., 2016).

It is known that amount of food that athletes consume can impact fatigue resistance and improve performance (Williams & Rollo, 2015). Researchers completed a study on basketball players, which observed their energy requirements, which found that

basketball players should consume about 20% more calories compared to the regular population in order to be able to support higher physical demands (Nikić et al., 2014). Based on this, the lack of energy availability could possibly diminish the subjects' performance. A decrease in calories consumed can be a possible explanation why the average number of shots made was significantly higher during the Pre-T week compared to No-BF and BF week and why we were not able to observe the difference between BF and No-BF when the shooting drills were observed separately. In addition, even when subjects during the day consumed the same amount of calories and skipped breakfast, a decrease in performance was observed (Clayton & James, 2015). Based on our data we are able to see a decrease in calorie consumption starting with Pre-T week – No-BF week – BF week (Table 2). We expected that increased daily amount of calories and macronutrients consumed at breakfast could possibly increase subject energy availability and potentially lead toward improvement in shooting accuracy. The previous research also found that skipping breakfast can have a negative impact on late evening performance (Clayton & James, 2015; Veasey et al., 2013). Even though subjects were able to make up for the lost calories during breakfast omission, their performance later in the day still declined (Veasey et al., 2013). Despite our expectations that skipping breakfast during the No-BF week would have a detrimental impact on the subject's shooting performance, we were unable to observe differences in any of the shooting drills between BF and No-BF week. Based on the dietary data, we were able to observe declining trends of calorie consumption of our subjects from Pre-T week to BF week. We can assume that inability of the subjects to consume the recommended amount of calories negatively affected the results of the study. This can be a possible explanation of why

subjects were able to perform better on the shooting drills during the Pre-T week compared to No-BF and BF week.

When we compared the dietary data for the three testing procedures, we were able to see patterns that could possibly negatively affect our results. Starting with the Pre-T - No-BF week - BF week, we were able to see that seven subjects had an obvious decrease in calorie consumption. Seven subjects had an obvious decrease in carbohydrate consumption, and five subjects had a constant decrease in protein intake, respectively, (Figure 9). The constant decrease in average amount of macronutrients consumed within those subjects could negatively affect our results. Improper breakfast intake could negatively affect subject's cognitive ability and increase in fatigue levels which could be a possible reason why we were not able to observe the difference between BF and No-BF week and why the shooting performance was usually better during Pre-T week compared to BF and No-BF week.

Based on our knowledge, this is the first study that used collegiate male and female basketball players to test their breakfast eating habits to observe the effect of breakfast consumption and shooting performance. Limitations of this study include not recording the time when the subject woke up on each day, small sample size and inability to access the subjects for follow up. Due to the lack of this data, we were not able to determine whether subjects were able to not eat breakfast during the 4-hour period for the No-BF week since waking up.

Furthermore, the previous research found that children coming from low socioeconomic backgrounds have higher chances of skipping breakfast or consuming inadequate nutrient-balanced breakfast (Dykstra et al., 2016; O'Dea & Caputi, 2001;

Ruxton & Kirk, 1996; Faith, 2016). Financial status and availability of food could possibly have had a negative effect on compliance of the protocols during the BF week. Future research should focus on providing subjects with different breakfast options that comply with our set dietary recommendations, consider monitoring essential fatty acids and observing total fat consumption.

In conclusion, despite the finding that mean shooting percentage was improved, we do not have enough evidence to say that breakfast consumption will improve basketball shooting accuracy based on inability of the subjects to comply with the recommended dietary guidelines.

Practical application

To our knowledge, this is the first study that observed the relationship between breakfast consumption and basketball shooting accuracy. High school, collegiate and professional basketball players are always looking for ways to improve performance. Well balanced diet with proper breakfast consumption can potentially improve their performance. The results of this study can be used to educate athletes, coaches and athletic trainers in order to help athletes improve their performance and achieve their goals.

Table 1 – Three-day (Mon-Tue-Wed) average amount of carbohydrates that each subjects consumed during specific testing week of the study starting with Pre-T week – No-BF week – BF including overall average amount of carbohydrates that all subjects consumed during the same week of the study

Subject	Pre-T week (g)	No-BF (g)	BF (g)
BB001	276	249	175
BB002	182	157	240
BB003	227	176	156
BB004	210	127	91
BB005	271	179	260
BB006	281	141	160
BB007	186	192	197
BB008	222	200	363
BB009	363	203	300
BB010	474	227	274
BB011	124	71	198
BB012	328	193	213
BB013	230	89	238
BB014	754	117	160
BB015	323	260	302
BB016	194	136	163
BB017	308	245	294
BB018	137	140	141
BB019	403	260	196
BB020	170	370	361
BB022	120	131	266
BB023	202	229	238
BB025	279	228	346
BB026	144	121	112
Average:	267.0	185.0	226.8

	decrease in carbohydrate consumption

Table 2 – Three-day (Mon-Tue-Wed) average amount of calories that each subjects consumed during specific testing week of the study starting with Pre-T week – No-BF week – BF including overall average amount of calories that all subjects consumed during the same week of the study

Subject	Pre-T week (kcal)	No-BF (kcal)	BF (kcal)
BB001	2354	2066	1589
BB002	1563	1526	2221
BB003	2010	1641	1650
BB004	1549	1006	905
BB005	2026	1975	2546
BB006	2932	1217	2001
BB007	1557	1470	1355
BB008	2066	1433	2625
BB009	3445	1778	2690
BB010	3288	2051	1803
BB011	1300	1098	2003
BB012	2481	1617	1427
BB013	1563	1147	2229
BB014	4215	1563	1403
BB015	2814	2031	2939
BB016	1678	959	1448
BB017	2732	2274	2348
BB018	897	1157	1084
BB019	2896	1956	1657
BB020	1498	2279	2517
BB022	1406	1322	2633
BB023	1805	1855	2724
BB025	2382	1752	2570
BB026	1580	1093	1122
Average:	2168.2	1594.4	1978.7

	decrease in calories

Table 3 – Three-day (Mon-Tue-Wed) average amount of protein that each subjects consumed during specific testing week of the study starting with Pre-T week – No-BF week – BF including overall average amount of protein that all subjects consumed during the same week of the study

Subject	Pre-T week (g)	No-BF (g)	BF (g)
BB001	87	84	83
BB002	75	81	110
BB003	80	78	70
BB004	77	53	48
BB005	75	110	142
BB006	141	63	118
BB007	84	55	68
BB008	122	57	113
BB009	164	99	134
BB010	132	109	82
BB011	79	71	78
BB012	102	87	69
BB013	50	78	106
BB014	147	73	65
BB015	137	75	120
BB016	89	50	96
BB017	115	89	102
BB018	33	43	46
BB019	148	105	81
BB020	63	55	121
BB022	88	89	139
BB023	96	91	200
BB025	111	51	70
BB026	75	49	58
Average:	98.8	74.8	96.6

	decrease in protein consumption

Table 4 – Daily recommended amount/range of carbohydrates based on the subjects' weight that subject is supposed to consume and the actual amount that subject consumed for the breakfast meal during the BF week

Subject:	Recommended CHO (g)	Amount of CHO consumed (g)		
		Mon	Tue	Wed
BB001	51.2 - 81.8	90.1	149.4	73.2
BB002	64.4 - 103.1	162.6	103.8	86.1
BB003	66.5 - 106.3	27.5	30.4	38.9
BB004	68.6 - 109.7	56.7	23.6	33.3
BB005	61.4 - 98.2	165.5	38.6	165.5
BB006	76.7 - 122.8	31.9	58.6	56.8
BB007	76.7 - 122.8	1.5	1.5	1.5
BB008	80.5 - 128.8	44.7	44.7	60.8
BB009	77.7 - 124.3	54.9	60	116.9
BB010	57.9 - 92.8	57.4	102.9	102.9
BB011	75 - 120	26.2	67.7	89.2
BB012	80.1 - 128.1	34.2	61.2	26.8
BB013	64.8 - 103.68	96.1	103.2	6.7
BB014	78.4 - 125.4	60.3	130.8	69.9
BB015	60.4 - 96.6	249.7	51.6	51.6
BB016	52.5 - 84	83.6	83.6	83.6
BB017	51.8 - 82.9	139.4	93.9	62.4
BB018	56.3 - 90	155.2	45.5	61.6
BB019	76.1 - 121.7	41.1	86.2	70.3
BB020	56.3 - 90	117.4	117.4	116
BB022	69.9 - 111.8	83.2	105.7	102.2
BB023	61.4 - 98.2	29.6	57.3	33.1
BB025	59.3 - 94.8	82.5	82.5	82.5
BB026	47.4 - 75.9	1	1	1

	Under recommendations
	Within the recommendations

Table 5 – Daily recommended amount/range of protein based on the subjects' weight that subject is supposed to consume and the actual amount that subject consumed for the breakfast meal during the BF week

Subject:	Recommended PRO (g)	Amount of PRO consumed (g)		
		Mon	Tue	Wed
BB001	13.7 - 20.5	9.9	26.1	7.8
BB002	17.2 - 25.8	25.8	10.3	22.5
BB003	17.7 - 26.6	18.5	20.2	13.4
BB004	18.3 - 27.4	27.3	17.9	19.2
BB005	16.4 - 24.5	21.3	31.9	21.3
BB006	20.5 - 30.7	14.8	34.8	21.6
BB007	20.5 - 30.7	16.6	16.6	16.6
BB008	21.5 - 32.2	9.9	9.9	13.9
BB009	20.7 - 31.1	27.9	12.7	48.2
BB010	15.5 - 23.2	12.8	17.8	17.8
BB011	20 - 30	16.3	13.4	19.4
BB012	21.4 - 32.0	10.7	15.1	9.6
BB013	17.3 - 25.9	6.5	6.9	17.5
BB014	20.9 - 31.4	21.6	11.1	11.2
BB015	16.1 - 24.2	20.9	27.1	16.9
BB016	14 - 21	26.7	26.7	26.7
BB017	13.8 - 20.7	20.1	8.8	16.1
BB018	15 - 22.6	28.1	15.9	5.8
BB019	20.3 - 30.4	10.4	13.7	10.9
BB020	15 - 22.6	27.9	27.9	27.9
BB022	18.5 - 27.9	37.9	61.9	24.5
BB023	16.4 - 24.5	29.6	57.3	33.1
BB025	15.8 - 23.7	30.7	30.7	30.7
BB026	12.6 - 18.7	10.9	10.9	10.9

	Under recommendations
	Within the recommendations

Figure 1 – Consort Diagram

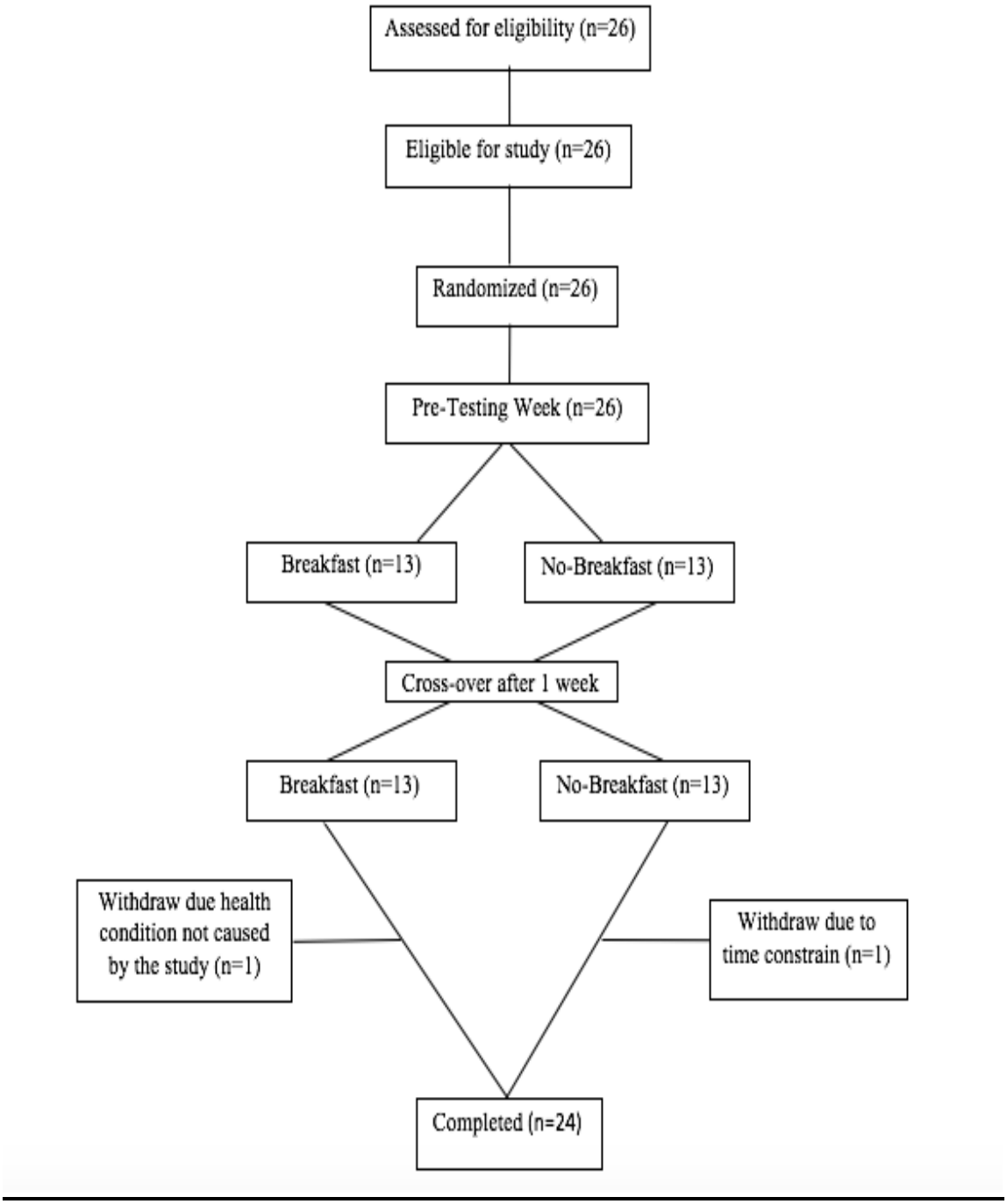
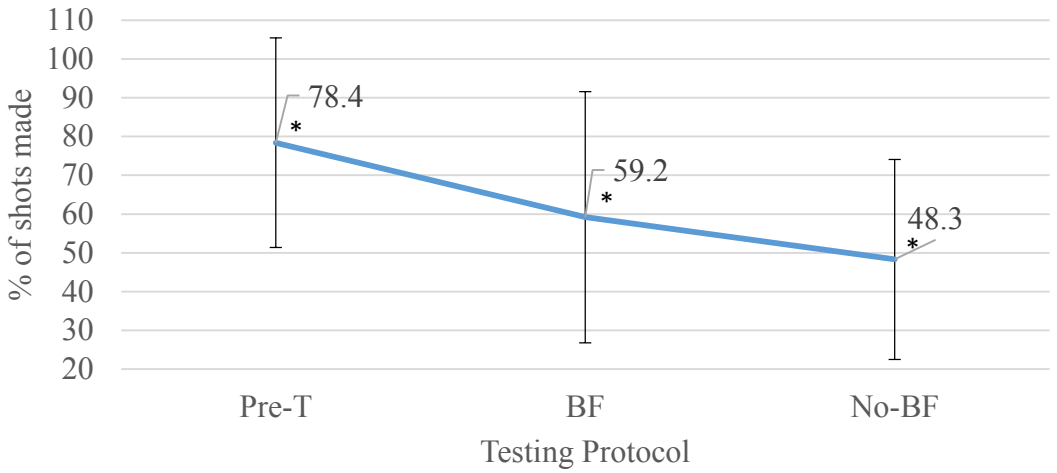


Figure 2 – Comparison of the mean percentage of shots collegiate male and female basketball players made combined during free throw, 2-point and 3-point drills during a breakfast no-breakfast cross-over research design



* significant difference < 0.05 for Pre-T - BF and Pre-T - No-BF week

PRE-T=Pre testing week
BF=Breakfast week
No-BF=No breakfast week

Figure 3 – Comparison of the mean percentage of shots collegiate male and female basketball players made during the free throw drill during a breakfast no-breakfast cross-over research design

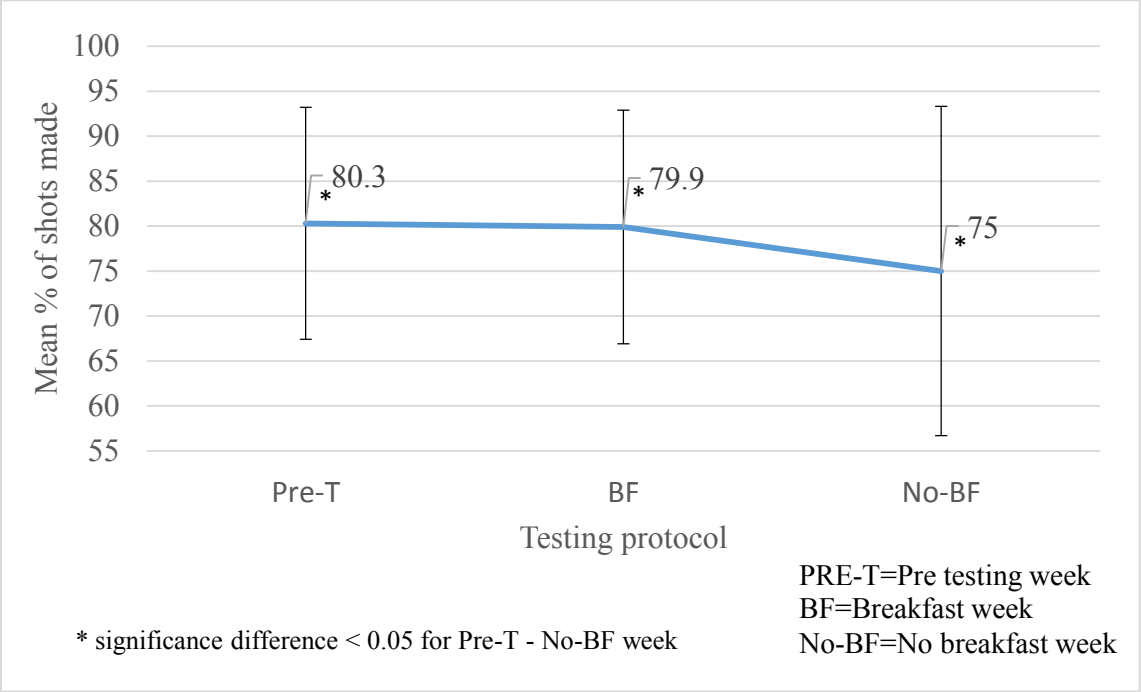


Figure 4 – Comparison of the mean percentage of shots collegiate male and female basketball players made during the 2-point drill during a breakfast no-breakfast cross-over research design

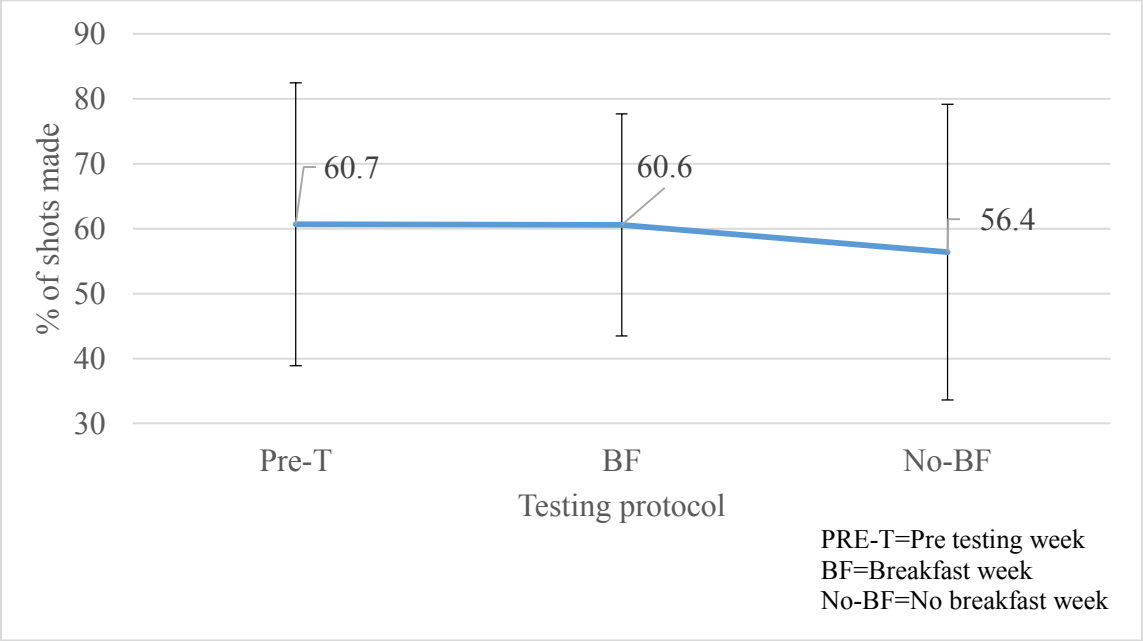


Figure 5 – Comparison of the mean percentage of shots collegiate male and female basketball players made during the 3-point drill during a breakfast no-breakfast cross-over research design

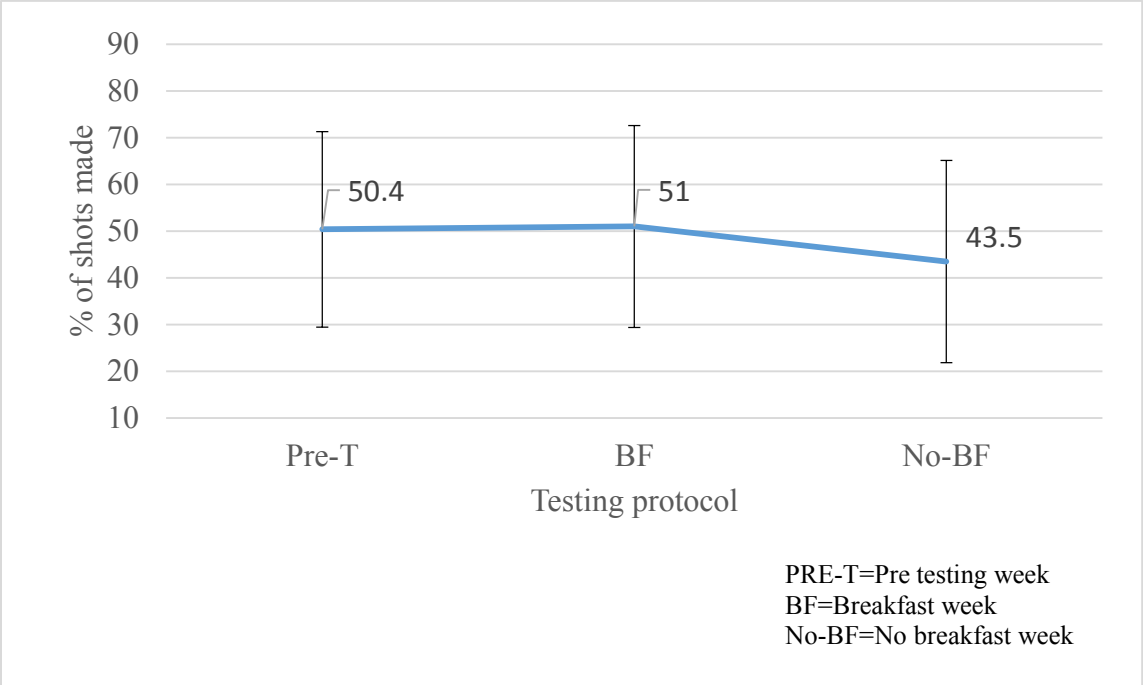


Figure 6 – Comparison of the mean percentage of shots collegiate male and female basketball players attempted during the 2-point and 3-point drills combined during a breakfast no-breakfast cross-over research design

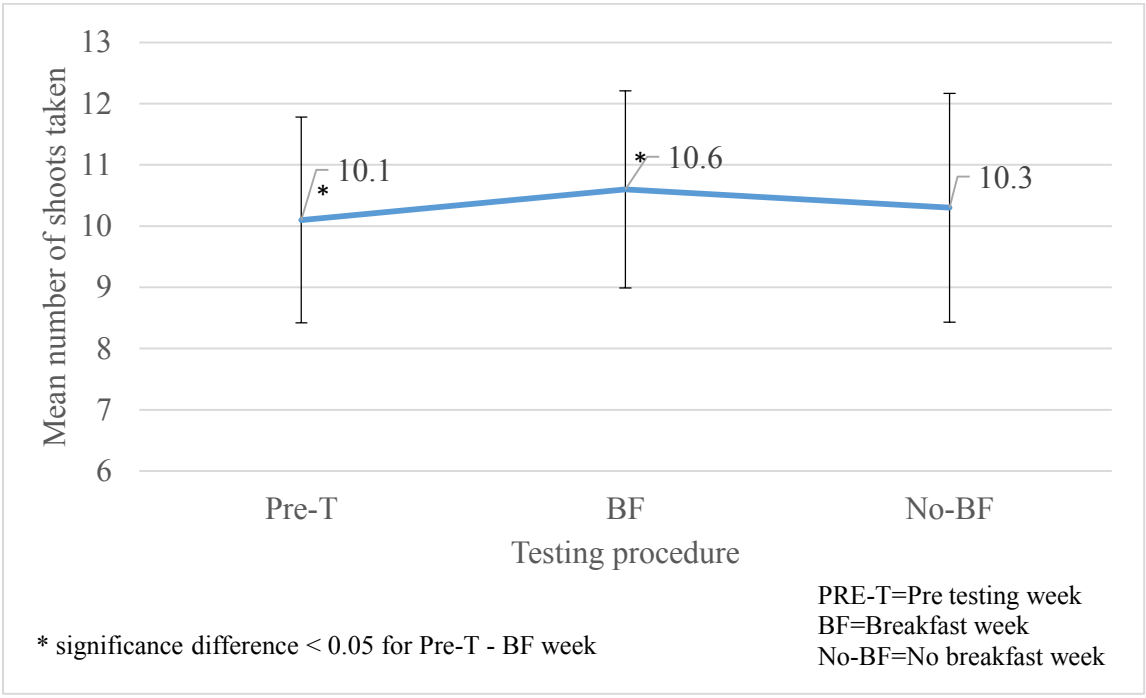
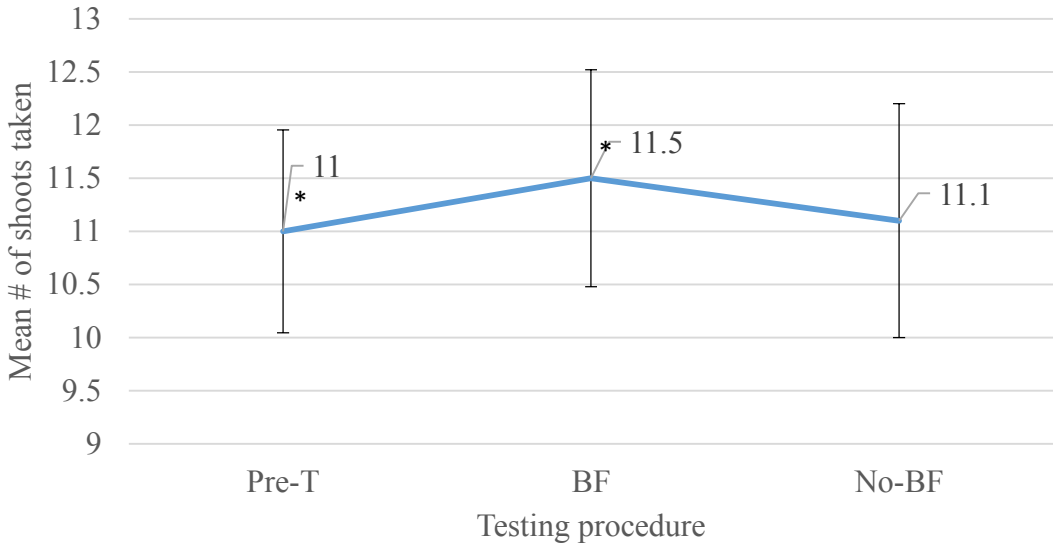


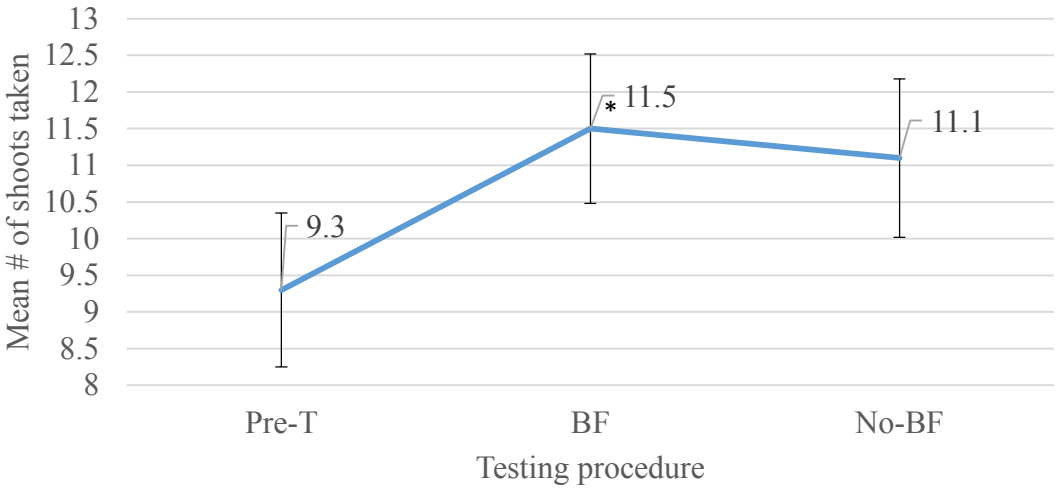
Figure 7 – Comparison of the mean number of shots collegiate male and female basketball players attempted during the 2-point drill during a breakfast no-breakfast cross-over research design



* significant difference < 0.05 for Pre-T - BF week

PRE-T=Pre testing week
BF=Breakfast week
No-BF=No breakfast week

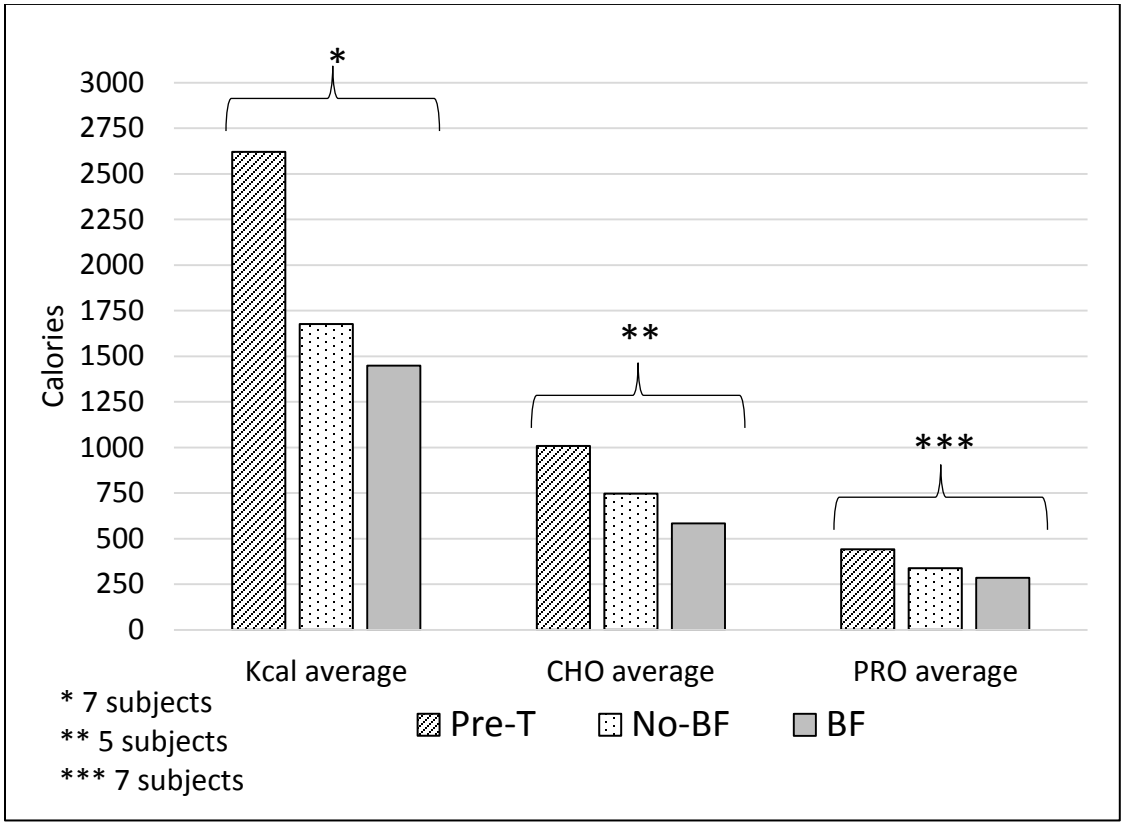
Figure 8 – Comparison of the mean number shots collegiate male and female basketball players attempted during the 3-point drill during a breakfast no-breakfast cross-over research design



PRE-T=Pre testing week
BF=Breakfast week
No-BF=No breakfast week

* significant difference < 0.05 for Pre-T-BF week and Pre-T-No-BF week

Figure 9 – Subjects with constant decrease in carbohydrate, protein and calorie intake during the Pre-T, No-BF and BF week



Manuscript References

Affenito, S. G. (2007). Breakfast: A missed opportunity. *Journal of the American Dietetic Association, 107*(4), 565-569.

Aranceta, J., Serra-Majem, L., Ribas, L., & Pérez-Rodrigo, C. (2001). Breakfast consumption in Spanish children and young people. *Public Health Nutrition, 4*(6a), 1439-1444.

Au, L. E., Whaley, S., Rosen, N. J., Meza, M., & Ritchie, L. D. (2015). Online and in-person nutrition education improves breakfast knowledge, attitudes, and behaviors: A randomized trial of participants in the Special Supplemental Nutrition Program for Women, Infants, and Children. *Journal of the Academy of Nutrition and Dietetics 116*(3), 490-500.

Benton, D., & Brock, H. (2010). Mood and the macro-nutrient composition of breakfast and the mid-day meal. *Appetite, 55*(3), 436-440.

Clayton, D. J., Barutcu, A., Machin, C., Stensel, D. J., & James, L. J. (2015). Effect of breakfast omission on energy intake and evening exercise performance. *Medicine and Science in Sports and Exercise, 47*(12), 2645-2652.

Clayton, D. J., & James, L. J. (2016). The effect of breakfast on appetite regulation, energy balance and exercise performance. *The Proceedings of the Nutrition Society, 75*(3), 319-327.

Cooper, S. B., Bandelow, S., & Nevill, M. E. (2011). Breakfast consumption and cognitive function in adolescent schoolchildren. *Physiology & Behavior, 103*(5), 431-439.

Cooper, S. B., Bandelow, S., Nute, M. L., Morris, J. G., & Nevill, M. E. (2015). Breakfast glycemic index and exercise: Combined effects on adolescents' cognition. *Physiology & Behavior, 139*(2), 104-111.

DeJong, C. S., van Lenthe, F. J., van der Horst, K., & Oenema, A. (2009). Environmental and cognitive correlates of adolescent breakfast consumption. *Preventive Medicine, 48*(4), 372-377.

Dykstra, H., Davey, A., Fisher, J. O., Polonsky, H., Sherman, S., Abel, M. L., Bauer, K. W. (2016). Breakfast-skipping and selecting low-nutritional-quality foods for breakfast are common among low-income urban children, regardless of food security status. *The Journal of Nutrition, 146*(3), 630-636.

Komiyama, T., Sudo, M., Okuda, N., Yasuno, T., Kiyonaga, A., Tanaka, H., Ando, S. (2016). Cognitive function at rest and during exercise following breakfast omission. *Physiology & Behavior, 157*, 178-184.

Kreider, R. B., Wilborn, C. D., Taylor, L., Campbell, B., Almada, A. L., Collins, R., Kalman, D. S. (2010). ISSN exercise & sport nutrition review: Research & recommendations. *Journal of International Sociaty of Sports Nutrition, 7*(7), 2-43.

Mahoney, C. R., Taylor, H. A., Kanarek, R. B., & Samuel, P. (2005). Effect of breakfast composition on cognitive processes in elementary school children. *Physiology & Behavior, 85*(5), 635-645.

Musaiger, A. O., & Ragheb, M. A. (1994). Dietary habits of athletes in Bahrain. *Nutrition and Health, 10*(1), 17-25.

Nigg, S., Whitting, J., Tomaras, E., Davis, E., & Nigg, B. (2015). The basketball-20: Development of a basketball-specific field-based work protocol. *Journal of Fitness Research, 4*(3), 26-35.

Nikić, M., Jakovljević, S., Pedišic, Ž, Venus, D., & Šatalic, Z. (2014). Adequacy of nutrient intakes in elite junior basketball players. *International Journal of Sport Nutrition & Exercise Metabolism, 24*(5), 516-523.

O'Dea, J. A., & Caputi, P. (2001). Association between socioeconomic status, weight, age and gender, and the body image and weight control practices of 6- to 19-year-old children and adolescents. *Health Education Research, 16*(5), 521-532.

O'Neil, C. E., Byrd-Bredbenner, C., Hayes, D., Jana, L., Klinger, S. E., & Stephenson-Martin, S. (2014). The role of breakfast in health: Definition and criteria for a quality breakfast. *Journal of the Academy of Nutrition and Dietetics, 114*(12 Supplement), S8-S26.

Pojskić, H., Šeparović, V., & Užičanin, E. (2011). Reliability and factorial validity of basketball shooting accuracy tests. *Sport Scientific and Practical Aspects*, *8*(1), 25-32.

Purvis, D. L., Lentino, C. V., Jackson, T. K., Murphy, K. J., & Deuster, P. A. (2013). Nutrition as a component of the performance triad: How healthy eating behaviors contribute to soldier performance and military readiness. *U.S. Army Medical Department Journal*, 66-78.

Ruxton, C., & Kirk, T. (1996). Relationships between social class, nutrient intake and dietary patterns in Edinburgh schoolchildren. *International Journal of Food Sciences and Nutrition, 47*(4), 341-349.

Ruxton, C., & Kirk, T. (1997). Breakfast: A review of associations with measures of dietary intake, physiology and biochemistry. *British Journal of Nutrition, 78*(02), 199-213.

Sherman, W. M., Jacobs, K. A., & Leenders, N. (1998). Carbohydrate metabolism during endurance exercise. *Overtraining in Sport*, 289-308.

Vanelli, M., Iovane, B., Bernardini, A., Chiari, G., Errico, M. K., Gelmetti, C., Students of the Post-Graduate School of Pediatrics, University of Parma. (2005). Breakfast habits of 1,202 northern Italian children admitted to a summer sport school. Breakfast skipping is associated with overweight and obesity. *Acta Bio-Medica : Atenei Parmensis, 76*(2), 79-85.

Veasey, R. C., Gonzalez, J. T., Kennedy, D. O., Haskell, C. F., & Stevenson, E. J. (2013). Breakfast consumption and exercise interact to affect cognitive performance and mood later in the day. A randomized controlled trial. *Appetite, 68*, 38-44.

Veasey, R. C., Haskell-Ramsay, C. F., Kennedy, D. O., Tiplady, B., & Stevenson, E. J. (2015). The effect of breakfast prior to morning exercise on cognitive performance, mood and appetite later in the day in habitually active women. *Nutrients, 7*(7), 5712-5732.

Videon, T. M., & Manning, C. K. (2003). Influences on adolescent eating patterns: The importance of family meals. *Journal of Adolescent Health, 32*(5), 365-373.

Williams, C., & Rollo, I. (2015). Carbohydrate nutrition and team sport performance. *Sports Medicine, 45*(1), 13-22.

Appendix A

Consent to Participate in Research

Identification of Investigators & Purpose of Study

You are being asked to participate in a research study that will contribute to the researcher's completion of his master's thesis conducted by Dimitrije Cabarkapa from James Madison University. The purpose of this study is to determine if basketball shooting accuracy of men and women's college basketball players is improved after consumption of breakfast compared to breakfast omission during a three-week intervention. It is hypothesized that basketball shooting percentage will improve when the subjects are provided with a breakfast before shooting workout compared to breakfast omission following the three-week intervention.

Research Procedures

Should you decide to participate in this research study, you will be asked to sign this consent form once all your questions have been answered to your satisfaction. This study consists of diet record collection combined with three basketball drills that serve as a measurement tool for testing a basketball shooting accuracy that will be administered to individual participants at James Madison University. You will be asked to complete food intake records three times for the period of 4 days from Monday to Thursday morning. The first week is going to be testing week where you will be asked to maintain your normal dietary habits. After the first week, one week will be breakfast consumption week and other week there will be no breakfast consumption. Discussion about the food records will be done on Thursday mornings when you will be also asked to preform specifically designed three basketball drills. The first drill will be stationary free throw shooting, the second drill with be two point shooting during the period of 60 seconds and the third drill will be three point shooting during the period of 60 seconds.

Time Required

Participation in this study each week will require 15 minutes to preform specific basketball drills including warm-up and 25 minutes to go over previously filled dietary records. In addition, the subjects will need small amount after every meal to enter the amount of food and fluids that they have eaten for the period form Monday morning until Thursday morning.

Risks

During the period of the study conduction, researcher does not expect any more risk to day to day activity. The possible risks that can appear as a consequences of breakfast omission are low blood glucose that can lead to dizziness. If subject gets dizzy we will have food available for them.

Benefits

There are no direct benefits to the participant, but benefits of the research as a whole are. The data obtained would possible be able to provide us with useful information about importance of breakfast for the basketball shooting performance that

can possibly be improved. Besides basketball players, coaches, athletic trainers and dieticians are going to be able to use this research to educate players about proper eating habits that can potentially lead to improvement in their performance.

Confidentiality

The results of this research will be presented in the way of poster presentation and the manuscript will be submitted to peer review journal. The results of this project will be coded in such a way that the respondent's identity will not be attached to the final form of this study. The researcher retains the right to use and publish non-identifiable data. While individual responses are confidential, aggregate data will be presented representing averages or generalizations about the responses as a whole. All data will be stored in a secure location accessible only to the researcher. Five years after the completion of the study, all information that matches up individual respondents with their answers including hard copy and electronic copy will be destroyed.

Participation & Withdrawal

Your participation is entirely voluntary. You are free to choose not to participate. Should you choose to participate, you can withdraw at any time without consequences of any kind.

Questions about the Study

If you have questions or concerns during the time of your participation in this study, or after its completion or you would like to receive a copy of the final aggregate results of this study, please contact:

Researcher's Name: Dimitrije Cabarkapa

Email Address: cabarkdx@dukes.jmu.edu

Telephone: (540)-246-3757

Advisor's Name: Jeremy Akers

Department: Health Sciences-Nutrition and Physical Activity

Email Address: akersjd@jmu.edu
James Madison University
Telephone: (540) …

Questions about Your Rights as a Research Subject
Dr. David Cockley
Chair, Institutional Review Board
James Madison University
(540) 568-2834
cocklede@jmu.edu

Giving of Consent

I have read this consent form and I understand what is being requested of me as a participant in this study. I freely consent to participate. I have been given satisfactory answers to my questions. The investigator provided me with a copy of this form. I certify that I am at least 18 years of age.

_____
Name of Participant (Printed)

_____ _____
Name of Participant (Signed) Date

_____ _____
Name of Researcher (Signed) Date

Appendix B

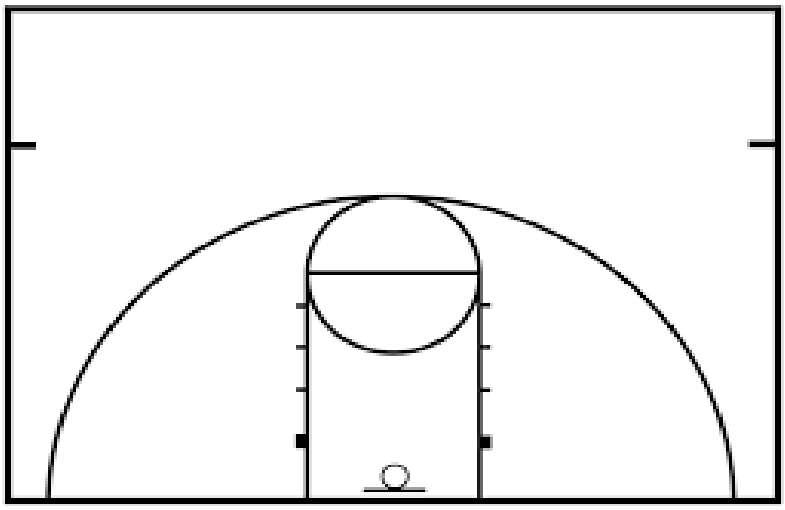
Shooting Chart

Subject ID: _____ Week: _____ Time: _____

Free-Throw:

1) _____ / 10 2) _____ / 10 3) _____ / 10

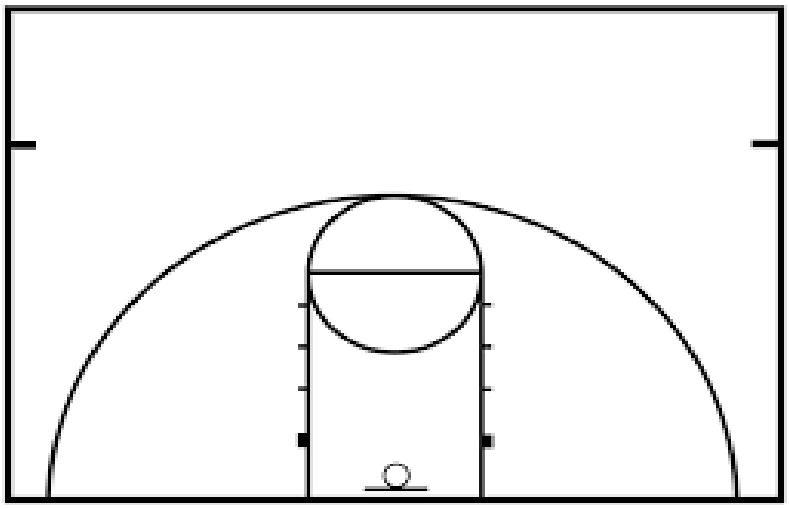
Two-Point Shooting (60 seconds):



Total:

_____ / _____

Three-Point Shooting (60 seconds):



Total:

_____ / _____

Appendix C

Food Intake Record

Name:_____ Date:_____ Day: 1 2 3 (*circle one*) Notes:_____

Time	Location	DETAILED Description	Amount EATEN (*be specific*)	User Notes

Appendix D

List of the common breakfast foods

Thank you for participating in this research. The list below entails common breakfast foods. You will be asked to consume specific amounts of carbohydrates and proteins based on your body weight for breakfast during this week of the study. The specific amount of carbohydrates and proteins to be consumed via breakfast are presented below:

Weight: _____ (lbs) = _____ (kg)

CHO: (0.75-1.2 g/kg) = _____
PRO: (0.2-0.3 g/kg) = _____

	Food Item	**Carbohydrates (g)**	**Protein (g)**	**Calories (kcal)**
Fruit				
	Strawberries (1 cup)	11	1	47
	Banana (1)	27	1.3	105
	Apple (1)	25	0.5	95
	Orange (1)	15	1.2	62
	Grapes (1 cup)	16	0.6	62
	Kiwi (1)	10	0.8	42
	Grapefruit (1)	25	2	97
	Blueberries (1 cup)	21	1.1	85
	Raspberries (1 cup)	15	1.5	65
Bakery				
	Bagel (1)	48	10	245
	English Muffin (1)	26	4.4	134
	Whole wheat bread (1 slice)	12	3.6	69
	White bread (1 slice)	15	2.7	79
	Pancake (1 - 6 inch in diameter)	22	4.9	175
	Waffle (1 - 7 inch in diameter)	25	6	218
	Doughnut (1-medium)	22	2.1	195
	Croissant (1)	26	4.7	231
	Biscuit (1 – 2 inch diameter)	27	4.2	212

	Chocolate Chip Muffin (1 – medium)	52	8	364
	Blueberry Muffin (1 – medium)	61	5	426
	Cereal (“Froot Loops – 1 cup)	22	1	87
	Cereal (“Raisin brand” – 1 cup)	44	4	170
	Cereal (“Honey bunches” – 1 cup)	46	4	220
	Cereal (“Cheerios” – 1 cup)	22	4	120
	Oatmeal (1 cup)	27	6	158
Meat				
	Ham (1 slice)	1.1	4.6	46
	Sausage (1 link)	0.7	3	87
	Egg (1 boiled)	0.6	6	78
	Egg (1 fried)	0.6	6	90
	Bacon (1 slice)	0.1	3	43
Diary				
	Milk (1% - 1 cup)	12	8	102
	Milk (2% - 1 cup)	12	8	122
	Milk (skim – 1 cup)	12	8	90
	Cheese (provolone – 1 slice)	0.6	7	98
	Cheese (American – 1 slice)	1	5	104
	Cheese (Swiss – 1 slice)	1.5	8	106
	Cheese (cheddar – 1 slice)	0.4	7	113
	Cheese (mozzarella – 1 slice)	0.9	8	78
	Cheese (cottage – 1 cup)	8	25	222
	Yogurt (Greek 1 – 6oz)	6	17	100
	Yogurt (strawberry – 1 – 6oz)	18	3.8	96
	Yogurt (raspberry – 1 – 6oz)	14	5	80
	Yogurt (vanilla – 1 – 6oz)	14	5	80
Supplements				
	Protein Bar (“Gatorade” – 1)	42	20	360
	Protein Bar (nature valley – 1)	40	20	331
	Protein Shake (“Rockin’ Refuel” – 1)	48	20	300

Snacks				
	Granola Bar (“Nutri Grain” – 1)	24	2	120
	Granola Bar (“Nature valley” – 1)	15	2	90
	Granola Bar (chewy – 1)	19	1	98
	Poptart – (1 pastry)	36	2	200
Juice				
	Orange (1 cup)	26	1.7	111
	Apple (1 cup)	28	0.2	113
	Cranberry (1 cup)	31	1	117
	Grape (1 cup)	37	0.9	152
Smoothies				
	Mango Magic (Tropical Smoothie – 24oz)	94	2	368
	Kiwi Quencher (Tropical Smoothie – 24oz)	103	2	430
	Strawberry Limeade (Tropical Smoothie – 24oz)	100	1	400
	Paradise Point (Tropical Smoothie – 24oz)	105	2	400
	Jetty Punch (Tropical Smoothie – 24oz)	86	2	340

Appendix E

Testing Subject Schedule

Time:	Subject:
6.00am	
6.20am	
6.40am	
7.00am	
7.20am	
7.40am	
8.00am	
8.20am	
8.40am	
9.00am	
9.20am	
9.40am	
10.00am	
10.20am	
10.40am	
11.00am	
11.20am	
11.40am	
12.00pm	
12.20pm	
12.40pm	
1.00pm	
1.20pm	
1.40pm	
2.00pm	
2.20pm	
2.40pm	
3.00pm	
3.20pm	
3.40pm	
4.00pm	
PRACTICE	
7.40pm	
8.00pm	
8.20pm	
8.40pm	
9.00pm	
9.20pm	
9.40pm	
10.00pm	

References:

Affenito, S. G. (2007). Breakfast: A missed opportunity. *Journal of the American Dietetic Association, 107*(4), 565-569.

Aranceta, J., Serra-Majem, L., Ribas, L., & Pérez-Rodrigo, C. (2001). Breakfast consumption in Spanish children and young people. *Public Health Nutrition, 4*(6a), 1439-1444.

Au, L. E., Whaley, S., Rosen, N. J., Meza, M., & Ritchie, L. D. (2015). Online and in-person nutrition education improves breakfast knowledge, attitudes, and behaviors: A randomized trial of participants in the Special Supplemental Nutrition Program for Women, Infants, and Children. *Journal of the Academy of Nutrition and Dietetics, 116*(3), 490-500.

Benton, D., & Brock, H. (2010). Mood and the macro-nutrient composition of breakfast and the mid-day meal. *Appetite, 55*(3), 436-440.

Clayton, D. J., Barutcu, A., Machin, C., Stensel, D. J., & James, L. J. (2015). Effect of breakfast omission on energy intake and evening exercise performance. *Medicine and Science in Sports and Exercise, 47*(12), 2645-2652.

Clayton, D. J., & James, L. J. (2016). The effect of breakfast on appetite regulation, energy balance and exercise performance. *The Proceedings of the Nutrition Society*, *75*(3), 319-327.

Cooper, S. B., Bandelow, S., & Nevill, M. E. (2011). Breakfast consumption and cognitive function in adolescent schoolchildren. *Physiology & Behavior, 103*(5), 431-439.

Cooper, S. B., Bandelow, S., Nute, M. L., Morris, J. G., & Nevill, M. E. (2015). Breakfast glycaemic index and exercise: Combined effects on adolescents' cognition. *Physiology & Behavior, 139*(2), 104-111.

DeJong, C. S., van Lenthe, F. J., van der Horst, K., & Oenema, A. (2009). Environmental and cognitive correlates of adolescent breakfast consumption. *Preventive Medicine, 48*(4), 372-377.

Dykstra, H., Davey, A., Fisher, J. O., Polonsky, H., Sherman, S., Abel, M. L., Bauer, K. W. (2016). Breakfast-skipping and selecting low-nutritional-quality foods for breakfast are common among low-income urban children, regardless of food security status. *The Journal of Nutrition, 146*(3), 630-636.

Faith, M. S. (2016). Reconsidering breakfast intake and children's neuropsychological function through the lens of behavioral economics. *The American Journal of Clinical Nutrition, 104*(3), 551-552.

Fulford, J., Varley-Campbell, J. L., & Williams, C. A. (2016). The effect of breakfast versus no breakfast on brain activity in adolescents when performing cognitive tasks, as assessed by fMRI. *Nutritional Neuroscience, 19*(3), 110-115.

Hoyland, A., Dye, L., & Lawton, C. L. (2009). A systematic review of the effect of breakfast on the cognitive performance of children and adolescents. *Nutrition Research Reviews, 22*(02), 220-243.

Janvier, B. E., Innocent, M. S., Aimé, T. P. J., Michel, B. K. J., Rachel, M., Martin, M. M., François, M. (2016). Food ration and mental training for the improvement of the free throw performance in Congolese beginners basketball players. *Journal of Education and Training Studies, 4*(11), 119-124.

Komiyama, T., Sudo, M., Okuda, N., Yasuno, T., Kiyonaga, A., Tanaka, H., Ando, S. (2016). Cognitive function at rest and during exercise following breakfast omission. *Physiology & Behavior, 157*, 178-184.

Kreider, R. B., Wilborn, C. D., Taylor, L., Campbell, B., Almada, A. L., Collins, R., Kalman, D. S. (2010). ISSN exercise & sport nutrition review: Research & recommendations. *J Int Soc Sports Nutr, 7*(7), 2-43.

Mahoney, C. R., Taylor, H. A., Kanarek, R. B., & Samuel, P. (2005). Effect of breakfast composition on cognitive processes in elementary school children. *Physiology & Behavior, 85*(5), 635-645.

Mishra, N. (2016). Effect of breakfast on cognitive performance of Indian school student. *Age (Yr), 10*(1.2), 9.8-0.7.

Musaiger, A. O., & Ragheb, M. A. (1994). Dietary habits of athletes in Bahrain. *Nutrition and Health, 10*(1), 17-25.

Nigg, S., Whitting, J., Tomaras, E., Davis, E., & Nigg, B. (2015). The basketball-20: Developement of a basketball-specific field-based work protocol. *Journal of Fitness Research, 4*(3), 26-35.

Nikić, M., Jakovljević, S., Pedišic, Ž, Venus, D., & Šatalic, Z. (2014). Adequacy of nutrient intakes in elite junior basketball players. *International Journal of Sport Nutrition & Exercise Metabolism, 24*(5), 516-523.

O'Dea, J. A., & Caputi, P. (2001). Association between socioeconomic status, weight, age and gender, and the body image and weight control practices of 6- to 19-year-old children and adolescents. *Health Education Research, 16*(5), 521-532.

O'Neil, C. E., Byrd-Bredbenner, C., Hayes, D., Jana, L., Klinger, S. E., & Stephenson-Martin, S. (2014). The role of breakfast in health: Definition and criteria for a quality breakfast. *Journal of the Academy of Nutrition and Dietetics, 114*(12 Supplement), S8-S26.

Pojskić, H., Šeparović, V., & Užičanin, E. (2011). Reliability and factorial validity of basketball shooting accuracy tests. *Sport Scientific and Practical Aspects, 8*(1), 25-32.

Ptomey, L. T., Steger, F. L., Schubert, M. M., Lee, J., Willis, E. A., Sullivan, D. K., Donnelly, J. E. (2016). Breakfast intake and composition is associated with superior academic achievement in elementary schoolchildren. *Journal of the American College of Nutrition, 35*(4), 326-333.

Purvis, D. L., Lentino, C. V., Jackson, T. K., Murphy, K. J., & Deuster, P. A. (2013). Nutrition as a component of the performance triad: How healthy eating behaviors contribute to soldier performance and military readiness. *U.S.Army Medical Department Journal*, 66-78.

Ruxton, C., & Kirk, T. (1996). Relationships between social class, nutrient intake and dietary patterns in Edinburgh schoolchildren. *International Journal of Food Sciences and Nutrition, 47*(4), 341-349.

Ruxton, C., & Kirk, T. (1997). Breakfast: A review of associations with measures of dietary intake, physiology and biochemistry. *British Journal of Nutrition, 78*(02), 199-213.

Sherman, W. M., Jacobs, K. A., & Leenders, N. (1998). Carbohydrate metabolism during endurance exercise. *Overtraining in Sport*, 289-308.

Vanelli, M., Iovane, B., Bernardini, A., Chiari, G., Errico, M. K., Gelmetti, C., Students of the Post-Graduate School of Paediatrics, University of Parma. (2005). Breakfast habits of 1,202 northern Italian children admitted to a summer sport school. breakfast skipping is associated with overweight and obesity. *Acta Bio-Medica : Atenei Parmensis, 76*(2), 79-85.

Veasey, R. C., Gonzalez, J. T., Kennedy, D. O., Haskell, C. F., & Stevenson, E. J. (2013). Breakfast consumption and exercise interact to affect cognitive performance and mood later in the day. A randomized controlled trial. *Appetite, 68*, 38-44.

Veasey, R. C., Haskell-Ramsay, C. F., Kennedy, D. O., Tiplady, B., & Stevenson, E. J. (2015). The effect of breakfast prior to morning exercise on cognitive performance, mood and appetite later in the day in habitually active women. *Nutrients, 7*(7), 5712-5732.

Videon, T. M., & Manning, C. K. (2003). Influences on adolescent eating patterns: The importance of family meals. *Journal of Adolescent Health, 32*(5), 365-373.

Williams, C., & Lamb, D. (2008). Does a high-carbohydrate breakfast improve performance? *Sports Science Exchange, 21*(2), 108.

Williams, C., & Rollo, I. (2015). Carbohydrate nutrition and team sport performance. *Sports Medicine, 45*(1), 13-22.