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Effect Of A Nutrition Program On Eating Habits In Female Collegiate Athletes

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EFFECT OF A NUTRITION PROGRAM ON EATING HABITS IN FEMALE COLLEGIATE ATHLETES

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APPROVAL PAGE

This thesis, submitted by Jorid Dagfinrud Oiestad, in partial fulfillment of the requirements for the Degree of Master of Science in Kinesiology from the University of North Dakota, has been read by the Faculty Advisor Committee under whom the work has been done and is hereby approved.

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Wayne Swisher
Dean of School of Graduate Students

June 24, 2014
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Jorid Dagfinrud Oiestad
4.16.14

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ABSTRACT

In the present study, an intervention took place using two female collegiate NCAA Division 1 (D1) teams. One team was randomized to be the experimental group, receiving the intervention of the 6-week nutrition education class Fueling for Performance (FFP). And the other team served as the control group, receiving no treatment. The purpose was to examine the effect of the FFP intervention on energy balance, body composition and self-efficacy compared to the control group, pre- and post- intervention.

The participants provided pre- and post intervention data through 3-day food records entered in MyPlate Super Tracker, wearing of a BodyMedia Senswear device, skin fold measures, circumference measures, and a self-efficacy questionnaire. The data retrieved was analyzed in Statistical Package for the Social Sciences (SPSS) version 20, using Analysis of Covariance (ANCOVA) to analyze inter-group changes in energy balance and body composition pre- and post- intervention. A Chi square analysis was used to examine differences at baseline for the six self-efficacy questions. Following Chi square analysis, a Log-linear ANOVA was used to examine inter-group changes in self-efficacy.

Results showed that the FFP group significantly improved body composition. There were no significant differences in energy balance and self-efficacy between groups, contrary to our hypothesis.

This study provided important information and underlined the importance of nutritional education for female collegiate athletes to prevent negative energy balance in the target population. This study also provided evidence that the nutritional education program FFP may improve dietary habits, body composition and self-efficacy in female athletes, which in turn will improve their health and help them improve their performance to meet their goals.

CHAPTER I
INTRODUCTION AND LITERATURE REVIEW

In the United States, 20 million women and 10 million men suffer from a clinically significant eating disorder at some point in their life (National Eating Disorders Association, 2013). Similarly, significantly higher rates of eating disorders are found in female elite athletes (20%), compared to non-athletes (9%) (National Association of Anorexia Nevrosa and Associated Eating Disorders, 2013). Thus, female athletes are at a higher risk of eating disorders than male and female non-athletes.

Not only do female athletes have the pressure of athletic success, they also have the cultural and social pressure of being thin and lean (Furnham et al., 2002). The social and cultural pressure to have a certain look is more common in sports where body weight and shape may play a role in the level of performance (Buchholz, Mack, McVey, Feder, & Barrowman, 2008). Shiever and colleagues (2013) conducted a study to assess the dietary intake and eating habits of female collegiate athletes compared to the minimum sport nutrition standards. A total of 52 National Collegiate Athlete Association (NCAA) D1 female athletes participated in the study and results showed that nearly all failed to meet their estimated energy needs in regards to their dietary intakes. Previous research also shows that female athletes tend to be energy deficient (Furnham et al., 2002; Buchholz et al., 2008). One way to effectively decrease the number of eating disorders is with nutrition education (Abood et al., 2004).

Abood and colleagues (2004) examined the efficacy of a nutrition education program for female collegiate athletes to improve their nutritional knowledge and self-efficacy to determine if there would be an improvement in dietary choices and dietary practices. Results showed that nutrition education among female athletes increased their ability to improve their dietary habits. Additionally, female athletes are receptive to nutritional education, meaning that female athletes are open for nutritional education to improve their dietary habits.

Zawila and colleagues (2003) suggest further that research is needed to understand female collegiate cross country runners' nutritional knowledge and attitudes. Similarly, other studies also highly recommend future research to examine the effects of nutritional education for the female athlete population, as an energy deficient diet over time can lead to the female athlete triad. The female athlete triad refers to the three health problems of low energy availability, irregular or missed menstrual periods, stress fractures and other bone problems because of changes in hormone levels (The Female Athletic Triad Coalition, 2013), as well as other eating disorders (Abood, Black & Birnbaum, 2004; Shriver, Betts & Wollenberg, 2013). As previous literature highly recommends further research in the field of female athletes and their diet, the present study evaluated the effects of a nutrition education intervention to improve female athlete's dietary habits and self-efficacy.

Athletes and Nutrition:

Optimal nutrition is one of the major factors for peak performance, while an inadequate diet can limit an athletes' potential of reaching his or her maximum level of performance. This statement is taken from United States Department of Agriculture (USDA) Anti-Doping Agency (2010), and highlights the importance of an adequate and balanced diet for athletes to reach their

potential. An adequate and balanced diet provides the athlete with accessible fuel for their workouts, for recovery and training adaptions to occur (Slater & Phillips, 2013).

The body has three main energy sources: carbohydrates, fats and proteins. All of these energy sources work as fuel for the body at rest and during activity. As the individual increases their level of activity, the need for energy intake increases. The appropriate percentage of which macronutrient energy source is/are used, is dependent on: duration and intensity of activity/training, individual fitness level, and the food and drinks consumed prior to and during exercise (USDA Anti-Doping Agency, 2010; Hausswirth & LeMeur, 2011).

Carbohydrates:

Carbohydrates are the main source of energy when the individual is exercising above 75% of VO2 peak (Stellingwerff, Maughan & Burke, 2011). As carbohydrates are the fastest macronutrient to metabolize, the body prioritizes the usage of easily and quickly accessible phosphagen and glycogen stored in the liver and muscles during high intensity activities. The intensity and the work accomplished during the workout or competition determines how much of the carbohydrate storage is depleted. Having an adequate daily intake of carbohydrates at strategic times is important to help athletes optimize their training. Guidelines include: having carbohydrates stored pre-exercise for available fuel when needed, and to restore the glycogen stores post-exercise to recover faster, minimize fatigue and to prepare for next exercise bout or competition. For exercise sessions lasting longer than 60 minutes, carbohydrates in the form of liquid or gel should be consumed to ensure adequate energy availability for the working muscles (USDA Anti-Doping Agency, 2010).

For female athletes, the daily intake of carbohydrates should reach 5g/kg per day; for a female athlete whose weight is 65 kg, her daily carbohydrate intake must reach: 65kg x 5g = 325g of carbohydrates/day. If the training volume increases, the recommendations of daily carbohydrate intake increase as well (Hausswirth & Le Meur, 2011).

Fat:

Lipid oxidation is the main source of energy in low to moderate intensity exercise sessions over longer durations (>30 minutes) as lipid oxidation is a slower metabolic process than carbohydrate metabolism and also requires oxygen. Even in lean adults, the muscle and liver glycogen stores can only provide ~2,500 kcal of energy, while the fat stored, can supply at least 70,000-75,000 kcal of energy (Wilmore, Costill, Kenney, 2008). Lipid intake is an important factor in the athlete's diet as it is a major fuel source at rest and for everyday activities. Healthy oils are a great source for many important fat-soluble vitamins. Female athletes should be within the daily recommendations of fat intake with 20-30% of daily caloric intake (Hausswirth & Le Meur, 2011).

Protein:

Protein oxidation is not a favorable source of fuel as protein work as building blocks in the body and are essential in the recovery phase. Protein may be used as an energy source when carbohydrate stores are low or depleted. In a healthy individual, protein catabolism is usually not more than 5% of total energy expenditure, or 10-15% if calories are inadequate (Wilmore et al., 2008).

To ensure that proper recovery is able to occur and to optimize building lean mass, female athletes specializing in strength sports are recommended to reach 1.4-1.8 g/kg per day of protein. Other female athletes are recommended to consume 1.2-1.4 g/kg per day (Hausswirth & Le Meur, 2011).

Nutrition Requirements During Exercise:

Females have a greater capacity for lipid oxidation than males allowing them to better maintain and preserve muscle glycogen during longer events. The higher levels of estrogen in females decrease both the utilization of glycogen stores and the breakdown of amino acids while increasing the utilization of fatty acids during exercise (Hausswirth & LeMeur, 2011). When it comes to post-exercise recovery metabolism, evidence suggest that females have a greater ability to maintain glycaemia, the presence of glucose in the blood, which may result in decreased lipid oxidation during the post-exercise recovery phase as compared to men (Hausswirth & Le Meur, 2011). To enhance restoration of muscle glycogen and improve muscle protein metabolism, acute ingestion of 0.8g/kg carbohydrate and 0.4 g/kg protein is recommended (Slater & Phillips, 2011), along with a well-balanced meal within 2 hours of exercise (USDA Anti-Doping Agency, 2010).

Nutrition plays a key role in providing energy for the sport-specific, strength and conditioning training, to optimize the recovery process, to promote training adaptions to occur and to maintain a frequent exercise schedule. The majority of female athlete's energy expenditure requires a minimum 2,300-2,500 kcal/day to maintain their body mass, and energy intake should mirror these numbers with allowance for fluctuation depending on training intensity (Hausswirth & Le Meur, 2011).

Consequences of Negative Energy Balance:

Previously in the literature review, we looked at the roles of the different macronutrients and what they do to fuel the body to prepare for exercise, as well as the nutrient's role in recovery. By understanding the macronutrients role, pre- during- and post-exercise, it is easier to understand the importance of creating a balance between energy intake vs. expenditure. Considering the importance of having an adequate and balanced diet, many athletes struggle to consume enough calories to meet their energy expenditure to create an energy balance (Jonnalagadda et al., 2004). Low energy consumption can occur with or without an eating disorder (daily caloric expenditure is higher than intake) (The Female Athletic Triad Coalition, 2013).

A negative energy balance can cause an experience of fatigue in the early states of a workout as glycogen stores in the body are not optimal before the start of a workout, and is also linked to the athlete's inability to continue the production of ATP (Hausswirth & LeMeur, 2011). The lack of ATP and depleted glycogen stores will cause the oxidation of fat to take over as the fuel source for energy. The intensity of the workout will decrease, as fat oxidation is a slower process in producing energy than carbohydrate metabolism. A negative energy balance also promotes a rise in protein catabolism, which will have a negative effect on lean mass.

Having a negative energy balance does not only affect the skeletal muscles and its ability to perform and optimal recovery to occur (Hausswirth & Le Meur, 2011), a negative energy balance also affects the athlete's mental health, feeling of fatigue and bone health. A hypocaloric diet is associated with chronic fatigue, sleep disturbance and decreased alertness, which in turn will affect the training intensity and results. An important factor for optimized training, is to be alert and mentally prepared for the work out. A daily inadequate energy intake also suppresses

the hypothalamic-pituitary gondal axis activity, which results in a lower production of estrogen and may cause menstrual cycle disturbance. Estrogen helps to slow down bone reabsorption and stimulate bone formation, which are important factors in maintaining bone health. A hypocaloric diet will also make it hard to take in the daily recommendations for calcium (females age 9-18: 1300 mg/day, and females age 19-50: 1000 mg/day), which is also an important factor in maintaining bone health. Female athletes who maintain a negative energy balance put themselves at risk for stress fractures, arthritis and other negative bone conditions (Hausswirth & Le Meur, 2011).

Disordered Eating and Athletes:

A hypocaloric diet over time may result in eating disorders. As stated earlier, 20 million women and 10 million men suffer from a clinically significant eating disorder at some point in their life in the U.S. (National Eating Disorders Association 2013). Eating disorders are described as: "Real complex, and devastating conditions that can have serious consequences for health, productivity, and relationships". Eating disorders are complex conditions that arise from a combination of long-term behavioral, biological, emotional, physiological, interpersonal and social factors (National Eating Disorders Association, 2013).

Involvement in sports offers many benefits for athletes, such as being physically active, high self-esteem and positive body image. Being a part of a competitive environment, however, also brings a lot of physiological and psychological stress for the individual participants (National Eating Disorders Association 2013). Not only is the pressure of success higher for an athlete as the emphasis in sports is winning and individual performance, but the social and cultural pressure of the stereotypical athlete of being lean, muscular and agile, is also a major

factor when it comes to an athlete's body image. As a male's focus is to gain weight and have a muscular body, the issue of having an eating problem might be smaller than for females, who are supposed to meet the stereotypical body image of being thin (Furnham et al., 2002; National Association of Anorexia Nervosa and Associated Eating Disorders 2013). Trying to lose weight and meet the stereotypical body image of being thin involves creating an energy deficiency. This is one of the reasons why females are at higher risk for disordered eating and eating disorders than men (National Association of Anorexia Nevrosa and Associated Disorders, 2013).

According to the American College of Sports Medicine (2007), there is a 28-62% prevalence of disordered eating, defined as "dietary restriction, binge eating, and/or purging behavior" among thin female athletes. For eating disorders, there is 25-31% prevalence among female athletes in thin built sports such as gymnastics, dance, figure skating etc., compared to 5-9% in the general population (ACSM Position Stand Slideshow, 2007). These statistics are clinically reported cases of individuals meeting the criteria's for eating disorders or disordered eating. For various reasons, many cases of eating disorders and disordered eating are not likely to be reported (National Association of Anorexia Nevrosa and Associated Disorders, 2013). Individuals who have some sort of eating disorder or disordered eating might not be aware of their energy deficiency, their obsession with foods and body image, or might be ashamed to admit they have a problem (National Association of Anorexia Nevrosa and Associated Disorders, 2013).

Female Athletes and Body Image:

As stated earlier, every sport has a certain optimal look, and the social pressure on how the stereotypical athlete should look is high. Society creates this stereotypical and ideal body

image through media, which leaves people with the impression of having to look that way to be accepted. Furnham and colleagues (2002) stated that what might be the difference regarding the higher number of eating disorders among female- compared to male- athletes is that the social pressure of the "perfect" thin body is higher among females than men (Furnham et al., 2002). Statistics from National Eating Disorders Association (2013) show that the average BMI of Miss America winners have decreased from around 22 kg/m^2 in the 1920's to 16.9 kg/m^2 in the 2000's, where the World Health Organization classifies normal BMI between 18.5-24.9 kg/m^2. This underlines how the media creates a social pressure of the ideal body to be accepted in today's society. The top sources of information for female athletes trying to achieve a goal of a lower body fat percentage are: magazines, internet, coaches, friends and parents (Zawila et al., 2003). Based on the non-researched based information sources, it is understandable that energy deficient dieting occurs. The information in the magazines, on the internet, and from what friends and coaches say is often misleading, especially for athletes, as fad diets are typically below the reccomendations for the general population when it comes to nutrient intake recommendations.

Nutter (1991) stated after finishing her study of Seasonal Changes in Female Athletes Diet: "The dietary practice of these female athletes may be influenced to a greater extent by their desire to be thin for personal reasons than by changes in their state of exercise". More recent studies have also shown female athlete tendencies towards negative energy balance. The reason that female athletes tend to have a negative energy balance is because they want to look a certain way or simply because they do not know the energy demands of their activity level and the effect of their food choices on their health (Shriver et al., 2013; Schilling & Nikita, 2008). Having a

negative energy balance over a long period of time is not healthy and can lead to the female athlete triad and other eating disorders (Zawila et al., 2003).

Nutrition Education and Female Athletes:

As becoming thin and losing weight involves having a lower caloric input than energy expenditure, there is a higher risk for a hypocaloric diet in females than males. Due to the higher rates of female athletes consuming hypocaloric diets, nutritional education for this population is important, as previous studies have shown that nutritional education increases the athletes understanding of the value of dietary habits role to enhance performance and promote health (Zawila et al., 2003; Abood et al., 2004; Shriver et al., 2013).

Shiever and colleagues (2013) conducted a study to assess the dietary intake and eating habits of female collegiate athletes compared to the minimum sport nutrition standards. A total of 52 NCAA D1 female athletes participated in the study that included a nutritional knowledge questionnaire, a 24-hour food recall, a 3-day food record, an exercise/activity log and measurements of height, weight, body composition and resting metabolic rate. Results showed that nearly all participants failed to meet their estimated energy needs with their energy intakes. The findings highly support the need to educate female athletes about nutrition to improve eating habits and optimize their nutrition status, performance and their recovery from training.

Other studies support the reccomendations of nutritional education for the female athlete after evaluating their dietary energy intake, nutrition knowledge, and activity levels. Evidence suggests that most participants did not meet the daily-recommended energy intake for athletes and studies show that nutritional education of these female athletes creates positive changes in dietary habits (Abood et al., 2004; Zawila et al., 2003).

Many female athletes tend to diet in the off-season (Nutter, 1991). Typically, in college, the off-season is the most intense training period with a focus on enhancing strength and lean body mass, and the energy output in the off-season might be higher than in-season for some athletes. This leads to a greater gap between energy intake vs. energy expenditure. Previous research provides evidence that female athletes respond to nutritional education by making healthier dietary choices and improvement in their dietary practice (Abood et al., 2004). The importance of nutritional education to inform female athletes on how the body uses energy as fuel and what can happen in a state of negative energy balance is important. Stellingweff and colleagues (2011) examined what to eat in the different phases of the training season with different volume and intensity, and suggested that the energy intake should follow the intensity and volume of training and be continuously adjusted and adapted on an individual basis.

Heaney and colleagues (2011) completed an extensive literature review to evaluate whether nutritional education enhances the athlete's nutritional knowledge and if the athletes would make better food choices and have a more adequate dietary intake thereafter. The authors concluded that there is a need for further research in this area, as this review only provided weak evidence that nutritional knowledge of athletes is potentially greater than non-athletes. Other studies conducted on nutritional knowledge and attitudes in athletes showed that athletes are open for nutritional education to enhance their eating habits for improved performance (Nutter, 1991). A study by Long and colleagues (2001) found that time was the core factor for food choices in male collegiate football players. Since student-athletes are required to plan, purchase and prepare their own food within an already busy schedule, it is easy to buy ready-to-go foods, such as microwave meals and so forth. Another factor that plays a role in the athletes' food choices was that eating healthy is more expensive. This study also showed that student athletes

would benefit from a nutritional education class that teaches the athlete to eliminate barriers, obstacles and excuses and provides examples of ways to plan meals so the athlete can bring the foods with them. Providing the tools for behavior modification making sure they get an adequate and balanced diet may be more effective than nutritional education alone (Long et al., 2001).

Summary:

In summary, this literature review suggests further investigation on the effect of nutritional education in creating energy balance, improvement in body composition and self-efficacy among athletes, especially female athletes. Evidence suggests that female athletes are vulnerable to having a negative energy balance throughout the year, especially in the off-season, as social pressure and individual desires to be thin are very high (Shriver et al, 2013; Nutter, 1991; Schilling & Nikta, 2008). Previous research shows that nutritional education classes may improve the way athletes look at food and how to fuel their body for optimal performance, recovery and most importantly health.

CHAPTER II
METHOD

The purpose of the present study was to investigate if the nutritional education class, Fueling for Performance (FFP) would improve female collegiate athletes energy intake vs. energy expenditure. A total of 24 D1 female collegiate athletes in the off-season participated in the 9-week study that started the week of January 13th and ended March 10th, 2014. Two female athletic teams were randomized, with one team serving as the experimental group receiving the nutritional education class, FFP, and the other team serving as the control group receiving no treatment. The control group was offered the nutrition education class after completion of the study.

Participants:

Two female NCAA D1 off-season athletic teams were chosen to participate. Both teams were chosen in the off-season to, as closely as possible, match the training intensity and daily energy expenditure of each other. The participants consisted of 24 female D1 athletes ranging from freshman to seniors. One team was randomly selected through a drawing to receive the nutritional education intervention of FFP, and the other team had the control condition of no intervention. An inclusion criterion for participation in this study was to be on the roster of the two female athletic teams chosen for this study. The team's chosen were doing similar off-season training with similar intensity and duration, which is why these teams were chosen.

Measures:

The female athletes participated in several measurements to assess the Fueling for Performance intervention. Specifically, energy intake, energy expenditure, self-efficacy and anthropometric measurements were taken. The measurements were obtained at baseline, prior to intervention, and after the 6-week intervention. The research took a total of 9 weeks and started the week of January 13th, 2014

Energy Intake:

Magkos & Yannakoulia (2003) reviewed different methods to assess dietary intake among athletes. It was shown that the most common way to assess dietary intake among athletes is a 3 day food record where the participants are asked to record all their food and beverage intake, and amount of intake on specific days. A limitation of using this method is under- and over- estimating the portion sizes. In the present study, a licensed dietitian provided a comprehensive education on how to better estimate portion sizes to reduce the limitation of under- and over- estimation of the portion sizes. In the present study, information of the participant's energy intake was collected through a 3-day food record (Wednesday, Thursday and Saturday) and entered into My Plate SuperTracker by usda.gov. My Plate SuperTracker is an online health management service designed to provide dietitians, other health care providers as well as individuals with the tools they need to manage nutrition and physical activity (usda.gov, 2014). The researchers entered the participant's 3-day food record in SuperTracker and gathered the participants analyzed food records to record the athlete's energy intake. See Appendix C.

Energy Expenditure:

Energy expenditure was measured by having the athletes wear the Sensewear Pro Armband (BodyMedia Pittsburg, PA), which has been used in several peer reviewed publications, research and clinical studies (sensewear.bodymedia.com). The participants wore the armband the same 3 days they recorded their food and beverage intake (Wednesday, Thursday and Saturday) and the total daily energy expenditure was averaged. The armband was worn on an adjustable elastic belt on the triceps of the non-dominant arm, and measured sedentary behavior (0 METS), moderate (≥3 METS), and vigorous (≥6 METS) physical activity. To make sure we collected the participants 24-hr energy expenditure, each participant put the armband on the night before they started the food record, and took the armband off the morning after they ended recording their food. The participants also took the armband off when showering or swimming. The Sensewear Pro Armband data was used to provide the participants energy expenditure.

Anthropometric Measures:

Anthropometric measures were taken, where weight was measured on a scale (Seca Corp, Model 876, Hamburg, Germany), and height was measured on a stadiometer (Seca Stadiometer, Model 213, Hamburg, Germany). Girth measurements of neck, wrist, forearm, upper arm, chest, waist, abdomen, upper hip, hip, lower hip, thigh and calf were measured with a tape measure using the average score of three measures at each site for our data collection. Measurements were taken in a private area at the meeting location. See Appendix F.

Body composition was assessed using the Jackson/Pollock 3-site fat caliper method measuring skinfold thickness measured to the nearest mm. The measurements for the

Jackson/Pollock 3-site caliper method was taken using Lange Skinfold Caliper pinching at the right side of the body: mid triceps, iliac crest and mid thigh. Three measures were taken on each site and the mean of these scores were recorded for our data collection. The participants mean skinfold thickness measure was entered and converted to body fat %, lean weight and fat weight on: http://www.linear-software.com/online.html. Measurements were taken by the same researcher pre- and post- tests in a private area at the meeting location. See Appendix F.

Self-efficacy:

As stated in the literature review, a female athlete's diet is often influenced by the society's norm of valuing a thin body (Nutter, 1991; Abood, Black & Birnbaum 2004; Shriver, Betts & Wollenberg, 2013). Claims are that mental function plays a role in regard to nutrition, and nutritional enhancement can be achieved with behavioral assessments (Schmitt, Benton & Kallus, 2005). Bandura (1977) suggests that high self-efficacy perception in individuals increase their ability for a successful change in behavior or completing of a task. As Fueling for Performance is a nutrition education program aimed to create a balanced lifestyle, the participants completed 7 self-efficacy questions using a Likert 5-point scale for answering the questions. The questions were developed based on Bandura's article (1977). The answers were analyzed to see whether Fueling for Performance improves the participant's self-efficacy for specific dietary behaviors. See Appendix E.

Procedures:

The coaches were contacted and informed about the study and asked for approval for their team to participate before the teams were contacted. The coaches also signed an agreement form that allowed us to talk with the teams (Appendix A). When the athletes showed up to the first meeting, the week of January 13th (Monday for the control group and Tuesday for the experimental group), they were asked to wear a T-shirt and shorts. The researchers explained the purpose of the research study, the study objectives, provided an overview of how much time and responsibilities the study would require, and explained the criteria to participate. The athletes who were not on the team roster, or not interested in participating, were asked to leave. The athletes who stayed comprised our study groups. All participating athletes completed an informed consent form (Appendix B I and B II). The athletic compliance office and the Institutional Review Board at the University of North Dakota approved the study protocol prior to initation.

First, the participants were provided an explanation of how to determine serving sizes and asked to complete the "homework" of a 3-day food record recorded on two weekdays and one weekend day (Wednesday, Thursday and Saturday). Participants were then shown the Bodymedia Senswear Device and instructed how to use it. Athletes were told to put on the Bodymedia Senswear Device the night before they started the food record, and to take the armband off the morning after they ended recording their food to ensure we got the energy expenditure over a full 24-hour period. The participants then completed a self-efficacy questionnaire (Appendix E). The participants in the experimental group also completed a needs analysis as part of the FFP curriculum. The researchers assigned a due date for the 3-day food records and Bodymedia Senswear device to be handed in (Monday week 2 for the experimental

group and Monday week 3 for the control group). Before the participants left, the facilitators conducted the anthropometric measures of height, weight, age, and girth measurements of neck, wrist, forearm, upper arm, chest, waist, abdominal, upper hip, hip, lower hip, thigh and calf. Lastly, the researchers conducted skinfold measurements using Lange Skinfold Caliper and the Jackson/Pollock 3-site fat caliper method pinching the right side of the body on mid triceps, iliac crest and mid thigh. The first meeting took about 1.5 hrs for both groups.

The experimental group handed in their 3-day food record and Senswear Pro Armband in their coaches' office for the researchers to collect Monday in week 2. The control group handed in their 3-day food record and Senswear Pro Armband Monday in week 3. Tuesday of week 2, the 6-week nutritional education class started for the experimental group. The curriculum for FFP is explained later in this section.

The researchers handed out the last "homework" Tuesday in week 7 for the experimental group and Monday in week 8 for the control group. The "homework" consisted of asking the participants to complete another 3-day food record and wearing of the Bodymedia Senswear device (the recordings were taken on Wednesday, Thursday and Saturday). The same day, the participants also completed the same self-efficacy questionnaire, data collection of anthropometric measures and body composition. The participants in the experimental group handed in the 3-day food record and Bodymedia Senswear device to their coach, Monday of week 8. The control group handed in the 3-day food record and Bodymedia Senswear device to their coach, Monday of week 9.

When the researchers collected the last data from the participants, the researchers also thanked the participants their participation. The control group was also offered the nutritional

education class in the future. Table 1 provides a timeline outlining the research study and data collection.

Table 1: Timeline:

Week:	**Experimental Group:**	**Control Group:**
Week 1	Meeting the group to educate participants on serving sizes and collect baseline data: - 3-day food record (Give assignment) - Bodymedia Senswear data (Give assignment) - Self-efficacy survey - Needs analysis - Anthropometric measures - Body composition measurements	
Week 2-6:	**Week 2:** Collection of 3-day food record and Bodymedia Senswear data. **Week 2-6:** - Intervention of Fueling for Performance for the experimental group described in the procedure section starts.	**Week 2:** Meeting the group to educate participants on serving sizes and collect baseline data: - 3-day food record (Give assignment) - Bodymedia Senswear data (Give assignment) - Self-efficacy survey - Anthropometric measures - Body composition measurements **Week 2-6:** - No intervention
Week 7:	Week 6 of Fueling for Performance and Post Data Collection of: - 3-day food record (Give assignment) - Bodymedia Senswear data (Give assignment) - Self-efficacy survey - Anthropometric measures - Body composition measurements	
Week 8:	- Collection of 3-Day food record and Bodymedia Senswear data	Post Data Collection of: - 3-day food record (Give assignment) - Bodymedia Senswear data (Give assignment) - Self-efficacy survey - Anthropometric measures - Body composition measurements
Week 9:		- Collection of 3-Day food record and Bodymedia Senswear data

Fueling for Performance Description:

Fueling for Performance (FFP) (Westereng, Langei & Dagfinrud, 2010) is an offshoot of the lifestyle program Healthy Creations (Westereng & Langei, 2005) for weight loss and weight management. FFP is a 6-week nutrition education class designed to educate participants on proper nutrition and exercise based on My Plate and USDA dietary guidelines, ACSM activity guidelines, as well as providing tools for cognitive-behavior modification. The curriculum of FFP is delivered using the teaching-learning approach of telling, showing and practicing to optimize learning and understanding of the material. Facilitators provide athletes with support, motivation and accountability to reach their performance goals. FFP also includes a needs analysis to determine personal goals prior to starting intervention.

A licensed dietitian recommended the daily caloric intake based on the participants Bodymedia Senswear Data (energy expenditure data) and the participant's goals and needs. The daily caloric reccomendations were divided and balanced out between the food groups of: grains, vegetables, fruits, diary, meats, oils and discretionary calories. The athlete's learned how to track their foods to meet the recommended daily caloric intake in a balanced manner. Participants were also trained how to look at foods, read labels and eliminate barriers, obstacles and excuses so they can plan ahead and make sure they reach their daily recommendations and understand why that is necessary.

Fueling for Performance Curriculum:

Week 1:

Nutrition: The participants received individual recommendations of daily calorie intake based on the 3-day Bodymedia Sensewear data collection. The participants found their daily calorie level

for each food group through a table of calories and food groups. The participants then took their tracking sheet and highlighted a set number of boxes for their balanced dietary intake. Each box had a different caloric value depending on the food group. The facilitator then talked about meal plan examples from different caloric levels and gave examples of foods that could be chosen at different times of the day. The facilitator also explained how to read food labels and how to track those foods on the tracking sheet. Additionally the facilitators provided a list of the most common foods and how to track those.

- The participants were asked to track their current food intake.

Behavior modification: Facilitator discussed cognitive practice with a focus on self-talk and how words create pictures, which create feelings, which create beliefs, which create actions.

- The participants were asked to write one positive action everyday.

Week 2:

Behavior modification: The class started out with an assignment with the focus on thinking outside the box. The facilitator also talked about how to stay active in a world of technology and how these choices affect the daily energy output.

- The participants were asked to continue to write one positive action every day and identify the feeling the action gave.

Nutrition: The facilitator discussed the importance of hydration and provided the participants with a hydration plan to create a picture of one way to stay hydrated throughout the day. The discussion was then turned over to the topic of how to gain healthy weight without gaining excess body fat. An overview of how to create a healthy weight loss without loosing lean mass was also given, as well as a discussion of how snacks can help you gain and loose weight.

- The participants were asked to follow the hydration plan and to eat a carbohydrate and protein snack 1-2 hours before exercise, and another carbohydrate and protein snack within 30 minutes of exercise.

Week 3:

Nutrition: The facilitators discussed the importance of carbohydrates and gave a review of the benefits of whole grains and how to include more whole grains in the participant's diet. There was also a discussion of the importance of breakfast and sharing of breakfast ideas and strategies.

- The participants were asked to eat at least 3 whole grains each day and mark the tracking sheets with a "W" to indicate the whole grain. The participants were also asked to eat breakfast everyday.

Behavior modification: The focus for behavior modifications was on identifying barriers, obstacles and excuses, and determine how to handle them next time.

- The participants were asked to identify a situation and to determine if it was a barrier, obstacle or excuse. The participants were also asked to come up with a plan of how to react to the situation next time.

Week 4:

Nutrition: The facilitator discussed the benefits of fruits and vegetables as well as ideas on how to include more fruits and vegetables in their daily diet. There was also a discussion of the importance of a nutritional lunch and different strategies on how to plan a well-balanced lunch.

- The participants were asked to eat at least 5 servings of fruits and vegetables with the goal of reaching the amount of fruits and vegetables in individual meal plan. Additionally, they were asked to eat breakfast and lunch everyday.

Behavior modification*:* Week 4 focused on how physical activity affects weight loss and the importance of eating enough. The focus was on metabolism and individual calorie allowance that needs to be reached every day for regular body functioning purposes. Caloric deficiency should be created by physical activity. The facilitator explained the Stimulus-Response Chain and what affects the momentum to eat healthy and stay active vs. out of control eating and inactivity.

Week 5:

Nutrition: The facilitator discussed the role and importance of proteins in the body. The participants were also given a review on the different types of protein and how to choose lean sources. The importance of a nutritional dinner was stressed, and ideas and strategies on how to prepare the meal were also provided. The facilitator discussed the importance of dietary fat and body fat.

- The participants were asked to choose lean sources of protein and to reach the individual meal plans amount of protein. The participants were also asked to choose healthy oils and to eat dinner every day.

Behavior modification: The 7 individual pillars of progress were the topic for week 5. The facilitator talked about how the physical, emotional, social, educational, spiritual, environmental and occupational factors play a role in the choices one makes. The facilitator had the participants identify how participating in FFP affected these pillars using an “I am statement”.

- Participants were challenged to write a behavior statement for each pillar using an "I will" statement.

Week 6:

Nutrition: The facilitator went through strategies for eating on the road, reinforced hydration and reviewed meal timing and planning.

Behavior modification: The curriculum for week 6 was focused on self-monitoring of eating habits and physical activity. The facilitator explained how self-monitoring and self-awareness of the choices one makes are keys to change of behavior, which will determine results. The facilitator went over the "pillar challenge" from last week and also helped the participants set smart goals for future success.

Data Analysis:

A paired t-test was used to examine intra-group differences at baseline for energy balance and body composition variables. Following the paired t-test, an Univariate Analysis of Covariance (ANCOVA) adjusting for baseline values was used to examine inter-group changes in energy balance and body composition from pre- to post-test.

A Chi square analysis was used to examine differences at baseline for the six self-efficacy questions. Following Chi square analysis, a Log-linear ANOVA was used to examine inter-group changes in self-efficacy.

CHAPTER III
RESULTS

Twenty-two female collegiate D1 athletes completed all the measurements, reaching 92% of the pre-intervention sample (n=24). Two participants from the control group did not match the participation criteria of being on the team roster when we collected our post-test measurements.

Table 2 illustrates the pre-and post-intervention differences, and changes between groups for each measured variable. Participants had a mean age of 19.8 (*SD=1.2*), 89% were Caucasian and 11.1% ethnic minorities. At the time of the study, all participants were in the off-season and had similar training opportunities.

Table 2: Participant Adjusted Means (SD) Pre-Test, Post-Test

	Fueling for Performance N=10		**Control N=12**			
Variable	**Pre Mean (SD)**	**Post Mean (SD)**	**Pre Mean (SD)**	**Post Mean (SD)**	**Adjusted difference (SE)**	**p**
Kcal input	1755.60 (469.83)	2010.50 (388.94)	1892.25 (549.41)	1901.25 (392.14)	150.21 (159.16)	0.35
Kcal output	2565.67 (261.15)	2907.00 (138.21)	2529.08 (273.60)	2866.75 (326.41)	18.59 (119.96)	0.88
Energy Balance	-810.07 (459.90)	-896.50 (405.90)	-636.83 (721.80)	-965.50 (671.00)	-131.62 (206.81)	0.58
Body Composition:						
- Weight	70.57 (6.20)	71.85 (6.15)	65.30 (4.96)	65.93 (4.98)	0.81 (0.63)	0.21
- Body Fat Percentage	22.60 (3.39)	19.30 (3.22)	24.54 (4.05)	25.40 (3.48)	-4.65 (0.80)	<0.001*
- Lean Weight	54.47 (3.25)	58.18 (3.90)	49.16 (3.01)	49.06 (3.06)	3.80 (0.86)	<0.001*
- Fat Weight	16.10 (3.69)	14.00 (3.34)	16.14 (3.54)	16.83 (3.10)	-2.79 (0.58)	<0.001*

Note. *Mean Change = post – pre; * = Significant at p < .05*

Table 3: Chi Square Analysis for Self-Efficacy Variables

Variable	Fueling for Performance N=10		Control N=12		p
	Pre Mean (SE)	Post Mean (SE)	Pre Mean (SE)	Post Mean (SE)	
Self-efficacy:					
- Eat breakfast	3.40 (0.58)	4.50 (0.67)	3.92 (0.57)	4.25 (0.59)	0.51
- Eat to be better athlete	4.30 (0.66)	4.30 (0.66)	4.08 (0.58)	4.25 (0.59)	0.89
- Eat 5 servings FV each day	3.00 (0.55)	4.00 (0.63)	3.58 (0.55)	3.58 (0.55)	0.38
- Eat protein and carb BEFORE exercise	3.40 (0.58)	3.90 (0.62)	3.67 (0.55)	3.67 (0.55)	0.66
- Eat protein and carb snack AFTER exercise	3.70 (0.61)	4.00 (0.63)	3.67 (0.55)	3.50 (0.54)	0.69
- Drink enough water to stay hydrated	4.30 (0.66)	4.10 (0.64)	4.17 (0.58)	3.33 (0.53)	0.56

Note. *Mean Change = post – pre; * = Significant at p < .05*

Energy Balance:

We looked at calorie input vs. calorie output pre- and post-test to find the energy balance. The experimental group increased their caloric (energy) intake by 254.90 kcal (1755.60 kcal pre-test to 2010.50 kcal post-test), while the control group increased their caloric intake 9.0 kcal (1892.25 kcal pre-test to 1901.25 kcal post-test), however this was not statistically significant (*p=0.35*).

The experimental group increased their calorie output by 341.33 kcal (2565.67 kcal pre-test to 2907.00 kcal post-test), while the control group increased their caloric output 337.67 kcal (2529.08 kcal pre-test to 2866.75 kcal post-test), this was not statistically significance either (*p=0.88*).

After the 6-week research study, the experimental group was less calorically imbalanced compared to the control group (-116.2 kcal, *p=0.58*), however the difference was statistically significant. The experimental group's mean pre- and post- experiment calorie balance was -880.70, and -896.50 calories, respectively. The control group's mean pre- and post- experimental

calorie balance was -636.83 and -965.5 calories, respectively. Thus, there was no statistical difference between groups for calorie balance.

Body Composition:

The experimental group's mean pre- and post- experiment weight was 70.57 kg and 71.85 kg, respectively. The control group's mean pre- and post- experiment weight was 65.30 kg and 65.93 kg, respectively. The change in weight was not statistically significant ($p=0.21$). The experimental group's increase in weight was a result of an increase in lean weight as explained in the following section.

The experimental group significantly decreased their body fat percentage compared to the control group (-4.20%, $p<0.001$). The experimental groups mean pre- and post- experiment body fat percentage was 22.60% and 19.30%, respectively. The control groups mean pre- and post-experiment body fat percentage was 24.55% and 25.40%, respectively.

The experimental group significantly increased lean weight compared to the control group (+3.80 kg, $p=<0.001$). The experimental groups mean pre- and post- experiment lean weight was 54.47 kg and 58.18 kg, respectively. The control groups mean pre- and post-intervention was 49.16 kg and 49.06 kg, respectively.

The experimental group significantly decreased fat weight compared to the control group (2.79 kg, $p=<0.001$). The experimental groups pre- and post- experimental fat weight was 16.10 kg and 14.00 kg, respectively. The control groups pre- and post- fat weight was 16.14 kg and 16.83 kg, respectively.

Self-Efficacy:

There were no statistical significant changes from pre-test to post-test in the self-efficacy questionnaire. The experimental group had a slight increase in their confidence in 4 of the 6 self-efficacy questions: to eat breakfast (*change=1.10, p=0.51*), to eat 5 servings of fruits and vegetables everyday (*change=1.0, p=0.38*), to eat a carbohydrate and protein snack before exercise (change=0.50, p=0.66) and to eat a carbohydrate and protein snack after exercise (*change=0.30, p=0.69*) increased with the intervention.

The last two of the six self-efficacy constructs did not have a significant effect either, although there was a negative change in both experimental- and control- groups confidence to drink enough water to stay hydrated (*change=0.63, p=0.22).* Additionally, there was an insignificant positive change in the control group's confidence to eat to be a better athlete (*change=0.17, p=0.89*).

CHAPTER IV
DISCUSSION

Nutrition education of collegiate athletes is a fertile area for future research as there is not a lot of research available (Abood et al., 2004). More so for female athletes as studies show that female athletes are at a higher risk than males and non-athletes to develop an eating disorder, due to the social pressure of a perfect, thin body (Furnham et al., 2002).

The primary aim for the present study was to investigate whether collegiate female athletes who gained appropriate nutritional knowledge through the nutritional education program, Fueling for Performance, would become more aware of the needs for an adequate diet resulting in meeting energy needs compared to the control group receiving no treatment. The secondary aim examined whether the nutrition education group gained positive changes in body composition and self-efficacy compared to the control group.

Energy Balance:

Participants in the experimental group increased their mean energy expenditure by 341.33 kcal from pre test (2565.67 kcal) to post test (2907.00 kcal), compared to the control group's mean energy expenditure, which increased 337.67 kcal from pre test (2529.08 kcal) to post test (2866.67 kcal). Typically, there is an increase in energy intake when you see an increase in exercise-induced energy expenditure (Westerterp, 2010), meaning that an increase in energy expenditure typically increases the individual's energy intake. The present study found that both

group's mean energy balance was reduced (experimental group pre-test: -880.70 kcal to post-test: -896.50 kcal, control group pre-test: -636.83 kcal to post-test: -965.5 kcal), where the increase in a negative energy balance was greater in the control group than in the experimental group (116.2 kcal). Other studies also found similar effects after an increase in energy expenditure, but not necessarily in energy intake: Blundell & King (1999) found that only 19% of interventionist studies report an increase in energy intake after an increase in exercise, 65% show no change and 16% show a decrease in appetite. Similarly, Shriver and colleagues (2013) examined dietary intake and eating habits of female collegiate athletes and showed that nearly all participants failed to meet their energy needs. Thus, this study is one of the first to develop an intervention that targets female athlete's energy balance. While this study was unable to significantly increase energy intake to meet energy expenditure, this study found positive body composition and self-efficacy changes, where self-efficacy affects the nutritional behavior, which in turn may affect body composition (Rayane et al., 1997).

Body Composition:

Both the experimental and control group increased their weight from pre-to post-test (experimental group: +1.28 kg, control group: 0.63 kg). The greater increase in weight for the experimental group was a result from an increase in lean weight, as the experimental group's body fat percent decreased 3.30%, their lean weight increased 3.71 kg, while their fat weight decreased 2.10 kg. The weight gain in the control group was a result from an increase in fat weight, as the control group's body fat percentage increased 0.85%, their lean weight decreased 0.10 kg, and their fat weight increased 0.69 kg. This statistically significant difference in body

fat percentage, as well as lean and fat weight indicates that the FFP nutritional education program was successful at improving body composition.

The present study is similar to a study done by Deutz and colleagues (2000) that evaluated energy balance and body composition in 20 runners and 42 swimmers, all whom were on the national team or nationally ranked. Their study suggests that daily energy deficiency is associated with higher body fat percentage in both aerobic and anaerobic elite athletes due to a possible reduction in the resting energy expenditure (REE). In the present study, the control group's greater energy deficiency may have resulted in a negative change in body composition compared to the experimental group.

Athletes have unique needs for their training and competition, thus, tailoring their macronutrient needs individually is especially important. Daily strategies that tailor athlete's macronutrient consumption will make it possible for athletes to reach their goals for training, competition and weight management (Rosenbloom, 2006., Slater et al., 2011., Stellingwerff et al., 2011). The difference of the positive gains in body composition for the experimental group versus the control group may have been due to a more balanced diet throughout the 6-week nutritional education class, as tracking their daily energy intake and handing in their individual tracking sheet at every weekly meeting was a part of the class.

Self-Efficacy:

There were no statistical significant changes from pre-test to post-test in the self-efficacy questionnaire. The experimental group had a slight increase in their confidence regarding eating breakfast, 5 servings of fruits and vegetables everyday, a carbohydrate and protein snack before exercise and a carbohydrate and protein snack after exercise for pre- to post- intervention.

Research has shown that eating breakfast, as well as a pre-workout and a post-workout meal consisting of both carbohydrates and protein are crucial for fueling your body for practice as well as for recovery after practice (Hausswirth & Le Meur, 2011). Although it is well known that protein needs are higher for athletes, there is recent interest in the timing of protein to maximize muscle mass gains (Rosenbloom, 2006). The present study suggests that FFP may improve self-efficacy, similar to other studies showing that nutritional education increases the athletes understanding of the value of dietary habits role to enhance performance and promote health (Zawila et al., 2003; Abood et al., 2004; Shriver et al., 2013).

Strengths:

This study has several strengths. First, the present study is a novel study that involved two female collegiate D1 athletic teams. Second, many studies recommend and support the use of nutritional education for female athletes due to their hypocaloric tendencies (Shriver et al., 2013; Abood et al., 2004; Zawila et al., 2003; Long et al., 2001), thus a key strength is that this is one of the first studies using an intervention approach to improve dietary habits that ultimately lead to better performance. Third, teams were randomly selected to experimental or control condition, thus, eliminating bias. Last, the curriculum, Fueling for Performance was developed and delivered by experts in the field of nutrition and behavior change.

Limitations:

This study is not without several limitations. First, we selected two different sports teams from the same university, which may have limit our results as we were unable to examine athletes from the same sport. Second, we used a small sample size. Third, both teams were in the

off-season to match training intensity, however, we did not monitor the strength and conditioning workouts. As the athlete's participated in two different sports, the strength and conditioning programs could possibly have had a different focus. Fourth, when completing the measure of the body composition, the researcher did not measure the distance and calculate the mid point on the triceps, supra iliac and thigh. Last, we did not analyze macronutrients, which are an important factor because we may have improved overall macronutrient intake, but not overall energy intake. This is consistent with other research that has shown that macronutrients play an important role in body composition. For example, an increase in protein and animal products are associated with weight gain and growth (Allen et al, 1992).

Future Studies:

Previous studies highly recommend future research looking at the effects of nutritional education for the female athlete population, as an energy deficient diet over time can lead to the female athlete triad, as well as other eating disorders (Abood, Black & Birnbaum, 2004; Shriver, Betts & Wollenberg, 2013; The Female Athletic Triad Coalition, 2013). As previous literature highly recommends further research in the field of female athletes and their diet, the present study's results suggest that female athletes struggle with a negative energy balance, and the Fueling for Performance curriculum may be one avenue to improve energy balance.

Future research studies should take into consideration the use of a greater sample size as well as using same sport athletes as each sport has different energy requirements and intensities. Future studies would also benefit from having a longer intervention, or a follow-up test to see the long-term effects of the intervention.

Conclusion:

Several studies recommend further research on the topic of female athletes and dietary intake due to the number of female athletes having a negative energy balance (Abood et al, 2004., Heaney, 2011., Shriver et al. 2013). The present study underlined the calorie deficiency of female athletes in the off-season. This is noteworthy, as a sufficient energy intake not only provides enough energy to optimize practice and recovery, but also to have a healthy body. This study illustrates that the nutritional education class, Fueling for Performance, may be a good way to improve dietary habits, body composition, and self-efficacy in collegiate female athletes.

APPENDICES

APPENDIX A
COACHES AGREEMENT FORM

THE UNIVERSITY OF NORTH DAKOTA
CONSENT TO PARTICIPATE IN RESEARCH

Title:	Effect of a Nutrition Program on Eating Habits in Female Collegiate Athletes
Project Director:	Jorid Dagfinrud Oiestad
Advisor:	Tanis Hastmann, PhD, MPH
Facilitators:	Becky Westereng, Chris Langei
Phone #:	(701)-740-0206
Department:	Kinesiology

We are doing a research study with the purpose to investigate if a nutritional education class will make a difference in female athletes diet in the off-season when it comes to energy input vs. energy output.

Your team is invited to be in this research study about female athletes and nutrition in the off-season because they are Female Division 1 Athletes in the off-season when I will be collecting my data. There will be approximately 50 Division 1 Female Athletes taking part in this 9 week long study starting the week of January 13th running through the week of March 10th. There will be one experimental group receiving the nutritional education class, and one control group receiving no treatment. The control group will be offered the nutrition education class after the study is done.

If you agree to have your team take a part in this study, we will ask them to:

1. On the 1st meeting (about 1.5hr), THEY will:
   - Learn how to estimate portion sizes and real foods for them to easier and more accurate record what they eat and drink for 3 days
   - Learn how to wear the BodyMedia SenseWear device to measure their energy output
   - Complete a survey on self-efficacy
   - Provide measures for body composition and anthropometric measures

2. On the 2nd meeting (about 10 min), THEY will:
   - Hand in the Bodymedia SenseWear device

3. On the 3rd -7th meeting (about 30-40 min), THEY will:
   - Participate in a 30-40 minute class once a week to learn about the different nutrients and how they provide energy for your body
   - Learn about how you look at foods and how you can eliminate barriers, obstacles and excuses to reach their goals

4. On the 7th meeting (about 1 hr total), THEY will also:
   - Be asked to record their food intake for 3 more days and wear the BodyMedia SenseWear
     Device the same 3 days as they record their food to look at their energy intake and output
   - Complete a self-efficacy survey
   - Provide measures for body composition and anthropometric measures

5. On the 8th meeting (about 10 min), THEY will:
   - Hand in the BodyMedia SenseWear device

We will plan the meetings around the athletes schedule to make it the most convenient for them, as we understand they are training and are going to school.

Now, we want to tell you about some things that may happen if you choose to let your team participate.

Participation and confidentiality:

Participation in the study is voluntary. All of the information that will be collected is confidential and confidentiality will be maintained as permitted by law. If this study gets published, your athletes will not be identified. Any information that is obtained in this study and that can be identified with them will be kept confidential and will only be disclosed with their permission. This information will only be available for the researcher and facilitators. After the study, there will be a report written about what we found out. I will not use any names in my report. The participants may choose to withdraw at any time during this study and their decision whether or not to participate will not affect their current and future relations with the team and/or the University.

Potential benefits and concerns:

The participants might feel uncomfortable when we measure body composition as we use the skinfold method to do so. There will be a feeling of a little pinch. This study will also take some spare time, as we will meet 8 times throughout the 8 weeks. The 1st meeting will be the longest with about 1.5 hr, the 2nd-7th meeting will be about 30 min once a week with the 7th about 1 hr, and meeting 8 about 10-15 minutes.

What do the participants benefit from this study?

They will get a free nutritional education class that is taught by a Nutritionist at Altru Health System, Becky Westereng and Fitness Manager at Choice Health and Fitness, Chris Langei. By completing the class, they will learn the understanding on how the different foods work to fuel their body for optimal performance as well as they will be provided a healthy plan to reach their goals no matter what they are when it comes to build muscle, lean out, and lose fat.

Questions/comments:

This project WILL BE approved by the Institutional Review Board at the University of North Dakota (701-777-4279). They will be able to answer any questions you have about your rights when participating in this study. If you have any other questions about this study, please contact Jorid Dagfinrud Oiestad (701-740-0206)

If you approve your team to be a part in this study, please sign your name:

_____

Print Your Name

_____ _____

Sign Your Name Date

APPENDIX B I
PARTICIPANTS INFORMED CONSENT FORM (Experimental Group)

THE UNIVERSITY OF NORTH DAKOTA
CONSENT TO PARTICIPATE IN RESEARCH

Title:	Effect of a Nutrition Program on Eating Habits in Female Collegiate Athletes
Project Director:	Jorid Dagfinrud Oiestad
Advisor:	Tanis Hastmann, PhD, MPH
Facilitators:	Becky Westereng, Chris Langei
Phone #:	(701)-740-0206
Department:	Kinesiology

STATEMENT OF RESEARCH

A person who is to participate in the research must give his or her informed consent to such participation. This consent must be based on an understanding of the nature and risks of the research. This document provides information that is important for this understanding. Research projects include only subjects who choose to take part. Please take your time in making your decision as to whether to participate. If you have questions at any time, please ask.

THE STUDY

You are invited to be in a research study about female athletes and nutrition in the off-season because you are a Division 1 female athlete in the off-season. There will be approximately 50 Division 1 Female Athletes taking part in this 8 week long study starting the week of January 13th running through the week of March 10th here at the University of North Dakota.

The purpose of this research is to investigate if a nutritional education class will make a difference in female athletes diet in the off-season when it comes to energy input vs. energy output.

If you want to take a part in this study, we will ask you to:

1. On the 1st meeting (about 1.5hr), YOU will:
    - Learn how to estimate portion sizes and real foods for you to easier and more accurate record what you eat and drink for 3 days
    - Learn how to wear the BodyMedia SenseWear device to measure your energy output
    - Complete a survey on self-efficacy
    - Provide measures for body composition and anthropometric measures

2. On the 2nd meeting (about 10 min), YOU will:
    - Hand in the Bodymedia SenseWear device

3. On the 3rd -7th meeting (about 30-40 min), YOU will:
    - Participate in a 30-40 minute class once a week to learn about the different nutrients and how they provide energy for your body
    - Learn about how you look at foods and how you can eliminate barriers, obstacles and excuses to reach your goals

4. On the 7th meeting (about 1 hr total), YOU will also:
    - Be asked to record your food intake for 3 more days and wear the BodyMedia SenseWear Device the same 3 days as you record your food to look at your energy
      intake and output
    - Complete a survey on self-efficacy
    - Provide measures for body composition and anthropometric measures

5. On the 8th meeting (about 10 min), YOU will:
    - Hand in the BodyMedia SenseWear device

Now, we want to tell you about some things that may happen if you choose to participate.

Participation and confidentiality:

Participation in the study is voluntary. All of your information that will be collected is confidential and confidentiality will be maintained as permitted by law. If this study gets published, you will not be identified. Any information that is obtained in this study and that can be identified with you will be kept confidential and will only be disclosed with your permission. This information will only be available for the researcher and facilitators. After the study, there will be a report written about what we found out. I will not use your name in my report. You may choose to withdraw at any time during this study and your decision whether or not to participate will not affect your current and future relations with the team and/or the University.

Potential benefits and concerns:

You might feel uncomfortable when we measure your body composition as we use the skinfold method to do so. You will feel a little pinch. This study will also take some of your spare time, as we will meet 8 times throughout the 8 weeks. The 1st meeting will be the longest with about 1.5 hr, the 2nd-7th meeting will be about 30 min once a week with the 7th about 1 hr, and meeting 8 about 10-15 minutes.

What do I benefit from this study?

You will get a free nutritional education class that is taught by a Nutritionist at Altru Health System, Becky Westereng and Fitness Manager at Choice Health and Fitness, Chris Langei. By completing the class, you will learn the understanding on how the different foods work to fuel your body for optimal performance, as well as you will be provided a healthy plan to reach your goals no matter what they are when it comes to build muscle, lean out, and lose fat.

Questions/comments:

This project WILL BE approved by the Institutional Review Board at the University of North Dakota (701-777-4279). They will be able to answer any questions you have about your rights when participating in this study. If you have any other questions about this study, please contact Jorid Dagfinrud Oiestad (701-740-0206)

If you want to be a part in this study, please sign your name:

_____

Print Your Name

_____ _____

Sign Your Name Date

APPENDIX B II
PARTICIPANTS INFORMED CONSENT FORM (Control Group)

THE UNIVERSITY OF NORTH DAKOTA
CONSENT TO PARTICIPATE IN RESEARCH

Title:	Effect of a Nutrition Program on Eating Habits in Female Collegiate Athletes
Project Director:	Jorid Dagfinrud Oiestad
Advisor:	Tanis Hastmann, PhD, MPH
Facilitators:	Becky Westereng, Chris Langei
Phone #:	(701)-740-0206
Department:	Kinesiology

STATEMENT OF RESEARCH

A person who is to participate in the research must give his or her informed consent to such participation. This consent must be based on an understanding of the nature and risks of the research. This document provides information that is important for this understanding. Research projects include only subjects who choose to take part. Please take your time in making your decision as to whether to participate. If you have questions at any time, please ask.

THE STUDY

You are invited to be in a research study about female athletes and nutrition in the off-season because you are a Division 1 female athlete in the off-season. There will be approximately 50 Division 1 Female Athletes taking part in this 8 week long study starting the week of January 13th running through the week of March 10th here at the University of North Dakota.

The purpose of this research is to look into female athletes dietary habits in the post season.

If you want to take a part in this study, we will ask you to:

1. On the 1st meeting (about 1.5hr), YOU will:
    - Learn how to estimate portion sizes and real foods for you to easier and more accurate record what you eat and drink for 3.
    - Learn how to wear the BodyMedia SenseWear device to measure your energy output
    - Complete a survey on self-efficacy
    - Provide measures for body composition and anthropometric measures

2. On the 2nd meeting (about 10 min), YOU will:
    - Hand in the BodyMedia SenseWear device

3. On the 3rd meeting (about 1 hr total), YOU will:
    - Be asked to record your food intake for 3 more days and wear the BodyMedia SenseWear

      Device the same 3 days as you record your food to look at your energy intake and output
    - Complete a survey on self-efficacy
    - Provide measures for body composition and anthropometric measures

4. On the 4th meeting (about 10 min), YOU will:
    - Hand in the BodyMedia SenseWear device

Now, we want to tell you about some things that may happen if you choose to participate.

<u>Participation and confidentiality:</u>

Participation in the study is voluntary. All of your information that will be collected is confidential and confidentiality will be maintained as permitted by law. If this study gets published, you will not be identified. Any information that is obtained in this study and that can be identified with you will be kept confidential and will only be disclosed with your permission.

This information will only be available for the researcher and facilitators. After the study, there will be a report written about what we found out. I will not use your name in my report. You may choose to withdraw at any time during this study and your decision whether or not to participate will not affect your current and future relations with the team and/or the University.

Potential benefits and concerns:

You might feel uncomfortable when we measure your body composition as we use the skinfold method to do so. You will feel a little pinch. This study will also take some of your spare time, as we will meet 4 times throughout the 8 weeks. The 1st meeting will be the longest with about 1.5 hr, the 2nd and 4th meeting will be about 10 min, and the 3rd meeting about 1 hr.

What do I benefit from this study?

You will gain an awareness of what you eat and drink to fuel your body compared to your energy output. This may help you to improve your dietary intake.

Questions/comments:

This project WILL BE approved by the Institutional Review Board at the University of North Dakota (701-777-4279). They will be able to answer any questions you have about your rights when participating in this study. If you have any other questions about this study, please contact Jorid Dagfinrud Oiestad (701-740-0206)

If you want to be a part in this study, please sign your name:

_____

Print Your Name

_____ _____

Signature Date

APPENDIX C
3-DAY FOOD AND BEVERAGE RECORD FOR CALORIC INTAKE

Title:	Effect of a Nutrition Program on Eating Habits in Female Collegiate Athletes
Project Director:	Jorid Dagfinrud Oiestad
Advisor:	Tanis Hastmann, PhD, MPH
Facilitators:	Becky Westereng, Chris Langei
Phone #:	(701)-740-0206
Department:	Kinesiology

Please write in what you eat and drink estimating the portion sizes you learned at the meeting. Please write each meal/snack in the separate boxes, what time you ate the meal/snack and what time you practice that day. Please enter the foods and beverages in Nutrihand as shown in class.

Example of a food record is listed on next page.

E.g.:

Day: Wednesday ID #:

Workout/Practice time: 9:30 am-11:00 am

Time/Occasion	Description of food/beverage	Amount
6:00am / Breakfast	- Yoplait yogurt vanilla reduced-fat - Quaker Old Fashion Oatmeal - 2% milk	- 6 oz - ½ cup - 1 cup
8:50 am / Snack	- Sara Lee Whole wheat bread - Jiff Peanut butter - Strawberry jelly - Powerade	- 2 slices - 2 Tbs - 1 Tbs - 12 oz
12:30 / lunch	- Pasta - Hamburger - Red sauce - Lettuce - Hidden Valley Ranch Dressing - Sprite	- 1 ½ cup - 3 oz - ½ cup - 1 cup - 1 Tbs - 8 oz
2:00/ Snack	- Caribou: White Chocolate Mocha	- Medium
6:00/Dinner	- Soft shells - Lettuce - Tomato - Chicken - Sour Crème - Salsa - Water	- 2 Medium - ½ cup - ¼ cup - 3 oz - 2 tbs - 3 tbs - 8 oz

Day: ID #:

Workout/Practice time:

Time/Occasion	Description of food/beverage	Amount

APPENDIX D
ENERGY INTAKE vs. ENERGY EXPENDITURE FORM

Participants ID #:	**Pre-Intake:**	**Pre-Expenditure:**	**Pre-Balance:**	**Post-Intake:**	**Post-Expenditure:**	**Post-Balance:**

APPENDIX E
SELF-EFFICACY SURVEY

Part I. Please write your age and circle one of the options of the following questions:

Age:_____

i. Race/Ethnicity: White African American Asian Pacific Islander

Hispanic Other

ii. Smoker: Yes No

iii. Dominate hand: Left Right

Part II. Please read each item and circle the number that best describes your level of confidence regarding the item.

	Not sure at all		Somewhat sure		Very sure
a) How sure are you that you can eat breakfast everyday?	1	2	3	4	5
b) How sure are you that you can eat to become a better athlete?	1	2	3	4	5
c) How sure are you that you can eat at least 5 servings of fruits/vegetables each day?	1	2	3	4	5
d) How sure are you that you can eat a protein and carbohydrate snack before exercise?	1	2	3	4	5
e) How sure are you that you can eat a protein and carbohydrate snack after exercise?	1	2	3	4	5
f) How sure are you that you can drink enough water to stay hydrated?	1	2	3	4	5

APPENDIX F
BODY COMPOSITION AND ANTHROPOMETRIC MEASURE
DATA COLLECTION FORM

Effect of a Nutrition Program on Eating Habits in Female Collegiate Athletes

Athlete Data Collection Cover Sheet

Athletes Name:_____

Athletes ID:	**Age:**
Date of Pre Test:	**Date of Post Test:**

Skinfold Test	**Pre Test:**				**Post Test:**				**Change:**
Measure #	**1**	**2**	**3**	**A**	**1**	**2**	**3**	**A**	
Height									
Weight									
Triceps									
Suprailiac									
Thigh									
Body fat %									
Lean weight									
Fat weight									
Girth Measures	**Pre Test:**				**Post Test:**				**Change:**
Measure #	**1**	**2**	**3**	**A**	**1**	**2**	**3**	**A**	
Neck									
Wrist									
Forearm									
Upper arm									
Chest									
Waist									
Abdominal									
Hip									
Lower hip									
Thigh									
Calf									

REFERENCES:

Abood, D A., Black, D R., Birnbaum, R D. (2004) Nutritional education for college female athletes. *Journal of Nutritional Education Behavior.* (36);135-139.

ACSM Position Stand Slideshow. (2007). Retrieved March 3, 2013, from http://www.femaleathletetriad.org/wpcontent/uploads/2010/03/FATC_Slideshow_2011.pdf

Allen, L. H., Backstrand, J. R., Stanek III, E, J., Pelto, G. H., Chavez, A., Molina, E., Castillo, J. B., Mata, A. (1992). The interactive effects of dietary quality on the growth and attained size of young mexican children. *The American Journal of Clinical Nutrition.* 56(2)353-364.

Bandura, A. (1977) Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review.* 84(2);191-215.

Blundell, J. E., King, N. A. (1999). Physical activity and regulation of food intake: current evidence. *Medicine & Science in Sports and Exercise. 31(11):573-583.*

Borgen, J.S. (1994). Risk and trigger factors for the development of eating disorders in female elite athletes. *Medicine and Science in Sports and Exercise. 26(4):414-419.*

Buchholz, A., Mack, H., McVey, G., Feder, S., Barrowman, N. (2008) Bodysense: An evaluation of a positive body image intervention of sports climate for female athletes. *Eating Disorders.* 16:308-321.

Furnham, A., Badmin, N., Sneade, I. (2002). Body image dissatisfaction: Gender differences in eating attitudes, self esteem and reasons for exercise. *Journal of Psychology. 136(6), 581-596.*

Hausswirth, C., Le Meaur, Y. (2011). Physiological and nutritional aspects of post exercise recovery. Specific reccomendations for female athletes. *Sports Medicine.* 41(19),861-882.

Heaney, S., O'Connor, H., Michael, S., Gifford, J., Naughton, G. (2011). Nutrition knowledge in athletes: a systematic review. *International Journal of Sport Nutrition and Exercise Metabolism.* 21, 248-261.

Jonnalagadda, S. S., Ziegler, P. J., Nelson, J. A. (2004). Food preferences, dieting behaviors, and body image perceptions of elite figure skaters. *International Journal of Sports Nutrition and Exercise Metabolism.* 14, 564-606.

Long, D., Perry, C., Unruh, S. A., Lewis, N., Stanek-Krogstrand, K. (2011). Personal food systems of male collegiate football players: a grounded theory investigation. *Journal of Athletic Training.* 46(6):688-695.

Magkos, J., Yannakoulia, M. (2003). Methology of dietary assessment in athletes: concepts and pitfalls. *Current Opinion in Clinical Nutrition and Metabolic Care.* 6, 539-549.

National Association of Anorexia Nevrosa and Associated Disorders. (2013). Retrieved March 3, 2013, from http://www.anad.org/get-information/about-eating-disorders/eating-disorders-statistics/

National Eating Disorders Association. (2013). Retrieved February 28, 2013, from http://www.nationaleatingdisorders.org/get-facts-eating-disorders

Nutter, J. (1991). Seasonal changes in female athletes diets. *International Journal of Sports Nutrition.* 1; 395-407.

Raatz, S., Combs, G. (2011). Healthy creations: community based lifestyle intervention validation.

Rosenbloom, C. (2006). Fueling athletes: facts versus fiction on feeding athletes for peak performance. *Nutrition Today.* 41(5):227-232.

Rayane, A., Achterberg, C. (1997). Review of self-efficacy and locus of control for nutrition and health-related behavior. *Journal of the American Dietetic Association.* 97(10):1122-1132.

Schilling, L., Nikita, M. (2008). What coaches need to know about the nutrition of female high school athletes: a dietitian's perspective. *Strength and Condition Journal.* 30:5, 16-17.

Schmitt, J. A. J., Benton, D., Kallus, K. W. (2005). General methodological considerations for the assessment of nutritional influences on human cognitive functions. *Euro Journal Nutrition.* 44:459-464

SensWear. (2013). Retrieved April 28, 2013, from http://link.springer.com/article/10.1007/s00421-010-1695-0

SenseWear. (2013). Retrieved April 28, 2013, from http://www.linear-software.com/online.html

Shriver, L. H., Betts, N. M., Wollenberg, G. (2013). Dietary intakes and eating habits of college athletes: are female collegiate athletes following the current sports nutritional standards? *Journal of American College Health.* 61(1),10-16.

Slater, G., & Phillips, S. M. (2011). Nutrition guidelines for strength sports: sprinting, weightlifting, throwing events, and bodybuilding. *Journal of Sports Sciences.* 29(1),67-77.

Stellingweff, T., Maughan, R. J., & Burke, L. M. (2011). Nutrition for power sports: middle-distance running, track cycling, rowing, canoeing/kayaking and swimming. *Journal of Sports Science.* 29(1), 79-89.

The Female Athletic Triad Colation. (2013). Retrieved February 28, 2013, from http://www.femaleathletetriad.org/wp-content/uploads/2010/03/Final_Hoogenboom_Public_Flyer-10.pdf

U.S. Anti-doping Agency. (2010). Retrieved March 3, 2013, from http://usada.discoveryeducation.com/DietaryIntake.pdf

USDA SuperTracker. (2014). Retrieved March 12, 2014, from: https://www.supertracker.usda.gov/

Volek, J. S., Forsythe, C. E., Kraemer, W. J. (2006). Nutritional aspect of women strength athletes. *Br. Journal of Sports Medicine.* 40(9):742-748.

Westerterp, K. R. (2010). Physical activity, food intake, and body weight regulations: insights from doubly labeled water studies. *Nutrition Reviews 68(3):148*

Wilmore, J. H., Costill, D. L., Kenney, L. K. (2008). *Physiology of Sport and Exercise.* Champaign, IL: Human Kinetics 4th edition.

Zawila, L. G., Steib, C-S. M., Hoogenboom, B. (2003). The female collegiate cross-country runner: nutritional knowledge and attitudes. *Journal of Athletic Training.* 38(1), 67-74.