# DIETARY PROTEIN VERSUS SUPPLEMENTAL PROTEIN IN COLLEGIATE FOOTBALL ATHLETES

By

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# ABSTRACT

Purpose**:** The purpose of this study was to determine if muscle hypertrophy and strength gains in athletes can be equally attained through dietary protein intake versus protein supplementation. Methods**:** Performance measures, body composition, and blood lipids were compared in redshirt football players who completed an eleven week protocol of either protein supplementation (S, n=6, 28 grams 3x/week) versus whole food protein (NS, n=9, 8-28 grams 3x/week). Subjects completed two 3-day diet records to determine nutrient intake. Results**:** Both groups reported meeting their protein requirements, but caloric intake was below the recommendation. Similar increases (P=0.003) in lean body mass were measured in the S (pre 72.2 ± 6.6, post 73.0 ± 6.3 kg) and NS groups (69.3 ± 8.6, post 70.9 ± 8.8 kg). No significant differences were found between the two groups in performance variables. For example, bench press increased (P=0.01) from 251 ± 32 to 264 ± 36 pounds in the S group and from 245 ± 26 to 256 ± 28 in the NS group. Conclusion**:** Both S and NS groups consumed on average at least the recommended protein intake and protein supplementation did not offer any performance or anabolic advantage over whole food protein.

# CHAPTER 1

# INTRODUCTION

Collegiate athletes are pressured and almost expected to use protein supplementation when involved in training. The use of additional supplementation shows a serious commitment to their sport. Although supplementation is unnecessary (Kerksick et al., 2006; Lemon, 1995; Nemet, Wolach, & Eliakim, 2005; Phillips, 2004), coaches and teammates alike encourage its use to create “an edge” over their opponents (Phillips, 2004). The misconception involving protein supplementation is that the dietary means of meeting the established protein requirements can be difficult and even impossible without incorporating protein supplementation. Many athletes believe that protein supplements are the magic bullet that will increase their lean body mass while improving their overall performance.

Incoming freshmen football players are encouraged to increase their weight and lean body mass. These athletes compensate for the required weight gain by integrating a higher caloric diet. Freshmen athletes generally live on campus and are limited to the food choices offered by campus food service. Their diets are often low in fruits and vegetables, and high in fatty food choices and simple carbohydrates (Cole et al., 2005). Due to their desire to gain weight, athletes consume as much food as possible without receiving nutritional counseling from a qualified source (Cole et al., 2005; Jonnalagadda, Rosenbloom, & Skinner, 2001). The long term consequences of their eating habits are overlooked to meet the short-term goal of weight gain, athletic performance, and the ability to play at the collegiate level.

Endurance and body building athletes are thought to have higher protein requirements due to their increased activity level. The current RDA for dietary protein for a sedentary individual is 0.8-1.0 g/kg of body weight or 15-20% of the total daily caloric intake (American Dietetic Association, 2000b). Through the research studies of Lemon and Tarnopolsky, it has been determined that the protein requirements for body building athletes are within the range of 1.4-1.8 g/kg/day (Lemon, 1995; Lemon, Tarnopolsky, MacDougall, & Atkinson, 1992; Nemet, Wolach, & Eliakim, 2005; Tarnopolsky et al., 1992; Tarnopolsky, MacDougall, & Atkinson, 1988). Due to these increased needs, many athletes have turned to protein supplements to meet and exceed this range (Applegate & Grivetti, 1997).

Protein is important in the daily processes within the body. Protein is made up of amino acids (aa), which are the building blocks for new tissue formation. Vital processes within the body could not continue without a well functioning protein metabolism to promote maintenance and growth. Protein is responsible for the formation of digestive enzymes, which make it possible to breakdown and absorb nutrients we have consumed (Lemon, 2000). Protein is the backbone of hormone and enzyme production, tissue maintenance, cell membrane formation, and the production of pump transporters within the cell membrane. Protein can also be used in the formation of new glucose molecules (gluconeogenesis) when liver and skeletal muscle stores are depleted.

Although athlete's bodies are physically trained through their daily and weekly workouts, nutrition education is often overlooked in their sports training (Cole et al., 2005; Jonnalagadda, Rosenbloom, & Skinner, 2001). Coaches and teammates within the athletic community encourage the use of protein supplementation to support the development of lean body mass, strength, speed, and skill (Phillips, 2004). Many individuals remain unclear on what their protein requirements are. This can lead to the consumption of elevated protein levels through the use of supplemental shakes and bars. Dietary protein, found within whole food sources, is a natural and more complete way for athletes to achieve their protein requirements. Through nutrition education and training, athletes would understand how to meet their needs through better food choices. A well balanced diet offers additional health benefits that they may not receive through protein supplementation.

Protein supplements are often used after exercise training to enhance physical adaptations and future performance. The use of a carbohydrate/protein supplement has been shown to improve glycogen resynthesis, lean body mass, and overall performance (Esmarck et al., 2001), but no research has observed at the use of whole food protein sources versus protein supplementation. The current research will observe the effects of nutrition education and post exercise utilization of whole food protein sources versus protein supplementation. By employing individualized nutrition education, the athlete will have more control of their health, performance, and longevity for many years to come.

## Statement of the Problem

The purpose of this study is to determine if muscle hypertrophy and strength gains in the Montana State University redshirt football players can be equally attained through dietary protein intake versus protein supplementation.

## Research Hypothesis

We hypothesize there will be no difference between the nutrition educated non-supplemented group and the protein supplemented group in the measures of strength and muscle hypertrophy.

## Delimintations

There were two primary delimitations to this study.

1. This study is restricted to male football athletes attending Montana State University.
2. The age range for these subjects is limited to 18-19 years of age.

## Limitations

1. The results of this study cannot be generalized to any other athlete type. Additionally, the results may only reflect the geographical area of Montana.
2. The results of this study cannot be generalized for any other gender or age group (18-19 year old males).

# CHAPTER 2

# LITERATURE REVIEW

Due to the many important functions of protein in the body, it has become a significant topic in research. Protein is of utmost importance to the athletic community due to its role in anabolic processes that improve athletic performance and muscle development. Up to this point, protein supplementation has been used to increase the intake of daily protein. There are many theories as to why protein supplementation is effective. Coaches and athletes are looking to scientific community to provide evidence to support or refute these theories. When looking at protein supplementation, it is important to understand the functions of protein, observe current dietary protein requirements, the types and dosages used, timing of administration, improved athletic performance associated with protein supplementation, protein safety, advantages of protein use, necessity, cost, and athlete's knowledge regarding this nutrient.

## Functions of Protein

During higher intensity exercise, the body's main source of energy is glucose (Gibala, 2007; Lemon, 2000). There is limited storage of glycogen (the storage form of glucose) within the liver and skeletal muscles of the body. Glycogen stores can easily be depleted during one single bout of exercise (Lemon, 2000). Although protein is not the most ideal energy source, it can be used to generate new glucose within the liver for adenosine triphosphate (ATP) production. If an individual is not meeting their daily energy requirements, the need for dietary protein increases. The increased protein requirement occurs as a result of limited glucose intake. The body tries to maintain the basic daily protein metabolic functions, while utilizing some protein for gluconeogenesis (Lemon, 2000).

Protein is used in the formation of new lean muscle mass. This process occurs during periods of exercise recovery not during times of activity. For the best results, an athlete should consume adequate caloric intake, replenish their glycogen stores with appropriate carbohydrate intake during and post exercise, and consume the recommended protein requirements to maintain a positive nitrogen balance. Proteins within the body are continuously being synthesized and degraded (Gropper, Smith, & Groff, 2005). The degradation of proteins generates ammonia, $CO_2$, $H_2O$, and ATP. Working muscles during exercise will increase the amount of ammonia produced due to elevated protein catabolism. The liver is responsible for converting the more poisonous ammonia molecule to a less destructive urea molecule that can be excreted from the body in urine and sweat (Gropper, Smith, & Groff, 2005).

Amino acids are the building blocks of individual proteins important in the formation of enzymes, hormones, neurotransmitters, transport proteins such as albumin, and amino acids help with the maintenance of fluid and acid-base balance (Gropper, Smith, & Groff, 2005; Hoffman & Falvo, 2004; M. H. Williams, 1999). Protein is also used in the development of blood tissues, skeletal muscle, bone, ligaments, and tendons (Gropper, Smith, & Groff, 2005). Amino acids are composed of carbon (C), hydrogen (H), oxygen (O), and nitrogen (N) (Fink, Burgoon, & Mikesky, 2006). Due to this arrangement, many amino acids can be converted to pyruvate (a precursor to glucose), and are transported to liver to be used for gluconeogenesis (Gropper, Smith, & Groff, 2005). Other amino acids can be converted into the Krebs Cycle intermediate Acetyl CoA for ATP production (Gropper, Smith, & Groff, 2005).

There are two classifications of amino acids; essential and non-essential. Nine amino acids are essential. This means they must be consumed in the diet because they are not made by the body. The essential amino acids include the three branched chain amino acids; 1) leucine, 2) isoleucine, and 3) valine, as well as 4) histidine, 5) lysine, 6) methionine, 7) phenylalanine, 8) threonine, and 9) tryptophan (Fink, Burgoon, & Mikesky, 2006). The branched chain amino acids can be used directly by the working muscles for energy production. The amino acids that are non-essential (they can be made by the body) include; 1) alanine, 2) arginine, 3) asparagine, 4) aspartic acid, 5) cysteine, 6) glutamic acid, 7) glutamine, 8) glycine, 9) praline, 10) serine, and 11) tyrosine (Fink, Burgoon, & Mikesky, 2006). As previously discussed, amino acids are the building blocks for many of the body’s vital tissues, hormones, and enzymes. Amino acids can be used to generate glucose within the liver during gluconeogenesis to help maintain adequate energy production for the working muscles during exercise.

The three branched chain amino acids (BCAA), leucine, isoleucine, and valine, have been used in a supplement to help prevent fatigue. The central fatigue theory states long bouts of exercise lower the concentration of BCAA in the blood plasma. As muscle glycogen stores diminish over time, BCAA are taken into the muscle cells to be oxidized for glucose production (Gropper, Smith, & Groff, 2005). Tryptophan competes with BCAA for binding sites within the brain. As the ratio of tryptophan to BCAA increases within the blood plasma, more tryptophan crosses the blood brain barrier and binds to the brain receptors. Tryptophan is converted to serotonin, which has a sedative effect, thus causing fatigue (Armsey & Grime, 2002). Due to the increased presence of trypotophan within the brain, fatigue is thought to occur more quickly. Branched chain amino acids have been supplemented into the diet to counteract this sedative effect. More research is required to determine if BCAA actually decrease fatigue and counteract the central fatigue theory.

Individual amino acids have been supplemented into an athlete's diet for many different purposes. Supplements including individual amino acids such as arginine, lysine, and ornithine are said to increase the formation and release of human growth hormone and insulin (M. H. Williams, 1999). These hormones are associated with storage and growth enhancement. For this reason, athletes have been known to use these amino acids when they are trying to increase their size. The presence of glutamine decreases in the plasma during prolonged exercise. It is supplemented into the diet to help maintain a healthy immune function. Glycine can be added to protein supplements, or taken individually, to promote creatine formation. Creatine is used as a supplement to help with the regeneration of adenosine triphosphate (ATP) from adenosine diphosphate (ADP). Tryptophan supplementation has been used to help athletes with their tolerance of pain during and after exercise, and has helped some patients with chronic pain. The use of tryptophan supplementation counteracts the supplemental use of branched chain amino acids when used to offset the central fatigue theory.

## Protein Requirements

The Recommended Daily Allowance (RDA) for protein has been established at 0.8 grams of protein per kilogram of body weight (American Dietetic Association, 2000a, 2000b). The RDA was designed to cover the basal protein requirements of the general population (Estimated Average Requirement), plus two standard deviations. This level of protein consumption is said to cover 97.5% of the population and their protein needs (Phillips, 2006). Adequate protein consumption would offer an individual enough protein for optimal functioning of all protein requiring metabolic processes, while maintaining an acceptable urea production level (Phillips, 2006).

Research confirms athletes do require more protein than sedentary individuals (Fogelholm, 2003). The recommendation for strength athletes ranges between 1.2-1.8 grams of protein per kilogram body weight (g/kg) (Hoffman & Falvo, 2004; Lemon, 1994, , 1995, , 1997, , 2000; Lemon & Proctor, 1991; Lemon, Tarnopolsky, MacDougall, & Atkinson, 1992; Tarnopolsky et al., 1992; Tarnopolsky et al., 1997; Tarnopolsky, MacDougall, & Atkinson, 1988; Tipton & Wolfe, 2004), while endurance athletes should ingest 1.2-1.4 g/kg (Armsey & Grime, 2002; Fogelholm, 2003; Lemon, 1995, , 2000; Lemon, Tarnopolsky, MacDougall, & Atkinson, 1992; Tarnopolsky et al., 1992; Tarnopolsky et al., 1997; Tarnopolsky, MacDougall, & Atkinson, 1988). Because athletes generally consume a higher calorie diet than most sedentary individuals, they generally meet their protein requirements without trying (Lawrence & Kirby, 2002; Tipton & Wolfe, 2004). Fifteen to twenty percent of their total daily caloric intake should come from protein sources. Athletes should have no problem meeting their protein requirement unless their diet is insufficient in energy intake (Lemon & Proctor, 1991). Due to the high cost of supplements ($12 billion in 1998, sport supplements sales $800 million sales in 1998), it would be cost effective to review the athlete’s current diet to determine if supplements are necessary (Armsey & Grime, 2002).

Total energy requirements for the individual athlete will be higher than a sedentary person due to an increased physical activity. Energy and protein requirements must be fulfilled for an athlete to perform at their highest potential. When caloric intake is inadequate, the muscle will be catabolized and used for necessary energy. This breakdown occurs in correspondence to the body's need for continued enzyme production and maintenance of organ structures within the body (Lemon, 2000). Under these conditions, the body will use the muscle, which is not essential to survival, to meet the requirements not being met through dietary intake. In this circumstance, the athlete's performance and health will be negatively affected.

## Protein Quality

There are varying levels of protein quality found within whole food sources and protein supplements. Animal protein (Fink, Burgoon, & Mikesky, 2006; Gropper, Smith, & Groff, 2005) and soy (Mateos-Aparicio, Redondo Cuenca, Villanueva-Suarez, & Zapata-Revilla, 2008) protein sources are considered complete proteins because they contain all the essential amino acids. Examples of complete protein sources include soy beans, milk, yogurt, cheese, eggs, meat, fish, and poultry. Most plant protein sources are considered incomplete proteins because they contain some, but not all of the essential amino acids. Plant protein sources are generally considered low quality protein sources (Fink, Burgoon, & Mikesky, 2006; Gropper, Smith, & Groff, 2005). Incomplete protein sources include grains, vegetables, legumes, and cereal. Although many plant protein sources are considered low quality, they do offer additional benefits. Plants sources, including soy protein, are low in saturated fat, high in fiber, and offer flavonoids that are not found in animal protein sources (Mateos-Aparicio, Redondo Cuenca, Villanueva-Suarez, & Zapata-Revilla, 2008).

The quality and purity of protein supplementation is not regulated by any governmental agency. This is due to the Dietary Supplement Health and Education Act of 1994. It is currently the responsibility of the supplement manufacturer to regulate the content, purity, and marketing of their product. This will continue to be their responsibility as long as they do not claim to treat, cure, or prevent disease (Armsey & Grime, 2002). The quality of a protein supplement also depends on the type of protein used in the supplement. Animal protein offers the highest quality of protein available. Animal protein is considered a complete protein due to the presence of all the essential amino acids (Hoffman & Falvo, 2004). Whey protein, which is found in milk, is the most widely recognize protein found in supplements. Whey protein is the clear portion of the milk that is removed during the cheese making process. It is high in essential amino acids and branched chain amino acids (Hoffman & Falvo, 2004).

The whey protein purification process determines the quality of whey found in protein supplements. There are three main types of whey protein; 1) whey powder, 2) whey concentrate, and 3) whey isolate. Whey powder is not purified, and it is often used as a food additive or recipe ingredient. Whey concentrate goes through a purification that removes water, lactose, ash, and some minerals (Hoffman & Falvo, 2004). The whey protein concentrate is most often found in sport supplements. Whey isolate is the purest form of whey. The whey isolate has had all the fat and lactose removed and contains 90% protein. Although this type whey protein is the purest form, some of the proteins can be denatured through the manufacturing process, thus making them unusable by the body (Hoffman & Falvo, 2004).

Casein protein makes up 70-80% of the protein found in milk, and is another protein used within protein supplements (Hoffman & Falvo, 2004). This protein is high in the amino acid glutamine, which helps with immune function and the maintenance of muscle (Scammell, Vergouwen, & Thimister, 2003). One of the benefits to casein protein is its ability to form a gel in the stomach, which slows the release of amino acids into the blood stream (Hoffman & Falvo, 2004). Due to this slow release, the nitrogen retention within the body is improved, and the utilization of the nitrogen increases the body's ability to promote growth and healing (Hoffman & Falvo, 2004; Scammell, Vergouwen, & Thimister, 2003).

## Protein Dosage and Types of Supplementation

Determining individual protein requirements is done simply, but the consumption of varying levels of protein can alter caloric intake and increase confounding variables within research. The RDA for protein intake is 0.8-1.0 g/kg of bodyweight for sedentary individuals (American Dietetic Association, 2000a, 2000b; Evans, 2004; Lemon, 2000). This amount of protein generally falls within a diet consisting of 50-60% carbohydrate (CHO), 20-35% fat, and 15-20% protein. Protein doses within the collected literature varied from as little as a single dose of 10 g of protein per day (Esmarck et al., 2001), up to three servings per day of differing levels of protein. Participants ingesting a single 10 g dose of protein were only receiving 14% of their daily protein requirements (Esmarck et al., 2001). Although 10 g of additional protein is not a huge amount, the participants in this study were still under the RDA for sedentary individuals. This presented a greater problem because these subjects had entered a study that was interested in observing muscle hypertrophy in an elderly population. Because subjects were not meeting their protein requirements, growth and hypertrophy could have been limited (Esmarck et al., 2001).

Studies utilizing higher doses of protein had diverse confounding variables associated with elevated caloric intake within their protein supplement. Participants consuming a highly concentrated protein supplement three times per day were also encouraged to eat their regular daily diet. The protein supplement offered 7.9 kcal/kg, 1.3 g CHO/kg (carbohydrate per kilogram), and 0.7 g protein/kg (Kraemer, Volek, Bush, Putukian, & Sebastianelli, 1998). This supplement averaged of 50 g of protein and 600 kcal per serving. Each supplement also supplied subjects with 50-1000% RDA of all essential vitamins and minerals (Kraemer, Volek, Bush, Putukian, & Sebastianelli, 1998). This elevated nutrient content is of concern due to the researcher's inability to determine what ultimately caused the experimental effect. By the participants ingesting an increased caloric diet and an extremely high level of vitamins and minerals, it is unclear which variable would have an effect on the research outcome. In this case, the researchers were looking at three consecutive days of resistance weight training, protein supplementation, and hormone response. There were several additional variables within the protein supplement that may alter results than just the increased level of protein.

Researchers observing the effect of protein supplementation on their human subjects have many different methods for administering their protein supplement. Observed protein dosages include a standardized protein load of a single 40 g dose of protein, which was a blend of casein, milk and whey proteins (Derave et al., 2003), to a twice daily administration of an amino acid mixture of 3.6 g per serving (Ohtani, Maruyama, Sugita, & Kobayashi, 2001). Other researchers individualized the administered protein supplement based on the study subject's body mass. Protein supplementation within these studies ranged from 1.1-2.2 g/kg/d of protein including dietary food sources (Ballard, Clapper, Specker, Binkley, & Vukovich, 2005) to a continuous protein supplementation throughout a six hour activity offering 0.25 g/kg/h (Koopman et al., 2004).

Individualized levels of protein between subjects are often of concern when administering protein supplements within research. If the rate of administration is not based on body mass, it is much more difficult to determine how relevant the protein intake is in relation to the outcome of the research. On the other hand, some researchers have concluded that a set rate standardization of protein administration and energy consumption is much more important. Based on concerns of differing caloric intake between participants and how an increase in caloric intake could alter results, the researchers who focused on a non-individualized protein supplementation were able to limit their confounding variables in relation to differing caloric intake.

Picking the right supplement for research is extremely important due to protein availability, protein quality, and what protein types are more readily absorbed within the body. Researchers must determine what combination of macronutrients (protein, carbohydrate, and fat) are appropriate for their research and decide if additional supplements, such as creatine, should be included in the research. Within the collected literature, the types of protein supplementation varied, while experimental design remained similar. Many authors attempted to distinguish between the effects of carbohydrate (CHO) and carbohydrate plus protein (CHO/pro) supplementation (Ballard, Clapper, Specker, Binkley, & Vukovich, 2005; Flakoll, Judy, Flinn, Carr, & Flinn, 2004; Ivy et al., 2002; Koopman et al., 2004; M. B. Williams, Raven, Fogt, & Ivy, 2003), while other research included fat within their supplement using a combination of CHO/Pro/Fat versus CHO versus placebo (Esmarck et al., 2001; Kraemer, Volek, Bush, Putukian, & Sebastianelli, 1998; Roy & Tarnopolsky, 1998; Tarnopolsky et al., 1997). One study chose to use only amino acid supplementation (Ohtani, Maruyama, Sugita, & Kobayashi, 2001), while another combined protein with creatine to determine if there was an enhanced effect (Derave et al., 2003).

As previously stated, many authors observed challenges within their research related to differing caloric levels within the supplements consumed by their subjects. Caloric levels were elevated in CHO/Pro supplements versus plain CHO, (Ivy et al., 2002; Roy & Tarnopolsky, 1998; Tarnopolsky et al., 1997). To correct for this problem, these authors added additional CHO to each serving, or supplemented additional fat to make the supplements isocaloric. To avoid confounding variables associated with differing caloric levels, the authors recommend using isocaloric protein supplements and placebos to observe the effect of protein on human subjects.

## Timing of the Protein Dose

The methodologies within the collected literature differ in regards to the timing of the protein dose. The timing and combination of macronutrients within a supplement can promote glycogen resynthesis, enhance recovery, and provide necessary building blocks for lean muscle mass. The varying methods include protein consumption post morning and evening meals (Ohtani, Maruyama, Sugita, & Kobayashi, 2001), to a half serving before and half after each workout (Kraemer, Volek, Bush, Putukian, & Sebastianelli, 1998). Kraemer et al. also had participants consume two more supplements throughout the day. Other studies administered a protein supplement right after their workout, and one hour later (Tarnopolsky et al., 1997).

To avoid confounding variables related to differing caloric intake, Roy et.al. gave the same distribution of all three of their nutritional supplements (Placebo versus CHO versus CHO/Pro/Fat) to each subject within the same day. The three different supplements offered either placebo, carbohydrate (CHO), or carbohydrate/protein/fat (CHO/Pro/Fat) to the designated treatment group right after exercise. In addition, each group consumed the other supplements at different times of day to equalize caloric intake. The placebo group was given the CHO/Pro/Fat supplement for breakfast, while the CHO group received the Pro/fat supplement, and the CHO/Pro/Fat group consumed the placebo (Roy & Tarnopolsky, 1998).

The timing of protein supplementation can have a profound effect on the recovery and anabolic changes that occur post exercise. According to Esmarck et.al., the timing of protein supplementation is crucial (Esmarck et al., 2001). Thirteen men between the ages of 70-80 were included in a study observing the effect of a protein supplement (combined with carbohydrate and fat) on muscle hypertrophy. Researchers were not only interested in the effect of the protein supplement, but in the timing of administration as well. Both groups underwent the same training program for a 12 week time period. One group (P0) took the protein supplement within five minutes of completing their workout. Group two

(P2) took their protein two hours post workout. Neither group consumed any other food within that two hour period. The P0 group increased their lean body mass from 54±2 kg to 55±3 kg, while the P2 subjects experienced a loss in lean body mass from 54±2 kg to 53±2 kg (Esmarck et al., 2001). Both groups increased dynamic strength during their 5 RM test, but only P0 increased in their isokinetic strength testing at 60 deg/s versus P2 respectively (24±9 versus 0±8 %) (Esmarck et al., 2001). Only the P0 group showed signs of hypertrophy and increased lean body mass. This study indicates that immediate consumption of protein is most effective in promoting hypertrophy.

The consumption of a protein supplement generates the best results if consumed immediately post exercise. Andersen et al. compared the differences between protein versus carbohydrate ingestion post exercise when they observed twenty two healthy young men (age 23.2 ± 0.6, height 184.5± 2.0 cm, weight 77.0 ± 2.6 kg) during a 14 week study (Andersen et al., 2005). Included subjects had not been involved in resistance training or supplemental use for at least six months prior to the start of this study. Participants performed three to four sets of the inclined leg press, knee extension, and hamstring curls three days a week for 14 weeks. The resistance of each exercise was increased to maintain 4-15 reps per set. Subjects ingested ½ L of water with either a carbohydrate (25 grams) or protein (25 grams) supplement immediately before and after each training session, with nothing else two hours before or two hours after the supplement ingestion (Andersen et al., 2005). The protein supplemented group increased their vertical jump by 9 ± 2%, type I fibers by 18%, and type II fibers by 26% (Andersen et al., 2005). The carbohydrate group had no significant changes.

Endurance and strength training exercise limits protein degradation while increasing protein synthesis (Phillips, 2006). After exercise, mRNA encoding is up-regulated to enhance protein production (Bianchi, Marzocchi, Agostini, & Marchesini, 2005). Ingesting a protein supplement and a carbohydrate source within one to two hours post exercise enhances glycogen synthesis and muscle hypertrophy (Fogelholm, 2003; Gibala, 2000). Peter Lemon suggests that a positive nitrogen balance combined with the anabolic stimulus of resistance training can explain the enhanced protein synthesis and reduced protein degradation that allows for greater muscle gains in the strength athlete (Lemon, 1991a).

## Protein Supplementation, Hypertrophy, and Performance in Athletes

Protein supplementation is highly correlated with an increase in muscle hypertrophy (Esmarck et al., 2001). Topics researched within the resistance training realm include the effect of protein supplementation on glycogen resynthesis after weight training (Roy & Tarnopolsky, 1998), glucose tolerance and GLUT-4 synthesis pre an post training (Derave et al., 2003), insulin-like growth factor-I in association with resistance training (Ballard, Clapper, Specker, Binkley, & Vukovich, 2005), and muscle hypertrophy (Esmarck et al., 2001). The theory of a post exercise protein supplement suggests there will be an increased availability of amino acids for muscle repair and expansion. With an increase in amino acid availability, post exercise recovery time will decrease (Flakoll, Judy, Flinn, Carr, & Flinn, 2004). Protein supplementation does not enhance muscle hypertrophy or the maintenance of muscle fibers without consistent training. If protein supplementation is used without training, an individual could be consuming unnecessary energy, which can ultimately lead to increased deposit of fat and decreased lean muscle mass due to inactivity.

Athletes consuming a protein supplement post exercise have been known to increase their muscle mass. To test hypertrophy changes as a result of protein supplementation, Esmarck et al. (2001) observed thirteen men (age, 74±1 years) during a twelve week (3 days per week) strength training program. Subjects in the P0 group received protein immediately following their training, while the P2 group received their supplement two hours later. A dual-energy x-ray absorptiometry (DEXA) machine was used to determine changes in body composition and bone density. A DEXA scan uses minimal radiation, and is a non-invasive technique that collects information about a participants bone density, lean body mass, and adipose tissue mass. The group who had immediate access to the protein supplement post exercise (P0) increased their lean body mass from 54±2 kg to 55±3 kg, while the subjects receiving protein two hours (P2) later experienced a loss in lean body mass 54±2 kg to 53±2 kg (Esmarck et al., 2001). Both groups increased their dynamic strength during their 5 RM test, but only P0 increased in their isokinetic strength testing at 60 deg/s versus P2 respectively (24±9 versus 0±8 %) (Esmarck et al., 2001). Protein supplementation post exercise improved muscle hypertrophy and strength measure gains.

## <u>Protein Supplementation and Endurance Trained Athletes</u>

The use of protein supplements can also enhance the training response of endurance trained athletes. Flakoll et al. (2004) observed the effect of CHO, CHO/pro supplements, versus placebo on post exercise muscle soreness, recovery, and the immune response of marine recruits during 54 days of basic training. Participants received either a CHO, CHO/pro supplement or placebo. Subjects completed self disclosure surveys to report their level of soreness, illness, and recovery from exercise. These CHO/protein supplemented group had 33% fewer visits to the base doctor, 28% fewer viral or bacterial infections, 37% fewer joint or muscle problems, and 83% fewer visits for heat exhaustion (Flakoll, Judy, Flinn, Carr, & Flinn, 2004). Marine recruits receiving the CHO/protein supplement reported lower rates of muscle soreness compared to those receiving a placebo or CHO supplement. Protein supplementation helps maintain a healthier immune system under stressful conditions, while decreasing muscle soreness (Flakoll, Judy, Flinn, Carr, & Flinn, 2004).

The use of protein supplementation post endurance exercise can improve insulin response, glycogen resynthesis, and the glucose response. Williams et. al. (2003) observed the difference of CHO/pro supplementation versus Gatorade on glycogen restoration post endurance exercise (M. B. Williams, Raven, Fogt, & Ivy, 2003). Individuals consuming the CHO/pro supplement had a 17% greater glucose response, a 92% greater insulin response, and a 128% greater glycogen storage versus the individuals using Gatorade (M. B. Williams, Raven, Fogt, & Ivy, 2003). Glycogen resynthesis improved post exercise in individuals consuming of CHO/pro versus CHO supplements (Ivy et al., 2002; Tarnopolsky et al., 1997). Ivy et al. (2002) used CHO/pro versus low CHO versus high CHO study design. Muscle glycogen was significantly higher in the individuals who received CHO/pro (88.8±4.4 mmol/L; P=0.004) versus low CHO (70.0±4.0 mmol/L; P=0.004) and high CHO (75.5±2.8 mmol/L; P=0.013) (Ivy et al., 2002).

## Food Versus Supplementation

Whole foods offer athletes their daily protein requirements without the use of supplementation. Many supplemental protein bars and shakes contain 5 to 30 grams of protein per serving (Beltz & Doering, 1993; Lawrence & Kirby, 2002). This amount of protein could easily be attained by making smart food choices that would offer many other nutritional benefits. For example, there are 30 grams of protein in half a medium chicken breast. This is a lean, high quality source of protein, which means it is more readily absorbed and utilized in the body. Animal sources offer the highest quality of protein (Hoffman & Falvo, 2004). They are considered complete proteins because they contain essential and non-essential amino acids. Animal proteins do contain higher levels of saturated fat, so it is important to choose lower fat cuts of meat.

It is possible to attain complete proteins through the mix/matching of vegetable protein sources (Gropper, Smith, & Groff, 2005). Combination eating can be done by mixing grains and legumes (beans and rice), a corn tortilla with pinto beans, whole grain pasta with peas, almonds and a tomato sauce, or whole grain toast with peanut butter. A diet incorporating rice, beans, tofu, nuts, seeds, and other vegetables can meet the protein requirements of an individual, but they must be educated and conscious of the foods they consume to achieve proper amino acid balance. Vegetable sources of protein, including soy, offer phytochemicals, flavonoids, and dietary fiber that maintain digestive regularity and intestinal health (Hoffman & Falvo, 2004; Mateos-Aparicio, Redondo Cuenca, Villanueva-Suarez, & Zapata-Revilla, 2008). By increasing vegetable and grain consumption, it is possible to increase protein consumption while decreasing fat intake (Mateos-Aparicio, Redondo Cuenca, Villanueva-Suarez, & Zapata-Revilla, 2008).

## Advantages of Protein Supplements

There are many concerns and risks associated with the use of protein supplements. On the other hand, high protein diets are associated with greater satiety and superior diet satisfaction versus low-protein diets (Phillips, 2006). For this reason, high protein diets have been used to help many individuals with weight loss (Bianchi, Marzocchi, Agostini, & Marchesini, 2005; Phillips, 2006). Other reasons for the use of protein supplements include the desire to increase muscle mass, increase weight, decrease body fat, increase athletic ability, and to help with injury or illness (Dorsch & Bell, 2005). Protein supplements can be used to supplement a diet if the individual is unable to consume enough energy through their diet alone (Dorsch & Bell, 2005). Benefits of high protein diets can be seen in individuals with liver disease who suffer from increased protein catabolism, as well as individuals who suffer from alcoholic liver disease (Hoffman & Falvo, 2004).

Protein supplements offer athletes the ability to consume their desired level of protein without increasing their consumption of total and saturated fat (Kerksick et al., 2006; Maughan, King, & Lea, 2004). Generally, these supplements are very easy to consume, and they store and travel well. Diets high in protein content are known to maintain satiety for longer periods of time, thus allowing individuals to feel satisfied (Bilsborough & Mann, 2006). Additional benefits to protein supplementation include psychological advantages. Not unlike the placebo affect, athletes and coaches mentally encourage the use of protein supplementation to give them a performance edge over their opponents. Protein supplements are often considered the “magic bullet” that increase lean muscle mass while improving overall performance.

## Safety of Protein Supplements

Adverse side affects can occur if an individual consumes more than 35% of their total caloric intake from protein. Such side effects include hyperaminoacidemia, hyperammonemia, hyperinsulinemia nausea, diarrhea, and death (Bilsborough & Mann, 2006). Another concern with the use of high protein diets and protein supplementation is the increased loss of calcium (Hayashi, 2003; Hoffman & Falvo, 2004). Calcium is often used as a buffer in the body to maintain homeostasis. With a highly acidic environment, due to high protein intake, the bone within the body is broken down for use of the calcium. According to Yuzo Hayashi, the administration of high levels of individual amino acids have been associated with growth retardation (glycine), hyperkalemia and hypermagnesemia (arginine), hypercholesterolemia and hepatomegaly (histidine), pancreatic damage and kidney enlargement (methionine), corneal lesions (tyrosine), and neurotoxicity (cysteine & glutamic acid). Protein levels between 20-35% have not been associated with these side effects (Hayashi, 2003).

Concerns of supplemental use arise when an individual ignores their diet and focuses solely on a supplement to enhance their performance and health. Excess protein is not stored in the body as amino acid, but is broken down into pyruvate, Acetyl CoA, and urea. Pyruvate can be used in the liver during gluconeogenesis for glucose production (Lemon, 2000), and Acetyl CoA can be stored as fat for later use (Gropper, Smith, & Groff, 2005). Urea is transported to the bladder and is excreted from the body as urine (Beltz & Doering, 1993). This is an energy requiring process that also causes water loss. Too much protein can lead to dehydration, gout, liver and kidney damage, calcium loss, and impaired absorption of essential amino acids (Beltz & Doering, 1993; Hoffman & Falvo, 2004; Lawrence & Kirby, 2002; Lemon, 1991b; Lemon & Proctor, 1991). Liver and kidney damage is generally seen in individuals who already are at risk for liver and kidney problems. There is no evidence to suggest that strength athletes have and increased incidence of kidney failure (Lawrence & Kirby, 2002; Lemon & Proctor, 1991). Other risks of high protein diets can include elevated blood lipid profiles if the use of animal sources are used, (Hoffman & Falvo, 2004) and incomplete glycogen restoration (Phillips, 2006).

## Necessity and Cost of Protein Supplements

Protein powder is one of the most commonly used supplements today (Schwenk & Costley, 2002). Although it is extremely common to find athletes using protein supplements, the need to do so is in question. The convenience factor associated with protein supplementation makes it an easy alternative for athletes and coaches. It is trouble-free to take, low in fat, and can be stored for long periods of time. Many authors discuss the lack of necessity of protein supplementation stating it is possible to get all protein needs through the ingestion of traditional foods (Kerksick et al., 2006; Lemon, 1995; Nemet, Wolach, & Eliakim, 2005; Phillips, 2004). High quality protein containing foods include eggs, meat, dairy, and soy foods. Many grains and vegetables also contain good quality protein sources.  It is possible for an athlete to consume their daily requirements of protein by eating a well balanced diet.

In 1998, Americans spent 12 billion dollars on nutritional supplements.  Of the $12 billion spent that year,  over 800 million dollars were spent on sport specific supplements (Armsey & Grime, 2002).  Cost is a huge issue when considering protein supplementation versus dietary protein intake.  If an individual were to focus their attention on dietary protein versus protein supplementation, the additional expense for the protein supplement would be unnecessary because it is possible to meet all protein requirement through dietary means alone.  Protein supplements are only necessary when an individual is unable to meet their energy and protein requirements through dietary means.

<u>Athlete's Knowledge</u>

The reasoning behind supplemental use include the promotion of growth, illness prevention, and improved performance (Froiland, Koszewski, Hingst, & Kopecky, 2004; Schwenk & Costley, 2002).  Many athletes exceed the established RDA for protein because they feel this recommendation is inadequate (Applegate & Grivetti, 1997). Jonnalagadda et al. (2001) designed a study to collect information regarding the knowledge and attitudes of thirty-one freshman football players (age 18.2±0.5 years). The players reported eating 3.6 (± 1.0) times a day, and eating out 4.8 (± 4.1) times per week.  The most common beliefs about supplements included; 1) protein is the main source of energy for muscle, 2) protein supplements are necessary for muscle growth and development, 3) vitamin and mineral supplements increase energy levels, 4) and sports drinks were not an appropriate substitute for water to replace fluid losses (Jonnalagadda, Rosenbloom, & Skinner, 2001). Froiland et al. (2004) found similar results in a review of 203 male and female varsity athletes (Froiland, Koszewski, Hingst, & Kopecky, 2004) while Bovill et.al. found limited knowledge in US Army Special Forces (Bovill, Tharion, & Lieberman, 2003). Nutrition education is a key factor missing within the training of collegiate athletes and beyond.

## What Freshman Football Players Eat

To educate football players on how they can alter their eating habits, it is important to understand how they currently eat. Cole et.al. (2005) collected dietary information (3-day diet records) from thirty Division I NCAA football players ages 19-23. During their seven week study, the participants completed two-three day diet records. The research team determined the caloric intake of these athletes to be lower than what is recommended for heavy-performance activity athletes (4,000-5,300 kcals recommended versus 3,288 kcals consumed) (Cole et al., 2005). They also discovered the protein level within the diet of these athletes was higher than a normal diet that recommends 0.8 g/kg. Daily intake of fruits and vegetables did not meet the 2-3 servings per day, thus suggesting these athletes put a lot of faith in protein to maintain their energy needs (Cole et al., 2005).

## Where Athletes Get Their Information

Many athletes believe protein supplementation is essential for the growth of muscle mass (Jonnalagadda, Rosenbloom, & Skinner, 2001). For this reason, other nutrients are often overlooked and may be inadequate within the athlete's diets. Nutrition counseling and dietary evaluation is recommended to help athletes meet their dietary goals (Cole et al., 2005). Many athletes receive the majority of their nutrition information from unreliable sources, such as magazines, parents, and friends (Froiland, Koszewski, Hingst, & Kopecky, 2004). Other sources include fellow athletes, strength coaches, trainers, and registered dietitian (Froiland, Koszewski, Hingst, & Kopecky, 2004). In regards to the average athletes understanding of nutrition, many have been misinformed by their current source. Jonnalagadda et al. (2004) conducted a survey of thirty-one NCAA freshman football players. They found out of the eleven questions included on their survey, none of the athletes were able to answer all of them correctly (Jonnalagadda, Rosenbloom, & Skinner, 2001). Over 50% of the athletes believed protein was their muscle's main source of energy, vitamins and mineral increased energy, and sports drinks were not a good substitute for water to help with fluid replacement (Jonnalagadda, Rosenbloom, & Skinner, 2001). Although protein can be used as an energy source, it is not the body's first choice (Hoffman & Falvo, 2004). Athletes need to receive some sore of nutrition education to help them understand the role of macro and micronutrients as well as the role and importance of hydration (Jonnalagadda, Rosenbloom, & Skinner, 2001).

Athletic performance and supplementation will remain in the spotlight from now and for many years to come. Not only does protein supplementation have an anabolic effect on the muscle fibers themselves, but glycogen synthesis is enhanced in the presence of post exercise carbohydrate/protein (CHO/pro) supplementation. These two variables are associated with an athlete's ability to enhance athletic performance. More information is needed to understand how strength athletes are meeting their protein requirements. A comparative study observing food based intake versus liquid supplementation is needed to compare the two methods and determine if there is a benefit to either method of protein consumption. For now, it is understood that protein is required for body maintenance and the athletic performance of both strength and endurance athletes.

# CHAPTER 3

# METHODS

This research methodology used whole food dietary protein versus protein supplementation post exercise to observe their effects on strength, power, speed, and body composition in redshirt football athletes entering Montana State University. Nutrition education and the consumption of food based forms of protein post exercise set the treatment group apart from the protein supplemented control. Measures of performance included pre and post one repetition max tests (1 RM) of the flat bench press, squat, and hang clean as well as a 10 yard dash, and vertical jump. Subjects also completed body composition analysis and blood draws for lipid analysis at pre and post measurements. Dietary records of both groups were collected and analyzed to monitor intake and pre and post time points. It was hypothesized there would be no difference in the performance measures between the subjects ingesting dietary protein versus protein supplements over the eleven week study.

## Subjects

Subjects were incoming Montana State University (MSU) redshirt football players between 18-24 years of age. Redshirt football players train, practice, and suit up with the MSU football team, but they do not play in games. Most of the participants had general lifting experience learned from their high school football coaches, but were inexperienced in the Olympic and power lifting techniques utilized by the Montana State University strength and conditioning staff.

## Experimental Design

The NCAA limits the amount of protein given to their athletes through supplemental form to less than 30% of the total energy of the supplement given per day. By incorporating nutrition education athletes can meet their protein requirements by making use of whole food sources while consuming a more balanced diet and eliminating potentially unnecessary supplements. A pretest-posttest control group experimental design was used. One group received nutritional education while obtaining their protein requirements from whole food sources. The other group utilized protein supplementation, but did not receive any nutrition education. With nutrition education and whole food source protein consumption, athletes were expected to achieve the same performance levels as those athletes consuming protein supplementation.

The purpose of this study was to determine if strength, power, and lean body mass gains of MSU redshirt football players could be equally attained through whole food protein intake compared to protein supplements. Informed consent approved by the IRB, was obtained from 17 young males. Participants were matched and placed into the S and NS groups according to their protein needs and body mass measures. The S group did not receive nutrition education, but consumed a protein supplement after weight training practices consisting of 28 g. The current supplement used by the MSU athletic department is ONS protein. The NS group received nutrition education regarding protein consumption from whole food sources, caloric requirements, hydration, and the importance of timing. Both S and NS groups completed two three-day diet records, two strength and power assessments (done by the MSU strength and conditioning coaches), two blood lipid profiles, and two DEXA scans.

## Nutritional Education

All participants (Groups S and NS) received training on how to accurately measure portion sizes and how to complete a three day diet record. The research team developed diet record materials that coincide with the MSU foodservice menu to ease the process of the three day diet records. Only the NS group received additional nutrition education (3 educations of 20 minutes each). The NS group did not consume any supplemental protein. Instead, they consumed all their protein from food sources offered by MSU foodservice and the research team. Nutrition education was managed by an MSU graduate nutrition student. Basic nutrition education included individual caloric and protein requirements, hydration needs, timing of consumption, and the importance of balancing macronutrients. Subject's caloric, hydration, and protein requirements (1.6-1.8g/kg) were determined. The nutrition education portion of the study followed the subsequent outline:

*Education 1 - 20 minutes*

- Consent form
- Questionnaire
- Time for questions
- Match participants and randomly break into groups

*Education 2 – 20 minutes*

- Portion sizes
- How to complete a 3 day diet record

*Education 3 - 20 minutes (NS group only)*

- Sports Nutrition
- What is protein?
- Benefits
- Caloric requirements
- Hydration - Why?
- Timing of each

*Education 4 - 20 minutes (NS group only)*

- Methods and ideas of how to meet individual requirements
- Whole food sources of protein

Non-supplemented subjects had access to a member of the research team at all of their weight training practices, and they could contact a team member through email if questions or concerns arise. Strength and conditioning workouts were three times per week (Wednesdays and Fridays at 6:00 AM & Sundays at 1:00 PM). At these practices, the research team continued nutrition education by offering helpful handouts and quick tips.

## Strength and Conditioning (12 week program)

The goals of the MSU Strength and Conditioning Program are to (1) decrease the risk and occurrence of injuries and (2) increase athletic performance. This is done through the education of proper lifting technique, and working with the individual weaknesses, such as inflexibility, weakness in certain areas, or tightness of the hamstrings. By observing individual player technique, coaches can incorporate methods to work with individual weaknesses to minimize these weaknesses while improving overall performance. The progression of weight training begins in the developmental stage where athletes learn basic body control, and master the technique of strength training through repeated efforts. Once these techniques are mastered, athletes enter the transitional phase where more complex exercises are done and sub-maximal efforts are incorporated into the workouts. If an athlete excels in the transitional phase, the coaching staff may develop an advanced program for that athlete to maintain the complex body control while introducing maximal effort lifting techniques.

The 12 week program weight training program was developed by the head strength and conditioning coach (See APPENDIX C). The strength and conditioning program is run by two to three strength and conditioning coaches and their assistants. These coaches demonstrate, instruct, and monitor Power and Olympic lifting techniques of all MSU athletes. Power lifting focuses on three lifts: the squat, the bench and the dead lift. Olympic lifting includes the clean/jerk, the jerk, and the power snatch. Both lifting methods are used to help improve dynamic training and movement. To monitor progress, coaches test athletes early in the semester and compare those testing variables with the re-test values completed at the end of the semester. Testing measures include multiple repetition max (RM) of the bench, squat, and clean to test strength and power gains. The ten yard dash is used to test speed, and the vertical jump with test power. All physical performance testing was completed by the MSU strength and conditioning program and their coaches as a regular component of their program.

## Exercise Testing and Strength Assessment

Participants followed strength and conditioning program developed by MSU strength and conditioning coaches. Strength and skill assessments took place during week 3-4 and week 11. Testing variables include the 1 RM bench, clean, and squat to measure the level of strength and power for each athlete. The 10 yard dash measured speed, and the vertical jump measured power.

## Blood draws

Blood samples were obtained in weeks 3-4 and 11-12. They began after participants had rested for 10 minutes after their arrival at the Nutrition Research Lab. Blood was collected from an antecubital vein into evacuated tubes using a standard venipuncture technique. Samples were obtained in a vacuum tube without additive for analysis of blood lipids. The tubes without additive were allowed to clot. Blood was separated using a refrigerated 21000 Marathon centrifuge (Fisher Scientific, Pittsburgh, PA). Samples were stored at -80° C until analysis. All samples from a given subject were be analyzed at the same time and within the same assay run for a given analysis to limit variability in tests.

## Anthropometric and Body Composition Measurements

Anthropometric data (height and weight) were collected during week one of nutrition education and training by the strength and conditioning coaches. Height and weight measures were also collected during both DEXA scans. Body composition measurements were collected with a DEXA (Dual Energy X-ray Absortiometry) scan by a certified radiology technologist at Bozeman's Urgent Care during weeks 2-3 and week 11-12. The DEXA scan has become a new gold standard in measuring lean and fat body composition. Many of the older measurement methods are being tested against the DEXA standard as the criterion measure to match for fat free mass. Research conducted shows DEXA to be an "accurate method for measuring soft-tissue body composition" (Kohrt, 1998; Svendsen, Haarbo, Hassager, & Christiansen, 1993), and is precise in analysis with minimal radiation exposure (Mazess, Barden, Bisek, & Hanson, 1990).

The DEXA scan uses low radiation (0.01 millisievert (mSv)) to scan the body to collect data regarding bone density, lean body mass, and body fat composition. Bozeman's Urgent Care uses the Hologic Delphi W DEXA scanner with the GDR System Software Version 11.1 for use with Microsoft Windows. Participants were asked to lay supine (face up) on the DEXA scan table. The technician modified their body position with the use of a foot restraint that positioned the hips correctly. The X-ray source is generated under the table and is projected up through the table towards a detector above the participant's body. The radiation exposure of 0.01 mSv is equivalent to amount of radiation a person is exposed to in a single day of regular living.

## Dietary Assessment

Three 3-day diet records were collected and analyzed using the dietary analysis program, Nutritionist Pro. The diet records were designed by the research team in relation to what the foodservice was serving for breakfast, lunch, and dinner during the specified dates. Athletes were educated on how to complete the diet records during the educational portion of this study. The diet records required the athletes to check off which foods they had consumed, and how much of each they had eaten. The foodservice department has agreed to offer the research team the nutritional content of the foods they serve on these occasions. With this information, the research team was able to add the individual food items into the Nutritionist Pro database used for dietary analysis.

Nutritionist Pro is a large dietary database that can have additional recipes, food items, or meals added in for dietary analysis. This program detects macronutrient (carbohydrates, fats, and protein) as well as micronutrient (vitamins and minerals) content. Food items can be added into the database based off of recipe cards, food wrappers, or by placing together pre-existing foods within the database to create a new food. With the collection of the three 3-day diet records, the research team has a general idea as to what each individual athlete's diet looks like, and how many calories, carbohydrates, proteins, and fats they are consuming. Researchers were able to use this program to determine if the athletes were reaching their individual nutritional requirements determined during the preliminary portion of the study.

## Statistical Analysis

Non-parametric statistical methods were used because the sample size was small. Differences between groups at each time point were detected using the Mann-Whitney test. The Mann-Whitney test compares the group's distributions instead of their means (Gravetter & Wallnau, 2004). This test requires that individual scores of each group be ranked in order to show if the treatment caused the scores of one group to be generally higher than the other (Gravetter & Wallnau, 2004). Differences from pre to post-testing were detected using the Wilcoxon signed ranks test. The Wilcoxson signed ranks test is a repeated-measures test that requires the subject be ranked in order, from smallest to largest (as an absolute value), to observe the difference in scores from pre to post measures (Gravetter & Wallnau, 2004). This test looks at signs and ranks to determine if there is a significant difference between the two groups. Descriptive data are given as means and standard deviations. Statistical significance was set at P=0.05.

# CHAPTER 4

# RESULTS

## Subject Description and Anthropometric Data

Seventeen subjects began and fifteen completed this study. Two of the original subjects from the supplemented group (S) were unable to complete the eleven week study. One subject chose to discontinue his participation in the MSU football program, while the other subject did not wish to continue with the study after the initial one day diet record. Descriptive information for each subject group is presented in Table 4.1. There were no significant differences in age, height, weight, or BMI between groups.

Table 4.1. *Subject Descriptive and Anthropometric Data*

| | Non-Supplement (n=9) | ± SD | Supplement (n=6) | ± SD |
|---|---|---|---|---|
| Age (years) | 18.6 | 0.5 | 18.6 | 0.7 |
| Height (cm) | 189.4 | 7.8 | 185.1 | 5.2 |
| Weight (pounds) | 210.1 | 28.8 | 215.8 | 37.1 |
| BMI (kg/m$^2$) | 26.8 | 3.2 | 26.4 | 3.9 |

*Values are means ± SD.*

## Dietary Intake – Pre versus Post

All subjects were asked to complete pre and post three day diet records to determine dietary nutritional content. All but one subject from the S group completed both pre and post three day diet records. The nutritional content of the diet records are presented in Table 4.2. There were no significant differences between groups in energy (kcals), carbohydrate, protein, fat, and fat subgroup intake. There was a significant increase (P<0.05) between pre and post training within caloric intake in both the S and NS groups, and there was a significant increase in carbohydrate consumption within the NS group.

Table 4.2. *Three Day Diet Record - Nutritional Content*

| Variable | NS | ±SD | S | ±SD |
|---|---|---|---|---|
| Calories (unit) | | | | |
| Pre | **3491.1**[a] | 956.2 | **3565.6**[a] | 713.7 |
| Post | **4797.2**[a] | 1473.5 | **5688.1**[a] | 3687.0 |
| Carbohydrate (g/d) | | | | |
| Pre | **363.7**[a] | 120.0 | 333.1 | 124.0 |
| Post | **572.8**[a] | 182.8 | 770.4 | 676.6 |
| Protein (g/d) | | | | |
| Pre | 160.0 | 55.6 | 184.1 | 47.5 |
| Post | 208.9 | 80.8 | 231.3 | 116.5 |
| Total Fat (g/d) | | | | |
| Pre | 157.0 | 50.9 | 165.1 | 36.0 |
| Post | 174.5 | 65.9 | 184.4 | 53.8 |
| Cholesterol (mg/d) | | | | |
| Pre | 731.8 | 342.9 | 802.9 | 349.3 |
| Post | 1042.5 | 600.0 | 936.0 | 309.1 |
| Saturated Fat (g/d) | | | | |
| Pre | 47.3 | 20.5 | 44.7 | 8.9 |
| Post | 45.0 | 21.2 | 51.2 | 9.0 |
| Mono Unsaturated (g/d) | | | | |
| Pre | 33.4 | 15.5 | 38.6 | 9.2 |
| Post | 37.7 | 15.6 | 30.3 | 12.3 |
| Poly Unsaturated(g/d) | | | | |
| Pre | 17.4 | 6.2 | 19.9 | 7.1 |
| Post | 14.2 | 8.0 | 16.9 | 5.8 |
| Trans Fat (g/d) | | | | |
| Pre | 2.4 | 1.2 | 1.4 | 2.0 |
| Post | 1.1 | 1.2 | 2.1 | 1.6 |

Table 4.2. – Continued

| | | | | |
|---|---|---|---|---|
| Dietary Fiber (g/d) | | | | |
| Pre | 19.2 | 8.0 | 19.4 | 8.8 |
| Post | 17.2 | 5.3 | 20.5 | 12.9 |

*Values are means ± SD.* [a] *= P<0.05 within groups NS = Non-Supplemented group; S = Supplemented group*

Subject caloric requirements compared with their pre and post caloric intake is presented in Figure 4.1.

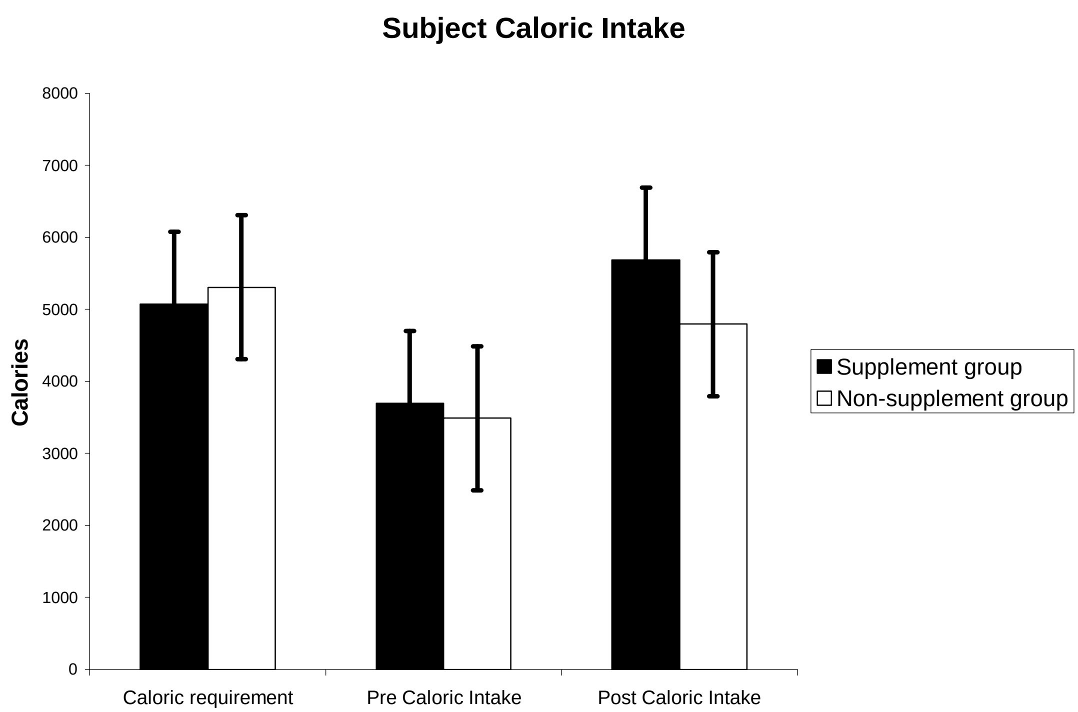


Figure 4.1. *Caloric requirements versus pre/post three day diet records. Values = mean ±SD.*

A comparison of the subject's protein requirements versus their pre and post protein consumption is presented in Figure 4.2. As a group, the subjects met their protein requirements. The average amount of protein (g) consumed per kilogram of body weight was 1.8 g/kg at both pre and post time points. The amount of protein consumed (g/kg) by each individual subject at pre and post time points is present in Table 4.3. Five out of six subjects in the S group, and four out of nine subjects from the NS group consumed at least 1.6 g of protein per kg of body weight. The amount of fat (grams) consumed by each individual at both pre and post time points in presented in Table 4.4.

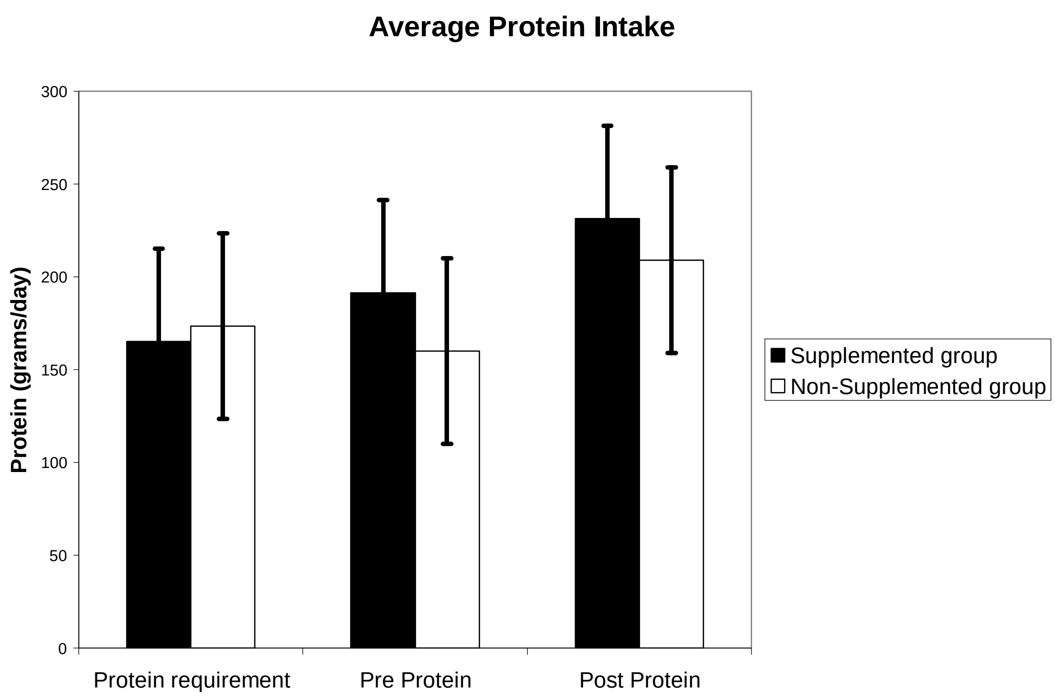


Figure 4.2. *Estimated protein requirements versus pre/post reported intakes. Values = mean ±SD.*

Table 4.3 - *Individual Levels of Protein Consumption*

| Subject | Pre Protein Consumed (g/kg) | Post Protein Consumed (g/kg) |
|---|---|---|
| S3 | 1.29 | 1.25 |
| S4 | 1.68 | 1.62 |
| S5 | 1.75 | 1.71 |
| S6 | 1.87 | 1.87 |
| S7 | 2.41 | 2.34 |
| S8 | 2.83 | 2.86 |
| | | |
| NS1 | 0.93 | 0.89 |
| NS2 | 1.13 | 1.06 |
| NS3 | 1.24 | 1.21 |
| NS4 | 1.35 | 1.33 |
| NS5 | 1.37 | 1.35 |
| NS6 | 1.64 | 1.56 |
| NS7 | 2.34 | 2.31 |
| NS8 | 2.77 | 2.69 |
| NS9 | 2.78 | 2.71 |

Table 4.4. - *Individual Fat Consumption*

| Subject | Pre Fat Consumed (grams) | Post Fat Consumed (grams) |
|---|---|---|
| S3 | 298.7 | |
| S4 | 134.4 | 134.5 |
| S5 | 173.5 | 153.6 |
| S6 | 202.8 | 220.9 |
| S7 | 121.1 | 152.5 |
| S8 | 193.8 | 260.5 |
| | | |
| NS1 | 122.3 | 136.7 |
| NS2 | 174.9 | 108.8 |
| NS3 | 256.3 | 238.4 |
| NS4 | 100.7 | 164.2 |
| NS5 | 193.1 | 307.4 |
| NS6 | 155.2 | 178.0 |
| NS7 | 113.8 | 152.3 |
| NS8 | 110.9 | 94.4 |
| NS9 | 185.9 | 190.1 |

## Performance Measures

Both groups completed several performance tests to measure changes in strength, power, and speed. Two subjects from the NS groups were excluded from the analysis due to a sport related injury and an inability to complete the testing protocol correctly. Pre and post performance variables are presented in Table 4.5. There were no significant differences in the performance variables between the S and NS groups. There was a significant improvement ($P<0.05$) within the NS group in the vertical jump, 10 yard sprint. Both groups showed a significant improvement in the hang clean and back squat variables, while the S also significantly improved in the bench press ($P<0.05$).

Table 4.5. *Pre and Post Performance Measures*

| Variable | NS | ±SD | S | ±SD |
|---|---|---|---|---|
| Vertical Jump (inches) | | | | |
| Pre | **25.8**[a] | 3.4 | 25.7 | 3.3 |
| Post | **26.9**[a] | 3.0 | 27.0 | 3.3 |
| 10 yard sprint (seconds) | | | | |
| Pre | **1.9**[a] | 0.04 | 1.8 | 0.1 |
| Post | **1.8**[a] | 0.08 | 1.9 | 0.1 |
| Hang clean (pounds) | | | | |
| Pre | **221.3**[a] | 25.7 | **238.7**[a] | 19.0 |
| Post | **244.0**[a] | 15.7 | **252.7**[a] | 10.1 |
| Back Squat (pounds) | | | | |
| Pre | **343.6**[a] | 26.1 | **363.0**[a] | 27.2 |
| Post | **369.4**[a] | 21.3 | **401.7**[a] | 47.4 |
| Bench Press (pounds) | | | | |
| Pre | 246.4 | 28.5 | **251.3**[a] | 32.2 |
| Post | 261.3 | 25.3 | **264.0**[a] | 36.3 |

*[a] = P<0.05 within groups NS = Non-supplemented group; S= Supplemented group*

## Body Composition

All subjects completed two DEXA scans to measure changes in lean and fat body mass. Variations between pre versus post measures are presented in Table 4.6. No significant differences were found between groups. There was a significant increase within the NS group in total weight gain, and subtotal gain in lean and fat mass ($P<0.05$).

Table 4.6. - *DEXA scan / Body composition by region*

| Variable | NS | ±SD | S | ±SD |
|---|---|---|---|---|
| Weight (pounds) | | | | |
| Pre | **210.1**[a] | 32.1 | 215.8 | 28.3 |
| Post | **216.9**[a] | 33.9 | 219.8 | 30.4 |
| Left arm fat mass (grams) | | | | |
| Pre | 1044.3 | 322.2 | 1025.3 | 437.9 |
| Post | 1167.1 | 445.0 | 991.7 | 397.1 |
| Left arm lean mass (grams) | | | | |
| Pre | 4885.4 | 467.6 | 5039.8 | 768.0 |
| Post | 4900.4 | 521.7 | 5061.5 | 585.7 |
| Left arm % fat | | | | |
| Pre | 16.7 | 4.7 | 16.0 | 6.0 |
| Post | 18.0 | 5.4 | 15.2 | 4.4 |
| Right arm fat mass (grams) | | | | |
| Pre | 897.8 | 280.0 | 846.6 | 361.7 |
| Post | 944.7 | 353.7 | 1063.0 | 346.2 |
| Right arm lean mass (grams) | | | | |
| Pre | 4764.3 | 606.7 | 5001.9 | 567.1 |
| Post | 5107.8 | 668.7 | 5370.2 | 418.3 |
| Right arm % fat | | | | |
| Pre | 15.1 | 4.1 | 13.7 | 5.4 |
| Post | 14.7 | 4.6 | 15.6 | 4.0 |

Table 4.6. – Continued

| | | | | |
|---|---|---|---|---|
| Trunk fat mass (grams) | | | | |
| Pre | **7637.5**[a] | 3277.0 | 7706.7 | 3781.0 |
| Post | **8691.2**[a] | 3792.0 | 8314.1 | 4293.2 |
| Trunk lean mass (grams) | | | | |
| Pre | **34939.1**[a] | 5169.0 | 35950.3 | 2729.6 |
| Post | **35834.0**[a] | 5202.0 | 36646.3 | 3251.9 |
| Trunk % fat | | | | |
| Pre | **17.0**[a] | 5.6 | 16.6 | 6.2 |
| Post | **18.4**[a] | 5.7 | 17.3 | 6.7 |
| Left leg fat mass (grams) | | | | |
| Pre | 3310.2 | 1345.7 | 3116.3 | 1127.5 |
| Post | 3496.4 | 1406.7 | 3109.3 | 1028.4 |
| Left leg lean mass (grams) | | | | |
| Pre | 12737.6 | 1208.0 | 13182.6 | 1677.9 |
| Post | 13053.5 | 1328.1 | 12789.4 | 1118.7 |
| Left leg % fat | | | | |
| Pre | 19.6 | 6.3 | 18.1 | 5.2 |
| Post | 21.0 | 6.4 | 18.3 | 4.1 |
| Right leg fat mass (grams) | | | | |
| Pre | 3169.9 | 1261.5 | 2909.0 | 1242.1 |
| Post | 3355.9 | 1289.6 | 3028.9 | 1179.9 |
| Right leg lean mass (grams) | | | | |
| Pre | 12308.1 | 1331.8 | 12967.5 | 1244.0 |
| Post | 12545.6 | 1403.2 | 13111.3 | 1471.1 |
| Right leg % fat | | | | |
| Pre | 19.1 | 6.0 | 16.9 | 5.6 |
| Post | 19.8 | 5.9 | 17.4 | 4.7 |
| Subtotal fat mass w/o head (grams) | | | | |
| Pre | **16059.6**[a] | 6170.7 | 15602.0 | 6815.8 |
| Post | **17765.1**[a] | 6963.7 | 16506.9 | 7058.2 |

Table 4.6. - Continued

| | | | | |
|---|---|---|---|---|
| Subtotal lean mass w/o head (grams) | | | | |
| Pre | **69310.9**[a] | 8579.7 | 72227.6 | 6624.7 |
| Post | **70911.8**[a] | 8779.2 | 73027.8 | 6327.8 |
| Subtotal % fat w/o head | | | | |
| Pre | 17.8 | 5.4 | 16.7 | 5.6 |
| Post | 18.9 | 5.5 | 17.3 | 5.3 |

*Values are means ± SD.* [a] *= P<0.05 within groups NS = Non-supplemented group; S = Supplemented group.*

## Blood Lipid Profile

Subjects completed pre and post blood draws for blood lipid analysis. One subject from the NS group did not participate in the blood draw due to a fear of needles. The pre versus post blood lipid variations are presented in Table 4.7. No significant differences were found between the S and NS groups. There was a significant increase within both groups in total cholesterol and LDL cholesterol measures ($P<0.05$).

Table 4.7. *Pre versus Post Blood Lipids*

| Variable | NS | ±SD | S | ±SD |
|---|---|---|---|---|
| Total Cholesterol (mg/dL) | | | | |
| Pre | **188.9**[a] | 35.1 | **199.7**[a] | 30.4 |
| Post | **215.3**[a] | 38.6 | **232.5**[a] | 43.3 |
| Triglyceride (mg/dL) | | | | |
| Pre | 155.5 | 85.2 | 175.3 | 99.1 |
| Post | 149.3 | 37.1 | 149.0 | 32.6 |
| VLDL (mg/dL) | | | | |
| Pre | 31.1 | 17.0 | 35.1 | 19.8 |
| Post | 29.9 | 7.4 | 29.8 | 6.5 |

Table 4.7 Continued

| | | | | |
|---|---|---|---|---|
| LDL (mg/dL) | | | | |
| Pre | **89.7**[a] | 33.3 | **96.8**[a] | 34.4 |
| Post | **115.7**[a] | 31.6 | **136.4**[a] | 38.1 |
| HDL (mg/dL) | | | | |
| Pre | 68.1 | 18.3 | 67.8 | 14.5 |
| Post | 69.8 | 14.8 | 66.3 | 14.8 |

Values are means ± SD. a = P<0.05 within groups NS = Non-supplemented group; S=Supplemented group

The purpose of this study was to determine if muscle hypertrophy and strength gains in the Montana State University redshirt football players could be equally attained through dietary protein intake versus protein supplementation. It was hypothesized that there would be no difference between the nutrition educated non-supplemented (NS) group and the protein supplemented (S) group in the measures of strength and muscle hypertrophy. No significant differences were observed between the S and NS groups in the areas of strength (performance variables) or body composition changes from pre to post measures.

# CHAPTER 5

# DISCUSSION

## Introduction

The purpose of this study was to determine if muscle hypertrophy and strength gains in the Montana State University redshirt football players could be equally attained through dietary protein intake versus protein supplementation. We hypothesized there would be no difference between the non-supplemented group (NS) and the supplemented group (S) in the measures of strength and muscle hypertrophy. Fifteen athletes completed the 11 week study, which consisted of pre and post measures of three day diet records, blood draws for lipid analysis, DEXA scans to observe body composition changes, and performance variables, which measured improvements in strength, power, and speed. Both groups showed improvements in performance measures and increased their lean body mass. No significant differences were found between the S and NS groups in any of the previously mentioned variables.

## Dietary Intake

Caloric requirements were determined using the Harris Benedict equation, with an activity factor of 2.0-2.4. The average caloric requirement for both groups ranged between 5076 and 5309 kcals per day. Subjects reported caloric intakes were below the estimated requirements. It has been established that NCAA Football athletes under report their caloric and macronutrient intake on self reported dietary records (Cole et al., 2005). Within the eleven week study, these subjects increased their body weight from a pre weight of 210 pounds to 216 pounds post measure (NS group) and 216 to 219 (S group). They also increased their total fat and lean body mass, as presented in Table 4.4. The observed weight gain and body composition changes of these athletes could not have occurred with the low reported caloric and macronutrient intake. This is consistent with the previous report presented by Cole et al. The subjects of the present study under reported their caloric intake as evidenced by their overall average body mass gain.

Although subjects did not report meeting their caloric requirements, the average protein intake for both groups was within the recommended range for this study (1.6-1.8 grams/kg). The estimated protein requirements were established to meet the needs of all involved subjects. Some of the subjects were unable to meet their protein requirements as reported by their collected diet records. One out of the six S group subjects, and five of the nine NS subjects were unable to meet their protein requirements through their daily food intake. Reported protein intake did not include the whole food protein sources or the protein supplement (8-28 g of protein). Individual average protein intake is presented in Table 4.3. As previously discussed, football athletes tend to under report their caloric and macronutrient intake (Cole et al., 2005). It is possible these athletes were meeting their protein requirements, as evidenced by the increase in weight and lean body mass. For those individuals unable to meet their protein requirements through dietary means alone, they could benefit from additional protein provided by protein supplements.

The current recommendations for a balanced diet states that 50-60% kcals should come from carbohydrate (CHO) sources, 20-35% from fat, and 15-20% from protein (Fink, Burgoon, & Mikesky, 2006). Saturated fat intake should be no greater than 10%

of the total daily caloric intake. Total % kcals of fat consumed by these subjects ranged from 30-54% (pre diet record) to 20-51% (post 3 day diet record). Saturated fat intake averaged 12% of the caloric intake at pre measure, while the post saturated fat intake was 8% total caloric intake. High dietary fat intake has been linked to many health risks, including but not limited to, Cardiovascular Disease (CVD), atherosclerosis, stroke, myocardial infarction (MI), and diabetes. Due to the presence of high fat consumption within these subjects, it is recommended they receive further nutritional education (Cole et al., 2005) to decrease the risk of long term health consequences.

## Performance Measures

All subjects completed the strength and conditioning program designed by the MSU Football and strength & conditioning coaches. Performance measures were collected by the MSU strength and conditioning coaches at both pre and post time points. Athletes trained in the MSU athletic department weight room during the entire eleven week study length. Testing conditions did not change from pre to post testing time points, as they were collected by the same individuals under the same testing conditions. Collected performance variables include the 10 yard sprint, vertical jump, bench press, back squat, and hang clean. All One Repetition Max (1 RM) variables (bench press, back squat, and hang clean) were determined through a projected 1 RM equation.

As hypothesized, there were no significant differences between the S and NS groups in any of the performance measures collected during this study. Both groups demonstrated improved physical performance (Table 4.4). The NS group significantly improved their vertical jump, 10 yard sprint, hang clean, and back squat. The S group significantly improved their hang clean, back squat, and bench press performance measures. Individuals using the protein supplement versus the whole food sources did not exhibit additional performance improvements over the NS group.

## Body Composition

All subjects completed two DEXA scans at the pre and post time points to determine body composition changes over time. DEXA scans were conducted by the same DEXA technician at both time points, and were used to determine body composition changes from pre to post measures. As hypothesized, body composition changes did not differ significantly between groups. Overall weight gain and increased lean and fat mass reflect a positive energy balance. As previously discussed, athletes met or exceeded their caloric requirements, but under-reported their food intake as evidenced by increased body mass and body composition changes.

Increasing lean body mass is the highest priority among these football athletes. An increase in muscle mass improves overall performance by enhancing strength, power, and speed. The non-supplemented group significantly increased their overall subtotal lean body mass from 69.3 to 70.9 kilograms, an increase of 1.6 kilograms. The supplemented group increased their lean mass from 72.2 to 73.0 kilograms, and increase of 0.8 kilograms, but this increase was not significant. Using the post dietary protein intake measures, the NS group consumed an average of 16,085.3 grams of protein over the 11 week study, and the S group consumed an average of 17,810.1 grams of protein. The NS group gained 0.1 grams of lean body mass per gram of protein consumed, while the S group gained 0.05 grams of lean body mass per gram of protein consumed.

Total body fat composition increased in both groups over the eleven week study. The NS group gained 1.7 kilograms of fat mass, while the S group increased on average 0.9 kilograms. Percent body fat increased 1.1% in the NS group and 0.6% in the S group. Cribb et al.(2006) found similar increases in % body fat using the DEXA scan analysis with resistance training and protein supplementation. According to the American College of Sports Medicine, males between the ages of 20-29 with a percent body fat between 14-19% have an average range of body fat. Individuals with less than 12% body fat are above average, and those with greater than 20% body fat are below average (Medicine, 2000). Athletes involved in this study fell within the average percent body fat range.

The body mass index (BMI) measurement is often used to predict an individual's percent body fat and disease risk. The BMI incorporates height (m) and weight (kg) measures to determine disease related risks. BMI Classifications are presented in Table 5.2. The average BMI for both study groups was greater than 26 $kg/m^2$. At this measurement, all included athletes would be considered overweight, or at increased risk of disease (American College of Sports Medicine, 2000). The utilization of the BMI measurement is not recommended for football players, or athletic individuals, due to their increased lean body mass. The BMI measurement is unable to distinguish between lean and fat mass, so as lean mass increases, the athlete's BMI does as well. According to Ode et al., BMI is not an accurate indicator of over fatness in athletes. They recommend the development of an additional classification for obesity in the athletic population (Ode, Pivarnik, Reeves, & Knous, 2007). To accurately determine an athlete's body composition and disease risk, multiple measures should be used.

Table 5.1**.** – *Body Mass Index (BMI) Classifications*

| Classification | BMI, kg/$m^2$ |
| --- | --- |
| *Underweight* | <18.5 |
| *Normal* | 18.5-24.9 |
| *Overweight* | 25.0-29.9 |
| *Obesity, class* | |
| *I* | 30.0-34.9 |
| *II* | 35.0-39.9 |
| *III* | = 40 |
| (2000). *ACSM's Guidelines for Exercise Testing and Prescription* (6th Edition ed.). Philadelphia, PA: Lippincott Williams & Wilkins. | |

Football athletes have been identified as an "at risk" population for cardiovascular disease due to their increased body mass and size (Kaiser et al., 2008). The philosophy of "bigger is better" has become common place within the sport of football. There is limited evidence supporting the claim that as body mass increases, so will athletic performance (Noel, VanHeest, Zaneteas, & Rodgers, 2003). Kaiser et al. observed the profiles of Division I football players versus the National Football League in areas of height, weight, BMI, and body fat related to athlete's team position. They found a consistency between the athlete's position and the variables height, weight, BMI, and body fat. The offensive and defensive linemen were taller and heavier than the other positions (running back, wide receiver, and defensive back) whom specialized in quick, dynamic movements (Kaiser et al., 2008). These findings suggest that specific body types are recruited for specific team positions throughout Division I athletics and beyond.

Football athletes of today have a greater body mass compared to players of the past. Kaiser et al. suggest the increase in body mass has a high correlation with rule changes observed within the sport (Kaiser et al., 2008). Rules that have encouraged an increase in body size include the restriction of below the waist blocking techniques. Thus, offensive linemen have been expected to gain mass to make up for restricted techniques. Harp and Hecht suggest this increase in body mass is linked with an increased risk of CVD, elevated blood pressure, and sleep-disordered breathing (Harp & Hecht, 2005). They also suggest that the "extreme" increase in body mass observed in these athletes is not lean body mass alone. A quarter of the athletes they observed were categorized with class 2 obesity through the BMI classification. They recommend utilizing other body composition measures to determine the tissue type that is increasing the overall body mass of these individuals to determine health risks (Harp & Hecht, 2005).

This observed weight gain in football players led Noel et al. to evaluate the body composition of NCAA Division I football players today versus college football players of the early 1980s and 1990s. The body mass of the offensive linemen, tight ends, and linebackers increased 10 kg since the 1980 measurements, and their total skinfold thickness were significantly greater (170.7 mm ± 10.1 mm versus 99.9 mm ± 6.7 mm) (Noel, VanHeest, Zaneteas, & Rodgers, 2003). The athletes of the Noel study showed a lower body density, or a higher percentage body fat compared to the athletes of the 1980s. The fat-free mass of these athletes remained unchanged or decreased over the same time period. For example, defensive linemen of today had fat-free mass of 77.96 ± 2.4 kg versus 97.06 ± 12.79 kg in the 1980s. Percent body fat ranged from 7.3% to 13.9% in the 1980's to 15.2%-25.4% today (Noel, VanHeest, Zaneteas, & Rodgers, 2003). These findings suggest that the increased body mass of these individuals is not a result of increased muscle mass, but a result of increased body fat. Noel et al. suggest there is a point where increasing body mass will no longer increase lean muscle mass, but rather will increase body fat. The diminished fat-free mass will ultimately decrease performance levels, while putting these athletes at a higher risk for developing health risks, such as obesity, diabetes, and CVD later in life (Noel, VanHeest, Zaneteas, & Rodgers, 2003).

## Blood Lipids

All but one subject from the NS group completed both pre and post blood draws. Total cholesterol increased significantly over the eleven week study within both groups, but there were no significant difference between groups. Low Density Lipoproteins (LDL) increased significantly within each group, with no significant difference between groups. Classification information regarding blood lipid levels is presented in Table 5.3. Post total cholesterol (TC) measures of both groups (S = 232.5 mg/dL, NS = 215.3 mg/dL) classify these athletes in the high total cholesterol category. Post LDL blood lipid measures for the NS group fall within the near/above optimal category, while the S group is classified as borderline high LDL cholesterol. Triglyceride levels decreased within both groups, but findings were not significant. HDL cholesterol levels for both groups were within the high HDL category at both pre and post measures. No significant changes were found within or between groups for the HDL measurement.

Table 5.2. *Blood Lipid Classifications*

| Blood Lipid TEST name | PURPOSE | NORMAL LEVEL |
|---|---|---|
| Total Cholesterol (TC) | Value represents the total measurement of all lipoprotein components in the blood; LDL, HDL, VLDL, and has a direct relationship to the risk of CVD | < 200 mg/dL |
| Triglycerides (TG) | - Value includes lipoproteins such as chylomicrons, VLDL, and IDL.<br>- High TG indicates an increased risk of CVD and metabolic syndrome.<br>- Extremely high levels puts patient in a category of risk for pancreatitis | Normal: <150 mg/dL<br>Borderline high: 150-199 mg/dL<br>High: 200-499 mg/dL<br>Very high: >500 mg/dL |
| High Density Lipoprotein (HDL) | Determines the amount of HDL in the blood, which is the main lipoprotein involved in cholesterol removal.<br>Increased HDL is associated with low levels of chylomicrons, VLDL remnants and LDL. | Normal: 40-60 mg/dL<br>Low: < 40 mg/dL<br>High: = 60 mg/dL |
| Low Density Lipoprotein (LDL) | Correlates highly with TC. LDL is a risk factor for atherogenesis and CHD<br>Can calculate with Freidewald equation<br>- LDL = TC-HDL-(TG/5) | Optimal: < 100 mg/dL<br>Near or above optimal: 100-129 mg/dL<br>Borderline high: 130-159 mg/dL<br>High: 160-189 mg/dL<br>Very high: = 190 mg/dL |

Mahan, K. L., & Escott-Stump, S. (2004). *Krause's Food, Nutrition, & Diet Therapy* (11th ed.). Philadelphia, PA: Saunders (Elsevier).

High total cholesterol levels increase the risk of heart disease, including high blood pressure, CVD, and coronary heart disease (CHD). Many dietary factors can be incorporated (soy protein, soluble fiber, plant sterols, rice bran oil and lecithin) or excluded (total fat and saturated fat intake) from a diet to help correct elevated blood lipid levels (Nicolosi, Wilson, Lawton, & Handelman, 2001). Dietary changes can help reduce elevated blood pressure. By simply increasing the proportion of mono-unsaturated fatty acids versus saturated fat in the diet, healthy, normal individuals may reduce their blood pressure. Rasmussen et al. found a significant decrease in both systolic (-2.2%: P=0.009) and diastolic blood pressure (-3.8 %; P=0.0001) in individuals who consumed a diet rich in MUFA versus those consuming a diet high in saturated fat (Rasmussen et al., 2006).

Individuals in an overfed state will experience changes in their blood lipid profile. After only six days of overfeeding with iso-caloric diets containing long chain triglycerides, medium chain triglycerides, or fish oil, Hill et al. (1990) observed changes in fasting triglycerides, plasma LDL, and HDL levels. Due to the nature of football, these athletes consume high amounts of calories to increase their body mass. As previously discussed, they also consume elevated levels of fat in their diets. Elevated plasma biomarkers for CVD and obesity (tPA antigen, homecystein, fasting insulin, C-peptide leptin, and C-reactive protein) were observed in individuals consuming a diet rich in red and processed meat, high fat dairy, sweets and desserts (Fung et al., 2001).

Nutrition education can decrease the prevalence of CVD risk factors in individuals involved in a long-term CVD prevention educational program. Miller, Reber, and Chapman-Novakofski observed the prevalence of CVD risk factors in 277 women (treatment/education n=174, control n=123) involved in a two year nutritional education program. The women receiving nutrition education over 24 months decreased their overall fat consumption from 33% at baseline to 29% at month 24 (Miller, Reber, & Chapman-Novakofski, 2001). The utilization of a nutrition education program for these athletes, while encouraging an active lifestyle, may improve dietary fat consumption and decrease their risk for developing CVD.

## Cost of Whole Food Protein versus Protein Supplements

The use of protein powders and bars can be very expensive. Many athletic programs utilize protein powders, shakes, and bars to give their athletes a performance edge. The Optimal Nutrition Systems (ONS) protein product utilized by the MSU athletic program offers 28 g protein per serving (3 scoops). The 3.4 pound jug costs \$44.99. A further price breakdown per serving and price per gram is presented below:

- 3.4 pound jug of ONS protein costs \$44.99 = \$2.81 per 3 scoop serving.
- 28 g = \$2.81 ✍ \$0.10 per gram of protein
- Total cost per week = \$8.43 per athlete

The cost of \$8.43 per athlete per week reflects the use of the ONS protein supplement three times per week. Many programs encourage further utilization of their protein products, thus increasing the overall cost of protein supplementation per athlete per week.

Through the use of whole food protein, athletes can meet their protein requirements without the expense of protein supplementation. Yogurt contains 9 g of protein per 6 oz serving at a cost of \$0.69. Chocolate milk provides 8 g of protein per 8 oz glass at a cost of \$2.49 per 8 servings. This calculates out to \$0.31 per serving. A half gallon of 2% milk averaged \$2.18, while a loaf of bread was \$2.89, and the individual 2-3 oz servings of roast beef cost \$0.86 (9 X \$0.86 = \$7.74). The combination of 8 oz of 2% milk, and a roast beef sandwich (2 slices of whole wheat bread and 2-3 oz roast beef) provides 28 grams of protein at a cost of $12.81 for 9 servings, or $1.42 per serving. Whole food costs per gram of protein are presented below:

- Yogurt - $0.69 per serving (9 g protein) = $0.08 per gram protein
- Chocolate milk - $0.31 per 8 oz serving (8 grams of protein) = $0.04 per gram of protein
- Roast beef sandwich with 8 oz of 2% milk - $1.42 per serving @ 28 g protein = $0.05 per gram of protein
- Cost per week = $2.42 per athlete per week.

The average cost of the whole food protein source per person is $2.42 per week versus $8.43 per athlete using the ONS protein supplement. To meet the 28 grams offered by the ONS protein supplement, the sandwich and milk option could be used all three days for a weekly cost of $4.26. Whole food sources of protein can be cost effective in meeting the athlete's protein requirements.

## Limitations

This study was conducted to determine if whole food protein sources could promote the same strength and hypertrophy gains as protein supplementation in redshirt football athletes. Although there were no significant differences between the two groups in any of the measured variables, there were several limitations to this research.

- Due to the attrition of the supplemented group, the sample became non-parametric and is limited by it size.

- As previously discussed, the self-reported three day diet records were not completed without error. The observed under-reporting could be corrected with additional documentation for snack time foods.
- The study length was eleven weeks. This length of time can not account changes that would occur over a longer period of time.
- The whole food protein sources used post exercise did not contain the same amount of calories or protein when compared to the protein supplement.
- Most team sports and active athletes would utilize a protein supplement more than three times per week. Future research may wish to offer a protein source five to seven days per week.
- NS subjects verbally confirm they did not use any protein supplements, but it is possible they could have used a product without our knowledge.

## Future Research

Recommendations for future research include following incoming redshirt athletes from their first year through graduation with the football training program. Observations throughout their program would include data collection regarding changes in body composition, blood lipid profile, performance measures, and dietary choices. Long-term nutritional education is recommended throughout this type of research to encourage life-long healthy choices in food and activity.

## Conclusion

Protein supplements are one of the most highly used nutritional supplements today. There are many misconceptions regarding their ability to enhance lean muscle mass development. Many individuals exceed their protein requirements by using both dietary and protein supplement sources within their daily routines. Protein sources are readily available in animal and plant forms, but often athletes are uneducated regarding their caloric and protein requirements. Football athletes enter their collegiate programs hoping to gain weight in the form of lean muscle mass. Their diets tend to be high in calories and dietary fat. High levels of fat increase an individuals risk for CVD.

It is possible to meet protein requirements through whole food sources without incorporating protein supplements. Nine of the fifteen subjects of this current study consumed at least 1.6 grams of protein per kilogram. If athletes had more direction in the area of nutrition education and proper food choices, caloric and protein requirements could be easily meet. Those individuals who do not consume animal, or complete, protein sources could benefit from incorporating protein supplements into their diets.

Both S and NS groups showed significant improvements in strength, power, and speed. Both groups increased their total body mass, muscle mass, and fat mass over time. Protein supplementation is not necessary to meet daily protein requirements of redshirt football athletes. Protein supplementation does not offer any performance benefits versus whole food protein sources in the measures of body composition or strength and power gains. Athletes consuming a high caloric/high fat diet experienced increased body fat, and an elevated blood lipid profile. Long-term utilization of a high calorie, high fat diet will increase their risk of developing CVD later in life.

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# APPENDICES

# APPENDIX A:

CONSENT FORM

SUBJECT CONSENT FORM FOR PARTICIPATION IN HUMAN RESEARCH
**MONTANA STATE UNIVERSITY**

**Study Title**: *Protein supplementation vs. Dietary Protein: Does the source of protein effect hypertrophy, strength, and power performance measures in MSU Red Shirt Football Players?*

**Investigators:** Rochelle Kirwan, Mary Miles, Ph.D.
Department of Health and Human Development
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Phone: 994-6678, mmiles@montana.edu

You are being asked to participate in a study investigating the effectiveness of protein consumption from food sources compared to consumption of protein supplements. Our aim is to determine if there is a difference in muscle gain and performance measures (strength and power) between individuals who consume whole food protein vs. those who use protein supplements. This may help us understand the most effective way to meet protein needs in athletes.

Montana State University athletes are involved in a well developed strength and conditioning program. The MSU football team is of interest due to the heavy concentration on strength and power training. As incoming football players, your gains in strength and power will be greater than those of the upper classmen, due to your training level.

The purpose of this study is to determine if muscle strength, power, and lean body mass gains can be equally attained through protein consumption by way of dietary protein intake compared to protein supplementation. We will randomly place you in either the protein supplemented group or the non-supplemented group. This will be done after we have determined your protein requirements. The non-supplemented group will receive nutrition education from the research team, and will obtain their protein requirements from whole food protein sources. The protein supplement group will use protein supplementation to meet their protein requirements, and will receive no nutrition education.

If you agree to participate in this study you will do the following things over the 15-week investigation:

ALL SUBJECTS:

1. Attend an instructional meeting to receive information regarding portion sizes and how to properly document the amount you consume.

2. Keep (3) Three Day Diet Records. Diet records will be provided for you based on what the MSU food service is serving each day. You will record the amount of food you eat. If you choose to eat outside sources of food, you will be asked to

record these items as well. Food records will be analyzed to determine if you are meeting your caloric, protein, and hydration requirements.

3. As a member of the MSU football team, you are involved in the MSU Strength and Conditioning Program. During your training, you will be tested on your strength and power through one repetition max tests(1 RM)), and speed (40 yard dash). We will use these test scores to measure changes in your performance throughout the 15 week study.
4. Have two Dual Energy X-ray Absortiometry (DEXA) scans, one at week 3 and the second at week 15. These scans use minimal radiation to collect information on muscle mass, fat composition, and bone density.
5. Have blood collected in the Nutrition Research Lab of Herrick Hall. Blood collections will be done on two different occasions to have blood lipids (cholesterol) analyzed. We will use this information to determine if there are changes in lipid levels between the two groups (supplemented vs. non-supplemented) and individually throughout the 15 week study.

<u>ADDITIONAL ACTIVITIES FOR THE NON-SUPPLEMENTED GROUP</u>:

1. Attend scheduled group nutrition education discussions that will last no longer than 45 minutes, and one individual meeting that will last no longer than 15 minutes. During these discussions, individual caloric, protein, and hydration requirements will be determined. Discussions will also include ideas and suggestions to help you meet these requirements through eating whole food sources of protein only.
2. Follow the guidelines for quantity and timing of protein consumption.
3. Consume food items given to you by the research team to help you meet your protein requirements, e.g. yogurt after strength and conditioning workout.

<u>PROTEIN SUPPLEMENTED GROUP</u>:

1. Consume supplemental protein formula each day. This supplement will be provided through the Strength and Conditioning program and will be the same supplement available to all varsity athletes at Montana State University.
2. Fill in a check sheet to indicate days that you have consumed the supplement.

All the information we collect during the course of the study regarding individual performance, body composition, and blood profiles will be available to you individually.

Sometimes there are side effects from having blood drawn or doing certain activities. These side effects are often called risks, and for this project, the risks are:

1. Approximately 10 ml of blood (2 teaspoons) will be removed by putting a needle in your vein. This is the standard medical method used to obtain blood for tests. There is momentary pain at the time the needle is inserted into the vein, but other discomfort should be minimal. In about 10% of the cases there

is a small amount of bleeding under the skin, which will produce a bruise. The risk of infection is less than 1 in 1,000.

2. As a participant in this study, you will receive extra radiation exposure from studies that are for research purposes only (not for your direct clinical benefit). Your radiation dose from the DEXA scan is 0.01 millisievert (mSv), which is equivalent to the amount of radiation you are exposed to on a daily basis of regular living. The National Council on Radiation Protection and Measurements has set permissible occupation radiation exposure limits for many radiologists, technologists, and scientists who work with radiation and are exposed nearly every day. These limits are defined as the dose of radiation that, in light of present knowledge, is not expected to cause appreciable bodily injury to a person at any time during his/her lifetime. The risk of this amount of occupational exposure to radiation is, thus, considered to be very small and less than that associated with normal everyday activities. The radiation dose mentioned is what you receive from the research component of this study only and does not include any exposure you may have received or will receive in the future from other tests. The DEXA X-ray source complies with the radiation performance standards under the Federal Food, drug and Cosmetic Act.
3. This is listed as a possible concern. The non-supplemented group may consume higher amounts of fat due to consumption of whole food and meat goods that are associated with higher fat content. This could put them at an increased risk of developing an elevated blood lipid profile. You will be given nutritional information to help you avoid excess fat consumption.

Confidentiality: The data and personal information obtained from this study will be regarded as privileged and confidential. A code number will identify the data that we collect from you, and all data will be kept in locked offices in the Nutrition Research Laboratory or in Dr. Miles' office. The information obtained in this study may be published in scientific journals, but your identity will not be revealed. They will not be released except upon your written request/consent. If during the study you decide to cease your participation, your name will be removed from our study records, and we will not contact you again regarding this study. You will not be penalized in any way.

Freedom of Consent: You may withdraw consent in writing, by telephone, or in person with the investigator (Mary Miles at 406-994-6678 or Rochelle Kirwan at 994-5001) and discontinue participation in the study at any time and without prejudice. Participation is completely voluntary.

In the event your participation in this research results in injury to you, medical treatment consisting of basic first aid and assistance in getting to Bozeman Deaconess Hospital or Student Health Services will be available, but there is no compensation for such injury available. Further information about this treatment may be obtained by calling Mary Miles at 994-6678.

You are encouraged to express any questions, doubts or concerns regarding this study. The investigator will attempt to answer all questions to the best of her ability. The investigator fully intends to conduct the study with your best interest, safety and comfort in mind. *The Chairman of the Human Subjects Committee, Mark Quinn can answer additional questions about the rights of human subjects at 406-994-5721.*

STATEMENT OF AUTHORIZATION

AUTHORIZATION: I have read the above and understand the discomforts, inconvenience and risk of this study. I, ___________________________________ (PRINT YOUR NAME), agree to participate in this research. I understand that I may later refuse to participate, and that I may withdraw from the study at any time. I have received a copy of this consent from for my own records.

Signed: _____________________________________ Date: ____________
*Subject's Signature*

Witness: ____________________________________ Date: ____________
*(If other than the investigator)*

Investigator:_________________________________ Date: ____________
*Rochelle Kirwan*

# APPENDIX B:

SAMPLE 3 DAY DIET RECORD

# 2nd 3- Day Diet Record

## Thursday, November 15
## Friday, November 16
## Saturday, November 17

## Reminders:

- **Please record *all beverages* throu hout the day This includes ater durin ractice, mil on your cereal, soda durin class, etc**
- **Please ay attention to servin si es Dressin s, sauces, butter, sour cream, syru s, and condiments all have 1 tables oon servin si es The servin si e or all meats is 3o - remember to com are it to a ac o cards Please note the other servin si es on the diet record, and do not assume that you are served or are eatin one servin si e only**
- **Please be sure to ill in hat ty e o cereal, mil , sauce, dressin , etc , that you eat**

**Name:**______________________________________________

**3-Day Diet Record**

**Please include all beverages consumed!!

**Thursday, November 15**

**Breakfast**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Cantaloupe wedges | 1/8 cantaloupe | |
| | Applesauce | ¼ cup | |
| | Fried Eggs | 1 egg | |
| | Scrambled Eggs | ¼ cup | |
| | Hard-boiled Eggs | 1 egg | |
| | Bacon | 2 slices | |
| | Hash Browns | ½ cup | |
| | French Toast | 1 slice | |
| | Cake Donut | 1 donut | |
| | Cinnamon roll w/ cream cheese frosting | 1 roll | |
| | White Bread | 1 slice | |
| | Whole Wheat Bread | 1 slice | |
| | Sunflower Bread | 1 slice | |
| | Bagel: | 1 bagel | |
| | Cream Cheese: | 1 Tbsp | |
| | Waffle | 1 waffle | |
| | Yogurt: | 1 cup | |
| | Whole Fruit: | 1 piece | |
| | Cereal: | 1 cup | |
| | Milk: | 1 cup | |
| | Juice: | ¾ cup | |
| | Coffee: | 1 cup | |
| | Butter | 1 Tbsp | |
| | Syrup | 1 Tbsp | |
| | Ketchup | 1 Tbsp | |
| | Tabasco sauce | 1 tsp | |

**Thursday, November 15**
**Lunch**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Chicken Noodle Soup | 1 cup | |
| | Teriyaki Pineapple Chicken Wings | 3oz | |
| | Sauce: | 1 Tbsp | |
| | Pepperoni Pizza | 16" pizza | |
| | Cheese Pizza | 16" pizza | |
| | BBQ Chicken Pizza | 16" pizza | |
| | Ranch Chicken Pizza | 16" pizza | |
| | Vegetarian Pizza | 16" pizza | |
| | Broccoli | ½ cup | |
| | Lime Jello | ¼ cup | |
| | Canned fruit | ½ cup | |
| | Nutty Pear Salad | ½ cup | |
| | Chocolate Pudding | ¼ cup | |
| | Salad Bar: | 1 cup | |
| | | | |
| | | | |
| | Dressing: | 1 Tbsp | |
| | | | |
| | Toppings: | 1 Tbsp | |
| | | | |
| | Sandwich bar: | | |
| | Bread: | 1 slice | |
| | Meat: | 3oz | |
| | Cheese: | 2oz | |
| | Spread: | 1 Tbsp | |
| | Toppings: | | |
| | | | |
| | | | |
| | Taco Bar: | | |
| | | 1 shell | |
| | | 3oz meat | |
| | | | |
| | Milk: | 1 cup | |
| | Juice: | ¾ cup | |
| | Other: | | |

**Thursday, November 15**
**Dinner**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Linguini | ½ cup | |
| | Meat Sauce | ½ cup | |
| | Alfredo Sauce | ½ cup | |
| | Clam Sauce | ½ cup | |
| | Roasted Vegetable Sauce | ½ cup | |
| | Salmon | 3oz | |
| | Green Beans | ½ cup | |
| | Corn Cobbette | ½ cup | |
| | Orange Jello | ½ cup | |
| | Pear Halves | ½ cup | |
| | Apple Wedges | ½ cup | |
| | Garlic Bread | 1 slice | |
| | Sundae bar: ice cream | ½ cup | |
| | Toppings: | | |
| | | | |
| | Mexican Wedding Cookie | 1 cookie | |
| | Salad Bar: | 1 cup | |
| | | | |
| | Dressing: | 1 Tbsp | |
| | | | |
| | Toppings: | 1 Tbsp | |
| | | | |
| | Sandwich Bar: | | |
| | Bread: | 1 slice | |
| | Meat: | 3oz | |
| | | | |
| | Cheese: | 2oz | |
| | | | |
| | Spread: | 1 Tbsp | |
| | | | |
| | Toppings: | | |
| | Milk: | 1 cup | |

| | | | |
|---|---|---|---|
| | Juice: | ¾ cup | |

**Thursday, November 15**
**Snacks/ Other**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Grill Menu: | | |
| | Burger | 1 burger + bun | |
| | French Fries | ½ cup | |
| | Chicken Grilla | 1 patty + bun | |
| | Chicken O's | 3oz | |
| | Hot Dog | 1 | |
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**Daily Water Consumption**
**8oz glasses**

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

**Friday, November 16**
**Breakfast**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Grapes | ½ cup | |
| | Grapefruit Sections | ½ cup | |
| | Fried Eggs | 1 egg | |
| | Scrambled Eggs | ¼ cup | |
| | Hard-boiled Eggs | 1 egg | |
| | Country Sausage Gravy | ¼ cup | |
| | Biscuit | 1 biscuit | |
| | Cheesy Scrambed Eggs | ¼ cup | |
| | Cake Donuts | 1 donut | |
| | Raspberry White Chocolate Scone | 1 scone | |
| | White Bread | 1 slice | |
| | Whole Wheat Bread | 1 slice | |
| | Oatmeal Wheat Bread | 1 slice | |
| | Bagel: | 1 bagel | |
| | Cream Cheese: | 1 Tbsp | |
| | Waffle | 1 waffle | |
| | Yogurt: | 1 cup | |
| | Whole Fruit: | 1 piece | |
| | Cereal: | 1 cup | |
| | Milk: | 1 cup | |
| | Juice: | ¾ cup | |
| | Coffee: | 1 cup | |
| | Butter | 1 Tbsp | |
| | Syrup | 1 Tbsp | |
| | Ketchup | 1 Tbsp | |
| | Tabasco sauce | 1 tsp | |

**Friday, November 16**
**Lunch**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Tomato Soup | 1 cup | |
| | Chili | 1 cup | |
| | Corn Bread | 1 piece | |
| | Honey Butter | 1 Tbsp | |
| | Grilled Ham & Cheese Sandwich on White/ Wheat (circle one) | 2 slices bread + ham & cheese | |
| | Turkey Honey Mustard Sandwich on 12 Grain | 2 slices bread + 3oz turkey + honey mustard | |
| | Green Beans | ½ cpu | |
| | Curly French Fries | ½ cup | |
| | Cherry Jello w/ Bananas | ½ cup | |
| | Peach Slices | ½ cup | |
| | Lemon Fruit Compote | ¼ cup | |
| | Brownie | 1 brownie | |
| | Salad Bar: | 1 cup | |
| | | | |
| | | | |
| | Dressing: | 1 Tbsp | |
| | | | |
| | Toppings: | 1 Tbsp | |
| | | | |
| | | | |
| | Sandwich bar: | | |
| | Bread: | 1 slice | |
| | Meat: | 3oz | |
| | Cheese: | 2oz | |
| | Spread: | 1 Tbsp | |
| | Toppings: | | |
| | | | |
| | | | |
| | Taco Bar: | | |
| | | 1 shell | |
| | | | |
| | Milk: | 1 cup | |
| | Juice: | ¾ cup | |

| | | | |
|---|---|---|---|
| | Other: | | |

**Friday, November 16**
**Dinner**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | BBQ Beef Shortribs | 3oz | |
| | General Tao Chicken Tempura | 3oz | |
| | White Rice | ½ cup | |
| | Pasta Primavera Sauce | ½ cup | |
| | Whole Wheat Fettuccini | ½ cup | |
| | Peas | ½ cup | |
| | Country Blend Vegetables | ½ cup | |
| | Raspberry Jello | ½ cup | |
| | Mandarin Oranges | ½ cup | |
| | Corn Salad | ½ cup | |
| | Whole Grain Roll | 1 roll | |
| | Red Velvet Cake | 1 slice | |
| | Salad Bar: | 1 cup | |
| | | | |
| | | | |
| | Dressing: | 1 Tbsp | |
| | | | |
| | Toppings: | 1 Tbsp | |
| | | | |
| | | | |
| | Sandwich Bar: | | |
| | Bread: | 1 slice | |
| | Meat: | 3oz | |
| | | | |
| | Cheese: | 2oz | |
| | | | |
| | Spread: | 1 Tbsp | |
| | | | |
| | Toppings: | | |
| | | | |
| | Milk: | 1 cup | |
| | Juice: | ¾ cup | |

| | | | |
|---|---|---|---|
| | Other: | | |

**Friday, November 16**
**Snacks/ Other**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Grill Menu: | | |
| | Burger | 1 burger + bun | |
| | French Fries | ½ cup | |
| | Chicken Grilla | 1 patty + bun | |
| | Chicken O’s | 3oz | |
| | Hot Dog | 1 | |
| | | | |
| | | | |
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| | | | |

**Daily Water Consumption**
**8oz glasses**

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |

**Saturday, November 17**

**Breakfast**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Grapefruit Halves | ½ fruit | |
| | Canned Fruit | ½ cup | |
| | Fried Eggs | 1 egg | |
| | Scrambled Eggs | ¼ cup | |
| | Hard-boiled Eggs | 1 egg | |
| | Pancakes | 1 pancake | |
| | Cake Donuts | 1 donut | |
| | Danish | 1 roll | |
| | White Bread | 1 slice | |
| | Whole Wheat Bread | 1 slice | |
| | Honey Wheat Bread | 1 slice | |
| | Bagel: | 1 bagel | |
| | Cream Cheese: | 1 Tbsp | |
| | Waffle | 1 waffle | |
| | Yogurt: | 1 cup | |
| | Whole Fruit: | 1 piece | |
| | Cereal: | 1 cup | |
| | Milk: | 1 cup | |
| | Juice: | ¾ cup | |
| | Coffee: | 1 cup | |
| | Butter | 1 Tbsp | |
| | Syrup | 1 Tbsp | |
| | Ketchup | 1 Tbsp | |
| | Tabasco sauce | 1 tsp | |

**Saturday, November 17**
**Lunch**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Beef Vegetable Soup | 1 cup | |
| | Baked Ziti | 1 cup | |
| | Ham & Swiss Burger | 1 burger + bun | |
| | Pork Chop John Sandwich on White/ Wheat (circle one) | 1 patty + bun + lettuce + tomato | |
| | Baked Southwest Turkey Burger | 1 patty + bun | |
| | Shoestring Fries | ½ cup | |
| | Mixed Vegetables | ½ cup | |
| | Lemon Jello | ½ cup | |
| | Pear Halves | ½ cup | |
| | Zesty Vegetable Salad | ½ cup | |
| | Pound Cake: | 1 slice | |
| | Salad Bar: | 1 cup | |
| | | | |
| | | | |
| | Dressing: | 1 Tbsp | |
| | | | |
| | Toppings: | 1 Tbsp | |
| | | | |
| | | | |
| | Sandwich bar: | | |
| | Bread: | 1 slice | |
| | Meat: | 30z | |
| | | | |
| | Cheese: | 2oz | |
| | | | |
| | Spread: | 1 Tbsp | |
| | Toppings: | | |
| | | | |
| | Milk: | 1 cup | |
| | Juice: | ¾ cup | |
| | Other: | | |

**Saturday, November 17**
**Dinner**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Chicken Drummettes | 3oz | |
| | Sauce: | 1 Tbsp | |
| | Beef Marsala | ½ cup | |
| | Egg Noodles | ½ cup | |
| | Zesty Chicken | 5oz breast | |
| | Pasta | ½ cup | |
| | Stuffed Scorn Squash | 1 cup | |
| | Peas | ½ cup | |
| | Cauliflower | ½ cup | |
| | Cheese Sauce | 1 Tbsp | |
| | Orange Jello | ½ cup | |
| | Apricot Halves | ½ cup | |
| | Fresh Fruit Salad | ½ cup | |
| | White Dinner Roll | 1 roll | |
| | Yellow Cake w/ Chocolate Frosting | 1 slice | |
| | Salad Bar: | 1 cup | |
| | | | |
| | Dressing: | 1 Tbsp | |
| | | | |
| | Toppings: | 1 Tbsp | |
| | | | |
| | Sandwich Bar: | | |
| | Bread: | 1 slice | |
| | Meat: | 3oz | |
| | | | |
| | Cheese: | 2oz | |
| | | | |
| | Spread: | 1 Tbsp | |
| | | | |
| | Toppings: | | |
| | | | |
| | Milk: | 1 cup | |
| | Juice: | ¾ cup | |

| | | | |
|---|---|---|---|
| | Other: | | |

**Saturday, November 17**
**Snacks/ Other**

| TIME | FOOD | SERVING SIZE | # SERVINGS |
|---|---|---|---|
| | Grill Menu: | | |
| | Burger | 1 burger + bun | |
| | French Fries | ½ cup | |
| | Chicken Grilla | 1 patty + bun | |
| | Chicken O's | 3oz | |
| | Hot Dog | 1 | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
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| | | | |
| | | | |

**Daily Water Consumption**
**8oz glasses**

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

# APPENDIX C:

# STRENGTH AND CONDITIONING PROGRAM

**MASTER**

EXTRA WARM UP SETS MAY BE NEEDED!!
***STRENGTH COACH MUST SIGN OFF EXERCISES IN CAPS AND COMPLETED WORKOUTS!!***

| | **PHASE I WEEKS 1-2** | | | | | | |
|---|---|---|---|---|---|---|---|
| **MONDAY** | | % | wt | reps | % | wt | reps |
| 100% | **Clean** | 0.0% | **0** | **x3t5** | 0.0% | **0** | **x3t5** |
| 1000 | **Pulls** | 0.0% | **0** | **x3t5** | 0.0% | **0** | **x3t5** |
| | | 0.0% | **0** | **x5** | 0.0% | **0** | **x5** |
| | | 0.0% | **0** | **x5** | 0.0% | **0** | **x5** |
| | | 0.0% | **0** | **x5** | 0.0% | **0** | **x5** |
| | | 0.0% | **0** | **x5** | 0.0% | **0** | **x5** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| 100% | **BOX** | 0.0% | **0** | **x3t5** | 0.0% | **0** | **x3t5** |
| 1000 | **SQUAT** | 0.0% | **0** | **x3t5** | 0.0% | **0** | **x3t5** |
| | | 0.0% | **0** | **x3t5** | 0.0% | **0** | **x3t5** |
| | | 0.0% | **0** | **x8** | 0.0% | **0** | **x6** |
| | | 0.0% | **0** | **x8** | 0.0% | **0** | **x6** |
| | | 0.0% | **0** | **x8** | 0.0% | **0** | **x6** |
| | | 0.0% | **0** | **x8** | 0.0% | **0** | **x6** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| **A1** | | 0.0% | **0** | **x10** | 0.0% | **0** | **x10** |
| 0% | **Pullups** | 0.0% | **0** | **x10** | 0.0% | **0** | **x10** |
| 0 | | 0.0% | **0** | **x10** | 0.0% | **0** | **x10** |
| **A2** | **Bar** | 0.0% | **0** | **x10e** | 0.0% | **0** | **x10e** |
| 48% | **Split Squat** | 0.0% | **0** | **x10e** | 0.0% | **0** | **x10e** |
| 480 | | 0.0% | **0** | **x10e** | 0.0% | **0** | **x10e** |
| **B1** | | 0.0% | **0** | **x10e** | 0.0% | **0** | **x10e** |
| 40% | **Db 1-Arm Row** | 0.0% | **0** | **x10e** | 0.0% | **0** | **x10e** |
| 400 | | 0.0% | **0** | **x10e** | 0.0% | **0** | **x10e** |
| **B2** | | 0.0% | **0** | **x12** | 0.0% | **0** | **x10** |
| 0% | **Db Curls** | 0.0% | **0** | **x12** | 0.0% | **0** | **x10** |
| 0 | | 0.0% | **0** | **x12** | 0.0% | **0** | **x10** |

| WEDNESDAY | | % | wt | reps | % | wt | reps |
|---|---|---|---|---|---|---|---|
| 100% | **POWER CLEANS** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 1000 | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 100% | **BENCH PRESS** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 1000 | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | **RDL+Shrug** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 80% | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 800 | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| **A2** | **Db Shoulder Press** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 25% | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 250 | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| **B1** | **Slideboard Curls** | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| 0% | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| **B2** | **Db Tricep Ext** | 0.0% | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |
| 0% | | 0.0% | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | 0.0% | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | DEVELOPMENTAL TECHNIQUE TO 5RM | | | | | |
| **FRIDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 100% | **Hang Cleans** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 1000 | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 75% | **FRONT SQUAT** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 750 | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | **Incline Bench** | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| 0% | | 0.0% | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x6*** |
| 0 | | 0.0% | ***0*** | ***2x8*** | *0.0%* | ***0*** | ***2x6*** |
| **A2** | **Db Stepups** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 15% | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 150 | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| **B1** | **Chinups** | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| 75% | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| 750 | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| **B2** | **Reverse Hypers** | 0.0% | ***0*** | ***x15*** | *0.0%* | ***0*** | ***x12*** |
| 0% | | 0.0% | ***0*** | ***x15*** | *0.0%* | ***0*** | ***x12*** |
| 0 | | 0.0% | ***0*** | ***x15*** | *0.0%* | ***0*** | ***x12*** |

**MASTER – Phase I Weeks 3-4**

EXTRA WARM UP SETS MAY BE NEEDED!!
***STRENGTH COACH MUST SIGN OFF EXERCISES IN CAPS AND COMPLETED WORKOUTS!!***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MONDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 100% | **Clean** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 1000 | **Pulls** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 100% | **BOX** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 1000 | **SQUAT** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x3*** | *0.0%* | ***0*** | ***x3t5*** |
| | **Week 4 -** | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | **Use Back Squat** | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | **for 5 RM** | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5RM*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| 0% | **Pullups** | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| **A2** | **Bar** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0% | **Split Squat** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0 | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0% | **Db 1-Arm Row** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0 | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0% | **Db Curls** | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0 | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |

| WEDNESDAY | | % | wt | reps | % | wt | reps |
|---|---|---|---|---|---|---|---|
| 100% | **POWER** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 1000 | **CLEANS** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 100% | **BENCH** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 1000 | **PRESS** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x3*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5RM*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0% | **RDL+Shrug** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0 | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| **A2** | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0% | **Db Shoulder** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0 | **Press** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| | | 0.0% | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x15*** |
| 0% | **Slideboard Curls** | 0.0% | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x15*** |
| 0 | | 0.0% | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x15*** |
| | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0% | **Db Tricep Ext** | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0 | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FRIDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 100% | **Hang Cleans** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 1000 | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 75% | **FRONT SQUAT** | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| 750 | | 0.0% | ***0*** | ***x3t5*** | *0.0%* | ***0*** | ***x3t5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | 0.0% | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| 0% | **Incline Bench** | 0.0% | ***0*** | ***x5*** | *0.0%* | ***0*** | ***x5*** |
| 0 | | 0.0% | ***0*** | ***2x5*** | *0.0%* | ***0*** | ***2x5*** |
| **A2** | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0% | **Db Stepups** | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0 | | 0.0% | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| 0% | **Chinups** | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0% | **Reverse Hypers** | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0 | | 0.0% | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |

**MASTER**

EXTRA WARM UP SETS MAY BE NEEDED!!
***STRENGTH COACH MUST SIGN OFF WORKOUT!!***

| PHASE II WEEKS 1-2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| MONDAY | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 100% | **3 Position** | *#####* | ***500*** | ***x3t5*** | *#####* | ***500*** | ***x3t5*** |
| 1000 | **Clean** | *#####* | ***650*** | ***x3t5*** | *#####* | ***650*** | ***x3t5*** |
| | **1 rep =** | *#####* | ***700*** | ***x3*** | *#####* | ***750*** | ***x3*** |
| | **1 Shrug** | *#####* | ***700*** | ***x3*** | *#####* | ***750*** | ***x3*** |
| | **1 Clean Pull** | *#####* | ***700*** | ***x3*** | *#####* | ***750*** | ***x3*** |
| | **1 Clean** | *#####* | ***700*** | ***x3*** | *#####* | ***750*** | ***x3*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | **SAFETY** | | | | | | |
| 85% | **BAR** | *#####* | ***340*** | ***x3t5*** | *#####* | ***340*** | ***x3t5*** |
| 850 | **BOX SQUAT** | *#####* | ***425*** | ***x3t5*** | *#####* | ***425*** | ***x3t5*** |
| | | *#####* | ***555*** | ***x3t5*** | *#####* | ***555*** | ***x3t5*** |
| | | *#####* | ***595*** | ***x6*** | *#####* | ***660*** | ***x5*** |
| | | *#####* | ***595*** | ***x6*** | *#####* | ***660*** | ***x5*** |
| | | *#####* | ***595*** | ***x6*** | *#####* | ***660*** | ***x5*** |
| | | *#####* | ***595*** | ***x6*** | *#####* | ***660*** | ***x5*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| 0% | **Chinups** | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| 0 | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| **A2** | **Bar** | *#####* | ***300*** | ***x8e*** | *#####* | ***315*** | ***x8e*** |
| 50% | **Stepups** | *#####* | ***300*** | ***x8e*** | *#####* | ***315*** | ***x8e*** |
| 500 | | *#####* | ***300*** | ***x8e*** | *#####* | ***315*** | ***x8e*** |
| | **Db** | *#####* | ***190*** | ***x8*** | *#####* | ***200*** | ***x8*** |
| | **Chest** | | | | | | |
| 32% | **Supported** | *#####* | ***190*** | ***x8*** | *#####* | ***200*** | ***x8*** |
| 320 | **Row** | *#####* | ***190*** | ***x8*** | *#####* | ***200*** | ***x8*** |
| | | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |
| 0% | **Bar Curls** | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **WEDNESDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 100% | **POWER CLEAN** | *#####* | ***400*** | ***x3t5*** | *#####* | ***400*** | ***x3t5*** |
| 1000 | | *#####* | ***500*** | ***x3t5*** | *#####* | ***500*** | ***x3t5*** |
| | | *#####* | ***650*** | ***x3t5*** | *#####* | ***600*** | ***x3t5*** |
| | | *#####* | ***700*** | ***x5*** | *#####* | ***775*** | ***x4*** |
| | | *#####* | ***700*** | ***x5*** | *#####* | ***775*** | ***x4*** |
| | | *#####* | ***700*** | ***x5*** | *#####* | ***775*** | ***x4*** |
| | | *#####* | ***700*** | ***x5*** | *#####* | ***775*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 100% | **BENCH PRESS** | *#####* | ***400*** | ***x3t5*** | *#####* | ***400*** | ***x3t5*** |
| 1000 | | *#####* | ***500*** | ***x3t5*** | *#####* | ***500*** | ***x3t5*** |
| | | *#####* | ***650*** | ***x3t5*** | *#####* | ***600*** | ***x3t5*** |
| | | *#####* | ***700*** | ***x6*** | *#####* | ***775*** | ***x5*** |
| | | *#####* | ***700*** | ***x6*** | *#####* | ***775*** | ***x5*** |
| | | *#####* | ***700*** | ***x6*** | *#####* | ***775*** | ***x5*** |
| | | *#####* | ***700*** | ***x6*** | *#####* | ***775*** | ***x5*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | | *0.0%* | ***0*** | ***x15*** | *0.0%* | ***0*** | ***x12*** |
| 0% | **Pullthroughs** | *0.0%* | ***0*** | ***x15*** | *0.0%* | ***0*** | ***x12*** |
| 0 | | *0.0%* | ***0*** | ***x15*** | *0.0%* | ***0*** | ***x12*** |
| **A2** | | *#####* | ***300*** | ***x8*** | *#####* | ***315*** | ***x8*** |
| 50% | **Bar Shoulder Press** | *#####* | ***300*** | ***x8*** | *#####* | ***315*** | ***x8*** |
| 500 | | *#####* | ***300*** | ***x8*** | *#####* | ***315*** | ***x8*** |
| | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| 0% | **Glute Ham Raise** | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| | | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |
| 0% | **Bar Tricep Ext** | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |

DEVELOPMENTAL
85% PERFORMANCE CYCLE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| FRIDAY | | % | wt | reps | % | wt | reps |
| 90% | **Back** | ##### | 450 | x3t5 | ##### | 450 | x3t5 |
| 900 | **Jerk** | ##### | 585 | x3t5 | ##### | 585 | x3t5 |
| | | ##### | 630 | x5 | ##### | 675 | x5 |
| | | ##### | 630 | x5 | ##### | 675 | x5 |
| | | ##### | 630 | x5 | ##### | 675 | x5 |
| | | ##### | 630 | x5 | ##### | 675 | x5 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| 85% | **SUMO** | ##### | 340 | x3t5 | ##### | 340 | x3t5 |
| 850 | **DEADLIFT** | ##### | 425 | x3t5 | ##### | 425 | x3t5 |
| | | ##### | 555 | x3t5 | ##### | 555 | x3t5 |
| | | ##### | 595 | x6 | ##### | 660 | x5 |
| | | ##### | 595 | x6 | ##### | 660 | x5 |
| | | ##### | 595 | x6 | ##### | 660 | x5 |
| | | ##### | 595 | x6 | ##### | 660 | x5 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| **A1** | **Db** | ##### | 245 | x6 | ##### | 270 | x5 |
| 35% | **Incline Bench** | ##### | 245 | x6 | ##### | 270 | x5 |
| 350 | | ##### | 245 | 2x6 | ##### | 270 | 2x5 |
| **A2** | **Db** | ##### | 90 | x8e | ##### | 95 | x8e |
| 15% | **Reverse Lunge** | ##### | 90 | x8e | ##### | 95 | x8e |
| 150 | | ##### | 90 | x8e | ##### | 95 | x8e |
| | | 0.0% | 0 | xMax | 0.0% | 0 | xMax |
| 0% | **Inverted Rows** | 0.0% | 0 | x-20% | 0.0% | 0 | x-20% |
| 0 | | 0.0% | 0 | x-20% | 0.0% | 0 | x-20% |
| | **45** | 0.0% | 0 | x15 | 0.0% | 0 | x12 |
| 0% | **Back Hypers** | 0.0% | 0 | x15 | 0.0% | 0 | x12 |
| 0 | | 0.0% | 0 | x15 | 0.0% | 0 | x12 |

**MASTER – Phase II –**
**Weeks 3-4**

EXTRA WARM UP SETS MAY BE NEEDED!!
***STRENGTH COACH MUST SIGN OFF WORKOUT!!***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MONDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 100% | **3 Position** | ***#####*** | ***500*** | ***x3t5*** | ***#####*** | ***500*** | ***x3t5*** |
| 1000 | **Clean** | ***#####*** | ***650*** | ***x3t5*** | ***#####*** | ***650*** | ***x3t5*** |
| | **1 rep =** | ***#####*** | ***600*** | ***x3*** | ***#####*** | ***800*** | ***x3*** |
| | **1 Shrug** | ***#####*** | ***600*** | ***x3*** | ***#####*** | ***800*** | ***x3*** |
| | **1 Clean Pull** | ***#####*** | ***600*** | ***x3*** | ***#####*** | ***800*** | ***x3*** |
| | **1 Clean** | ***#####*** | ***600*** | ***x3*** | ***#####*** | ***800*** | ***x3*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | **SAFETY** | | | | | | |
| 85% | **BAR** | ***#####*** | ***340*** | ***x3t5*** | ***#####*** | ***340*** | ***x3t5*** |
| 850 | **BOX SQUAT** | ***#####*** | ***425*** | ***x3t5*** | ***#####*** | ***425*** | ***x3t5*** |
| | | ***#####*** | ***555*** | ***x5*** | ***#####*** | ***555*** | ***x3t5*** |
| | | ***#####*** | ***555*** | ***x5*** | ***#####*** | ***725*** | ***x4*** |
| | | ***#####*** | ***555*** | ***x5*** | ***#####*** | ***725*** | ***x4*** |
| | | ***#####*** | ***555*** | ***x5*** | ***#####*** | ***725*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | ***#####*** | ***725*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| 0% | **Chinups** | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| 0 | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| **A2** | **Bar** | ***#####*** | ***325*** | ***x8e*** | ***#####*** | ***340*** | ***x8e*** |
| 50% | **Stepups** | ***#####*** | ***325*** | ***x8e*** | ***#####*** | ***340*** | ***x8e*** |
| 500 | | ***#####*** | ***325*** | ***x8e*** | ***#####*** | ***340*** | ***x8e*** |
| | **Db** | ***#####*** | ***210*** | ***x8*** | ***#####*** | ***215*** | ***x8*** |
| | **Chest** | | | | | | |
| 32% | **Supported** | ***#####*** | ***210*** | ***x8*** | ***#####*** | ***215*** | ***x8*** |
| 320 | **Row** | ***#####*** | ***210*** | ***x8*** | ***#####*** | ***215*** | ***x8*** |
| | | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0% | **Bar Curls** | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0 | | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| WEDNESDAY | | % | wt | reps | % | wt | reps |
| 100% | **POWER CLEAN** | ##### | 450 | x3t5 | ##### | 400 | x3t5 |
| 1000 | | ##### | 550 | x3t5 | ##### | 500 | x3t5 |
| | | ##### | 650 | x5 | ##### | 650 | x3t5 |
| | | ##### | 650 | x5 | ##### | 850 | x4 |
| | | ##### | 650 | x5 | ##### | 850 | x4 |
| | | ##### | 650 | x5 | ##### | 850 | x4 |
| | | 0.0% | 0 | 0 | ##### | 850 | x4 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| 100% | **BENCH PRESS** | ##### | 450 | x3t5 | ##### | 400 | x3t5 |
| 1000 | | ##### | 550 | x3t5 | ##### | 500 | x3t5 |
| | | ##### | 650 | x5 | ##### | 650 | x3t5 |
| | | ##### | 650 | x5 | ##### | 850 | x4 |
| | | ##### | 650 | x5 | ##### | 850 | x4 |
| | | ##### | 650 | x5 | ##### | 850 | x4 |
| | | 0.0% | 0 | 0 | ##### | 850 | x4 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| **A1** | **Pullthroughs** | 0.0% | 0 | x10 | 0.0% | 0 | x8 |
| 0% | | 0.0% | 0 | x10 | 0.0% | 0 | x8 |
| 0 | | 0.0% | 0 | x10 | 0.0% | 0 | x8 |
| **A2** | **Bar Shoulder Press** | ##### | 325 | x8 | ##### | 340 | x8 |
| 50% | | ##### | 325 | x8 | ##### | 340 | x8 |
| 500 | | ##### | 325 | x8 | ##### | 340 | x8 |
| | **Glute Ham Raise** | 0.0% | 0 | x12 | 0.0% | 0 | x15 |
| 0% | | 0.0% | 0 | x12 | 0.0% | 0 | x15 |
| 0 | | 0.0% | 0 | x12 | 0.0% | 0 | x15 |
| | **Bar Tricep Ext** | 0.0% | 0 | x10 | 0.0% | 0 | x8 |
| 0% | | 0.0% | 0 | x10 | 0.0% | 0 | x8 |
| 0 | | 0.0% | 0 | x10 | 0.0% | 0 | x8 |

DEVELOPMENTAL
85% PERFORMANCE CYCLE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FRIDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 90% | **Back Jerk** | ##### | ***450*** | ***x3t5*** | ##### | ***450*** | ***x3t5*** |
| 900 | | ##### | ***585*** | ***x5*** | ##### | ***585*** | ***x3t5*** |
| | | ##### | ***585*** | ***x5*** | ##### | ***720*** | ***x4*** |
| | | ##### | ***585*** | ***x5*** | ##### | ***720*** | ***x4*** |
| | | ##### | ***585*** | ***x5*** | ##### | ***720*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | ##### | ***720*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 85% | **SUMO DEADLIFT** | ##### | ***340*** | ***x3t5*** | ##### | ***340*** | ***x3t5*** |
| 850 | | ##### | ***425*** | ***x3t5*** | ##### | ***425*** | ***x3t5*** |
| | | ##### | ***555*** | ***x5*** | ##### | ***555*** | ***x3t5*** |
| | | ##### | ***555*** | ***x5*** | ##### | ***725*** | ***x4*** |
| | | ##### | ***555*** | ***x5*** | ##### | ***725*** | ***x4*** |
| | | ##### | ***555*** | ***x5*** | ##### | ***725*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | ##### | ***725*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | **Db Incline Bench** | ##### | ***230*** | ***x5*** | ##### | ***300*** | ***x4*** |
| 35% | | ##### | ***230*** | ***x5*** | ##### | ***300*** | ***x4*** |
| 350 | | ##### | ***230*** | ***3x5*** | ##### | ***300*** | ***2x4*** |
| **A2** | **Db Reverse Lunge** | ##### | ***100*** | ***x8e*** | ##### | ***100*** | ***x8e*** |
| 15% | | ##### | ***100*** | ***x8e*** | ##### | ***100*** | ***x8e*** |
| 150 | | ##### | ***100*** | ***x8e*** | ##### | ***100*** | ***x8e*** |
| | **Inverted Rows** | *0.0%* | ***0*** | ***xMax*** | *0.0%* | ***0*** | ***xMax*** |
| 0% | | *0.0%* | ***0*** | ***x-20%*** | *0.0%* | ***0*** | ***x-20%*** |
| 0 | | *0.0%* | ***0*** | ***x-20%*** | *0.0%* | ***0*** | ***x-20%*** |
| | **45 Back Hypers** | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0% | | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |
| 0 | | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x8*** |

**CORE**

| Phase III<br>Weeks 1-2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MONDAY** | | % | wt | reps | % | wt | reps |
| 100% | **Clean** | ##### | **400** | **x3t5** | ##### | **400** | **x3t5** |
| 1000 | **Pulls** | ##### | **500** | **x3t5** | ##### | **500** | **x3t5** |
| | | ##### | **650** | **x3t5** | ##### | **650** | **x3t5** |
| | | ##### | **750** | **x5** | ##### | **825** | **x4** |
| | | ##### | **750** | **x5** | ##### | **825** | **x4** |
| | | ##### | **750** | **x5** | ##### | **825** | **x4** |
| | | ##### | **750** | **x5** | ##### | **825** | **x4** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| 100% | **BACK** | ##### | **400** | **x3t5** | ##### | **400** | **x3t5** |
| 1000 | **SQUAT** | ##### | **500** | **x3t5** | ##### | **500** | **x3t5** |
| | | ##### | **650** | **x3t5** | ##### | **650** | **x3t5** |
| | | ##### | **750** | **x5** | ##### | **825** | **x4** |
| | | ##### | **750** | **x5** | ##### | **825** | **x4** |
| | | ##### | **750** | **x5** | ##### | **825** | **x4** |
| | | ##### | **750** | **x5** | ##### | **825** | **x4** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| **A1** | | 0.0% | **0** | **x8** | 0.0% | **0** | **x8** |
| 0% | **Pullups** | 0.0% | **0** | **x8** | 0.0% | **0** | **x8** |
| 0 | | 0.0% | **0** | **x8** | 0.0% | **0** | **x8** |
| **A2** | **Db** | ##### | **105** | **x8e** | ##### | **110** | **x8e** |
| 15% | **Bulgarian** | ##### | **105** | **x8e** | ##### | **110** | **x8e** |
| 150 | **Split Squat** | ##### | **105** | **x8e** | ##### | **110** | **x8e** |
| **B1** | **Db** | ##### | **80** | **x10** | ##### | **90** | **x10** |
| 16% | **Chest Supported** | ##### | **80** | **x10** | ##### | **90** | **x10** |
| 160 | **Wide Row** | ##### | **80** | **x10** | ##### | **90** | **x10** |
| **B2** | | 0.0% | **0** | **x12** | 0.0% | **0** | **x10** |
| 0% | **Db Curls** | 0.0% | **0** | **x12** | 0.0% | **0** | **x10** |
| 0 | | 0.0% | **0** | **x12** | 0.0% | **0** | **x10** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **WEDNESDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 100% | **POWER CLEAN** | *#####* | ***400*** | ***x3t5*** | *#####* | ***400*** | ***x3t5*** |
| 1000 | | *#####* | ***500*** | ***x3t5*** | *#####* | ***500*** | ***x3t5*** |
| | | *#####* | ***650*** | ***x3t5*** | *#####* | ***600*** | ***x3t5*** |
| | | *#####* | ***750*** | ***x3*** | *#####* | ***825*** | ***x3*** |
| | | *#####* | ***750*** | ***x3*** | *#####* | ***825*** | ***x3*** |
| | | *#####* | ***750*** | ***x3*** | *#####* | ***825*** | ***x3*** |
| | | *#####* | ***750*** | ***x3*** | *#####* | ***825*** | ***x3*** |
| | | *#####* | ***750*** | ***x3*** | *#####* | ***825*** | ***x3*** |
| | | *#####* | ***750*** | ***x3*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 100% | **BENCH PRESS** | *#####* | ***400*** | ***x3t5*** | *#####* | ***400*** | ***x3t5*** |
| 1000 | | *#####* | ***500*** | ***x3t5*** | *#####* | ***500*** | ***x3t5*** |
| | | *#####* | ***650*** | ***x3t5*** | *#####* | ***600*** | ***x3t5*** |
| | | *#####* | ***750*** | ***x5*** | *#####* | ***825*** | ***x4*** |
| | | *#####* | ***750*** | ***x5*** | *#####* | ***825*** | ***x4*** |
| | | *#####* | ***750*** | ***x5*** | *#####* | ***825*** | ***x4*** |
| | | *#####* | ***750*** | ***x5*** | *#####* | ***825*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | **RDL** | *#####* | ***560*** | ***x8*** | *#####* | ***580*** | ***x8*** |
| 80% | | *#####* | ***560*** | ***x8*** | *#####* | ***580*** | ***x8*** |
| 800 | | *#####* | ***560*** | ***x8*** | *#####* | ***580*** | ***x8*** |
| **A2** | **Db 3-Way Shoulder** | *0.0%* | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0% | | *0.0%* | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| 0 | | *0.0%* | ***0*** | ***x10e*** | *0.0%* | ***0*** | ***x10e*** |
| **B1** | **Band Leg Curls** | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| 0% | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| **B2** | **Db Tricep Ext** | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |
| 0% | | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x10*** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FRIDAY | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 75% | **Hang Clean** | *#####* | ***300*** | ***x3t5*** | *#####* | ***300*** | ***x3t5*** |
| 750 | | *#####* | ***375*** | ***x3t5*** | *#####* | ***375*** | ***x3t5*** |
| | | *#####* | ***490*** | ***x3t5*** | *#####* | ***490*** | ***x3t5*** |
| | | *#####* | ***565*** | ***x5*** | *#####* | ***600*** | ***x4*** |
| | | *#####* | ***565*** | ***x5*** | *#####* | ***600*** | ***x4*** |
| | | *#####* | ***565*** | ***x5*** | *#####* | ***600*** | ***x4*** |
| | | *#####* | ***565*** | ***x5*** | *#####* | ***600*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 75% | **FRONT SQUAT** | *#####* | ***300*** | ***x3t5*** | *#####* | ***300*** | ***x3t5*** |
| 750 | | *#####* | ***375*** | ***x3t5*** | *#####* | ***375*** | ***x3t5*** |
| | | *#####* | ***490*** | ***x3t5*** | *#####* | ***490*** | ***x3t5*** |
| | | *#####* | ***565*** | ***x5*** | *#####* | ***620*** | ***x4*** |
| | | *#####* | ***565*** | ***x5*** | *#####* | ***620*** | ***x4*** |
| | | *#####* | ***565*** | ***x5*** | *#####* | ***620*** | ***x4*** |
| | | *#####* | ***565*** | ***x5*** | *#####* | ***620*** | ***x4*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | **4-Board Bench** | *#####* | ***820*** | ***x5*** | *#####* | ***900*** | ***x4*** |
| 109% | | *#####* | ***820*** | ***x5*** | *#####* | ***900*** | ***x4*** |
| 1090 | | *#####* | ***820*** | ***2x5*** | *#####* | ***900*** | ***2x4*** |
| **A2** | **1-leg Box Squat** | *0.0%* | ***0*** | ***x6e*** | *0.0%* | ***0*** | ***x6e*** |
| 0% | | *0.0%* | ***0*** | ***x6e*** | *0.0%* | ***0*** | ***x6e*** |
| 0 | | *0.0%* | ***0*** | ***x6e*** | *0.0%* | ***0*** | ***x6e*** |
| **B1** | **Suspended Row** | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| 0% | | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | *0.0%* | ***0*** | ***x10*** | *0.0%* | ***0*** | ***x10*** |
| **B2** | **Pause Hypers (2 sec Pause)** | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| 0% | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |
| 0 | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x10*** |

| Phase III Weeks 3-4 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MONDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 100% | **Clean** | ##### | **450** | **x3t5** | ##### | **450** | **x3t5** |
| 1000 | **Pulls** | ##### | **550** | **x3t5** | ##### | **550** | **x3t5** |
| | | ##### | **650** | **x3t5** | ##### | **650** | **x3t5** |
| | | ##### | **700** | **x3** | ##### | **750** | **x3** |
| | | ##### | **700** | **x3** | ##### | **850** | **x3** |
| | | ##### | **700** | **x3** | ##### | **900** | **x2** |
| | | ##### | **700** | **x3** | ##### | **900** | **x2** |
| | | 0.0% | **0** | **0** | ##### | **900** | **x2** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| 100% | **BACK** | ##### | **450** | **x3t5** | ##### | **450** | **x3t5** |
| 1000 | **SQUAT** | ##### | **550** | **x3t5** | ##### | **550** | **x3t5** |
| | | ##### | **650** | **x3t5** | ##### | **650** | **x3t5** |
| | | ##### | **700** | **x3** | ##### | **750** | **x3** |
| | | ##### | **700** | **x3** | ##### | **850** | **x3** |
| | | ##### | **700** | **x3** | ##### | **900** | **x2** |
| | | ##### | **700** | **x3** | ##### | **900** | **x2** |
| | | 0.0% | **0** | **0** | ##### | **900** | **x2** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| | | 0.0% | **0** | **0** | 0.0% | **0** | **0** |
| **A1** | | 0.0% | **0** | **x6** | 0.0% | **0** | **x6** |
| 0% | **Pullups** | 0.0% | **0** | **x6** | 0.0% | **0** | **x6** |
| 0 | | 0.0% | **0** | **x6** | 0.0% | **0** | **x6** |
| **A2** | **Db** | ##### | **115** | **x6e** | ##### | **115** | **x6e** |
| 15% | **Bulgarian** | ##### | **115** | **x6e** | ##### | **115** | **x6e** |
| 150 | **Split Squat** | ##### | **115** | **x6e** | ##### | **115** | **x6e** |
| **B1** | **Db** | ##### | **95** | **x8** | ##### | **110** | **x8** |
| 16% | **Chest Supported** | ##### | **95** | **x8** | ##### | **110** | **x8** |
| 160 | **Wide Row** | ##### | **95** | **x8** | ##### | **110** | **x8** |
| **B2** | | 0.0% | **0** | **x10** | 0.0% | **0** | **x8** |
| 0% | **Db Curls** | 0.0% | **0** | **x10** | 0.0% | **0** | **x8** |
| 0 | | 0.0% | **0** | **x10** | 0.0% | **0** | **x8** |

| WEDNESDAY | | % | wt | reps | % | wt | reps |
|---|---|---|---|---|---|---|---|
| 100% | **POWER** | ##### | 450 | x3t5 | ##### | 450 | x3t5 |
| 1000 | **CLEAN** | ##### | 550 | x3t5 | ##### | 550 | x3t5 |
| | | ##### | 650 | x3t5 | ##### | 650 | x3t5 |
| | | ##### | 700 | x3 | ##### | 750 | x3 |
| | | ##### | 700 | x3 | ##### | 850 | x2 |
| | | ##### | 700 | x3 | ##### | 900 | x1 |
| | | ##### | 700 | x3 | ##### | 900 | x1 |
| | | 0.0% | 0 | 0 | ##### | 900 | x1 |
| | | 0.0% | 0 | 0 | ##### | 900 | x1 |
| | | 0.0% | 0 | 0 | ##### | 900 | 2x1 |
| 100% | **BENCH** | ##### | 450 | x3t5 | ##### | 450 | x3t5 |
| 1000 | **PRESS** | ##### | 550 | x3t5 | ##### | 550 | x3t5 |
| | | ##### | 650 | x3t5 | ##### | 650 | x3t5 |
| | | ##### | 700 | x3 | ##### | 750 | x3t5 |
| | | ##### | 700 | x3 | ##### | 850 | x3 |
| | | ##### | 700 | x3 | ##### | 900 | x2 |
| | | ##### | 700 | x3 | ##### | 900 | x2 |
| | | 0.0% | 0 | 0 | ##### | 900 | x2 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| | | 0.0% | 0 | 0 | 0.0% | 0 | 0 |
| **A1** | | ##### | 600 | x8 | ##### | 620 | x6 |
| 80% | **RDL** | ##### | 600 | x8 | ##### | 620 | x6 |
| 800 | | ##### | 600 | x8 | ##### | 620 | x6 |
| **A2** | **Db** | 0.0% | 0 | x8e | 0.0% | 0 | x8e |
| 0% | **3-Way Shoulder** | 0.0% | 0 | x8e | 0.0% | 0 | x8e |
| 0 | | 0.0% | 0 | x8e | 0.0% | 0 | x8e |
| **B1** | | 0.0% | 0 | x12 | 0.0% | 0 | x15 |
| 0% | **Band Leg Curls** | 0.0% | 0 | x12 | 0.0% | 0 | x15 |
| 0 | | 0.0% | 0 | x12 | 0.0% | 0 | x15 |
| **B2** | | 0.0% | 0 | x10 | 0.0% | 0 | x8 |
| 0% | **Db Tricep Ext** | 0.0% | 0 | x10 | 0.0% | 0 | x8 |
| 0 | | 0.0% | 0 | x10 | 0.0% | 0 | x8 |

90% PERFORMANCE
CYCLE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FRIDAY** | | *%* | *wt* | *reps* | *%* | *wt* | *reps* |
| 75% | **Hang** | *#####* | ***340*** | ***x3t5*** | *#####* | ***340*** | ***x3t5*** |
| 750 | **Clean** | *#####* | ***375*** | ***x3t5*** | *#####* | ***415*** | ***x3t5*** |
| | | *#####* | ***490*** | ***x5*** | *#####* | ***490*** | ***x3t5*** |
| | | *#####* | ***490*** | ***x5*** | *#####* | ***640*** | ***x3*** |
| | | *#####* | ***490*** | ***x5*** | *#####* | ***640*** | ***x3*** |
| | | *#####* | ***490*** | ***x5*** | *#####* | ***640*** | ***x3*** |
| | | *0.0%* | ***0*** | ***0*** | *#####* | ***640*** | ***x3*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| 75% | **FRONT** | *#####* | ***340*** | ***x3t5*** | *#####* | ***340*** | ***x3t5*** |
| 750 | **SQUAT** | *#####* | ***415*** | ***x3t5*** | *#####* | ***415*** | ***x3t5*** |
| | | *#####* | ***490*** | ***x3t5*** | *#####* | ***490*** | ***x3t5*** |
| | | *#####* | ***525*** | ***x3*** | *#####* | ***565*** | ***x3*** |
| | | *#####* | ***525*** | ***x3*** | *#####* | ***640*** | ***x3*** |
| | | *#####* | ***525*** | ***x3*** | *#####* | ***675*** | ***x2*** |
| | | *#####* | ***525*** | ***x3*** | *#####* | ***675*** | ***x2*** |
| | | *0.0%* | ***0*** | ***0*** | *#####* | ***675*** | ***x2*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| | | *0.0%* | ***0*** | ***0*** | *0.0%* | ***0*** | ***0*** |
| **A1** | | *#####* | ***765*** | ***x3*** | *#####* | ***980*** | ***x2*** |
| | **4-Board** | | | | | | |
| 109% | **Bench** | *#####* | ***765*** | ***x3*** | *#####* | ***980*** | ***x2*** |
| 1090 | | *#####* | ***765*** | ***2x3*** | *#####* | ***980*** | ***x2*** |
| **A2** | | *0.0%* | ***0*** | ***x8e*** | *0.0%* | ***0*** | ***x8e*** |
| | **1-leg Box** | | | | | | |
| 0% | **Squat** | *0.0%* | ***0*** | ***x8e*** | *0.0%* | ***0*** | ***x8e*** |
| 0 | | *0.0%* | ***0*** | ***x8e*** | *0.0%* | ***0*** | ***x8e*** |
| **B1** | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| | **Suspended** | | | | | | |
| 0% | **Row** | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| 0 | | *0.0%* | ***0*** | ***x8*** | *0.0%* | ***0*** | ***x8*** |
| **B2** | | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x15*** |
| 0% | **Pause Hypers** | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x15*** |
| 0 | **(2 sec Pause)** | *0.0%* | ***0*** | ***x12*** | *0.0%* | ***0*** | ***x15*** |

**Monday**
**CORE**

| | |
|---|---|
| V-Ups | x30sec |
| Twists | x60sec |
| Side Hip Lifts | x60sec |
| Shoulder Bridge | x2min |

**POST WORK**
STRETCH

**Wednesday**
**CORE**

| | |
|---|---|
| MB Toe Touches | 2 x 30 |
| MB Clockwork | 2 x 30 |
| KOR Side Bend | 2 x 30e |
| Lateral Bridge | x60 sec each |

**POST WORK**
STRETCH

**Friday**
**CORE**

| | |
|---|---|
| SB Plate Crunch | 2 x 30 |
| SB Plate Twist | 2 x 30 |
| Band Side Bend | 2 x 30e |
| Elbow Bridge | x90 sec |

**POST WORK**
STRETCH