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MONTCLAIR STATE UNIVERSITY

NUTRITIONAL EVALUATION OF LEAN AND NON-LEAN FEMALE HIGH SCHOOL ATHLETES USING MYPYRAMID

by

William Edward McSheffrey

A Master's Thesis Submitted to the Faculty of

Montclair State University

In Partial Fulfillment of the Requirements

For the Degree of

Master of Science

January 2008

College of Education and Human Services

Department Health and Nutrition Sciences

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THESIS ABSTRACT

NUTRITIONAL EVALUATION OF LEAN AND NON-LEAN FEMALE HIGH SCHOOL ATHLETES USING MYPYRAMID

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MyPyramid was used to evaluate the nutritional status of twelve lean and fourteen non-lean high school female athletes. Lean athletes are those who participate in sports where weight control is considered important for performance. Weights of athletes participating in non-lean sports are less likely to influence performance. In this study, all the lean sport athletes participated in track, and the non-lean athletes competed in softball. Subjects included twenty-five middle-class Caucasians and one Hispanic from two northern New Jersey high schools. All subjects and their parents gave their consent to participate. Subjects needed to be in good health, between the ages of 14-18, and be a member of a varsity or junior varsity school team. Three-day food records were evaluated for intake of MyPyramid food groups, calories, protein, carbohydrates, lipids, vitamin B12, folic acid, calcium, magnesium and iron. Specific nutrients were selected based on their effect on bone health, blood volume and energy levels. A questionnaire assessed common health concerns of female athletes associated with nutrient evaluations. Average height and weight was 64.6 inches and 116.7 pounds for the lean athletes and 63.9 inches and 126 pounds for the non-lean athletes. Average age was 16.5 years for the lean and 16.1 years for the non-lean. A MyPyramid website profile was established for each study participant to evaluate food records. Data was transferred to a Microsoft Excel worksheet for further analysis. Results showed that combined lean and non-lean subjects were below the USDA MyPyramid standards for milk (-1.5 cups, P<0.001), vegetables (-1.40, cups, P<0.001), fruit (0.59, P<0.001), carbohydrates (P<0.001), calcium (P<0.001), magnesium (P<0.001) and iron (P<0.001). Lean athletes consumed a three-day mean caloric intake of 1,779 calories, whereas, the non-lean had a three-day mean caloric intake of 1,524 calories. The USDA calcium recommendation is 1300 mg for this age group. Lean group athletes had a three-day mean calcium intake of 1,006.1 mg, while the non-lean group had a mean of 553.46 mg, well below the USDA requirement. The USDA magnesium recommendation is 360 mg. Lean group mean intake was 261.99 mg, 98.01 mg below the USDA standard. The non-lean group three-day mean was 180.98 mg, 179.02 mg under the standard. The USDA iron recommendations for this age group is 15 mg. The lean athletes were above the USDA mean for days one and two and only below for day three. Overall, the lean athletes' three-day mean was 0.62 above the standard. The non-lean athletes were below the USDA standard for all three days. Their three-day mean was 11.89, 3.11 mg below the recommendation.

CONCLUSION: Results indicated that the diets of participants were not providing them with adequate amounts of daily servings of dairy, vegetables, fruits, and meat and beans according to the USDA MyPyramid standards. Only the grain group was not below the food group standards. Caloric intakes were within recommended ranges. Intakes of protein, carbohydrates, lipids, vitamin B12 and folic acid were above the USDA nutrient standards. Mean intakes of calcium, magnesium and iron were significantly below Dietary Reference Intake mineral standards.. These findings should alert athletes, parents, and coaches that the current dietary status of female high school athletes may be lacking in important bone-building and performance related nutrients.

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RATIONALE FOR STUDY

Research shows that female high school athletes' diet may be lacking in certain vitally important nutrients such as protein, fats, carbohydrates, vitamin B12, folic acid, iron, calcium, magnesium and calories. Although research has been conducted on the deficiencies of these nutrients in the mainstream population (Hawley, Dennis, Linsey, & Noakes, 1995; Jonnalaqadda, Berndot, and Nelson 2000; Torstveit & Sungot-Borgen 2005; Petrie, Stover, and Horswill, 2004; Clarkson and Haymes, 1995; Herrmann, Herrmann, Obeid, Scharhaq, and Kindermann, 2005; Beals, 2002; Ziegler, Sharp, Evans, Hughes, and Khoo 2002; Hiraoka, 2001), extensive research has been lacking on the intake of these nutrients in the diets of female high school athletes (Goulopoulou and Unnithan, 2004). The purpose of this project was to evaluate whether selected female high school athletes meet the MyPyramid's nutritional standards for these selected nutrients. An additional goal was to evaluate the effectiveness and usability of the new MyPyramid evaluation tool for this population group.

Since adolescent female athletes are often prone to fractures and anemia, nutrients selected for scrutiny were those shown to be involved in these health issues. Bone-building nutrients in this study included calcium and magnesium. Nutrients related to anemia prevention included protein, iron, vitamin B12, and folic acid. Macronutrients, protein, vital for muscle recovery, carbohydrates and fats, essential for energy production were examined as well.

Previous research indicates that nutritional habits of lean and non-lean athletes may differ. Lean sports are those that consider weight an issue in performance, such as track, cross-country and gymnastics. Lean sports athletes generally weigh less and have more lean body mass than those of non-lean sports. Lean sport athletes in particular may be at a higher risk for nutritional deficiencies and eating disorders manifested in sub-standard food and nutrient intake, as well as an increased tendency to use vomiting, laxatives, and even steroids as a means of weight reduction (Vertalino, Eisenberg, Story, & Neumark-Sztainer, 2007). Their performance often is contingent on endurance, aesthetic agility and limberness. Non-lean athletes are in sports where their weight is less of an issue for performance. These sports include softball, soccer, tennis, field hockey and fencing. They tend to have higher body weights than lean sport athletes. Strength and power are important characteristics for athletes participating in these types of sports. In this study, lean sport athletes participated in track and ran distance and middle distance running events and non-lean sport athletes participated in softball.

LITERATURE REVIEW OF STUDY NUTRIENTS

CALORIES

Adolescent Calorie Intake Recommendations:

The RDA calorie recommendation for active female high school athletes is 1735 kcal daily (Food and Nutrition Board, 2004). However, the position statement of the American College of Sports Medicine, American Dietetic Association, and the Dietitians of Canada do not specifically give a numerical amount of calories that all female adolescent athletes should consume. They address this issue by stressing that during times of high physical activity, energy and macronutrient needs, especially carbohydrates and protein intake-must be met in order to maintain body weight, glycogen stores, and provide adequate protein for building and tissue repair.

Calorie Intake of Adolescent Female Athletes:

Jonnalaqadda, Berndot, and Nelson (2000) examined the energy intakes using three-day food records of 33 elite female U.S. artistic gymnasts. The gymnasts reported energy intake was 43.4 kcal/kg (total 1678 kcal /day), which was 20% below the energy estimated requirement. Goulopoulou and Unnithan (2004), who have conducted research on respiratory function and creatine values in pediatric athletes, advise monitoring energy intake during resistance training.

Health Consequences of Inadequate Energy Intake:

Due to a high-energy output, coupled with an inadequate caloric intake, young females are vulnerable to amenorrhea, which may lead to bone demineralization resulting in fractures and osteoporosis. Eliakim and Beyth (2003) state that amenorrhea is 4 to 20 times higher in athletic adolescents than in sedentary adolescents. Torstveit & Sungot-Borgen (2005) reported that the age of menarche was significantly later in athletes (13.4 years as compared to 13.0 years in controls), and differed among sport groups. They found a higher percentage of athletes (7.3%) than controls (2.0%) reporting a history of primary amenorrhea ($P<0.001$). Primary amenorrhea is a delay in the onset of menstruation. A higher percentage of athletes competing in lean sports reported present menstrual dysfunction (24.8%) than athletes competing in non-lean sports (13.1%) ($P<0.01$) and controls ($P<0.05$).

Eliakim, Beyth and other researchers believe that increased energy expenditure coupled with inadequate calorie intake is the main cause of the central suppression of the hypothalamic-pituitary-gonadal axis resulting in decreased estrogen production. As a result, these athletes with disordered eating problems can develop amenorrhea, stress fractures and eventually osteoporosis (Timmerman, 1996).

Growth impairment can be another consequence for the calorie deficient female adolescent athlete. Bertelloni, Ruggeri, and Baroncelli (2006), contend that this may be due to impairment of the growth hormone-insulin-like growth factor-I axis. Not surprisingly, this condition is often accompanied by delayed menarche and menstrual dysfunctions.

Female Athlete Triad (FAT)

If this condition includes an eating disorder, the condition is referred to as Female Athlete Triad (FAT). Because the athlete has a calorie deficit, the body reduces estrogen production causing bone loss (Beals & Manore, 1994). Other nutritional issues relating to the triad are abnormal body/weigh composition, physical/emotional stress, and numerous nutritional deficiencies including low protein, carbohydrate and essential fatty acid intakes (Manore, 2002). FAT and low ferritin levels may be the most common issues facing heavy-training female athletes. Improved energy balance will improve overall nutritional status and may reverse menstrual dysfunction, thus returning the athlete to normal reproductive function (Manore, 2002). Golden (2002), an eating disorders researcher from the Schneider Children's Hospital, Adolescent Medicine, Long Island Jewish Medical Center, and the Albert Einstein College of Medicine, emphasizes the importance of early detection and treatment.

Calorie Under-Reporting of Adolescent Athletes:

Research indicates that adolescent athletes are under-reporting caloric intake. Jonnalaqadda, Bernadot, and Dill (2000) evaluated calorie intake of 28 female U.S.

national team artistic gymnasts using a 3-day food record. The ratio of reported energy intake (EI) to the predicted basal metabolic rate (BMRestd) was used to determine under-reporting. Sixty-one percent of the subjects had an EI/BMRestd ratio of <1.44, and were classified as under-reporters.

PROTEIN

Adolescent Protein Intake Recommendations :

The current protein Recommended Dietary Allowance for females (14 – 18 years of age) is 46 grams per day based on 0.85 grams protein per kilogram body weight, (Food and Nutrition Board, 2004). The Position Statement of the American Dietetic Association and Dietitians of Canada, and the American College of Sports Medicine (2001) provide no specific guidelines regarding amount of protein needed for training athletes. However, they stress the importance of obtaining adequate energy and macronutrients, especially carbohydrate and protein, to maintain body weight, replenish glycogen stores, and provide adequate protein for building and repair of tissue during times of high physical activity. Tipton and Witard (2007), researchers from the University of Birmingham, United Kingdom who have conducted studies on amino acid and protein metabolism, contend that recommendations for protein among athletes have not been without controversy. They divide scientists into two camps – those who believe participation in exercise and sports increases the nutritional need for protein and those who believe protein requirements for athletes and exercising individuals are no different from those of sedentary people. They acknowledge that there is scientific evidence to support both points of view. Tarnopolsky (2004), a protein researcher from McMaster, University, Hamilton Ontario, recommends that athletes involved in moderate intensity activity consume 1.0g protein/kg body weight, while top athletes maintain an intake of 1.6g protein/kg body weight.

There are special nutritional concerns for the young athlete. Petrie, Stover, and Horswill, of the Gatorade Sports Science Institute, Barrington, Illinois, (2004) warn that athletes in weight-control sports (lean-sports) may be at greater risk for dietary shortfalls. They stress that unlike team sport athletes, athletes in weight control sports may be at greater risk for failing to meet requirements for energy, protein, and some micronutrients. They base this on the low caloric consumption and high-energy expenditure of these weight-conscious athletes.

CARBOHYDRATES

Adolescent Carbohydrate Intake Recommendations:

One of the issues affecting high school athletes is their source of food energy. The recommended carbohydrate intake is 130 grams a day for adolescent females (14-18 years) based on the Recommended Dietary Allowance, (Food and Nutrition Board, 2004). The acceptable Dietary Reference Intake Macronutrient Distribution Range (MDR) for children fourteen to eighteen years of age for carbohydrate is 45 to 65 percent.

Carbohydrate Recommendations for Adolescent Athletes

In general, authorities recommend that young athletes should consume carbohydrates at the higher range of the MDRl. In addition, special emphasis should be placed on carbohydrate-rich foods with a moderate to high glycemic index in order to provide a readily available source of carbohydrate for glycogen synthesis (Burke, Cox, Cummings, & Desbrow, 2004). Burke (2001), a researcher at the Department of Sports Nutrition, Australian Institute of Sport, suggests CHO intake ranges of 5 to 7g/kg/day for general training needs, and 7 to 10g/kg/day for the increased needs of endurance athletes. Burke and colleagues recommend that in order to replenish glycogen stores to optimum levels, athletes should refuel with nutrient-rich carbohydrate and some protein food as soon as possible during their post exercise recovery (Burke, Kiens, & Ivy, 2004).

Higher carbohydrate intake has been associated with improved performance as well as to enhanced mood. This is of special interest since a high level of endurance can deplete glycogen stores causing hypoglycemia resulting in inadequate glucose for nerve and brain tissue. Changes in mood are an indication that brain and nerve tissue are not receiving adequate glucose. In a randomized crossover design, seven trained runners performed time trials consuming either a control or a high carbohydrate intravenous infusion (Achten, Halson, Mosley, Rayson, Casey, & Juekendrup, 2004). Those on the high carbohydrate infusion did not perform better in 30-minute workouts of 58 and 77% Vo2 max. However, those on the high carbohydrate infusions performed better on additional runs after intense work out sessions indicating usefulness of high carbohydrate intake for long distance and endurance events. This study also used the Daily Analysis of Life Demands of Athletes questionnaire to evaluate mood. Although the high level of training had a negative impact on mood in both the high carbohydrate and control groups, there was greater deterioration of mood in the control group. After analyzing the results of their investigation, the researchers concluded that an increase in dietary carbohydrate content from 5.4 to 8.5 g carbohydrate x kg (41% vs. 65% total energy intake, respectively) allowed a better maintenance of physical performance and mood state over the course of training, thereby reducing the symptoms of overtraining.

Actual Intake of Adolescent Athlete Carbohydrate Intake:

Complex carbohydrates have been low among high school athletes and fat and sugar consumption remains higher than recommended (Schmalz, 1993). A survey of sport nutritionists and exercise physiologists by Hawley, Dennis, Lindsey & Noakes (1995) reported that a majority of athletes including adolescent athletes consume a diet significantly deficient in carbohydrates.

In a study of carbohydrate intake of 14 male and 10 female cross-country collegiate runners Tanaka, Tanaka & Landis, (1995), found inadequate carbohydrate intakes using 10g/kg body weight and 65% of the diet as optimal intake. Male runners did not meet this standard since their carbohydrate intake was below 60% of their diet. Although female runners did derive the recommended percent of carbohydrate due to a low calorie intake, the daily amount of total carbohydrate taken was inadequate (<10g/kg body weight). Both adolescent female endurance athletes were not practicing the recommended feeding regimen for optimal muscle glycogen restoration (Tanaka, Tanaka & Landis, 1995). Another study of energy and carbohydrate intake in 22 female adolescent runners over a three-year period (Wiita & Strombaugh, 1996) also found a low calorie intake and a corresponding inadequate intake of total carbohydrates.

LIPIDS

Adolescent Fat Intake Recommendations:

The Dietary Reference Intake - Acceptable Macronutrient Distribution Range for female adolescents is between 25 -35 percent of calories, which would calculate to 43.2-61.2 grams of fats daily (Food and Nutrition Board, 2004). Manore (2005) suggested that athletes consume lipids at the lower range of acceptable since athletes primary source of energy expenditure is in the form of carbohydrates. In addition, many believe that protein requirements also are elevated due to muscle tissue breakdown during heavy training.

VITAMIN B12 AND FOLIC ACID

Adolescent Vitamin B12 and Folic Acid Recommended Daily Intake:

The Recommended Dietary Allowance intake for vitamin B12 is 2.4 ug/d and 400 ug/d for folic acid in adolescent females (Food and Nutrition Board, 2004).

Research on High School Female Athletes and Vitamin B12 and Folic Acid:

Little research studies on vitamin B12 and folic acid among female high school athletes have been reported. However, a review of the limited studies in female athletes, indicate a marginal folic acid and vitamin B12 status (Herrmann, Herrmann, Obeid, Scharhaq, & Kindermann, 2005; Beals, 2002; Ziegler, Sharp, Evans, Hughes, and Khoo 2002; Hiraoka, 2001). Beals (2002) investigated the nutritional status of 23 nationally ranked adolescent female volleyball players. Three-day food records, serum, and whole blood were used to measure nutritional status of iron, B12 and folic acid. Mean dietary iron, and folic acid were below the respective RDA. Three athletes had iron-deficiency anemia (Hb>12mg/dl) and six and marginal B12 status (<200 pg/ml).

BONE-ENHANCING MINERALS & FOOD GROUP – Calcium, Magnesium and Dairy Products

Recommended Intakes:

The Recommended Daily Reference Intakes (Adequate Intakes) for adolescents is 1300 mg for calcium and 360g for magnesium (Food and Nutrition Board, 2004). The USDA MyPyramid recommendation for dairy intake is three cups of milk or dairy equivalent per day for children nine years of age and older (USDA MyPyramid web site, www.mypyramid.gov). Flynn (2003), a nutrition researcher from the Department of Food and Nutritional Science, University College, Cork, Ireland, maintains that there are disagreements among expert groups on levels of daily calcium intake requirements.

Adolescent Calcium Intake

Although there is a disagreement on the recommended calcium dose for bone health, evidence indicates that dietary calcium intake is inadequate for the maintenance of bone health in a substantial proportion of population groups, particularly adolescent girls and older women (Flynn, 2003; Petrie, Stover, & Horswill, 2004).

Health Consequences of Inadequate Calcium Intake:

Although supplemental calcium of the usual diet for to 3 years has been shown to increase bone mineralization in children and adolescents, the long-term effects of supplementation are not clear (Flynn, 2003). Zeni, Street, Dempsey, & Staton (2000) report that stress fractures are common among women athletes, especially in the femoral neck, sacrum, and pelvis. They maintain that stress fractures may be the result of amenorrhea, low calcium intakes, disordered eating, bone geometry, and leg-length discrepancy.

Research that may not Support General Recommendations of Calcium & Dairy:

Studies of active female adolescents indicate that activity level may be more instrumental in achieving higher levels of bone density than actual calcium intake (Runyan, Stadler, Bainbridge, Miller, & Moyer-Mileur, 2003; Henderson, Price, Cole, Gutteridge & Bhagat, 1995). McCulloch, Bailey, Houston and Dodd (1990) studied 101 women between the ages 20 to 35 (mean age 28.5). They examined the effect of milk consumption, dietary calcium intake, and activity level had on Bone Mineral Density

(BMD). Subjects had to assess whether their childhood milk consumption was *low*, *moderate* or *high*, and whether their adolescent activity level was "*sometimes active*" to "*very active*". An analysis of variance evaluation showed a significant difference in bone density values and the activity categories (F= 2.74, 3 and 97 degrees of freedom, P<0.05). Scheffe' procedure's for pair-wise comparison among means revealed that very active subjects as children had significantly higher bone density than those who were sometimes active, active, or more active (P<0.05). The subjects were also asked to classify their childhood milk consumption as "low", "moderate", or "high" in comparison to other children of the same age. The bone density values for the three groups were similar. An analysis of variance showed no significance in bone density between groups.

In a study of young adults, calcium intakes ranged from 150 mg to 1650 mg with a mean intake of 800 mg/day. There were no significant differences in bone density between subjects with low (less than 500 mg/d) and high (more than 900 mg/d) dietary calcium intake. In addition, there was not a significant difference between calcium intake and bone density. This study does not indicate that calcium intake decreases bone density (McColloch, Bailey, Dodd, & Houston, 1990.

A related study by Merrilees, Smart, Gilchrist, Frampton, Turner, Hooke, March and Maguire (2000) examined healthy late adolescent females for the effects and benefits of high calcium intake from dairy products on high bone mineral density, body composition, lipids, and biochemistry. A second aim was to determine if a high intake of dairy products had a long-term positive impact on bone density. In this randomized controlled study, ninety-one teenage girls between the ages 15-18 received calcium supplementation for two years. One year after the end of supplementation there was a follow-up. They were able to increase their Bone Mineral Density (BMD, strength of bone) at the trochanter, femoral neck, and lumbar spine when supplementing with dairy product foods to a mean calcium intake of 1160 mg/d. There was also an effect on the Bone Mineral Content particularly at the trochanter and to a lesser extent at the lumbar spine. The calcium intake achieved did not adversely affect body weight, fat, lean mass, or blood lipid profiles. Twelve months after the supplementation the girls had returned to their baseline diet, indicating self-selection of a high dairy diet may be hard to achieve.

Magnesium Requirements and Deficiency

The Dietary Reference Intakes – Recommended Dietary Allowance for magnesium for adolescent females (14-18 years) is 360 mg per day (Food and Nutrition Board, 2004). Inadequate intake may lead to gastrointestinal, neuromuscular, and cardiovascular dysfunctions (Bohl and Volpe, 2002). Additionally, physical exercise may deplete magnesium, which together with a marginal dietary magnesium intake may impair energy metabolism efficiency, and the capacity for physical work – a serious concern for athletes. Studies, although limited, indicate that reduced muscle strength and incidence of muscle cramps can occur on low magnesium diets (Clarkson and Haymes, 1995).

Clarkson and Haymes, (1995) exercise science researchers from the Department of Exercise Science, Amherst, Massachusetts, warn that athletes on calorie-restricted diets may not be ingesting sufficient quantities of magnesium.

Evaluation of Magnesium Status

There is concern that magnesium intake among the general population is low (Bohl and Volpe, 2002; Bielinski, 2006). Additionally, Bohl and Volpe cite that magnesium assessment has been a challenge because of the absence of a convenient assessment method. The standard assessment method, magnesium-loading test, is too complex for general use (Bielinski, 2006).

Magnesium Supplementation

Magnesium supplementation or increased dietary intake of magnesium has a beneficial effect on athletic performance in magnesium-deficient individuals but not those with adequate magnesium status. Athletes participating in lean-sports are especially vulnerable to inadequate magnesium status due to inadequate calorie intake and increased utilization of magnesium for a high level of performance (Nielsen and Lusaski, 2006). They acknowledge that more research is needed on how effective magnesium is for enhancing athletic performance. Rayssinquier, Guezennec and Durach (1990), suggest that a possible explanation for decreased magnesium concentrations during prolonged endurance events is the effect of lipolysis. Since fatty acids are mobilized for muscle energy and lipolysis requires magnesium, lipolysis would cause a decrease in plasma magnesium.

Newhouse and Finstad (2000) reviewed twelve studies regarding magnesium and supplementation in athletes and concluded that trained subjects benefited less than untrained. Although they report that most evidence shows no advantage of magnesium supplementation on performance (strength, anaerobic-lactate acid, aerobic) in trained athletes, they point out a need for well-controlled studies in this population group. This is particularly important since low dietary intake, coupled with increased urinary loss due to exercise, may eventually lead to magnesium deficiency.

Magnesium and Bone Density

Two-thirds of the body's magnesium is located in the skeleton and is related to skeletal strength. Martini (1991) has shown in rat studies that magnesium is necessary for dynamic strength of bones. Martini adds that more research is needed in studying how magnesium supplementation affects bone turnover in young adults.

IRON

Adolescent Iron Intake Recommendations and Assessment:

The iron Recommended Dietary Allowance for female adolescents is 15 mg. per day (Food and Nutrition Board, 2004). An assessment for iron deficiency anemia may not adequately evaluate iron status in female adolescent athletes. Due to menstruation, inadequate diet, and iron depletion through strenuous physical training, they may significantly deplete their iron stores, causing low ferritin levels but not anemia (Pate, Miller, Davis, Slentz, & Klingshirn 1993).

Iron Status of Adolescent Female Athletes:

According to researchers Petrie, Stover, and Horswill of the Gatorade Sports Science Institute in Barrington, Illinois (2004), iron deficiency among female distance runners frequently occurs. In fact, female intercollegiate athletes and non-athletes have often been found to have iron deficiency as found in a study measuring hemoglobin, ferritin and transferrin levels in 100 female athletes and 66 non-athletes (Risser, Lee, Poindexter, West, Pivarnik, Risser, & Hickson, 1988). Jonnalaqadda, Bernadot, and Nelson (1998) also found iron problems in their dietary study of 33 U.S. national artistic gymnasts. Similarly, Rowland, Stagg, and Kelleher (1991) reported in their study of swimmers, runners, and non-athlete adolescents, that the high prevalence of hypoferritinemia at the beginning of a competitive season among high school female athletes was similar to that of non-athletes. This is of special concern for adolescent athletes since iron depletion is likely to increase with training particularly in some sports such as running. In a similar study, Pate, Miller, Davis, Slentz, and Klingshirn (1993) evaluated the iron status of 111 habitual female runners and 82 inactive females of similar age. Runners were significantly lower ($P < 0.05$) than the reference group in mean serum ferritin (SF), total iron binding capacity, and red blood cell count, but significantly higher ($P<0.05$) in mean corpuscular hemoglobin. Chi Square analysis indicated that iron depletion (SF <20 ng.ml-1) was significantly more prevalent in the runners than in the controls.

Evidence Supporting the Need for Iron Supplementation in Adolescent Female Athletes

Studies support that iron supplementation can benefit female athletes who have low ferritin levels (Brownlie, Utermohlen, Hinton, & Haas, 2004). In a study of 42 iron-depleted (serum ferritin<16 microg/L), non-anemic (Hb>12g/dl) women (18-33 yr old), subjects were given 100 mg of ferrous sulfate (S) or placebo (P) per day for six weeks in a randomized, double-blind trial (Hinton, Giordano, Brownlie, & Haas, 2000). There was no difference in total serum iron status or 15 km time at baseline. Subjects trained for 30 minutes per day at 75-85% of maximum heart rate for the final four weeks of the study. Iron supplementation increased serum ferritin, decreased transferrin receptors and improved 15 km time in the experimental group as compared to the placebo group. The investigators concluded that iron-deficiency without anemia impairs favorable adaptation to aerobic exercise and iron supplementation improved iron status indicators and performance (Hinton et al., 2000).

A similar study by Rowland, Diesroth, Green, & Kelleher (1988) followed 14 iron-deficient (serum ferritin level, less than 20 micrograms/L) non-anemic runners by assessing hematologic and treadmill running values during a competitive season. After a four-week control period, runners were treated for one-month in a double-blind protocol with ferrous sulfate (975 mg/d) or placebo. During the treatment period, the mean ferritin level rose from 8.7 to 26.6 micrograms/L in those participants taking iron and fell from 10.6 to 8.6 micrograms/L in the placebo group. The iron-treated runners significantly improved treadmill endurance times as compared to the control group. Endurance times declined in all seven controls (range, 0.7 to 1.30 minutes), while six of the seven iron-treated subjects improved their performance (range, 0.03 to 1.92 minutes). The authors concluded that non-anemic iron deficiency impairs exercise performance (Rowland et al, 1988).

Friedmann, Weller, Mairbauril, & Bartsch (2001) investigated the effects of iron repletion on red blood cell volume (RBV) and performance capacity in iron-deficient non-anemic athletes. Forty young elite athletes (13-25 yr) with low serum ferritin (<20 microg.L-1) and normal hemoglobin (males 13.5 g.dl-1, female>11.7 g.d-1) were randomly assigned to twelve-week treatment with either twice a day ferrous iron (equivalent to 2x100 mg elemental iron) or a placebo using a double blind method. Before and after treatment, hematological measures and parameters of iron status were determined in venous blood. For determination of the aerobic and anaerobic capacity (maximal accumulation oxygen deficit, MAOD), the athletes performed an incremental as well as a highly intensive treadmill test. The results showed that after 12 weeks, ferritin levels were within the normal range in the iron-treated group with a significant

($P<0.001$) mean increase by 20 micrograms per liter as opposed to a slight non-significant decrease in the placebo group. Only the iron treated group showed significant increases in VO2 max and O2 consumption.

Indications for Monitoring Iron Status of Pediatric Athletes:

After an analysis of iron research and performance among pediatric athletes by Goulopoulou and Unnithan (2004), they conclude that serum ferritin as well as hemoglobin concentrations need to be measured in this population group. In addition, they stress a need for increased research on iron status for young athletes.

TRENDS IN FEMALE ATHLETIC PARTICIPATION

The number of females participating in sports has substantially increased in the past few decades. According to Women's Sports & Fitness Facts and Statistics, high school girls are participating in athletics at an all-time high of 2,865, 299 for the 2003-04 school year (NFHS, 2004 Participation Survey). What has not progressed with the increased female involvement in high school sports is an investigation of their dietary habits.

In the past, the USDA's Food Guide Pyramid has been on the forefront in educating the general U.S. population concerning healthy eating. While it was broad in scope, it lacked the specificity that the new MyPyramid offers. The new MyPyramid offers the individual the opportunity to fill-out a personalized nutritional profile. This profile can be customized to include age, gender, activity level and dietary intake. An analysis of nutritional status and needs is then calculated. Since nutrition is an extremely important component in performance and well-being, the following study was undertaken to assess the usefulness of the pyramid for adolescent female athletes participating in lean or non-lean sports.

RESEARCH QUESTIONS

This study was designed to answer the following research questions:

1. Do female high school athletes participating in lean sports vs. non-lean sports meet the new USDA's MyPyramid standards for food groups and calories?

2. Do female high school athletes participating in l ean sports vs. non-lean sports have different dietary habits and intakes of selected nutrients that influence bone-building and anemia?

3. Do selected female athletes meet the DRI's for calories; the macronutrients protein, carbohydrates, and lipids; minerals iron, calcium, and magnesium; and vitamin B12 and folic acid?

METHODS

Subject Profile

In order to participate in this study, subjects had to be female athletes participating in high school junior varsity or varsity spring sports. Subjects needed to be in good health, and between the ages of 14-18. They were selected from lean and non-lean junior varsity and varsity teams in two northern New Jersey high schools. Since this selection criteria requires a high level of health and mental functioning, no additional exclusion criteria was applied. Subjects included twenty-five middle-class Caucasians and one Hispanic. Subjects and their parents gave their consent to participate. Twelve track, a lean sport, athletes who ran distance and middle distance running events participated in this study. Of the twelve, all participated in additional lean sports during other seasons of the year including gymnastics, winter track, and cross-country. A few participated in a non-lean sport. See Figure 1 Lean Sport Participation. Fourteen softball, a non-lean sport, athletes participated in this study. During other seasons, the nonlean athletes played a variety of non-lean sports. One non-lean athlete participated in winter track, a lean sport. See Figure 2 Non-Lean Sport Participation A summary of demographic data can be found in Table 1.

Figure 1. Lean Sport Participation

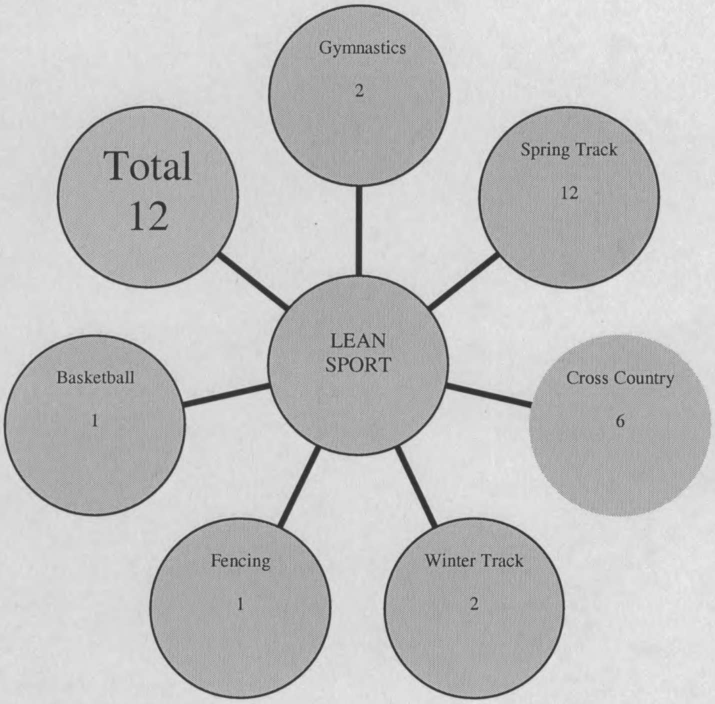


Figure 2. Non-Lean Sport Participation

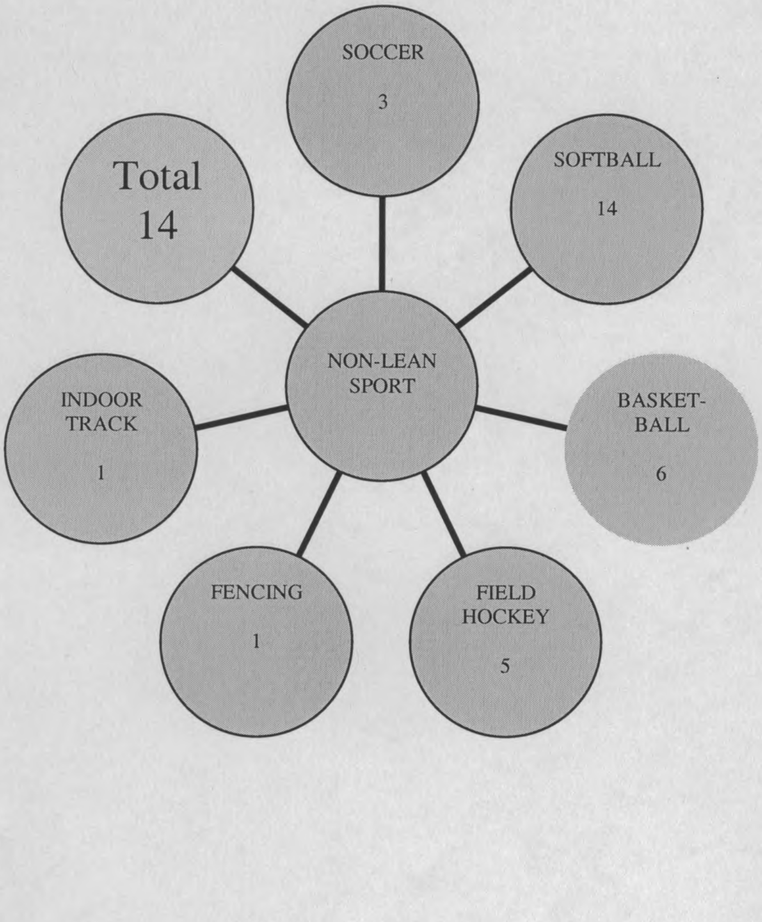


Table 1. Demographic Data of Research Participants

Category	Lean	Non-Lean
Number	12	14
Mean Age	16.6	16.1
Age Range	15-18	14-18
Type of sport	Track	Softball
Varsity	12	9
Junior Varsity	0	5
School location	West Milford High School	Pompton Lakes
Ethnicity	11 Caucasian 1 Hispanic	14 Caucasian

Procedure

From August 2005 through May 2006, recruitment of female athletes took place in two northern New Jersey high schools in Passaic County, West Milford and Pompton Lakes. In order to conduct the study in these locations, respective high school athletic directors, coaches, and school board members gave their consent and provided letters of approval. (See appendix A.) The research project received final approval by the Montclair State University Institutional Review Board on January 20, 2006. Coaches of the selected teams informed athletes of the opportunity to participate in the study. Twenty-six volunteers took part in the study and completed all paperwork from a potential pool of 45 subjects.

Once schools gave clearance, informational meetings were conducted with potential subjects, parents and coaches at both schools. At the meetings, the purpose and procedures of the study were reviewed, along with an explanation of portion size and maintenance of food records. Document folders were distributed to willing participants. The folder included three-day food record sheets, a student assent form, a parental consent form, and a survey questionnaire (See Appendices B, C, D, and E). Instructions included recording all servings and portion sizes of food and beverages consumed for three-days - two weekdays and one weekend day. After completed folders were collected, the researcher met with each subject to confirm the accuracy of her responses and to address any uncertainties regarding her responses. Each folder received an identification number to assure privacy and color-coded by sport to ensure accuracy. The MyPyramid website provided the standards for evaluation of food group intake and consumption of selected nutrients and calories. After the analysis, computer printouts were distributed to study participants and subjects were given the option for additional counseling.

Questionnaire Data

The survey questionnaire addressed areas of health concerns for adolescent female athletes and included the following: height, weight, age, broken bones, age of menstruation, anemia, fatigue, hours of sleep, sports played, restrict food intake, dieting, hunger, eat enough calories, satisfied with weight, and desire for nutrition counseling. Age of menstruation was recorded because prior research indicated inadequate calorie intake might delay the onset of menstruation. Sleeping hours were recorded since fatigue can result from overtraining as well as inadequate sleep. Height and weight were recorded to help associate the body-types with the type of sport in which study volunteers participated.

Data Analysis

After the establishment of a MyPyramid profile for each subject, three-day food record data was entered in the profile. The MyPyramid website was used to analyze intake of calories, food groups and selected nutrients. Specifically, the food group categories of interest included milk, meat and beans, grains, fruits, and vegetables. The MyPyramid sets standards for recommended food group intake based on gender, age and activity level. The website analysis uses the Dietary Reference Intakes (DRIs) as the standard for calorie and nutrient analysis. Specific nutrients of interest in this study included protein, lipids, carbohydrates, lipids, vitamin B12, folic acid, calcium, magnesium and iron. These nutrients were selected based on their effect on bone health, blood volume and energy levels.

Statistical Analysis

MyPyramid food groups were analyzed by analysis of variance, first with lean and non-lean separated and again with the groups combined. In addition, Chi-square tests were used to analyze food groups. Analysis of variance, parameter estimates, Manova Fit and t-tests analyzed nutrient data. A contingency chi square test analyzed lipids. The entire questionnaire data were analyzed by a 2-tail Fisher's exact Test, as well as a univariate test. Height, weight, age, menstruation, age by year, hours of sleep was analyzed by oneway analysis and t tests. A contingency analysis chi-square test and a 2-tail fisher's exact test analyzed broken bones, anemia, fatigue, dieting, hunger, eating sufficient calories, satisfied with weight, and desiring nutrition counseling. Contingency analysis chi-square test also analyzed type of sport played, whether it be lean or non-lean.

RESULTS

Anthropometric Findings

Height

Mean height of the 12 lean subjects was 64.6 inches and mean height of the non-lean was 63.9 inches. There was not a significant difference between the heights of the two groups. The mean height difference between the lean and non-lean was 0.7 inches. Assuming unequal variances, the lower mean was 63.8 inches for lean and 62.6 inches for non-lean. The upper mean was 65.3 inches for the lean and 65.6 inches for the non-lean athletes. .

Table 2. Height of Lean and Non-lean Subjects

Height	**Lean** Inches n = 12	**Non-lean** Inches n = 14	**P Value**
Total mean	64.6	63.9	0.3617
Upper mean	65.3	65.6	0.3617
Lower mean	63.8	62.2	0.8192

Weight

In comparing the weight differences between each group, the mean weight of the lean subjects was 116.7 pounds and 126 pounds for the non-lean group. The mean weight difference between the lean and non-lean was 9.3, with the non-lean being higher. There was not a significant weight difference between both groups (P = 0.1733). The mean lower weight for the lean was 107.1, and for the non-lean, it was 115.2. The mean upper weight for the lean was 126.3 and the non-lean was 136.8. The nonlean group had two outliers with weight values at 160 and 170 pounds.

Table 3. Weight of Lean and Non-lean Subjects.

Weight	**Lean** pounds n = 12	**Non-lean** pounds n = 14	**P Value**
Total mean	116.7	126	0.1733
Upper mean	126.3	136.8	0.1733
Lower mean	107.1	115.2	0.0866

MyPyamid Food Group Results

Results of a statistical analysis of combined data from lean and non-lean athletes' intake of food from the dairy, meat, vegetable and fruit groups were significantly below the USDA MyPyramid standards. See Table 2. Only the grain group was not significantly below the standard.

The mean three-day meat and bean intake for both groups combined was 3.80 ounces. The MyPyramid standard is 5 oz. This shows a three-day deficit of 1.20 oz. The lean sport athletes had a three-day mean intake of 3.77 oz., 1.23 oz under the standard. The non-lean sport athletes averaged 3.82 oz, 1.18 oz under the standard. Meat and beans intake was the highest on the weekend day for the lean group, not for the non-lean group.

The mean three-day milk intake for both groups combined was 1.5 cups, 1.5 below the USDA three-day mean standard of 3.0 cups. The lean had a three-day mean of 2.1 cups, 0.9 cups less than the standard. However, the non-lean athletes had only a three-day mean of 0.9 cups, a 2.1 cup deficit. Milk intake was the lower on the weekend day for both the lean and non-lean athletes.

The mean three-day fruit total for both groups combined was 1.0 cups per day, 0.5 cups less than the MyPyramid standard. Lean sport athletes had a three-day mean of 1.1 cups per day, 0.4 cups less than the standard of 1.5 cups per day. The non-lean averaged 0.9 cups, 0.7 cups less than the MyPyramid standard of 1.6 cups. Note that the standard is different by 0.1 cups for the two groups. MyPyramid fruit recommendations take into account individual differences such as height and weight. Fruit intake was lower on the weekend for the lean group, but was higher for the non-lean group.

The three-day mean vegetable intake for both the lean and non-lean groups combined was 0.9 cups per day, 1.4 cups below the standard of 2.3 cups per day. Lean athletes averaged 1.1 cups per day, 1.2 below the MyPyramid standard of 2.25. Non-lean athletes' three-day mean was 0.7 cups, 1.5 less than the standard of 2.3 cups per day.

Three-day mean grain intake for both groups together was 6.3 ounces per day, 0.7 above the MyPyramid daily standard of 5.6 ounces. Lean athletes had a daily three-day mean intake of 6.9 ounces, 1.3 above the standard of 5.6. Non–lean had a mean intake of 5.9 cups, 0.3 ounces higher than the standard of 5.6 ounces per day.

Table 4 MyPyramid Food Group Intake of Adolescent Female Athletes

FOOD GROUP	Mean Intake	USDA Standards*	Difference from Standard	Standard Deviation	P Value
Milk	1.5 cups	3 cups	-1.5	0.94	0 .0001
Meat/Bean	3.80 oz.	5 oz.	-1.2	1.90	0 .0027
Vegetable	0.90 cups	2.0-2.5 cups	-1.40	0.58	0 .0001
Fruit	0.97	1.5-2.0 cups	-0.59	0.64	0 .0001
Grains	6.35	5.5 oz.	+0.77	2.44	0.1199

* Since the recommended amounts of the food groups varied according to an individuals age, height, weight and activity level, there was variation in individual standards.

Nutrient Evaluation

Lean and non-lean nutrient intake data was combined for statistical analysis of calorie and nutrient intake. Caloric intakes were within recommended ranges. However, intakes of protein, carbohydrates and lipids were above the USDA standards. See Tables 3 and 4. Intakes of calcium, magnesium, and iron were significantly below the USDA DRI standard. Mean intake of vitamin B12 and folic acid were above the recommended amount.

Combined calorie data was within recommended ranges however, intake was at the low end of normality. The three-day mean caloric intake for both the lean and non-lean groups combine was 1641.74 - below the USDA mean caloric standard of 1735.19. Lean group athletes had a three-day mean caloric intake of 1778.83 and the USDA mean was 1712.42. The three-day mean for the non-lean group was 1524.24, while the USDA mean for this group was 1754.71. Both subjects combined mean was about 93 calories below USDA standard. The three-day mean for the lean group was 254 calories more than the non-lean group.

The mean three-day protein intake for the combined lean and non-lean groups was 61.5 grams. This compares favorable with the USDA of 46 grams. The lean group had a three-day mean protein intake of 67.72. This is about 21 grams higher than the USDA standard. The mean three-day carbohydrate intake for both the lean and non-lean groups was 220.68 grams. This is well above the USDA standard of 130 grams daily. The three-day carbohydrate mean for the lean group was 241.39 grams and 202.93 grams for the non-lean group.

The USDA standard for vitamin B12 is 2.4 mcg. The three-day mean for both the lean and non-lean groups combined was 3.57 mcg, 1.17 mcg above the standard. The high mean intake was mainly due to the lean group. Lean group mean was 5.01 mcg (2.61 mcg above standard) and the non-lean group was at 2.32 (0.08 mcg below standard).The three-day mean intake of folic acid for both groups was 410.44 mcg. This compares favorably to the USDA's daily recommendation of 400 mcg. Overall, the mean three-day intake for the folic acid intake of the lean group was 429.16 and was 394.40 for the non-lean.

The daily mean calcium intake for both groups combined was 762.37 mg. The USDA recommendation is 1300 mg. Lean group athletes had a three-day mean calcium intake of 1006.10 mg, while the non-lean group had a mean of 553.46 mg., well below the USDA requirement.

Magnesium three-day mean intake for both groups combine was 218.67 mg, 141.63 mg under the standard of 360. Lean group mean was 261.99 mg, 98.01 mg below the USDA standard. The non-lean group three-day mean was 180.98 mg, 179.02 mg under the standard.

The three-day mean for both groups combined for iron was 13.61 mg, below the USDA standard of 15 mg. Actually, the lean athletes fared better than the non-lean athletes. The lean athletes were above the USDA mean for days one and two and only below for day three. Overall, the lean athletes' three-day mean was 0.62 above the standard. The non-lean athletes were below the USDA standard for all three days. Their three-day mean was 11.89, 3.11 mg below the recommendation

Table 5. Select Nutrient Intake of Adolescent Female Athletes

Nutrients	Mean Intake	USDA DRI*	Standard Deviation	P Value
Calories	1641.74	1516-2041	507.39	0.3567
Protein	61.46 gm	46 gm	19.34	0.0015
Carbohydrates	220.68 gm	130 gm	79.90	0.0001
Folic acid	410.44 mcg	400 mcg	302.30	0.1969
B12	3.57 mcg	2.4 mcg	3.13	0.0462
Calcium	762.37 mg	1300 mg	372.64	0.0001
Magnesium	218.37 mg	360 mg	80.57	0.0001
Iron	13.61 mg	15 mg.	8.70	0.0001

*USDA Dietary Reference Intake

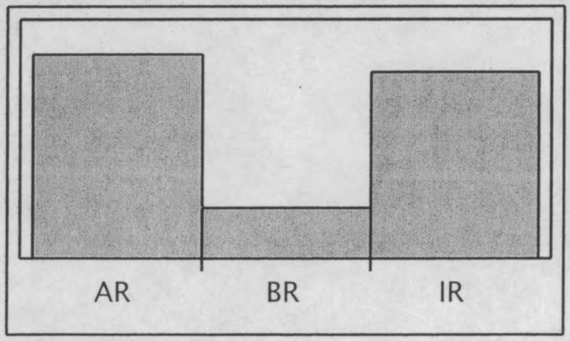
The USDA MyPyramid Lipid Requirement Range for adolescent female varies according to activity level, height and weight. Therefore, the lipid standard for each subject was a range requirement rather than a set number and the range values differed for each participant. Table 4 lists the lowest and highest range, the mean for each of the three-days, and the mean for the three-days combined. Only one lean athlete and two non-lean athletes were below the USDA range for their three-day mean intake. Six lean and six non-lean athletes were above the USDA range for their three-day mean intake. Five lean and six non-lean athletes were in the USDA range for their three-day mean intake.

Table 6 Lipid Intake Data Analysis of Adolescent Female Athletes

Category	**Lean** n = 12	**Non-Lean** n = 14
Lowest 3-day mean intake	25.77 gms	30.40 gms
Highest 3-day mean intake	89.87 gms	79.53 gms
Number below recommended range	1	2
Number above recommended range	6	6
Number within range	5	6

Figure 3 Mean Fat Intake Compared to USDA Standard*

Mean Fat Compared to USDA



Frequencies

Level	Count	Prob
AR	12	0.46154
BR	3	0.11538
IR	11	0.42308
Total	26	1.00000
N Missing	0	
3 Levels		

* AR = Above Range, BR = Below Range, IR = In Range

Questionnaire Data

Table 7 contains a summary of questionnaire data analysis for lean and non-lean research participants. Analysis of categories found no significant differences.

Table 7. Questionnaire Findings

Category	**Lean** n = 12	**Non-lean** n = 14	**Difference**	**P Value**
Broken Bones	2	5	3	0.3913
Menstruation, age of onset	12.8	12.9	0.1	0.8510
Mean menses/yr	11.9	11.5	0.42	0.5862
Anemia	0	1	1	*
Hours of Sleep	6.8	7.1	0.31	0.3943
Restrict Food Intake	9	12	3	0.6348
Dieting	2	2	0	*
Hunger	11	10	1	0.3304
Eat Enough Calories	9	13	3	1.0000
Satisfied with Weight	8	10	2	1.0000
Desire Nutritional Counseling	6	4	2	0.4216

*** Analysis omitted since data missing**

Broken Bones

Two of the twelve lean sport athletes had broken a bone while performing their sports and five of the fourteen non-lean athletes received sport-related fractures. There was no significant difference between the groups.

Menstruation

The mean age of the onset of menstruation for the lean was 12.8 years, while for the non-lean it was from 12.9 years of age. The non-lean group did have one onset of menstruation age at 17, the highest recorded in the survey. There was no significant difference between groups pertaining to age of onset of menstruation.

The mean number of menses per year for the lean was 11.9 years, while for the non-lean it was from 11.5 years of age. This is somewhat surprising since prior research indicated that menstruation more likely begins at a younger age in non-lean sport athletes.

The youngest age of menstruation was 11 for both the lean and non-lean. Conversely, the oldest age of menstruation for the lean was 15 and 17 years of age for the non-lean.

Anemia

No member of the lean group had anemia, while only one member of the non-lean had anemia. However, some athletes may have low iron stores without having an anemia diagnosis.

Fatigue

When questioned if they were often tired, 7 out of the 12 lean sport respondents said that they were often tired. Seven out of the thirteen non-lean sport athletes responded that they were often tired.

Table 8. Reported Description of Fatigue of Lean and Non-lean Subjects

Category	Often tired	Not often tired
Lean n=12	7	5
Non- lean n=13	7	6

Hours of Sleep

The mean hours of sleep for the lean were 6.8, while for the non-lean it was 7.1. The upper end of sleep hours for the lean was 9, while for the non-lean it was 8 hours. The lower end of sleep for the lean was 6, while for the non-lean it was 5.5. There was no significant difference in mean between both groups.

Table 9. Reported Hours of Sleep of Lean and Non-lean Subjects.

Category	Mean Hours of Sleep	Upper End Hours of Sleep	Lower End Hours of Sleep
Lean n=12	6.8	8	5.5
Non-lean n=14	7.1	9	6

Food Restriction

Twelve non-lean athletes said they restricted their food intake, while two said they did not. Nine lean athletes said that they did not limit their food intake, while two did not, and one said she sometimes does.

Table 10. Reported Food Restriction of Lean and Non-lean Subjects

Level of Restriction	**Yes**	**No**	**Sometimes**
Lean n=12	9	2	1
Non- lean n=14	12	2	

Weight Loss Attempts

Two non-lean respondents went on weight reduction diets during the last year. One responded with both yes and no. Eleven said no. The lean group reported two yes answers, and ten no responses.

Table 11. Weight Loss Attempts in the Past Year of Lean and Non-lean Subjects

Type of Sport	**Yes**	**No**	**Sometimes**
Lean n=12	2	10	0
Non- lean n=14	2	11	1

Hunger

A 2-tail Fisher's exact test was used to compare perception of hunger. No significant differences were found between lean and non-lean responses. Ten of the non-lean group said that they are often hungry, while four said that they were not. Eleven of the lean group said that they were often hungry, while one said she was not.

Perception of Calorie Intake Adequacy

In the questionnaire, one of the questions asked participants if they feel they eat enough calories for their activity level. More non-lean athletes reported that they believed they did not eat enough calories.

Table 12. Perception of Calorie Intake Adequacy of Lean and Non-lean Subjects

Type of Sport	Eat Enough	Do Not Eat Enough	Unsure
Lean n=11	9	1	1
Non-Lean n=14	13	1	0

Weight Satisfaction

When asked if they were satisfied with their current weight, 33% of the lean and 29% of the non-lean athletes reported dissatisfaction.

Nutrition Counseling

In the questionnaire, participants were asked if they would like to receive nutritional counseling. Fifty-percent of the lean participants requested counseling while only 29% of the non-lean made this request.

DISCUSSION

Anthropometric Data – Weight

The mean weight difference between the lean and non-lean was 9.3 pounds, with the non-lean being higher. This was expected, since the lean sports generally require a more slender body-type for better performance. Not surprising, these results corresponded with more non-lean study participants than lean reporting dissatisfaction with weight. Also not surprising is the fact that more lean than non-lean sport athletes requested nutrition counseling. Lean athletes participate in sports where weight is a factor in performance so this may have influenced their request.

Age of Onset of Menstruation

There was no significant difference between lean and non-lean groups regarding age of onset of menstruation. The mean age of menstruation for the lean was 12.8 years, while for the non-lean it was 12.9. Prior research indicates that lean athletes would have a later onset than non-lean athletes. This may not have been found in this study due to a small sample size.

Food Groups – Meat and Beans

The mean three-day meat and bean intake for both groups combined was 3.80 ounces, 1.24 oz below the MyPyramid standard of 5 oz. This was surprising since the diet analysis for protein intake was high. The MyPyramid food group evaluation may not take into account hidden milk by-products, such as whey, non-fat milk solids often used as an added ingredient. A review of the subjects' three-day food records, showed turkey, chicken and cheese were the primary protein sources. Fish and beans were a rarity.

Food Groups - Fruits

Fruit intake was low for both lean and non-lean athletes in this study - between 0.5 and 0.7 cups below the standard. This corresponds to reports that less than 15% of children eat the recommended servings of fruits (PBH, 2007). Similarly, the National Cancer Institute found that in their study of 3148 youths aged two to eighteen years that their fruit consumption was much lower than the recommendations, and that only one in five consumed five or more servings of fruits per day (Krebs-Smith, Cook, Subar, Cleveland, Friday & Kahle, 1996). In a large scale study of teenagers by the Harvard

University School of Environmental Health, a low intake of fruits and vegetables corresponded to respiratory health problems and low intakes of antioxidant levels vitamins C and E, beta-carotene (Burns, Dockery, Neas, Schwartz, Coull, Raizenne, & Speizer, 2007). In this study subjects included 2,112 twelfth-grade students in 13 communities spanning the United States and Canada from 1998 to 1999. Results indicated that adolescents with the lowest dietary intakes of antioxidant and anti-inflammatory micronutrients had lower pulmonary function and increased respiratory symptoms, especially among smokers. This study indicates that adequate dietary intake may promote respiratory health and lessen the effects of oxidative stress (Burns et al., 2007).This would obviously be a concern about the health of any teenager but for athletes there would be an added concern about their performance.

The "More Matters" campaign indicates a host of nutrient deficiencies corresponding to low intakes of fruits and vegetables (More Matter, 2007). This campaign strongly encourages Americans to increase their fruit and vegetable consumption because of the benefits of particularly fiber, magnesium, folic acid, potassium, vitamin A and vitamin C. Fiber is important for reducing the risk of coronary heart disease. Magnesium supports normal nerve and muscle function, as well as a steady heart rhythm and a healthy immune system. Folic acid may reduce a woman's risk of having a child with brain or spinal cord defects. Potassium may help reduce blood pressure. Vitamin A keeps eyes and skin healthy and protects against infections. Vitamin C helps heals cuts and wounds, keeps teeth, and gums healthy (More Matters, 2007).

Food Groups - Vegetables

Low vegetable intake among study participants appears to confirm national findings. Products for Better Health/More Matters web site reported that less than 20% of children eat the recommended servings for vegetables. One study conducted by researchers from the National Cancer Institute involved 3148 children and adolescents aged two to eighteen from the 48 conterminous United States (Krebs-Smith et al., 1996). Not surprisingly, nearly one-fourth of all the vegetables consumed by the children and adolescents were French fries. Their intakes of dark green and/or deep yellow vegetables were very low compared to the recommendations (Krebs-Smith et al., 1996). Lower fruit and vegetable consumption in adolescents may originate from low fruit and vegetable consumption in the adolescent's younger years. An investigation conducted by the Mary Imogene Bassett Research Institute in Syracuse, New York studied 116 two-year-old children and 107 five-year-old children from a general primary care center in Upstate New York (Dennison, Rockwell & Baker, 1998). The researchers examined their fruit and vegetable consumption from a seven-day dietary record calculated according to the USDA definition of serving size. They found that total vegetable consumption was strongly correlated with beta-carotene and vitamin A intakes. Total fruit and vegetable consumption correlated with intakes of beta-carotene, vitamin A, vitamin C, fiber, and potassium. Forty percent of 2-year-old children and 50% of 5-year-old children consumed < 2 servings/day of fruits and vegetables. Ninety-five percent of children consuming > or = 2 servings/day of fruits and vegetables met the RDA for vitamin C vs. 50% of those consuming < 2 servings/day ($p < 0.001$). The subjects in this study also proved to be under the USDA standard in their fruit and vegetable consumption.

Food Groups - Grains

Grains were one food group in which the subjects from both groups easily met the MyPyramid standard. Upon examination of the athlete's three-day food records, it was found that the high grain intake was from refined sources, rather than from whole grains. The USDA recommends three serving of whole grain because of its benefits in reducing the risk of coronary heart disease, diabetes, and perhaps aiding weight control (USDA, 2005, Chapter 5). The USDA reported in the 2005 Dietary Guidelines for Americans that children and adults had relatively low intakes of fiber and magnesium (USDA, 2005, Part D).

Calorie Intake

In this study, high school female athletes' caloric intake was on the low end of the USDA's standard – a finding that coincides with the existing research (Jonnalaqadda, Berndot, and Nelson, 2000; Eliakim & Beyth, 2003). Analysis of questionnaire data indicated that approximately 80 percent of participants stated that they were often hungry. Possibly this discrepancy could be due to the inability of the MyPyramid to adequately analyze calorie intake. At the time of this study, the MyPyramid website asked limited questions regarding degree of physical activity. Currently, the website does a more thorough analysis of physical activity calories. A more sensitive analysis may indicate an even greater discrepancy with the USDA standard. Nonetheless, most lean and non-lean athletes stated in their questionnaires that their perception of calorie intake was adequate. However, a large number of both lean and non-lean athletes reported that they often felt hungry. The lean athletes' three-day mean calorie intakes were 254 higher than the three-day mean for the non-lean group. This appears not to support the findings of similar studies of elite athletes (Beals & Manore, 1994; Torsveit & Sundgot-Borgen, 2004; Torstveit, Rosenvings, & Sundgot-Borgen, 2007). One of the major contentions of the Female Athletic Triad (FAT) is that lean sport female athletes typically consume fewer and expand more calories than non-lean sport athletes, thus creating an undesirable calorie deficit. In this study, the number of participants may have been too small to obtain this finding or the theory may not apply to high school female athletes.

Protein Intake

In this study, participants had a higher protein intake than the standard. Some authorities consider higher protein intakes for athletes to be desirable (Philips, 2006; Lemon & Proctor, 1991). However, the lean group was 21 grams higher than the standard and that level may be too high for optimum health. In general, the higher protein intake between both groups was somewhat surprising, since both the lean and non-lean group averaged lower than the recommended servings for the meat and bean food group. Their higher protein intake was due to cheese intake rather than milk, meat or bean intake.

Carbohydrate Intake

The mean three-day carbohydrate intakes for both the lean and non-lean groups were well above the standard. An overwhelming portion of studies on carbohydrate consumption and exercise favors an increase of dietary intake as athletes train harder, especially in sports that require more endurance (Burke, Cox, Cummings & Desbrow, 2004; Burke, 2001; Achten, Halson, Mosley, Rayson, Casey, & Juekendrup, 2004; Burke, Kiens, & Ivy, 2004). Not surprisingly, the lean athletes (endurance sport athletes) consumed 38 grams more carbohydrate per day than non-lean athletes did in this study.

Vitamin B12

Vitamin B12, like iron, folic acid, and to a lesser degree vitamin B6 are important co-factors in the development of red blood cells. The three-day mean for vitamin B12 was above the USDA standard. B12 is contained in animal foods. Since protein intake was high among research participants, it is not surprising that vitamin B12 intake was adequate. However, this finding was in contradiction with a study reported by Barger-Lux et al., 1992) that low calcium intake corresponded with low intakes of vitamin B12. The subjects in this study had lower than the recommended calcium intake, but a higher than recommended intake of vitamin B12.

Folic Acid

The three-day mean intake of folic acid for both groups was adequate. Since fruit and vegetable intake was quite low and carbohydrate intake was high, a major source of folic acid for research participants must have been the grain group, which is fortified with folic acid. Analysis of 1999-2000 National Health and Nutrition examination data indicated that consumption of grain products enriched with folic acid provided a significant source of folic acid in the diets of children and adult women. "Although there has been concern that obtaining folic acid from fortification may not offer the same level of protection from neural tube defects as could be achieved by consuming foods naturally rich in folic acid" (IOM, 1998, p 12), recent studies point towards the efficacy of fortification. Evans, Llurba, Landsberger, Obrien, & Harrison., (2004) report that post fortification, the percentage of high maternal serum alpha-fetoprotein values (an indicator of neural tube defects in the fetus) obtained during midtrimester of pregnancy decreased by 32 percent. A Centers for Disease Control and Prevention (CDC, 2004b) report confirm that the incidence of spinal bifida and anencephaly decreased by 26 percent between the pre- and post-fortification periods (1995–1996 and 1999–2000), suggesting that the fortification of enriched grains has helped reduce risk. These studies indicate that research participants getting a substantial portion of their foliate from fortification does offer them protection. It should be noted that the USDA generally recommends a safe daily folic acid supplementation of 400 mcg for those at risk of a folic acid deficiency. In addition, the USDA'S Dietary Guidelines for Americans strongly urge female adolescents to ensure that they are getting adequate folic acid (USDA, 2005).

Calcium and Food Group – Milk Group

Low calcium intakes in this study are associated with the low dairy intake. USDA recommends that this female age group consume three cups of milk (or the equivalent) per day. The combined three-day mean for both groups together was 1.47 cups, 1.71 cups under the standard. Kalkwarf, Khoury and Lanphear (2003) suggest that childhood and adolescent milk consumption will benefit their bone health. Using data from 3251 Caucasian women from NHANES III, low intake (<1 serving of milk per week compared to >1 serving per day) during childhood and adolescence was associated with less hip bone mass in adulthood ($P<0.04$), and low milk intake during childhood was associated with a two-fold greater risk of fracture ($P<0.05$). A review of the three-day food records of the females athletes in this study indicate that they get most of their calcium through milk and dairy. Other dietary calcium sources like salmon, sardines (with bones), sesame seeds, soybean, and leafy green vegetables were rarely eaten. Another interesting finding of this study was the lower intake of calcium/dairy of the non-lean subjects as compared to the lean subjects and their higher incidence of stress fractures. The non-lean group consumed a mean intake of 0.9 cups of milk as compared to 2.1 cup mean intake of the lean. The lean group reported incidences of two broken bones, while the non-lean reported 5. There are a number of studies indicating that high dairy intake and calcium levels increase bone density (Petrie, Stover, & Horswill, 2004; Zeni, Street, Dempsey, & Staton, 2000; Merrilees, Smart, Gilchrist, Frampton, Turner, Hooke, March, & Maguire, 2000).

However, there are dissenting opinions about the significance of calcium/dairy intake and the incidence of bone fractures (Flynn, 2003). McCulloch, Bailey, Houston and Dodd's (1990) study showed no significant increase in bone mineral density in subjects when they increased their dairy intake. In addition, Runyan, Sadler, Bainbridge, Miller & Moyer-Mileur (2003) and Henderson, Price, Cole, Gutteridge & Bhagat (1995) found that adolescent activity level played a more important role in bone mineral density than dietary calcium intake. Although the effect of low calcium intake on bone density has created controversy, the low intake of calcium found in the study participants cannot be good for optimum health and performance.

Magnesium

Three-day mean intake of magnesium for both lean and non-lean groups was significantly below the USDA standard. Magnesium is vital for bone density, since two-thirds of the magnesium in the body is in the skeleton (Martini, 1991). Low intake of magnesium may have been a contributing factor in the fractures experienced by study participants. In addition, magnesium is needed for muscle and nerve functioning, two systems needed for optimal athletic performance (Clarkson and Haymes, 1995, Nielsen and Lusaski, 2006; Rayssinquier, Guezennec & Durach, 1990, Bohl and Volpe, 2002;

Newhouse and Finstad 2000). Whole grains, fatty fishes, nuts, seeds, and leafy green vegetables such as swiss chard and mustard greens, and beans are very good sources of this important mineral. As expected, these food sources were lacking in the three-day food records of the subjects.

Iron

The low intake of iron, especially for the non-lean athletes, is disturbing since numerous studies indicate that low ferritin levels among high school female may affect athletic performance (Rowland et al, 1988; Goulopoulou & Unnithan, 2004). Female teenage athletes can be iron-depleted from blood loss due to menses, iron depletion in sweat, hematuria, and low dietary iron. Runners in particular are frequently identified as having lower ferritin levels than other athletes (Rowland, Stagg, & Kelleher, 1991) and non-athletes (Pate, Miller, Davis, Slentz, & Klingshirm, 1993). The USDA recommends that female adolescents pay special attention in getting adequate iron (USDA. 2005). Although none of the subjects in the study recorded that they were or had been anemic, these results need to be viewed with caution, since some athletes may be anemic without having a formal diagnosis.

Study Benefits

Participation in this study was a benefit to subjects because of their exposure to information regarding the importance of eating well for optimal health and performance and by becoming aware of any outstanding nutritional problems. In addition, they had the option to take advantage of personalized nutrition counseling to improve their dietary inadequacies. Furthermore, participation in the study increased awareness regarding the possibilities available on the MyPyramid website. Awareness of any dietary deficiencies may help to prevent future health disorders, such as low bone density or low ferritin levels. Additionally, by sharing the research findings with a wider audience, there will be a greater understanding of the nutritional health of high school female athletes.

Limitations of Study

Information regarding food intake came from analysis of self-recorded dietary records. Although all subjects were educated regarding proper recording and all records were reviewed with participants, there was no verification of the data. Research done by Jonnalaqadda, Bernadot, and Dill (2000) using gymnasts found underreporting dietary energy intake to be an issue.

A major limitation was the number of subjects who participated in this investigation. Some of the analysis of data may not have shown a statistical significance due to a small sample size. In most cases, lean and non-lean data was combined to increase the validity of the findings. Interpretation of the differences between lean and non-lean data was left to subjective analysis. A larger sample size may have been possible if the time to obtain IRB and school approvals was not so long. This reduced the number of possible teams available to participate in the research project. Since research subjects were high school female athletes, teams are active for limited periods.

Reluctance to provide information about sensitive issues such as age of menstruation may have also been a limitation. Since the primary researcher in this study was male, this might have caused some concern. In order to decrease feelings of discomfort, the question was asked on a questionnaire in order to lessen feelings of uneasiness.

The subjects recruited to participate in this study were from middle-class, predominately white, school district in northern New Jersey. Only one of the participants was a member of a minority group. Therefore, results cannot be generalized to include the entire population of female high school athletes across the nation. Another limitation may have been that individuals with a greater interest in health and nutrition may have been more inclined to participate. Results of this survey project may indicate better nutrition and health behaviors than the general population of female high school athletes. In addition, those who are inclined to have an eating disorder would also shy away from participating in this investigation.

Usability and Effectiveness of MyPyramid Website

MyPyramid has shown to be a useful tool for those interested in improving their nutrition by using their computer. It is technologically more user-friendly than the past USDA Food Guide Pyramid.

As a research instrument, the MyPyramid though helpful, did have significant limitations. One glaring obstacle that was evident was the limitations in the food database. Subjects recorded not only what and how much they ate, but also recorded brand names as well. Since the nutritional content in a given food item may vary from brand name to brand name, this information was deemed important. However, the website has a limited selection of brand names and the analysis of the three-day food records was hampered. For example, one slice of Wonder wheat bread has a different nutrient breakdown than a slice of Arnold wheat bread. Subjects in this study often ate similar type foods, but the brand names often differed.

A limitation of the MyPyramid website for evaluating diets of athletes is the limited information available regarding standards for specific nutrients. The MyPyramid website uses Dietary Reference Intakes, specifically Recommended Dietary Allowances and Adequate Intakes, as the standard. However, these standards are based on gender, age and reproductive status not activity level. In addition, the highest activity level that one can select is one-hour daily. High school varsity and junior varsity athletes may well be involved in more than one hour of physical activity. Also, the specific activities were grouped together, not allowing for variation in nutrient requirements for various activities.

Another issue was the way the subjects were profiled on the MyPyramid website. Calorie standards appeared to be on the lower level for many of our active subjects. Although the standards took into consideration some individual differences, the highest calorie standards of all the subjects was 2,041, the lowest being 1,516. Research for this study found that adolescent female athletes might lose bone density if their caloric intake does not compliment their activity level.

Magnesium research has shown this nutrient to be vital for bone-building, muscle, and nerve functioning (Martini, 1991). It may be debatable as to whether there is justification in the calcium recommendation of 1300 mg., while the magnesium standard is set as low as 360 mg. Both the lean and non-lean groups were significantly under the USDA standards for both calcium and magnesium. One may argue with such low magnesium standards, perhaps the bar has been set too low.

Another issue that may have affected results of this study is the subject's grain intake. This was the only food group that the subjects were above the USDA standard.

The MyPyramid grain group does not differentiate between whole grains and processed grains. MyPyramid results indicated how much fiber was consumed and how many servings of grains were eaten, but not the number of servings of whole grains. Nutritionally speaking, MyPyramid would better serve its users if they would decipher whole grains from processed grains. Whole grains contain vital phytochemicals that are important for good health.

Conclusions

Results indicated that the diets of participants were not providing them with adequate amounts of daily servings of dairy, vegetables, fruits, and meat and beans according to the USDA MyPyramid standards. Only the grain group was not below the food group standards. Caloric intakes were within recommended ranges. Intakes of protein, carbohydrates, lipids, vitamin B12 and folic acid were above the USDA nutrient standards. Mean intakes of calcium, magnesium and iron were significantly below Dietary Reference Intake mineral standards.. These findings should alert athletes, parents, and coaches that the current dietary status of female high school athletes may be lacking in important bone-building and performance related nutrients.

SUGGESTIONS FOR FUTURE RESEARCH

The usefulness of the MyPyramid website is hampered by a lack of appropriate standards for athletes. The Dietary Reference Intakes need to include a category for those involved in high levels of activity. In order for this to be accomplished, more research needs to be done on specific nutrient requirements for athletes at various ages of the lifecycle.

This research study only scratches the surface on examining the dietary habits of lean and non-lean high school female athletes. This type of research is still in its infancy. Better understanding of their dietary habits can help guide parents, coaches and educators to address relevant nutritional issues.

It is important that research findings regarding the adolescent female athlete get into the hands of those that would benefit the most; this includes the athletes, parents, coaches and counselors. For example, there is a great deal of information available about the Female Athlete Triad (FAT), but this information is not disseminated to athletes, parents and coaches. Athletes who develop stress fractures may associate it with factors such as overused training stressors, lack of calcium or structural imbalances, but may never suspect that it was the result of a low caloric intake, coupled with high-energy output.

Future research must broaden their scope to involve the nutrients that affect the high school female athlete's ability to ward off anemia and adequate development of red blood cells and satisfactory ferritin levels. Just focusing on calcium and dairy consumption regarding bone density is too narrow a focus. Future research needs to examine other bone forming nutrients such as vitamin D, boron, magnesium, and vitamin K. Heavy training, coupled with a diet lacking sufficient levels of antioxidants like vitamins A, C and E, and the minerals selenium and zinc need to be addressed. More research examining the adolescent female athlete's intake of these important nutrients should become a priority. Ultimately, research needs to identify deficiencies in the high school female athlete's diet and find ways to increase awareness of the importance of good nutrition. This may then lead to helpful interventions that would prevent potential casualties.

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Appendices

Appendix A

Letters of Approval

WEST MILFORD TOWNSHIP HIGH SCHOOL
Office of the Athletic Director

Dear Dr. Bauer,

February 4, 2006

West Milford Township High Schools grants permission to William McSheffrey to conduct his thesis study at West Milford Township High School as per the outline provided by Mr. McSheffrey.

If you should need any other information, I can be reached at 973 607-1701, ext 263.

Sincerely,

Timothy S. Gillen

Timothy S. Gillen
Director of Athletics
West Milford Township High School

c: Maureen Bernstock, Principal
Judy Meusel, Girls Cross Coach
William McSheffrey

CARDINAL ATHLETICS

PRIDE, HUSTLE,"NEVER SAY DIE"
Colleen M. Moyle Athletic Director
973-835-6939
973-835-1054 (fax)

February 4, 2006

Dear Dr. Bauer,

Pompton Lakes High School grants permission to William McSheffrey to conduct his thesis study at Pompton Lakes High School as per the outline provided by Mr. McSheffrey.

If you should need any further assistance, I can be reached at 973-835-6939.

Sincerely,

Colleen M. Moyle
Director of Athletics

Appendix B

Three Day Food Record Form

Name (optional) ______________________ Date: _________________

Code # ________ (ask your coach to give you one, use same # on your questionnaire)

- Complete this form as accurately as possible, using examples as a guide.
- Use one form per day.

Try to record all food and beverages, including water for each of the three days.

Time	Food/Drink	Type	Preparation	Amount
8:00 A.M.	Bagel	Cinnamon raisin	toasted	1 medium size
8:00 A.M.	Milk	1% fat	Fresh	8 oz.
Noon	Chicken	Leg & thigh	Fried	1 each

Appendix C

Student Assent Form

William McSheffrey
Department of Health and Nutrition Sciences

Assent Form

I am inviting you to participate in a research study that I am now going to describe to you so you can decide whether you want to participate or not. Feel free to ask me questions at any time.

Project Title:
Comparison of dietary habits of high school female athletes with the new USDA MyPyramid

Purpose:
The purpose of this study is to better understand the dietary habits of high school female athletes.

Procedures:
Here's what I will ask you to do as part of the study: First I will give you a form to complete. Second, I will meet with you, your parent(s) and coach to give a brief description on what constitutes a serving size and how to complete a food record. Then you will keep a food journal (write down everything you eat) for three days. After you complete the food journals, I will review the records with you to be sure I understand every thing you wrote. These journals will be analyzed by a computer for nutrient intake. You will receive a copy of these results. If you wish I can meet with you and your parent(s) to go over the computer analysis.

Time involvement:
It will take about one-hour-and-thirty five minutes of your time for you to participate in the study. The meeting to go over serving sizes will take about 30 minutes. Three days of writing down your food should take about 10 minutes a day or a total of 30 minutes. The meeting to go over your food journal should take about 30 minutes. The optional meeting to go over the computer analysis should take about 15 to 30 minutes.

Risks:
Participating in this project poses little risk for you. You may feel some discomfort answering questions about your food habits or health on the questionnaire. If this is the case feel free to skip specific questions.

Benefits:
You will benefit from participating in this study because you will receive the nutritional results of your three-day dietary food journal and see how your food intake compares to the new USDA's My Pyramid guidelines. Additionally have the option of meeting with me for a 30 minute nutrition counseling session to review your results

Confidentiality:
Data will be kept in locked file cabinets in the investigators offices. All participants will be assigned a number for data analysis. Report of findings will only reflect numbers, not actual names of participants.

Voluntary participation:
You should participate in this study only if you want to. You can say you do not want to participate now, and you can stop participating at any time without any punishment or penalty. You can tell me that you do not want to answer any questions you don't want to answer. Your signature below indicates that you have decided to participate in the study voluntarily.

For questions about the study: Contact William McSheffrey **Email**: wmcsheffrey@yahoo.com or Dr. Kathleen Bauer, Department of Health and Nutrition Sciences, Montclair State University, Montclair, NJ 07043. **Phone:** 973-655-7155. **Email**: bauerk@mail.montclair.edu.

For questions about your rights: If you have any questions about your rights as a research participant, you may contact the IRB chair, Tamara Lucas (lucast@mail.montclair.edu, 973-655-7718) or the MSU Director of Research and Sponsored Programs, Tim Kirby (Kirbyt@mail.montclair.edu, 973-655-7534).

A summary of study results will be provided to you upon request.

The extra copy of this form is for you to keep.

If you have read this form and have decided to participate in this research project, please sign below.

______________________	______________________	__________
Name of Research Participant	Signature	Date
______________________	______________________	__________
Name of Parent/Guardian	Signature	Date
William Edward McSheffrey	______________________	__________
Principal Investigator	Signature	Date
Kathleen D. Bauer, Ph.D., R.D.	______________________	__________
Faculty Sponsor	Signature	Date

Appendix D

Parental Consent Form

William McSheffrey
Department of Health and Nutrition Sciences

PARENT/GUARDIAN CONSENT FORM

Please read below with care. You can ask questions at any time, now or later. You can talk to other people before you fill in this form.

Study's Title: Comparison of dietary habits of high school female athletes with the new USDA MyPyramid

Why is this study being done? The purpose of this study is to better understand the dietary habits of high school female athletes.

What will happen while your child or dependent is in the study? After receiving your consent form, I will give your child another form to complete. Second, I will meet with you and your child to give a brief description on what constitutes a serving size and how to complete a food record. Then your child will keep a food journal (write down everything she eats) for three days. After the food journals are completed, I will review the records with your daughter and to be sure I understand every thing she wrote. These journals will be assessed by a computer for nutrient intake. Your daughter will receive a copy of thes results. If you wish I can meet with you and your daughter to go over the computer analysis.

Time: It will take about one-hour-and-thirty five minutes of your time for you to participate in the study. The meeting to go over serving sizes will take about 30 minutes. Three days of writing down your food should take about 10 minutes a day or a total of 30 minutes. The meeting to go over your food journal should take about 30 minutes. The optional meeting to go over the computer analysis should take about 15 to 30 minutes

Risks: Your child or dependent may feel some discomfort answering questions about your food habits or health on the questionnaire. If this is the case they will be told to feel free to skip specific questions.
The risks are no greater than those in ordinary life.

Benefits: Your child dependent may benefit from this study because she will receive the nutritional results of rthe three-day dietary food journal and see how her food intake compares to the new USDA's My Pyramid guidelines. Additionally she will have the option of meeting with me for a 30 minute nutrition counseling session to review the results

Who will know that your child or dependent is in this study? Your child or dependent will not be linked to any presentations. We will keep who your child or dependent anonymous according to the law.
Data will be kept in locked file cabinets in the investigators offices. All participants will be assigned a number for data analysis. Report of findings will only reflect numbers, not actual names of participants.

Does your child or dependent have to be in the study?

Your child or dependent does not have to be in this study. She/he is a volunteer! It is okay if she/he wants to stop at any time and not be in the study. She/he does not have to answer any questions that she/he does not want to answer. Nothing will happen to your child or dependent. She/he will still get the things that were promised.

Do you have any questions about this study? Contact William McSheffrey **Email**: wmcsheffrey@yahoo.com or Dr. Kathleen Bauer, Department of Health and Nutrition Sciences, Montclair State University, Montclair, NJ 07043. **Phone:** 973-655-7155. **Email**: bauerk@mail.montclair.edu.

Do you have any questions about your rights? Phone or email the IRB chair, Debra Zellner (zellnerd@mail.montclair.edu, 973-655-4327) or the IRB Administrator, Fitzgerald Edwards (edwardsf@mail.montclair.edu, 973-655-7781)."

It is okay to use her/his data in other studies:

Please initial: ______ Yes ______ No

I would like to get a summary of this study:

Please initial: ______ Yes ______ No

The copy of this consent form is for you to keep.

If you choose to have your child or dependent in this study, please fill in the lines below.

Name of Parent/Guardian	Signature	Date
Name of Parent/Guardian	Signature	Date

If you choose to be in this study, please fill in your lines below.

Print your name here	Sign your name here	Date
Name of Principal Investigator	Signature	Date
Kathleen D. Bauer, Ph.D., R.D.		
Name of Faculty Sponsor	Signature	Date

Appendix E

Participant Survey Questionnaire

PARTICIPANT QUESTIONNAIRE CODE # ______ (OFFICIAL USE)

Comparison of Dietary Habits of High School Female Athletes with My Pyramid

The purpose of this study is to examine the dietary habits of high school female athletes. A computer software program will be used to assess how close their diets come to meeting the new USDA's 2005 My Pyramid goals. An optional nutritional consultation will be offered to participants after the results are completed.

Please answer the questions as best as you can.

DEMOGRAPHIC INFORMATION

Name ____________________________ Height ____________ Weight ___________

Contact phone ______________________ E-mail _________________________________

Age _____ Grade level: 9 10 11 12 (circle one)

HEALTH HISTORY

1. Have you had any broken bones or fractures while competing in sports?

Yes _____ No _____ If yes, please indicate when, and what were the circumstances.

____

____

____

2. At what age did you begin menstruation? ____________________________

3. As best as you can remember, how many times do you menstruate per year?__________

4. Have you ever had anemia? Yes _____ No _____ If yes, when? _______

5. Is there any other health problem you have that you would like to mention?
If so, please indicate ____

6. Do you often feel tired? Yes _____ No _____

7. How many hours do you normally sleep per day? __________

HIGH SCHOOL ATHLETICS

8. Do you play high school sports? Yes _____ No _____ If yes, please indicate which ones, and at what level.

____

____

____

DIETARY CHARACTERISTICS

9. Do you consciously restrict your food intake? Yes ____ No ____ If yes, why?

____

____

____

10. Have you been on a diet for weight loss in the past year? Yes ____ No ____ If yes, please briefly describe the diet.

____

____

____

11. Are you often hungry? Yes _____ No _____

12. Do you feel you eat enough calories for your activity level? Yes ____ No ____

PERSONAL ASSESSMENT

13. Do you feel satisfied with you current weight? Yes ____ No ____
If not, how many pounds do you want to lose or gain?

____

____

____

14. Would you like to receive nutritional counseling? Yes ____ No ____

Thank you for your participation!

APPENDIX F

Food Frequency Chart

NUMBER OF TIMES ITEMS WERE CONSUMED BOTH GROUPS COMBINED

FOOD OR DRINK	FREQUENCY OF CONSUMPTION
WATER	93
COOKIES	32
CEREAL	30
TYPES OF CEREALS LISTED BELOW	
CHEERIOS	4
OATMEAL	2
APPLE CRUNCH	1
BERRY KRISPIES	1
WHEAT FLAKES	1
WEIGHT WATCHERS	1
QUAKER OATS	1
FRUIT LOOPS	1
LUCKY CHARMS	1
MULTIGRAIN	1
TOTAL SANDWICH	29
TYPES OF SANDWICHES LISTED BELOW	-
TURKEY SANDWICHES	14
CHEESE SANDWICHES	8
CHEESE SANDWICH ON WHOLE WHEAT	1
CHICKEN SLICE WITH CHEESE	1
ROAST BEEF ON ROLL	1
HAMBURGER ON ROLL	1
CHEESE AND TOMATO	1
CHEESE BURGER	1
BACON SANDWICH	1
HAM SANDWICH	
MILK	27
TYPES OF MILK LISTED BELOW	-
CHOCOLATE MILK	6
STRAWBERRY	1
FAT FREE MILK	1
ICED TEA	26
BREAD	26
TYPES OF BREAD LISTED BELOW	-
CINNAMON	1
WHEAT	2

SOURDOUGH	1
PUMPERNICKLE	1
FRENCH	1
WHITE	1
BAGEL	25
TYPES OF BAGELS LISTED BELOW	-
PLAIN BAGEL	6
TWO EGG-WHILES BAGEL	1
BUTTER BAGEL	1
BLUEBERRY	1
POPPY SEED BAGEL	1
SALAD	20
TYPES OF SALADS LISTED BELOW	-
CHIKEN SALAD	2
CAESAR SALAD	2
LETTUCE AND TOMATO SALAD	1
ROMAINE	1
SALAD WITH CHEESE DRESSING	1
SALAD WITH ITALIAN DRESSING	1
CHIPS	19
FRENCH FRIES	18
GRANOLA BAR	18
TYPES OF GRANOLA BARS BELOW	-
OATS AND HONEY	4
KASHI	3
SEMOLI	2
PASTA WITH SAUCE	17
TYPES OF PASTAS LISTED BELOW	-
PENNE WITH VODKA SAUCE	2
PENNE WITH TOMATO SAUCE	1
RAVIOLI	1
TORTELLINI ALFREDO	1
NOODLES, TOMATO	1
SPAGHETTI, TOMATO	1
APPLES	16
YOGURT (4 VANILLA)	16
COKE	15
TURKEY	

TOTAL TURKEY LISTED BELOW		
TURKEY (SANDWICHES)	14	
TURKEY SLICES	2	
GATORADE	14	
BANANA	14	
PIZZA WITH CHEESE	12	
ICE CREAM, CHOCOLATE	11	
TOTAL CHICKEN	11	
TYPES OF CHICKEN LISTED BELOW	-	
CHICKEN BAKED BREAST	4	
CHICKEN BREAST GRILLED	3	
CHICKEN NUGGETS	3	
CHICKEN TENDERS FRIED	1	
CHICKEN FINGERS	1	
CHICKEN SANDWICH	1	
CHICKEN FRANCHISEE	1	
VITAMINS	9	
DIET SODA	8	
MASHED POTATOES	8	
CARROTS	7	
BROWNIES	7	
RICE	6	
MOZZARELLA STICKS	6	
STEAK	6	
POPCORN	6	
CHOCOLATE BARS	6	
CHEESEBURGER	5	
GRAPES	5	
QUESADILLAS (CHEESE)	5	
COFFEE	5	
TYPES OF COFFEE LISTED BELOW	-	
CAPPACHINO	1	
REGULAR	1	
JUICE	5	
TYPES OF JUICE LISTED BELOW	-	
ORANGE JUICE	7	
CRANBERRY JUICE	2	
MUFFIN	4	

TYPE OF MUFFIN LISTED BELOW	1
ENGLISH MUFFIN	1
BLUEBERRY MUFFIN	1
APPLE CRISP	4
PRETZELS	4
SOUP	4
TYPES OF SOUPS LISED BELOW	-
CHICKEN NOODLE	2
BROCCOLI AND CHEEDAR SOUP	1
PEA SOUP	1
LIPTON CHICKEN	1
STRAWBERRIES	4
FISH	4
TYPES OF FISH LISTED BELOW	-
TALAPIA, BAKED	1
SHRIMP, FRIED	1
TROUT, GRILLED	1
FLOUNDER, FRIED	
EGGS	3
FRUIT SALAD	3
CRACKERS	3
CHINESE FOOD	2
TYPES OF CHINESE FOOD LISTED BELOW	-
BEEF AND BROCCOLI	1
EGG ROLL	1
PINEAPPLES	2
HAMBURGERS	2
WALNUTS	2
CORN	2
GREEN BEANS	2
BACON	2
HOT POCKETS	2
PEARS	2
JELL-O	2
SAUSAGE & PEPPERS	1
HONEY DEW MELON	1
TACO BELL	1

PANCAKES	1
CHEETOS	1
INSTANT BREAKFAST	1
PICKLES	1
HOT DOGS	1
FRUIT SNACK	1
SKITTLES	1
VEGGIE BURGERS	1
COTTON CANDY	1
FRENCH TOAST	1
BUFFALO WINGS	1
ZUCCHINI	1
EGG PLANT	1
MEATLOAF	1