ABSTRACT

**Background.** Female athletes often have inadequate diets due to lack of nutritional knowledge and nutritional misconceptions. Poor nutrition may lead to an increased chance of developing the Female Athlete Triad, a trio of low energy availability, menstrual dysfunction, and low bone mass. Physical therapists, as part of a healthcare team, must be prepared to address nutritional issues, recognize signs and symptoms of the female athlete triad, and make the appropriate intervention or referral.

**Objectives.** The purpose of this study was to determine the nutritional knowledge of female collegiate swimmers and how effectively they apply their nutritional knowledge to their everyday eating habits.

**Methods.** Eighty-five female collegiate swimmers from six Michigan universities completed a nutritional knowledge questionnaire and a 24-hour food recall survey. Demographic, nutritional, and statistical data were analyzed.

**Results.** The mean score on nutritional knowledge test was 54.53/76 (71.75% correct). Mean total caloric intake of swimmers was 3229.10 calories per day. Ninety-five point nine percent did not meet the recommended dietary allowance (RDA) for all three macronutrients. No difference in total mean survey score existed between the three collegiate divisions.

**Conclusion.** This study suggests that athletes lack knowledge of nutrition, healthy food choices, components of a well-balanced diet, and the implications of nutrition on performance.

**Key Words.** nutrition, swimming, and female athlete triad

**CORRESPONDENCE**

Barbara Hoogenboom PT, EdD, SCS, ATC
Grand Valley State University
Cook-DeVos Center for Health Sciences
300 Michigan NE, Room 266
Grand Rapids, MI 49503
Phone: (616)-331-2695
email: hoogenbb@gvsu.edu

**ACKNOWLEDGEMENTS**

We extend our thanks to John Gabrosek, PhD for his patience, understanding, and enlightening us in the field of statistics and to Laurie Stickler, MSPT for her physical therapy and nutritional expertise, and allowing us to use the nutritional questionnaire that was modeled after her physical therapy research practicum in 2001. Special thanks to Katherine Kim, PhD, RN for allowing use of the food recall kit and to Dr. Stephen Glass, PhD for allowing use of the Nutritionist Pro software in the Human Performance Laboratory.
INTRODUCTION
In 1972, the Federal Government passed the Education Amendment known as Title IX, which prohibited the discrimination on the basis of sex in all curricular and extracurricular activities at educational institutions that received federal funding. Prior to the introduction of Title IX, females comprised 2% of collegiate athletes. Since 1972, collegiate female athlete participants have increased from 32,000 to greater than 170,000 in number. By 2001, 43% of the athletes participating in collegiate sports were women. This percentage remains relatively stable, with the most currently available data indicating that 42.77% (n = 170,526) of all participants in the National Collegiate Athletic Association (NCAA) during the 2005-2006 competitive season were female. Over eleven thousand of these athletes were swimmers and divers. With increased participation and pressures to perform at a high level of intensity, the recognition of the condition known as the female athlete triad has come to the forefront of sports medicine.

The female athlete triad is a condition that refers to the association between energy availability, menstrual function, and bone mineral density. Athletes are dispersed along spectrums between health and dysfunction in each of these areas. At the dysfunctional end of each spectrum are clinical problems such as disordered eating, amenorrhea, and low bone mass for age. Prevalence of the individual aspects of the triad, alone or in combination, have been reported by several authors. In a study of 112 female collegiate athletes representing seven sports, Beals and Hill reported that 28 athletes (25%) met the criteria for disordered eating, 29 athletes (26%) met the criteria for menstrual dysfunction, and 2 athletes (2%) were diagnosed with low bone mineral density. Only one athlete met criteria for all three components of the triad. The authors concluded that although the combined prevalence of all three aspects of the triad was low, a significant number of athletes experience select aspects of the triad, which in itself is cause for concern.

Extreme consequences of the female athlete triad may include irreversible bone loss, psychological sequelae, disorders related to decreased serum estrogen levels, starvation, or possible death. In addition, disturbances of the endocrine, gastrointestinal, and cardiovascular systems may result from disordered eating. Low bone density may put the athlete at risk for premature osteopenia with resultant stress fractures of the lower extremity, hip, and vertebral column. One key element that impacts all aspects of the female athlete triad is nutrition. Good nutrition requires adequate caloric and nutrient intake in order to sustain positive energy availability. Adequate nutrition has been proven to increase overall performance and may give athletes a competitive edge. Despite the importance of nutrition, many female athletes perform at an energy or nutrient deficit, and place themselves at risk for poor performance and injury.

Researchers agree that many female athletes have inadequate diets. Nutritional practices identified in female athletes include deficient caloric, vitamin, and mineral intakes. The causes of inadequate dietary intake have been identified as lack of nutritional knowledge and nutritional misconceptions. Athletes receive most of their nutritional knowledge from parents, coaches, and peers, yet many athletes’ knowledge bases are lacking and incorrect. This lack of accurate information may lead to an increased chance of athletes developing one or more aspects of the female athlete triad due to poor food choices and the resultant nutritional inadequacies mentioned previously. Tables 1 and 2 summarize the recommended daily allowances for female swimmers for the three macronutrients and three micronutrients of which female athletes commonly show deficiencies.

While all female athletes are potentially at risk for developing part or parts of the female athlete triad, certain sports present a higher risk for this disorder than others. Sports that are subjectively scored (gymnastics and figure skating), endurance sports with an emphasis on low body weight (distance running), sports that require tight fitting clothing for competition (volleyball and swimming), use of weight categories for participation (wrestling and rowing), and emphasize a pre-pubertal body for performance success (gymnastics and figure skating) all present high risks for the development of the female athlete triad. A survey of 182 female collegiate athletes found 32% were affected with aspects of the female athlete triad, with 15.4% of swimmers and 62% of gymnasts affected.

Swimming, due to its emphasis on lean body weight and tightly fitting clothing, has been associated with several nutritional deficiencies which place these athletes at risk of developing components of the female athlete triad. More specifically, swimming has energy requirements four times that of running on land. Many female swimmers do not meet basic requirements for energy intake.
needed to train for swimming. This energy deficit, when coupled with high levels of demanding training, can be a factor in development of facets of the female athlete triad. Iron and calcium are the two most commonly deficient minerals in the diets of female swimmers. Previous studies indicate that more than 50% of female swimmers do not meet the recommended dietary allowance (RDA) for iron or calcium. These nutritional deficiencies, in addition to the lack of weight-bearing impact during exercise put the female swimmer at high risk for developing osteopenia or poor bone mass for age, one component of the female athlete triad. Due to the non-weight bearing nature of swimming, osteoblastic formation is decreased leading to an increased risk of altered bone health.

One critical function of the physical therapist is to “restore, maintain, and promote not only optimal physical function but optimal wellness and fitness and optimal quality of life as it relates to movement and health.” With the increase in societal pressures to conform to an “ideal” body image and concurrent pressures to perform at increasingly high levels, the female athlete triad continues to be a concern for female athletes and those who work with them. Several studies have shown that female athletes, including swimmers, do not have adequate knowledge of nutrition. This lack of knowledge demonstrates a need for education and instruction regarding proper eating habits in this population. Currently, literature regarding nutritional inadequacies and nutritional knowledge of female collegiate swimmers is lacking. Therefore, specific sports-related nutritional deficiencies must be examined in order to assist in athlete education/injury prevention. Physical therapists, as one member of the health care team, must possess adequate knowledge about the female athlete triad and be able to recognize signs and symptoms of the conditions associated and be armed with nutritional knowledge in order to provide optimal patient care and education for this population.

The purpose of this study was to determine the nutritional knowledge of female collegiate swimmers and how effectively they apply their nutritional knowledge to their everyday eating habits. Information gained from this study can be used to address nutritional needs of the female swimmer with educational endeavors.

**METHODS**

A basic nutritional knowledge survey (Appendix A) and a 24-hour dietary recall (Appendix B) were used in this descriptive study. Note: Appendix A contains the correct answers in bold for the purpose of the article. The original survey sent to swimmers did not contain any bold.

Both instruments were completed by female collegiate swimmers who were part of their respective teams at the time of the study. The 76 question nutritional knowledge survey included demographic information and true/false
questions assessing knowledge of various nutritional components. The 24-hour food recall produced quantitative data including total caloric intake and individualized micro- and macro-nutrient intake. The nutritional questionnaire used in the current study was developed by Zawila et al.\(^3\)\(^3\) and revised to its current form by Bailey et al.\(^3\)\(^4\) who determined face validity and construct validity for the survey. The test-retest and inter-rater reliabilities of the 24-hour food recall were examined by Frank et al.\(^3\)\(^5\) who found reliability to be .96. Their study also reported a detailed protocol for interview techniques, identification of food items, qualification and quantification of foods, food calculations, and nutrient calculations. The exact, standardized methods used by Frank et al.\(^3\)\(^5\) were used in the current study.

**Subjects**

Eighty-five collegiate swimmers, eighteen years and older from six colleges and universities in the Lower Peninsula of Michigan voluntarily completed both the questionnaire and the 24-hour food recall. Teams from two universities in each NCAA division were chosen for participation in the study in order to equally represent Division I, II, and III levels of competition. Entire teams were invited to participate, although total voluntary participation was accepted for each team, and some team members declined due to schedule conflicts or practice conflicts, thus the final return rate for surveys from all athletes comprising the six swimming teams was 78%. All participants were members of their respective collegiate teams for the 2005-2006 competitive swimming season. This study was approved by the Grand Valley State University Human Subjects Institutional Review Board.

**Procedures**

Participants were recruited via phone contact with the respective swim coach at each university. The coaches were informed on the purpose of the study and asked if they were interested in having their athletes participate on a voluntary basis. If the head swim coach was interested, he/she was sent an informative letter, including the purpose of the study, research methodology, importance of involvement, and personal and team requirements. After review of the letter and consent for a team to participate, a visit date was set for data collection.

During the initial contact, an emphasis was placed on assuring the head swim coach that participation in the study was voluntary, and that although the researchers desired participation of the entire team, his/her swimmers were able to decline participation at any time. The swimmers were given the option of declining by not filling out the data collection forms (i.e. the survey or 24 hour food recall form) and were instructed to turn in blank data forms when all other data was collected. This procedure allowed those who did not wish to participate to maintain their privacy from other teammates, coaches, and the researchers. No swimmers present at data collection sessions declined to participate.

The participants were provided with a consent form prior to participation. Subjects must have read and signed the consent form in order to participate in this study. By voluntary completion of the consent form, questionnaire, and food recall, the subject committed to participation in this study. Participants were instructed to fill out the nutritional questionnaire (Appendix A) and then to record everything that they consumed within the last 24 hours on the 24-hour food recall form (Appendix B) using attached written instructions, guided by scripted verbal instructions used by the researchers. Specific verbal instructions were provided for the completion of the 24-hour food recall, using time blocks and meal composition questions, along with consistent verbal cues and reminders (e.g. to record use of any condiments, snacks or beverages). The participants were provided with example measuring spoons and cups, plastic food models and posters, along with a detailed instructional sheet in order to record accurate quantification of portion size. Analysis of the 24-hour food recall data was performed using the Nutritionist Pro™ Software (Axxya Systems; Stafford, TX).

**Data Analysis**

Data analysis was both descriptive and inferential in nature. The nutritional questionnaire generated nominal data in the form of true/false responses and in the form of a total score. This data was analyzed using t-tests, frequencies, analysis of variance, and Pearson’s correlation coefficient. Frequencies were used for demographic data, displaying scores on the nutritional survey by age group, and displaying the percentage of subjects that met the RDA values of macro and micro-nutrients. Analysis of variance (ANOVA) was used to compare total scores on the nutritional survey between Division I, II, and III female collegiate swimmers. Total caloric intake, proportion of intake from fats, carbohydrates, and proteins, and vitamin
and mineral intake were calculated by entering food recall information into the Nutritionist Pro™ software. Finally, the relationship between the athletes' level of nutritional knowledge and the athletes' eating behaviors based on the nutritional survey score and food recall results (if RDA was achieved for macronutrients) were analyzed using an independent t-test.

RESULTS
Eighty-five of the eighty-nine female swimmers who agreed to participate in this study completed both the nutritional questionnaire and 24 hour food recall. Subject demographic information is included in Table 3. The mean age of the swimmers was 19.26 years old (SD 1.16 years). Swimmers from all three divisions of the NCAA participated in this study.

Descriptive Data
The mean caloric intake for all of the female collegiate swimmers was 3229.10 kcal with a range of 980.27 kcal to 8050.24 kcal. An outlier who reported consuming 15,415.92 kcal was excluded from data analysis.

Athletes were asked to identify their sources of nutritional information (Figure 1). Choices included athletic trainer, books, coach, community education courses, dietician, doctor, fitness classes, friends, health food store, high school, internet, magazines, newspaper, radio, parents, teammates, university courses, or other. The distribution of sources was widespread with the largest contributor being athletes' parents (12.01%), followed by coaches (10.63%) and magazines (10.29%).

Athletes were grouped according to whether or not they met the female RDA for calcium, iron, and zinc. Mean calcium intake was 1578.88mg, and 48 (56.7%) of all athletes met the RDA for calcium of 1200mg. However, of those athletes who did not meet the RDA for calcium (43.3%), the mean calcium intake was only 822.27 mg. Sixty-eight athletes (80.0%) met the RDA for iron.
intake for women ages 19-24 years old. The average intake for iron was 28.83 mg, well above the RDA of 15 mg. Forty-five of the female swimmers (52.94%) met the female RDA for zinc. The RDA for zinc is 12 mg, and average zinc intake was 14.35 mg. Table 4 displays the RDA's, means and standard deviations for the three macronutrients, and micronutrients calcium, iron and zinc.

Whether or not athletes fell within the RDA range for daily caloric intake for protein, fats, and carbohydrates was also examined. The RDA for protein is 12-15%, carbohydrate is 55-65%, and fat is 25%-30%. The majority of the athletes (90.59%) failed to meet at least one of the RDA ranges for proteins, carbohydrates, or fats. Eighty percent of the athletes did not meet two of the three RDA ranges for macronutrients.

Individually, 84.71% of the female swimmers did not fall within the RDA range for carbohydrates, with 72.9% consuming below the RDA and 11.8% above the RDA range. Mean percentage of the diet from carbohydrates in this sample was 54.15%. For protein intake, 52.94% of the athletes did not fall within the RDA range, with 36.5% of the athletes consuming above and 17.6% below the RDA. Mean protein intake was 14.13% of the diet. Lastly, 62.71% of the swimmers did not fall within the RDA range for dietary fat intake. Nine point four percent consumed below the RDA and 55.3% were above the RDA, with a mean intake of 31.17% of the diet from fats.

The mean nutritional survey test for all female swimmers was 54.53 (standard deviation = 4.34) out of a possible 76 or a score of 72% correct. The scores ranged from 44 to 65 correct answers out of 76 total questions. Total mean scores for the female swimmers were compared between the three divisions and are displayed in Table 5.

### Statistical Analysis

The summaries of the statistical tests used are found in Tables 6 and 7. The level of significance was pre-set at 0.05 and was used for all analyses.

An independent *t*-test was used to compare the mean questionnaire scores of the female swimmers to determine whether or not they met the RDA range for the macronutrients (protein, carbohydrate, and fat). No significant difference was found (*p* = 0.509) between mean nutritional questionnaire score of the athletes who were within the RDA for carbohydrates, fats, and proteins and those who were not within the RDA range for at least one of the macronutrients.

An ANOVA was used to compare the mean total nutritional survey score between the three collegiate divisions. No significant difference was found (*p* = 0.573) in the mean nutritional questionnaire scores between the three divisions of athletes (Table 6).

### DISCUSSION

The recommended daily caloric intake for in-season female collegiate swimmers has been suggested to be as high as 4,000 to 5,000 calories and swimmers may require up to 11.67 calories per minute of swimming depending on intensity of the activity. However, mean daily caloric intake for female swimmers has been previously reported.
to range from 2,064 to 3,571 calories. Of the 85 subjects included in this study, only 9.41% had a caloric intake between 4,000 and 5,000 calories. The mean total caloric intake of the swimmers in this study was 3,229.10 calories, similar to past research reports. While caloric expenditure is dependent on type of stroke, weight of the athlete, duration of the activity, and whether the athlete is training or competing, all of the swimmers in this study were in season and expected to be using the upper quartile of energy expenditure each day.

Despite the fact that exact energy expenditure cannot be determined for the swimmers in this study, the mean reported caloric intake for the swimmers was well below the lower range of recommended intake. Other research by Ousley-Pahnke et al and Hawley et al demonstrated energy deficits present among female swimmers. In the current study, 65 (76.47%) of the 85 subjects were below the suggested lower end caloric intake level of 4,000 calories. Therefore, a significant portion of the swimmers may be at risk of performing at an energy deficit which may be followed by a decrease in performance. Performing with an energy deficit may lead to development of one of the components of the female athlete triad, low energy availability. In turn, low energy availability is a critical factor in development of low bone mass and amenorrhea, the duo that complete the female athlete triad.

According to the nutritional survey used in this study, 100% of the female swimmers felt that skipping meals was not justifiable to lose weight. Despite this knowledge, athletes often had low caloric intake and appeared to have skipped meals based on information recorded on the 24-hour food recall. Societal pressures, the ideal body image, and weight restricting behaviors are possible reasons that caloric intake for female swimmers tends to be lower than recommended.

Nutritional knowledge has been positively correlated with positive eating behaviors. The swimmers in the current study demonstrated fair knowledge of nutrition as measured by the mean score of 54.53/76 (71.75% of questions answered correctly) on the nutritional test, yet 90.59% of subjects did not meet the RDA for all macronutrients. Additionally, only 80% of the female swimmers met two of the three RDA ranges for macronutrients. These statistics imply that despite ability to “pass” a nutritional knowledge questionnaire and previous background knowledge in nutrition, the athletes did not apply their knowledge to their eating habits. For example, 84.71% of the female swimmers did not fall within the RDA range for carbohydrates which should comprise 55-65% of the athlete’s diet. Seventy-two point nine percent of athletes were below the RDA range for carbohydrates, while 11.8% were above the RDA range. Adequate carbohydrate intake is critical to avoid glycogen depletion which may lead to fatigue and muscle breakdown.

The proportion of diet from protein was also unbalanced, as 52.94% of the athletes did not fall within the RDA range of 12-15%. For protein, 17.6% of athletes were below the RDA range, while 36.5% were above the RDA range, with a mean intake of 14.13% of the diet. The surplus of protein intake in the subjects may relate to the concurrent low intake of carbohydrates. Interestingly, 77.65% of the swimmers erroneously believed that carbohydrates and protein had different caloric values. This inaccurate belief may have played a role in their dietary selections with a skew toward protein rich food choices versus carbohydrate rich food choices.

Finally, 62.71% of the swimmers did not fall within the RDA range of 25-30% of diet from fats. Nine point four percent of athletes were below the RDA range for fats, while 55.3% were above the RDA range. If an athlete eats an increase in fat and does not consume adequate carbohydrates, the fat cannot be easily used as energy in the body and protein will be used, resulting in muscle breakdown.

A majority of the athletes (74.12%) were unable to identify the correct percentage of daily diet from fats on the nutritional questionnaire. Due to the fact that many athletes did not meet the RDA for fat and a majority did not know the daily recommended intake, nutritional education specific to the role of fats in the diet and its impact on performance is necessary.

Several studies have found that swimmers have carbohydrate intake below recommended values. In the current study, the mean percentage of carbohydrate in the swimmer’s diet was 54.15%, just below the RDA range of 55-65%. Average fat intake in this study was also above the RDA range at 31.16%. A study by Hassapidou et al identified a similar trend among female adolescent swimmers, in which a low carbohydrate intake and high fat intake diet were consumed. This macronutrient consumption trend is also supported by Berning, who stated that swimmers often ingest a high amount of fat at the expense of carbohydrates. Hassapidou et al asserts that the presence of this
unbalanced diet leads to sub-maximal performance in the female swimmer. One explanation for this dietary trend may be the increased popularity of and media attention to low carbohydrate, high fat diets, making them attractive to athletes. The results of the current study suggest that female collegiate swimmers would benefit from education on the risks of consuming too much or too little of the macronutrients, and the consequences of a low carbohydrate diet on athletic performance.

Because calcium is critical for optimal health in female athletes, calcium consumption was assessed using the 24 hour food recall. The recommended daily value for calcium intake for the competitive female swimmer is 1200 mg. Of the swimmers in the current study 56.7% met the RDA, with an average intake of 1778.88 mg (ranging from 419.60 mg to 6,698.60 mg/day). Although this percentage indicates that the majority of swimmers are consuming an adequate amount of calcium in their diet, a large percentage, 43.53%, of the swimmers did not meet the RDA. The average calcium intake of the athletes who did not meet the RDA was 822.27 mg, suggesting that several of the athletes may be at a large calcium deficit. Hawley and Williams found that 55% of adolescent female swimmers had calcium intakes below the RDA when age matched to male swimmers. Additionally, Berning et al found that although on average elite national adolescent swimmers met the RDA for calcium as a group, over 50% of the female athletes were low in calcium. A slightly higher proportion of female swimmers in the current study met the RDA for calcium as compared to other reports in the literature. The higher percentage may be due to the fact that a majority of the previous studies calculated calcium intake for adolescent swimmers as opposed to collegiate swimmers. Additionally, recent media attention to the consequences of osteoporosis and the implications of a low carbohydrate diet on athletic performance.

The swimmers’ iron consumption was assessed using the 24-hour food recall. The daily recommended caloric intake of iron for females is 15 mg/day with an average intake ranging from 11.8 to 12.7 mg/day in female athletes in general. In the current study, the majority of the swimmers (80.0%) met the RDA, with average intake well above the recommended 15 mg. The results suggest that female collegiate swimmers are consuming the appropriate amount of iron in their diets. However, it cannot be assumed that athletes in the study were aware of their iron sources. The relatively high proportion of swimmers meeting the RDA for iron may be due to presence of iron fortified (non-heme iron) foods in their diet. Heme-iron rich foods include meat, poultry, and fish, each providing readily absorbable iron. A relatively small proportion of swimmers listed individual servings of red meat on their 24 hour food recall forms, with only a few listing servings of poultry or fish. A majority of the swimmers listed iron enriched cereals on the recall form; some consuming two or three bowls a day. This finding, in concordance with the relatively low protein intake, suggests that athletes are receiving their iron from iron enriched (non-heme iron) foods such as cereal and protein shakes, not meat (heme iron) products. Iron from non-heme sources are less easily absorbed than heme sources of iron.

The final micronutrient analyzed with the 24-hour food recall was zinc. Zinc is an important mineral essential to enzyme function, tissue growth, and repair. Several studies have found that female athletes often are zinc deficient. College female swimmers have been found to have an average intake of 10.4 mg/day of zinc. The current RDA for zinc is 12 mg/day for adolescent and adult females. In this study, just over half of the athletes (52.94%) met the RDA for zinc, with an average intake of 14.35 mg. Though the majority of the athletes assessed in the current study met the RDA for zinc, a significant percentage did not (47.06%). Despite the mean intake being slightly above the RDA, many of the swimmers are still at risk for a deficiency. The high proportion of females that did not meet the RDA for zinc, may be due to the relatively low consumption of zinc rich foods such as meats, eggs, and seafood. Similar to iron intake, this finding is in concordance with the low protein intake, demonstrating that some of the athletes may be unaware of nutritional sources and would benefit from further education on sources of zinc and recommended daily intakes.

The mean total percentage score on the nutritional questionnaire was a 71.75%, suggesting that, on average, swimmers did not know 28.25% of the information. Therefore, health care professionals, including physical therapists, should not assume that athletes have adequate nutritional information and should address this area during intervention. The questionnaire used in this study could not be compared to a recognized “gold standard”
because one does not exist. Although there is no standard or “cut” score for the questionnaire that was used, the mean scores across all three divisions suggests there may be a lack of nutritional knowledge among female collegiate swimmers.

The female collegiate swimmers in this study were asked to identify their sources of nutritional information. While there were many options, the top two informants were parents (12.01%) and coaches (10.63%) which is similar to previous studies. Rosenbloom et al found that coaches have an overall lack of nutritional knowledge and they, like their athletes, would benefit from nutritional educational programs with an emphasis on disordered eating. Despite reliance on coaches for nutritional information, 36.47% of the female swimmers in this study did not believe it was the coach's responsibility to stress good nutritional practices. Therefore, a nutritional education program with information available for the athletes, parents, and coaching staff may be beneficial in increasing nutritional knowledge and positively affecting resultant food choices among female swimmers. This education program should include participation by a nutritionist or dietitian specializing in performance.

The main limitation in this study was the use of the 24-hour food recall. Despite use of specific scripted instructions, pictures, food models, and memory triggers, it was difficult for subjects to recall everything consumed within the designated 24-hour period, and to accurately estimate serving size. This difficulty was evidenced by a lack of recorded information on some of the 24-hour food recall forms, incomplete data regarding serving sizes, each of which could contribute to under-reporting. Under-reporting on the 24 hour food recall may have led to an underestimation of total caloric intake for the subjects in this study.

CONCLUSION

The female collegiate swimmers in this study demonstrated fair nutritional knowledge while demonstrating a lack of application of their knowledge to their current dietary habits. This lack of application included both macro- and micro-nutrient consumption, regardless of the NCAA Division in which they participated. Female collegiate swimmers must not be overlooked concerning nutritional education as 90% of the subjects did not meet the RDA for all the macronutrients (proteins, carbohydrates, or fats), and many were outside of normal ranges for calcium, iron, and zinc consumption. The swimmers may benefit from education regarding the importance nutrition has on energy availability and performance.

Physical therapists, as part of a multi-disciplinary team, may be responsible for providing education for wellness and general health and may be the first contact for females at risk of developing the female athlete triad. The serious consequences related to the female athlete triad are often associated with nutritional misinformation, disordered eating, and poor energy availability. As a part of their role in the primary and secondary prevention of this disorder, physical therapists must be aware of the signs and symptoms of the triad and be prepared to address any areas of nutritional concern through either patient education or appropriate referral.

REFERENCES


