Original Research

Dietary Habits, Menstrual Health, Body Composition, and Eating Disorder Risk Among Collegiate Volleyball Players: A Descriptive Study

SUZANNE L. VARGAS†, KELLY KERR-PRITCHETT‡, CHARILAOS PAPADOPOULOUS‡, and VIRGINIA BENNET‡

Nutrition Exercise and Health Sciences Department, Central Washington University, Ellensburg, WA, USA

†Denotes graduate student author, ‡Denotes professional author

ABSTRACT

International Journal of Exercise Science 6(1) : 52-62, 2013. Volleyball is typically considered a non-aesthetic sport. However, the revealing nature of volleyball uniforms may place additional pressure on female volleyball players to be thin and increase the risk of disordered eating. The purpose of this study was to provide descriptive data concerning the body composition, nutritional habits, eating disorder risk, and menstrual health of collegiate volleyball players. Female collegiate volleyball players (N = 14) completed a 7-day food record, menstrual health questionnaire, and EAT-26 survey. Participant body composition was determined using a 3 site skinfold test and the Bod Pod®. Half (50%) of participants were deemed "At-Risk" (AR) for disordered eating according to EAT-26 results, while the other half were consider "Not At- Risk" (NR). Participants consumed inadequate calories (1928 ± 476) meeting only 69.35% of their predicted energy expenditure (2780.66 ± 148.88). Additionally, all participants were below the recommended CHO intake range of 6-10g/kg/day for athletes (3.49 + 0.89g/CHO/kg/day) and the recommended intake range of 1.2-1.7 g/kg/day for protein for athletes (1.17 + 0.35). Body fat percentage using the Bod Pod® (22.76 ± 6.25%) was similar to values reported by other studies. Seven of the participants were currently using oral contraceptives (OC). Menstrual dysfunction was reported by 3 participants not using OC. Of those using OC, 3 reported irregular menses as the reason for taking OC. No significant difference existed in macronutrient and energy intake, prevalence of menstrual dysfunction, or body composition between AR and NR groups. In conclusion, the current study suggests that collegiate female volleyball players' diets tend to be inadequate in calories, protein, and carbohydrates, placing them at risk for subsequent medical ailments including menstrual dysfunction.

KEY WORDS: Volleyball, eat 26, macronutrient intake

INTRODUCTION

Regular participation in organized sports, such as volleyball, can offer many health benefits including increased bone density (7), improved fitness, and increased chance for individuals to maintain an active lifestyle (19). Johnson et al. collected data from 1,445 Division I collegiate athletes to examine body dissatisfaction, signs and symptoms of eating disorders, and eating-related behaviors such as dieting (13). The authors concluded that only a small percentage (1.1%) of female athletes met the

DSM-IV (Diagnostic and Statistical Manual for Mental Disorders) criteria for a clinical eating disorder. However, 34.8% and 38% were identified as at risk for anorexia nervosa or bulimia, respectively and 23.9% of female athletes reported self-induced vomiting to lose weight at some point in their life (13). Furthermore, it has been suggested that athletic competition particularly when coupled with revealing uniforms such as in volleyball, may increase the risk for disordered eating (6, 10, 18, 19).

The female athlete triad refers to the co-existence of three inter-related conditions; decreased energy availability, amenorrhea, and osteoporosis (11). Current literature reports that although most athletes don't meet all three of the components that make up the female triad, many experience 1 or 2 of the conditions. Punpilai et al. suggested that almost half of the 63 elite regional level athletes examined in their study experienced menstrual dysfunction (16). Beals et al. reported similar, with 17% of the elite volleyball players (*N*=23) who participated in their study reporting past or present amenorrhea as well as inadequate energy intakes indicating that elite female volleyball players were at an increased risk for menstrual dysfunction and have insufficient energy intakes placing them at risk for compromised performance and health issues (2).

Current nutrition recommendations suggest that athletes should consume adequate energy to match energy expenditure, particularly during periods of high intensity training. Those who do not may experience a loss of muscle mass, increased fatigue, increased risk of menstrual dysfunction, loss of bone mineral density, and injuries (15). Adequate carbohydrate intake is critical to maintain blood glucose levels during exercise and to replenish glycogen stores. Current recommendations for athletes are between 6 and 10g/kg/day of carbohydrates (15). For optimal tissue recovery and repair, protein recommendations for athletes are between 1.2 to 1.7 g/kg per day (ADA, 2009). Fat intake should range between 20 and 35% of total energy intake (15). Fat intakes outside of this range are generally believed to be detrimental to athletic performance (15). Beals et al (2002) examined the dietary habits, nutritional status and menstrual function of adolescent, nationally ranked volleyball players (*N*=23) and found that mean caloric intakes were 21% less than mean estimated energy expenditure. Beals et al also reported that mean protein (1.1g/kg/bw) and carbohydrate (5.4g/kg/bw) intakes were below recommendations for highly active women (2, 14).

Female athletes, particularly those in aesthetic sports, are at an increased risk for developing eating disorders when compared to their non-athletic counterparts. Volleyball is typically considered a non-aesthetic sport similar to golf, or softball rather than an aesthetic sport, such as gymnastics, swimming, and dance (8). However, the revealing nature of volleyball uniforms may place additional pressure on female volleyball athletes to be thin and increase the risk of disordered eating. This pressure is often overlooked due to volleyball's classification as non-aesthetic.

Little research has examined the relationship between menstrual health, eating disorder risk, body composition, and nutritional habits of collegiate female volleyball players. Thus the purpose of this study was to (a) provide descriptive data regarding nutritional intakes, eating disorder risk, menstrual health and body composition of collegiate female volleyball players and (b) compare participant's macronutrient intakes to the current sport nutrition recommendations (15). This study will provide valuable information for coaches as well as players and needed scientific research pertaining specifically to collegiate female volleyball players.

METHODS

Participants
Female, collegiate level volleyball players (*N*=15) between the ages of 18 and 25 were recruited for this study. Subjects were members of the collegiate volleyball team and currently participating in team practices and competitions. Participants were recruited from Central Washington University athletic teams and had no physical ailments or injuries that prohibited them from participating in physical activity. Pregnant participants were excluded from participation. The Human Subjects Review Committee of Central Washington University approved all of the study procedures prior to data collection. Each participant was informed and familiarized with the procedures and measurements before signing an informed consent form. Following recruitment participants reported to the lab on three occasions to complete testing.

Protocol
Demographics: A questionnaire was used to acquire basic personal information including the following: (1) age (2) accordance with any exclusion criteria (including: pregnancy, previous diagnosis of an eating disorder) (3) menstrual health function and (4) weight history. The following supplemental questions were also included: (1) Have you ever missed your period for three or more months in a row?; (2) Do you believe it is healthy to miss a period?; (3) Has anyone ever told you to lose weight?, If so, who? In addition, participants were asked to self-report height, current weight, highest adult weight, lowest adult weight, and ideal weight.

Body Composition: Body composition was assessed using a three-site method (triceps, quadriceps, and suprailiac) with Lange skinfold calipers (Beta Technology Inc, Cambridge, MD) using standard procedures as described by Jackson and Pollock (15). Three cyclic measurements were taken per skinfold site. The mean measurement of each site was used to calculate body density using the Siri formula (12, 17).

Air displacement plethysmography was also used to determine body composition using the Bod Pod® body composition system version 2.30 (Life Measurement Instruments, Concord, CA) Participant height was measured to the nearest 0.5cm using a stadiometer (Itin Scale Inc, Brooklyn NY) and done in duplicates. Weight was measured to the nearest 0.1 kg using a calibrated digital read scale connected to the Bod Pod® system; participants voided the bladder prior and wore minimal clothing (bathing suit), a swim cap, and removed shoes and jewelry. Once these measurements were done, the computer calculated the corrected body volume (Vbcorr), which was used in calculating body density (Db) (Life Measurement Inc 1997). The Bod Pod®

software calculated percent body fat using the Siri equation (17).

Eating Attitudes Test-26: An EAT-26 survey was administered to participants to screen for eating-disorder risk (19). The EAT-26 was designed to provide a standardized measure of symptoms and characteristics of eating disorders (9). This widely used and well-validated instrument has a reliability of □ = 90 (9). Although not diagnostic, the EAT-26 is commonly used as a screening tool to identify early characteristics and behaviors indicating the potential presence of an eating disorder (9). It contains three subscales: dieting, bulimia, and food preoccupation/oral control. An EAT-26 score of more than 20 or a "yes" answer to one of the supplemental question identifies an individual as "At Risk" for eating disorder characteristics and behaviors (19). An EAT-26 score of less than 20 and no answers to all of the supplemental questions categorizes the individual as "Not at Risk" for eating-disorder characteristics and behaviors (19).

Diet Records and Total Daily Energy Expenditure: Energy (kcals) and macronutrient (carbohydrate, protein, and fat) intake were assessed using seven-day food records. Participants' were asked to record the type and amount of foods and beverages consumed for seven consecutive days. Participants received oral and written instructions on how to accurately record their food intake. Food records were analyzed for kilocalories and macronutrient (carbohydrate, protein, and fat) intake using FOOD PROCESSOR SQL software (version 9.6.2; ESHA Research, Salem, OR). The Cunningham Equation, which takes into account Fat Free Mass (FFM), was used to estimate Total Daily Energy Expenditure (TDEE) based on an activity factor of 1.73 (Very active: Hard exercise or sports 6-7 days/week) (15).

Statistical Analysis

Basic descriptive characteristics (mean ± SD) were analyzed for each participant to describe the sample population. Diet records were analyzed for macronutrients (carbohydrate, protein, and fat) and compared to the current sports nutrition recommendations (15). A two-tailed, two sample unequal variance, t-test was implemented to compare EAT-26 scores, anthropometric measurements, EAT-26 subscale scores, macronutrient intake, and percent of energy needs met between the "At-Risk" and "Not At-Risk". All statistics were analyzed using Microsoft Excel version 2007. An alpha level of $p < 0.05$ was used to determine statistical significance.

RESULTS

Division II collegiate female volleyball (N=14) players participating in pre-season training completed the study. One participant dropped out due to a pregnancy. The participant's weekly training regimen consisted of approximately three hours weight training, two hours of cardiovascular exercise, and seven hours of group practice (a mix of cardio, drills, and skill building). Table 1 displays anthropometric data for the participants. Both groups (At risk (AR), and Not at risk (NR) based on EAT26 scoring guidelines) had similar anthropometric data. Although not statistically significant, skinfold measurements estimated body fat to be slightly lower than the Bod Pod® for both groups. Though not statistically significant, The AR group identified their goal weight to be 7.76% lower than their

Table 1. Participant Anthropometric Characteristics.

Dependent Variable	Overall Mean	At Risk Group (*N*=7)	Not At Risk Group (*N*=7)	P Value
Current Weight (kg)	72.9 ± 6.96	72.91 ± 7.45	72.88 ± 7.05	0.99
Highest Weight (kg)	75.05 ± 7.41	74.02 ±7.49	76.07 ± 7.15	0.62
Lowest Weight (kg)	67.62 ± 7.99	66.93 ±7.88	68.31 ± 8.04	0.76
Reported Ideal Weight (kg)	67.75 ± 6.46	67.25 ± 6.48	68.25 ± 6.39	0.78
% Body Fat (Skinfold)	21.15 ± 4.48	21.10 ± 3.19	21.2 ± 5.76	0.96
% Body Fat (Bod Pod®)	22.76 ± 6.25	22.73 ±5.82	22.8 ± 7.29	0.98

Values are the Mean ± SD.

current weight, while the NR group reported their goal weight to be slightly closer to their current weight at 6.37% lower that their current body weight.

Disordered Eating Behaviors and Menstrual Health: Based on the EAT 26 scoring guidelines (9), 50% of the volleyball players met the criteria for "At Risk" disordered eating characteristics and behaviors. Participants with an EAT 26 score exceeding 20 or a "Yes" answer to any of the supplemental questions were categorized as "At Risk". The "At Risk" group scored higher on the EAT-26 subscales for dieting and bulimia (Table 2). Both groups reported similar scores on the oral control subscale (Table 2). Supplemental questions revealed 100% (*n*=7) of those identified as "At-Risk" engaged in binge eating at least one time a month and one individual reported vomiting to control weight or shape. The menstrual health questionnaire revealed that 42.87% (*N*=3) of those not taking oral contraceptives (OC) (*N*=7) reported menstrual dysfunction (<10 periods a year) and one individual reported amenorrhea (<2 periods a year). Additionally, 25.57% of participants reported that they believe it is healthy to miss a period, however, all reported they believed it was not healthy to miss their period over a long period of time. Half (*N*=7) of the participants were using oral contraceptives, and 57.14% (*N*=4) indicated irregular periods as the reason for taking oral contraceptive.

Calorie and Macronutrient Intake: Based on seven-day diet records, mean energy intakes for both "At-Risk" and "Not At-Risk" participants were below predicted energy requirements using the Cunningham equation (1991) with a 1.73 (Very active: Hard exercise or sports 6-7 days/week) activity factor (15). Mean estimated TDEE (total daily energy expenditure) was 2780.66 ± 148.88 calories; mean average EI (energy Intake) was 1928.28 ±476.58 placing them at an average daily calorie deficit of 852.37 ± 512.74. No significant differences between TDEE and EI existed between the AR and NR group (Table 3). Mean reported carbohydrate (CHO) (3.49 ± 0.89g/kg/d) intakes for participants were below the recommended range for ACSM/ADA sport nutrition recommendations for carbohydrate intake (6-10 g CHO/kg/d) (ADA 2009). The closest reported intake to meet the CHO recommendation was at 5.2g/kg/d. Mean protein (1.17 ± 0.35g/kg/d) intakes were slightly below the recommended range of 1.2-1.7g/kg/d (15). Interestingly, though not significantly different, when compared to the "Not at Risk" group, the "At Risk"

Table 2.Participant EAT-26 Scores and Subscales

Dependent Variable	Overall Mean	At Risk Group (*n*=7)	Not At Risk Group (*n*=7)	P Value
EAT-26 (Total Score)	11.07 ± 10.25	11.97 ± 16.57	3.74 ± 5.57	0.05**
Dieting	7.14 ± 7.98	9.36 ± 11.43	2.79 ± 2.87	0.05**
Bulimia/Preoccupation with Food	2.00 ± 2.18	2.58 ± 3.00	1.15 ± 1	0.09**
Oral Control	1.71 ± 1.07	1.25 ± 1.71	0.95 ± 1.71	1.00

Values are the mean + SD. **Indicates approaching significance (T-Test p > 0.1).

group met the lower end of the recommended intake range (1.25 ± 0.44g/kg/d) for protein intake.

Table 3. Participant Caloric and Macronutrient Intake Comparisons.

Dependent Variable	Recommended Intake	Overall Mean
Carbohydrate Intake (g/kg/day)	6-10 g/kg/day	3.49 ± 0.89
Protein Intake (g/kg/day)	1.2-1.7 g/kg/day	1.17 ± 0.35
Energy Intake (kcal/day)	2780.67 ± 148.88	1928 ± 476
% of Energy Needs Met	100%	63.32 ± 16.10

Values are Mean + SD.

DISCUSSION

The primary findings of this study suggest that collegiate female volleyball players diet's tend to be inadequate in calories, protein, and carbohydrates needed to support their high activity level and thus placing them at risk for subsequent medical ailments including menstrual dysfunction. The findings of this study are similar to previous research that examined the nutritional intake, eating disorder risk, menstrual health and body composition of collegiate female athletes (1-6, 10, 12, 14, 15, 18-19).

The mean measured body weights were very similar between the AR and NR group (72.91 ± 7.45 kg and 72.88 ± 7.05 kg for AR and NR, respectively), and slightly higher than their self-reported "ideal weight" (67.25 ± 6.48 kg and 68.25 ± 6.39 kg for AR and NR, respectively). Guidelines for optimal body composition of female athletes are highly individualized and dependent on many factors including the requirements of their sport, their genetics, and age. Ideal body fat percentage should be determined when an athlete is in good health and performing at an optimal level. The minimal level of body fat for female athletes for ideal health is 12% (15). The mean body fat percentage was 21.15% and 22.76% for skinfold and Bod Pod® techniques, respectively and ranged from 13.4% to 36.31%. These values are similar to the findings of Anderson et al. (1), who reported a mean body fat of 22% (Bod Pod® technique) among collegiate female volleyball players (*N*=15) and Malousaris et al. (2008) who reported 23.4% (skinfold technique) among elite volleyball players (*N*=163) (14).

According to the EAT-26 survey, 50% (*N*=7) of the collegiate female volleyball players in this study were at risk (AR) for disordered eating. This percentage is higher than the prevalence reported by similar studies, Torres-McGhee et al. (29.70%) (19), Beals et al. (15.2%), Sundgot-Borgen (17%) (18) and Greenleaf et al. (25.5%) (10). All of the studies, except Greenleaf et al., used the same questionnaire and scoring cutoff implemented in the current study (9). Greenleaf et al. (10) and Sundgot-Borgen (18) used a questionnaire based on the DSM-IV criteria that aims to measure eating disorder symptoms and therefore may not be as comparable to the EAT-26 and EDI questionnaire. Furthermore, the current study only examined volleyball, while the other studies (18) grouped the volleyball participants with other ball sports. As mentioned previously, the revealing nature of volleyball uniforms may place additional pressures on the athlete to be thin compared to other ball sports such as basketball, where non-revealing uniforms are worn (6, 10, 19). The grouping of volleyball with other ball sports may explain the lower prevalence of eating disorders characteristics reported in other studies (18).

Similar to Torres et al. (19), who reported a mean score of 16.6 $\pm$ 20.4 for the dieting subscale the AR group in this study reported a higher prevalence of dieting and preoccupation with food compared to the other subscales (Table 2), as well as a slightly greater difference between their actual weight and self-reported ideal weight. This larger difference may indicate higher levels of body dissatisfaction and promote unhealthy behaviors in effort to lose weight (19). The use of self-induced vomiting and long duration (> 1 hour) workouts in an attempt to lose weight were found to be relatively common among our sample 25.57% reported using these methods. These medically worrisome weight loss behaviors may be promoted by the relatively high prevalence of binge eating episodes, reported by 50% of participants in the current study. Typically, college athletes get adequate levels of physical activity from their group practices and workouts (10). Those exercising above this level in efforts to lose or prevent weight gain may be at risk for subsequent health issues including severe energy deficit, menstrual dysfunction, illnesses, and overuse injuries (10).

Half of the participants in this study reported current oral contraceptive use. Oral contraceptives have the ability to regulate the menstrual cycle, because of this; this factor was controlled when examining the prevalence of menstrual dysfunction among our population (4). Of those currently using oral contraceptives, 43% (N=3) reported irregular periods as the purpose for taking them. Of those not currently using oral contraceptives, 43% (N=3) reported menstrual dysfunction (<10 periods a year). It is possible that the use of oral contraceptives is masking a higher prevalence of menstrual dysfunction among this population, particularly in those citing irregularity as the reason for taking them (4) Most studies do not control for the use of oral contraceptives, Beals (2) examined 23 nationally ranked volleyball players and 17% of participants reported amenorrhea (absences of menses for 3+ months) and 48% reported menstrual dysfunction. When accounting for the use of oral contraceptives, the present study found that 42.85% of participants experienced menstrual dysfunction, lower than 48% reported by Beals et al. (2). Menstrual dysfunction is believed to be most directly related to low energy availability (EA), defined as an EA less than 30 calories per kilogram of fat free mass a day (3). The information needed relating to exercise energy expenditure to accurately calculate energy availability was not available for the current study. Therefore an estimate of TDEE was calculated and TDEE exceeded energy intake in all participants. Furthermore, although participant's energy expenditure was high, inadequate energy intake appeared to be of concern in the current study.

The mean energy intake among participants in the current study was 1928 ± 476 calories a day, while daily energy deficit ranged from 313.62 to 1892.13 calories a day. Beals et al. (2) studied 23 nationally ranked volleyball players and based on 3-day food records found the mean energy intake to be 2248 ± 414 calories a day. Similarly, Anderson et al reported mean energy intake for 15 division II female volleyball players to be 2425 ± 204 calories. The mean energy in the current study is slightly lower than the aforementioned studies, but higher than findings of Cortez et al. who reported mean energy intake of 1577 ± 451 in Division I female volleyball players (6). Seven-day food records, as used in the current study, have been suggested to be more accurate (20) compared to the three day diet records used in the majority of the studies (1, 4, 6) because of the ability to capture more days of variability in an individual's diet. However, seven–day food records are not without weakness. Keeping a food record may promote an individual to consume less and make healthier choices in attempt to "look good" (20). The issue of underreporting food quantity must also be considered when interpreting the results of this study. To negate these issues we provided guidelines for accurate estimation of food portions, instructed individuals to consume a normal diet, and to record immediately following eating. Chronic energy deficit, as inferred by the diet records, is a major medical concern and will lead to disruption of endocrine function, a loss of lean tissue, and compromised immune and musculoskeletal function. It will compromise performance, reduce strength, and actually negate the benefits of training (15).

Adequate protein intake also plays in integral role in athletic performance. The current protein recommendation for endurance and strength training athletes is 1.2 to 1.7 g/kg/day. This is the amount believed to be needed to maintain nitrogen balance due to the increase in protein oxidation caused by endurance exercise and to provide the essential amino acids needed to support muscle growth (15). Our participants were just short of meeting the recommended intake range at an average protein intake of 1.17 ± .35 g/kg/day. On average the AR group reported a higher protein intake (1.25 ± 0.44g/kg/d) than that NR group (1.09 ± 0.23) and met the lower end of the recommendations for protein (15). This is similar to findings of other studies, Beals (1.1 ± .30) (2), Anderson et al. (1.1 ± .09) (1), and Cortez et al. (1.04 ± .23) (6).

Carbohydrate is the body's primary energy source; therefore adequate carbohydrate intake also plays a vital role in optimizing athletic performance. The recommended range for carbohydrate intake is 6 -10 g/kg/day for athletes. This is the amount needed to maintain blood glucose levels during a workout and to replenish muscle glycogen following a workout (15). Our sample had mean carbohydrate intakes (3.49 ± 0.89g/kg) significantly lower than reported by Beals (5.4 ± 1.0) (2) and

Anderson et al. (5.1 ± .07) (1). The low carbohydrate displayed by the participants in the current study may contribute to early fatigue during workouts and sub-optimal performance (15). We also believe it may be related to an intentional avoidance of high carbohydrate foods, as reported to occur "sometimes" or "usually" by 42.85% of participants and "often" or "always" by 14.28% of participants.

To identify individuals as "At-Risk" or "Not At-Risk" we used the EAT-26 questionnaire. The EAT-26 is a reliable (alpha = 0.90) and valid, widely used screening tool for characteristics of eating disorders (9). It is not intended to be used as a diagnostic tool, because of this we cannot conclude that any of the subjects in the AR group had an eating disorder. Individuals could have artificially inflated scores in the absence of a true eating disorder in cases such as obsessive dieters (19).

In addition, the sample size used in the current study was relatively small and limited to one Division II volleyball team. Eating habits could be specific to the individual team due to some members of the team living together and thus cooking together. Future research of a national sample of female collegiate volleyball players from different collegiate divisions needs to be conducted. This will allow for the capture of potential variable measurements depending on the geographical location and institutional classification (19). Larger sample sizes would allow prevalence of eating disorder risk to be established specific to each volleyball position. Relating to menstrual dysfunction, energy availability is an important variable to calculate. In order to do this, exercise logs need to be kept concurrent with food records to allow for accurate estimation of exercise expenditure and thus enable the calculation of energy availability.

In summary, the results of this study are similar to the findings of previous studies suggesting that female collegiate volleyball players tend to consume diets inadequate to support their high levels of activity. Participant's met only 69.35% of their energy needs in the current study, on average. Additionally, mean carbohydrate and protein intakes were below the American Dietetic Association Sports Nutrition recommendations (15), potentially compromising energy levels during workouts and muscle protein resynthesis. The observed inadequate diets may be related to disordered eating habits or beliefs, suggested being prevalent in 50% of the participants. Finally, menstrual dysfunction, as reported by three of the seven participants not using oral contraceptives, may be more prevalent than reported by other studies not controlling for oral contraceptive use.

This study has implications for collegiate volleyball players and coaches. Coaches need to be aware of disordered eating characteristics and prevalence among athletes in their sport. In the case of volleyball, the current study suggests that approximately half of the collegiate volleyball players examined in this study were at risk for disordered eating beliefs and/or habits according to the EAT 26 scale. Common characteristics of disordered eating among this population include binge eating, loss of normal menses, fear of carbohydrates, and excessive exercise in addition to team activities. The athletic performance of collegiate volleyball players may be improved if they consume adequate level of calories, protein, and carbohydrates sufficient to replenish glycogen stores, maintain blood glucose levels, maintain energy balance and repair muscle protein. Therefore, nutrition education is warranted to provide players with knowledge of their individual nutritional needs.

REFERENCES

1. Anderson D. The impact of feedback on dietary intake and body composition of college women volleyball players over a competitive season. J Strength Cond Res 24 (8): 2220-2226, 2010.

2. Beals K. Eating behaviors, nutritional status, and menstrual function in elite female adolescent volleyball players. J Am Diet Assoc 102 (9): 1293–1296, 2002.

3. Beals K, Henderson K. Assessment of the Range of energy Availabilities and The Prevelance of Low Energy Availability Among Female Endurance Athletes. SCAN Symposium. 2012.

4. Beals K, Hill A. The prevelance of disordered eating, menstral dysfunction, and low bone mineral density among collegiate athletes. Int J Sport Nutr 16: 1-23, 2006.

5. Beals K, Manore M. Disorders of the female athlete triad among collegiate athletes. Int J Sport Nutr 12: 281-293, 2002.

6. Cortez D, Krebs-Holm L, Gish D, Wildman R. Anthropometric measures and nutrition intake habits and perceptions of division 1 women's volleyball players. J Int Soc Sports Nutr 8(1): 8, 2001.

7. Creighton D, Morgan A, Boardley D, Brolinson P. Weight-bearing exercise and markers of bone turnover in female athletes. J Appl Physiol 90: 565-570, 2001.

8. Davison K, Earnest M, Birch L. Participation in aesthetic sports and girls' weight concerns at ages 5 and 7 years. Int J Eat Disord. 31(3): 312-317, 2002.

9. Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: Psychometric features and clinical correlates. Psychological Med. 12: 871-878 1989.

10. Greenleaf C, Petrie T, Carter J, Reel J. Female Collegiate Athletes: Prevalence of Eating Disorders and Disordered Eating Behaviors. J of ACH 57: 489-496, 2009.

11. Hoogenboom B, Morris J, Morris C, Schaefer K. Nutritional knowledge and eating behaviors of female, collegiate swimmers. N Am J Sports Phys Ther 4(3): 139–148, 2009.

12. Jackson A, Pollock M, Ward A. Generalized equations for predicting body density of women. Med Sci Sports Exerc 12: 175-182, 1980.

13. Johnson C, Dick R. Athletes and Eating Disorders: The National Collegiate Athletic Association. Int J Eat Disord 26: 179-188, 1999.

14. Malousaris G, Bergeles N, Barzouka K, Bayios I, Nassis G, Koskolou M. Somatotype, size and body composition of competitive female volleyball players. J Sci Med Sport 11 (3): 337-334, 2008.

15. Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. J Am Diet Assoc 109 (3): 509-527, 2009.

16. Punpilai, S, Sujitra, T, Ouyporn, T, Teraporn, V. Sombut, B. Menstrual status and bone mineral density among female athletes. Nurs Health Sci, 7: 259–265, 2005.

17. Siri, W. Body composition from fluid space and density. Techniques for measuring body composition. In Brozek, J, Hanschel A: 223-244, 1961.

18. Sundgot-Borgen J, Torstviet M. Prevelance of eating disorders in elite athletes is higher than in general population. Clin J Sport Med 1: 25-32, 2004.

19. Torres-McGhee T, Green J, Leeper J, Leaver-Dunn D, Rishardson M, Bishop P. Body image, anthropometric measures, and eating disorder prevalence in auxiliary unit members. J Athl Train 4: 418-426, 2009.

20. Tucker L, Thomas, K. Increasing total fiber intake reduces risk of weight and fat gains in women. J Nutr 139(3): 576-581, 2009.