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Research article

NUTRIENT INTAKES OF MEN AND WOMEN COLLEGIATE ATHLETES WITH DISORDERED EATING

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ABSTRACT

The objective of this study was to assess the macro- and micronutrient intakes of men and women collegiate athletes with disordered eating behaviors and to compare the nutrient intakes of athletes with restrictive- versus binge-eating behaviors. National Collegiate Athletic Association (NCAA) Division I University athletes (n = 232) were administered an anonymous, written questionnaire to compare nutrient intakes, desired weight change, and weight control behaviors in athletes with restrictive- (R) and binge- (B) eating behaviors to those in asymptomatic (A) athletes. T-tests, χ^2 statistic, and ANOVA were used to test for differences among disordered eating groups within genders ($p < 0.05$). Data are means ± standard error of the mean. Among men athletes, those with disordered eating consumed a smaller percentage of energy from carbohydrate compared to controls (R = 49.7 ± 1.5; B = 48.7 ± 2.3; A = 53.4 ± 0.7%). Among female athletes, those with disordered eating wanted to lose a greater percentage of their current body weight than did asymptomatic athletes (B = -6.1 ± 1.4; R = -6.7 ± 1.1; A = -3.7 ± 0.4%). Women who were classified with binge eating consumed significantly more alcohol than did controls (B = 6.8 ± 1.3; A = 3.9 ± 0.4 g alcohol per day). Athletes with disordered eating were more likely to report restricting their intake of carbohydrate and fat and using supplements to control their weight than asymptomatic athletes. Disordered eating was not associated with greater frequencies of inadequate micronutrient intake in either gender. Athletes with disordered eating may be at significantly greater risk for nutritional inadequacies than athletes who are asymptomatic due to macronutrient restriction and greater alcohol consumption.

KEY WORDS: Eating disorder, Female Athlete Triad.

INTRODUCTION

There is evidence to suggest that women athletes, particularly women who participate in endurance sports or sports that emphasize appearance, are at greater risk for eating disorders than their non-competitive peers (Hausenblas and Carron, 1999; Smolak et al., 2000). For example, the prevalence of eating disorders is 15-62% in women athletes compared to 0.5-3.0% in late adolescent and young adult women (Brownell et al., 1992). Recently the NCAA surveyed 562 Division I women athletes and found that 34.8 and 38.0% were at risk for developing anorexia nervosa or bulimia, respectively, and that 2.9% and 9.2% had subclinical anorexia and bulimia, respectively, based on self-reported attitudes and behaviors (Johnson et al., 1999). In a study of 425 collegiate athletes from seven universities, 3.3% reported receiving a clinical diagnosis of anorexia nervosa and 2.3% had been diagnosed with bulimia nervosa. In addition, an additional 15-30% of athletes were classified as being at risk for developing an eating disorder based on the Eating Attitudes Test and the Body

Dissatisfaction Subscale of the Eating Disorders Inventory (Beals and Manore, 2002).

The health consequences of clinical eating disorders are pervasive and serious. Short-term physical complications include electrolyte imbalances, cardiac arrhythmias, increased musculoskeletal injuries, and amenorrhea. Hypoestrogenemia may result in irreversible bone demineralization and increased risk of stress fractures and osteoporosis later in life (Drinkwater et al., 1984). In addition, athletes with eating disorders are likely to experience social isolation, arrested social and emotional development, depression, and suicide.

In 1992 the American College of Sports Medicine (ACSM) convened a panel of experts to develop a plan for prevention, assessment, and treatment of three interrelated pathogenic processes unique to women athletes-amenorrhea, osteoporosis, and disordered eating-collectively termed the Female Athlete Triad (Yeager et al., 1993). The subsequent position paper broadened the definition of problematic eating behaviors to include "disordered eating," recognizing that many athletes engage in potentially harmful and ineffective weight control practices but do not meet the diagnostic criteria for an eating disorder.

The information regarding the nature, prevalence, and nutrition-related consequences of disordered eating in athletes is very limited. Only two studies have examined the effects of disordered eating on nutrient intakes in women athletes, comparing the dietary intakes of women with "subclinical eating disorders" (Beals and Manore, 1998) and "anorexia athletica" (Sundgot-Borgen, 1993) to those of control athletes. To our knowledge, the effects of disordered eating on diet have not been examined in men athletes with the exception of wrestlers (Short and Short, 1983; Steen and McKinnery, 1986). Moreover, previous investigations evaluated dietary adequacy by comparing mean intakes to the Recommended Dietary Allowances (RDAs; National Research Council, 1989) or by determining the proportion of individuals with intakes below the RDAs or some proportion of the RDA. Both methods overestimate the prevalence of inadequate nutrient intakes (Food and Nutrition Board, 2000a). In addition, it is important to acknowledge that athletes engage in a variety of disordered eating behaviors that may not have a uniform impact on nutrient intake. That is, some athletes may engage primarily in behaviors that are restrictive in nature (e.g., chronic dieting or occasional fasting) and may thus reduce their total nutrient intake. In contrast, other athletes may experience episodes of binge eating with or without compensatory behaviors, which may or may not decrease nutrient intake.

Thus, the purpose of this study was to assess the macro- and micronutrient intakes of men and women collegiate athletes with disordered eating behaviors and to compare athletes with restrictive- versus binge-eating behaviors. We hypothesized that, compared to asymptomatic athletes, individuals who were symptomatic for disordered eating would have a larger discrepancy between their current and desired weights and would be more likely to report restricting their intake of fat and carbohydrate in order to control their weight. We also hypothesized that athletes with restrictive disordered eating behaviors would be more likely to have inadequate macro- and micronutrient intakes compared to athletes without disordered eating behaviors or to those with binge-eating behaviors.

METHODS

Participants

Men and women students (n = 345) participating in intercollegiate athletics at a National Collegiate Athletic Association (NCAA) Division I university were recruited to participate in this study; of these, two hundred thirty-two completed the study. Data were collected at the beginning of the fall semester at mandatory meetings that included teams from one or more sports. After verbal explanation of the study's purpose and assurance that participation was anonymous and voluntary, study personnel to all athletes distributed a written questionnaire, and time was allowed for them to complete the survey. The study was approved by the university's Institutional Review Board.

Disordered eating behaviors and nutrient intakes

The Questionnaire for Eating Disorder Diagnoses (Q-EDD; Mintz et al., 1997) is a 50-item self-report questionnaire that operationalizes DSM-IV criteria for eating disorders (American Psychiatric Association, 1994). Categorical labels (e.g., eating-disordered, non-eating-disordered) are generated using a scoring manual that consists of flow-chart decision rules, in which items or combination of items are dichotomously scored ("Yes" or "No") for meeting or not meeting individual DSM-IV criteria. These criteria then are combined with additional decision rules to assess whether all criteria for a specific diagnosis or category are met. Thus, respondents are placed into one of two major diagnostic categories: eating-disordered (DSM-IV diagnosis) or non-eating-disordered (no DSM-IV diagnosis). The non-eating-disordered category comprises two subcategories: symptomatic (no

diagnosable disorder, but some symptoms) and asymptomatic (no eating disorder symptoms). The eating disorder category comprises six specific diagnoses including anorexia, bulimia, and four types of Eating Disorder, Not Otherwise Specified (EDNOS).

Mintz et al. (1997) described three studies examining the psychometric properties of the Q-EDD. Convergent validity was supported by the correspondence between Q-EDD diagnoses and scores on the Bulimia Test-Revised (BULIT-R; Thelen et al., 1991) and the EAT (Garner and Garfinkel, 1979). Incremental validity was supported by the greater accuracy of Q-EDD diagnoses as compared to those yielded by the BULIT-R. For the differentiation of eating-disordered and non-disordered, the test-retest reliability was 0.94 over two weeks and 0.64 over a one- to three-month period. For the differentiation of eating-disordered, symptomatic, and asymptomatic, test-retest reliability was 0.85 over two weeks and 0.54 over a one- to three-month period. Inter-rater agreement was 100% across the two studies. Most important, criterion validity was supported by a high correspondence between Q-EDD and clinical interview/clinician diagnoses (Mintz et al., 1997). In addition, the Q-EDD has been recommended for (Hausenblas and Carron, 1999) and used in athletic populations (Hausenblas and McNally, 2004).

Athletes were placed into one of three categories based on the assessment of their eating behavior by the Q-EDD: asymptomatic (A), restrictive disordered eating (R), or binge eating (B). For example, the restrictive-eating group included individuals who used chronic dieting and fasting to control their weight. Athletes with binge eating disorder or bulimia nervosa and those who reported binge eating were put in the binge-eating category. The Q-EDD was not used to assign clinical eating disorder diagnoses, but to classify athletes on the basis of their eating behavior.

Nutrient intakes were assessed using the Youth Assessment Questionnaire (YAQ), a food frequency questionnaire that has demonstrated reproducibility and validity in adolescents aged nine to eighteen years (Perks et al., 2000; Rockett et al., 1995; 1997). The YAQ was developed for adolescents from the validated, semi-quantitative Nurses' Health Study food frequency questionnaire (Willett et al., 1985). The YAQ differs from the adult version in that it includes a separate category of twenty-seven snack foods such as corn chips, nachos, pop-tarts, and snack cakes. In addition, other foods that were added to the YAQ include chicken nuggets, tacos, lasagna, macaroni and cheese, instant breakfast drink, and chicken or turkey sandwich. We chose to use the YAQ food frequency questionnaire rather than the adult version because the dietary patterns of college students are more similar to those of adolescents than to those of adults, i.e., they consume more snack and convenience foods.

The YAQ lists 131 foods and beverages and specifies the serving size for each item. The response categories for frequency of consumption vary depending on the food. The YAQ contains detailed written instructions and examples of how to appropriately complete the items. The last section of the YAQ asks respondents to list other foods that they usually eat at least once per week and how often they eat these foods. Athletes were given verbal promptings and additional written instructions to list all nutritional supplements (e.g., sports drinks, energy bars, protein powders) in this section and to indicate how often they consume these additional foods. The nutrient analysis of the YAQ was performed at Channing Laboratory at the Harvard School of Public Health using a specifically designed program that utilizes the U.S. Department of Agriculture Handbook (1976-1992), journals, and food manufacturers as the nutrient database.

The nutrient intakes presented are based on nutrients derived from food and all nutritional supplements, including multi-vitamins and minerals. The percentage of energy derived from each macronutrient was calculated by multiplying the grams of each nutrient by the appropriate energy density and then dividing by the total energy intake. The intakes of energy, carbohydrate, protein, and fat per kilogram of body weight (BW) also were calculated using self-reported body weight.

The joint position stand of the American Dietetic Association, Dietitians of Canada, and the ACSM on nutrition and athletic performance (Position of The American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine, 2000) and the RDAs (National Research Council, 1989) were used to evaluate energy and macronutrient intakes. The prevalence of inadequate micronutrient intakes was assessed using the DRIs (Food and Nutrition Board, 1997, 1998, 2000b, 2001) as recommended by the Food and Nutrition Board (2000a). For nutrients with an Estimated Average Requirement (EAR), the prevalence of inadequate intakes was equivalent to the proportion of athletes with an intake less than the EAR. For nutrients with no established EAR, such as calcium and vitamin D, the mean intake was compared to the Adequate Intake (AI), and if it was at or above the AI, the prevalence of inadequate intake was determined to likely be low.

Dietary behaviors assessed included restricting dietary fat, carbohydrate, protein, or fluids, and using supplements other than vitamins or minerals for the purpose of weight control. Frequency and

duration of each behavior was assessed, with options ranging from daily to once per month and one month to more than one year, respectively. Additional sociodemographic information obtained included age, gender, race, sport, position played, current height and weight, desired weight, and class in school.

Statistical analyses

Data were examined for normality of distribution prior to analysis and were log-transformed when necessary. Previous studies that utilized the YAQ in non-athletic populations deleted subjects whose daily energy intakes were less than 500 kcal or greater than 5,000 kcal per day, deeming these values to be implausible (Rockett et al., 1997). However, this assumption may not be valid in athletes who consume in excess of 5,000 kcal due to large body mass, large energy expenditure, or efforts to gain weight. Likewise, athletes who are attempting to lose weight may severely restrict their energy intake. Thus, we decided to retain these subjects in the analyses. Repeating the analyses with these individuals omitted from the data (<500 kcal, n = 2; >5,000 kcal, n = 2) did not alter the results.

Table 1. Participant characteristics

	Men (n = 95)		Women (n = 135)	
Class	n	%	n	%
Freshman	30	31.6	50	37.0
Sophomore	24	25.3	36	26.7
Junior	25	26.3	22	16.3
Senior	16	16.8	27	20.0
Race				
Caucasian	74	77.9	114	84.5
African American	19	20.0	12	8.9
Hispanic	0	0	1	0.7
American Indian	0	0	0	0
Asian	0	0	3	2.2
Other	2	2.1	5	3.7

Descriptive statistics included determination of frequencies of disordered eating behaviors, race, class in school, and sport affiliation by gender. One-way analysis of variance with the System for Statistical Analysis generalized linear model program (PROC GLM) was used to test for differences in nutrient intakes among disordered eating categories (asymptomatic, restrictive, binge-eating) within genders. Because of unbalanced sample sizes, the Type III sum of squares from the generalized linear model was used to calculate the F-test. The protected least-significant difference technique was used to test for differences between groups. The χ^2 statistic was used to test for significant differences among disordered eating categories for variables with categorical outcomes within genders. The statistical significance was set at $p < 0.05$. All statistical analyses were performed using SAS statistical software, version 8.2 (SAS Institute, 1999).

Table 2. Distribution of men and women among varsity sports.

	Men (n = 97)		Women (n = 135)	
Sport	**n**	**%**	**n**	**%**
Track/Distance	8	8.3	21	15.6
Track/Sprints and Field	11	11.3	16	11.9
Basketball	7	7.2	5	3.7
Golf	11	11.3	8	5.9
Swimming/Diving	16	16.5	20	14.8
Football	27	27.8		
Baseball	5	5.2		
Wrestling	12	12.4		
Soccer			19	14.1
Gymnastics			7	5.2
Softball			16	11.8
Volleyball			17	12.6
Tennis			6	4.4

RESULTS

The characteristics of the participants and their distribution among the different sports are shown in Tables 1 and 2. Three hundred forty-five athletes completed the sociodemographic portion of the questionnaire, and of these, 52% were men and 48% were women. Two hundred thirty-two athletes also completed the food frequency questionnaire and the Q-EDD (67%) and comprised the sample for this study. The response rate for the food frequency questionnaire differed significantly ($p < 0.05$) between men (54%) and women (82%). Differences in the baseline characteristics between respondents and non-respondents were assessed for the men and women separately. For the men athletes, the response rate varied by sport and was approximately 50% for football, wrestling, track, and baseball, and approximately 90% or greater for golf, basketball, and swimming and diving. There were no significant differences in age, race, height, weight, body mass index (BMI), or class rank between respondents and non-respondents. For the women athletes, the response rate also varied by sport and was greater than 90% for all sports except gymnastics (41%) and basketball (45%). Response rate also varied significantly ($p < 0.05$) with class rank (freshmen, 94%; sophomores, 77%; juniors, 73%; seniors, 100%).

Based on the Q-EDD 2 men (2%) and 7 women (5.2%) reported behaviors that were characteristic of EDNOS and 2 women (1.5%)

Table 3. Frequencies of clinical eating disorders and restrictive- and binge-eating disordered eating patterns in men and women collegiate athletes

	Men (n = 97)		Women (n = 135)	
	n	**%**	**n**	**%**
Eating Disorder Diagnostic Category [a]				
Non-eating-disordered, asymptomatic	74	76.3	110	81.4
Non-eating-disordered, symptomatic	21	21.7	16	11.9
Eating disordered, anorexia nervosa	0	0	0	0
Eating disordered, bulimia nervosa	0	0	2	1.5
Eating disordered, not otherwise specified	2	2.0	7	5.2
Disordered Eating Pattern [b]				
Non-eating-disordered, asymptomatic	74	76.3	110	81.4
Restrictive eating	7	7.2	15	11.1
Binge eating	16	16.5	10	7.4

[a] Categories derived from the Q-EDD. [b] Restrictive- and binge-eating categories include clinical and symptomatic athletes.

reported behaviors at a frequency and duration that were consistent with bulimia nervosa (Table 3). Behaviors symptomatic of an eating disorder were more common, with 21 men (21%) and 16 women (11.9%) classified as "non-eating-disordered, symptomatic." The overall prevalence of disordered eating patterns (characterized by severity as "symptomatic" or "clinical") did not differ between men and women, but women were more likely to report behaviors at a frequency and duration consistent with EDNOS or bulimia nervosa ($p < 0.001$) and to exhibit restrictive disordered eating patterns than men ($p < 0.01$, Table 3). There were no significant associations between sport affiliation or class and disordered eating.

For the men athletes, individuals with restrictive- and binge-eating behaviors did not differ from asymptomatic athletes for current BMI, desired BMI, or desired weight change (Table 4). Women athletes engaging in restrictive eating behaviors wanted to lose a greater proportion of their current body weight compared to asymptomatic individuals (R = -6.7 ± 1.1; A = -3.7 ± 0.4%); a similar result was found for individuals engaging in binge eating (B =-6.1 ± 1.45%), although it did not reach statistical significance (Table 4). Individuals with restrictive- or binge-eating patterns were more likely to report restricting their intake of carbohydrate and fat and using dietary supplements other than multivitamins to control their weight (Figure 1).

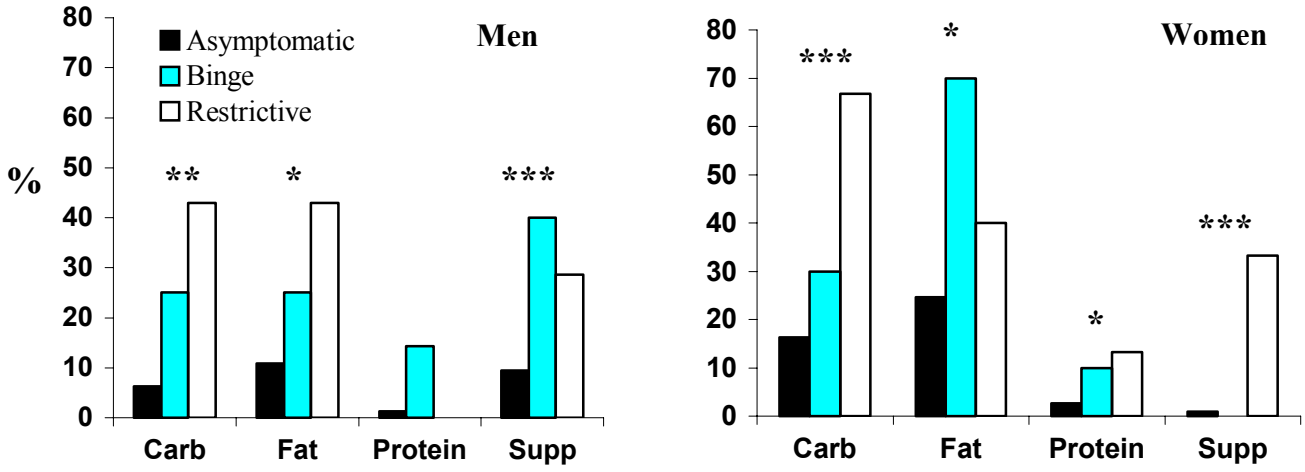
The absolute energy and macronutrient intakes did not differ among athletes with asymptomatic, restrictive-, or binge-eating patterns. Likewise, there were no significant differences in relative macronutrient intake (i.e., grams per kg of body weight) or in the proportion of participants meeting the recommendations for athletes. All of the men athletes had relative energy and carbohydrate intakes that were below the recommendations. The athletes classified as having disordered eating patterns consumed a smaller proportion of their daily energy from carbohydrate than did asymptomatic individuals (R = 49.7 ± 1.5; B = 48.7 ± 2.3; A = 53.4 ± 0.7% kcal from carbohydrate, Table 5). For the women, there were no significant differences in the macronutrient composition of the diet, although disordered athletes tended to consume relatively fewer calories from protein than did asymptomatic individuals. Among women who reported consuming alcohol, those who engaged in binge

Table 4. Anthropometry and desired weight for men and women athletes with binge- and restrictive-eating behavior. Values are means (±SEM).

	Men (n = 97)			Women (n = 135)		
	Asympt (n =74)	**Binge (n = 16)**	**Restrictive (n = 7)**	**Asympt (n = 110)**	**Binge (n = 10)**	**Restrictive (n = 15)**
Height (m)	1.85 (0.01)	1.85 (0.02)	1.81 (0.03)	1.71 (0.01)	1.64 (0.03)	1.73 (0.02)
Weight (kg)	85.5 (2.0)	96.9 (4.4)	87.9 (6.5)	65.7 (1.0)	61.6 (3.3)	69.6 (2.7)
BMI ($kg \cdot m^{-2}$)	25.0 (0.5) *	28.1 (1.1) †	26.7 (1.7) *†	22.5 (0.3)	23.0 (0.9)	23.1 (0.7)
Desired BMI	26.1 (0.5)	28.6 (1.1)	26.5 (1.7)	21.5 (0.2)	21.5 (0.7)	21.4 (0.6)
Desired W change (%)	4.6 (0.9)	2.3 (1.9)	-1.4 (2.8)	-3.7 (0.4) †	-6.1 (1.4) *†	-6.7 (1.1) *

Abbreviations: Asympt = asymptomatic, W = weight. * and † denote significant ($p < 0.05$) differences for within gender comparisons.

Figure 1. Frequencies of athletes with restrictive- and binge-eating patterns who restricted dietary carbohydrate (Carb), fat, or protein or who used dietary supplements (Supp) other than vitamins and minerals to control their weight. * $p < 0.05$, ** $p < 0.01$, ***$p < 0.001$ for disordered eating group, within genders.



eating consumed significantly more alcohol compared to asymptomatic women (B = 6.8 ± 1.3; A = 3.9 ± 0.4 g alcohol per day). The difference between the two groups was equivalent to approximately 1.5 drinks per week. A similar trend was observed for the women athletes with restrictive eating patterns; although, it did not reach statistical significance (Table 5).

The absolute intakes of the micronutrients did not differ between the asymptomatic and disordered individuals. Because the prevalence of inadequate nutrient intakes cannot be determined by comparison of mean intakes to the RDAs, the EAR cut-point method was used for this purpose. Significant proportions of athletes had intakes of vitamin E and magnesium that were below the EAR (women, 61% <EAR for vitamin E, 37% <EAR for magnesium; men, 63% <EAR for vitamin E, 59% <EAR for magnesium). There were no statistically significant associations between frequencies of inadequate intakes and disordered eating category for any of the micronutrients for either gender.

DISCUSSION

The results of this study are novel because they describe the nutrient intakes of athletes whose eating behaviors are "disordered" and compare the nutrient intakes of athletes whose disordered eating behaviors are primarily restrictive to those who

Table 5. Daily energy and macronutrient intakes for men and women athletes with binge- and restrictive-eating behaviours. Values are means (± SEM).

	Men (n = 97)			Women (n = 135)		
	Asympt (n = 74)	**Binge (n = 16)**	**Restrictive (n = 7)**	**Asympt (n = 110)**	**Binge (n = 10)**	**Restrictive (n = 15)**
Energy						
kcal	2503 (1111)	2471 (240)	2102 (362)	2083 (73)	2455 (243)	2144 (198)
kcal·kg^{-1} BW	30.2 (1.5)	27.4 (3.2)	24.9 (4.9)	32.7 (1.3)	40.7 (4.4)	32.0 (3.6)
Carbohydrate						
% of total E	53.4 (.7) *	49.7 (1.5) †	48.7 (2.3) †	55.6 (.5)	57.3 (1.7)	55.7 (1.4)
g·kg^{-1} BW	4.0 (.2)	3.4 (.5)	3.0 (.7)	4.5 (.2)	5.9 (.7)	4.5 (.5)
Fat						
% of total E	31.4 (.6)	32.5 (1.3)	35.4 (2.0)	28.4 (.5)	25.9 (1.6)	27.6 (1.3)
Protein						
% of total E	15.6 (.3) †	17.5 (.7) *	15.5 (1.1) *†	21.5 (.2)	16.6 (.3)	16.4 (.7)
g·kg^{-1} BW	1.2 (.1)	1.2 (.1)	.9 (.2)	1.3 (.1)	1.7 (.2)	1.3 (.2)
Alcohol						
g·day^{-1}	4.8 (.4)	5.9 (.8)	6.6 (1.2)	3.9 (.4) †	6.8 (1.3) *	5.1 (.8) *†

Abbreviations: Asympt = asymptomatic, BW = body weight. * and † denote significant ($p < 0.05$) differences for within gender comparisons.

engage in binge eating. Furthermore, this study included men athletes, who are often ignored in assessments of disordered eating patterns and nutrient intakes. The validity of these findings is strengthened by a large study population; the appropriate use of the DRIs to evaluate nutrient intakes; and the use of standardized diagnostic criteria rather than attitudinal criteria, such as body dissatisfaction, for the determination of disordered versus non-disordered eating. Although the high response rate for the women athletes (82%) is a strength of the study, the response rate for the men (54%) is a limitation.

Disordered eating has been recognized by the ACSM as a problematic group of behaviors for some athletes, with potentially negative health consequences (Yeager et al., 1993; ACSM, 1997). The ACSM has defined disordered eating as a wide spectrum of harmful and often ineffective behaviors that athletes use to control their body weight. These behaviors include caloric restriction and a wide range of other behaviors, such as vomiting, diuretics, diet pills, laxatives, and fasting (Yeager et al., 1993; ACSM, 1997). There is little information available on the nature and prevalence of disordered eating in athletes, or on the nutritional consequences of these behaviors.

Thus, the aims of this study were to assess the macro- and micronutrient intakes of men and women collegiate athletes with disordered eating behaviors and to compare athletes with restrictive- versus binge-eating behaviors. In general, we found that athletes with disordered eating patterns were not at increased risk for inadequate macro- or micronutrient intakes compared with asymptomatic athletes.

To our knowledge, this is the first study that had as a primary aim to examine nutrient intakes in men athletes with disordered eating. There are several published reports on the nutrient intakes of men collegiate wrestlers—a population that is likely to have a high prevalence of disordered eating (Short and Short, 1983; Steen and McKinney, 1986). For example, in a study of 42 NCAA Division I wrestlers, Steen and McKinney reported that significant proportions of the athletes had intakes of energy, carbohydrate, vitamin A, vitamin B_6, zinc, and magnesium that were less than two-thirds of the RDA. Large percentages of these athletes reported reducing food intake (81%), using saunas (51%), wearing a rubber suit while exercising (42%), or wrestling in a heated room (78%) to lose weight. However, it cannot be assumed that the group as a whole would be classified as having disordered eating patterns, and nutrient intakes were not compared between individuals who utilized disordered eating practices and those who did not.

In our sample of men athletes that included individuals who reported restrictive- and binge-eating patterns, we found that absolute energy intakes were lower than recommended for all groups and that there were no significant differences among the groups. Similar to the results in the wrestlers (Steen and McKinney, 1986), athletes with disordered eating patterns were more likely to report restricting their intake of carbohydrate to control their weight. In addition, they consumed relatively less of their energy from carbohydrate than asymptomatic athletes. We also found that significant proportions of the men athletes had intakes of vitamin E (63%) and magnesium (59%) that were below the EARs. However, the frequencies of inadequate intakes were not greater in the athletes with disordered eating than in those who were asymptomatic. Interestingly, the disordered eating behaviors in the men athletes did not appear to be motivated by wanting to gain or lose weight, as the current BMI did not differ from the desired BMI for any of the groups.

In contrast, the women athletes who reported disordered eating patterns wanted to lose significantly more weight than the asymptomatic athletes, although the desired BMIs did not differ among groups. Athletes with restrictive eating patterns were more likely to report limiting their intake of carbohydrate and using dietary supplements to control their weight than asymptomatic athletes. There were no significant differences in absolute or relative energy or macronutrient intakes among groups, but carbohydrate intakes for the disordered and asymptomatic athletes were below the recommendation for athletes. The two published reports of nutrient intakes in women athletes with disordered eating contain conflicting results. In a study of Norwegian elite women athletes, Sundgot-Borgen (1993) found no differences in absolute energy or macronutrient intake between athletes with anorexia athletica and controls, although both groups had intakes that were below the recommendations for energy and carbohydrate. This is in contrast to the results of Beals and Manore (1998), who reported significantly lower absolute energy, protein, and fat intakes in athletes with subclinical eating disorders compared to controls.

There were no significant differences in mean micronutrient intakes among the disordered and asymptomatic groups in the current study. This result is consistent with those reported by Sundgot-Borgen (1993) and Beals and Manore (1998). We did not detect any significant differences in the frequencies of inadequate nutrient intakes using the EAR cut-point method between disordered and asymptomatic athletes. Beals and Manore reported

that more athletes with subclinical eating disorders had intakes for calcium, iron, magnesium, zinc, niacin, vitamin B_6, and vitamin B_{12} that were less than two-thirds of the RDA compared to control athletes. One potential explanation for the discrepant conclusions is that Beals reported only foods and not vitamin/mineral supplements, while the nutrient intakes presented in the current study include vitamin/mineral supplements.

It is noteworthy that among women athletes who consumed alcohol, those with disordered eating had a significantly higher intake than the asymptomatic individuals. This finding is consistent with higher rates of alcohol use in individuals with eating disorders compared to their non-eating-disordered peers in non-athletic populations (Holderness et al., 1994).

There are several possible reasons why we did not observe greater frequencies of nutritional inadequacies in athletes with disordered eating, particularly those with restrictive eating patterns, compared to asymptomatic athletes. First, by definition, individuals who are classified as symptomatic exhibit abnormal eating behaviors with less frequency and/or duration than individuals whose behaviors are consistent with clinical eating disorders. Thus, their disordered eating behavior may not be severe enough or may not occur with high enough frequency to affect their habitual nutrient intake. There were insufficient numbers of individuals who reported behaviors consistent with clinical eating disorders in the sample to compare nutrient intakes in clinical vs. subclinical eating disorders. Similarly, our ability to detect statistically significant differences between the groups was affected by the small numbers of athletes in the eating disorder groups.

The final explanation relates to the methodological difficulties associated with assessment of usual nutrient intake. These include the ability of the respondents to recall what foods they ate and to accurately estimate serving size, limitations of the time period sampled being representative of habitual intake, alterations in the usual diet as a result of recording food intake, under-reporting of food intake, subject burden, and participant compliance. Given these difficulties, we chose to use a semi-quantitative food frequency questionnaire to assess habitual nutrient intake as opposed to written food records or a 24-hour dietary recall for several reasons. We wanted to maximize the response rate by increasing the likelihood that athletes would complete the dietary assessment. Our primary strategy for accomplishing this goal was to provide sufficient time for the athletes to complete the food frequency questionnaire in a team meeting, rather than relying on the athletes to complete and return food records. We were interested in habitual intake and because daily or weekly food intake can vary significantly, we chose not to use the 24-hour recall or written food records. Furthermore, as mentioned above, under-reporting is a recurrent problem in determining true food intake. Recently, energy expenditure assessed by doubly-labeled water has become the gold standard by which energy intake data are evaluated. Using this technique, the magnitude of the underestimation was ~15% using either a food frequency questionnaire or a seven-day written food record (Livingstone and Black, 2003). Thus, we were confident that the food frequency would perform as well as a written food record in this regard.

Nevertheless, we recognize that food frequency questionnaires rely on self-reported data and are semi-quantitative. In addition, they may not accurately reflect nutrient intake in individuals with disordered eating patterns that are characterized by unstable eating habits, consumption of food in serving sizes that deviate significantly from normal portion sizes, or loss of some nutrients via purging.

CONCLUSIONS

In conclusion, the consequences of disordered eating, and of different types of disordered eating, on the nutritional status and health of athletes warrant further investigation. The results of the current study indicate that energy and carbohydrate intakes are the most apparent dietary inadequacies among all athletes. We also found significant gender differences regarding disordered eating and nutrient intake. The men with disordered eating consumed a smaller proportion of their energy as carbohydrate compared to asymptomatic athletes, while there were no significant differences in macronutrient intake among the women. A desire to lose weight appeared to be the motivation for disordered eating behaviors for the women, but not the men, athletes. Another important finding from the current study is the significantly greater alcohol consumption among women athletes with binge-eating behaviors. The association between the two behaviors suggests that coaches, athletic trainers, and sports nutritionists should have heightened awareness in screening athletes for either disordered eating or alcohol misuse.

Future investigations of the nutritional status of athletes with disordered eating would be strengthened by using written diet records concurrent with biochemical assessment of micronutrient status in prospective studies of disordered eating behavior in athletes. Although it appears that weight control is the underlying motivation for disordered eating in women athletes,

further investigation of the attitudes and beliefs about diet, body weight and composition, and performance is warranted for both men and women athletes. This information would be invaluable in designing prevention and intervention programs for athletes with disordered eating.

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KEY POINTS

- Athletes with disordered eating were more likely to report restricting their intake of carbohydrate and fat and using supplements to control their weight than asymptomatic athletes
- Among female athletes, those with disordered eating wanted to lose a greater percentage of their current body weight than did asymptomatic athletes
- Disordered eating was not associated with greater frequencies of inadequate micronutrient intake in either gender
- Athletes with disordered eating may be at significantly greater risk for nutritional inadequacies than athletes who are asymptomatic due to macronutrient restriction and greater alcohol consumption

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