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The Female Collegiate Cross-Country Runner: Nutritional Knowledge and Attitudes

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Objective: To assess the nutritional knowledge and attitudes of the female collegiate cross-country runner. Awareness of the deficient areas of nutritional knowledge, important in performance and healing, may assist professionals in educating female runners.

Design and Setting: In this descriptive study, subjects completed a nutritional questionnaire with both quantitative and qualitative components. In a 9-day period, the nutritional questionnaire was administered at 6 colleges and universities in Illinois and Michigan.

Subjects: The convenience sample included female collegiate cross-country runners (N = 60). Overall compliance rate was 61% (60 out of 99).

Measurements: Our questionnaire included a demographics section, 76 Likert-scale true-false questions, and 7 open-ended questions. True-false questions were divided into subscales of 3 or more questions based on the topic. Statistical analyses focused on quantitative analysis.

Results: Runners who completed a nutrition course in college scored significantly higher overall. Runners scored significantly higher in the knowledge for the athlete component than in the general knowledge component. Several specific areas of deficient nutritional knowledge were identified. Overall, the mean of the runners' total positive responses for the attitudes component of the questionnaire was 90.6%.

Conclusions: Our findings suggest that the female collegiate cross-country runner lacks nutritional knowledge critical to preventing nutrition-related health problems. Because most of the runners in our study exhibited positive attitudes toward nutrition, female collegiate cross-country runners may be receptive to nutritional education.

Key Words: female athlete triad, education, athletic trainer, performance

Since the passage of Title IX, girls' participation in high school sports has increased 600%.[1,2] Unfortunately, increased participation in women's athletics came without an understanding of the specific needs of the female athlete. Physiologic differences in females, combined with internal demands and external pressures during cross-country running, have led to health problems and injuries occurring uniquely in the female cross-country runner. Female athletes' emphasis in cross-country running often is not only on skill and endurance but also on leanness and appearance.[3] Hence, these athletes are susceptible to what has become known as the female athlete triad of disordered eating, menstrual dysfunction, and osteoporosis.[4] Studies of female athletes, including figure skaters, runners, and gymnasts, have revealed a tendency toward distorted body image, excessive concern regarding body weight, and severe food restriction.[3]

Proper nutrition is a key component in preventing many female-specific health problems. The incidence of health problems in female collegiate cross-country runners remains high, and subtle changes such as fatigue and poor performance appear to be prevalent. Thus, despite the importance of good nutrition, the female athlete appears to lack nutritional knowledge or fails to comply with recommendations for other unknown reasons. Past research focused on the adolescent runner, with little attention being paid to the female collegiate cross-country runner. Both athletes and coaches have been found to have limited nutritional knowledge, and many studies indicate that nutritional education is needed for athletes and those who influence this population.[3,5–11] In contrast, a recent study by Turner and Bass[12] described female collegiate athletes participating in various sports as having better knowledge of osteoporosis and dietary calcium requirements than noted in previously published studies. Overall, the areas of knowledge deficit are poorly described in the previous literature, and research completed in the 1980s does not agree on whether athletes lack more basic nutritional knowledge or more knowledge pertaining to athletes.[13,14]

Studies have indicated that athletes appear to have positive attitudes toward nutrition.[11,15] This suggests that if the areas of knowledge deficits or reasons for nutritional choices can be identified, the female runner will be receptive to nutrition education. Our purpose was to assess the nutritional knowledge

and attitudes of the female collegiate cross-country runner. Coaches, female runners, and health professionals, including athletic trainers, may then be informed of the areas lacking in nutritional knowledge important in performance and healing.

METHODS

Instrumentation

In this descriptive study, the instrument was a questionnaire designed to assess nutritional knowledge and attitudes of female collegiate cross-country runners and coaches. Components of the questionnaire included a demographics section, 76 Likert-scale true-false questions (Appendix A), and 7 open-ended questions. We developed the instrument using carefully selected questions from questionnaires created by Barr[14] and Werblow et al[11] (permission was granted by the authors). Reliability ($r = 0.82$) and construct validity have been determined for the questionnaire by Barr[14] when used in its entirety. The questionnaire by Werblow et al has been used in several studies[9,15,16]; however, there is no mention of reliability or validity in the research. We constructed additional questions to assess the components of nutritional knowledge that were not addressed by either questionnaire. The research committee, several university faculty members, and a physician reviewed the pilot questionnaire to establish face validity and trustworthiness. The questionnaire was revised appropriately based on their feedback.

Subjects

Sixty female collegiate cross-country runners from 6 colleges and universities in Illinois and Michigan completed the questionnaire. All participants were members of their respective collegiate teams for the 1999–2000 competitive cross-country season. The sample was one of convenience, with 3 schools chosen from each state to represent National Collegiate Athletic Association Division I, Division II, and Division III levels of competition.

Procedures

A pilot study was conducted at a local university after project approval was received from the Grand Valley State University Human Subjects Review Board. Area coaches were contacted by telephone to explain the research purpose, methods, and benefits. The questionnaire was administered at each college or university by one or more researchers. The same directions were read to all participants to ensure that the questionnaire was completed appropriately. As described in the cover letter, completion of the questionnaire served as each participant's informed consent.

Statistical Analysis

The true-false questions were divided into the following subscales of 3 or more questions based on the following topics: carbohydrates, protein, fats, calcium, iron, vitamins and minerals, functional foods, vegetables, health benefits of foods, hydration, nutrition for the athlete, and weight loss (Table 1). The remaining 11 true-false questions addressed the participants' attitudes toward nutrition. We divided the knowledge portion into nutrition for the athlete (questions 5, 7, 16, 24, 27, 28, 48–52, and 55–62) and general nutrition (remaining knowledge-component questions) sections. Frequencies were calculated for all demographic data and for knowledge and attitudes questions. For analysis of questions using the Likert scale, ''strongly agree'' and ''agree'' were combined as positive responses and ''strongly disagree'' and ''disagree'' as negative responses.

Table 1. Knowledge Subscales: Means and Percentages Correct Scored by Runners (N = 60)

Subscale	Mean Number Correct/Total Questions	Mean Percentage Correct
1. Carbohydrates	2.6/5	51.7
2. Protein	1.6/3	51.7
3. Fats	2.2/4	54.6
4. Calcium	3.7/6	61.7
5. Iron	4.5/6	75.8
6. Vitamins and minerals	5.8/13	44.6
7. Functional foods	2.3/3	75.6
8. Vegetables	2.1/4	53.3
9. Health benefits of foods	1.1/3	37.2
10. Hydration	6.4/9	71.1
11. Nutrition for the athlete	3.3/6	54.7
12. Weight loss	1.6/3	53.9
Total	37.2/65	57.2

For 2-group comparisons, independent *t* tests were used to identify evidence of a significant difference. Before data collection, .05 was selected as the level of significance. An analysis of variance was used for comparisons with more than 2 groups. Paired *t* tests were computed to compare individual subscales.

Qualitative analysis performed on the open-ended questions established themes describing reasons for food choices and selection. Written responses to questions 79 to 85 of the nutritional questionnaire were typed onto index cards. A random sort was performed to decipher patterns and trends in language, and index cards were sorted accordingly. Groups of index cards with similar responses were labeled as themes. A third sort narrowed themes into 2 main categories (mind and body). Categories and themes were reevaluated to guarantee that responses were sorted appropriately, and outliers were noted and set aside. A code book (Appendix B) was created to outline categories and themes.

RESULTS

The runners' ages ranged from 18 to 22 years (mean = 19.8 $\pm$ 1.04 years). The distribution of runners was as follows: 19 in Division I, 14 in Division II, and 27 in Division III; 26 in Illinois and 34 in Michigan. Eighty-five percent (51 of 60) of the runners participated in at least one other intercollegiate sport, most in track and field. Runners classified their body weights into 1 of 3 categories: 8.3% (5 of 60) below ideal weight; 60% (36 of 60) at ideal weight; 30% (18 of 60) above ideal weight; and 1.7% (1 of 60), no response. Twenty-two percent (13 of 60) of the runners completed a nutrition course in college. In addition, runners who took a nutrition course in college scored higher ($t_{58} = 2.82$, $P = .007$) than those who did not take a course.

Participants were asked to classify their eating situation according to the following choices: (1) I buy or prepare most of my own food; thus, I generally control what I eat, or (2) my

Table 2. Questions Answered Correctly by Fewer than 35% of Runners

Question	Correct Reponse	Percentage Correct
Vitamin E is required for blood clotting	False	5.0
800 milligrams of calcium per day is the recommended dietary allowance (RDA) for females ages 15–24	False	6.7
Vitamin supplementation is recommended for all physically active people	False	10.0
Fresh, frozen, and canned vegetables all have similar nutrient values	True	15.0
No more than 15% of calories in the diet should be provided by fat	False	18.3
Caffeine has been shown to improve endurance performance	True	20.0
Carotenoids work to prevent the formation of free radicals	True	20.0
Natural and organic foods are more nutritious than foods grown under conventional methods	False	21.7
A physically fit person eating a nutritionally adequate diet can improve her performance by consuming greater amounts of nutrients	False	21.7
Vitamins in mineral-enriched foods are not used by the body as well as naturally occurring vitamins	False	22.0
When trying to lose weight, acidic foods such as grapefruit are of special value because they burn fat	False	23.4
An equivalent weight of carbohydrates and protein has approximately the same caloric value	True	26.7
An athlete involved in endurance events (eg, distance running) should follow a considerably different diet than one participating in events of short duration (eg, sprinting)	False	28.3
Foods such as potatoes and honey are best eaten after exercise	True	30.0
Protein is not stored in the body; therefore, it needs to be consumed every day	True	30.0
Meats and eggs are good sources of zinc	True	31.6
Vitamins are a good source of energy	False	31.6
Protein is the primary source of muscular energy for the athlete	False	31.7
Whole milk is a better source of vitamin D than skim or 2% milk	False	33.3

food is normally prepared by a family member, roommate, food service of a dorm, sorority house, student union, etc; thus, I am somewhat limited in my food selection. Choice 1 applied to 35% (21 of 60) of the runners, and choice 2 applied to 65% (39 of 60) of the runners. Runners who prepared their own food scored higher than runners whose food was prepared for them ($t_{58} = 2.09$, $P = .041$).

Runners obtained nutritional information from a variety of sources. The top 4 reported sources were magazines, parents, coaches, and teammates. Only 17% (10 of 60) cited the athletic trainer, and just fewer than half (27 of 60) reported a physician as a source of nutritional information. The number of nutritional sources used by the runners and total score on the questionnaire demonstrated little to no relationship ($r = 0.19$, $P = .15$).

The total number of questions answered correctly on the knowledge component was compared for several groups. For runners in Illinois and Michigan, the mean scores between the groups did not differ ($t_{58} = 1.85$, $P = .07$). Similarly, there was no difference in the mean scores among Division I, II, and III athletes ($F_{2,57} = 0.098$, $P = .907$) and no interaction between division and state ($F_{5,54} = 1.0$, $P = .427$).

Runners scored greater than 70% on 3 subscales: iron, functional foods, and hydration. Overall, the mean score on the nutrition for the athlete component was higher ($t_{59} = 2.39$, $P = .02$) than the mean for the general nutrition component. Overall, 19 questions were answered correctly by fewer than 35% of the subjects (Table 2).

The mean of athletes' total positive responses for the attitudes component was 90.6%. When asked, ''Does your knowledge of nutrition affect how you eat?'' 83.3% (50 of 60) responded yes. Also, 91.7% (55 of 60) strongly agreed or agreed with the statement, ''Learning facts about nutrition is the best way to achieve favorable changes in food habits.'' Within the last year, 61.7% (37 of 60) of the runners had an increased interest in nutrition.

Qualitative analysis revealed several themes for food selection and choices. Food preference, health indication, and body appearance and weight issues were the top 3 themes. Examples of runners' written statements included, ''I feel the less you weigh, the faster you run,'' ''If you know more about nutrition, you are more likely to make more healthy food choices,'' and ''I want to eat better, but I really don't know enough.''

DISCUSSION

The American College of Sports Medicine[8] recently published a position statement on the female athlete triad. The document states that prevention of the female athlete triad requires education of athletes, peers, parents, coaches, and health care workers about warning signs, contributory psychological factors, and outcomes of the female athlete triad.[8] Proper nutrition is the key to prevention of the female athlete triad. The athletic trainer has the opportunity to serve as the first line of defense in preventing and identifying nutrition-related health problems.

Analysis of individual questions revealed multiple questions in which fewer than 35% of runners responded correctly. Several of these questions related directly to nutrition for the athlete: topics included the glycemic index, sources of muscle energy, nutrients and performance, and diet requirements for distance runners versus sprinters. Although runners scored higher overall on nutrition for the athlete versus general nutritional knowledge, these areas related to nutrition for the athlete may need to be targeted in education. For example, preseason seminars conducted by athletic trainers should address a balanced energy intake to maximize running performance. Although many alternative dietary practices remain in the spotlight without proof of benefit, the nutritionally balanced diet is still considered the best approach to eating for the athlete. Following the American Dietetic Association guidelines,[17] carbohydrates should compose approximately 60% of daily caloric intake, fats 25% to 30%, and proteins 15%. Caloric intake should be increased in relation to the runner's added energy expenditure. Carbohydrates are the source of muscle energy, followed by fats and proteins, whereas vitamins, min-

erals, and water also are essential for health but do not provide energy.[17]

Runners failed to respond correctly to several questions regarding vitamins. Vitamin supplementation (question 27), natural versus vitamin-enriched foods (question 29), and vitamin content in frozen, fresh, and canned vegetables (question 43) were prime areas of misconception (see Table 2). Often, these topics are debated in the media, which may explain the confusion regarding these areas. The nutrient values of fresh, frozen, and canned vegetables are similar, although overcooking vegetables can destroy nutrients. Exercise does not increase the needed amount of vitamins; it is possible to obtain the recommended amount of vitamins through a balanced diet. Vitamin-enriched foods are used by the body as well as naturally occurring vitamins. However, supplements are recommended for individuals who are restricting calories, allergic to certain foods, lactose intolerant, or total vegetarians.[17]

Runners in our sample appeared knowledgeable about the benefits of the role of calcium in the body. All runners agreed with the statements, ''Milk is a good supplier of calcium for all ages'' and ''Adequate calcium intake is necessary for female athletes of all ages to prevent osteoporosis.'' However, only 6.7% (4 of 60) of the runners knew the recommended daily allowance for calcium, and only 40% (24 of 60) rejected the statement, ''Two 8-ounce glasses of milk are enough to fulfill the recommended amount of calcium per day.'' Of the 83.3% (50 of 60) of runners who drank milk, the average consumption was 2 glasses per day, and only 26.7% (16 of 60) took a calcium supplement. Thus, runners may be unaware of the daily recommended amount and the number of servings necessary to achieve the benefits of calcium and, therefore, are more susceptible to calcium-deficient health problems such as stress injury and the female athlete triad. The Daily Recommended Intake Committee[18] recommended 1300 mg of calcium, the amount in approximately 4 cups (0.96 L) of milk, each day for individuals 9 through 18 years of age and 1000 mg through 50 years. Furthermore, Clark[17] recommended 4 to 5 servings of milk per day for athletes ages 19 to 24 years.

In a previous study,[16] two thirds of adolescent runners thought little or no fat in the diet was best. In our sample, only 18.3% (11 of 60) of runners disagreed with the statement, ''No more than 15% of calories in the diet should be provided by fat.'' Therefore, education for runners should include the role and necessity of fat in the body. Also related to fat, only 33% (20 of 60) disagreed with the statement, ''Whole milk is a better source of vitamin D than skim or 2% milk.'' Although the nutritional questionnaire did not include a question related to fat content in dairy products, previous researchers[5] found that dairy products were avoided because athletes feared the fat content. Qualitative data indicate that body image is more important than fat and caloric content of food during food selection. Although not specifically stated, within concern for body image may lie a fear of fat intake. Combined avoidance or fear of fat and lack of knowledge regarding low-fat dairy products may perpetuate the lack of calcium in the diet of female runners, further increasing the risk of the female athlete triad.

With the apparent fear of fat, athletic trainers need to emphasize the roles of fat in the body. Fats are a necessary form of energy and help transport lipid-soluble vitamins, regulate cholesterol metabolism, and provide essential fatty acids that the body does not produce.[17] Estrogen production also requires fat.[19] Amenorrhea and bone loss can result from decreased estrogen.[6] Fats should compose 25% to 30% of daily caloric intake.

Athletes who participate in sports stressing body physique as related to appearance or performance are at a higher risk of developing health problems,[5] including the female athlete triad, stress injury, and increased difficulty in healing. Runners in our sample were more concerned with body appearance and weight issues versus energy and performance when selecting foods. One athlete asserted, ''I feel the less you weigh, the faster you run.'' The statement implies that some runners in the sample may be susceptible to pressures to maintain an excessively thin body type; however, no single body type has been demonstrated to be the most beneficial for performance. Excessive thinness can result in a decrease in performance and an increase in fatigue.[5] Hence, runners need to be educated on the implications of body type, specifically excessive thinness, as related to energy and performance.

Previous findings[13,14] disagree on whether college athletes score higher in general nutrition knowledge or in nutrition for the athlete. In our sample, runners scored significantly higher on questions related to the athlete. Higher scores on nutrition for the athlete may suggest an increased focus on knowledge related to the athlete without a foundation of general nutritional knowledge. However, analysis of individual questions related to the athlete, as discussed previously, revealed specific areas in which runners lack knowledge.

The mean score of the 35% of runners who had control over what they ate was significantly higher than those of runners who had food prepared for them. The athlete who has control must make decisions and become more aware of her nutritional habits. In an effort to make healthy choices, she may seek out nutritional information, thus increasing her knowledge. Furthermore, qualitative analysis revealed that food availability may more frequently affect food choices made by runners who have food prepared for them. Because food choices may be predetermined for this population, runners may not be motivated enough to seek out additional nutrition information.

A previous study[13] found that collegiate athletes who completed a nutrition course in college demonstrated greater nutritional knowledge than those who did not complete a nutrition course. Our study's data support this finding, suggesting that athletes may benefit from taking a nutrition course or from receiving additional nutritional information for optimal health and performance.

Barr[14] found a weak positive correlation ($r = 0.16$, $P \leq .01$) between the athletes' reported number of nutritional information sources and nutritional knowledge. In the current study, a positive correlation, although not statistically significant, was found between the same factors. The most frequently cited sources were magazines, parents, coaches, and teammates. However, just fewer than half of the runners cited a physician, and only 17% cited an athletic trainer as the source of nutritional information. Thus, we theorize that the quality of nutrition sources is more important than the number of nutritional sources a runner uses, and the athletic trainer may need to assume a more active role in nutritional education.

Nutritional knowledge and attitudes may have an effect on female collegiate cross-country runners' eating habits. When asked, ''Does your knowledge of nutrition affect how you eat?'' 83.3% responded yes. From this statement, we cannot determine whether the effect is positive or negative; however, 91.7% strongly agreed or agreed with the statement, ''Learn-

ing facts about nutrition is the best way to achieve favorable changes in food habits.'' Also, Perron and Endres[15] reported that attitudes may have a good influence on behavior, perhaps more than nutritional knowledge, in high school athletes. In a study of collegiate athletes by Werblow et al,[11] nutritional knowledge and positive attitudes toward nutrition were found to be positively correlated. In our sample, the mean of runners' total positive responses for the attitudes component subscale was 90.6%. Moreover, 61.7% of runners had an increased interest in nutrition within the last year. These findings suggest that female collegiate cross-country runners may be receptive to nutritional education, and the potential for behavioral changes toward better eating habits may exist.

Limitations

The nutritional questionnaire was a variation of 2 previous surveys by Barr[14] and Werblow et al,[11] with additional questions developed by us. The questionnaire was piloted to establish construct validity, but the questionnaire cannot be shown reliable without test-retest analysis. Also, a third reference group (nutritionists or a similar group) was not included in the sample. Consequently, the standard for ''acceptable'' nutritional knowledge could not be accurately defined.

Not all coaches and runners of selected teams participated in completion of the nutritional questionnaire. The overall compliance rate was 61% for runners and 55% for coaches. It is unknown if the runners who chose not to participate had particularly low or high nutritional knowledge. In addition, with only 6 coaches participating, statistical analysis was limited to the runners, and the effect of a coach's knowledge on his or her runners could not be determined.

Suggestions for Further Research

We assessed nutritional knowledge and attitudes of female collegiate cross-country runners in Illinois and Michigan. Future research could include runners from additional geographic locations outside the Midwest. Similar studies could use the same nutritional questionnaire to assess nutritional knowledge of broader populations, including athletes in other sports, athletes of various ages, male athletes, and coaches and athletic trainers.

Poor nutritional habits contribute to the development of the female athlete triad.[5,6,9,20] Further research is necessary to determine the relationship between nutritional knowledge and the components of the triad: eating disorders, menstrual dysfunction, and osteoporosis.

For a high level of nutritional knowledge to have a positive effect, this knowledge must affect eating behaviors. Analysis of the relationship between increased nutritional knowledge and eating behaviors may identify the benefits of improved nutritional knowledge.

CONCLUSIONS

Poor nutritional habits contribute to the development of the female athlete triad and other health problems.[5,6,9,20] Proper nutrition is considered a significant determinant of athletic performance; other than limits from heredity and training, ''no single factor plays a greater role in optimizing performance than diet.''[21]

Although the participants in this study appeared to perform reasonably well in most parts of the questionnaire, areas in which they lacked nutritional knowledge were evident. Body image has been demonstrated in previous research as a key factor in development of the triad.[4] In this study, qualitative analysis revealed body appearance and weight issues as some of the prime reasons for food selection. Thus, the areas of nutritional-knowledge deficits and body image should be targeted when educating female collegiate cross-country runners and health care professionals.

Our results suggest that runners may benefit from a nutrition course in college. Moreover, female collegiate cross-country runners demonstrated positive attitudes toward nutrition, indicating that this population of runners may be receptive to nutritional education.

Athletic trainers are active in both the prevention and healing of injuries; therefore, the role of the athletic trainer should include educating athletes on the importance of nutrition to performance and healing. The athletic trainer should be aware of areas of decreased nutritional knowledge in collegiate runners and be qualified to formulate a plan of intervention through preseason seminars, handouts, posters, and individual counseling.

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Appendix A. Likert-Scale Component of Nutritional Questionnaire

For each question, please circle the number that best describes your answer
SA = Strongly agree
A = Agree
U = Undecided
D = Disagree
SD = Strongly disagree

	SA	A	U	D	SD
1. An equivalent weight of carbohydrates and protein have approximately the same caloric value	1	2	3	4	5
2. Carbohydrates are not as easily and rapidly digested as protein and fat	1	2	3	4	5
3. A slice of bread is an example of 1 serving from the bread and cereals food group	1	2	3	4	5
4. Honey contains fewer calories than an equal amount of sugar	1	2	3	4	5
5. Foods such as potatoes and honey are best eaten after exercise	1	2	3	4	5
6. Eggs and legumes are examples of protein sources other than meat	1	2	3	4	5
7. Protein is the primary source of muscular energy for the athlete	1	2	3	4	5
8. Protein is not stored in the body; therefore, it needs to be consumed every day	1	2	3	4	5
9. All red meat is high in saturated fat	1	2	3	4	5
10. No more than 15% of calories in the diet should be provided by fat	1	2	3	4	5
11. Substitution of polyunsaturated fat for some saturated fat is recommended to lower the risk of heart disease	1	2	3	4	5
12. Adequate fat intake is necessary for estrogen production	1	2	3	4	5
13. Broccoli is a plant source of calcium	1	2	3	4	5
14. Milk is a good supplier of calcium for all age groups	1	2	3	4	5
15. 800 milligrams of calcium per day is the recommended dietary allowance (RDA) for females ages 15–24	1	2	3	4	5
16. Adequate calcium intake is necessary for female athletes of all ages to prevent osteoporosis	1	2	3	4	5
17. Two 8-ounce glasses of milk is enough to fulfill the recommended amount of calcium per day	1	2	3	4	5
18. Carbonated beverages can negatively affect calcium metabolism	1	2	3	4	5
19. Iron-deficiency anemia results in a decrease in the amount of oxygen that can be carried in the blood	1	2	3	4	5
20. Cheese is a good source of iron in the diet	1	2	3	4	5
21. Those with a meatless diet are at a higher risk for iron deficiency	1	2	3	4	5
22. Iron in meat is absorbed at the same rate as iron in a plant food	1	2	3	4	5
23. Due to menstruation, females need more iron in their diets than men	1	2	3	4	5
24. A lack of iron in the diet can result in fatigue, injury, and illness	1	2	3	4	5
25. Meat and eggs are good sources of zinc	1	2	3	4	5
26. Bananas and avocados are good sources of potassium	1	2	3	4	5
27. Vitamin supplementation is recommended for all physically active people	1	2	3	4	5
28. Excess vitamin supplementation may harm the physically active person	1	2	3	4	5
29. Vitamins in mineral-enriched foods are not used by the body as well as naturally occurring vitamins	1	2	3	4	5
30. Vitamins are a good source of energy	1	2	3	4	5
31. Green, leafy, and yellow vegetables are important because they help ensure the vitamin A requirement for the individual	1	2	3	4	5
32. Carrots are a good source of vitamin A	1	2	3	4	5
33. Whole milk is a better source of vitamin D than skim or 2% milk	1	2	3	4	5
34. The body can synthesize vitamin D upon exposure to the sun	1	2	3	4	5
35. Potatoes, strawberries, and cantaloupe are good sources of vitamin C	1	2	3	4	5
36. The best sources of folic acid are supplemented grain products and fortified breakfast cereals	1	2	3	4	5
37. Vitamin E is required for blood clotting	1	2	3	4	5
38. Salt is an essential part of a healthy diet	1	2	3	4	5
39. Fiber in the diet may help to decrease constipation, decrease blood cholesterol levels, and prevent cancers	1	2	3	4	5
40. Bread and cereals is the only food group that is a good source of fiber	1	2	3	4	5
41. Two servings of vegetables per day fulfills recommended dietary allowances	1	2	3	4	5
42. Dark-colored vegetables have more nutritional value than pale vegetables	1	2	3	4	5
43. Fresh, frozen, and canned vegetables all have similar nutrient values	1	2	3	4	5
44. Nutrients can be destroyed if vegetables are overcooked	1	2	3	4	5
45. Eating oatmeal may decrease the risk of heart disease	1	2	3	4	5
46. Carotenoids work to prevent the formation of free radicals	1	2	3	4	5
47. Natural and organic foods are more nutritious than foods grown under conventional methods	1	2	3	4	5
48. Dehydration can impair physical performance	1	2	3	4	5
49. During activity, thirst is an adequate guide to the need for fluids	1	2	3	4	5
50. During exercise, mass ingestion of large amounts of fluid is preferred over frequent ingestion of small amounts	1	2	3	4	5
51. An athlete should drink no water during practice, but rather rinse out her mouth or suck on ice cubes	1	2	3	4	5
52. Sports drinks are the best way to replace body fluids lost during exercise	1	2	3	4	5
53. Alcohol consumption can affect absorption and utilization of nutrients	1	2	3	4	5
54. Alcohol has more calories per gram than protein	1	2	3	4	5
55. Caffeine has been shown to improve endurance performance	1	2	3	4	5
56. Caffeine can increase the risk of dehydration	1	2	3	4	5
57. An athlete involved in endurance events (eg, distance running) should follow a considerably different diet than one participating in events of short duration (eg, sprinting)	1	2	3	4	5

Appendix A. Continued

58. A physically fit person eating a nutritionally adequate diet can improve her performance by consuming greater amounts of nutrients	1	2	3	4	5
59. A muscular person expends more energy at rest than a nonmuscular person of the same age, sex, and weight	1	2	3	4	5
60. A 200-pound person uses about twice as many calories to run a mile as a 100-pound person	1	2	3	4	5
61. A person with a higher percentage of body fat may weigh less than a person of the same size with a greater muscle mass	1	2	3	4	5
62. A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day	1	2	3	4	5
63. Skipping meals is justifiable if you need to lose weight quickly	1	2	3	4	5
64. When trying to lose weight, acidic foods such as grapefruit are of special value because they burn fat	1	2	3	4	5
65. If trying to lose weight, carbohydrates should come only from fruits and vegetables rather than from breads and pastas	1	2	3	4	5
66. The relationship of good eating habits to good health should be stressed to the athlete	1	2	3	4	5
67. Coaches need to have good attitudes toward nutrition because of their close contact and influence upon athletes	1	2	3	4	5
68. The type of food an athlete eats affects her physical performance	1	2	3	4	5
69. What the athlete eats is only important if the athlete is trying to gain or lose weight	1	2	3	4	5
70. Nutrition is more important during the competitive season than during the off-season for the athlete	1	2	3	4	5
71. Food advertisements are a very reliable source of nutritional information	1	2	3	4	5
72. It is the coach's responsibility to stress good nutritional practices	1	2	3	4	5
73. The athlete should schedule her activities so she has time to eat	1	2	3	4	5
74. Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need	1	2	3	4	5
75. Learning facts about nutrition is the best way to achieve favorable changes in food habits	1	2	3	4	5
76. Nutritional counseling would be important to the athlete who is trying to change her weight	1	2	3	4	5

Appendix B. Code Book for Qualitative Analysis

Mind refers to the emotional response to, or the perception of, foods

A. Attitudes refers to the runner's temperament or perspective with regard to foods
B. Body appearance and weight issues refers to a focus on the way one perceives herself
C. Food availability refers to the ability of the athlete to obtain food
D. Food preference refers to favoring foods with regard to taste or enjoyment
E. Frequency of consumption refers to how often certain foods were consumed

Body refers to the physical or physiological aspects of foods

A. Balanced diet refers to a focus on acquiring all necessary nutrients
B. Energy and performance refers to the impact of food on energy and performance
C. Fat and calories refers to concerns with the fat or caloric content of food
D. Health indication refers to the athlete's opinion on what is good or bad for her
E. Hunger refers to the physiologic state of being hungry
F. Nutritional knowledge refers to the impact of knowledge on food selection
G. Nutritional value refers to required nutritional components to maintain health