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Sports Nutrition Knowledge Among Collegiate Athletes, Coaches, Athletic Trainers, and Strength and Conditioning Specialists

Toni M. Torres-McGehee, PhD, ATC*; Kelly L. Pritchett, PhD, RD, CSSD†; Deborah Zippel, MS, RD*; Dawn M. Minton, MS, ATC*; Adam Cellamare, MS, ATC*; Mike Sibilia, MS, ATC, PES, CES*

*University of South Carolina, Columbia; †Central Washington University, Ellensburg

Context: Coaches, athletic trainers (ATs), strength and conditioning specialists (SCSs), and registered dietitians are common nutrition resources for athletes, but coaches, ATs, and SCSs might offer only limited nutrition information. Little research exists about sports nutrition knowledge and current available resources for nutrition information for athletes, coaches, ATs, and SCSs.

Objective: To identify resources of nutrition information that athletes, coaches, ATs, and SCSs use; to examine nutrition knowledge among athletes, coaches, ATs, and SCSs; and to determine confidence levels in the correctness of nutrition knowledge questions within all groups.

Design: Cross-sectional study.

Setting: National Collegiate Athletic Association Division I, II, and III institutions across the United States.

Patients and Other Participants: The 579 participants consisted of athletes (n = 185), coaches (n = 131), ATs (n = 192), and SCSs (n = 71).

Main Outcome Measure(s): Participants answered questions about nutrition resources and domains regarding basic nutrition, supplements and performance, weight management, and hydration. *Adequate sports nutrition knowledge* was defined as an overall score of 75% in all domains (highest achievable score was 100%).

Results: Participants averaged 68.5% in all domains. The ATs (77.8%) and SCSs (81.6%) had the highest average scores. Adequate knowledge was found in 35.9% of coaches, 71.4% of ATs, 83.1% of SCSs, and only 9% of athletes. The most used nutrition resources for coaches, ATs, and SCSs were registered dietitians.

Conclusions: Overall, we demonstrated that ATs and SCSs have adequate sports nutrition knowledge, whereas most coaches and athletes have inadequate knowledge. Athletes have frequent contact with ATs and SCSs; therefore, proper nutrition education among these staff members is critical. We suggest that proper nutrition programming should be provided for athletes, coaches, ATs, and SCSs. However, a separate nutrition program should be integrated for ATs and SCSs. This integrative approach is beneficial for the continuity of care, as both categories of professionals might be developing and integrating preventive or rehabilitative programs for athletes.

Key Words: nutrition education, registered dietitians, nutrition resources

Key Points

- Athletic trainers and strength and conditioning specialists have adequate sports nutrition knowledge but should defer to an expert in the field, such as a registered dietitian, when situations arise beyond their scopes of practice.
- Most collegiate athletes and coaches have inadequate nutrition knowledge.
- Nutrition education programs should be provided for athletes, coaches, athletic trainers, and strength and conditioning specialists.
- Nutrition programs should be integrated into the undergraduate or graduate and continuing education of athletic trainers and strength and conditioning specialists to improve continuity of care.

Over the past 20 years, researchers have documented the benefits of nutrition related to exercise performance. In a joint position statement, the American College of Sports Medicine, American Dietetic Association, and Dietitians of Canada reported that "physical activity, athletic performance, and recovery from exercise are enhanced by optimal nutrition."[1(p709)] Following these guidelines might improve an athlete's training, recovery, and performance. However, collegiate athletes might encounter numerous barriers that hinder healthful eating, including deficits in nutrition knowledge,[2–6] vegetarian or restricted dietary intake, or participation in excessive exercise.[1,7–10] Athletes must have appropriate nutrition knowledge and easily accessible resources for nutrition guidance. Coaches, athletic trainers (ATs), strength and conditioning specialists (SCSs), and registered dietitians (RDs) are primary nutrition resources[4,11]; however, athletic department staff personnel (eg, coaches, ATs, SCSs) might offer only limited factual information.[2] The joint position statement identified key areas of nutrition that are important for athletes: energy needs, body composition, macronutrient requirements, vitamins and minerals, hydration, training diet, and supplements and ergogenic aids.[1]

A major concern for professionals lacking sports nutrition knowledge is that they might disseminate incorrect information

formulated on theory or unsupported by research. A few researchers[4,12,13] have examined nutrition knowledge of collegiate coaches, ATs, and SCSs; however, sample sizes for these studies were small, and the results are nearly a decade old. Investigators have suggested that coaches lack nutrition knowledge, but ATs' knowledge has been inconsistent. Smith-Rockwell et al[13] found that the nutrition knowledge of ATs was less (66%) than that of ATs in the study by Shifflett and colleagues[4] (74%). Since the earlier studies,[4,13] the National Athletic Trainers' Association (NATA)[14] has updated its curriculum on educational competencies on nutrition; therefore, basic nutrition knowledge for ATs should increase for recently certified ATs. Current ATs might not have received nutrition education associated with these competencies. Reexamining ATs' nutrition knowledge for this decade is critical. Strength and conditioning specialists are a newly credentialed profession and an integral part of athletics. The SCSs generally are responsible for the athlete's physical development, fitness, and conditioning and often address nutrition. Little research has been conducted on the nutrition knowledge and resources of SCSs because it is a rather new profession. Smith-Rockwell et al[13] conducted the only study that has included SCSs; however, because the sample was small (n=10), SCSs were combined with coaches.

Given academic, financial, psychosocial, and sport performance stressors, optimizing nutrition might be challenging in the collegiate environment. Demands of performance and training place athletes at greater risk for musculoskeletal injury, psychological problems, medical complications, and suboptimal energy availability.[9,10] Proper training and optimal energy availability are essential to maximize both health and performance[9]; however, access to nutrition resources might be limited for athletes. They have reported consulting coaches, ATs, SCSs, university courses, parents, and RDs for nutrition guidance,[2,4,11] but they still lack nutrition knowledge.[4,5,15–17] Although some universities have RDs on staff, athletic support staff (coaches, ATs, and SCSs) are in daily contact with athletes and might be called on to distribute nutrition information. Consequently, support staff should have adequate nutrition knowledge until an RD can provide more extensive information.

The importance of having an RD on staff has been identified at some universities, but other institutions might not have access to an RD or do not have a full-time RD working directly with athletes. Therefore, nutrition guidance for athletic teams and support staff might be limited. Little information is available about sports nutrition knowledge and current available resources for nutrition information among athletes, coaches, ATs, and SCSs. Therefore, the purposes of our study were to (1) identify resources of nutrition information that athletes, coaches, ATs, and SCSs use; (2) examine nutrition knowledge among athletes, coaches, ATs, and SCSs; and (3) determine confidence levels in the correctness of answers to questions about nutrition knowledge in all groups. Given educational requirements of ATs and the daily duties of SCSs, we hypothesized that ATs and SCSs would have adequate knowledge, would have greater confidence in their responses, and would select more reliable sources of nutrition knowledge than athletes and coaches.

METHODS

Participants

A simple random sample of athletes (n=400), coaches (n=400), and SCSs (n=200) were contacted at 100 National Collegiate Athletic Association (NCAA) Division I, II, and III universities to participate in the study. A random sample of collegiate ATs (n=500) were selected by the NATA via a member request for random e-mail distribution of members for research. The total response rate was 38.6% (n=579). The response rate for each group was 46.3% (n=185) of athletes (women=111, men=74; age=19.9±1.6 years; freshmen=60, sophomores=64, juniors=36; seniors=25), 32.8% (n=131) of coaches (women=60, men=71; age=34.2±9.7 years), 38.4% (n=192) of ATs (women=94, men=98; age=33.7±9.1 years), and 35.5% (n=71) of SCSs (women=12, men=59; age=32.6±7.2 years). A diverse sample of coaches represented the following sports: baseball (n=7), basketball (n=25), cheerleading (n=2), cross-country (n=5), equestrian (n=2), football (n=11), golf (n=8), gymnastics (n=3), ice hockey (n=4), lacrosse (n=1), rowing (n=2), soccer (n=12), swimming and diving (n=7), tennis (n=3), track and field (n=11), volleyball (n=12), and wrestling (n=16). A diverse sample of athletes represented the following sports: baseball (n=13), basketball (n=16), cheerleading (n=4), dance (n=10), equestrian (n=21), football (n=34), golf (n=1), ice hockey (n=5), lacrosse (n=6), soccer (n=12), swimming and diving (n=13), tennis (n=5), track and field (n=5), volleyball (n=25), and wrestling (n=15). All volunteers completed an online informed consent form and were given the opportunity to decline to participate. The study was approved by the University of South Carolina Institutional Review Board.

Instruments

The survey consisted of a demographics section and sports nutrition knowledge questionnaire. Participants reported age, ethnicity, sex, level of education, occupation, years of experience, number of health and nutrition courses taken, and sport. They used a 10-point Likert scale (1=*not at all,* 5=*fairly well,* 10=*extremely well*) to rank answers to questions about nutrition programs attended, nutrition resources available, perceived nutrition knowledge, and habits and were instructed to rank their top 3 choices of nutrition information used and top 3 recommended resources for athletes. Athletes also were asked, "Who do you feel most comfortable discussing your nutritional needs with?"

The sports nutrition knowledge questionnaire consisted of 20 multiple-choice questions. To assess adequate nutrition knowledge, questions were categorized into 4 domains of sports nutrition: micronutrients and macronutrients, supplements and performance, weight management and eating disorders, and hydration. The micronutrient and macronutrient portion focused on adequate caloric intake from carbohydrates, fats, and proteins and information about vitamins and minerals. Supplements and performance focused on knowledge about pregame meals, supplements, and ergogenic aids. The weight management and eating disorders section focused on safe weight loss and gain strategies, complications from eating disorders, and body composition assessment. Hydration questions focused on heat complications, fluid loss, electrolytes, and hyponatremia. All domains were weighted equally during scoring, and percentages were determined by the number of incorrect answers divided by 20. An overall score of 75% or more from the domains of basic nutrition, supplements and performance, weight management, and hydration indicated *adequate nutrition knowledge,* with a score less than 75% indicating *inadequate nutrition knowledge*. After each question, participants were

instructed to specify their confidence in the correctness of their answers by selecting the appropriate level of confidence from a 4-point Likert scale (1=*not at all confident,* 2=*not very confident,* 3=*somewhat confident,* 4=*very confident*). We graded the survey questions and then divided confidence scores into 2 categories: confidence score for correct answers and confidence score for incorrect answers.

Construct validity was established by 12 professionals who regularly worked with collegiate athletes in the following disciplines: nutrition (sports dietitians=2), athletic training (n=5), exercise physiology (n=2), SCSs (n=2), and sports medicine (physician=1). The ATs and SCSs verified educational competencies on nutrition in their respective disciplines. The RDs (experts) and physicians provided valid feedback on development of questions and answers for all basic sports nutrition categories. All reviewers had at least 5 years of experience working in their disciplines. The survey initially included 50 nutrition questions but was reduced to 20 in response to recommendations from the review panel and a pilot study. The pilot survey was completed by additional athletes (n=21), coaches (n=8), ATs (n=15), and SCSs (n=8). Suggestions from the experts and feedback from the pilot study were considered, and appropriate corrections were made.

Procedures

Athletes, coaches, and SCSs were selected randomly from NCAA Division I, II, and III institutions. Through simple random selection, coaches and SCSs were chosen from university directories. Coaches who responded were sent a follow-up e-mail to ask whether their athletes could participate in the study. If coaches allowed their athletes to participate, they were instructed to send e-mail addresses without names or type of sport associated with their teams through a link on a professional, secure Web site (SurveyMonkey, Palo Alto, CA). If coaches did not allow their athletes to participate, then they did not submit e-mail addresses. After e-mail addresses were compiled, each participant was assigned an identification number and was sent an e-mail via SurveyMonkey. The e-mail message included a short statement about the purposes of the study along with a statement including benefits ("If you consent to participate in this study, results may help enhance nutrition information distributed to collegiate athletes to provide the best care possible and to enhance athletes' training, recovery, and performance"). The link given in the e-mail provided more in-depth information about the study along with a statement about giving consent to participate. Sending an e-mail directly through SurveyMonkey allowed us to track responses via the identification number. To encourage participation, reminders were sent every 10 days for 30 days. The ATs were selected randomly via the NATA and sent only 1 e-mail from the NATA. We were unable to send follow-up e-mails to the ATs. Data collection lasted approximately 1 month.

Data Analysis

To determine power and sample size for each population, we used an a priori $\alpha = .05$ and a between-groups effect size of 0.4, following the method of Cohen.[18] Power calculation indicated a need for approximately 100 participants per group to have adequate statistical power of approximately 60%. We used χ^2 analyses to examine the distribution of variables, including occupational background (athlete, coach, AT, or SCS), professional experience, institutional level, and basic questions about nutrition resources. We computed basic descriptive statistics for all descriptive data and computed individual test scores and confidence levels for correct and incorrect responses. A criterion score (75%) was established to determine adequate nutrition knowledge. We used a χ^2 analysis to examine the distribution of athletes, coaches, ATs, and SCSs with adequate and inadequate nutrition knowledge. One-way analysis of variance (ANOVA) was used to compare differences among groups (athletes, coaches, ATs, SCSs) for knowledge and healthful eating habits. Tukey post hoc tests were used to determine the mean differences within each group. The α level was set at .05 for all analyses. We used SPSS statistical software (version XVII; SPSS Inc, Chicago, IL) for all analyses.

RESULTS

Results pertaining to professional experience, institutional level, access to RDs, and RDs' location of employment are presented in Table 1. Choices for nutrition resources used for themselves and nutrition resources recommended to athletes are presented in Table 2. The data represent choices selected within each group. Data from first and second choices were combined to determine the top resources that each group used. The first and second choices (data combined) of people from whom athletes felt comfortable seeking nutritional advice included SCSs (15.3%, n=85), parents (12.1%, n=67), and ATs (10.5%, n=58). Supplemental questions about the level of understanding of athletes' nutritional needs, the importance of adhering to a healthful diet, and the quality of personal eating habits revealed differences ($F_{3,575}$ range, 3.9–11.3; $P<.001$) among all groups for each of the 3 questions (Table 3).

Percentages for adequate and inadequate nutrition knowledge are presented in Table 4. Overall nutrition knowledge scores, nutrition categories, and confidence level scores for athletes, coaches, ATs, and SCSs are reported in Table 5. We found a difference ($F_{3,570}$ range, 39.3–88.7; $P<.001$) among all groups for all sports nutrition categories (micronutrients and macronutrients, supplements and performance, weight management and eating disorders, and hydration). Tukey post hoc analysis revealed differences for athletes versus ATs and SCSs for all categories and for coaches versus ATs and SCSs (Table 5). We did not find a difference between ATs and SCSs throughout all categories (Table 5). The number of nutrition courses (3–4 credits) taken by athletes was 0.9±0.66; coaches, 1.1±1.4; ATs, 1.8±1.9; and SCSs, 2.9±2.3. The number of health courses (3–4 credits) taken by athletes was 1.2±2.0; coaches, 2.6±3.5; ATs, 4.8±6.0; and SCSs, 3.9±3.9.

DISCUSSION

Registered Dietitian

An RD with specialization in sports nutrition is a critical member of the sports medicine team. The RD is involved in conducting a comprehensive nutrition assessment and consultation, providing medical nutrition therapy, identifying nutrition problems that affect health and performance, addressing energy balance and weight management issues, addressing nutrition challenges to performance, promoting wound and injury healing, and overseeing menu planning and design (pre-event, postevent, and travel).[1] Overall, 58.2% (n=337) of our participants reported having access to an RD. Many collegiate athletic departments have created positions for RDs. Our results

Table 1. Background Information for All Participants, Athletes, Coaches, Athletic Trainers, and Strength and Conditioning Specialists[a]

	All, n (%)	Athletes, n (%)	Coaches, n (%)	Athletic Trainers, n (%)	Strength and Conditioning Specialists, n (%)
Professional experience, y					
0–5	128 (32.5)	NA	41 (31.3)	61 (31.8)	26 (36.6)
5–10	114 (28.9)	NA	38 (29.0)	53 (27.6)	23 (32.4)
10–15	65 (16.5)	NA	27 (20.6)	24 (12.5)	14 (19.7)
15–20	35 (8.9)	NA	2 (1.5)	29 (15.1)	4 (5.6)
>20	52 (12.3)	NA	23 (17.6)	25 (13.0)	4 (5.6)
National Collegiate Athletic Association Division					
I	354 (61.1)	83 (44.9)	89 (67.9)	122 (63.5)	60 (84.5)
II	132 (22.8)	78 (42.2)	21 (16.0)	28 (14.6)	5 (7.0)
III	93 (16.1)	24 (12.9)	21 (16.0)	42 (21.9)	6 (8.5)
Access to registered dietitian?					
Yes	337 (58.2)	94 (50.8)	78 (59.5)	121 (63)	44 (62)
No	242 (41.8)	91 (49.2)	53 (40.5)	71 (37)	27 (38)
Location of employment for registered dietitian					
Full-time athletics	74 (21.9)	34 (36.2)	10 (12.8)	23 (19.0)	7 (15.9)
Part-time athletics	95 (28.2)	33 (35.1)	22 (28.2)	29 (24.0)	11 (25.0)
Full-time student health	68 (20.2)	11 (11.7)	21 (26.9)	22 (18.2)	14 (31.8)
Part-time student health	40 (11.9)	7 (7.4)	11 (14.1)	15 (12.4)	7 (15.9)
Off-campus or private practice	60 (17.8)	9 (9.6)	14 (17.9)	32 (26.4)	5 (11.4)

Abbreviation: NA, not applicable.

[a] Indicates that values are reported in sample sizes and percentages and are rounded.

Table 2. Distribution of Personal Nutrition Resources Used and Nutrition Resources Recommended for Athletes by Athletes, Coaches, Athletic Trainers, and Strength and Conditioning Specialists[a]

	Personal Nutrition Resources Used		Resources Recommended for Athletes	
Group	Resource	n (%)	Resource	n (%)
Athletes				
	Strength and conditioning specialist	90 (16.2)	Strength and conditioning specialist	95 (17.1)
	Athletic trainer	63 (11.4)	Athletic trainer	77 (13.9)
	Coach	43 (7.7)	Registered dietitian	75 (13.5)
Coaches				
	Athletic trainer	65 (16.5)	Registered dietitian	85 (21.6)
	Registered dietitian	50 (12.7)	Athletic trainer	64 (16.3)
	Strength and conditioning specialist	35 (8.9)	Strength and conditioning specialist	32 (8.1)
Athletic trainers				
	Academic journal	116 (20.1)	Registered dietitian	147 (25.5)
	Registered dietitian	108 (18.8)	Athletic trainer	112 (19.4)
	Physician	42 (7.3)	Physician	53 (9.2)
Strength and conditioning specialists				
	Academic journal	41 (19.2)	Registered dietitian	47 (22.1)
	Registered dietitian	35 (16.4)	Strength and conditioning specialist	42 (19.7)
	Strength and conditioning specialist	21 (9.9)	College nutrition course	16 (7.5)

[a] Given the large amount of data, sample size and percentage values represent the combined first and second choices for associated forced ranked responses; therefore, not all data are presented.

indicated that 50.1% (n=169) of athletic departments had a full-time (21.9%, n=74) or part-time (28.2%, n=95) RD designated for athletes. The other 49.9% (n=168) had access to an RD from either the student health center or a private practice off campus. Athletes, coaches, ATs, and SCSs have busy schedules; therefore, an expert in nutrition (eg, an RD, if available) needs to develop a working relationship with the athletic staff and provide education and counseling about food and nutrition.[11]

Nutrition Resources

Often, athletes have misinformed beliefs about their nutritional needs and are exposed to nutrition information from

Table 3. Understanding of Athletes' Nutritional Needs, Importance of Adherence to a Healthful Diet, and Quality of Eating Habits for All Participants, Athletes, Coaches, Athletic Trainers, and Strength and Conditioning Specialists (Mean ± SD)[a]

	All	Athletes	Coaches	Athletic Trainers	Strength and Conditioning Specialists	$F_{3,575}$	*P* Value
Understanding of athletes' nutritional needs[b]	6.6 ± 1.9	6.3 ± 1.9	6.2 ± 2.0	6.9 ± 1.6	7.5 ± 1.5	11.3	<.001
Importance of athletes' adherence to a healthful diet[c]	8.9 ± 1.5	8.63 ± 1.6	9.1 ± 1.4	8.9 ± 1.3	9.2 ± 1.7	3.9	.01
Quality of eating habits[d]	6.5 ± 1.8	6.2 ± 1.8	6.6 ± 1.9	6.4 ± 1.6	7.6 ± 1.6	9.5	<.001

[a] Indicates that scores were based on a Likert scale, with anchors of 1 (*not at all*) and 10 (*extremely well*).
[b] Indicates that Tukey post hoc assessment revealed differences between coaches and athletic trainers and between coaches and strength and conditioning specialists ($P \leq .01$).
[c] Indicates that Tukey post hoc assessment revealed differences between athletes and coaches and between athletes and strength and conditioning specialists ($P \leq .01$).
[d] Indicates that Tukey post hoc assessment revealed differences between strength and conditioning specialists and coaches, athletic trainers, and athletes ($P \leq .01$).

Table 4. Distribution of Adequate and Inadequate Nutrition Knowledge for All Participants and Within Each Group for Athletes, Coaches, Athletic Trainers, and Strength and Conditioning Specialists[a]

	Adequate Nutrition Knowledge, n (%)	Inadequate Nutrition Knowledge, n (%)	χ^2	*P* Value
All	261 (45.1)	318 (55.9)	192.1	<.001
Athletes[b]	16 (9.0)	161 (91.0)		
Coaches	47 (35.9)	84 (64.1)		
Athletic trainers	137 (71.4)	55 (28.6)		
Strength and conditioning specialists	59 (83.1)	12 (16.9)		

[a] Indicates that values are presented in sample sizes and percentages.
[b] Indicates that 8 athletes did not answer the questions.

multiple professional resources (coaches, ATs, SCSs, RDs). In our study, the top choice of coaches, ATs, and SCSs was an RD, whereas previous researchers have found health books[12] and ATs to be the primary resources for coaches and academic journals for ATs.[4] Athletes' primary nutrition resources were ATs and SCSs, which is consistent with the findings of Jacobson et al[2] and Burns et al[11]; however, their top choices did not include RDs. These findings are consistent with our results that athletes felt most comfortable seeking nutrition advice from ATs and SCSs. This might be due to the relationships developed through everyday contact and the responsibilities these people have for the athlete's overall well-being. In contrast, Shifflett et al[4] found that the primary choice for nutrition information for many athletes was their parents. Although we did not find that athletes selected parents as their primary choice, many athletes (22.2%, n = 41; data not shown) felt very comfortable seeking nutrition advice from their parents. No researchers have examined nutrition resources specifically for SCSs.

Participants ranked the top 3 nutrition resources they would recommend for their athletes. Interestingly, the recommendations of coaches, ATs, and SCSs for athletes were slightly different from their own nutrition resources. The ATs and SCSs both used reliable nutrition resources, such as RDs, academic journals, college nutrition courses, and physicians. They might have consulted these resources for personal knowledge while seeking advice for their athletes. Our participants reported understanding the importance of proper nutrition for athletes, and most had an average understanding of athletes' nutritional needs and the quality of their personal eating habits. Although those working with athletes need to understand the importance of adhering to a healthful diet, modeling healthful eating behaviors is also important and can positively affect athletes.

Nutrition Knowledge

Overall, participants had just below-average nutrition knowledge for all domains. The ATs and SCSs had the highest nutrition scores, suggesting that they have enough nutrition knowledge to disseminate appropriate information to athletes. However, 28.6% of ATs had inadequate nutrition knowledge, compared with only 16.9% of SCSs. Possible reasons for lower scores could include ATs not completing the newer curriculum competencies for nutrition and ATs needing to use continuing education to enhance their nutrition knowledge. The findings regarding the overall nutrition knowledge of ATs are similar to those of previous investigations.[4,13,19] Our results demonstrated no difference between ATs and SCSs, suggesting comparable nutrition knowledge. Both coaches and athletes had lower average scores than the ATs and SCSs, showing continuity with previous research.[3,4,12,13,17] No researchers have examined SCSs as a single group.

Micronutrients and Macronutrients. This section had the lowest average score for all participants. The ATs and SCSs had the highest average scores and were the most confident in their correct answers. Questions about micronutrients and macronutrients might have been different from those in previous studies, but ATs' knowledge in this domain has increased compared with previously reported findings.[13] Although ATs scored high,

Table 5. Nutrition Knowledge Scores Presented by Percentages and by Domains and Mean Confidence Scores (Likert Scale, 1–4) Among All Participants, Athletes, Coaches, Athletic Trainers, and Strength and Conditioning Specialists (Mean ± SD)[a]

	All	Athletes[b]	Coaches[c]	Athletic Trainers[d]	Strength and Conditioning Specialists[c]	$F_{3,570}$	*P* Value
All questions						135.8	<.001
Knowledge score, %	68.5 ± 16.1	54.9 ± 13.5	65.9 ± 14.3	77.8 ± 10.3	81.6 ± 10.3		
Confidence score for correct answers	3.2 ± 0.23	2.8 ± 0.34	3.0 ± 0.27	3.4 ± 0.20	3.5 ± 0.26		
Confidence score for incorrect answers	2.6 ± 0.25	2.4 ± 0.37	2.4 ± 0.34	2.9 ± 0.38	2.9 ± 0.38		
Micronutrients and macronutrients						39.3	<.001
Knowledge score, %	62.6 ± 22.3	51.8 ± 20.5	58.0 ± 19.4	70.7 ± 20.9	76.1 ± 20.2		
Confidence score for correct answers	3.3 ± 0.27	3.0 ± 0.45	3.1 ± 0.35	3.4 ± 0.18	3.5 ± 0.32		
Confidence score for incorrect answers	2.7 ± 0.25	2.6 ± 0.39	2.6 ± 0.44	2.9 ± 0.33	2.3 ± 0.50		
Supplements and performance						45.4	<.001
Knowledge score, %	78.7 ± 20.1	66.3 ± 19.9	79.9 ± 18.9	85.0 ± 17.1	90.4 ± 13.9		
Confidence score for correct answers	3.2 ± 0.05	2.8 ± 0.23	3.1 ± 0.10	3.3 ± 0.09	3.5 ± 0.14		
Confidence score for incorrect answers	2.4 ± 0.28	2.2 ± 0.44	2.2 ± 0.28	2.7 ± 0.41	2.8 ± 0.26		
Weight management and eating disorders						88.7	<.001
Knowledge score, %	64.8 ± 23.2	47.0 ± 21.9	63.8 ± 20.9	76.2 ± 15.9	80.3 ± 16.4		
Confidence score for correct answers	3.3 ± 0.28	2.8 ± 0.34	3.1 ± 0.39	3.6 ± 0.17	3.7 ± 0.21		
Confidence score for incorrect answers	2.7 ± 0.27	2.5 ± 0.36	2.6 ± 0.22	3.3 ± 0.38	3.1 ± 0.48		
Hydration						54.6	<.001
Knowledge score, %	67.7 ± 23.5	54.7 ± 24.2	61.9 ± 22.4	79.4 ± 17.2	79.4 ± 16.2		
Confidence score for correct answers	3.1 ± 0.34	2.7 ± 0.33	2.7 ± 0.22	3.4 ± 0.36	3.4 ± 0.35		
Confidence score for incorrect answers	2.5 ± 0.18	2.3 ± 0.27	2.3 ± 0.43	3.0 ± 0.42	3.2 ± 0.28		

[a] *Confidence score* is the confidence level determined by respondents' actual correct or incorrect answer.
[b] Indicates that Tukey post hoc assessment revealed differences between athletes and athletic trainers ($P < .05$) and between strength and conditioning specialists and all groups ($P < .05$).
[c] Indicates that Tukey post hoc assessment revealed differences between coaches and athletic trainers ($P < .05$) and between strength and conditioning specialists and all groups ($P < .05$).
[d] Indicates no differences in all categories for athletic trainers and strength and conditioning specialists ($P > .05$).

they had higher-than-normal confidence in incorrect answers, suggesting that incorrect information might be disseminated to athletes. Although coaches and athletes were confident in their correct answers, they reported the lowest scores, which was consistent with the findings of Corley et al[12] and Smith-Rockwell et al.[13]

Supplements and Performance. This section had the highest average scores for all participants, which is consistent with the findings of previous studies[13]; however, comparisons should be made with caution because of possible differences in survey questions. Whereas coaches, ATs, and SCSs reported above-average knowledge in this category, athletes remained at the bottom. Athletes must understand supplements and performance so they can avoid taking supplements that are detrimental to their health and impermissible when participating in NCAA sports. All groups were confident in their correct answers; however, SCSs reported higher confidence in incorrect answers than any other group.

Weight Management and Eating Disorders. This category had the second lowest average score for all participants. The ATs and SCSs had the highest scores, with athletes having lower scores than all other groups. All participants had high confidence in correct answers, but the ATs and SCSs were equally confident in incorrect answers, which is disconcerting. This suggests that people who usually are believed to be the most reliable resources for weight gain and loss information and eating disorders might be overly confident in their advice, although it might be inaccurate.

Hydration. The ATs and SCSs had both the highest average scores and the most confidence in both correct and incorrect responses, suggesting that further nutrition research for these people might be warranted. Athletes and coaches were in the middle regarding confidence in correct answers and were unsure of incorrect responses, suggesting that they should seek assistance from resources other than themselves when inquiring about sports nutrition. Although the mean scores for ATs and SCSs were above average for nutrition knowledge, seeking help from RDs and sports dietitians still might be beneficial for them because it is outside their scope of practice to prescribe or develop nutrition plans.

Limitations

One limitation of our study was that the survey was sent via e-mail, and the participant was directed to an online survey. Participants might not have received the e-mail because it might have been filtered into junk or spam folders. In addition, the NATA sent only 1 e-mail to ATs; therefore, a follow-up was not conducted. Although many of the coaches completed the survey, many chose not to include their athletes, so recruiting athletes was difficult. Dispersion of participants among NCAA Division I, II, and III institutions was low, prohibiting comparison between divisions. In addition, the survey was anonymous, and we could not establish links to participants within the same institution. This would have allowed us to identify mutual staffing and access to sports medicine services. Lastly, the survey included only 20 questions, but each question required a confidence interval selection, increasing the length of time to complete the survey.

CONCLUSIONS

Athletes often work with ATs and SCSs rather than RDs; therefore, proper nutrition education among the athletic staff is critical. Overall, we demonstrated that ATs and SCSs have adequate sports nutrition knowledge; however, some of them were overly confident in their incorrect answers. The ATs and SCSs should be cautious when disseminating nutrition advice to athletes. When situations arise beyond the ATs' or SCSs' scope of practice, referral to an RD or expert in the field is imperative and professionally beneficial. Furthermore, adequate sports nutrition knowledge can improve an AT's standard of care (eg, injury prevention, rehabilitation), yet approximately one-third of ATs reported inadequate sports nutrition knowledge. This might be due to the magnitude of additional responsibilities (eg, clinical evaluation and diagnosis, immediate care, treatment, rehabilitation and reconditioning of athletes, and organization and administration). On the other hand, SCSs might focus more on specific performance enhancement, body composition assessment, and team or individual training on a daily basis with no medical responsibilities. Finally, we suggest that nutrition programming should be integrated for both ATs and SCSs during their collegiate and continuing education. This integrative approach improves the continuity of care because both categories of professionals might be developing and integrating preventive or rehabilitative programs for athletes.

Athletes and coaches were represented from a wide variety of sports, thus eliminating any assumptions that responses from athletes and coaches would be from those sports more likely to have an interest in nutrition or rely heavily on nutrition for performance (eg, sports that rely on high-intensity training, such as football, wrestling, or track and field, or aesthetic sports, such as gymnastics, cross-country, or dance). Coaches and athletes are using more reliable resources for nutrition information, yet their nutrition knowledge is still lacking. More importantly, athletes in our study revealed that they understood the importance of adhering to a healthful diet and fairly well understood the value of an athlete's nutritional needs, but as a group, they had the poorest overall scores. Because athletes and coaches both reported frequently obtaining nutrition information from ATs and SCSs, we suggest that nutrition education programs include athletes and coaches. Ideally, these educational programs would be instructed by qualified nutrition educators (eg, nutritionists, RDs). Future research should include (1) examining nutrition knowledge differences between NCAA Division I, II, and III institutions; (2) examining the sports nutrition knowledge of athletes, coaches, ATs, and SCSs who have access to full-time RDs and comparing it with the knowledge of those who do not have this access; and (3) examining sports nutrition knowledge for specific or categorized sports (eg, power sports, aesthetic sports).

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Address correspondence to Toni M. Torres-McGehee, PhD, ATC, University of South Carolina, Blatt PE Center 218, Columbia, SC 29208. Address e-mail to torresmc@mailbox.sc.edu.