The Effectiveness of Nutrition Education Interventions on Nutrition Knowledge and Dietary Behaviors of Division I Collegiate Athletes: A Review

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ABSTRACT

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Nutrition is crucial for optimal athletic performance, while poor nutritional knowledge and inadequate nutrient intake can negatively impact a college athlete's success. Nutrition education is widely used across various population groups to disseminate nutrition and dietary information to enhance health and performance, suggesting a potential method for improving collegiate athletes' nutrition knowledge and dietary behaviors. The purpose of this review is to provide a summary of current-state studies on the effectiveness of nutrition education interventions within Division I collegiate athletes regarding nutrition knowledge and dietary behaviors. The review methods included electronic databases of PubMed, Science Direct, SPORTDiscus (EBSCOhost), and Google Scholar to search for studies that involved nutrition education interventions in Division I collegiate athletes published between 1990 and 2012. Studies were included if the: 1) participants were Division I collegiate athletes throughout the time of the study, 2) study was performed in the United States within a National Collegiate Athletic Association (NCAA) member school, 3) study implemented a nutrition education intervention, and 4) study collected pre- and post-test knowledge or dietary measures. Results indicated 14 studies of which 9 met inclusion criteria with a total of 308 participants, mostly female. There were 3 major forms of nutrition education interventions: informational handouts, individualized counseling sessions and classroom lectures. All studies used pre- and post-test questionnaires for nutrition knowledge measures. Dietary intake was collected using 3-day food records or dietary habit questionnaires. The outcome measures varied among the studies, with indicators such as knowledge, attitudes, self-efficacy, and dietary habits. Variations and inconsistencies across studies were identified. In conclusion, this review suggests that nutrition education interventions significantly increase nutrition knowledge of Division I collegiate athletes; however, interventions were inconsistent in improving dietary habits. Further research is required to evaluate nutrition education interventions that incorporate methods found to affect behavioral outcomes. The highlighted methodological issues should be considered to improve the dissemination of nutrition education to impact athletes' eating behaviors of future studies in this emerging field of research.

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INTRODUCTION

Physical activity, athletic performance, and recovery from exercise are enhanced by optimal nutrition; energy and macronutrient needs must be met in order to maintain body weight, replenish glycogen stores, provide adequate protein for building and repair of tissue, maintain blood glucose during exercise, maintain immune and reproductive function, maximize training and performance, and maintain overall health (25). Research supports nutrition's vital role in athletic success, yet collegiate athletes are vulnerable to nutritional risks, such as suboptimal energy intake, due to the rigorous demands of their sport (28). Competitive athletes, specifically at the Division I level, have increased energy and nutrient needs required by their intense training and competition performance regimes (see Table 1) (25). The preferred method for calculating an athlete's individual nutrient needs is based upon grams per kilogram body weight per day and recommendations are also based upon the type of exercise performed, considering intensity, frequency, and duration of activity (25). Inadequate dietary intake result in unfavorable effects on athletic potential, including loss of muscle mass, loss of strength and endurance, loss or failure to gain bone density, menstrual dysfunction, compromised performance, and increased risk of fatigue, injury, and illness (25).

	Collegiate athlete	**Normally active person**
Energy	Up to 50 kcal/kg BW	37-41 kcal/kg BW
Carbohydrates	6-10 g/kg BW	5-7 g/kg BW
Fat	20-35% of calories	
Protein	1.2-1.7 g/kg BW	0.8 g/kg BW

Table 1: Comparison of nutrient needs for a collegiate athlete versus a normally active person

Despite evidence of the beneficial effects of nutrition on athletic performance, research suggests a large percentage of collegiate athletes still consume diets that do not meet their nutrient needs (15). There

are several potential factors that may explain inadequate dietary intakes among this population, including increased pressure to win in competitive sports, athletes' demanding schedules, the nature of the college environment, and nutrition knowledge. Research has shown that collegiate athletes tend to skip meals, frequently consume fast food, and participate in unhealthy dieting practices (26). Realities of the college lifestyle to manage time efficiently and support basic health needs place this population at risk for undernutrition and fatigue. Additionally, dietary intake may be impacted by nutrition knowledge; it has been well-documented within the literature that collegiate athletes lack basic nutrition knowledge (2, 10, 17, 28). Nutrition knowledge may affect food choices; if an athlete is unaware of which food choices and behaviors are healthy versus hazardous, he may be unknowingly hindering his performance. Athletes with higher levels of nutrition knowledge make better food choices, resulting in better health, well-being, and athletic performance (26); therefore, the prevalence of insubstantial dietary intake among collegiate athletes may be attributed to the lack of knowledge this population possesses.

Common nutrition misconceptions among collegiate athletes pertain to protein; the recommended amount and the body's utilization of the macronutrient are both widely misunderstood (18, 28). Jacobson (1992) found that 51% of Division I collegiate athletes believed protein was the main source of immediate energy during activity. Nearly 80% of the participants thought protein intake should account for 40% or more of total calorie intake and almost 75% of the respondents thought athletes could not obtain protein recommendations through diet alone and required protein supplements to meet their protein needs. Further, the same study found only 1.1% of collegiate athletes surveyed chose the correct percentage of protein from total calories, 2.9% chose the correct percentage of fat, and 5.1% chose the correct percentage of carbohydrates (16). Additionally, a study assessing knowledge and behaviors regarding hydration and fluid intake of 139 collegiate athletes found that one-third (33.1%) of the participants did not correctly answer 80% or more of the survey's knowledge questions (23). Since many collegiate athletes lack nutrition knowledge and misunderstand nutrition-related concepts they may fail to consume adequate levels of nutrients for support of optimal performance and health (15, 18, 28).

Nutrition education provides accurate nutrition information to a wide range of population groups; specifically, in competitive athletics, Sports Dietitians are the most credible sources for athletes to rely on for safe, effective, evidence-based nutrition information for athletic performance (25). However, very few resources exist to promote nutritional well-being among collegiate athletes. The National Collegiate Athletic Association (NCAA) governs 340 Division I member schools and, currently, only 35 of those programs staff full-time RDs within the athletic department (20). College athletes who have nutrition concerns often look to coaches, athletic trainers, strength and conditioning staff, or peers for advice and, thus, are at risk for receiving misinformation (19, 26). The lack of qualified RDs accessible to Division I collegiate athletes as reliable resources as well as the risk of receiving misinformation presents a lush area for research; however, nutrition education interventions have not been extensively studied in this population. Based on existing literature, the need for and lack of nutrition education has been well established, and although the NCAA recognizes that adequate nutrition is crucial for achieving peak performance and overall health, a comprehensive program does not exist (20). Proper athletic training coupled with sound dietary practices can assist athletes in maximizing both health and performance (26). The purpose of this review is to describe the effectiveness of current nutrition education interventions in the literature on nutrition knowledge and dietary behaviors of Division I athletes. This article presents evidence of the discrepancies within current published studies by describing study methods that may be influential in future study designs for effective nutrition education interventions.

METHODS

Articles were identified through relevant databases (i.e. Google Scholar, PubMed, Science Direct, Academic Search Complete, Medline and SPORTDiscus [EBSCO*host*]) from 1990 until 2012 using the following keywords: Division I athletes, nutrition knowledge, nutrition education intervention, dietary behaviors, and sports nutrition.

The keyword-based strategy generated 14 articles that included nutrition education interventions in collegiate athletes, but only 9 met the specified inclusion criteria: 1) participants were Division I collegiate athletes throughout the time of the study, 2) study was performed in the United States within an NCAA member school, 3) study implemented a nutrition education intervention, and 4) study collected pre- and post-test knowledge or dietary measures. A large number of articles that observe nutrition knowledge and dietary behaviors in collegiate athletes with no intervention were found but, were excluded in this review. Review articles were also excluded. Due to the lack of extensive peer-reviewed research findings within this specific population, abstracts, theses, and dissertations were included. Studies that were included were subsequently compared based on the sample size, experimental design, length of study, year of publication, type of nutrition intervention, and outcome measures (summarized in Figure 1).

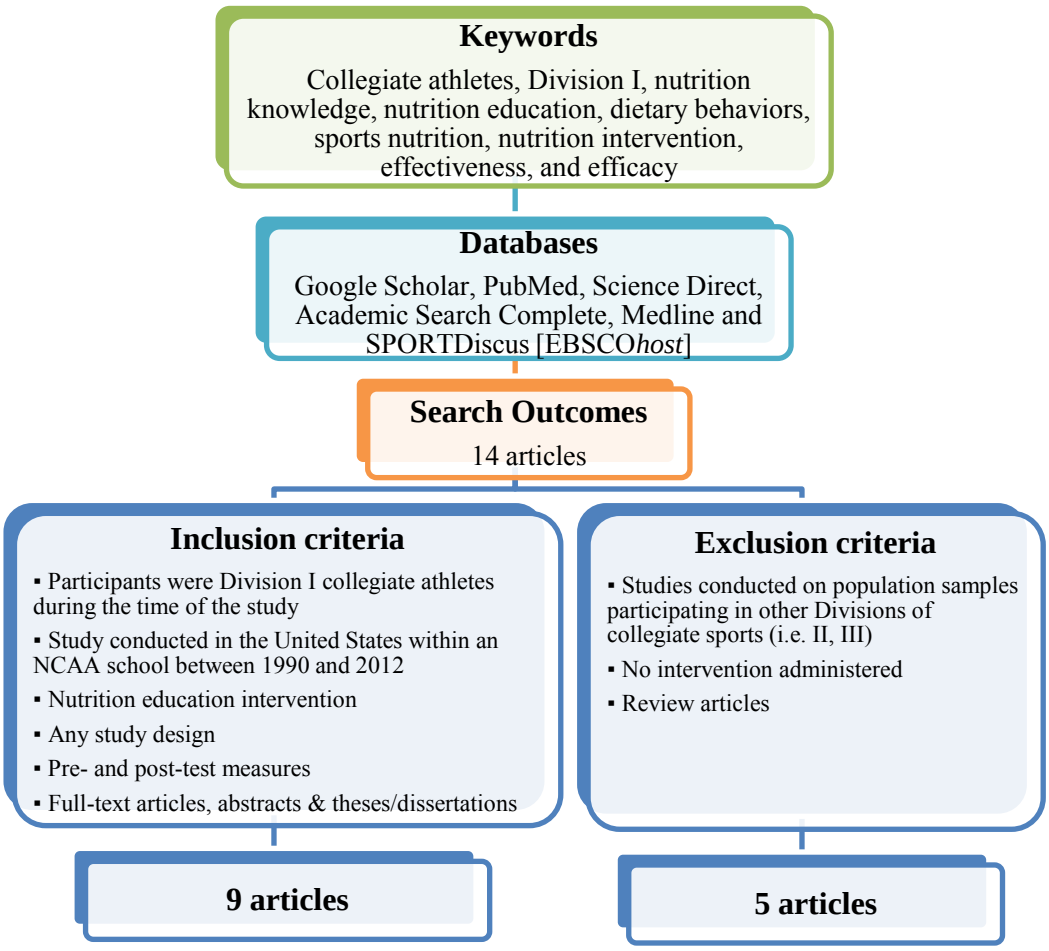

Figure 1: The process of article selection

RESULTS

The 9 studies included a total of 308 participants (Table 2). Seven of the studies included female athletes only, while one study did not specify gender differences of its participants (4); therefore, the number of female collegiate athletes known (n=246) was significantly larger than male (n=6). The objective within these studies was consistent to increase athletes' nutrition knowledge to improve dietary behaviors for support of optimal health and performance.

As outlined in Table 2, only three studies were experimental containing a control group with the six remaining studies' as pre-experimental not including a control group. Sample sizes varied across the studies, ranging from 11 to 70 participating athletes. Questionnaire tools varied to assess pre- and post-test measures between studies with six out of the nine reporting questionnaire validity. The overall duration of the studies ranged from 2 weeks to 1 year. The type of athletic teams included in the studies was of broad scope: only one study targeted a single team, volleyball (29); 2 studies included two teams, swimming and volleyball (22), and swimming and soccer (2); 2 studies encompassed three sports, volleyball, soccer, and basketball (6), and volleyball, field hockey, and tennis (9); one study contained 7 sports teams, diving, cross-country, track, swimming, softball, basketball, and volleyball (1); one study included 8 teams, baseball, cross-country, equestrian, soccer, softball, tennis, track & field, and wrestling (5); lastly, two studies did not specify what sport athlete participants were affiliated with (4, 21).

Intervention strategies differed among studies with the delivery mode, in three studies as individualized counseling sessions, one study provided informational newsletter handouts, and the rest of the studies used educational classroom lectures. The educational lectures differed as well with some using traditional lectures only, while others used educational workshops with hands-on activities combined with lecture. Also as expected, the educational content and specific nutrition topics varied across studies. Only 2 studies stated the use of a theory-based intervention, both being Social Cognitive Theory (SCT).

To assess nutrition knowledge at pre- and post-intervention, an assortment of questionnaire tools was used throughout the studies with a range in possible total score. All data was self-reported and, with analysis generally presented as the mean test score± standard deviation. Seven studies assessed nutrition knowledge and post-test results suggested significant increases for nutrition knowledge across all seven studies. Two of these studies targeted nutrition education for the prevention of eating disorders within collegiate athletes. Six studies assessed dietary behavior change pre- and post-intervention with four studies using 3-day food records and two studies using dietary habit questionnaires. Data showed differing results regarding the effects of nutrition education on dietary behaviors. Four studies suggested improved dietary behaviors while two found no significant impact on dietary behaviors. Of the four studies suggesting positive behavior change, only two gave a p-value for a significance level. Only one study saw significant improvements in total energy ($P < .05$) and specific nutrient intake ($P < .01$) based on post-test dietary records (29). A separate study's results suggested a significant ($P = .03$) overall difference in the number of positive dietary changes favoring the experimental group but found no significant difference in energy or specific nutrient intake based on post-test dietary records (2). All studies had self-reported data which could result with possible limitations as self-report bias.

<table>
<tr><td colspan="4">1. Baer et al., 1995 (4)</td></tr>
<tr><th>Design</th><th>Intervention</th><th>Result/Conclusion(s)</th><th>Comments</th></tr>
<tr><td>Uncontrolled
Sample
n=12, athletes at risk for disordered eating
Duration
One year</td><td>▪ Targeted eating disorder prevention
▪ Comprised disordered eating response team, including a RD
▪ Participants attended individual sessions with RD, once per week
▪ Outcome measures included nutrition knowledge and dietary behaviors</td><td>▪ Improved knowledge of nutrition among athletes to support health and performance
▪ Improved dietary behaviors following nutrition education</td><td>▪ No p-value given
▪ Small sample size</td></tr>
<tr><td colspan="4">2. Collison et al., 1996 (9)</td></tr>
<tr><th>Design</th><th>Intervention</th><th>Result/Conclusion(s)</th><th>Comments</th></tr>
<tr><td>Uncontrolled
Sample</td><td>▪ Two classroom workshops, 1 week apart
▪ Program content was based upon pre-test results</td><td>▪ Significant increase in athletes' scores for knowledge and attitude</td><td>▪ Limited intervention exposure
▪ Several presentation</td></tr>
</table>

Forty one subjects: athletes (n=28) and non-athletes (n=32) **Duration** 2 sessions, one week apart	▪ Compared outcome measures between athletes vs. non-athletes, with no control ▪ Used 3-day diet records to assess dietary behavior change ▪ Outcome measures included nutrition knowledge and dietary behavior change	(P < .0005) ▪ No significant impact on dietary practices	times were available for each workshop
3. Chieppa, 2000 (6)			
Design	**Intervention**	**Result/Conclusion(s)**	**Comments**
Uncontrolled **Sample** Female athletes, n=43, including 5 different sports teams **Duration** ~3 months	▪ Informational newsletters handed out once a month when the participants were at a scheduled practice ▪ A total of 3 newsletters were distributed ▪ Outcome measures included nutrition knowledge only	▪ Significant increase in nutrition knowledge (p < .005).	▪ Unpublished thesis ▪ Information pertained to questions asked in the survey, which may present bias ▪ Newsletters given to participants at an inconvenient time
4. Murphy et al., 2001 (22)			
Design	**Intervention**	**Result/Conclusion(s)**	**Comments**
Uncontrolled **Sample** Total of 18 female athletes; swimming (n=11) and volleyball (n=7) **Duration** Two-30 minute sessions, one week apart	▪ Two 30-minute sessions, 1 week apart ▪ Focused on group education via classroom lecture ▪ Used dietary habit questionnaire to assess dietary behavior change ▪ Outcome measures included dietary behavior change only	▪ Dietary habits can be impacted through group nutrition education	▪ Abstract only ▪ Small sample size ▪ Limited intervention exposure ▪ No p-value
5. Kunkel et al., 2001 (21)			
Design	**Intervention**	**Result/Conclusion(s)**	**Comments**
Uncontrolled **Sample** Female athletes, n=32 **Duration**	▪ Participants attended individual or small group (<4 individuals) meetings with a peer educator, once per week ▪ Peer educators taught basic nutrition and encouraged positive dietary behaviors ▪ Peer educators were dietetic students, at least junior status ▪ Outcome measures included nutrition knowledge only	▪ Peer nutrition education significantly increased participants' nutrition knowledge and attitudes (p ≤ .05).	▪ Study does not specify duration of intervention or when post-test data was collected

Not specified			
6. Wenzel et al., 2012 (29)			
Design	**Intervention**	**Result/Conclusion(s)**	**Comments**
Uncontrolled **Sample** Women's volleyball team, n=11 **Duration** 4 months, January to April	▪ Participants attended 4 individualized counseling sessions with a RD, 1 per month ▪ Used 3-day diet records to assess dietary behavior change ▪ Each athlete submitted 1 diet record at each session, total of 4 records ▪ Outcome measures included dietary behavior change only	▪ Energy intake as a percent of needs significantly improved ($P < .05$) ▪ Mean carbohydrate intake ($P < .01$) and mean protein intake ($P < .05$) significantly increased, approaching estimate goals	▪ Small sample size ▪ Limited intervention exposure
7. Abood et al., 2004 (2)			
Design	**Intervention**	**Result/Conclusion(s)**	**Comments**
Experimental **Sample** Women's soccer team, n=15 (EG) and a women's swim team, n=15 (CG). **Duration** 8 weeks	▪ Experiment group (EG) attended 1 hour classroom lectures, total of 8 lectures ▪ Control group (CG) received no treatment and attended supervised study hall at the same time of EG's lectures ▪ Used 3-day diet records to assess dietary behavior change ▪ Outcome measures included nutrition knowledge and dietary behavior change	▪ EG experienced significantly improved nutrition knowledge, self-efficacy ($P < .05$), and the overall number of positive dietary changes ($P < .03$).	▪ Intervention favored EG ▪ Used true-false questionnaires, which may not represent accurate knowledge values
8. Abood et al., 2000 (1)			
Design	**Intervention**	**Result/Conclusion(s)**	**Comments**
RCT **Sample** Female athletes, n=70, 10 athletes from 7 different sports teams; EG (n=35), CG (n=35) **Duration** 8 weeks	▪ Experiment group (EG) attended 1 one-hour session per week, total of 8 sessions ▪ Control group (CG) received no treatment and attended regularly scheduled study hall at the same time as the intervention ▪ Focused on eating disorder prevention ▪ Outcome measures included nutrition knowledge only	▪ EG nutrition knowledge increased, compared to CG ($p < .05$).	▪ Intervention favored EG
9. Brown, 2009 (5)			
Design	**Intervention**	**Result/Conclusion(s)**	**Comments**
RCT **Sample**	▪ Experiment group (EG) attended 5 one-hour sessions, 1 per week ▪ Control group (CG) received no treatment	▪ EG significantly improved nutrition knowledge ($p=0.0008$),	▪ Intervention favored EG ▪ More than half of

Total of 32 athletes: females, n=26 and males, n=6; included 8 different teams **Duration** 5 weeks	▪ Sessions consisted on lecture, group activities, food demonstration, reward activities, and case studies ▪ Used 3-day diet records to assess dietary behavior change ▪ Outcome measures included nutrition knowledge and dietary behavior change	compared to CG ▪ No significant difference was seen in dietary intakes of participants	participants were female (81%), which may present bias ▪ Unpublished thesis

Table 2: Studies using nutrition education interventions for Division I collegiate athletes

DISCUSSION

This review compiles evidence of the effectiveness of nutrition education interventions used for NCAA Division I collegiate athletes. Sample participants including sample size, gender and sport, methodology variances, related outcomes, and suggestions for future research are highlighted in this discussion.

Since the sample across all studies predominantly included only female athletes, the overall sample composition lacks ability to generalize across all collegiate athletes of gender. This higher rate of female participation may be related to the increase in the number of female collegiate athletes observed over the past decade (9). As the number of female collegiate athletes rises, the nutrient needs and factors influencing dietary intake within this population become important to study. Additionally, the use of various sub-populations of sports teams in studies also lacks ability to generalize across all collegiate athletes. When multiple sport teams are used in studies, it decreases means to target sport-specific athletes in relation to knowledge and/or dietary behaviors and cannot yield valid conclusions regarding the overall population. The use of one sports team across many Division I schools may unveil specific nutrition-related needs for athletes based upon their sport.

Addressing discrepancies in methodology is found in Table 2. The common usage of quasi-experimental design brings with it the lack of randomization making it complicated to rule out confounding variables and, therefore, threatening internal validity. In addition, it is difficult to determine

conclusions of causal relationships. The majority of the studies (6 out of 9) include uncontrolled trials lending to intrinsically weak evaluative designs, as sudden changes make it difficult to attribute observed changes to the intervention (13). In general, uncontrolled pre- and post-test studies should not be used to evaluate the effects of guideline implementation strategies, and the results of studies using such designs have to be interpreted with great caution (13). Small sample size in several studies with as few as 11 participants contributes to less powerful statistical techniques used to analyze data. Thus, study samples are not likely to represent more general populations. In this population, large n's are hard to acquire because Division I athletes cannot be incentivized for participating, based on NCAA regulations. Additionally, a range of questionnaire tools were used across studies, while validity was not widely reported. Validity is necessary for determining the effectiveness of an intervention.

Results showed that nutrition education is significantly beneficial in improving nutrition knowledge in Division I collegiate athletes. Peer nutrition education, individualized counseling sessions, and educational classroom lectures have shown to be effective intervention methods. Therefore, nutrition education may be presented as a well-suited technique to improve collegiate athletes' nutrition knowledge. Conversely, studies presented inconsistent results as to whether nutrition education interventions significantly improve dietary behaviors. While two studies using interactive educational lectures found that participants failed to improve their dietary intakes even though they attended the nutrition education intervention (5, 9), one intervention consisting of educational lectures found that dietary habits can be positively impacted through nutrition education (22). After the intervention, one half of the athletes replaced "junk food" snacks with healthful foods, 56% of athletes increased fruit consumption, and 56% reported increased attention to proper nutrition intake for exercise rather than dieting to lose weight (22). A separate intervention using individualized counseling sessions provided by a RD saw significant increases in energy ($P < .05$), carbohydrate ($P < .01$), and protein intake ($P < .05$) (29). Although four studies saw improved dietary behaviors, two did not demonstrate p-values which lessens the strength of the evidence. Based upon current studies within collegiate athletes, nutrition

education interventions suggest being successful in increasing nutrition knowledge however, similar conclusions cannot be made for dietary behavior change. The relationship between knowledge and behavior is inconsistent and it is not clear whether nutrition knowledge is a good predictor of an individual's behavior (5). A study conducted by Rash et al. (2008) assessed collegiate track athletes' nutrition knowledge and dietary intakes and found that nutrition knowledge was not a primary factor impacting dietary behaviors. While acquiring nutrition knowledge is important, the ultimate goal of nutrition education is to improve dietary practices for lifelong success; currently, reliable suggestions for effective nutrition education strategies for improved dietary intakes in collegiate athletes cannot be made because of comprehensive inconclusive results. With varied outcomes across studies, preliminary evaluations of newly developed interventions need to be reported so future research may provide stronger outcomes.

Additionally, research should focus on the development of nutrition education tools, which are not only effective but also relevant and easily accessible for collegiate athletes. Future interventions should incorporate technological advances and social media networks as methods of distribution. Considering the finite amount of time in athletes' schedules, tailoring educational strategies to make information easily accessible and available during their free time with minimal personal contact may be beneficial. Collegiate athletes spend a large portion of their time traveling for competition; it may be advantageous if nutrition information was made available to athletes via mobile technologies during this time. For example, health-related behavior change interventions delivered by mobile telephone text-messaging have been studied and reviewed (8, 11) and have demonstrated positive results for diabetes management (12), weight loss (14, 24), and improved dietary intake (3). Mobile technologies with internet capability (e.g. iPhone, BlackBerry, iPod) could prove to be a useful channel for delivery of a nutrition education intervention to Division I athletes. Social media networks, such as Twitter, provide mediums to disseminate influential information and should be considered for future interventions. Additionally, the effectiveness of internet-based nutrition education programs has been demonstrated in

Division II collegiate athletes (19). Lastly, targeting freshmen or first-year students for nutrition education may be effective in future studies, as this population may still be adjusting to the college lifestyle and have not yet formed their own habits. The independence that comes with the college lifestyle gives individuals new experiences and allows them to grow into their own. Reaching out to these individuals at an early stage with nutrition education may help shape the way they think about nutrition, ultimately forming lifelong dietary habits.

CONCLUSIONS

Despite many differences among the existing studies, we found various nutrition education interventions to be significantly effective in increasing nutrition knowledge among Division I collegiate athletes. It appears that the most favorable interventions provided flexibility and convenience for participation around athletes' rigorous schedules. While studies suggest significant increases in nutrition knowledge from nutrition education interventions, there are still discrepancies present within the research regarding whether or not these interventions can significantly improve dietary behaviors of participants. As reliable nutrition resources, such as qualified RDs, remain limited among Division I athletes, we suggest that further research, including similar trials with improved methodology, is highly necessary.

APPLICATIONS IN SPORT

It has been well documented that nutrition can enhance athletic performance and recovery from exercise. Currently, funding for full-time dietetic positions in athletic departments remains sparse; therefore, science is needed to support the financial business model to place qualified RDs in the reach of Division I collegiate athletes.

REFERENCES

1. Abood, D. A., & Black, D. R. (2000). Health education prevention for eating disorders among college female athletes. *American Journal of Health Behavior, 24*(3), 209-219.
2. Abood, D. A., Black, D. R., & Birnbaum, R. D. (2004). Nutrition education intervention for college female athletes. *Journal of Nutrition Education & Behavior, 36*(3), 135-139.
3. Atienza, A. A., King, A. C., Oliveira, B. M., Ahn, D. K., & Gardner, C. D. (2008). Using hand-held computer technologies to improve dietary intake. *American Journal of Preventive Medicine, 34*(6), 514-518.
4. Baer, J. T., Walker, W. F., & Grossman, J. M. (1995). A disordered eating response team's effect on nutrition practices in college athletes. *Journal of Athletic Training, 30*(4), 315.
5. Brown, L. (2009). *The effects of a 5-week nutrition education intervention on collegiate athletes' knowledge and dietary intake.* (Unpublished MS). Oklahoma State University,
6. Chieppa, J. (2000). *The effectiveness of nutrition education on nutrition knowledge of female college athletes.* (Unpublished MS). West Virginia University,
7. Cole, C. R., Salvaterra, G. F., DAVIS JR, J. E., Borja, M. E., Powell, L. M., Dubbs, E. C., & Bordi, P. L. (2005). Evaluation of dietary practices of national collegiate athletic association division I football players. *The Journal of Strength & Conditioning Research, 19*(3), 490.
8. Cole-Lewis, H., & Kershaw, T. (2010). Text messaging as a tool for behavior change in disease prevention and management. *Epidemiologic Reviews, 32*(1), 56-69.
9. Collison, S. B., Kuczmarski, M. F., & Vickery, C. E. (1996). Impact of nutrition education on female athletes. *American Journal of Health Behavior, 20*(1), 14-23.
10. Dunn, D., Turner, L. W., & Denny, G. (2007). Nutrition knowledge and attitudes of college athletes. *Sport Journal, 10*(4), 45-52.
11. Fjeldsoe, B. S., Marshall, A. L., & Miller, Y. D. (2009). Behavior change interventions delivered by mobile telephone short-message service. *American Journal of Preventive Medicine, 36*(2), 165-173.
12. Franklin, V. L., Waller, A., Pagliari, C., & Greene, S. A. (2006). A randomized controlled trial of sweet talk, a text-messaging system to support young people with diabetes. *Diabetic Medicine, 23*(12), 1332-1338.
13. Grimshaw, J., Campbell, M., Eccles, M., & Steen, N. (2000). Experimental and quasi-experimental designs for evaluating guideline implementation strategies. *Family Practice, 17*, S11.
14. Haapala, I., Barengo, N. C., Biggs, S., Surakka, L., & Manninen, P. (2009). Weight loss by mobile phone: A 1-year effectiveness study. *Public Health Nutrition, 12*(12), 2382-2391.
15. Hinton, P. S., Sanford, T. C., Davidson, M. M., Yakushko, O. F., & Beck, N. C. (2004). Nutrient intakes and dietary behaviors of male and female collegiate athletes. *International Journal of Sport Nutrition & Exercise Metabolism,14*(4), 389-405.
16. Jacobson, B. H., & Gemmell, H. A. (1992). Nutrition information sources of college varsity athletes. *The Journal of Strength & Conditioning Research, 5*(4), 204.

17. Jacobson, B. H. (2001). Nutrition practices and knowledge of college varsity athletes: A follow-up. *Journal of Strength and Conditioning Research, 15*(1), 63.
18. Jonnalagadda, S. S. (2001). Dietary practices, attitudes, and physiological status of collegiate freshman football players. *Journal of Strength and Conditioning Research, 15*(4), 507.
19. Karpinski, C. (2011). *The impact of a 9-week interactive internet-based nutrition education program on nutrition knowledge, dietary behaviors and self-efficacy of collegiate athletes.* (Unpublished PhD). University of Medicine and Dentistry of New Jersey,
20. Karpinski, C. (2012). Exploring the feasibility of an academic course that provides nutrition education to collegiate student-athletes. *Journal of Nutrition Education & Behavior, 44*(3), 267-270.
21. Kunkel, M. E., Bell, L. B., & Luccia, B. H. D. (2001). Peer nutrition education program to improve nutrition knowledge of female collegiate athletes. *Journal of Nutrition Education, 33*(2), 114.
22. Murphy, M., Osborn, L., & Gorman, M. (2001). The effect of group nutrition education on the dietary habits of division I university female athletes [Abstract]. *Journal of the American Dietetic Association, 9*(101) A-85.
23. Nichols, P. E., Jonnalagadda, S. S., Rosenbloom, C. A., & Trinkaus, M. (2005). Knowledge, attitudes, and behaviors regarding hydration and fluid replacement of collegiate athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 15*(5), 515-527.
24. Patrick, K., Raab, F., Adams, M. A., Dillon, L., Zabinski, M., Rock, C. L., Norman, G. J. (2009). A text message–based intervention for weight loss: Randomized controlled trial. *Journal of Medical Internet Research, 11*(1)
25. Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. (2000). *Journal of the American Dietetic Association, 100*(12), 1543-1556.
26. Quatromoni, P. A. (2008). Clinical observations from nutrition services in college athletics. *Journal of the American Dietetic Association, 108*(4), 689-694.
27. Rash, C. L., Malinauskas, B. M., Duffrin, M. W., Barber-Heidal, K., & Overton, R. F. (2008). Nutrition-related knowledge, attitude, and dietary intake of college track athletes. *Sport Journal, 11*(1), 48-54.
28. Rosenbloom, C. A., Jonnalagadda, S. S., & Skinner, R. (2002). Nutrition knowledge of collegiate athletes in a division I national collegiate athletic association institution. *Journal of the American Dietetic Association, 102*(3), 418-420.
29. Wenzel, R., Kieckhaefer, Valliant, M., Wells, Chang, Y., Bomba, A., K., & Lambert, L., G. (2012). Dietary assessment and education improves body composition and diet in NCAA female volleyball players. *Topics in Clinical Nutrition, 27*(1), 67-73.