

Nutrition Knowledge of Division I Student-Athletes at a Private Four -Year Institution

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Citation: Colleran HL, Alghuraybi S, Fuller T, Roberta CS, Hall EE, et al. (2019) Nutrition Knowledge of Division I Student-Athletes at A Private Four - Year Institution, Archives | Food and Nutrition | ReDelve: RD-FNU-10002.

Received Date: 13 February 2019; **Acceptance Date:** 4 March 2019; **Published Date:** 5 March 2019

Abstract

Effective nutrition education can result in an increase in nutrition knowledge among college Student-Athletes (SA) who often lack adequate nutrition knowledge related to health. Thus, the purpose of this study was to assess SA nutrition knowledge in two cohorts with the first cohort assessment prior to hiring a part-time sports dietitian (RD) and the second cohort assessment four-years later. A validated Nutrition Knowledge Questionnaire (NKQ) was emailed to all registered SA (cohort 1=358; cohort 2=399) who were participating on 16 National Collegiate Athletic Association (NCAA) Division I teams. The part-time sports RD provided individual or small group counseling sessions and nutrition education. The NKQ section II- Sources of Foods/Nutrients was significantly different between the two cohorts, 38.3 ± 14.9 vs. 32.9 ± 14.1 , $p = 0.02$. On average, nutritional counseling was provided to 173 athletes and 10.5 teams out of the 16 teams that participated in team nutrition education over the four-year period. Despite nutrition education opportunities, there was no significant difference in results between the two cohorts. Overall, this study demonstrated a need for nutrition education and interventions among college athletes. Sports RDs are becoming valued designers of nutrition education programs that can enhance the sports nutrition knowledge as well as general nutrition knowledge of student-athletes. As a result, the future health and well-being of these student athletes will likewise be enhanced far beyond the time frame of college athletics.

Keywords: NCAA Student-Athlete; Nutrition Knowledge

Introduction

The role of nutrition in disease prevention, promotion of health and well-being and enhancement of athletic performance has become an emergent area of research. Genetic endowment, physical fitness, nutrition status, and sports-specific training can influence the performance of an athlete by the magnitude of milliseconds [1]. As more research on athletic performance emerges, there is an increase in support for the role that nutrition plays in

optimizing athletic performance and recovery as well as health [2]. In the joint position statement for Nutrition and Athletic Performance, sports performance may be enhanced with adequate nutrition intake including appropriate macronutrients and micronutrients, hydration and nutrient timing as well the role sports dietitians have in nutrition education for athletes [3].

College athletes often lack knowledge about nutrition about the importance of healthy dietary patterns for long-term well-being and successful athletic careers. Two systematic reviews found that nutrition knowledge among college athletes ranged from 43.8% to 81.8% for all genders [4,5]. It has even been even suggested that gender plays a role in nutrition knowledge [4]. However, in a recent review, Trakman et al. (2016) found no significant difference in nutrition knowledge between female (>60%) and male (>50%) athletes.

Nutrition education may play a role in improving nutrition knowledge and dietary choices. Three studies measured nutrition knowledge pre- and post- nutrition education interventions [5-8]. Two of the nutrition education studies were with NCAA Division I female college athletes [6,7], and one was with NCAA Division I male college athletes [8]. Despite the variations of the nutrition education delivery and time frame between the studies, nutrition knowledge increased. However, student athletes still lacked knowledge of general nutrition concepts.

Nutrition interventions can effectively change dietary habits among college students [9] and increase nutrition knowledge [4] for health beyond college athletics. Consequently, the purpose of this study was to assess the nutrition knowledge of two cohorts of Division I SA using the Nutrition Knowledge Questionnaire (NKQ). Nutrition education was provided during the timeframe between the two cohorts by a part-time board-certified sports dietitian.

Materials and Methods

A convenience sample was used to survey the nutrition knowledge of two cohorts of NCAA Division I student-athletes enrolled at a private four-year university in the southeastern United States. The first cohort was assessed in the fall of 2012 (n=358) prior to the hiring of a part-time (less than four hours per week) sports dietitian (RD). The second cohort was assessed in the spring of 2016 (n = 399) after the part-time sports RD had worked with the Division I teams for four academic years. The student-athlete population, who took the cohort 1 and cohort 2 surveys and participated in nutrition education, may not have been the same student-athletes due to transfers, retirement from sports and graduation. The timeframe of the study reflects nutrition knowledge prior to the student-athlete population having access to a part-time sports dietitian (less than 4 hours a week of contact time) and four years later. For the purposes of this study, an academic year was defined as starting at the beginning of the fall semester (August) and ending at the end of the spring semester (May).

The university in this study fielded 16 NCAA Division I teams (nine women's and seven men's teams) and a cheer/ dance squad during the 2012 to 2016 timeframe. Participation in the study was voluntary, and all participants were at least 18 years of age. Consent was obtained before answering survey questions, and the Institutional Review Board (IRB) at the university approved the study (cohort 1, IRB#: 2012 13-062 and cohort 2, IRB#: 2016 17-007).

Nutrition Knowledge

The Survey Monkey online tool was used to conduct an online survey. The survey was disseminated to enrolled student-athletes through email. A Nutrition and Knowledge Questionnaire (NKQ) was provided to each student-athlete who consented to participate [10]. The NKQ questionnaire contained 56 multiple-choice and ranking-type questions from

different subsections related to the nutrition concepts [10]. The questions in the NKQ questionnaire explored basic nutrition-related concepts from four broad categories: section I- Dietary Recommendations; section II- Sources of Foods/Nutrients; section III- Choosing Everyday Foods; and section IV- Perception of Diet-Disease Relationships. Some questions were also included to collect demographic information about student-athletes such as age, gender, marital status, and ethnicity. Each student-athlete was asked to answer all questions to the best of their ability and without guessing. All responses were anonymous.

The questionnaire was adopted from Parameter and Wardle (2000) such that it reflected foods consumed in the United States versus the United Kingdom, e.g. beans and toast changed to peanut butter and toast. The NKQ was previously validated, and responses were scored using the “Scoring the Nutrition Survey” rubric [10]. The nutritional knowledge of the student-athletes at baseline was evaluated based on the number of correct responses in the NKQ questionnaire. Section I: Dietary Recommendations had a maximum score of 11; Section II: Sources of Foods/Nutrients had a maximum score of 69; Section III: Choosing Everyday Foods had a maximum score of 10, and Section IV: Diet-Disease Relationships had a maximum score of 20. The maximum total score for the combined four subsections was thus 110.

Nutrition Education Opportunities

The nutrition education opportunities for the athletes in the study reflect the timeframe that a sports dietitian was employed at the university (Fall 2012 to Spring 2016). Prior to 2012, athletic trainers, coaches and strength and conditioning coaches were primarily responsible for nutrition education. The nutrition education program (2012 to 2016) consisted of nutrition counseling sessions and team nutrition talks. The athletic trainer scheduled nutrition counseling sessions for the athlete to meet with the sports dietitian for 30 minutes per session for both individual and small group. Topics in nutrition counseling sessions ranged from healthy eating, hydration, weight loss/ gain and maintenance to medical nutrition therapy for gastrointestinal issues including irritable bowel syndrome, injury, chronic fatigue, anxiety, amenorrhea and disordered eating/ eating disorders. The sports dietitian and student-athlete determined the number of follow-up sessions during the initial session.

Each NCAA Division I team had the opportunity to participate in two team nutrition talks per academic year: one talk during the regular season and one in the off-season. Team nutrition talks were held at coaches’ requests (one per semester) starting in the fall of 2012 after the nutrition knowledge questionnaire was administered. Topics covered in team nutrition talks included the importance of eating breakfast, meal patterns, hydration including a reduction in sweet tea, lemonade and soda consumption, healthy eating on campus, supplement use, the importance of refueling (chocolate milk), eating off-season and pre-/ post- game nutrition strategies. Handouts to supplement and reinforce the nutrition education content were distributed during the nutrition talks.

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Science (SPSS) software (IBM SPSS Statistics for Windows, version 22.0. Armonk, NY: IBM Corp released 2013). Descriptive statistics (percentage) were used to report demographic data. Nutrition knowledge was scored, and one-way analysis of variance (ANOVA) was used to determine differences in nutrition knowledge between cohort 1 and cohort 2 and by gender. Results are reported as the mean \pm standard deviation, significance set at $p < 0.05$.

Results

Response rates to the NKQ were 26.3% (cohort 1, n = 94) and 20.8% (cohort 2, n = 82). Demographics are presented in Table 1 for pre- and post-nutrition education. There was no significant difference between demographic variables at either time point. The majority of student-athletes were female (70.4% and 67.7%, respectively); between 18 and 24 years of age (98.6% and 92.3%, respectively) with a self-identified ethnic origin of white (88.6% and 90.0%, respectively) at both time points (2012 and 2016). The majority reported having no health or nutrition qualifications and were not on a special diet.

		Cohort 1 (n=94)	Cohort 2 (n=68)
Gender	Male	29.6%	32.3%
	Female	70.4%	67.7%
Age	<18	1.4%	6.2%
	18-24	98.0%	92.3%
	25-34	0.0%	1.5%
Marital Status	Single	97.2%	100.0%
	Living as married	1.4%	0.0%
Ethnic Origin	Non-Hispanic White	88.6%	90.0%
	Non-Hispanic Black	11.4%	1%
Education	High School	29.6%	43.1%
	Some College	67.6%	49.2%
	College Degree	2.8%	6.2%
	Some Postgraduate Work	0.0%	1.5%
Health/Nutrition Qualifications	Yes	2.8%	3.1%
	No	97.2%	96.9%
Special Diet	Yes	5.6%	7.7%
	No	94.4%	92.3%

Table 1: Demographic Data of Division I NCAA Student-Athletes.

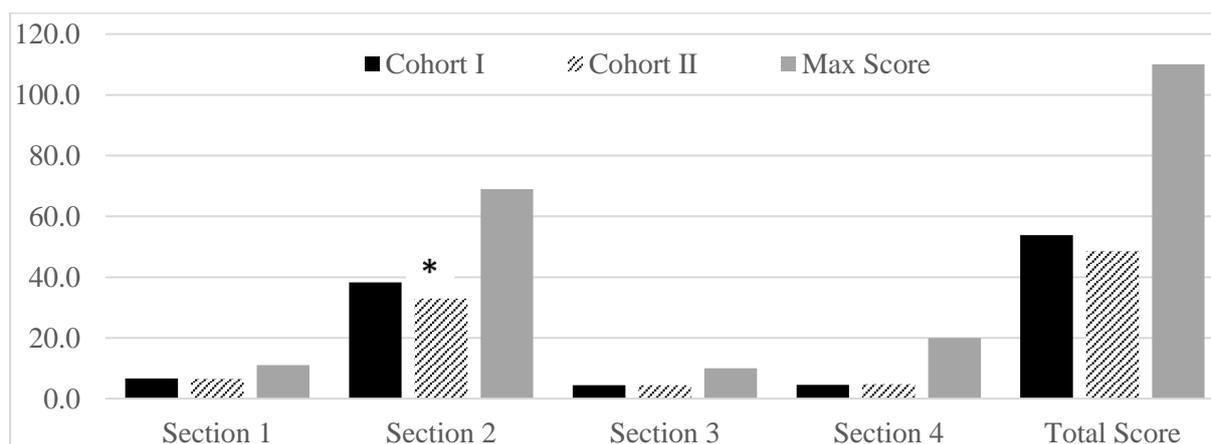
The response rates for individual teams were low compared to the number of student-athletes on each team (Table 2). For example, soccer and cheer/dance (cohort 1), and tennis and basketball (cohort 2) had zero student-athletes participate in the NKQ. The women's teams had a higher response to the NKQ compared to the men's teams, pre- and post-nutrition education.

		Cohort 1 (n=94)	Cohort 2 (n=82)
		Percentage	Percentage
Men's Sports	Baseball	1.4%	7.6%
	Basketball	5.6%	0.0%
	Cross Country	1.4%	6.1%
	Golf	2.8%	4.6%
	Football	11.1%	9.1%
	Soccer	0.0%	3.0%
	Tennis	6.9%	0.0%
Women's Sports	Basketball	16.7%	3.0%
	Cheer/Dance	0.0%	13.6%
	Cross Country	9.7%	4.6%
	Golf	2.8%	3.0%
	Lacrosse	4.2%	12.1%
	Soccer	5.6%	12.1%
	Softball	16.7%	6.1%
	Tennis	1.4%	0.0%
	Track & Field	8.3%	6.1%
	Volleyball	5.6%	7.6%

Table 2: Summary of Sports Teams from Division I NCAA Enrolled Student-Athletes.

Nutrition Knowledge

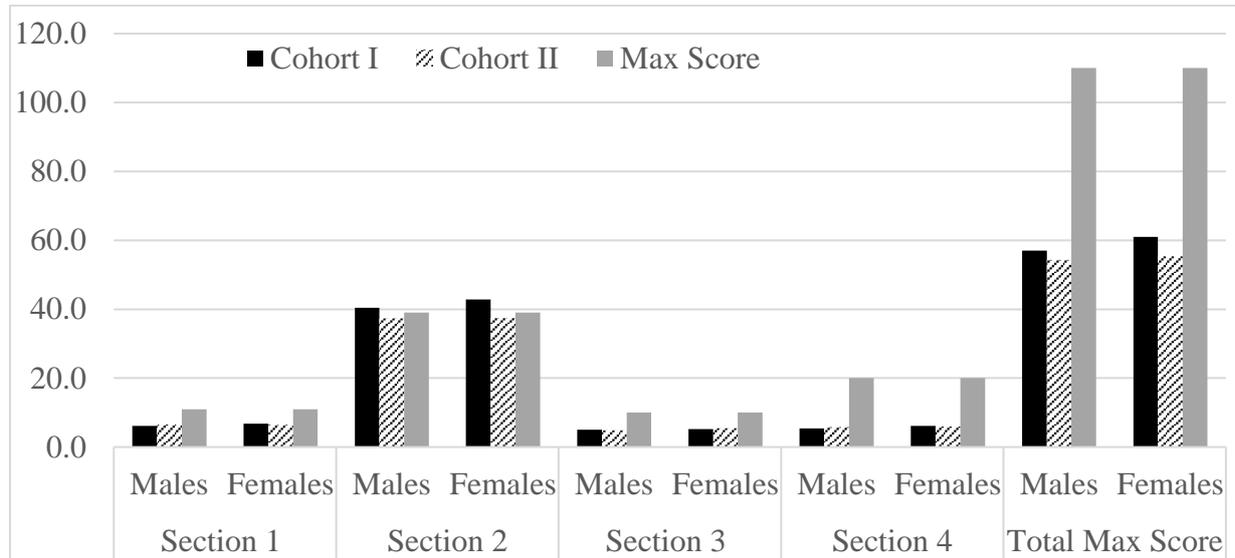
There was no significant difference ($p > 0.05$) between cohort 1 and cohort 2 nutrition knowledge scores for the following sections: Section I “Dietary Recommendations”, Section III “Choosing Everyday Food/Nutrients” and Section IV “Diet-Disease Relationships” (**Figure 1**), whereas section II, “Sources of Foods/Nutrients” scores on nutrition knowledge was significantly different from pre- to post-, with $p = 0.02$.



	Section 1	Section 2	Section 3	Section 4	Total Score
Cohort I	6.6 (1.8)	38.3 (14.9)	4.5 (2.4)	4.5 (3.2)	53.9 (18.9)
Cohort II	6.5 (1.5)	32.9 (14.1)	4.4 (2.6)	4.8 (3.0)	48.6 (18.1)
Max Score	11	69	10	20	110

Figure 1: Total Nutrition Knowledge scores per section for cohort 1 and cohort 2 reported by means (standard deviation). Section II (Sources of Foods/Nutrients) is significantly different between the two cohorts* (p = 0.02).

The nutrition knowledge scores were analyzed to determine differences in responses between male and female student-athletes (**Figure 2**). The female student-athletes scored higher than males on all sections of the survey, although these results were not statistically significant (p>0.05).



	Section 1		Section 2		Section 3		Section 4		Total Max Score	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Cohort I	6.1 (1.9)	6.8 (1.6)	40.4 (9.0)	42.9 (8.4)	5.1 (1.2)	5.3 (1.8)	5.4 (2.1)	6.1 (2.2)	57.1 (11.1)	61.0 (11.0)
Cohort II	6.5 (1.4)	6.4 (1.4)	37.3 (7.1)	37.4 (7.6)	4.8 (1.9)	5.5 (1.7)	5.8 (2.4)	6.0 (1.9)	54.4 (9.7)	55.4 (9.9)
Max Score	11	11	39	39	10	10	20	20	110	110

Figure 2: Average Nutrition Knowledge scores for cohort 1 and cohort 2 by gender reported by means (standard deviation). There is no significant difference in nutrition knowledge between genders over time between the cohort 1 (males n=21; females n=51) and cohort 2 (males n = 21; females n = 45) p> 0.05.

Nutrition Education Opportunities

Over the four academic years of the study, a total of 173 student-athletes participated in nutrition counseling sessions (Table 3). Male student-athletes utilized nutrition counseling sessions three times more frequently than female student-athletes. However, during the 2012-2013 academic year, more female student-athletes participated in one-on-one or small group counseling sessions, with the highest number of athletes seen in the 2014-2015 academic year. Total team meetings for men and women over the course of four academic years were 15 and 25, respectively (Table 3). The 2014-2015 academic year had the highest number of recorded team meetings for both men and women, with 2015-2016 the lowest number of team nutrition meetings.

		Individual or Small Group Counseling	Team Meetings
Men's Sports	Baseball	15	3
	Basketball	39	4
	Cross Country	4	3
	Golf	0	2
	Football	75	4
	Soccer	2	3
	Tennis	24	3
Women's Sports	Basketball	24	4
	Cheer/Dance	1	0
	Cross Country	29	3
	Golf	2	2
	Lacrosse	5	2
	Soccer	10	4
	Softball	42	2
	Tennis	7	4
	Track & Field	17	2
	Volleyball	10	2

Table 3: Nutrition Education Contacts for Individual or Small Group Counseling and Team Meetings between Fall 2012 and Spring 2016.

Discussion

The purpose of this study was to assess the nutrition knowledge of two cohorts of Division I student athletes using a previously validated nutrition knowledge questionnaire. The timeframe of the study reflected the period of time a part-time board certified sports dietitian was employed. Nutrition education was provided during the timeframe between the two cohorts by a part-time board certified sports dietitian. The results for overall nutrition knowledge of the student-athlete populations for both cohorts were similar to those from studies reported in two previous systematic reviews (<50%) [4,5].

Both cohorts of student-athletes exhibited the highest scores on section I: Dietary Recommendations (average score 6.5 out of 11 or 60%), specifically the questions that focused on eating more or less of certain types of foods. Section II: Understanding of Food and Nutrient Sources yielded a mixed response on most questions with either a full understanding of the question or not. The scoring of questions such as “Do you think foods (e.g. bananas, unflavored yogurt etc.) are high or low in added sugar?” was 52% (35.6 out of 69). Questions regarding the selection of foods that are high in fiber or low in fat, or questions about healthier food choices revealed a gap in knowledge within the student-athlete population. The best understanding of healthy food choices (Section III) was related to meats that were higher in fat or treats that were lower in sugar. Both cohorts scored poorly (4.7 out of 20 or 23%) on the last section of the questionnaire that related to health problems and disease (section IV). All of the survey participants lacked knowledge of the relationship between nutrition and diseases, specifically cardiovascular disease, cancer and bowel disorders and periodontal disease. When assessing nutrition knowledge by gender, there was no difference in scoring between genders

or by cohort. Most studies have shown a lack of knowledge or a gap in knowledge with regard to healthy food choices and an understanding of the relationship between nutrition and disease. However, a better understanding of athletes is revealed when questionnaires are related to sports performance or related to those athletes who have undergone a direct nutrition intervention by a sports dietitian.

The nutrition education the part-time sports dietitian provided included one-on-one or small group counseling and team sports nutrition talks. The counseling sessions were focused on specific nutrition goals for the athlete(s). Sample meal plans based on the athletes' dietary needs were provided along with nutrition education. The team sports nutrition talks focused on topics ranging from hydration to sleep to meal timing and meal composition related to sport. While the sports dietitian did provide nutrition education, the focus was on sports performance or specific nutrition information related to the athlete's medical condition. The athletes may have improved their sports nutrition knowledge but not general nutrition knowledge.

In the student-athlete population studied, we anticipated an improvement in nutrition knowledge given the participants' access to a part-time sports dietitian and increased opportunities for nutrition education. However, results revealed that there was no difference in the cohorts' nutrition knowledge. There are several factors that may have contributed to this lack of change in nutrition knowledge. First, the response rate was low (less than 30%) in both cohorts. Second, those student-athletes who participated in the survey in order to derive the baseline scores were likely not the same athletes who responded four years later. Finally, only 43% of the sample population of student-athletes who might have participated in the NKQ may have received nutrition counseling over the four years.

On average, four male teams and six female teams participated in team nutrition talks during the four-year period. The men's basketball team and women's softball team participated during each of the four years of the study. However, men's basketball contributed only 5.6% of the responses in cohort 1 and 0.0% in cohort 2 four years later. A similar response rate was seen in the cohorts with softball. While both teams participated in the nutrition education every year over the four-year period, we were unable to capture if nutrition knowledge was improved based on the study limitations including low-response rate.

Conclusion

Nutrition knowledge may help to improve the eating habits, health, and performance of student athletes. However, more research is needed in order to develop an athlete-specific nutrition knowledge questionnaire. The variation in nutrition knowledge within the literature and within this study is perhaps due to the types of questions that were asked. Additionally, interventions should focus on sport-specific nutrition education, hydration and healthy eating along with questionnaires that capture input in these areas in order to help athletes benefit beyond college sports. Overall, this study adds to the literature that continues to demonstrate a need for nutrition education and interventions among college athletes. In addition, as the field of sports nutrition grows, so does the demand for board certified sports dietitians. These nutrition specialists are at the forefront of designing nutrition education programs that not only improve the sports nutrition knowledge of athletes but also enhance the athletes' general nutrition knowledge for their lifelong health and well-being.

Author Contributions

Conceptualization, Colleran & Hall HC. and EH; Methodology, HC, SA, TF, RC, EH, and SI; Validation, RC, EH, and SI; Formal analysis, HC, SA. and EH; Investigation, HC, SA, EH; resources, HC, S.A, T.F, R.C, E.H, and SI; Data curation, HC, SA, TF, RC, EH, and SI; Writing-original draft preparation, HC,SA, TF, RC, EH, and SI; Writing-review and editing, HC, SA, TF, RC, EH, and SI; Supervision, HC; Project administration, SA.

Acknowledgments

The authors would like to thank Lauren San Diego for administrative help.

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