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A Comparison Between an NAIA and an NCAA Division I Women's Soccer Teams' Nutrition Knowledge, Nutrition Knowledge Sources, and Dietary Habits

Original Research

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Abstract

Introduction: The nutritional needs of college athletes differ from their non-athlete counterparts. Sufficient consumption of nutrients among this population is dependent on a variety of factors, including nutrition knowledge and access to nutrition information resources. Financially, National Association of Intercollegiate Athletics (NAIA) schools are at a disadvantage compared to National Collegiate Athletic Association (NCAA) Division I schools. This may potentially give NCAA Division I athletes access to more reliable nutrition education sources, while placing NAIA college athletes at a nutritional disadvantage.

Methods: This research study investigated the relationship(s) between female soccer players' (n=16) nutrition knowledge sources, nutrition knowledge, and dietary habits. This study also assessed the differences in the nutrition knowledge and dietary habits of NCAA Division I athletes and NAIA athletes. Data was collected using an online survey.

Results: Descriptive statistics indicate that nutrition knowledge was poor among all study participants. Inferential analyses indicate that there is not a significant difference in nutrition knowledge scores using division as a grouping variable ($p = 0.312$). Similarly, there was not a significant difference in dietary quality scores using division as a grouping variable ($p = 0.336$).

Conclusions: The results of this study indicate that collegiate female soccer players may lack nutrition knowledge, regardless of the division in which they participate. Because of the importance of adequate nutrition in college athletes, this area would benefit from additional research.

Key Words: athletes, college, females

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Introduction

The acceptable macronutrient distribution ranges for adults generally recommend that an adult's calorie consumption be distributed as follows: 45-65% from carbohydrates, 10-35% from protein, and 20-35% from fats.[1,2] However, nutrient recommendations for adult athletes differ slightly and are somewhat dependent on the daily variation of their physical activity. Specifically, adult collegiate soccer players require different daily intakes of carbohydrates, protein,

and some micronutrients than their non-athlete counterparts.[3] To navigate their unique nutritional needs, many college athletes have access to a Registered Dietitian: there are 53 colleges/universities that employ full-time Registered Sports Dietitians across the United States to assist their college athletes.[4] According to Hull et al. (2016), current research suggests that those student athletes who have received nutrition education from a Registered Sports Dietitian have greater nutrition knowledge than those student athletes who do not have access to a Registered Sports Dietitian.[5] Unfortunately, these Registered Dietitians are employed exclusively at National Collegiate Athletic Association (NCAA) Division I and Division II colleges.[4] For NCAA Division III and National Association of Intercollegiate Athletics (NAIA) student athletes, nutrition information is provided by sources other than Registered Dietitians. Unfortunately, other nutrition sources like the internet, peers, coaches, and social media do not demonstrate consistent reliability.

Inclusion of Registered Dietitians in athletic programs among colleges and universities is primarily determined by funding. In 2021, $49,321,924 out of $613,226,716 was allotted to be divided amongst all the NCAA Division I schools for Academic Enhancement Funds. In this category, nutrition education was listed as one of the allowable uses for which the money could be spent.[6] Historically, NAIA schools have not had a comparable budget to invest in nutrition education. Thus, this may put NAIA college athletes at a greater nutritional disadvantage than athletes attending an NCAA Division I school.

The primary purpose of this study was to compare the nutrition knowledge source(s) and nutrition knowledge of athletes on a NCAA Division I women's soccer team to female athletes on a NAIA soccer team. For this research, "nutrition knowledge source" was operationalized using the following options: athletic trainers, coaches, celebrities/influencers, dietitians, internet, magazines/books, parents/guardians, peers, academic coursework, siblings, and social media platforms. Additionally, this project aimed to assess the relationship between the two teams' nutrition knowledge and dietary habits. Lastly, this study also intended to determine if those who played on the NCAA Division I team had improved nutrition knowledge and dietary habits relative to the NAIA soccer players.

Scientific Methods

Participants

Participants were recruited from two Midwestern universities using convenience sampling: seven subjects from William Woods University (an NAIA school) and nine subjects from Southeast Missouri State University (an NCAA Division I school) comprised the sample (16 total participants). Informed consent was provided to the subjects prior to survey data collection. This study was reviewed and approved by Southeast Missouri State's Institutional Review Board (IRB).

Participants' Access to a Registered Dietitian

Neither participating school had a Registered Sports Dietitian employed onsite. However, unlike the NAIA women's soccer team, the NCAA Division I women's soccer team had access to multiple Registered Dietitians (nutrition faculty in the undergraduate and graduate dietetics programs), an Athletic Nutrition Center, along with many nutrition students on campus.

Protocol

Instrument items included multiple-choice, true or false, and short answer formats (40 items total). The first 8 items were used to collect demographics and background information. The subsequent set of items (16) were used to assess nutrition knowledge. The final set of items (16) were related to participants' dietary habits (instrument available upon request).

The majority of nutrition knowledge items were adapted from previously used instruments. 12 out of the 16 items were adapted from Trakman's (2019) The Nutrition for Sport Knowledge Questionnaire (NSKQ).[7] The remaining four questions were developed using information found in articles focusing on nutrition for athletes: *Nutrition Introduction,* written by Jeukendrup et al. (n.d.) and *Nutrition for the Soccer Student-Athlete* (n.d.).[1,8]

Along with the information from Trakman (2019), three additional sources were used to develop the items in the demographic and dietary habit sections (Blidy, 2020; Hornstrom et al., 2011; What's on your plate?, n.d.).[7,9,10,2] The questionnaire was reviewed by former athletes as well as faculty and staff members before implementation in the study. The questionnaire was administered one time through email to the participants' coaches in March 2022. The coaches were instructed to send the soccer players the survey link to their emails. Participants were then allowed to complete the survey one time.

Participants were given one month to complete the survey. The time began after the initial emails with the survey link were sent to the players' coaches. A reminder email was sent to coaches during the last week of April to reiterate the deadline (April 30, 2022).

Statistical Analysis

Descriptive statistics were used to evaluate a variety of instrument items, including means related to the nutrition knowledge and dietary habits portion(s) of the survey. Additionally, measures of frequency were used to assess nutrition knowledge source. One-way analysis of variance (ANOVA) was used to assess if reported primary nutrition knowledge sources yielded differences in nutrition knowledge scores. Pearson's correlation was used to assess if participants' nutrition knowledge and dietary habits scores were related. An independent groups t-test was used to determine if division grouping (NAIA, NCAA) yielded different nutrition knowledge scores. Likewise, the independent group t-test was used to evaluate if there were differences in dietary scores using division as a grouping variable. Survey data was analyzed using IBM Statistical Package for Social Sciences (IBM SPSS) 28.0. Both descriptive (measures of central tendency and measures of frequency) and inferential data (one-way ANOVA, Pearson's correlation, and independent groups t-test) were assessed. For inferential data, it is important to note a p-value </=0.05 was considered statistically significant.

Results

Nutrition Knowledge Sources

The most frequently cited nutrition "primary nutrition source" was social media, while the most frequently selected source overall was the internet. Descriptive data related to nutrition knowledge sources is provided in Table 1.

Table 1: Overall & Primary Nutrition Knowledge Sources

Nutrition Knowledge Source	Overall Selection Frequency (N)	Frequency of Being Selected as the "Primary Nutrition Source" (N [%])
Athletic Trainers	10	0 (0.0%)
Coaches	9	0 (0.0%)
Celebrities/Influencers	6	0 (0.0%)
Dietitians	5	1 (6.3%)
Internet	13	5 (31.3%)
Magazines/Books	0	0 (0.0%)
Parents/Guardians	11	0 (0.0%)
Peers (Friends, Teammates, etc.)	11	2 (12.5%)
School	6	1 (6.3%)
Siblings	1	0 (0.0%)
Social Media Platforms (Twitter, Instagram, Facebook, Tik Tok, Snapchat, etc.)	10	6 (37.5%)
Other (Recommendations from Unidentified Source)		1 (6.3%)

Additionally, Table 2 shows the primary nutrition knowledge source. As indicated, the top response was social media platforms, with a preference for TikTok®.

Table 2: Primary Nutrition Knowledge Sources

	N	%
Dietitians	1	6.3%
Internet	5	31.3%
Peers	2	12.5%
School	1	6.3%
Social Media Platforms	6	37.5%
Other (Recommendations from Unidentified Source)	1	6.3%

Participants were also asked to characterize the utility of their prior nutrition education by rating it on a "helpfulness" scale. Descriptive results are provided in Table 3.

Table 3: Reported Helpfulness of Prior Nutrition Education

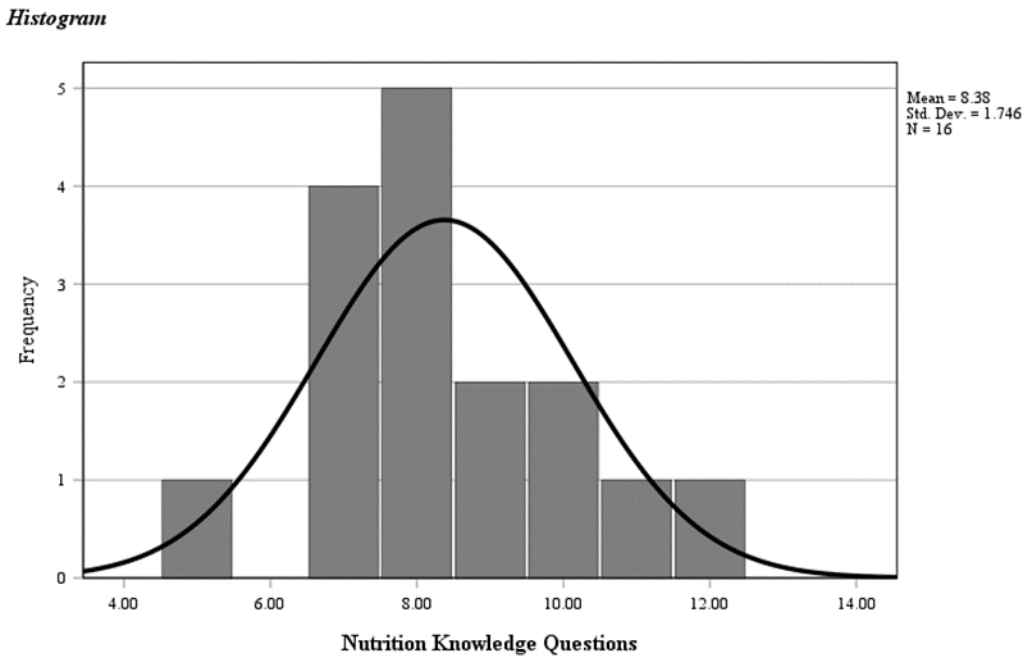
On a scale of 1-5 (with 1 being the least helpful and 5 being the most helpful), how helpful did you find your prior nutrition education?	N	%
1 (Least helpful)	1	6.3%
2	6	37.5%
3	6	37.5%
4	3	18.8%
5	0	0.0%
Mean		2.7 (n = 16)
Standard Deviation		0.9

Additionally, it is important to note that 81.3% of participants indicated that their academic area of study was not related to nutrition. Additionally, 7 out of 16 respondents indicated that they had previously or were currently taking a nutrition course in their program of study or as a general education course. The mean number of nutrition courses taken among participants was 0.75, with the option of "0" being the most frequently selected when asked how many nutrition courses they had taken/were currently taking.

Nutrition Knowledge

A passing score on the nutrition knowledge assessment portion of the instrument was 12/16, or 75%. The following chart (Figure 1) is a representation of the range of participants' nutrition knowledge questions' (NKQ) scores.

Figure 1: Figure of Nutrition Knowledge Questions' Scores



The mean score was 8.38: only one participant received a passing score of 75%.

Data related to frequently missed questions (characterized by 12 or more incorrect responses) are provided in Table 4. As indicated, the most incorrectly answered question was answered incorrectly by 15 out of 16 of the participants.

Table 4: The Most Incorrectly Answered Nutrition Knowledge Questions

Nutrition Knowledge Question	N (Number of Participants that Answered Correctly [out of 16])	% of sample
Question 1: Which nutrient do you think has the most energy (kcals) per 100 grams (3.5 ounces)?	3	18.8%
Question 8: True or False? A balanced diet with kcals has enough protein for most athletes.	1	6.3%
Question 10: True or False? As you increase the intensity of exercise, the % of fat you use as fuel also increases.	3	18.8%
Question: 15: Which is a better recovery meal option for an athlete who wants to put on muscle?	3	18.8%

Of the remaining questions, three were answered correctly by 12 or more of the subjects. This data is displayed in Table 5. The question most frequently answered correctly was answered appropriately by 16 out of 16 of the participants and can be seen in Table 5.

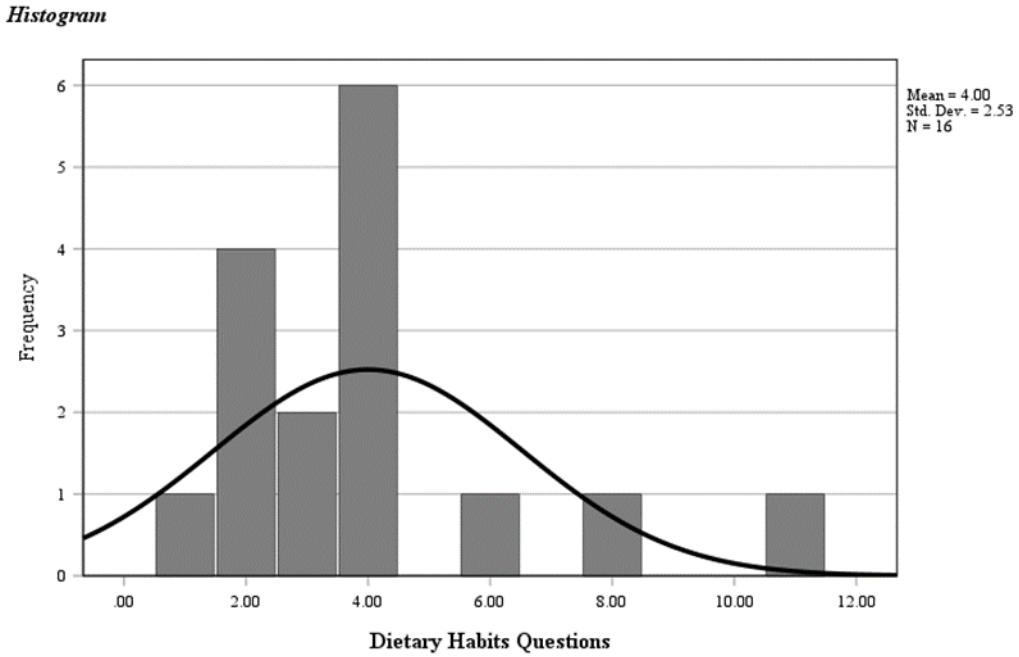
Table 5: The Most Correctly Answered Nutrition Knowledge Questions

Nutrition Knowledge Question	N (Number of Participants that Answered Correctly)	%
Question 3: Which food contains the most fat?	12	75.0%
Question 6: Proteins are important for athletes for which of the following reasons?	16	100.0%
Question 13: During a competition, soccer players should eat a snack that is high in	13	81.3%

Dietary Habits

Similar to the NKQ scores, in order to get a passing score on the dietary habits questionnaire (DHQ), participants had to correctly answer 12 out of 16 questions, or 75%. The following chart (Figure 2) is a representation of the range of participants' DHQ scores.

Figure 2: Figure of Dietary Habits Questions' Scores



As indicated, the mean score among participants was 4.00. Zero participants received a passing score on this portion of the assessment.

Frequency data for participant response options to this portion of the instrument are provided in Table 6. As indicated, at least 12 out of 16 people unfavorably answered nine of the DHQs.

Table 6: Dietary Habits Questions

Dietary Habits Questionnaire Item	Favorable Response Frequency (N [%])	Unfavorable Response Frequency (N [%])	Mean Response	Standard Deviation
Question 1: How often does your food intake change depending on your activity level for the day? *	5 (31.3%)	11 (68.8%)	3.13	0.72
Question 2: How often does your fluid intake change depending on your activity level for the day? *	8 (50%)	8 (50%)	3.44	0.63
Question 3: How often do you consume at least three meals per day? *	8 (50%)	8 (50%)	3.25	0.93
Question 4: How often do you eat shortly before a practice or game? *	5 (31.3%)	11 (68.8%)	2.88	1.02
Question 5: How often do you eat during a game? *	0 (0.0%)	16 (100.0%)	1.31	0.60
Question 6: How often do you eat shortly after a game? *	10 (62.5%)	6 (37.5%)	3.56	0.63
Question 7: How often do you read the nutrition facts food labels to help you make healthy food choices? *	1 (6.3%)	15 (93.8%)	2.38	0.89
Question 8: How often do you eat fast food per week? *Scale:*	7 (43.8%)	9 (56.3%)	0.75	0.77

0: 0-1 times *1: 2-3 times* *2: 4-5 times* *3: 6-7 times* *4: 8 or more times*				
Question 9: On average, how many servings of whole grain foods do you eat per day? Examples include: 1/2 cup of brown rice, 1 slice of whole wheat bread, 1/2 cup of whole wheat pasta, 1/2 cup of oatmeal, etc. **	1 (6.3%)	15 (93.8%)	1.25	0.77
Question 10: On average, how many servings of vegetables do you eat per day? Examples include: 2 cups of raw lettuce, 1 large bell pepper, 1 cup of cucumber slices, 1 avocado, 1 medium white or sweet potato, 1 cup of corn, 1 cup of tomatoes, 1 cup baby carrots, etc. **	1 (6.3%)	15 (93.8%)	1.50	0.73
Question 11: On average, how many servings of fruit do you eat per day? Examples include: 1 small apple, 1 large banana, 1 cup of blueberries, 22 seedless grapes, 1 cup of fruit cocktail, 1 large peach, 1 medium pear, 1 cup of pineapple, 8 large strawberries, 1/2 cup of dried fruits, etc. *Scale:* *0: 0 servings* *1: 1 serving* *2: 2 or more servings*	3 (18.8%)	13 (81.3%)	0.88	0.72

Question 12: On average, how many servings of protein do you eat per day? Examples include: 1 oz of lean ground meat, 1 slice of deli meat, 1 oz of cooked chicken, 1 oz of catfish, bass, light tuna, clams, crab, shrimp, or salmon, 1 egg, 3 Tbsp of liquid egg white, 1/2 oz of nuts, 1 Tbsp of nut butter, 1/4 cup of cooked beans, etc. ***	0 (0.0%)	16 (100.0%)	1.25	0.68
Question 13: On average, how many servings of dairy do you eat per day? Examples include: 1 cup of milk, 1 cup of yogurt, 1 oz or 1/3 cup of cheese, etc. **	2 (12.5%)	14 (87.5%)	1.50	1.03
Question 14: On average, how many cups of water do you drink per day? ***	9 (56.3%)	7 (43.8%)	2.50	0.63
Question 15: How often do you drink sports energy drinks per week? Examples include: Powerade, Gatorade, etc. *	2 (12.5%)	14 (87.5%)	2.44	0.81
Question 16: How often do you drink sweetened beverages per week? Examples include: soda, sweet tea, fruit juices, etc. *	2 (12.5%)	14 (87.5%)	2.75	0.93

*Scale: 1: Never; 2: Rarely: 3: Sometimes; 4: Always
** Scale: 0: 0 servings; 1: 1 serving; 2: 2 servings; 3: 3 or more servings
*** Scale: 0: 0-1 servings; 1: 2-3 servings; 2: 4-5 servings; 3: 6 or more servings

Research Question 1: Are there differences in participants' nutrition knowledge scores when divided into groups based on reported "primary nutrition knowledge source"?

Research Question 1 was evaluated using One-Way Analysis of Variance (ANOVA), using nutrition knowledge source as the grouping variable. Descriptive results are provided in Table 7. There was not a statistically significant difference in nutrition knowledge scores among knowledge source categories ($F(5, 10) = 0.590$, $p = 0.709$).

Table 7: One-Way ANOVA Test Results of Nutrition Knowledge Sources to Nutrition Knowledge

	N	Mean	Std. Deviation
Dietitians	1	11.0	-
Internet	5	8.0	2.6
Peers	2	8.0	1.4
School	1	8.0	-
Social Media Platforms	6	8.7	1.2
Other (Recommendations from Unidentified Source)	1	7.0	-
Total	16	8.4	1.8

Research Question 2: Do college athletes' nutrition knowledge and dietary habits have an association?

Research Question 2 was evaluated using correlation analysis. Descriptive results are provided in Table 8. As indicated, there was not a significant association between nutrition knowledge and dietary habits ($r = 0.392$, $p = 0.133$).

Table 8: Descriptive Statistics: Nutrition Knowledge Scores and Dietary Habit Scores

	N	Mean	Std. Deviation
Nutrition Knowledge Scores	16	8.4	1.8
Dietary Habits Scores	16	4.0	2.5

Research Question 3: Are there differences between the means of the NAIA and NCAA Division I women's soccer teams' nutrition knowledge scores?

Research Question 3 was evaluated using an Independent Groups T-Test. The descriptive results are provided in Table 9. There was not a statistically significant difference in nutrition knowledge scores between NCAA and NAIA athletes ($p = 0.312$).

Table 9: Independent Groups T-Test on Nutrition Knowledge

	What school do you play soccer for?	N	Mean	Std. Deviation	Std. Error Mean
Nutrition Knowledge Questions	NCAA Division I	9	8.8	1.4	.5
	NAIA	7	7.9	2.1	.8

Research Question 4: Are there differences between the means of the NAIA and the NCAA Division I women's soccer teams' dietary habit scores?

Similarly, research Question 4 was evaluated using an Independent Groups T-Test. Descriptive results are provided in Table 10. There was not a statistically significant difference in dietary scores between NAIA and NCAA athletes (t (14) = 0.996, p = 0.336).

Table 10: Independent Groups T-Test on Dietary Habits

	What school do you play soccer for?	N	Mean	Std. Deviation	Std. Error Mean
Dietary Habits Questions	NCAA Division I	9	4.6	2.7	.9
	NAIA	7	3.3	2.3	.9

Discussion

Nutrition Knowledge Sources

Previous research indicates that college athletes receive their nutrition information from a wide variety of sources.[10] The results of this study seem to be in alignment with the current literature. There were 10 different sources of nutrition information indicated by study participants: these sources included athletic trainers, coaches, celebrities, the internet, and dietitians. Overall, the data from this study suggests that most participants do not consistently receive nutrition information from credentialed nutrition experts such as Registered Dietitians; rather, social media platforms and the internet collectively represented the principal information sources, with 68.8% of study participants selecting one of those options as their "primary" source. This is consistent with the findings from Ali et al. (2015).[11]

Inferential analyses indicate that there was not a significant relationship between nutrition knowledge sources and nutrition knowledge ($p = 0.709$). These results support Trakman et al.'s (2019) findings that the use of the internet and Registered Dietitians both provide college athletes with nutrition information and yield similar mastery of nutrition information.[14]

Interestingly, regardless of primary information source selected, none of the participants found their prior nutrition education as very helpful (a score of 5). In fact, the mean score of 2.7 indicates that the participants carry an overall negative opinion about their nutrition knowledge sources. Because their preferred nutrition knowledge source was social media platforms, their satisfaction level could potentially be improved if they had consistent access to an entity such as a Registered Sports Dietitian.

Nutrition Knowledge

The results from the nutrition knowledge section on the survey revealed that the participants were lacking in mastery of sports nutrition information. A mean score of 8.38 on the NKQ translates to a score of 52.3%. Only one study participant in the sample (6.3%) received a passing score of 75%. This finding is in alignment with the research of both Andrews et al. (2016) and Holden et al. (2018).[12,13] In both studies, many participants did not receive a passing score on instruments designed to assess nutrition knowledge.

In the present study, there did not seem to be consistency of mastery/lack thereof among content areas: For example, most participants were able to correctly choose which food items had the most protein and fats; however, the majority were unable to identify the food item with the most carbohydrates. 68.8% of participants were able to identify that they need carbohydrates and fluids during a game, but only 31.3% knew what to consume following a game. Because of these inconsistencies, it is difficult to determine if the frequency of correctness was due to participant nutrition knowledge or through random probability. Regardless, the results of this study suggest that college athletes may not possess adequate nutrition knowledge.

Dietary Habits

Regarding dietary implications, similar to what Hornstrom et al. identified in 2011, the findings of this study suggest there is not a meaningful relationship between nutrition knowledge and dietary habits ($r = 0.392$, $p = 0.133$).[10] To further illustrate, the participant associated with the highest nutrition knowledge score received a low score (25%) on the dietary habits assessment. Based on these inconsistencies, it appears that dietary habits are not influenced by knowledge in this population.

Using the MyPlate Recommendations for this population, the participants in this study did not report consuming adequate quantities of necessary food groups.[2] A passing score on the DHQ used to assess dietary quality is 12.0: the mean score among study participants was 4.0. This is in alignment with Colleran et al.'s (2021) findings in their research with female college athletes.[15]

In the present study, of the five food groups, the fruit group was the most consistently associated with underconsumption, with 31% of participants stating they consume zero servings on average per day. Only 18.6% of study participants reported eating an appropriate amount of fruit each day. In addition, 31.3% of study participants reported that their dietary habits were influenced by changes in daily activity level. However, most participants indicated that they drink at least six or more cups of water per day, and half of the participants reported that their fluid intake is influenced by their physical activity.

NCAA Division I vs NAIA College Athletes

The nutrition knowledge scores and dietary habit scores were similar among NCAA and NAIA study participants. The mean score among NCAA participants was 8.8, the mean score among NAIA participants was 7.9, although this difference was statistically insignificant ($p = 0.312$). The dietary habits score of NCAA participants was 4.6, and the mean dietary habits score among NAIA participants was 3.3. However, this difference was also statistically insignificant ($p = 0.336$).

Weakness and Suggestions for Future Research

The primary limitation associated with this data collection was sample size. Future research should aim to evaluate the differences in NCAA and NAIA universities with a larger sample size. To further measure the impact of Registered Dietitians in athletics, future research should aim to include a population that has dedicated sports Registered Dietitian (RD) to evaluate the efficacy of RD availability in predicting dietary habits and/or nutrition knowledge.

Conclusions

The results of this study indicate that there were not meaningful relationships between nutrition knowledge sources and nutrition knowledge, or nutrition knowledge and dietary habits among female collegiate soccer players. Furthermore, the data suggests that there are not differences in nutrition knowledge or dietary habits between NCAA Division 1 athletes and NAIA athletes. However, the data suggests that overall, college athletes may lack nutrition knowledge and proper dietary habits to support their training and athletic performance. Future research should examine these relationships further with a larger sample size. Adequate nutrition consisting of appropriate daily consumption of whole grains, protein, fruits, vegetables, and dairy is extremely important for all individuals, but particularly among those performing at the collegiate level.

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