

ORIGINAL ARTICLE

Dietary Habits, Nutritional Knowledge and Barriers to Optimal Nutrition among University Student Athletes in Delhi NCR Region, India

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ABSTRACT

Background: Nutritional knowledge and dietary habits are critical elements for collegiate athletes; while they can affect athletic performance and their overall health too. This study examined nutritional knowledge, dietary behaviours, and barriers to nutrition of collegiate athletes.

Methods: In a cross-sectional analysis, 200 collegiate athletes were enrolled. A structured and validated questionnaire was used to gather data on demographics, nutritional knowledge, dietary habits, and barriers to nutrition.

Results: It was shown that collegiate athletes had moderate nutritional knowledge with a significant positive correlation between nutritional knowledge and dietary habits ($p=0.489$, $p<0.001$). Conversely, barriers to nutrition could significantly impact dietary habits ($p=0.020$) highlighting that nutritional knowledge alone was not sufficient for adequate dietary choices. Collegiate athletes had greater nutritional knowledge and followed healthier dietary habits. No significant differences in dietary habits as well as nutritional knowledge were observed between males and females. The commonly reported barriers to a proper nutrition were accessibility of healthy foods, lack of nutritional knowledge, time constraints, financial limitations, and taste preference emphasizing that knowledge alone was insufficient to ensure correct dietary practices.

Conclusion: The findings emphasized the importance of developing targeted strategies to enhance dietary habits by strategies like introduction of educational programs regarding sport's nutrition. Additionally, implementing policies that can improve food accessibility, affordability and healthy food options in campus can be key dietary barriers.

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Introduction

Collegiate athletes play a vital role in national sports development and represent the country in competitive levels. They represent the country on

the international stage and create history through their achievements. However, collegiate athletes face several challenges in maintaining proper health and performance due to the double requirements

of academics and athletics. Healthy diet has been essential for an athlete to focus on energy needs, recovery and injury prevention. An adequate diet will supply the necessary macronutrients as carbohydrates to power activity, protein to allow recovery by repairing muscle damage, and fats to enable endurance (1, 2). Without a proper nutrition, an athlete's endurance may decrease, recovery may take longer and the risk of injury may increase. Structured dietary plans help enhance the performance of athletes and promote long-term health (3).

The closest step is nutrition to fulfil athletic potential. Despite significance of nutrition in sports along with overall health, there is no structured course in nutrition at a higher educational level. College-level athletes are often found to have poor dietary habits because of the lack of nutritional knowledge which can leave them unable to make good food choices (4-6). Apart from proper nutritional knowledge, other barriers include convenient availability of unhealthy foods, time lack, high cost of healthy foods, as well as limited access to professional nutritional advices (7-9). Additionally, cultural differences and personal dietary choices can often impact dietary decisions that may lead to poor nutritional practices (10-12). Several studies have consistently demonstrated that collegiate athletes generally possess poor nutritional knowledge. Nutritional knowledge is made worse by the limited availability of targeted nutritional education. Collegiate athletes can rely primarily on coaches, teammates, and other non-expert sources for nutritional information (13-15).

Furthermore, some studies suggested that while athletes had high nutritional knowledge, it was not translated into adequate dietary habits (16-18). Collegiate athletes generally believe in sources to be unreliable for information on nutrition, including coaches, teammates, as well as online resources, which can lead to misconceptions about nutrition and poor dietary choices (19, 20). Athlete's gender and level of competition can also influence nutritional knowledge. Many studies suggested that knowledge alone does not guarantee better dietary habits. Factors like motivation, self-confidence, and environmental support are essential in turning knowledge into actionable behaviour (21-25). The dietary habits of collegiate athletes are often indicated by greater intake of fast foods, sugary drinks, and outside food. These food options are readily available and convenient but deficient in vital nutrients (26).

Athlete's dietary habits have been impacted by various factors including limited time, insufficient information on nutrition, financial challenges as well as social influence (27, 28). Coaches or team-mates

who advocate for particular eating habits, whether beneficial or detrimental, may have an impact on athletes. Furthermore, dietary habits and food choices can be influenced by cultural origins (1, 17). In some cases, this can lead to contradictions between traditional diets and the nutritional requirements for optimal athletic performance (29). Extensive studies on collegiate athlete's eating habits and nutritional knowledge exist in Western countries. However, India has a significant research gap in this field. A handful of studies conducted in India; such examined the nutritional attitudes, practices, as well as college athletes' knowledge in Tamil Nadu that showed different sports disciplines had differing degrees of nutritional awareness (30). There is insufficient evidence on how nutritional knowledge is translated into dietary habits among Indian collegiate athletes. This gap underlines the urgent need for region-specific research to assess the dietary behaviors of Indian athletes, identify their barriers to nutrition, and design tailored interventions (31).

Western studies have consistently shown that healthy dietary practices are not always related to high levels of nutritional understanding. Athlete's food habits are significantly influenced by many factors such as financial constraints, social influences, cultural differences, constraints on time, as well as availability of healthy food items. There is insufficient research to determine the same trend among Indian college athletes. Comprehensive Interventions are required to enhance collegiate athlete's eating habits and nutritional awareness. Targeted nutritional education initiatives that can give athletes precise and useful information about diet and performance should be a part of these interventions (32).

These programs should be customized to meet the unique requirements and situations of collegiate athletes, taking into account typical barriers including time and budgetary limitations (17, 24). Additionally, by offering reasonably priced and easily available healthy food alternatives in dining halls and cafeterias, campus-wide efforts can contribute to the development of an atmosphere that can encourage a healthy status (1, 22). This research aimed to explore the connection between nutritional knowledge and eating habits among college athletes in India. It also examined how gender affected these aspects and identified the main obstacles to maintaining a proper diet. Given the increasing focus on the development of sports in India, especially with initiatives such as Khelo India and the National Sports Policy, it is essential for understanding and addressing dietary difficulties faced by collegiate athletes. The results of our study can contribute to creating targeted

nutrition educational programs and provide valuable insights into integrating sports nutrition into a higher educational curriculum.

Materials and Methods

A cross-sectional study was carried out among collegiate athletes from universities in the Delhi NCR region, India. A total of 255 student-athletes were initially recruited by a convenience sampling method for the study. However, 55 responses were excluded due to incomplete data, which led to a final sample of 200 participants who were enrolled for analysis. Ethical approval was obtained from GD Goenka University, the Research Ethics Committee of the School of Healthcare and Allied Sciences (R&D/SA/12/24/248). Informed consent was obtained from all participants who were involved in the study, ensuring respect for confidentiality and voluntariness principles. Data were gathered through a structured and validated questionnaire (Food Frequency Questionnaire: FFQ) that evaluated knowledge on nutrition and dietary patterns. To understand the barriers to nutrition, athletes were asked to select the relevant factor from the list of lack of nutrition knowledge, budget constraints, accessibility to healthy foods, time constraints, and taste and other factors. The questionnaire was pre-tested for validity and reliability before administration.

A set of statistical analyses was performed to check the validity, and interrelationships among the questionnaire scales used in this study. Standard deviations, means along with frequency distributions were computed for both categorical as well as continuous variables to summarize participant characteristics and responses. Spearman's correlation coefficients were calculated to investigate relationships among the different scales (FFQ) and their subdomains, offering insights into the

connection among dietary habits as well as knowledge on nutrition. Stepwise multiple regression analysis was undertaken to determine primary predictors affecting food frequency patterns and dietary habits, incorporating factors such as nutritional knowledge, sleep quality, and demographic characteristics. All statistical analyses were carried out using JASP software and a $p < 0.05$ was considered the threshold for statistical significance.

Results

Statistical methods discovered that 67% of research population comprised male collegiate athletes, while 33% were female. Knowledge on protein function among collegiate athletes was more than information about fat and carbohydrate activities. However, understanding regarding hydrating beverages was notably lacking (62% of the participants). In contrast, the understanding of dietary supplements was relatively high. Table 1 represents the descriptive statistics for the dietary habit scores, barriers to nutrition and nutritional knowledge scores. The average dietary habit score was 10.030 (SD=5.142), with a range from 2 to 20, suggesting a diverse range of dietary behaviours among participants. The average nutritional knowledge score was 4.745 (SD=2.266), with scores ranging from 0 to 8, reflecting varying levels of understanding of sports nutritional concepts. The mean barrier to nutrition was 1.890 (SD=1.138). The standard deviations indicated moderate variability in all three parameters, demonstrating individual differences in sleep patterns, dietary habits, and nutritional knowledge.

To choose the parametric or non-parametric test for further analysis normality of data, skewness and kurtosis values were examined. Nutritional knowledge and barriers to nutrition showed slight negative skewness (-0.588 and -0.278, respectively),

Table 1: Descriptive statistics and normality tests for nutritional knowledge, dietary habits, and barriers to nutrition.

Variable	Nutrition knowledge score	Dietary habit score	Barriers to nutrition
Valid responses	200	200	200
Missing responses	0	0	0
Median	5	9	2
Mean	4.745	10.03	1.89
Standard deviation	2.266	5.142	1.138
Skewness	-0.588	0.3	-0.278
Standard error of skewness	0.172	0.172	0.172
Kurtosis	-0.71	-1.232	-0.926
Standard error of kurtosis	0.342	0.342	0.342
Shapiro-Wilk statistic	0.913	0.93	0.889
Shapiro-Wilk p value	<0.001	<0.001	<0.001
Minimum	0	2	0
Maximum	8	20	4

whereas dietary habit scores showed a small positive skew (0.300). Furthermore, all three variables' kurtosis values were within an acceptable range, representing moderate deviations from normality.

Furthermore, the Shapiro-Wilk test for normality was done for these three variables, with statistically significant results ($p < 0.001$) for all variables, suggesting a violation of normality assumptions. Therefore, non-parametric tests were chosen for subsequent analysis statistical analysis. A descriptive evaluation of knowledge levels on nutrition revealed that 27% of collegiate athletes had low nutritional knowledge, 48% demonstrated moderate nutritional knowledge, and 24.5% displayed an advanced knowledge level on nutrition. Regarding dietary habits, 40.5% of participants exhibited unhealthy dietary behaviors, 32% followed a moderately balanced diet, and 27.5% reported healthy dietary habits. Furthermore, the analysis revealed that 31% of participants presented time constraints as a primary barrier, 30% cited access to healthy food as a challenge, 18% noticed budget constraints, 16% observed knowledge constraints and 4% described taste and other reasons.

Findings highlighted critical gaps in nutritional awareness, particularly concerning hydration and dietary patterns, which further emphasized the requirement for personalised educational interventions to optimize athlete's dietary habits and overall health.

The findings from Spearman's correlation analysis, exploring the relationships among nutrition knowledge scores, barriers to nutrition, and dietary habit scores revealed that Spearman's correlation as a non-parametric method was chosen because Table 1 did not follow a normal distribution. Dietary habit score was 0.489 for nutritional knowledge

determined by Spearman's rho ($p < 0.001$). Barriers to nutrition was -0.229 for nutritional knowledge and -0.216 for dietary habit score determined by Spearman's rho ($p = 0.001$ and $p = 0.001$, respectively).

A moderate positive correlation had been identified for nutritional knowledge scores and dietary habit scores (Spearman's rho = 0.489, $p < 0.001$), indicating that greater nutritional knowledge was significantly linked to healthier dietary habits. The statistically significant p value ($p < 0.001$) suggests this relationship to be unlikely to occur by chance. Moreover, weak negative correlation was noticed for nutritional knowledge scores as well as barriers to nutrition (Spearman's $p = -0.229$, $p = 0.001$), and between dietary habit scores and barriers to nutrition (Spearman's $p = -0.216$, $p = 0.002$), implying that greater knowledge and healthier habits were associated with experiencing fewer nutrition-related barriers. This suggests that collegiate athletes with higher nutritional knowledge faced fewer barriers to maintaining a healthy diet. In other words, greater knowledge may help athletes overcome challenges related to nutrition, such as access to healthy foods, and time constraints.

Furthermore, it also indicated that athletes with better dietary habits wished to experience fewer barriers to a proper nutrition. Mann-Whitney U test revealed no significant differences among male and female collegiate athletes based on their nutritional knowledge as well as dietary behaviors. Multiple linear regression analysis was conducted for examining relationship for nutrition knowledge Score, barriers to nutrition, and dietary habit score in collegiate athletes. Dietary habit score was defined to be 4134.5 by Mann-Whitney U test ($p = 0.455$) and nutritional knowledge score was described to be 4586 ($p = 0.667$).

Table 2: Stepwise regression analysis of nutritional knowledge and nutritional barriers as predictors of dietary habits.

A: Model summary for dietary habit score						
Model	R	R2	Adjusted R2	RMSE		
M0	0	0	0	5.142		
M1	0.514	0.264	4.434			
B: ANOVA for regression model						
Model		Sum of squares	df	Mean square	F	P value
M1	Regression	1388.521	2	694.261	35.311	<0.001
	Residual	3873.299	197	19.661		
	Total	5261.82	199			
C: Regression coefficients and collinearity statistics						
Model	Predictor	Unstandardized coefficient	Standard error	Standardized coefficient	t value	P value
M0	Intercept	10.03	0.364	-	27.585	<0.001
M1	Intercept	6.42	1.026	-	6.258	<0.001
	Nutrition knowledge score	1.029	0.144	0.454	7.158	<0.001
	Nutrition barriers	-0.675	0.286	-0.149	-2.355	0.02

M1 includes nutrition knowledge score and barriers to nutrition. Df: Degree of freedom.

Regarding model summary, outcomes indicated that regression model was significant [$F(2,197)=35.311, p<0.001$], accounting for 26.4% of variance in dietary habits ($R^2=0.264$). The model exhibited an adjusted R^2 of 0.256, indicating that the predictors contributed meaningfully to explain dietary habit scores. The root mean square error (RMSE=4.434) suggests reasonable predictive accuracy. For regression coefficients, the final regression equation was demonstrated as dietary habit score= $6.420+(1.029\times$ nutrition knowledge score) $-(0.675\times$ Barriers to Nutrition). Nutrition knowledge score could significantly predicted dietary habit score ($\beta=1.029, p<0.001$) and demonstrated a positive relationship for higher nutrition knowledge as well as improved dietary habits. The barriers to nutrition could negatively predict dietary habit score ($\beta=-0.675, p=0.020$) that suggest athletes to experience more nutrition-related barriers and exhibit poorer dietary habits. The variance inflation factor (VIF<1.075) confirmed that multicollinearity was not a concern (Table 2).

Discussion

The study's findings suggest that both nutritional knowledge and barriers to nutrition were key factors influencing dietary habits in collegiate athletes. Particularly, a higher nutritional knowledge was correlated with healthy dietary habits. On the other hand, higher barriers to nutrition negatively influenced dietary behaviour. Past studies have provided similar results, highlighting nutritional education's impact in improving diet quality and barriers as key determinants of malnutrition (33, 34). Nutritional knowledge has an important function in shaping dietary habits. These results are aligned with studies showing that athletes who have higher nutritional literacy reflect better meal planning, food choices, and nutrient timing (35, 36). Similar to our results, a study also revealed that higher nutritional knowledge has been consistent with better dietary intake, mainly in macronutrient distribution and meal timing strategies. These are critical for athletic performance too. Our study also showed that collegiate athletes' nutritional knowledge and dietary behavior are not influenced by their gender (male or female). Similar results were presented in other studies (37, 38). Although barriers to nutrition results represented a significant challenge to dietary habits; some researches confirmed that budget constraints, time constraints, and limited access to healthy food items could negatively influence athlete's dietary habits and nutritional needs (39, 40).

Conclusion

This study underscored the important role of nutritional knowledge in promoting healthy dietary habits among collegiate athletes; while also recognized the adverse impact of nutritional barriers. Our findings suggest that enhancing nutritional education programs could lead to significant improvements in both nutritional knowledge and dietary behaviors. This would further support collegiate athletes to overcome the barrier of nutrition. Although, there is a limited study available on assessing nutritional knowledge, dietary behaviours and barriers to nutrition among athletes in the Indian demographic; future researches are needed to be undertaken to explore these factors in depth. Extensive interventions are required in future to integrate nutritional education together with practical implementations to overcome nutritional barriers. These practical strategies for implementing nutritional knowledge will help convert knowledge into implementable dietary habits.

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Authors' Contribution

JS conceptualized and designed the study, supervised the research process, contributed to statistical analysis, interpreted the data, and critically revised the manuscript for important intellectual content, DD was involved in data collection, questionnaire administration, data entry, and preliminary statistical analysis. He also contributed to drafting the initial manuscript. GS assisted with literature review, data interpretation, and manuscript editing and formatting in accordance with journal guidelines. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Conflict of Interest

The authors declare no conflict of interest.

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