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Nutritional knowledge and awareness of adolescent athlete: Preventing nutritional deficiencies and efforts to improve performance

Dinda Nafilla, Melly Anisa Putri, Agustina Agustina

Department of DIV Physiotherapy, Poltekkes Borneo Citra Medika, Kalimantan, Indonesia.

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Abstract

Adolescents who participate in sports have increased nutritional needs; adolescent athletes require a wide range of nutrients to support significant growth and physical development. This study aimed to examine the nutrition knowledge and eating habits of adolescent athletes in relation to their nutritional status in special sports classes and to identify the most well-understood basic nutritional concepts. The research was quantitative and descriptive, involving 133 students selected through simple random sampling. The research instruments included the NUKYA (Nutritional Knowledge for Young and Adult Athletes) questionnaire (covering macronutrients, hydration, eating periodization, micronutrients) and the Adolescent Food Habit Checklist. Results showed that 35% of students had adequate nutritional knowledge, while 65% had inadequate knowledge. Regarding eating habits, the characteristics of KKO students tend to lean towards healthy eating behaviors, with 77.4% exhibiting healthy habits and 22.6% unhealthy habits. Analysis of the nutritional knowledge section revealed that the highest percentage of knowledge was in sports nutrition periodization, while the lowest was in macronutrients. Based on the data, there was no significant relationship between nutritional knowledge ($p = 0.188$) or eating habits ($p = 0.848$) and nutritional status. However, comprehensive nutritional education is essential for adolescent athletes to develop into professional athletes. Providing education and optimal nutritional materials can improve their behavior and knowledge, leading to better health and sports performance.

Introduction

The nutritional intake factor is a key component for optimizing sports performance and exercise adaptation (Catháin et al., 2020) Coaching athletes during adolescence can help improve their physical function (Parmadi, 2020). During adolescence, unhealthy eating habits sometimes develop, such as frequently snacking outside of school or skipping breakfast when going to school (Safaei et al., 2021). Adolescent athletes involved in different sports need more calories, protein, or vitamins than others, and each sport has unique nutritional requirements (Gerber et al., 2023). Knowledge about sports nutrition is fundamental for adolescent athletes to develop healthy eating behaviors in daily life. Food choices influence habits and lifestyle patterns. Unhealthy eating habits can negatively impact nutritional status and overall health. Nutritional knowledge helps optimize performance and serves as an important resource for professional athletes (Bird & Rushton, 2020). An athlete's nutritional well-being depends on food choices based on personal knowledge (Hitendre et al., 2022). Athletes need to understand information about consuming a healthy and balanced diet and incorporate it with specific sports nutrition strategies relevant to their training and competition needs (Cherian et al., 2020). This research is expected to be an evaluation in monitoring the nutritional status of athletes and the nutritional knowledge of athletes so that it can provide an evaluation overview in the process of implementing athlete development in adolescence to support good performance and physical quality.

Method

This study used an analytical observational research design with a Cross-sectional research design. Data

✉ D. Nafilla, e-mail: dindanafilla7@gmail.com

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collection is carried out once on each subject and, at the same time, aims to provide an overview and situation. The sampling technique in this study was carried out by simple random Sampling using OpenEpi software, which is an application for calculating sample size in cross-sectional research with a margin of error (α) = 5%, confidence level (CI) = 95%, population size (N) = 192 (number of KKO students at SMPN 1 Surakarta and response distribution = 50%, so that the minimum sample size obtained from the calculation is 129 samples. The NUKYA (Nutritional Knowledge for Young and Adult Athletes) questionnaire is a standardized questionnaire consisting of 59 questions covering micronutrients, hydration, sports nutrition periodization, and macronutrients (Vázquez-Espino et al., 2020). NUKYA is measured by summing all correct answers from all questions, then categorizing based on total correct answers; if the answers are correct >60%, then nutritional knowledge is adequate, and if <60%, nutritional answers are inadequate (Jamil, 2022). We validated the NUKYA questionnaire as an effective tool to appraise nutrition knowledge in athletes. This questionnaire can be used for guiding in educational interventions, studying the influence of nutrition knowledge on nutrient intake and assessing/monitoring sport nutritional knowledge in large groups. The adolescent food habit checklist (AFHC) is an international questionnaire validated to measure adolescents' eating habits. The interpretation of the questionnaire is divided into healthy eating habits and unhealthy eating habits. All questionnaires used in this study were translated by a linguist and tested for validity, involving adolescent athletes, adolescent students, sports teachers, and nutritionists, with reliability and validity values for NUKYA (R = 0.895, p < 0.001) and (Cronbach's α=0.849) and AFHC (R= 0.90 p <0.001) and (Cronbach's α=0.83). The collected data will then be analyzed descriptively and analytically using SPSS 25 software and Microsoft Excel.

Participants

The population of this study was all students of the Sports Special Class at Surakarta Junior High School. The total student population of the special sports classes is 192 students.

The total number of research respondents was 133, with male respondents totaling 82 people (61.7%) and women amounting to 51 people (38.3%). The percentage of nutritional status of respondents was categorized into three based on the findings of the z-score calculation, with the category of undernutrition amounting to 4 respondents (3%), good nutrition 104 respondents (78%), and nutrition more than 25 respondents (19%). The respondents of the study were students in the early adolescent category, ranging from the age of 12-16 years, with a distribution of 12 years old 12 people (9%), 13 years old 42 people (31.6%), 14 years old 48 people (36.1%), 15 years old 29 people (21.8%) and 16 years old two people (1.5%).

Table 1
Respondent characteristics.

General Characteristics	n	%
Gender		
Male	82	61.7
Female	51	38.3
Ages		
12	12	9
13	42	31.6
14	48	36.1
15	29	21.8
16	2	1.5
Nutritional Status		
Under Nutrition	4	3
Normal	104	78
Overweight	25	19

Results

Nutritional Knowledge and Eating Habit

The NUKYA questionnaire measures nutritional knowledge based on accuracy in answering the questionnaire; if the answer is correct ≥ 60%, the category of nutritional knowledge is considered adequate (Jamil, 2022). Of all study respondents without differentiating characteristics (age, sport, and gender), 35% had adequate nutritional knowledge, and 65% had inadequate nutritional knowledge. While in the variable of eating habits, the characteristics of eating habits in KKO students tend to have healthy eating habits with a percentage of 77.4% and unhealthy eating habits with 22.6%. Bivariate analysis was carried out to determine the relationship between independent and dependent variables; in this study, the test was carried out using the chi-square test, and the chi-square test results were obtained if $p < 0.05$.

Table 2
Bivariate analysis the relationship of nutritional knowledge and eating habits with nutritional status.

Variables		Undernutrition		Normal		Overweight		df	*p*
		n	%	n	%	n	%		
Nutritional Knowledge	Adequate	2	1.5	39	29.3	6	4.5	1	0.188
	Inadequate	2	1.5	65	48.9	19	22.1		
Eating Habit	Healthy	4	3	80	60.2	19	14.3	1	0.848
	Unhealthy	0	0	24	18	6	4.5		

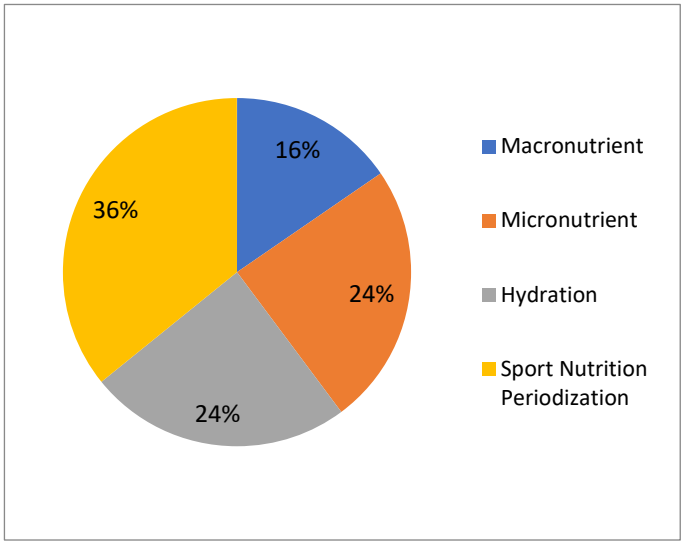

Figure 1. Percentage of Knowledge in NUKYA nutritional sub-section.

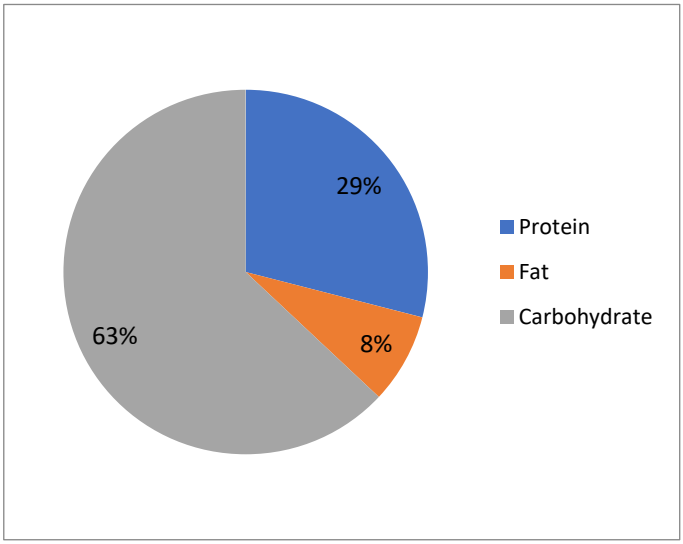

Figure 2. Percentage of Knowledge in Section Macronutrient.

The variable of nutritional knowledge and eating habits has a value of $p>0.05$, so it can be interpreted that there is no relationship between nutritional knowledge and eating habits with nutritional status in sports special class students.

Analysis of Nutritional Knowledge based on questionnaire

Further analysis was carried out to determine the picture of nutritional knowledge based on the material and question section of the questionnaire, which consisted of macronutrients (carbohydrates, proteins, and fats), micronutrients, hydration, and sports nutrition periodization.

Nutritional knowledge is basic information related to energy, proportions, types of nutrients, and eating habits applied by individuals. Nutritional knowledge plays an important role in influencing healthy food habits which ensures their nutrient needs during adolescence and later life (Raut et al., 2024). A person's level of nutritional knowledge influences attitudes and behavior in food selection, which ultimately will affect the nutritional status of the person concerned (Oktavia & Amelia, 2022). Based on the results of this analysis, something that needs to be considered is macronutrient knowledge, especially knowledge about fat. Most people assume that fat is a type of nutrient that should be avoided and is not needed by the body. This is in line with research (Pradigdo et al., 2023) on adolescent subjects who believe that consuming fat can make the body fat and fat lack of knowledge about the types of fat.

Table 3
NUKYA questionnaire table and average answers for each section.

Section	Question/Scope	Athletes with Correct Answer	Mean Scores
		n	%
Macronutrient (carbohydrate)			
	Identifying good food sources of carbohydrates (9 items).		66.8
	Should an athlete who wants to lose weight completely eliminate carbohydrates from his/her diet?	88	66.2
	Are carbohydrates stored in the muscle as glycogen?	93	69.9
Macronutrient (protein)			
	Does the muscle use protein as the main energy source during exercise?	51	38.3
	Identifying good food sources of protein (6 items).		37.9
Macronutrient (fat)			
	Do fats play an important role in the body?	75	56.4
	Do saturated and unsaturated fats have the same impact on health?	92	69.2
	Identifying foods with a high or low unsaturated fat content (9 items).		27.5
Micronutrient			
	How many servings of fruits and vegetables is recommended to eat per day?	64	48.1
	Can the human body get most of its vitamin D from sunlight exposure	104	78.2
	Are vitamins and minerals a good source of energy?	47	35.3
	Identifying good food sources of iron (8 items)		49.8
	Identifying good food sources of calcium (8 items)		46.9
Hydration			
	Your athletic performance will decrease if you lose 2% of your body weight (for example, 1.5 kg if you weigh about 75 kg) due to water loss.	64	48.1
	To be well hydrated during sports training, you have to wait until you are thirsty to drink.	78	58.6
	To fully rehydrate after exercise, you need to drink a volume of liquid greater than the volume of water lost during exercise (which we know by weighing yourself before and after training or competition).	97	72.9
	Fruit juice is a liquid suitable to drink in the training session and in the middle of the match	81	60.9
	Energy drinks are recommended for athletes to ingest during exercise.	89	66.9
	What do you think is the most suitable urine color before training?	53	39.8
	During intense or prolonged exercise, what is the best way to replace the water that is lost in the form of sweat?	63	47.4
	The percentage of carbohydrates in an isotonic sports drink.	53	39.8
Food intake periodicity			
	What is the optimum time to eat and drink something for kick-starting recovery after exercise or competition?	54	40.6
	The most important nutrient(s) to ingest after training.	87	65.4
	Should the last main meal (breakfast, lunch or dinner) be eaten at least 3–4 h before a competition/ exercise?	101	75.9

Table 3 shows the average accuracy of respondents in answering questions and the highest knowledge score is in the Sport Nutrition Periodization section, followed by hydration and micronutrients, and finally macronutrients. In the food identification section, the highest knowledge is in carbohydrates, with a mean score of 66.8%. In the micronutrient section, of the three macronutrients (carbohydrates, proteins, and fats), respondents had adequate knowledge in determining carbohydrate sources (66.8%). Meanwhile, in the micronutrient section, the most correct answers were in questions related to vitamin D. In the hydration section, the most correct answers were in the rehydrate after exercise section, while knowledge about urine color and sports drinks had the least number of correct answers in the hydration section. Meanwhile, in the final section, namely food intake periodicity, knowledge about meal planning was already known by 101

respondents with a mean score of 75.9%. Students in specialized sports classes have never received education related to nutritional status, nutritional knowledge, or eating habits. According to research conducted by (Raut et al., 2024) nutrition education is related to nutritional status and eating habits. The most frequently discussed and considered knowledge related to nutritional status for athletes is protein requirements. Protein is considered the most important nutrient for athletes, while carbohydrates and fats are nutrients to be avoided. This information must be clarified according to training needs. Media exposure for adolescents is a challenge that must be addressed wisely to ensure that adolescents receive the right information.

Discussion

Students of special sports classes are teenagers with high physical activity. The need for nutritional fulfillment in adolescence is essential for athletes in adolescence. From the results of the research conducted, based on four categories of nutritional material presented in the questionnaire, the highest accuracy and understanding is in the sports nutrition periodization 75.1%, hydration and micronutrients have the same percentage 51.1% and the last is macronutrient 32.3%. While in the subcategory of nutrients in the category of nutritional materials presented in the questionnaire, the highest accuracy and understanding is in the food periodization 75.1%, hydration, and micronutrients have the same percentage 51.1% and the last is macronutrient 32.3%.

Macronutrient

Nutritional knowledge of the macronutrient category has the lowest percentage of the other four categories. Macronutrients consist of 3 main parts: fat, protein, and carbohydrates (Zahra & Muhlisin, 2020). In the results of the macronutrient category research, the highest nutritional knowledge in the macronutrient section in a row from the highest to the lowest knowledge was in the carbohydrate (78.9%), protein (36.8%), and fat (9.7%) categories. However, most respondents could only identify foods containing fat, 27.5% correctly. As many as 44.6% of respondents did not consider fat a good function for the body. In line with the study's results, according to a qualitative study conducted (Cherian et al., 2020), the most general nutritional advice from trainers in Canada is about hydration and consumption of protein-rich foods. Fat or lipid is one of the nutrients needed by the body because it functions to provide the most energy compared to other nutrients, which is 9 kilocalories/gram and functions to dissolve fat-soluble vitamins such as A, D, E, K. In line with the results of the study by (Ernawati et al., 2019) found a tendency that the greater the age of the child, the greater the average fat consumption, but when children aged ten years and over where a child begins to enter early adolescence, it is seen that their fat consumption begins to decrease. Teenagers need energy not only used as energy materials but for growth needs, which means that limiting fat also has risks in meeting energy needs (Firmansyah & Prasetya, 2021). Sometimes athletes' assumptions about fat tend to be negative. Fat is a macronutrient with a long digestion time and tends to be stored when unused. So fat is considered the leading cause of being overweight and other health effects (Tsani et al., 2022) For this reason, it is necessary to provide an understanding of the weak, healthy that needs and is needed by athletes, especially adolescent athletes (Ernawati et al., 2019; Firmansyah & Prasetya, 2021; Zahra & Muhlisin, 2020).

Micronutrient

Micronutrients (micronutrients) are nutrients the body needs in small quantities but have an essential role in forming hormones and enzyme activity and regulating the function of the immune system and reproductive systems, which includes micronutrients, namely vitamins and minerals(Firmansyah & Muhammad RAP, 2021). From the results of research in the micronutrient category, 51.1% of respondents experienced adequate knowledge. 49.8% of respondents were able to identify food sources containing iron, and 46% of respondents were able to identify foods containing calcium. While the majority of respondents, 78.2%, understand that sunlight can help the absorption of vitamin D. Micronutrients are obtained from outside the body, such as from food or supplements, because the body cannot produce them in sufficient quantities according to the body's needs.

Hydration

Fluids function to maintain a stable body temperature and maintain acid-base balance in the body (Firmansyah & Prasetya, 2021). When a person lacks fluid because less fluid enters than the fluid that comes out, the person will experience dehydration. The human body consists of fluids and solids. Solids comprise 40%

of the human body, such as proteins, fats, minerals, carbohydrates, and organic and non-organic materials; the remaining 60% are liquids. Fluid balance is necessary to maintain blood volume, regulate body temperature and engage in muscle contraction (Zahra & Muhlisin, 2020). From the study results, as many as 51.1% of respondents have adequate nutritional knowledge. Consuming fluids replenishing fluids (rehydration) lost during exercise will restore fluids and maintain normal muscle function, help prevent decreased physical performance and reduce the risk of heat stress. A high percentage of knowledge related to post-workout rehydration/exercise has been known to most respondents, with 72.9% understanding that post-drinking. Exercise should be more than the volume of fluid lost during exercise. However, knowledge related to signs of dehydration seen from urine color was only known to 53 respondents (39.8%).

Sport Nutrition Periodization

Nutritional periodization is the management of nutrition during the periodization period, which aims to support physical exercise in athletes (Zahra & Muhlisin, 2020). Providing the proper nutritional intake to athletes can support the improvement of body performance due to the energy intake given following the needs of athletes (Firmansyah & Prasetya, 2021). 75.1% of respondents experienced adequate nutritional knowledge in the nutritional periodization category. Fulfillment of balanced nutrition is a priority for adolescent athletes, but determining meal times is equally essential for optimizing exercise performance and recovery. 49.4% of respondents need to learn the optimal timing for eating and drinking after sports/matches. Consumption of high-carbohydrate foods with high protein after exercise helps restore muscle glycogen (Firmansyah & Prasetya, 2021). Fulfillment of hydration should be done as soon as possible, while consumption of the main meal can be done 3 hours after training/match; this has been known by 75.9% of respondents. Food consumed three hours after exercise needs to be high in carbohydrates but low in fat and fiber so that the sugar in it will quickly flow into the blood and replace glycogen stores (Zahra & Muhlisin, 2020).

Conclusion

Providing proper nutrition to adolescent athletes will have an impact on the athlete's performance during training and competing. Nutrition will greatly help athletes improve performance through energy produced, delay fatigue, increase strength and focus, and speed up recovery. In sports nutrition, especially among athletes in adolescence, the adequacy of nutritional fulfillment is essential because it has an increased need for nutritional needs in growth. From the results of this study, it can be concluded that, in general, nutritional knowledge in adolescent athletes is inadequate (65%) and not relation with nutritional status as well as with eating habit ($p>0.05$). Inadequate nutritional knowledge will lead to decision-making in the selection and inappropriate eating habits. Of the four categories of nutritional material in the questionnaire, the highest accuracy and understanding is in the meter periodization of eating 75.1%, hydration and micronutrients have the same percentage 51.1% and the last is macronutrient 32.3%. Thus, comprehensive nutritional material must be given, especially to adolescent athletes, to provide a comprehensive and primary understanding of breeding professional athletes. Providing education and optimal nutritional materials will change the behavior and knowledge of adolescent athletes. This research is expected to highlight educational priorities for adolescent athletes. Providing gradual, structured education can bring about changes in athletes' nutritional knowledge.

Authors' Contribution

Study Design: DN, MAP; Data Collection: DN, MAP; Statistical Analysis: DN, MAP, A; Manuscript Preparation: MAP, A.

Ethical Approval

The study was approved by the Research Ethic Committee of Faculty Medicine Universitas Sebelas Maret Protocol ID: 01/02/12/185 and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki.

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Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this research.

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