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Nutritional Status of Young Athletes in Central Java, Indonesia

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Abstract

Proper nourishment is vital for persons who participate in physical activity and require increased amounts of important nutrients. Adolescents should give priority to this matter, as their developing bodies require greater nutritional requirements to support their growth and physical activity. An investigation carried out on adolescent athletes in Indonesia revealed that sports schools and athlete training facilities frequently encounter insufficient food consumption, which may have an impact on athlete performance and long-term well-being. The study aimed to examine the nutritional factors that influence body fat in young athletes who are enrolled in sports schools in Central Java, Indonesia. The study was conducted with the participation of 110 young athletes. The data for this study were analyzed using Pearson correlation and multiple linear regression. The result shows a relationship between gender, energy intake, protein intake, physical activity, and body fat percentage, as well as a correlation between age and BMI for age. The result of the multivariate analysis suggests that gender had the most effect on body fat percentage (r=0.77; p-value=<0.0001). Young athletes should receive comprehensive education and monitoring from certified experts to ensure eating and exercise habits that enhance performance and promote long-term health.

INTRODUCTION

Nutritional intake is crucial for individuals who engage in physical activity and have a heightened need for essential nutrients. Adolescents must prioritize this issue as their maturing bodies necessitate increased dietary needs to facilitate their growth and physical activity. The performance and achievements of young athletes depend heavily on providing an adequate energy supply and addressing their vital nutrient needs. (Szeja et al., 2017). Athletes, both junior and elite, are prone to dietary deficiencies according to several studies (Jenner et al., 2018a; Kim et al., 2019; Michael et al., 2019; Ong and Brownlee, 2017). A study conducted on adolescent athletes in Indonesia has found that sports schools and athlete training facilities often face inadequate dietary intake (Penggalih et al., 2018, 2017, 2016).

During adolescence, individuals are more susceptible to fluctuating emotions and actions about their bodies, such as changes in dietary patterns and physical activity. Studies have found that school-age teenagers have a significant occurrence of eating behaviors that are harmful to their health. Several factors in the environment might influence adolescent physical activity, such as parental attitude and encouragement towards sports participation, the amount of time spent outdoors, the geographical location, and the season (Macedo-Uchôa et al., 2019).

Researchers have conducted numerous studies to focus on the nutritional status of athletes and develop detailed nutrition guidelines. Nevertheless, there still needs to be more comprehensive knowledge regarding the nutritional status of young athletes due to the

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diverse range of sports and training methods. This situation necessitates extensive research and screening to ensure young athletes' proper growth and development (Chalcarz and Radzimirska-Graczyk, 2009). According to data acquired from the Football Association in Indonesia (PSSI) in 2014, it was found that 53.33% of body fat is considered excessive for a U-19 football athlete. Furthermore, it is observed that athletes often experience an elevation in their body fat levels during holiday tournaments. Research has also demonstrated that 27% of athletes undergo a rise in body weight during the off-season (Penggalih et al., 2017). Based on the given data, it is evident that the nutritional status of young athletes in Indonesia is suboptimal. This study aimed to assess the factors that influence the nutritional status of adolescents participating in school sports, such as nutrition intake and physical activity, and to conduct a comprehensive analysis of the nutritional status within this population.

METHOD

This descriptive study uses a cross-sectional design to analyze the relationship between nutrition intake, physical activity, and nutritional status of young athletes attending sports schools in Central Java, Indonesia. This research was carried out in 2023 at two sites, namely Student Sports Education and Training Center (BPPLOP), Semarang City, and Football Academy Safin, Pati Regency, with an ethical clearance number of 356/KEPK/EC/2023. The sites were selected because of their proximity and accessibility to the community, as well as the availability of the respondents required for the study, as they are among the leading sports schools in Central Java.

The research population consisted of male and female young athletes attending sports schools who were categorized in the young adult age group between 10 and 23 years old at the time of the interview. The chosen student-athletes participated in the sports games, such as football, basketball, sepak takraw, table tennis, volleyball, and softball. The minimum sample size required for the research was 100 young athletes, determined using the Lemenshow formula. A dropout rate of 10% was taken into account when selecting the research participants. The study included 124 young athletes from Central Java, Indonesia, using simple random sampling in the population of 138 young athletes, divided into 86 young athletes from BPPLOP and 38 young athletes from Safin. By the study's conclusion, the population had decreased to 110, as subjects withdrew due to being out of school, selection for regional sports competitions, illness, injury, and returning home.

Body weight was measured using the OMRON Digital Personal Weight Scale Type HN-289 (0.1 kg precision level), and height was measured using the GEA Wireless Body Height Meter Type HT-721 (0.1 cm precision level). Standard measuring techniques and standard equipment were used. Before height measurement, the respondent was asked to remove their footwear and headdress (if applicable). They were then requested to stand upright, facing the measurer, with their arms at their sides, feet flat on the floor, and heels firmly against the wall. In addition, participants were given instructions to maintain a direct gaze at eye level. To obtain a precise measurement, participants were instructed to take off their wristwatches or bracelets, eyeglasses, footwear, and hats, as well as empty their pockets (Gibson, 2005). The nutritional condition of the individuals was assessed using the World Health Organization's body mass index (BMI) and BMI-for-age categorization.

The thickness of the subcutaneous fat was measured using the Karada Scan Body Composition Monitor Type HBF-375. The energy and nutrient adequacy levels were obtained from interviews about daily food intake using a 24-hour recall. Three non-consecutive food recalls were conducted to measure the average food consumption by young athletes to consider their typical dietary intake. This method was used since it is a quantitative tool that is globally accepted for evaluating food consumption trends. A 24-hour food recall encompasses a comprehensive account of all food and beverages ingested, including the cooking techniques employed and the specific brand names (Gibson, 2005). The results of the interview regarding the average daily intake would be converted into units of calories (energy) and grams (macronutrients) and compared with the energy and nutrient requirements for athletes, who are based explicitly on TEE (Total Energy Expenditure) calculations.

The Bleep Test was employed for the quantification of physical activity. The Multistage Fitness Test (MSFT) is an alternative name for it. The 20 m MSFT is a widely used high-intensity running aerobic fitness test. The test consists of continuous jogging between two lines that are 20 meters apart while recording the sounds. Participants are required to persist in the test for as long as they can, until they are unable to reach the end line between two consecutive beeps or choose to quit the test themselves, typically due to fatigue. The acquired data was analyzed utilizing Microsoft Excel and SPSS 26. Univariate analyses were applied to describe data collection and convert it into valuable insights. Bivariate analyses were used to examine the association between physical activity, dietary intake, and nutritional status. The study employed the Pearson correlation test, followed by multivariate analysis with multiple linear regression, to conduct the statistical tests. The significance level (α) of this study was judged to be 5% (0.05).

RESULT AND DISCUSSION

Table 1 shows the participants' socio-demographic characteristics. The table stated that adolescent boys account for 74.5% of the total. A significant proportion of the participants (70.9%) were between the ages of 10 and 17, classified as adolescents based on the Indonesian Ministry of Health. Adolescents commonly fluctuate emotionally due to several rapid changes, especially physical transformations. These alterations often result in embarrassment or self-doubt over one's physical shape or low self-esteem. During adolescence, individuals are more vulnerable to peer influence, leading them to explore new activities that may harm their well-being. The environment often influences the health issues that teenagers commonly face, such as problems related to nutrition intake (National Academies of Sciences, 2019). Additionally, 50.0% of the participants were involved in soccer. Most participants had normal nutritional status based on BMI or BMI-for-age indicator (83.6%).

TABLE 1. Socio-demographic Characteristics of the Participants

Characteristics	n	%
Gender		
Boys	82	74.5
Girls	28	25.5
Age (year)		
10.0 – 17.9	78	70.9
18.0 – 23.0	32	29.1
Sports		
Basketball	11	10.0
Sepak takraw	22	20.0
Soccer	55	50.0
Softball	11	10.0
Table tennis	6	5.5
Volleyball	5	4.5
Nutritional status*		
Underweight	4	3.7
Normal	92	83.6
Overweight	12	10.9
Obese	2	1.8

*Nutritional status using BMI or BMI-for-age

TABLE 2. Anthropometric Measurements Result

Measurements	Total (n=110)	Boys (n=82)	Girls (n=28)
Body weight (kg)	59.33±7.71	60.93±0.82	54.65±1.27
Height (m)	167.33±8.83	170.42±0.83	158.26±1.07
BMI (kg/m2)	21.17±1.96	20.94±0.19	21.84±0.46
BMI/age (z score)	0.06±0.75	-0.02±0.08	0.33±0.17
Body fat (%)	16.42±6.20	13.42±0.36	25.21±0.75

TABLE 3. Nutrition intake and Physical Activity Result

Components	Total (n=110)	Boys (n=82)	Girls (n=28)
Energy (kkal)	2177.34±601.16	2317.74±65.34	1766.19±78.74
Protein (g)	85.82±22.96	90.83±2.44	71.14±3.61
Fat (g)	81.34±36.51	83.69±2.76	74.44±11.09
Carbohydrate (g)	285.89±98.58	301.76±11.04	239.43±14.92

Anthropometric measurements were conducted on all subjects to assess nutritional status and body fat percentage. The average nutritional status using the BMI or BMI-for-age indicator was normal, which was 21.17±1.96 kg/m2 for BMI and between -2 SD and +1 SD for BMI-for-age. The mean body fat percentage among participants was 16.42±6.20%. A higher body fat percentage was found in girls (25.21±0.75%) compared to boys (13.42±0.36%) (Table 2).

Table 3 shows the results of nutrition intake and physical activity. The means of energy, protein, fat, and carbohydrate intake were 2177.34±601.16 kcal, 85.82±22.96 gram, 81.34±36.51 gram, and 285.89±98.58 gram, respectively. The mean energy intake for both genders was pretty good—88.93% for boys and 83.05% for girls—of the required intake. To meet the energy requirement, adolescent boys need 2000–2650 kcal, and adolescent girls need 1900–2250 kcal (Ministry of Health, Republic of Indonesia, 2019). During adolescence, it is necessary to have sufficient energy to fulfill the requirements of both growth and development, as well as the energy demands associated with physical activity, training, and competition. The optimal energy consumption for adolescents is subject to variation based on their age, gender, and level of physical activity (Aerenhouts et al., 2011). Modifications in training and competition intensities, engagement in multiple competitive sports, part-time work, or simultaneous compensatory inactive behaviors can all influence the energy required. The energy required for growth, which is a part of the energy needs of teenage athletes, can be divided into two components: the energy utilized for synthesizing new tissues and the energy stored in the growing tissues (Desbrow, 2021).

Like the energy intake, the fat intake for both genders has met the standard. Compared to the Recommended Dietary Allowance (RDA), the respondents' fat intake already met 100.58% of the requirement for boys and 109.05% for girls. Sufficient consumption of dietary fat is necessary to fulfill the need for fat-soluble vitamins and essential fatty acids and supply energy to promote development and maturity (Petrie et al., 2004). Given the link between consistently elevated fat consumption and heightened risk of chronic diseases, the guidelines for the type and total amount of fat intake among adolescent athletes align with public health recommendations. Generally, these recommendations propose that dietary fat should comprise 20–30% of total energy consumed, saturated fatty acids should not exceed 10% of total energy intake, and trans-fats should be less than 1% of total energy intake (World Health Organization, 2018).

Regarding the protein intake, it was found that the respondents' intake for both genders was higher than standard (124.08% for boys and 112.37% for girls). Based on RDA, the protein intake for adolescent boys and girls should be within 65–85 g and 55–65 g, respectively. Protein is necessary for adolescents to facilitate overall growth and development and improve their ability to respond to exercise training (Petrie et al., 2004; Witard et al., 2019). During the highest growth phase, lean body mass can increase by roughly 2.3 grams per day in girls and 3.8 grams per day in males. This represents a threefold increase compared to the time before puberty (Desbrow, 2021). Furthermore, longitudinal data demonstrate that young individuals who engage in physical activity experience more substantial gains in lean body mass than their inactive counterparts (Baxter-Jones et al., 2008). An intake of around 1.5 grams of protein per kilogram of body weight per day should compensate for any amino acid losses caused by exercise, improve overall protein balance, and promote average growth and development in adolescent athletes (Aerenhouts et al., 2011).

Respondents' carbohydrate intake was quite good, with 76.73% of the requirement for boys and 77.13% for girls. Exercise duration and intensity impact patterns of carbohydrate use and the need for replenishing. Furthermore, both external and internal carbohydrate availability impact the training adaptations induced by exercise. Current research indicates that the consumption of carbohydrates in teenagers is similar to that of adults. The dietary carbohydrate requirements should be considered considering the training loads and competitive tendencies that typical adolescent athletes exhibit. There are multiple ways in which these differ from the efforts of adult athletes. Adolescent athletes often participate in many organizations, such as schools, clubs, and regions, which results in varying competition schedules and formats, including sports carnivals, representative events, and trials. Furthermore, it is customary for ambitious adolescent athletes to engage in various sports. It is crucial to consider the various energy demands and corresponding carbohydrate requirements, especially while participating in multiple sports simultaneously (Desbrow, 2021). A carbohydrate-rich diet improves both endurance and intermittent high-intensity performance due to an increased store of carbohydrates in the muscles and liver known as glycogen. It is generally established that athletes must replace glucose storage in the body, particularly during periods of hard training or competition. Consuming carbs during workouts lasting more than an hour can also improve performance and delay the onset of weariness. According to research, athletes who participate in intermittent sports like basketball and soccer should consume more carbs during training and competition. This is not surprising given that carbs, as opposed to protein and dietary fat, are the most efficiently broken down and digested form of energy in the body (usa.org). Studies have shown that a high-CHO diet improves endurance performance (Ahlborg et al., 1967; Karlsson and Saltin, 1971). High CHO availability is favorable for endurance exercise and high-intensity training (Hawley, 2002; Stellingwerff et al., 2006). To achieve glycogen super-compensation, athletes should consume a high CHO intake (10 g/kg) the day before a competition, around 36 hours after their last training session, and engage in physical inactivity (Domínguez et al., 2017; Thomas et al., 2016). However, it may not be necessary for low-intensity workouts (Thomas et al., 2016). The American College of Sports Medicine recommends appropriate nutrition during contests. However, there is no common prescription for optimal intake.

Bivariate analysis suggests a correlation between gender and physical activity and body fat percentage (p-value = 0.0001). However, the strength of its correlation was moderately positive (Table 4). Additionally, the intake analyses for energy (p-value = 0.0001), protein (p-value = 0.0001), and carbohydrates (p-value = 0.004) all showed a weakly positive and significant correlation with body fat percentage. The only intake that did not show a significant correlation with body fat percentage was fat (p-value = 0.387). There was no significant correlation between all independent variables and BMI (p-value >0.05) in the present study, and only the age variable correlated with BMI-for-age (p-value = 0.004) (Table 4).

The study found a strong positive link between energy, protein, and carbohydrate intake and body fat percentage. This means that an increase in calorie or macronutrient intake directly corresponds to an increase in body fat percentage (Jiménez, 2013). Adolescent athletes may engage in unhealthy weight-control practices, such as rapid weight loss or gain, dehydration ion, or use of supplements, to achieve a desired body composition or performance. These practices can have negative consequences for their health, growth, and development, as well as their performance and well-being (Mardiana et al., 2022). Therefore, young athletes must receive appropriate education, monitoring, and counseling from qualified professionals, such as sports dietitians, coaches, and physicians, to help them adopt healthy eating and exercise habits that promote optimal performance and well-being (Caine et al., 2016). An Athlete may require support to continue with performance-based nutrition plans in periods surrounding body composition assessment (Jenner et al., 2018b).

The bivariate analysis reveals a modestly positive correlation between physical activity and body fat percentage. The negative correlation indicates that higher physical activity levels may cause an elevated body fat percentage. The findings differ from those of other researchers, indicating a negative correlation (Dewi et al., 2021; Effendy et al., 2018; Mateo-Orcajada et al., 2022). In other words, the higher the level of physical activity, the lower the body fat percentage. Body fat percentage refers to the relative amount of fat mass in an individual's body. The body fat percentage (BFP) is directly and significantly associated with the elevation of risk factors for cardiovascular disease, including total cholesterol, triglyceride, low-density lipoprotein cholesterol, and fasting plasma glucose. According to the study, BFP is a better indicator of cardiovascular illness because it is more closely linked to BMI (Effendy et al., 2018).

Insufficient physical activity is not only linked to a higher percentage of body fat but also leads to a reduction in relative muscle mass. The greater the amount of muscle mass engaged during exercise, the more substantial the impact of the muscular pump on venous return. Hence, increasing muscle mass enhances cardiac output and overall physical fitness (Dewi et al., 2021). Enhanced physical exercise is also associated with muscular strength, flexibility, and satisfaction with life (Mateo-Orcajada et al., 2022). The other research showed that In this sample of middle-aged adults from the general community, physical activity was found to be inversely related to BMI and body fat percentage. Among those with the same BMI, those who were more active had a lower body fat percentage. Physical activity alone cannot maintain BMI and body fat overweight and high body fat percent in the population percent, but it can reduce the risk of overweight and high body fat percent in the population (Kesavachandran et al., 2009). A multivariate analysis performed using multiple linear regression revealed that carbohydrate intake had no significant effect on body fat percentage, so it was excluded from the modeling, and a reanalysis was carried out. The final result of the multivariate analysis demonstrates that gender, energy intake, protein intake, and physical activity were the variables that had a 64% effect on respondents' body fat percentage (Table 5). Age had no impact on BMI-for-age in

TABLE 4. Relationships Between Independent and Dependent Variables

Variable	%BF		BMI		BMI/age	
	Correlation (r)	p-value	Correlation (r)	p-value	Correlation (r)	p-value
Gender[a]	0.77	<0.001*	0.27	0.135	0.20	0.077
Age	0.10	0.320	0.17	0.348	0.32	0.004*
Energy intake	0.35	<0.001*	0.02	0.839	0.06	0.569
Protein intake	0.24	<0.001*	0.04	0.674	0.04	0.665
Fat intake	0.08	0.387	0.01	0.952	0.03	0.766
Carbohydrate intake	0.27	0.004*	0.01	0.949	0.09	0.342
Physical activity	0.44	<0.001*	0.17	0.084	0.15	0.118

*p-value <0.05: significant

TABLE 5. Multivariate Analysis of Body Fat Percentage

Variable	Coefficient B	p-value	R square
(Constant)		<0.001	
Gender	0.684	<0.001	
Energy intake	0.239	0.016	0.640
Protein intake	0.218	0.026	
Physical activity	-0.195	0.002	

this study after controlling for other variables.

Multivariate analysis suggests that gender, energy intake, protein intake, and physical activity significantly affect body fat percentage. Gender variable has the most substantial effect on body fat percentage. Adolescent boys generally exhibit a lower body fat percentage than girls due to their regular engagement in physical activities (Sitoayu et al., 2023). Boys have a body fat percentage of <25%, and girls have a body fat percentage of <35% when they have an average body weight (Marques-Vidal et al., 2008). It suggests that the majority of participants had a healthy body fat percentage. An elevation in body fat percentage typically signifies a disparity between energy intake and expenditure, resulting in the storage of excess intake as adipose tissue reserves. This ultimately contributes to an augmented BMI, heightened susceptibility to degenerative diseases, and the development of metabolic syndrome (Sitoayu et al., 2023). We did not investigate several dietary aspects related to the body fat percentage of adolescents, such as knowledge, snacking behaviors, and the use of dietary supplementation, which became limitations of this study.

CONCLUSION

In conclusion, the present study's findings show that energy intake, protein intake, and physical activity are important modifiable factors to be considered by young athletes, as those aspects impact body fat percentage. Young athletes should receive comprehensive education, monitoring, and counseling regarding their gender from certified experts to ensure eating and exercise habits that enhance their performance and promote long-term health.

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