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Nutrition Profile, Body Composition, Somatotype of Adolescent Football Athlete and It's Correlation with Performance

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Abstract

Background: *Performance in athletes is influenced by multiple factors, including the athlete's physical profile, technique, and tactics related to the sport being played. The objective of this research is to analyze the nutrition profile, body composition, and somatotype of adolescent football athletes and determine their correlation with athletes' performance. Methods: This study uses a quantitative descriptive technique with a measurement survey method. The study took place in June-August 2023, with 35 adolescent football athletes involved as respondents. The data obtained are presented in the form of a frequency distribution for each indicator. Statistical analysis with SPSS was conducted for correlation analysis. Results: Based on the results of the study, it is known that 86.11% of athletes have good nutritional status, and 13.89% of athletes have excess nutritional status. The results of measuring the percentage of body fat showed 77.78% in the normal category, 19.44% in the high category, and 2.78% in the low category. The dominant somatotype categories in athletes are endomorph and ectomorph. Statistical analysis shows that performance has significantly correlated with supraspinal skinfold (p=0.020), femur (p=0.027), and ectomorph (p=0.021). Conclusion: It can be concluded that for adolescent football athletes, body linearity and supraspinal fat folds are a significant influence on performance.*

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Pendahuluan

Performance in athletes is influenced by multiple factors, including the athlete's physical profile, technique, and tactics related to the sport being played (Amin, 2023). Other factors, such as sleep time and stress levels or the athlete's psychological condition, also affect the results of match performance (Pang et al., 2020; Walsh et al., 2021). Perez-Montilla et al stated that diet in athletes affects performance (Perez-Montilla et al., 2022). A studies also shown a relationship between body composition and somatotype that affects performance in athletes in various sports (Campa & Coratella, 2021).

Research conducted by Hansen et al stated that body composition will affect overall sports performance (Hansen et al., 2024). Increasing lean body mass and muscle mass will provide benefits to strength or power during the match. Tracking hydration status during training and matches also provides positive benefits for athlete performance (Hansen et al., 2024). Another thing is that body composition can be used to evaluate training strategies in athletes (Campa & Coratella, 2021). The gold standard for measuring body composition is densitometric, imagine with dual X-ray, and diluting technique. More affordable measurements can use formulas or formulas to determine the percentage of fat mass, muscle mass, or total body water (Campa & Coratella, 2021).

Somatotype is a type of body shape consisting of endomorph, mesomorph, and ectomorph. There are specific somatotype categories for each position in soccer players (Kolena et al., 2024). The majority of somatotype categories for soccer players are ectomorphic mesomorphic (Kolena et al., 2024). Martinez-Mireles et al stated that the results of a scoping review showed that in combat, speed, endurance, individual and team sports, the majority of somatotype categories were endomorphic mesomorphic. The endomorphic mesomorph category shows a body with a high percentage of muscle followed by fat. This condition supports strength and power from muscle mass and stability (Martínez-Mireles et al., 2025).

Nutrition profile, body composition, and somatotypes that corresponding to sports type can help optimize performance in athletes. Research related to the description of body composition or somatotype in youth athletes has been published, but there is limited research spesifically focusing on adolescent and using a combined, multidimensional approach that links all three indicators with performance. Therefor the objective of this research is to analyze nutrition profile, body composition, and somatotype of adolescent football athletes and determine their correlation with athletes performance.

Method

This study uses quantitative descriptive techniques with a measurement survey method. The study took place in June - August 2023 football athletes at one of football club in Yogyakarta. The sampling technique used was the total population. At the beginning of study, 45 athletes were measured. There were 9 athletes who did not complete the measurements, so they were not included in the data analysis. A total of 35 athletes were involved in the analysis both univariate and bivariate. Research permits were obtained from the Ethics Commission of Aisyiyah University of Yogyakarta No. 2793 / KEP-UNISA / VI / 2023. Measurements carried out included height using a microtoa tool. Measurement of body weight and fat percentage using the Bioelectrical Impedance (BIA) tool. Measurement of fat fold thickness / skinfold using a skinfold caliper tool. The spreading caliper tool is used to measure bone width (humerus and femur). The width of the limb circumference (upper arm and calf circumference) is measured using the metline tool. Nutritional status is determined using the age-appropriate body mass index (BMI / U) indicator which is calculated using WHO Anthro Plus. The athlete's somatotype or body shape is calculated using the Heath Carter formula to obtain endomorph, mesomorph, and ectomorph values. Performance was measured with VO2 max using Bleep Test.

The inclusion criteria used in this study were: 1) male athletes; 2) Athletes who have undergone training for at least 6 months; 3) Athletes who have participated in competitions at least at the provincial level. The exclusion criteria used in this study were: 1) Athletes who were injured so they could not train when data collection was carried out; 2) Athletes who were participating in training or competitions outside the region; 3) Athletes who were sick. Data collection was carried out at one time. There were 9 enumerators involved in this data collection. Enumerator training for the use of the tool was carried out to ensure standardization of measurements. The data obtained were presented in the form of a frequency distribution for each indicator. Data analysis was carried out with the help of Microsoft Excel to present descriptive data. Statistical analysis was used with SPSS software. Normality test was used to all variables, then Pearson correlation used to find out correlation of athlete performance with all variables. Data shows significant results when $p < 0.05$.

Results and Discussion

This study involved adolescent football athletes as respondents. At the beginning of study, 45 athletes were measured. There were 9 athletes who did not complete the measurements, so they were not included in the data analysis. A total of 35 athletes were involved in the analysis both univariate and bivariate. The nutritional status of athlets was seen using body max index according to age (BMI/A), this is because athletes are still in the adolescent category. Table 1 shows the results of nutritonal profile, body composition, somatotype of athletes. The results of statistical correlation also shows in the Table 1.

Skinfold in anthropometry measurements are generally used to estimate body fat and calculate somatotype. Skinfold measurements include several areas of the body covered by skin and adipose tissue between skin and muscle tissue (Padilla et al., 2021). Research conducted by Gradascevic and Bjelica showed that the skinfolds value of football athletes in the tricep, subscapula, and suprapinal were 6.91, 8.75, and 8.47 mm (Gardasevic & Bjelica, 2020). Compared with the results of this study, the skinfold values of respondents had a higher average (Table 1). This may be because the athletes involved in this stud were still in the adolescent category, while in the other study the average age of athlete was 22.75 years (Gardasevic & Bjelica, 2020).

Table 1. Results of nutritional status, body composition, somatotype and correlation with performance

Variables	Mean	Standar Deviation	Minimal Value	Maximal Value	p-Value[1]
Age (years) [2]	15.14	1.22	13.00	17.00	0.752
Weight (kg)	59.17	8.28	43.40	80.65	0.696
Height (cm)	169.74	6.88	156.50	189.00	0.054
BMI/A (z-score)	0.10	0.65	-1.38	1.41	0.416
Fat percentage (%)	13.99	4.14	5.60	24.50	0.431
Skinfolds					
Tricep (mm) [2]	10.89	5.40	5.00	31.00	0.057
Supraspinal (mm) [2]	10.06	3.21	5.00	17.50	***0.020***
Subscapula (mm)	9.82	2.10	6.50	15.00	0.631
Medialis betis (mm) [2]	15.17	10.32	7.00	54.00	0.081
Girth					
Humerus (cm) [2]	6.17	1.02	5.00	10.30	0.363
Femur (cm) [2]	7.95	1.65	5.30	13.90	***0.027***
Circumferences					
Upper arm (cm)	25.22	2.22	21.50	30.00	0.879
Calf (cm)	36.05	3.13	22.90	41.00	0.933
Somatotype					
Endomorph[2]	3.11	0.83	1.87	5.28	0.060
Mesomorph	2.43	1.47	0.30	5.26	0.564
Ectomorph	3.39	0.86	1.30	5.33	***0.021***
Performance (kg/ml/min)	48.82	3.16	42.20	57.10	-

[1] p-Value of Pearson correlation statistical analysis, significant $p < 0.05$; [2] Variables were not normally distributed, statistical analysis using Spearman

Bone width or known as biepicondylar breadth is the lateral distance between two epicondyle points that are parallel to the intracondylar (Vora & Patel, 2019). Estimation of the distance or width of the bone is an indicator to measure bone growth in athletes. A study that looked at the width of the humerus and femur bones in adolescent football athletes in Italy showed that an average humerus value 5.92 cm and femur 9.07 cm (Toselli et al., 2024). Another study showed that in elite female football athletes the avarage humerus value was 6.1 cm and femur was 8.9 cm (Strauss et al., 2021). When compared to the two studies, respondents involved in this study had wider humerus values and smaller femur.

Measurement of the circumference of the extrimities namely the curcumference of the upper arm and calf, was also carried out to calculate the somatotype. Based on research from Hansen et al changes in calf circumference are one of the indicators of change in muscle mass (Hansen et al., 2024). Other studies also mention the same result, upper arm circumference can be seen for changes in muscle mass (Kardani & Rustiawan, 2020). Research that looked at the upper arm and calf circumference in elite female football athletes showed an average value of 26.4 cm and 32.9 cm (Strauss et al., 2021). When compared to this value, the athletes who were respondents in the study had lower upper arm circumference values and larger calf circumference.

Various body composition measurements such as skinfolds, bone width, and limb width are used to determine the somatotype value. Somatotype reflects a significant body shape from body morfology. Changes in fat and muscle mass in the body will affect the somatotype values, therefor in some conditions somatotype is also used a selection for athletes (Jakovljević et al., 2022). In general, somatotype is divided into 3 including endomorph, mesomprh, ectomoprh. Endomorph reflects the condition of fat mass in the body, mesomorph shows muscle mass, and ectomorph the condition of the musculoskeletal bones in the body (Penggalih et al., 2020). The results of Table 1 shows that the highest somatotype value is ectomorph, then endomorph and mesomorph. This condition shows that overall the athletes involved involved have tall bodies with higher fat mass than muscle mass.

Table 2 shows the categories of nutritional status and body fat percentage of athletes. Nutritional status is one of the components that affects athlete's performance condition. Nutritional status reflects the amount of food consumed and energy use during exercise for athletes. Research by Hambali et al on junior athletes at Football School (SSB) showed that all athletes had normal nutritional status (Hambali et al., 2023). Other studies show that soccer athletes of the same age as the respondents still experience under nutrition (Miftah et al., 2023). On the other hand, an athlete may have overweight according to BMI because the indicator used for calculation is body weight which also consists of fat mass, muscle mass, and bone mass. If there is high muscle mass it can cause BMI value to be excessive, so it needs to be validated with other body composition measurement such as fat or muscle percentage.

Table 2. Frequency distribution of nutritional status and body fat percentage of athletes

Variables	Frequency (people)	Percentage (%)
Nutritional status		
Normal	31	86.11
Overweight	5	13.89
Fat percentage		
Low	1	2.78
Normal	28	77.78
High	7	19.44
Total	**36**	**100**

Fat mass reflects the condition of the percentage of adipose tissue in the body. Body fat percentage is categorized specifically for male athletes, where normal body fat is 10 – 20% (Penggalih et al., 2020). A study conducted by Rizal et al stated that the higher percentage of fat, the higher incidence of muscle fatigue (Rizal et al., 2020). Other studies have shown that the higher percentage of body fat in football athletes indicates lower cardiorespiratory performance (Damayanti & Adriani, 2021). Football is included in the aerobic sports category where research shows that this sport tends to have more muscular body composition (Martín-Rodríguez et al., 2024). Research on professional male soccer athlete shows fat percentage is 29.9% while muscle components 42.9% (Santofimio-Sierra et al., 2024).

Table 3 shows the various somatotype categories in athletes. In addition to endomorph, mesomorph, and ectomorph there are also other categories that are spesific to the values of each body type. The results show that 41.68% of athletes have endomorphic ectomorph category, 16% ectomorphic endomorph, and 13.89% endomorph ectomorph. These three somatotype categories (endomorphic ectomorph, ectomorphic endomorph, endomorph ectomorph) are the majority of respondents measured.

Table 3. Frequency distribution of somatotype categories athletes

Category Somatotype	Frequency (people)	Percentage (%)
Endomorphic ectomorph	12	41.68
Ectomorph	3	8.33
Ectomorphic endomorph	6	16.66
Endomorph	3	8.33
Endomorph ectomorph	5	13.89
Mesomorph	4	11.11
Mesomorphic ectomorph	3	8.33
Total	**36**	**100**

The endomorphic ectomorph category shows that the most dominant somatotype part is ectomorph and second is endomorph. The ectomorphic endomorph category shows that the largest part is endomorph followed by ectomorph. The endomorph ectomorph category shows that the values of the two parts are not significantly different (<0.5) (Penggalih et al., 2020). Based on the results of three largest somatotype categories, it can be concluded that dominant body type in athletes are bone and fats. The muscle part of the body seen from the mesomorph type is only seen in 11.11% athletes. Statistical analysis of correlations between performance with another variable also shows the same results. From Table 1 it can concluded that ectomorph, femur girth, and supraspinal skinfold have significant correlations with athletes performance. Ectomorph and femur girth are part of the body bones, while supraspinal skinfold portray fats under supraspinal skin.

There are various factors that influence nutritional status, body composition, and somatotype in athletes. Factors that influence food selection and intake, sport performed, gender, genetics, age, and match schedule in athletes (Malsagova et al., 2021; Walker et al., 2022). The age of athletes also influences values of somatotype. Research shows that in U-20 soccer athletes, there are significant differences in somatotype value in the endomorph and mesomorph part between each position on the football games, while in the U-19 age group differences are only seen in the mesomorph section (Nobari et al., 2021; Zambrano-Villacres et al., 2024). This could be due to the different conditions of accelerated growth or maturity status in athletes due to age differences (Čaušević et al., 2023).

Research conducted by Penggalih et al (2021) on senior elite soccer athletes, showed the somatotype categories they had, namely balanced mesomorph, endomorphic mesomorph, and ectomorphic mesomorph. The three somatotype categories show the most dominant mesomorph part values. The mesomorph ectomorph somatotype category has a positive relationship with explosive performance and VO2 max, while the mesomorph endomorph category is known to be positively related to power output (Çinarli & Kafkas, 2019; Paradya et al., 2024). Research conducted on elite athletes shows that ectomorph values are more dominant than endomorph values (Esteve-Ibáñez et al., 2025). Also another study shows the somatotype of athletes are balanced mesomorphs (Puspaningtyas et al., 2022). The value of mesomorph and endomorph significantly different beside professional and amateur athletes (Leko et al., 2024).

In spite of all, scoping review about soccer athletes shows the somatotype category for male is endomorphic mesomorph (Martínez-Mireles et al., 2025; Petri et al., 2024). This category of somatotype has tendency of dominant muscle mass followed by fat component. The majority of somatotype categories are endomorphic ectomorph (41.68%), ectomorphic endomorph (16.66%), and endomorph ectomorph (13.89%) according to Table 3. Correspondingly the result, athlete somatotype categories are still not match with the recommendation. There are factors that cause an inappropriate somatotype include an imbalance in nutritional intake especially protein, an inappropriate training program, the quality of rest and recovery, and the athlete's age and development stage (Penggalih et al., 2020).

To adjust the appropriate somatotype still requires an increase in mesomorphic values. Mesomorphic values are associated with low carbohydrate and high protein consumption in athletes (Baranauskas et al., 2024). Also a study state that mesomorph has a strong correlation with daily energy consumption (Esteve-Ibáñez et al., 2025). Daily energy consumption of athletes needs to be calculated specifically according to the level of training and physical activity performed. Increasing protein intake 1.2 - 1.7 gr/kg body weight is recommended in an effort to increase muscle (Penggalih & Solichah, 2018). Daily carbohydrate requirements can be reduced below 65% and choosing complex carbohydrates that can provide a longer feeling of fullness (Cao et al., 2021). The average time required for protein formation with diet and exercise modifications is between 6 - 10 weeks (Krzysztofik et al., 2019).

Conclusion

Based on the results of the study, it is known that 86.11% of athletes have good nutritional status and 13.89% of athletes have excess nutritional status. The results of body fat percentage measurements showed 77.78% normal category, 19.44% high category, and 2.78% low category. The dominant somatotype categories in athletes are endomorph and ectomorph. Statistical analysis shows that performance has significantly correlated with supraspinal skinfold (p=0.020), femur (p=0.027), and ectomorph (p=0.021). It can be concluded that for adolescent football athlete body linierity and supraspinal fat folds be a significant influence on performance. Throughout this finding, there are several improvement to do as well as increasing training time, focusing on exercises to increase muscle mass, and modifying daily food intake. Future research could consider intake and exercise factors for a more comprehensive approach.

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