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Anthropometric assessment of nutritional status among young football athletes

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Abstract

Background: Nutritional status is an important component of growth and development in young football athletes. Differences in growth and maturation may result in variations in nutritional status among athletes of similar age. **Objective:** This study aimed to describe the nutritional status of early-age football athletes at SSB Jaguar Muda Malang. **Methods:** This descriptive study involved 21 male football athletes aged 10–13 years at SSB Jaguar Muda Malang, selected using total sampling. Body weight and height were measured to calculate body mass index (BMI), and nutritional status was determined using BMI-for-age Z-scores based on the WHO 2007 reference. **Results:** Of the 21 athletes assessed, 13 athletes (61.9%) had normal nutritional status, 7 athletes (33.3%) were classified as overweight, and 1 athlete (4.8%) was classified as obese. Thus, 8 athletes (38.1%) had excess nutritional status. These findings indicate that although most athletes had normal nutritional status, a considerable proportion had excess nutritional status. **Conclusion:** Most early-age football athletes at SSB Jaguar Muda Malang had normal nutritional status. However, the presence of overweight and obese athletes highlights the importance of regular anthropometric and nutritional monitoring to support healthy growth and sustainable athlete development.

Keywords: Nutritional Status; BMI-For-Age; Young Football Athletes; Anthropometry; Youth Football

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INTRODUCTION

Nutritional status is a fundamental determinant of healthy growth, physical development, and overall well-being during childhood and adolescence. During this period, substantial changes occur in body size, body composition, physiological function, and biological maturation. Adequate nutritional intake is essential to support these developmental processes and the additional demands of regular training and competition among young athletes (Desbrow, 2021; Norris et al., 2022).

Youth football involves repeated running, acceleration, deceleration, changes of direction, and intermittent high-intensity activities. Although regular participation may contribute to favourable body composition and physical fitness, individual responses vary according to age, training

exposure, dietary intake, and biological maturation (Hernandez-Martin et al., 2021). Anthropometric characteristics and biological maturity are also associated with physical performance and athlete development, highlighting the importance of monitoring growth alongside physical and technical training (Dut et al., 2023; Toselli et al., 2024).

Nutritional management is particularly important for young football athletes because their dietary requirements must support both growth and exercise. Inadequate intake and inappropriate fuelling or recovery practices may compromise energy availability, recovery, training adaptation, and long-term health (Stables et al., 2024). Nutrition knowledge and appropriate dietary behaviors are therefore important components of youth athlete development (Irwin et al., 2026). Conversely, overweight and obesity remain concerns among physically active children and may increase the risk of future non-communicable diseases (WHO, 2025). Evidence from Indonesian schoolchildren also indicates that excessive body weight remains an important public health concern (Widyahening et al., 2023). Consequently, regular sports participation does not eliminate the need for systematic nutritional monitoring.

Anthropometric assessment provides a practical approach to monitoring growth and nutritional status. Body weight and height can be used to calculate Body Mass Index (BMI), while BMI-for-age Z-scores (BAZ) enable age- and sex-specific interpretation. For children and adolescents aged 5–19 years, the WHO 2007 Growth Reference classifies overweight as BAZ greater than +1 SD, obesity as greater than +2 SD, thinness as below −2 SD, and severe thinness as below −3 SD (World Health Organization, 2007, 2025). However, BMI is an indicator of nutritional status rather than a direct measure of body fat or body composition. Because body size and muscular development vary with age, sex, and biological maturation, BMI-for-age should be interpreted within the developmental context of young athletes (World Health Organization, 2025; Dut et al., 2023; Toselli et al., 2024).

Despite growing interest in youth sports nutrition, evidence concerning the nutritional status of young athletes in grassroots football-school environments remains limited. Previous research has examined general

school populations, academy or elite football players, and relationships between dietary intake, body composition, and physical performance (Hernandez-Martin et al., 2021; Mardiana et al., 2023; Toselli et al., 2024). However, findings from these populations may not fully represent local football schools, where access to professional nutritional support and monitoring may differ. In Indonesia, context-specific evidence on the nutritional profiles of young football athletes in grassroots settings remains relatively limited, despite the importance of early identification of nutritional concerns.

Jaguar Muda Malang Football School provides a relevant setting for examining the nutritional status of young football athletes. Athletes aged 10–13 years are undergoing substantial growth and developmental changes, making anthropometric monitoring particularly important for identifying nutritional patterns and establishing baseline information for athlete development.

Therefore, this study aims to assess the nutritional status of male football athletes aged 10–13 years at Jaguar Muda Malang Football School using anthropometric measurements and BMI-for-age Z-scores based on the WHO 2007 Growth Reference. The findings are expected to provide context-specific evidence to support nutritional monitoring in grassroots football development. Given the relatively small sample and single-school setting, the results are intended primarily to describe the characteristics of the participants rather than to represent all young football athletes.

METHOD

Community Service Program and Participants

This anthropometric assessment was conducted as part of a community service program (Pengabdian kepada Masyarakat/PkM) at Jaguar Muda Malang Football School. The program included anthropometric assessment and nutritional-status screening intended to provide information regarding the nutritional condition of young football athletes and to support awareness of nutritional monitoring in youth football development.

The participants consisted of 21 male football athletes aged 10–13 years who were actively involved in the football school's regular training activities.

All eligible athletes participating in the community service program were included in the anthropometric assessment. Thus, the assessment involved the entire accessible group of athletes participating in the program rather than a sample selected for inferential research purposes.

Because the assessment was conducted in a single football school and involved only male athletes aged 10–13 years, the findings describe the nutritional-status profile of the participating group. The results should therefore not be generalized to young football athletes from other football schools, regions, age groups, or populations.

Anthropometric Assessment

Anthropometric assessment was performed to obtain body weight and standing height as indicators for nutritional-status screening. Body weight was measured using a digital weighing scale, while standing height was measured using a microtoise. Measurements were performed without shoes using standardized anthropometric procedures.

Body mass index (BMI) was calculated from body weight and standing height using the following formula:

$$\text{BMI} = \text{body weight (kg)} / \text{height}^2 (\text{m}^2) \quad (1)$$

BMI was used as an anthropometric screening indicator of nutritional status and not as a direct measure of body composition. BMI cannot distinguish between fat mass and lean mass. This limitation is particularly relevant among young football athletes because differences in muscular development and biological maturation may influence body weight and BMI. Accordingly, the results were interpreted as indicators of nutritional status rather than direct measures of body composition.

Nutritional-Status Classification

Nutritional status was assessed using the BMI-for-age Z-score (BAZ) based on the WHO 2007 Growth Reference for children and adolescents aged 5–19 years (World Health Organization, 2007). BAZ was determined according to the participant's age and sex.

Table 1. The nutritional-status classification

BAZ	Nutritional Status
< −3 SD	Severe thinness
≥ −3 SD to < −2 SD	Thinness
≥ −2 SD to ≤ +1 SD	Normal
> +1 SD to ≤ +2 SD	Overweight
> +2 SD	Obesity

The complete WHO classification was retained in the assessment framework. Categories with no participants were reported as zero or omitted from the descriptive presentation when appropriate. Therefore, if no participants were classified as severe thinness or thinness, the observed results may be presented only for the categories identified in the participating group, such as normal, overweight, and obesity.

Data Analysis

The anthropometric data obtained through the community service program were analyzed descriptively to describe the nutritional-status profile of the participating athletes. Continuous variables, including age, height, weight, BMI, and BAZ, were summarized using mean ± standard deviation (SD), together with minimum and maximum values. Nutritional-status categories were presented as frequencies (n) and percentages (%).

BMI was calculated from measured body weight and height, while BAZ was determined according to the WHO 2007 Growth Reference for children and adolescents aged 5–19 years. The analysis was limited to descriptive statistics and did not involve hypothesis testing, association analysis, or causal inference.

Ethical and Participant Protection Considerations

The anthropometric assessment was conducted as part of a community service program and was not originally designed or conducted as a formally ethics-reviewed research study. Accordingly, the activity did not receive prior approval from an institutional research ethics committee, and no ethical approval number is reported.

Because the participants were children aged 10–13 years, participant protection and appropriate permission were considered during the implementation of the program. Participation in the anthropometric assessment was voluntary and was coordinated with the football school's

management. Information obtained from individual participants was treated confidentially, and no personally identifiable anthropometric information was disclosed in the presentation of the results.

The authors acknowledge that the absence of formal prior ethical review is an important limitation when the activity's data are subsequently presented in a scientific publication. The findings should therefore be understood as descriptive results obtained from a community service-based anthropometric assessment rather than as evidence generated from a prospectively ethics-approved research study. Future community service activities involving systematic data collection and publication, particularly those involving children, should incorporate appropriate ethical review and documented parental or legal-guardian permission before data collection.

RESULT

Participant Characteristics

The community service-based anthropometric assessment involved 21 male young football athletes aged 10–13 years from Jaguar Muda Malang Football School. The participants had a mean age of 141.14 ± 9.86 months, with ages ranging from 121 to 157 months. The mean standing height was 146.10 ± 9.71 cm (range: 125.50–172.80 cm), while the mean body weight was 39.87 ± 9.07 kg (range: 24.45–64.15 kg).

Anthropometric Characteristics

The anthropometric characteristics of the participating athletes are presented in Table 1. The mean BMI was 18.44 ± 2.22 kg/m², with individual values ranging from 15.33 to 22.41 kg/m². The mean BMI-for-age Z-score (BAZ) was 0.89 ± 0.61 SD, with values ranging from 0.00 to 2.10 SD.

Overall, the descriptive anthropometric data indicated variation in body size among the participating athletes. The BAZ values also showed variation in nutritional status, with most participants falling within the normal range, while several participants were classified as overweight and one participant as obese according to the WHO 2007 Growth Reference.

Table 2. Descriptive Anthropometric Characteristics of Young Football Athletes

Variable	Mean ± SD	Minimum	Maximum
Age (months)	141.14 ± 9.86	121	157
Height (cm)	146.10 ± 9.71	125.50	172.80
Weight (kg)	39.87 ± 9.07	24.45	64.15
BMI (kg/m²)	18.44 ± 2.22	15.33	22.41
BMI-for-Age Z-score (BAZ)	0.89 ± 0.61	0.00	2.10

Nutritional Status

The distribution of nutritional status based on BMI-for-age Z-score (BAZ) is presented in Table 2. Of the 21 participants, 13 athletes (61.9%) were classified as having normal nutritional status (BAZ ≥ −2 SD to ≤ +1 SD). Seven athletes (33.3%) were classified as overweight (BAZ > +1 SD to ≤ +2 SD), while one athlete (4.8%) was classified as obese (BAZ > +2 SD).

No participants were classified as having thinness (BAZ ≥ −3 SD to < −2 SD) or severe thinness (BAZ < −3 SD). Thus, although the complete WHO classification was applied, the observed nutritional-status categories in this group were limited to normal, overweight, and obesity.

Table 3. Distribution of Nutritional Status Based on BMI-for-Age Z-score

Nutritional Status	BAZ Classification	n	%
Severe thinness	< −3 SD	0	0.0
Thinness	≥ −3 SD to < −2 SD	0	0.0
Normal	≥ −2 SD to ≤ +1 SD	13	61.9
Overweight	> +1 SD to ≤ +2 SD	7	33.3
Obesity	> +2 SD	1	4.8
Total		**21**	**100.0**

The findings indicate that 8 of the 21 athletes (38.1%) were above the normal nutritional-status range, consisting of seven athletes classified as overweight and one classified as obese. The highest individual BAZ value was 2.10 SD, corresponding to the participant classified as obese.

DISCUSSION

The variations in nutritional status among young football athletes reflect individual differences in growth, body composition, and biological maturation. Chronological age alone may not adequately represent developmental status because maturation influences anthropometric characteristics and physical performance. Differences in growth and maturation have also been reported

between selected and unselected young football players (Portella et al., 2023; Toselli et al., 2024). Therefore, developmental characteristics should be considered when interpreting the physical profiles of youth athletes.

The predominance of normal nutritional status in the present study is consistent with findings of generally favourable nutritional profiles among young football players. Staśkiewicz et al. (2023) examined age-related variations in body composition and nutritional awareness among football players, while Solichah and Putriana (2025) found that most adolescent football athletes had good nutritional status, although some had excess nutritional status. These findings suggest that regular participation in football does not necessarily prevent excess weight. Nutritional status may also be influenced by dietary intake, training load, daily physical activity, sedentary behavior, and individual growth requirements.

The presence of athletes with excess nutritional status requires careful interpretation because body mass comprises both fat mass and fat-free mass. Although BMI is a practical screening indicator, it cannot distinguish these components and may be influenced by growth and maturation. Complementary anthropometric and body-composition assessments are therefore recommended to avoid interpreting increased body mass as excessive adiposity without considering individual development (Tornero-Aguilera et al., 2022; Portella et al., 2023).

The relationship between nutritional status, body composition, and physical performance is multidimensional. Body composition has been associated with physical fitness, lower-body power, speed, and agility in youth soccer players, although these relationships may vary according to age, maturation, playing level, and performance characteristics (Leão et al., 2022; França et al., 2024). Anthropometric and maturation-related differences between selected and unselected players further emphasize the relevance of developmental characteristics in athlete assessment (Toselli et al., 2024). However, no single anthropometric indicator can adequately explain football performance among developing athletes.

Regular football participation may contribute to favourable body-composition outcomes. A systematic review and meta-analysis of 20 studies

involving 2,906 children and adolescents aged 8–17 years found that recreational football was associated with reductions in BMI, body-fat percentage, and waist circumference, alongside a small increase in lean mass, although methodological heterogeneity limited the certainty of the evidence (Lei et al., 2026). Nevertheless, the cross-sectional design of the present study does not establish whether football participation caused the nutritional profiles observed.

Nutrition is essential for supporting growth, training, recovery, and performance in young football athletes. North et al. (2022) highlighted the nutritional demands associated with growth and intensive training among high-performance youth soccer players. Although nutrition education improved nutritional knowledge among young football players, Vicente et al. (2025) found no significant overall improvement in dietary adherence, suggesting that knowledge alone may not consistently translate into behavioural change. Previous studies have examined sports nutrition knowledge and carbohydrate intake among young elite football players (Tomljanovic et al., 2025) and the relationships between nutritional knowledge, body composition, and cardiopulmonary exercise performance in adolescent football players (Dumitrescu et al., 2026). Nutritional guidance should therefore address energy availability, carbohydrate and protein intake, hydration, food quality, and recovery while accounting for individual developmental needs.

Longitudinal monitoring is important because body composition may change with growth, maturation, and training. Changes in body composition across pre-season and in-season periods have been reported among adolescent soccer players, while differences in body-composition characteristics have also been examined across playing positions (Zaccagni et al., 2025; Łuszczki et al., 2025). These findings support individualized monitoring that considers athletes' developmental changes and positional demands rather than applying the same body-composition targets to all players.

Practically, anthropometric monitoring can help coaches and support staff identify athletes who may require further assessment or nutritional

guidance. However, BMI and body mass should not be used as standalone indicators of health or performance. A comprehensive approach should integrate age- and sex-specific anthropometric measures, biological maturation, body composition, physical fitness, dietary intake, training load, and health status (North et al., 2022; Victoria-Montesinos et al., 2026). Collaboration among coaches, parents, athletes, and qualified nutrition or health professionals is also important. Although nutrition education can improve nutritional knowledge (Vicente et al., 2025), broader evidence suggests that educational and behavioral interventions may also improve dietary practices, hydration, body composition, and aspects of performance in youth team sports (Victoria-Montesinos et al., 2026). Nutritional management should consequently be integrated into long-term athlete development rather than restricted to competition periods or athletes with apparent weight-related concerns.

Overall, the predominance of normal nutritional status in the present study is encouraging, although the presence of athletes with excess nutritional status highlights the need for continued monitoring. Football participation alone does not guarantee optimal nutritional health. Longitudinal and individualized approaches integrating anthropometric assessment, body-composition monitoring, nutrition education, appropriate training loads, and healthy lifestyle practices may better support healthy growth, recovery, and sustainable athlete development.

CONCLUSIONS

The findings indicate that most young football athletes at SSB Jaguar Muda Malang have normal nutritional status, although a small proportion were classified as overweight or obese. The mean BMI and BMI-for-age Z-score (BAZ) generally reflect a favourable nutritional profile; however, individual variations highlight the importance of regular nutritional monitoring during growth and development. These variations may be associated with differences in biological maturation, dietary intake, and physical activity, although these factors were not directly examined in this study.

Future research should investigate dietary intake, physical activity outside training, and eating behaviours, as well as employ longitudinal

designs to monitor changes in nutritional status throughout growth and maturation. Collaboration among coaches, parents, and qualified sports nutrition professionals is also recommended to support appropriate nutritional guidance and the healthy, sustainable development of young football athletes.

AUTHOR CONTRIBUTIONS

Conceptualization: B.A.H., G.E.P.M., M.R.A., & W.D.Z.; Methodology: B.A.H., G.E.P.M., M.R.A., & W.D.Z.; Investigation: B.A.H., G.E.P.M., M.R.A., & W.D.Z.; Data curation: B.A.H., G.E.P.M., M.R.A., & W.D.Z.; Formal analysis: B.A.H., G.E.P.M., M.R.A., & W.D.Z.; Project administration: B.A.H., G.E.P.M., M.R.A., & W.D.Z.; Visualization: B.A.H., G.E.P.M., M.R.A., & W.D.Z.; Writing – original draft: B.A.H., G.E.P.M., M.R.A., & W.D.Z.; Writing – review & editing: B.A.H., G.E.P.M., M.R.A., & W.D.Z. All authors have read and approved the final version of the manuscript and agree to be accountable for the integrity and accuracy of the work.

ETHICAL STATEMENT

The study was conducted in accordance with ethical principles for research involving human participants. Formal permission to conduct the study was obtained from the relevant educational authorities and Jaguar Muda Malang Football School prior to data collection. The research procedures were coordinated with the coach before the study was conducted.

INFORMED CONSENT

Written informed consent was obtained from the participants' parents or legal guardians prior to participation in the study. In addition, assent was obtained from all participating students. Participation was voluntary, and participants were informed that they could withdraw from the study at any time without penalty.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) solely to improve language, grammar, and readability. After using this tool, the authors reviewed and edited the content as needed and take full

responsibility for the accuracy, integrity, and content of the publication.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest with any party in the implementation of this research.

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