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Anthropometric Profile and Physical Condition of Young Futsal Athletes Reviewed from a Sports Physiology Perspective

Irana Mery Alviana[1], Qorry Armen Gemael[1], Rafa Dinnantra Limastyningrum[1], Muhammad Lutfanpadil[1], Irfan Marhandika[1], Muhammad Rifky Arifin[1], Ajri Nurli Almuhtadi[1]

[1]*Sport Science/Faculty of Health Sciences, Universitas Singaperbangsa Karawang, Indonesia*

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Abstract

This study aims to analyze the anthropometric profile and physical condition of adolescent futsal athletes and relate them to aspects of sports physiology. The method used is descriptive quantitative with 10 futsal athletes aged 14–16 years as research subjects. The instruments used include anthropometric measurements (weight, height, and body mass index/BMI), speed (20-meter sprint), power (vertical jump), strength (wall sit, push-up, sit-up), and cardiorespiratory endurance (12-minute Cooper test). Data analysis was carried out using descriptive statistics in the form of minimum, maximum, average, and standard deviation values. The results showed that the average BMI of athletes was 18.94 kg/m² in the normal category. The speed component had an average of 3.32 seconds (moderate category), power was 42.20 cm (moderate category), muscle strength showed varying results with moderate to good categories, and cardiorespiratory endurance was 2216 meters (moderate category). Physiologically, these results indicate that futsal athlete performance is influenced by the interaction of the anaerobic, aerobic, and neuromuscular energy systems. The study concluded that the athletes' general physical condition was moderate to good, but improvements in aerobic endurance and muscle power were still needed. Therefore, it is recommended to implement exercise physiology-based training programs such as high-intensity interval training (HIIT) and plyometric training to optimally improve the performance of adolescent futsal athletes.

Keywords: *anthropometry, physical condition, futsal, sports physiology.*

INTRODUCTION

Futsal is a high-intensity sport characterized by intermittent activity such as sprinting, acceleration, deceleration, and rapid changes of direction. This activity demands complex physical abilities, particularly the body's energy systems, which

Correspondence author: Irana Mery Alviana, Universitas Singaperbangsa Karawang, Indonesia
Email: irana.mery@fikes.unsika.ac.id

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work simultaneously between aerobic and anaerobic (Spyrou et al., 2020). Futsal falls into the category of intermittent high-intensity sports, where players perform repetitive, high-intensity activities for short periods followed by short recovery periods. This results in dynamic and complex energy demands during a match.

Research shows that the aerobic energy system plays a significant role in supporting futsal performance, particularly in sustaining repetitive activity throughout the match (Spyrou et al., 2020). This system plays a role in energy recovery after anaerobic activities such as sprinting. Furthermore, the anaerobic system (ATP-PC and glycolytic) plays a role in explosive activities such as short sprints and jumps. Therefore, speed and power are crucial components of futsal.

Anthropometric components such as height and weight also play a crucial role in determining movement efficiency and athlete performance. Athletes with ideal body composition tend to have better energy efficiency during play (Bonilla et al., 2022). During adolescence, physiological development is still ongoing, including the development of the cardiorespiratory and neuromuscular systems. This leads to significant variation in physical performance between individuals (Armstrong & McNarry, 2016). VO_2max is a key indicator for assessing an athlete's aerobic capacity and correlates with the ability to maintain playing intensity over long periods (Grzebisz-Zatońska et al., 2022).

Recent research (Febriliana et al., 2025) shows that exercises such as high-intensity interval training (HIIT) and speed endurance training effectively improve aerobic capacity in futsal performance. (de Carvalho e Silva et al., 2022) state that in addition to endurance, muscle strength, and explosive power, these components, related to the neuromuscular system, also play a crucial role in supporting technical and tactical performance during matches.

Thus, evaluating the physical condition of futsal athletes is crucial for understanding their physiological profiles and determining appropriate training programs. Based on this background, this study aims to analyze the anthropometric profiles and physical condition of adolescent futsal athletes and relate them to the principles of exercise physiology.

METHOD

This study adhered to ethical research principles. The researcher obtained permission from the school before collecting data. Participants were given an explanation of the research objectives and procedures before administering the test. Confidentiality of respondent data was strictly maintained, and all research activities were conducted with the safety and comfort of participants in mind.

Research Type

This study employed a quantitative approach with descriptive methods. The quantitative approach was chosen because the data obtained were numerical anthropometric test results and the athletes' physical condition. The descriptive method was used to systematically, factually, and accurately describe the physical condition of futsal athletes without providing any specific treatment. This study design was cross-sectional, meaning data collection was conducted over a specific period of time to determine the athletes' actual condition.

Place and Time

This research was conducted at a junior high school (MTS) in Batujaya, Karawang, on April 30, 2026. The location was selected based on the presence of active futsal extracurricular activities, the production of young athletes, and the ease of data collection.

Population and Sample

The population in this study was students participating in futsal extracurricular activities. The subjects in this study were all students participating in futsal extracurricular activities, with a total of 10 students. The sampling technique used was total sampling, meaning all members of the population were used as samples due to the relatively small population size.

Data Collection Technique

Data collection in this study was conducted through direct field tests and measurements, where each participant underwent a series of tests directly in the field. The instruments used in this study were standard measuring instruments for sports tests and measurements. Weight was measured using a scale in kilograms (kg), while height was measured using a stadiometer in centimeters (cm). Speed was measured using a 20-meter run test in seconds. Power is measured using a

vertical jump test in centimeters (cm), while muscle strength is measured using a push test. The athletes' performance was measured using push-ups, sit-ups, and wall sits, expressed in repetitions and time. Endurance was measured using the Cooper Test (12-minute run) expressed in distance traveled. The instrument used was based on the standard for measuring physical fitness in sports recommended by the American College of Sports Medicine (Mendola, 2025).

Data Processing

The data obtained were then analyzed using descriptive statistics, including calculating the mean, minimum, maximum, and standard deviation. The results were then interpreted into norms for the 14-16 age category, including excellent, good, sufficient, and poor, to provide an overview of the athletes' physical fitness level.

RESULTS

Based on the data analysis, the characteristics of the study subjects indicated that the athletes were aged between 14 and 16 years, with a mean of 14.6 years and a standard deviation of 0.69. This indicates that the study subjects were in their early to middle adolescence, with relatively low age variation. Therefore, the sample group can be considered fairly homogeneous in terms of age.

In terms of anthropometrics, the athletes' weight ranged from 44 to 66 kg, with an average of 53.30 kg and a standard deviation of 6.12. Meanwhile, the athletes' heights ranged from 160 to 174 cm, with an average of 167.70 cm and a standard deviation of 4.65. Based on body mass index (BMI) calculations, the average value was 18.94 kg/m², with a range of 16.36 to 22.66 kg/m². These values indicate that the athletes are generally within the normal or ideal body composition, indicating a body composition adequate for futsal performance.

In terms of speed, the 20-meter sprint results showed a minimum value of 3.22 seconds and a maximum of 3.48 seconds, with an average of 3.32 seconds and a standard deviation of 0.07. Based on the assessment criteria, the athletes' speed capabilities fall into the moderate category. This indicates that the athletes' acceleration abilities are quite good, although there is still room for improvement, especially in the context of futsal's demands for high, repeated speeds.

In the muscular explosive power component, the vertical jump results showed a minimum value of 39 cm and a maximum value of 46 cm, with an average of 42.20 cm and a standard deviation of 2.56. Based on the classification, these values fall into the moderate category. This indicates that the athletes' leg muscle explosive ability is quite good, but still needs improvement to support the performance of rapid movements and changes of direction in futsal.

In terms of muscular strength, the wall sit test results showed an average value of 76.40 seconds with a range of 68 to 85 seconds and a standard deviation of 4.92, which is in the good category. Meanwhile, the push-up results showed an average of 26.40 repetitions with a range of 21 to 32 and a standard deviation of 3.14, which is in the moderate category. The sit-up results showed an average of 29.30 repetitions, with a range of 25 to 33, and a standard deviation of 2.53, which falls within the good category. Overall, these results indicate relatively good muscle strength and endurance for the athletes, particularly in the core and static muscles.

For the cardiorespiratory endurance component, the 12-minute Cooper test results showed a minimum distance of 2,100 meters and a maximum of 2,280 meters, with an average of 2,216 meters and a standard deviation of 55.35. Based on the assessment criteria, these values fall within the moderate category. This indicates that the athletes' aerobic capacity is sufficient to support futsal activities, although there is room for improvement to achieve optimal performance.

Overall, the results of this study indicate that the physical condition profile of adolescent futsal athletes falls within the moderate to good category, with muscle strength demonstrating relatively better performance compared to speed, power, and cardiorespiratory endurance. The relatively small data variations across all variables also indicate that the physical ability levels among athletes are quite homogeneous. The research results data can be seen in table 1.

Tabel 1. Anthropometric Data and Physical Condition

Variabel	Min	Max	St. Dev	Mean	Criteria
Age	14	16	0.69	14.6	-
Anthropometry					
BW (kg)	44	66	6.12	53.30	-
BH (cm)	160	174	4.65	167.70	-
BMI (kg/m^2)	16.36	22.66	2.09	18.94	Normal/Ideal
Speed					

Variabel	Min	Max	St. Dev	Mean	Criteria
Sprint 20m (s)	3.22	3.48	0.07	3.32	Moderate
Power					
Vertical Jump (cm)	39	46	2.56	42.20	Moderate
Strength					
Wall Sit (s)	68	85	4.92	76.40	Good
Push Up	21	32	3.14	26.40	Moderate
Sit Up	25	33	2.53	29.30	Good
Endurance					
Cooper Test 12min (m)	2100	2280	55.35	2216	Moderate

BW: Body Weight, BH: Body Height, BMI: Body Mass Index

DISCUSSION

The results of the Body Mass Index (BMI) analysis showed that the athletes' BMI values ranged from 16.36 to 22.66 kg/m² with an average of 18.94 kg/m² and a standard deviation of 2.09, which is included in the normal or ideal category. This condition indicates that the athletes have a proportional body composition between fat mass and fat-free mass, which plays an important role in supporting physical performance. In sports physiology, body composition has been shown to influence performance, where increased fat mass tends to decrease movement efficiency and muscle work capacity, as explained by (dos Santos et al., 2021) in the Journal of Sports Sciences, which showed that body fat percentage is negatively related to the physical performance of young athletes. Furthermore, (Ben Mansour et al., 2021) explained that body composition has a significant influence on muscle strength and power, which are important components in high-intensity sports. Thus, the BMI values in this study reflect a physiological condition that is quite good to support the demands of futsal games that require movement efficiency, strength, and endurance.

These findings indicate that most athletes have a nutritional status that supports high-intensity physical activity. In futsal, ideal body composition plays a role in increasing agility, speed of change of direction, and metabolic efficiency during matches. Athletes with an excessive body fat percentage tend to experience decreased acceleration ability and increased mechanical load during movement, while optimal muscle mass contributes to force production and movement efficiency during high-intensity activities. This condition indicates that balanced body composition is a crucial factor in supporting physical performance and helping

prevent premature fatigue during matches.

These findings align with research indicating that anthropometric characteristics and body composition are closely related to the physical capacity of futsal players, particularly in the components of aerobic endurance, sprinting, and change of direction. Research by Nikolaidis et al., 2019, showed that BMI and body composition status are associated with the physical performance of futsal players across various age groups, with increases in body mass and body fat associated with declines in certain physical abilities. Furthermore, a recent study by Figueiredo Machado et al., 2023, showed that total and regional body fat percentages were negatively associated with aerobic capacity in professional futsal players, while fat-free mass was positively associated with aerobic performance and maximal speed. These results reinforce the importance of optimal body composition management in supporting the quality of futsal player performance during high-intensity intermittent sports.

The study showed that moderate 20-meter sprint performance reflects the dominance of the anaerobic alactacid (ATP-PC) energy system in explosive activity. In the context of exercise physiology, repeated sprinting in futsal requires rapid energy availability from the anaerobic system, but recovery between sprints relies heavily on the aerobic system. This aligns with findings by Spyrou et al., 2020, which explain that futsal is an intermittent sport with a complementary combination of aerobic and anaerobic energy contributions. This study confirms that the ability to maintain sprint performance is significantly influenced by the efficiency of the energy system during the match.

Moderate sprint performance also indicates that athletes' acceleration capacity can be improved through specific training such as repeated sprint training and high-intensity interval training (HIIT). Physiologically, improved sprint performance is influenced by the muscles' ability to generate force quickly, neuromuscular efficiency, and the energy system's ability to optimally regenerate phosphocreatine. In futsal matches, repeated short sprints are a dominant component because players are required to transition between offense and defense in a short period of time. This activity requires players to maintain repeated acceleration with relatively short recovery times. Therefore, repeated sprint ability

is a crucial indicator of modern futsal performance.

This finding is supported by research showing that repeated sprint ability is closely related to physical performance and game intensity in team sports, including futsal. Research by Buchheit & Laursen (2013) explains that repeated sprint ability is influenced by anaerobic capacity, neuromuscular efficiency, and aerobic capacity to accelerate energy recovery during sprint breaks. Furthermore, research by (Naser et al., 2017) shows that elite futsal players have better sprinting, acceleration, and change-of-direction performance than sub-elite players, making sprinting ability a key characteristic distinguishing futsal player performance levels.

The moderate muscle power results indicate that athletes' explosive ability can still be improved through neuromuscular adaptation. Physiologically, muscular explosive power is related to the nervous system's ability to recruit motor units quickly and efficiently. A study by (Matić et al., 2020) showed that plyometric training can increase the efficiency of the stretch-shortening cycle, which plays a role in increasing muscle power. This is important because futsal demands explosive ability for acceleration and rapid changes of direction.

Suboptimal muscle power capacity can be influenced by training frequency, the quality of the conditioning program, and the athlete's training experience. In futsal, muscular explosive power plays a significant role in shooting, jumping, initial sprinting, and rapid changes of direction. Good neuromuscular adaptation allows for more efficient motor coordination, resulting in stronger muscle contractions in a shorter period of time. Plyometric training is known to increase the efficiency of the stretch-shortening cycle and the ability to generate explosive force, thus contributing to improved sprinting and change of direction. This is supported by research (Ramírez-Campillo et al., 2014), which shows that structured plyometric training effectively improves explosive performance, sprinting ability, and change of direction in team sports athletes. These findings suggest that increased muscle power is a crucial component in supporting modern futsal performance, which demands repeated explosive activity during matches.

Good muscle strength scores in wall sits and sit-ups indicate positive adaptations in the muscular system, particularly the core muscles. Core muscle strength plays a role in maintaining body stability and increasing the efficiency of

energy transfer during dynamic activities. Research (Oliveira et al., 2024) explains that good muscle strength is associated with improved performance of complex movements and a reduced risk of injury in team sports. Therefore, muscle strength is a crucial component in supporting overall futsal performance.

Good core muscle strength also plays a role in maintaining posture during physical contact, dribbling, and rapid changes of direction. Core stability helps distribute force from the lower extremities to the upper body, resulting in more efficient and controlled movements. In addition to supporting performance, good core strength serves as a protective factor against musculoskeletal injuries caused by repetitive motion loads during matches. Core strength training is known to improve neuromuscular control, dynamic balance, and movement efficiency in athletes during sports activities. This is crucial in futsal because players are required to perform explosive movements and change direction repeatedly at a fast pace.

These findings are supported by research (Prieske et al., 2016), which shows that core strength training in elite young soccer players can improve neuromuscular performance and athletic ability, particularly in aspects of stability and movement control. Furthermore, research (Granacher et al., 2014) explains that core strengthening training has a positive effect on athletes' dynamic balance, jumping ability, and postural control. These results indicate that core strength is a crucial component in supporting performance and helping reduce the risk of injury in team sports like futsal.

A moderate cardiorespiratory endurance score indicates that the athlete's aerobic capacity is sufficient, but not yet optimal. Physiologically, VO_2max plays a crucial role in enhancing phosphocreatine respiration. Individuals with a high VO_2max have denser muscle capillaries, a greater number of mitochondria, and improved oxygen delivery efficiency. This accelerates the rate of PCr regeneration during rest periods and reduces lactate accumulation during repetitive activity. A study (Sekulic et al., 2021) explained that aerobic capacity is significantly related to physical performance and high-intensity activity in futsal. Athletes with higher aerobic capacity tend to be able to maintain game intensity longer than those with lower aerobic capacity.

A moderate aerobic capacity indicates that the athlete still has potential for improvement through structured aerobic training programs such as interval training or small-sided games. In futsal, players are required to maintain high intensity throughout the match with short recovery times. Therefore, good aerobic capacity not only supports endurance but also accelerates recovery between repeated sprints. Research by (Castagna et al., 2009) indicates that VO_2max is closely related to intermittent running ability in futsal players. Furthermore, research by (Barbero-Alvarez et al., 2008) shows that high aerobic capacity allows players to maintain technical and tactical performance more consistently throughout the match.

CONCLUSION

Based on the research results and discussion, it can be concluded that the physical condition profile of adolescent futsal athletes aged 14–16 years is in the moderate to good category. Body mass index (BMI) values within the normal category indicate that the athletes' body composition is relatively proportional and supports physical performance. Muscle strength components are in the good category, while speed, power, and cardiorespiratory endurance are still in the moderate category and therefore not optimal. Physiologically, futsal athlete performance is the result of the integration of anaerobic, aerobic, and neuromuscular energy systems, making improvements in aerobic endurance and muscle power important aspects in developing athlete performance.

This study is limited by the relatively small sample size, the use of a descriptive approach without analysis of relationships between variables, and the use of body composition measurements solely using BMI. Therefore, it is recommended that future research use a larger sample size, more accurate body composition measurement methods, and inferential statistical analysis to examine the relationships between variables. In addition, coaches are advised to implement training programs that focus on increasing aerobic endurance and muscle power, such as through high-intensity interval training (HIIT) and plyometric training, to optimally improve the performance of futsal athletes.

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