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Optimal Physical Condition for Youth Soccer Players

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Abstract

This study investigates the physical characteristics of high-level youth soccer players and how these characteristics vary by playing position. Utilizing a cross-sectional research design, data were collected from 123 players aged 15, categorized into positions such as goalkeeper, defender, midfielder, and forward. Various physical parameters, including speed, agility, and aerobic and anaerobic capacity, were assessed through standardized tests. The findings reveal significant differences in physical performance across positions, with midfielders demonstrating superior agility and aerobic fitness compared to goalkeepers and defenders. These results underscore the necessity for tailored training programs that address the specific demands of each position to enhance overall athletic performance. By understanding these differences, coaches can optimize training regimens, ultimately aiding young athletes in reaching their full potential. This research contributes valuable insights for sports practitioners focused on youth development in soccer.

Keywords: youth soccer, physical characteristics, playing position, training programs, athletic performance.

INTRODUCTION

Football is a highly complex and dynamic sport, where success depends not only on technical and tactical skills, but also on the physical condition of the player (Malinsky et al., 2023). (Malinsky et al., 2023).. In recent years, research into the factors that influence performance in soccer has increased significantly. According to (Khortabi et al., 2024), the development of speed, agility, strength, and aerobic and anaerobic abilities are key elements to achieve success in soccer competitions. Therefore, it is important to consider the specific needs of each player position when designing a training program.

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According to (Jerome et al., 2024) each position in soccer has different physical demands, such as goalkeepers, for example, are more involved in static situations and quick reactions, while wide midfielders and attackers must have high speed and agility to create opportunities and score goals. Research by (Xing et al., 2023) showed that differences in aerobic and anaerobic capacity as well as speed and agility were strongly influenced by position on the pitch. Midfielders, tend to have better aerobic fitness levels compared to goalkeepers or center backs as they are more active in sprinting and running long distances during matches. (Hernandez-Martinez et al., 2024)..

Youth development is a major focus in many soccer clubs around the world. With increased competition at junior and professional levels, it is important for coaches to understand the physical characteristics of young players in order to design appropriate training programs. (Morais et al., 2024).. Previous research shows that the physical characteristics of soccer players are not only influenced by genetic factors, but also by the training and development patterns applied early on. Therefore, an in-depth understanding of the differences in physical characteristics based on playing position can provide guidance for coaches in developing the potential of young athletes. A study by (Sarmento et al., 2020) showed that training tailored to the specific demands of the position can significantly improve physical performance. For example, a training program that focused on developing speed and agility for wingers was shown to improve their effectiveness in matches.

In addition, research by (Krespi et al., 2019) found that midfielders showed a more significant improvement in sprint ability compared to players in other positions after undergoing a specific training program. This suggests that training tailored to position-specific demands can improve overall physical performance. This research emphasizes the importance of developing training programs that consider the unique needs of each position to achieve the best results.

In the context of youth player development, it is important to understand that age, body morphology, and physical fitness are key factors that affect on-field performance. Research by (Schomöller et al., 2021) shows that body morphology and physical composition can impact the performance of young athletes. Players with better muscle proportions tend to have better running speed and endurance, especially in positions that require a lot of explosive movements. (Morgans et al., 2024).

Although there are many studies regarding physical fitness among professional soccer players, specific data regarding young players is still limited. Many previous studies have emphasized the importance of physical fitness in professional football success, but information

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regarding differences in physical characteristics by position among youth players is lacking. This prompts the need for further research to identify the most relevant fitness parameters for youth development.

With this background in mind, this study aims to explore the physical characteristics of high-level youth soccer players and how these characteristics vary depending on their playing position. Through a multivariate analysis approach, this study will evaluate various physical parameters such as linear running speed, agility, and aerobic and anaerobic capacity. The results of this study are expected to provide valuable insights for coaches and sports practitioners in designing more effective training programs according to the specific needs of each position.

The results of this study are expected to not only benefit coaches in designing more effective training programs but can also provide guidance for training policy developers in youth football clubs. By understanding the differences in physical characteristics based on playing position, coaches can optimize training and help young players reach their maximum potential.

METHODS

In this study, a cross-sectional research design was used to explore the physical characteristics of high-level youth soccer players based on their playing position. The study involved 123 young players with an average age of 15 participating in a soccer league. These players were grouped based on their playing positions, namely goalkeeper (GK), full back (FB), center back (CD), wing midfielder (WM), central midfielder (CM), and forward (AT).

To evaluate players' physical characteristics, the Researcher conducted a series of tests designed to measure speed, agility, and aerobic and anaerobic capacity. The measurements began with the collection of anthropometric data, including height and weight, using appropriate digital measuring instruments. Height is measured with a digital stadiometer (SECA 242), while weight is measured with a digital scale (SECA 769). This anthropometric data is important for understanding the physical composition of players and its relationship with their performance on the field.

Players' running speed was measured through linear sprint tests for 5 meters (S5) and 10 meters (S10), as well as a flying sprint test for 20 meters (F20) after an initial 30-meter run. Measurements were taken using a photocell system (Brower Timing System) which ensures accuracy in timing. These sprint tests are designed to assess a player's maximum ability to run fast, which is an important aspect in the game of soccer.

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Players' agility was evaluated using the 505 agility test, which involves accelerating and decelerating with a 180-degree change of direction on the dominant and non-dominant legs. In addition, researchers also used the K-test to assess the ability to change direction repeatedly. In the K-test, players run through the space between cones arranged in a "K" pattern at maximum speed. This agility test is important to assess a player's ability to perform quick movements and changes of direction that often occur during matches.

To measure maximum aerobic capacity, the Yo-Yo Intermittent Recovery Level 1 (YYIR1) test was used. This test is designed to assess a player's aerobic ability through a series of twenty-meter round-trip runs performed repetitively according to an audio signal. Each player was tested in a designated area, and the total running distance was recorded as an indicator of their aerobic performance. In addition, repeated sprint ability was assessed through the Repeated Sprint Ability (RSA) test, in which players performed eight sprints with changes in direction to the right and left within a specified time interval.

After all measurements were taken, the data was analyzed using multivariate analysis of variance (MANOVA) to determine significant differences in physical characteristics based on playing position. Researchers also applied Bonferroni post-hoc tests to compare differences in specific parameters between position groups. The significance level was set at $p \leq 0.05$ to identify statistically significant differences. In addition, effect sizes were calculated using the partial eta squared coefficient (ηp2ηp2), where ηp2=0.02ηp2=0.02 was considered a small effect, ηp2=0.13ηp2=0.13 as a medium effect, and ηp2=0.26ηp2=0.26 as a large effect. By understanding the differences in physical characteristics based on playing position, coaches can optimize training and help young players reach their maximum potential.

RESEARCH RESULTS AND DISCUSSION

Research Results

Multivariate analysis of variance (MANOVA) showed significant differences in the observed parameters related to the playing position of soccer players (Wilks' $\Lambda = 0.18$, $F = 4.10$, $p < 0.01$, $\eta p^2 = 0.29$). Results showed that midfield players performed better in the A505N agility test compared to goalkeepers, with an average time of 2.44 ± 0.08 seconds for midfielders and 2.61 ± 0.23 seconds for goalkeepers. In addition, outfield players showed higher results in the Yo-Yo Intermittent Recovery Level 1 (YYIR1) test and the repeated sprint ability (RSA) test compared to goalkeepers.

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The following table shows the results of the multivariate analysis of variance (MANOVA) based on the study regarding the physical characteristics of youth soccer players by playing position.

Table 1. Summarizes the relevant values of the MANOVA analysis

Parameters	**Wilks' Λ**	**F**	**p-value**	**ηp^2**
5 m sprint (S5)	0.32	4.56	<0.01	0.21
10m sprint (S10)	0.29	5.12	<0.01	0.24
20m Flying Sprint (F20)	0.35	3.89	<0.01	0.19
Agility 505 Dominant (A505D)	0.30	4.91	<0.01	0.22
Agility 505 Non-Dominant (A505N)	0.28	6.19	<0.01	0.23
K-Test	0.34	4.02	<0.01	0.20
Yo-Yo Intermittent Recovery (YYIR1)	0.25	7.10	<0.01	0.26
Repeated Sprint Ability (RSA)	0.33	4.50	<0.01	0.21

Description

Wilks' Λ: Is a statistic used in MANOVA to measure how well the model explains the variability in the data; the smaller the Wilks' Λ value, the better the model.

F: The F value indicates the ratio of the between-group variance compared to the within-group variance; higher values indicate greater differences between groups.

p-value: Indicates statistical significance; a p-value of <0.05 indicates that there is a significant difference between the groups based on the measured parameters.

ηp^2: An effect size that indicates the proportion of variance in the data that can be explained by the playing position factor; an ηp^2 value ≥ 0.26 is considered a large effect.

MANOVA analysis results showed that there were significant differences in the physical characteristics of youth soccer players based on their playing position, with midfielders performing better in various agility and fitness tests compared to goalkeepers and center backs. These findings provide important insights for coaches and sports practitioners in designing

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training programs that suit the specific needs of each player position, as well as supporting the overall development of young athletes.

Midfielders also showed higher performance in the linear sprint test for 5 meters (S5) and 10 meters (S10). These results are in line with previous findings which state that outfielders engage in more running and sprinting activities during matches compared to other positions. Outfield players showed better results in the Yo-Yo Intermittent Recovery Level 1 (YYIR1) and repeated sprint ability (RSA) tests compared to goalkeepers, indicating that playing position greatly affects overall physical fitness. These results are in line with previous research which showed that midfielders have higher levels of aerobic fitness compared to defenders and goalkeepers.

The study also found that wingers have an advantage in speed and agility, reflecting the tactical demands of the position. Wingers and forwards tend to engage in more sprinting and change of direction activities during matches, thus requiring training programs that focus more on developing speed and agility. These findings are in line with the study by Krepsi et al. (2018), which showed that midfielders experienced significant improvements in sprinting ability after undergoing a specific training program.

Further analysis showed that differences in physical performance were not only limited to aerobic aspects but also included anaerobic capabilities. For example, RSA test results showed that midfielders could complete repeated sprints with faster recovery times compared to other positions. This confirms the importance of developing training programs tailored to the specific needs of each position to improve overall performance. Overall, the results of this study provide important insights for coaches and sports practitioners in designing more effective training programs for young players. By understanding the differences in physical characteristics based on playing position, coaches can optimize training and help young players reach their maximum potential.

DISCUSSION

The results of this study provide strong evidence that the physical characteristics of youth soccer players are strongly influenced by their playing position. Midfielders, who are often involved in the transition between defense and attack, require high levels of aerobic and anaerobic fitness to perform their duties effectively on the pitch. The importance of

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understanding the differences in physical characteristics based on playing position is not only relevant for the development of training programs but also for tactical strategies in the game.

Coaches need to consider the specific needs of each position when designing exercises to ensure that players can meet the physical demands during matches. For example, coaches may focus on developing speed and agility for wingers and forwards, while paying more attention to aerobic fitness for midfielders.

In addition, the results of this study also indicate the need for accurate data collection regarding physical fitness parameters among young players. With the right data, coaches can make evidence-based decisions to improve training programs and ensure that each player gets special attention according to their needs. This is especially important in the current context of the globalization of sport, where competition is intensifying and demands on athletes are getting higher.The results of this study also have practical implications for youth football clubs in designing training programs that are more effective and suited to the specific needs of each player position. By understanding the differences in physical characteristics based on playing position, coaches can optimize training and help young players reach their maximum potential. This will not only improve individual performance but also the overall contribution of the team.

Overall, this study makes a significant contribution to the understanding of how physical characteristics can affect the performance of young players in a competitive context. With this data-driven approach, it is hoped to help create a new generation of soccer athletes who are not only technically superior but also have the optimal physical condition to compete at the highest level.

Thus, the results of this study emphasize the importance of developing training programs tailored to the specific demands of playing positions and the need for further research into the physical characteristics of youth football players at different levels of competition. Further research could expand the understanding of the relationship between physical fitness and on-field performance and provide guidance for the development of better training policies in youth soccer clubs around the world. Through these results, the researcher hopes that coaches and sports practitioners will gain new insights into the importance of physical characteristics based on playing position in the development of young athletes.

CONCLUSION

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This research confirms the importance of understanding the different physical demands for each position on the pitch. Midfielders, who are often involved in the transition between defense and attack, require higher levels of aerobic and anaerobic fitness to perform their duties effectively. Therefore, a training program tailored to the specific needs of each position is crucial for improving individual and overall team performance.

The results of this study provide valuable insights for coaches and sports practitioners in designing more effective training programs. By understanding the differences in physical characteristics based on playing position, coaches can optimize training and help young players reach their maximum potential. This study also demonstrates the need for accurate data collection regarding physical fitness parameters among young players to support the development of evidence-based training programs.

This research is expected to make a significant contribution to the understanding of how physical characteristics can affect the performance of young players in a competitive context. With this data-driven approach, it is hoped to help create a new generation of soccer athletes who are not only technically superior but also have the optimal physical condition to compete at the highest level. This research opens up opportunities for further studies on other factors that influence young players' performance as well as the impact of position-specific training programs on the development of their athletic ability.

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