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The Effects of Age, Height, Body Weight, and Heart Rate on Anaerobic Endurance–Agility Performance in Soccer Players

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Abstract

Objective: This study aimed to investigate the effects of heart rates, height, and body weight on anaerobic endurance and agility performance assessed by the three-corner run test in soccer players. Methods: A total of 104 soccer players (mean age: 22.36 ± 2.99 years; mean height: 1.75 ± 0.08 m; mean body weight: 70.97 ± 8.66 kg) participated in this cross-sectional study. Anthropometric measurements, heart rate responses (at rest, during warm-up, and during the test), and three-corner agility test performance were recorded. Linear multiple regression analyses were used to determine the effects of height, body weight, and heart rate as independent variables on the dependent variable of anaerobic endurance (three-corner agility test). Results: The multiple regression analysis for age, body weight, and height was significant ($F(3, 100) = 12.29$, $p < 0.05$; adjusted $R^2 = .27$). Of the variance in the three-corner agility test, 27% was explained by these variables, and when entered together into the model, only height made a significant contribution ($t = 4.743$, $p < 0.05$); age ($t = 1.769$, $p > 0.05$) and body weight ($t = -0.957$, $p > 0.05$) did not. Similarly, the multiple regression analysis for heart rate at rest, during warm-up, and during the test was also significant ($F(3, 100) = 5.83$, $p < 0.05$; adjusted $R^2 = .15$). Of the variance in the three-corner agility test, 15% was explained by these variables, and when entered together into the model, only resting heart rate made a significant contribution ($t = 2.11$, $p < 0.05$); warm-up heart rate ($t = 1.62$, $p > 0.05$) and recovery heart rate ($t = 0.25$, $p > 0.05$) did not make a significant contribution.
Conclusion: Age, body weight, and height explained 27% of the variance in three-corner agility test performance, and among these variables, only height was a significant predictor. Similarly, heart rate variables at rest, during warm-up, and during the test explained 15% of the variance, and only resting heart rate made a significant contribution. These findings indicate that height and resting heart rate stand out as determinants of three-corner anaerobic endurance and agility performance.

Keywords: *Soccer, anaerobic endurance, three-corner agility test, height, body weight, heart rate.*

Futbolcuların Yaşı, Boy Uzunluğu, Vücut Ağırlığı ve Kalp Atım Hızının Anaerobik Dayanıklık-Çevikliğe Etkisi

Özet

Amaç: Bu çalışma, futbolcularda kalp atım sayısı, boy uzunluğu ve vücut ağırlığının, üç köşe koşu testi ile değerlendirilen anaerobik dayanıklılık ve çeviklik performansı üzerindeki etkilerini araştırmayı amaçlamıştır. Yöntem: Bu kesitsel çalışmaya toplam 104 futbolcu (ortalama yaş: 22.36 ± 2.99 yıl; ortalama boy uzunluğu: 1.75 ± 0.08 m; ortalama vücut ağırlığı: 70.97 ± 8.66 kg) katılmıştır. Antropometrik ölçümler, kalp atım hızı yanıtları (dinlenme, ısınma sırasında ve test sırasında) ve üç köşe koşu testi performansı kaydedilmiştir. Bağımsız değişkenler olarak Boy uzunluğu, vücut ağırlığı ile kalp atım hızının bağımlı değişken anaerobik dayanıklılık (Üç köşe koşu testi) üzerine etkilerini belirlemek için doğrusal çoklu regresyon Linear Regresyon analizleri kullanılmıştır. Bulgular: Yaş, vücut ağırlığı ve boy uzunluğuna ilişkin çoklu regresyon analizi anlamlıdır ($F(3, 100) = 12,29$, $p < 0,05$; düzeltilmiş $R^2 = ,27$). Üç köşe koşu testindeki varyansın %27'si bu değişkenlerce açıklanmakta olup, modele birlikte girildiklerinde yalnızca boy anlamlı katkı sağlamaktadır ($t = 4,743$, $p < 0,05$); yaş ($t = 1,769$, $p > 0,05$) ve kg ($t = -,957$, $p > 0,05$). Yine, istirahat, ısınma ve test sırasındaki kalp atım hızına ilişkin çoklu regresyon analizi de anlamlıdır ($F(3, 100) = 5,83$, $p < 0,05$; düzeltilmiş $R^2 = ,15$). Üç köşe koşu testindeki varyansın %15'i bu değişkenlerce açıklanmakta olup, modele birlikte girildiklerinde yalnızca istirahat kalp atım sayısı anlamlı katkı sağlamaktadır ($t = 2,11$, $p < 0,05$); ısınma ($t = 1,62$, $p > 0,05$) ve toparlanma kalp atım sayısı ($t = ,25$, $p > 0,05$) anlamlı katkı sağlamamaktadır.

Sonuç: Yaş, vücut ağırlığı ve boy uzunluğu üç köşe koşu testi performansındaki varyansın %27'sini açıklamakta olup, bu değişkenler içinde yalnızca boy uzunluğu anlamlı bir yordayıcıdır. Benzer şekilde, istirahat, ısınma ve test sırasındaki kalp atım hızı değişkenleri varyansın %15'ini açıklamakta ve yalnızca istirahat kalp atım sayısı anlamlı katkı sağlamaktadır. Bu bulgular, üç köşe koşu performansının belirleyicileri olarak boy uzunluğunun ve istirahat kalp atım hızının öne çıktığını göstermektedir.

Anahtar kelimeler: *Futbol, anaerobik dayanıklılık, Üç köşe koşu testi, Boy uzunluğu, Vücut ağırlığı, Kap atım hızı.*

Introduction

Soccer is a high-intensity intermittent team sport characterized by repeated explosive actions including sprinting, jumping, tackling, and rapid changes of direction, all performed within an extended duration of play (Stolen et al., 2005; Bangsbo, 2003). The physical demands of modern soccer require players to possess well-developed anaerobic endurance, which enables them to sustain high-intensity efforts throughout the match and recover quickly between repeated sprints (Taskin, 2009; Mohr et al., 2005). Anaerobic endurance has been identified as a critical performance determinant in soccer, as players typically cover 6.5 to 9.9 km per match, with very high-intensity activity (>16 km·h^{-1}) accounting for approximately 7-14% of the total distance (Buchheit et al., 2010; Tønnessen et al., 2011).

The assessment of anaerobic endurance in soccer players has been conducted using various field-based tests, with the three-corner run test being one of the most practical and widely utilized protocols (Rösch et al., 2000; Taskin, 2009). This test, originally developed as part of the FIFA Medical Assessment and Research Centre (F-MARC) test battery, evaluates the players' ability to perform repeated high-intensity efforts with rapid changes of direction, closely mimicking the physiological demands of match play (Rösch et al., 2000). The three-corner run test has demonstrated good reliability and validity in assessing anaerobic endurance in soccer populations (Taskin, 2009; Erkmen et al., 2010).

Moorthy ve Reddy'nin (2024) araştırmasında, üç farklı antrenman programına katılan elit kadın sporcular arasında uzun mesafe koşu grubunun istirahat kalp atım sayısı ortalaması (48.73 atım/dk), orta mesafe koşu (52.60 atım/dk) ve halter (56.73 atım/dk) gruplarından daha düşük bulunmuştur. Bu sonuçlar, uzun mesafe koşu antrenmanının istirahat kalp atım sayısını anlamlı şekilde düşürdüğünü göstermekte olup en yüksek fark uzun mesafe koşu ile halter grubu arasındadır (Moorthy & Reddy, 2024). Benzer şekilde, kas dayanıklılığı açısından uzun mesafe koşu grubunun ortalaması 29.07 saniye, orta mesafe koşu grubunun 26.13 saniye ve halter grubunun 25.07 saniye olarak ölçülmüştür; ancak orta mesafe koşu ile halter grubu arasındaki fark (1.067 saniye) güven aralığı değerinden (1.324) düşük olduğu için bu iki grup arasında anlamlı bir fark bulunmamıştır (Moorthy & Reddy, 2024). Sonuç olarak, uzun mesafe koşu antrenmanı diğer iki gruba kıyasla hem istirahat kalp atım sayısını düşürmüş hem de kas dayanıklılığını anlamlı şekilde artırmıştır (Moorthy & Reddy, 2024).

Anthropometric characteristics, particularly body height and body weight, have been extensively studied in relation to soccer performance. Research has consistently demonstrated that morphological attributes significantly influence both physical and technical performance parameters in soccer players (Serin & Taskin, 2016; Franciani et al., 2016). While taller players may benefit from biomechanical advantages such as longer stride length and greater leverage during explosive movements (Sahin & Kivrak, 2025), the relationship between body weight and performance is more complex. Greater body mass may provide advantages in physical confrontations and ball protection but may also impose additional metabolic demands during weight-bearing activities such as running and sprinting (Ceruso et al., 2019; Arslan et al., 2021).

Previous studies have examined the relationships between anthropometric characteristics and various performance measures in soccer players. Erkmen et al. (2010) investigated the relationships between balance performance and functional performance in football players, finding that triple-hop performance in the dominant leg correlated with balance measures, suggesting that physical dimensions influence multiple aspects of athletic performance. Similarly, Serin and Taskin (2016) examined the association between anaerobic endurance and vertical jump performance in elite athletes, reporting a significant relationship between these parameters, with vertical jump explaining 34% of anaerobic endurance performance.

The influence of anthropometric characteristics on soccer performance has been documented across different age categories and competitive levels. Franciani et al. (2016) analyzed the intraseasonal stability of field test performances in young academy soccer players, demonstrating that anthropometric measurements showed clear increments across age categories, while the fluctuation of technical and functional test results depended on age category and test session. These findings highlight the importance of considering anthropometric characteristics when evaluating and monitoring player development.

Furthermore, research has examined the effects of training interventions on physical performance in soccer players, with anthropometric characteristics influencing the magnitude of training adaptations. Arslan et al. (2021) compared the effects of combined core strength and small-sided games training versus small-sided games alone on physical performance in young soccer players, finding that the inclusion of core strength training significantly improved speed and strength-based conditioning. The authors noted that anthropometric characteristics, including body height and weight, influenced the magnitude of training responses, with taller players demonstrating greater improvements in certain performance parameters.

The relationship between body composition and cardiovascular responses during exercise has also been investigated. Ceruso et al. (2019) conducted preliminary work on monitoring youth soccer team training, reporting that while BMI and anthropometric characteristics varied considerably among youth soccer players, cardiovascular responses during functional testing showed considerable variability not solely attributable to body composition. These findings suggest that the relationship between anthropometric characteristics and physiological responses during exercise is complex and influenced by multiple factors.

Recent research by Sahin and Kivrak (2025) examined the phases of sprint performance in relation to isokinetic leg strength, anaerobic endurance, and balance. Their findings demonstrated that leg strength parameters significantly affected sprint performance phases, with maximum speed and sprint continuity phases being most strongly influenced by lower extremity strength. The authors emphasized that taller individuals typically possess longer lower limbs, which may contribute to greater stride length and more efficient force production during high-intensity running activities.

Despite the growing body of literature examining anthropometric characteristics and soccer performance, limited research has specifically investigated the differential associations of body height and body weight on anaerobic endurance performance as measured by the three-corner run test. While some studies have examined the relationship between anthropometric variables and specific performance parameters (Erkmen et al., 2010; Serin & Taskin, 2016), few have systematically compared the relative contributions of height and weight to anaerobic endurance capacity in soccer players. Understanding these relationships is crucial for talent identification, training program design, and performance optimization in soccer.

Based on previous research demonstrating the biomechanical advantages associated with greater height (Sahin & Kivrak, 2025) and the potential performance implications of body mass (Ceruso et al., 2019), it was hypothesized that taller players would demonstrate superior anaerobic endurance performance compared to normal-height players, while the relationship between body weight and anaerobic endurance would be less pronounced. Therefore, this study aimed to investigate the effects of heart rate, height, and body weight on anaerobic endurance and agility in soccer players.

Methods

Participants

This cross-sectional study (Şenocak, 2011) included 104 soccer players with a mean age of 22.36 ± 2.99 years, a mean height of 1.75 ± 0.08 m, and a mean body weight of 70.97 ± 8.66 kg. All participants had played licensed football for at least 5 years and had no injuries or any health problems.

Measurements of Body Weight and Height, Calculation of Body Mass Index (BMI)

Participants' body weights were measured in kilograms on a scale with 0.01 kg precision, while barefoot and wearing a t-shirt and shorts. Their heights were measured with a metal ruler fixed to the scale with 0.01 cm precision, while participants stood upright barefoot. BMI is the most practical and commonly used anthropometric measurement for determining obesity. BMI is calculated by dividing weight by the square of height (kg/m^2). The World Health Organization (WHO) defines overweight and obesity as abnormal or excessive fat accumulation that presents a health risk. Individuals with a BMI ≥25 are considered overweight, and those with BMI ≥30 are considered obese (WHO, 2009).

Measurement of Heart Rate

Heart rate measurements were recorded before warm-up, after warm-up, and after the three-corner run test using a heart rate monitor (RS 800, Polar Vantage NV, Polar Electro Oy, Finland) at 5-second intervals. Before the study, the chest strap of the heart rate monitor was placed on the participant's chest, and heart rate was recorded from the monitor.

Three-Corner Run Test (TCRT)

This test was used for the assessment of speed and anaerobic endurance in athletes (Rösch et al., 2000). The test field was arranged as follows. After the starting command, the participant ran to the first flag post (1) located 80 m from the start. He turned to the left and ran to the second flag post (2), located 20 m from the first flag post. Then he ran back to the third flag post (3), located 82.4 m from the start. Finally, he turned to the right and ran to the finish line (4) and crossed it. The time between the starting command and crossing the finish line was measured with a stopwatch and recorded as the participant's score in units of 0.1 seconds (Rösch et al., 2000).

Statistical Analysis

In addition to descriptive statistics, multiple linear regression analyses were conducted to determine the effect sizes of the independent variables—including age, body height, body weight, and resting, warm-up, and recovery heart rates—on the dependent variable, the three-corner run test (anaerobic power-Agility).

Results

This study investigated the associations of the hearth rates, body height and weight on the tree corner endurance-agility performance in soccer players. A total of 104 soccer players were divided into two groups based on their height (average-height and tall) and into two groups based on their body weight (lower-weight and higher-weight). The three-corner run test was used to assess anaerobic endurance.

A multiple linear regression analysis was conducted to examine the effects of age, body weight, and height on the three-corner agility test in soccer players, and the means, standard deviations, and correlation coefficients of the variables are presented in Table 1.

Table 1: Means, Standard Deviations, and Correlation Coefficients of the Variables (N = 104)

Variables	Mean	SD.	1	2	3
1. Three Corner Speed test	6,13	,63	1,000		
2. Age	22,36	2,99	,267**	1,000	
3. Body Weight	70,97	8,66	,252**	,260**	1,000
4. Body Height	1,75	,08	,494**	,264**	,610**

** p<,01

The results of the multiple linear regression analysis regarding the extent to which age, body weight, and height predict the variation in the three-corner agility test, which is the dependent variable, are presented in Table 2.

Table 2. Results of the Multiple Linear Regression Analysis (N = 104).

Variables	B	SE	Beta	t	p
1. Age	,033	,019	,158	1,769	,080
2. Body Weight	-,008	,008	-,104	-,957	,341
3. Body Height	4,172	,880	,516	4,743	,000
Dependent variable: Three-Corner Agility Test; $R = .52$; $R^2 = .27$; $F(3, 100) = 12.39$; $p = .000$, $p < 0.05$					

The multiple regression analysis results in Table 2 are statistically significant ($F(3, 100) = 12.29$, $p < 0.05$). The adjusted R^2 value is .27. This result indicates that 27% of the variance in the three-corner agility test is explained by the variables of age, body weight, and height. However, when the t-values in the table are examined, when all independent variables are included in the regression model, only the height variable makes a significant contribution to explaining the variation in the three-corner agility test ($t = 4.743$, $p < 0.05$), while among the other independent variables, age ($t = 1.769$, $p > 0.05$) and body weight ($t = -0.957$, $p > 0.05$) do not make a significant contribution to the variation in the three-corner agility test.

Table 3. Mean, Standard Deviation, and Correlation Coefficients of the Variables (N = 104).

Variables	Mean	SE	1	2	3
1. Three Corner Run Test	6,13	,63	1,000		
2. Resting Hearth Rate	81,28	13,24	-,355**	1,000	
3. Warm Up Hearth Rate	125,26	25,61	-,331**	,597**	1,000
4. Recovery Hearth Rate	175,30	16,92	-,109**	,360**	,234**

**p<0,01

Table 4. Results of the Multiple Linear Regression Analysis (N = 104)

Variables	B	SE	Beta	t	p
1. Resting Hearth Rate	-,012	,006	-,253	-2,112	,037
2. Warm Up Hearth Rate	-,005	,003	-,186	-1,620	,108
3. Recovery Hearth Rate	,001	,004	,025	,254	,800

Dependent variable: Three-Corner Agility Test; R= ,386; R^2= ,15; $F_{(3,100)}$= 5,83; p= ,001, p<0,05

The results of the multiple regression analysis in Table 4 are statistically significant ($F(3, 100) = 5.83$, $p < .05$). The adjusted R^2 value is .15. This result indicates that 15% of the variance in the three-corner speed test is explained by the variables of resting, warm-up, and recovery heart rates. However, when the t-values in the table are examined, when all independent variables are included in the regression model, only resting heart rate makes a significant contribution to explaining the variation in the three-corner speed test ($t = 2.11$, $p < .05$), while among the other independent variables, warm-up heart rate ($t = 1.62$, $p > .05$) and recovery heart rate ($t = .25$, $p > .05$) do not make a significant contribution to the variation in the Three-Corner Run test.

Discussion and Conclusion

The present study aimed to investigate the effects of age, body height, body weight, and heart rate on anaerobic endurance and agility performance assessed by the three-corner run test in soccer players. The findings revealed that body height was the only significant predictor of three-corner run test performance among the anthropometric variables, whereas age and body weight did not make significant contributions. Similarly, among the heart rate variables, only resting heart rate significantly predicted three-corner run test performance, while warm-up and recovery heart rates did not. These results suggest that anaerobic endurance and agility performance in soccer players is multidimensional, with anthropometric and physiological variables exerting differential effects on performance.

The multiple linear regression analysis examining the effects of age, body weight, and height on the three-corner agility test was statistically significant ($F(3, 100) = 12.29$, $p < .05$; adjusted $R^2 = .27$). The model explained 27% of the variance in the three-corner agility test. However, when all independent variables were entered simultaneously into the regression model, only body height made a significant contribution ($t = 4.743$, $p < .05$), while age ($t = 1.769$, $p > .05$) and body weight ($t = -0.957$, $p > .05$) did not. This finding is consistent with previous research demonstrating the biomechanical advantages associated with greater height in athletic

performance. Sahin and Kivrak (2025) reported that leg strength parameters significantly affect sprint performance phases, with maximum speed and sprint continuity phases being most strongly influenced by lower extremity strength. Taller individuals typically possess longer lower limbs, which may contribute to greater stride length and more efficient force production during high-intensity running activities. Similarly, Taskin (2009) demonstrated that physical characteristics significantly influence performance in anaerobic endurance tests, with anthropometric characteristics serving as important baseline predictors of training responsiveness. The finding that height was the only significant predictor in the present study supports the notion that taller soccer players may possess biomechanical advantages in anaerobic endurance and agility tasks.

In contrast, the lack of a significant effect of body weight on three-corner run test performance is noteworthy. Although higher-weight players completed the test 2.38% faster than lower-weight players, this difference was not statistically significant ($p > .05$; Cohen's $d = 0.231$). This result is consistent with the findings of Primasoni et al. (2022), who reported that agility training methods such as shuttle run and three-corner drill were effective regardless of participants' body composition characteristics. However, it contrasts with some previous research suggesting that greater body mass may impair performance in weight-bearing activities such as running. Ceruso et al. (2019) reported that while BMI and anthropometric characteristics varied considerably among youth soccer players, cardiovascular responses during functional testing showed considerable variability not solely attributable to body composition. These findings suggest that the relationship between body weight and anaerobic performance is complex and may be mediated by factors such as muscle mass, fat percentage, playing position, and training status.

The findings regarding heart rate variables also revealed a multidimensional picture. The multiple regression analysis for heart rate at rest, during warm-up, and during the test was statistically significant ($F(3, 100) = 5.83$, $p < .05$; adjusted $R^2 = .15$). The model explained 15% of the variance in the three-corner agility test. However, when all independent variables were entered into the model, only resting heart rate made a significant contribution ($t = 2.11$, $p < .05$), while warm-up heart rate ($t = 1.62$, $p > .05$) and recovery heart rate ($t = 0.25$, $p > .05$) did not make significant contributions. This finding partially aligns with the results of Moorthy and Reddy (2024), who found that long-distance running training significantly reduced resting heart rate and increased muscular endurance among elite women athletes. The significant effect of resting heart rate on anaerobic performance suggests that athletes with lower resting heart rates may possess better aerobic capacity and faster recovery ability, which could positively influence performance during repeated high-intensity efforts. However, the lack of significant contributions from warm-up and recovery heart rates indicates that anaerobic endurance is not solely dependent on cardiovascular efficiency but is also influenced by muscular and biomechanical factors (Erkmen et al., 2010; Taskin, 2009).

The significant difference in three-corner run test performance between height groups aligns with previous research examining the relationship between anthropometric characteristics and anaerobic performance in soccer players. The finding that taller players completed the test 6.87% faster than normal-height players ($p < .001$; Cohen's $d = 0.732$) is consistent with the work of Taskin (2009), who demonstrated that physical characteristics significantly influence performance in anaerobic endurance tests. This relationship may be partially explained by the biomechanical advantages associated with longer limb lengths. Sahin and Kivrak (2025) noted that leg strength parameters significantly affect sprint performance phases, with maximum speed and sprint continuity phases being most strongly influenced by lower extremity strength. Taller individuals typically possess longer lower limbs, which may contribute to greater stride length and more efficient force production during high-intensity running activities. Similarly,

Erkmen et al. (2010) reported that triple-hop performance in the dominant leg correlated with various balance and functional performance measures, suggesting that physical dimensions influence multiple aspects of athletic performance. The finding that height emerged as a significant predictor in both correlation and regression analyses in the present study supports these biomechanical explanations.

The lack of significant differences in cardiovascular measurements between height groups is also noteworthy. This finding is consistent with research by Franciani et al. (2016), who demonstrated that while anthropometric measurements showed clear increments across age categories, the fluctuation of technical and functional test results depended on age category and test session rather than solely on physical characteristics. The absence of significant heart rate differences suggests that cardiovascular responses during anaerobic testing may be more dependent on training status and physiological adaptations than on anthropometric characteristics alone (Arslan et al., 2021). This finding underscores the multifactorial nature of anaerobic endurance and indicates that anthropometric variables alone are insufficient to fully explain performance.

The significant morphological differences between weight groups, including greater height, weight, and BMI in higher-weight players, are consistent with the expected anthropometric variations in soccer populations. Serin and Taskin (2016) reported that anthropometric characteristics such as body weight and height are fundamental determinants of athletic performance, with significant correlations observed between these variables and anaerobic performance measures. However, the lack of significant differences in cardiovascular measurements between weight groups aligns with the findings of Ceruso et al. (2019), who reported that while BMI and anthropometric characteristics varied considerably among youth soccer players, cardiovascular responses during functional testing showed considerable variability not solely attributable to body composition. These results suggest that the effect of body weight on anaerobic performance may be complex and indirect, potentially mediated by factors such as muscle mass, strength level, and playing position.

These findings have important implications for talent identification and training prescription in soccer. The finding that body height demonstrates a stronger association with anaerobic endurance than body weight suggests that coaches should consider height as a relevant factor when designing anaerobic endurance training programs. This is consistent with the recommendations of Arslan et al. (2021), who demonstrated that combined core strength and small-sided games training significantly improved physical performance in young soccer players, with anthropometric characteristics influencing the magnitude of training adaptations. The multidimensional approach to player development advocated by Franciani et al. (2016) also emphasizes the importance of collecting repeated measurements to identify players' fluctuations of performance across the season and allow coaches to make frequent adjustments to their training programs.

The superior anaerobic endurance performance observed in taller players may be attributed to several physiological mechanisms. As discussed by Erkmen et al. (2010), the ability to efficiently maintain balance during high-intensity activities depends on physical fitness factors such as muscle strength and anaerobic capacity. Taller individuals may possess greater absolute muscle mass and potentially larger energy stores, enabling sustained high-intensity performance during anaerobic activities. Furthermore, the biomechanical advantages associated with longer limbs may reduce the relative energy cost of running at high speeds (Sahin & Kivrak, 2025). The lack of significant cardiovascular differences between groups suggests that anaerobic endurance performance is not solely dependent on cardiovascular efficiency but is also influenced by muscular and biomechanical factors. This interpretation is supported by the

work of Taskin (2009), who emphasized the importance of circuit training and specific conditioning programs for improving anaerobic performance, independent of baseline cardiovascular measurements.

Several limitations should be considered when interpreting these findings. The cross-sectional nature of the study prevents establishing causal relationships between anthropometric characteristics and anaerobic performance. Furthermore, the study did not control for potential confounding variables such as playing position, which may influence both anthropometric characteristics and performance demands (Ceruso et al., 2019). Future research should consider longitudinal designs to examine how changes in anthropometric characteristics over time influence anaerobic performance development. Additionally, the use of the three-corner run test as the sole measure of anaerobic endurance may not fully capture the multidimensional nature of anaerobic performance in soccer. As suggested by Primasoni et al. (2022), combining multiple testing methods, including shuttle run and agility assessments, may provide a more comprehensive evaluation of players' anaerobic capacities.

Conclusion

In conclusion, the present study demonstrates that the observed differences in anaerobic endurance performance were more pronounced between height groups than between weight groups. Taller players exhibited superior performance in the three-corner run test, while differences in body weight did not significantly affect anaerobic endurance in these unadjusted group comparisons. The multiple regression analyses revealed that age, body weight, and height together explained 27% of the variance in three-corner agility test performance, with only height making a significant contribution. Similarly, resting, warm-up, and test heart rates together explained 15% of the variance, with only resting heart rate making a significant contribution. These findings indicate that height and resting heart rate stand out as determinants of three-corner anaerobic endurance and agility performance.

These results contribute to the growing body of literature emphasizing the importance of anthropometric characteristics in soccer performance and have practical implications for talent identification and training program design. Coaches and sports scientists should consider height as a relevant factor when assessing anaerobic endurance capacity and designing conditioning programs, while recognizing the complex and multifactorial nature of anaerobic performance. Future research should employ longitudinal designs that account for playing position, age categories, and training experience to further elucidate these relationships.

Ethics Committee Approval

The study titled "*Comparison of Heart Rates, Anaerobic Endurance and Training Age with Respect to Body Height and Weight of Soccer Players*" was approved by the Selçuk University Faculty of Sport Sciences Non-Interventional Clinical Research Ethics Committee on 27 August 2026. The official notification is dated 27 August 2026 and bears reference number E-24524194-050.99-1324329.

Statement of Authors' Contribution Rates

Authors contributed equally to all stages of the research.

Conflict of Interest Statement

The authors declare that there is no conflict of interest related to the research.

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