Duzce University Journal of Sport Sciences
Düzce Üniversitesi Spor Bilimleri Dergisi

6 (2), 2026, 140–146.

e-ISSN: 2822-227X
https://dergipark.org.tr/en/pub/dujoss

Research Article

An Investigation of the Effects of Speed and Body Fat Percentage on Agility Performance in Young Female Soccer Players

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Abstract: The objective of this study is to examine the impact of speed and body fat percentage values on agility performance in young female footballers. The study's sample group consists of 30 volunteers aged 13–16 who actively participate in sports in the Galatasaray Women's Football Youth Teams. The athletes' height and body weight were measured using SECA measuring devices, and their body fat percentage was determined using an Inbody 270S body composition analyser. Sprint performance was measured using a 30-metre sprint test, and agility performance using a 505 agility test. The data were analysed using the SPSS 20.0 programme. The normality of the data was established through the implementation of the Shapiro-Wilk test, and subsequent to the confirmation of the suitability of the conditions for parametric tests, Pearson's correlation analysis was conducted. The findings of the present study indicate that no statistically significant relationship was observed between body fat percentage and agility ($r=0.047$; $p>0.05$) or between agility and speed ($r=0.133$; $p>0.05$). Furthermore, no significant correlation was identified between body fat percentage and speed ($r=0.275$; $p>0.05$). In conclusion, this study found no significant relationships between the examined parameters.

Keywords: *Football, Speed, Agility, Performance, Body fat percentage*

Received: 07.04.2026
Revision: 22.09.2026
Accepted: 23.09.2026
Online: 27.10.2026

I. INTRODUCTION

Soccer is a complex sport that requires the combined use of high-level physical, physiological, and motor skills. The dynamic nature of the game demands that athletes possess the capacity to generate and sustain high levels of speed, sudden changes of direction, and high mobility. In this context, speed and agility are among the key components that determine soccer performance (Little & Williams, 2005).

Speed is defined as an athlete's ability to cover a specific distance in the shortest possible time, while agility is described as the combination of speed, balance, coordination, and the ability to change direction. This is particularly evident in sports such as football, which demand a high level of open-skill performance and agility (Sheppard & Young, 2006).

A significant factor influencing speed performance is the athlete's body composition. It is widely acknowledged that body fat percentage represents a significant variable that exerts a considerable influence on the physiological and biomechanical characteristics associated with performance in soccer players (Reilly et al., 2000). Adipose tissue does not directly contribute to active force production; therefore, an increased body fat percentage exerts additional load on the athlete, which can have a detrimental effect on performance, particularly in short-distance sprints, acceleration, and agility. Indeed, studies conducted on soccer players have reported that as body fat percentage increases, 10-meter and 30-meter sprint times deteriorate significantly; conversely, athletes with lower body fat percentages demonstrate superior sprint and jumping performance (Çelik et al., 2022; Arı et al., 2024).

The extant literature indicates the presence of significant correlations between anthropometric characteristics and repeated sprint capacity, as well as high-intensity running performance, in football players. It is widely acknowledged that the ratio between muscle and fat mass is a pivotal factor in determining the calibre of an individual's speed performance. In this context, it can be argued that for soccer players, it is not only total body weight but also the composition of that weight – specifically, which tissues it consists of – that is decisive for performance. Consequently, examining the relationship between body fat percentage and speed performance constitutes an important area of research in terms of training planning, player monitoring processes, and performance optimisation (Campa et al., 2019).

Despite the growing body of literature examining the relationships among speed, agility, and body composition in soccer, studies focusing specifically on adolescent female soccer players remain limited. Most previous research has predominantly involved male athletes or adult populations, resulting in insufficient evidence regarding the interaction of these performance parameters during adolescence in female football players. Therefore, the present study is

Cite as: Gök, B. (2026). An investigation of the effects of speed and body fat percentage on agility performance in young female soccer players. *Duzce University Journal of Sport Sciences, 6*(2), 140–146.

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considered original in that it investigates the combined relationship between speed, body fat percentage, and agility performance in young female soccer players competing at the youth level. Accordingly, the aim of this study was to examine the effects of speed and body fat percentage on agility performance in young female soccer players. Based on the existing literature, it was hypothesized that (H1) body fat percentage would be significantly associated with agility performance, (H2) speed performance would be significantly associated with agility performance, and (H3) body fat percentage would be significantly associated with speed performance.

II. MATERIAL AND METHOD

A. Research Design

This study employed a correlational survey design to examine the relationships among body fat percentage, speed, and agility performance in young female soccer players. The correlational survey model aims to determine the existence and strength of relationships between variables without manipulating them (Karasar, 2011).

B. Variables of the Study

The independent variables of the study were body fat percentage (%) and 30-m sprint performance (s), whereas the dependent variable was agility performance measured using the 505 agility test (s).

C. Participants

The sample of the study consisted of 30 volunteer female athletes aged 13–16 years who were actively competing in the youth teams of Galatasaray Women's Football Club in Istanbul, Türkiye. Prior to participation, all athletes and their parents were informed about the purpose and procedures of the study.

The inclusion criteria were as follows: (a) being between 13 and 16 years of age, (b) actively participating in organized football training for at least six months, (c) regularly attending team training sessions, and (d) having no medical contraindications to physical activity. The exclusion criteria included: (a) experiencing any lower-extremity injury within the previous three months, (b) not participating regularly in football training during the last six months, and (c) having any chronic disease that could affect physical performance.

C.1. Sample Size and Power Analysis

An a priori power analysis was conducted using G*Power 3.1 software (Faul et al., 2009). Based on a bivariate correlation model, a large effect size (r = .50), an alpha level of .05, and a statistical power of .80 were assumed. The analysis indicated that a minimum sample size of 29 participants was required. Therefore, the inclusion of 30 athletes in the present study was considered sufficient to ensure adequate statistical power.

C.2. Ethical Approval

The study was conducted in accordance with the principles of the Declaration of Helsinki and the ethical standards for research in sport and exercise sciences (Harriss & Atkinson, 2015). Ethical approval was obtained from the Ethics Committee of Istanbul Gelisim University on 18 March 2026 (Approval No: 2026-04). Written informed consent forms were obtained from the parents or legal guardians of all participants prior to data collection.

D. Research Procedure

All measurements and performance tests were conducted on the same day by qualified sport scientists in accordance with standardized testing protocols. Before the assessments, the participants completed a standardized 10-minute warm-up consisting of light jogging and dynamic stretching exercises.

The testing order was as follows: (1) anthropometric measurements, including height, body weight, and body fat percentage, (2) the 30-m sprint test, and (3) the 505 agility test. Each participant performed two trials for both performance tests, and the best result was retained for statistical analysis.

Recovery intervals between trials were determined according to the 1:10 work-to-rest ratio principle to minimize fatigue and ensure optimal performance during subsequent tests. Prior to testing, all participants received detailed explanations regarding the test procedures and were familiarized with the testing environment.

E. Data Collection Instruments and Measurements

The following data collection instruments and performance tests were used in the present study:

- Height measurement (SECA stadiometer, Germany)
- Body weight measurement (SECA electronic scale, Germany)
- Body fat percentage assessment (InBody 270S, South Korea)
- 30-m sprint test (SEVEN Electronic photocell system)
- 505 agility test

E.1. Height Measurement

Height measurements were obtained without shoes using a SECA (Germany) stadiometer with an accuracy of 0.1 cm, following standardized anthropometric assessment procedures (ISAK, 2019).

E.2. Body Weight Measurement

Body weight was measured with participants wearing light sports clothing and no shoes using an electronic SECA scale (Germany) with an accuracy of 0.1 kg, in accordance with standardized anthropometric protocols (ISAK, 2019).

E.3. Assessment of Body Fat Percentage

Body fat percentage was assessed using an InBody 270S portable body composition analyzer (InBody Co., Seoul, South Korea). All measurements were conducted under standardized conditions, with participants barefoot and in a rested state prior to testing (Heyward & Wagner, 2004).

E.4. 30-Meter Sprint Test

Sprint performance was evaluated using a 30-m sprint test. The participants started from a standing position and were instructed to run at maximal speed throughout the entire distance. Sprint times were recorded using a SEVEN Electronic photocell timing system, which has demonstrated acceptable validity and reliability for assessing sprint performance in soccer players (Altmann et al., 2019). Each athlete performed two trials, and the best performance was retained for analysis. Rest intervals between trials followed a 1:10 work-to-rest ratio to minimize fatigue effects (Sevim, 1997).

E.5. 505 Agility Test

The 505 agility test was used to evaluate change-of-direction performance. The participants accelerated for 10 m, passed through the timing gate, sprinted an additional 5 m to the turning line, performed a 180° change of direction, and sprinted back through the timing gate. Each participant completed two trials, and the best result was recorded for statistical analysis. Standardized instructions were provided, and adequate recovery periods were implemented between trials according to the 1:10 work-to-rest principle (Nimphius et al., 2018).

F. Statistical Analysis

The data obtained from the measurements of speed, agility, and body fat percentage were analyzed using SPSS 24.0 (IBM Corp., Armonk, NY, USA). The normality of the data distribution was assessed using the Shapiro–Wilk test, skewness and kurtosis values, and the ratios of these values to their standard errors. The findings indicated that all variables met the assumptions of normality (Büyüköztürk, 2007).

Following confirmation of normal distribution, Pearson's correlation analysis was performed to determine the relationships among the variables. Correlation coefficients were interpreted according to Cohen (1988), where values of 0.10–0.29 indicate a small correlation, 0.30–0.49 a moderate correlation, and 0.50 or above a strong correlation. Statistical significance was accepted at $p < .05$. Additionally, 95% confidence intervals (CI) were considered when interpreting the findings.

III. RESULTS AND DISCUSSIONS

The sample group's descriptive statistics, encompassing the arithmetic mean, standard deviation, minimum, and maximum values, are presented in Table 1. The results of the correlation analysis, utilised for the identification of relationships between variables, are presented in Table 2.

Table 1. The following report presents the descriptive statistics for female football players.

	N	Min.	Max.	$\bar{X}$	Ss
Age (year)	30	13,00	16,00	14,5667	,93526
Height (cm)	30	153,00	174,00	163,5333	5,03596
Weight (kg)	30	44,70	70,60	54,9467	6,74039
Body Fat Percentage (%)	30	16,70	28,30	21,6633	3,11863
Speed (sec)	30	4,50	5,53	4,9183	,22573
Agility (sec)	30	2,23	2,92	2,5373	,16373

The study comprised 30 female football players with a mean age of 14.56 years ± 0.935 years, a mean height of 163.53 cm ± 5.03 cm, and a mean body weight of 54.94 kg ± 6.74 kg. The performance metrics encompassed the mean 30-metre sprint time of 4.91 ± 0.22 seconds and the mean 50-metre agility time of 2.53 ± 0.16 seconds.

Table 2. The following study will examine the correlation values between body fat percentage and sprint and agility performance measurements.

Variables	Body Fat Percentage	Speed	Agility
Body Fat Percentage	1	,275	,047
Speed	,275	1	,133
Agility	,047	,133	1

**p<0,01, *p<0,05

As illustrated in Table 2, the correlation coefficients for body fat percentage, 30-metre sprint and 505 agility test measurements are presented. Subsequent to thorough analysis of the athletes' performance, no significant relationship was identified between body fat percentage and the sprint and agility parameters.

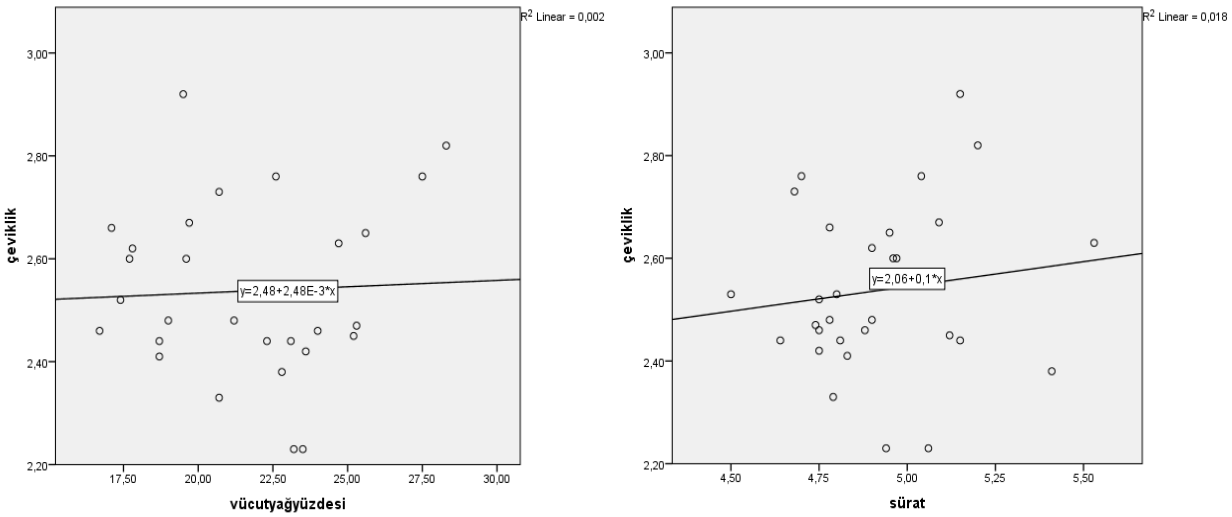


Figure 1. Scatter Plot (BFP-Agility, Speed-Agility).

Upon rigorous examination of the relationship between athletes' body fat percentage and speed parameters, as well as their agility characteristics, it is observed that a clear linear relationship between body fat percentage and agility performance is not evident. It is noteworthy that the data points are dispersed irregularly on the scatter plot, thus failing to demonstrate a discernible trend. The results of the Pearson correlation analysis also revealed no statistically significant relationship between body fat percentage and agility ($r = 0.047$; $p > 0.05$).

A preliminary analysis of Figure 1 reveals a modestly positive correlation between speed and agility performance. However, the scatter plot reveals that the data points are widely dispersed and the linear relationship is weak. The Pearson correlation analysis revealed no statistically significant relationship between speed and agility ($r = 0.133$; $p > 0.05$).

IV. DISCUSSION

The present study examined the effects of speed and body fat percentage on agility performance in young female soccer players. The findings revealed no statistically significant relationships between body fat percentage and agility, speed and agility, or body fat percentage and speed. Although these findings are not entirely consistent with several studies reported in the literature, they provide important insights into the multifactorial nature of agility performance in adolescent female athletes.

Previous studies have generally reported significant relationships between speed and agility performance in soccer players. Little and Williams (2005) demonstrated that sprint performance was moderately associated with agility in professional male soccer players, suggesting that acceleration and maximum running speed contribute substantially to change-of-direction ability. Similarly, Sheppard and Young (2006) emphasized that agility comprises both physical and cognitive components, including speed, balance, coordination, and decision-making processes. However, no significant relationship was observed between speed and agility in the present study. This discrepancy may be explained by differences in age, sex, training status, and developmental characteristics of the participants.

Recent studies have continued to support the influence of body composition on physical performance in soccer players. França et al. (2024) reported that body fat percentage showed significant associations with sprint and agility performances in youth soccer players, with higher body fat levels being related to poorer speed and change-of-direction abilities. Likewise, Çelik et al. (2022) found that lower body fat percentages were associated with superior sprint and

vertical jump performances in football players. In contrast, the present study did not reveal any statistically significant relationships between body fat percentage and either speed or agility performance. One possible explanation is the relatively homogeneous nature of the sample. Since all participants belonged to the same elite youth academy and followed similar training programs, the limited variability in body composition may have reduced the likelihood of detecting significant correlations.

The developmental characteristics of the participants may also have contributed to the present findings. The athletes included in this study were between 13 and 16 years of age, a period characterized by rapid growth, biological maturation, and neuromuscular development. Recent evidence suggests that maturation status may substantially influence physical capacities such as sprinting, agility, and strength independently of chronological age (Konarski et al., 2024). Therefore, the relationships among body composition, speed, and agility may not yet be fully established during adolescence, particularly among female athletes whose developmental trajectories differ from those of male players.

Furthermore, recent investigations conducted specifically on female soccer players have highlighted the multidimensional nature of agility performance. De Marco et al. (2024) demonstrated that relative lower-body strength significantly contributes to sprint and change-of-direction abilities in elite youth female soccer players, indicating that physical capacities other than body composition may play an important role in performance. Similarly, contemporary research has emphasized the contribution of neuromuscular and cognitive factors to multidirectional movements and agility performance in female football players. These findings suggest that agility should not be interpreted solely as a function of speed or anthropometric characteristics but rather as an integrated outcome of physical, technical, neuromuscular, and cognitive abilities.

The findings of Özkan et al. (2012) also support this interpretation by emphasizing that agility performance depends not only on physical characteristics but also on reaction time, coordination, and decision-making processes. In adolescent athletes, cognitive and neuromuscular maturation may exert a greater influence on agility performance than body composition variables alone. Therefore, the absence of significant relationships in the present study may reflect the complex and multifactorial determinants of agility during this developmental stage.

Several limitations of the present study should be acknowledged. First, the relatively small sample size may have limited the statistical power to detect significant associations among the variables. Second, all participants belonged to the same club and age category, reducing the generalizability of the findings to broader populations of female soccer players. Third, biological maturation, lower-body strength, and cognitive determinants of agility were not directly assessed. Future studies should include larger and more heterogeneous samples, different competitive levels, and additional physiological, neuromuscular, and cognitive variables to provide a more comprehensive understanding of agility performance in young female soccer players.

In conclusion, no significant relationships were identified among speed, body fat percentage, and agility performance in young female soccer players. The findings suggest that agility performance during adolescence may be influenced by developmental, neuromuscular, and cognitive factors beyond anthropometric characteristics and linear sprint ability. Further longitudinal studies involving different age groups and competitive levels are recommended to clarify these relationships and contribute to evidence-based training practices in female youth football.

V. CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it is recommended that coaches and sport scientists working with young female soccer players design training programmes that address the multidimensional nature of agility performance rather than relying solely on linear speed or body composition measures. Incorporating perceptual-cognitive and reactive agility exercises alongside neuromuscular training may better support the development of change-of-direction performance during adolescence. Additionally, further research with larger and more diverse samples is encouraged to generalize these findings and explore their long-term effects on youth female football development.

The present study examined the effect of speed and body fat percentage on agility performance in young female soccer players. The findings indicated an absence of a statistically significant relationship between speed and agility, body fat percentage and agility, or body fat percentage and speed.

The findings can be attributed to three factors. Firstly, the physical and neuromuscular development of athletes in this young age group has not yet reached full maturity. Secondly, the sample group is homogeneous. Thirdly, agility performance is multidimensional in nature. Conversely, it is hypothesised that agility performance is associated with not only physical attributes such as speed and body composition, but also with psychological factors including reaction time, coordination, and cognitive processes such as decision-making.

It is recommended that the following action be taken in light of the findings:

- It is recommended that future studies utilise samples that encompass a more extensive range of age demographics.

- A potential avenue for future research would be the conducting of studies that make comparisons between male and female football players.
- In the context of future research, there is a need to consider the influence of cognitive and neuromuscular factors on agility performance.
- It is imperative that training programmes encompass not only components such as speed and body composition, but also incorporate multifaceted exercises that facilitate the enhancement of agility (Chaalali et al., 2016).
- It is imperative that longitudinal studies are conducted in order to examine the effects of the developmental process.

In conclusion, although no significant relationship was found among the variables examined in this study, it is believed that more comprehensive research is necessary, taking into account the multifactorial nature of agility performance.

DECLARATIONS

Acknowledgements: The author would like to thank the athletes of the youth teams of Galatasaray Women's Football Club and their families for their voluntary participation, as well as the club's coaching and technical staff for their support during the data collection process.

Author Contributions: All parts of the study were conducted by the Author.

Conflict of Interest: The author declares no conflict of interest.

Supporting Institutions: This research received no external funding.

Ethical Approval: This study was approved by the Ethics Committee of Istanbul Gelisim University (Date: 18 March 2026; Approval No: 2026-04) and was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians of all participants prior to data collection.

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