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"Who's Got Talent?" Change of Direction, Anthropometric Characteristics and Maturity Offset Differences Between Elite and Sub-Elite Young Soccer Player

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ABSTRACT

Agility, anthropometrics and maturity-offset have been considered fundamental for talent identification in soccer. The aim of this study is to compare 83 young soccer players (U12) from elite (28) and sub-elite (55) teams, to investigate the influences of anthropometric characteristics and maturation on Change-of-Direction (CoD) with the ball (dribbling) and without the ball. ANCOVA was run to investigate potential differences in Agility T-Test and Shuttle Dribble Test between categories while simultaneously controlling for the effects of anthropometric variables such as Peak Height Velocity (PHV), Weight, and Height. Agility T-Test performance does not significantly differ between the two categories (F-value = 0.537, $p > .05$). However, the Weight significantly influences the results (F-value = 18.425, $p < .001$, Eta-Squared = 0.172) and also PHV has a significant impact on them (F-value = 10.099, $p < .01$, Eta-Squared = 0.094). The Shuttle Dribble Test performance significantly varies between two groups (F-value = 5.207, $p < .05$, Eta-Squared = 0.057). Only Weight significantly influences this test (F-value = 4.324, $p < .05$, Eta-Squared = 0.048). Our findings indicate that during the U-12 age period, technical skills emerge as a crucial discriminant factor between elite and sub-elite young soccer players, contrarily to the athletic performance without the ball. In addition, the maturity stage specifically influences the Agility T-Test and Weight is significantly related to lower time to complete both in Agility T-Test and SDT.

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Soccer is an intermittent sport with demands of high intensity movements that are also required in youth challenges (Bangsbo, 1994; Bangsbo et al., 2006). While a considerable portion of a player's activities involve low metabolic and mechanical demands, such as standing, walking, and jogging (Hostrup & Bangsbo, 2023) the intermittent nature of soccer involves numerous high-intensity actions. These intense efforts include high-intensity runs (exceeding 19.8 km/h, constituting 8% of the total distance covered), sprints (40–60 per game, covering a total of 0.3 to 0.6 km), abrupt changes of direction (cuts), and rapid deceleration (Bastida Castillo et al., 2018; Taylor et al., 2017; Wallace & Norton, 2014). Additionally, there has been a consistent rise in the frequency of high-intensity activities in soccer over recent years (Andrzejewski et al., 2013; Barnes et al., 2014). Approximately 90% of these actions are attributed to rapid changes in running directions, coupled with the anticipation and decision-making process.

The physical ability that describes this type of action is defined as change-of-direction (CoD) ability, and is considered as an essential performance indicator (Gates & Sheffield, 1940; Nimphius et al., 2018). CoD ability includes the skills or abilities needed to change direction, velocities, or modes of travel and it is well studied for talent identification programs (Gil et al., 2007; Reilly et al., 2000). Another crucial aspect for performance prediction is the ability to perform CoD and sprints while controlling the ball. Indeed, talent prediction emphasizes the importance of technical, physical and anthropometric factors (Fuhre et al., 2022; Lovecchio et al., 2021).

In the context of young elite players' performances, it is also crucial to consider the influence of biological maturation (Solley, 1957). Previous studies have highlighted how biological maturation plays a significant role in the profiles of elite athletes. For example, a study conducted by Dugdale et al. (2020) confirmed that the maturation stage of the player highly influences CoD ability, with more mature players showing worse performance. Moreover, young elite athletes exhibit distinctive physical characteristics, including lower adiposity, increased flexibility, and superior outcomes in various physiological assessments (Pion et al., 2015; Vaeyens et al., 2006). A thorough analysis demonstrating the impact of biological maturation on CoD performance highlights the necessity of fully understanding the challenges and opportunities that athletes may encounter during development (Carnevale Pellino et al., 2020; Giuriato, Codella et al., 2021; Giuriato, Kawczynski et al., 2021). Further, Giuriato et al. (2023) suggested that anthropometrics, maturation and muscle qualities influenced CoD performance in adolescents. In conclusion, both in adult and young soccer players, high levels of CoD are correlated with high-speed repetitive actions, essentials to achieve successful performance in soccer (Trecroci et al., 2016). However, there is a need for further investigation into the complex relationship between various factors such as anthropometric characteristics and maturation on CoD performance. For these reasons, the aim of this study is to compare

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a sample of young soccer players from elite teams with a group of sub-elites, to investigate the influences of anthropometric characteristics and maturation on CoD with the ball (dribbling) and without the ball. Moreover, since there is a lack of data on whether it is better to analyze CoD performance with or without the ball, our study aims to assess what is best to consider for talent identification.

Materials and methods

Participants

A total of 83 young soccer players, 28 from elite soccer teams (youth sectors of Serie A teams) and 55 from sub-elite teams (youth sectors of Serie D teams) were involved in the study. Inclusion criteria were as follows: i) male young soccer players players aged 11 years old; ii) playing for more than 2 years in the same soccer team and iii) playing in a U12 soccer team in Northern Italy. One group belonged to youth academies of professional soccer teams, considered as an elite level, while the other group was composed of players from teams from a nonprofessional soccer club, considered as a sub-elite level. Data were collected in April 2023 in the training facilities of the teams, and the tests were carried out on a surface of artificial grass. The protocol was explained first to the team managers and then to the parents of the children. Then, we obtained written informed consent from the parents, while to obtain verbal assent the general purpose of the study was explained to the children. All participants were free to withdraw their participation at any time and without consequences. No credit or rewards were given to the children for their participation in the study. After ethical approval of the research protocol, we obtained written informed consent and medical declaration from the participants and their parents/legal guardians in line with the procedures set by the local Institution's Research Ethics Committee (Approval no. 44/17, attachment 3). The study protocol was conducted in accordance with the Declaration of Helsinki (World Medical Association, 2013).

Anthropometrics

Height and weight were recorded according to the standard procedures described by da Silva & Vieira (2020) in the guidelines of the International Society for the Advancement of Kinanthropometry. Before the participants performed the tests, height was measured with a wall-mounted meter (Seca 213; Seca GmbH & Co., Hamburg, Germany) to the nearest 0.1 centimeter (cm) with participants barefoot, standing in an upright position with the head in the Frankfort plane. After that, weight was measured to the nearest 0.1 kilogram (kg) with an electronic scale (Seca 864; Seca GmbH & Co., Hamburg, Germany) with the subject wearing minimal clothing.

Peak height velocity

To compute Maturity offset we used Moore's equation: Mat Offset (boys)= $-7.9 + (0.004 \times \text{Age} \times \text{H})$. Then, we computed predicted age at Peak Height Velocity (PHV) (years) as the difference between chronological age and maturity offset (Kozieł & Malina, 2018) according to these cutoffs:

years before (−3 = −2.51 to −3.50, −2 = −1.51 to −2.50, −1 = −0.51 to −1.50), on time (0 = −0.50 to + 0.49) and after (+1 = +0.50 to + 1.49, +2 = +1.50 to + 2.49 and + 3 = +2.50 to +3.49).

Agility T-Test

The Agility T-Test (ATT) is a reliable and valid test for assessing CoD and agility performance of young soccer players (Sporis, 2010). The ATT was administrated following the instructions outlined by Pauole et al. (2000). The players started with both feet behind starting point A and, after the sound signal, sprinted forward to point B (9.14 m apart) touching the cone. Without stopping the run, they changed direction to the right to touch the cone C (4.57 m) and, again, to the cone D (9.14 m) and consecutively to B cone. At the end, a back run from B to A concluded the tests. A graphical illustration of the test is presented in Figure 1. Time was recorded using an electronic optical system and players started 50 cm behind single-beam photocell gates (Racetime2, Microgate, Bolzano, Italy). The ATT was performed three times with a complete rest of 3 min between each trial, while only the best time of the three attempts was recorded.

Shuttle Dribble Test

The Shuttle Dribble Test (SDT) has been used to assess the dribbling performance of young soccer players, and it has been validated previously in literature (Huijgen et al., 2010; Sarmento et al., 2018). The participants had to place themselves with both feet behind the starting line (point A). Then, participants were required to sprint 5 m to point B with the ball, return to point A, then sprint to point C (10 m), concluding by returning to point A (10 m), as illustrated in Figure 2. The SDT was carried out 3 times with 3-min rest between each trial (Huijgen et al., 2010), while the best time of the three trials was recorded. Time was recorded using an electronic optical system and players started 50 cm behind single-beam photocell gates (Racetime2, Microgate, Bolzano, Italy).

Statistical analysis

All quantitative data were summarized as mean and standard deviation (SD). In this study, ANCOVA was employed to investigate potential differences between categories while simultaneously controlling for the effects of continuous variables such as Peak Height Velocity (PHV), weight, and height. The inclusion of these covariates in the analysis allows for a more nuanced understanding of the relationship between the categorical variable of interest and the dependent variable. By covarying for PHV, weight, and height, the study aims to isolate and assess the specific impact of the categorical variable on the dependent variable while accounting for potential confounding effects of these continuous variables. The ANCOVA model's appropriateness was rigorously ensured through a systematic process. The continuous and normal distribution nature of the dependent variable,

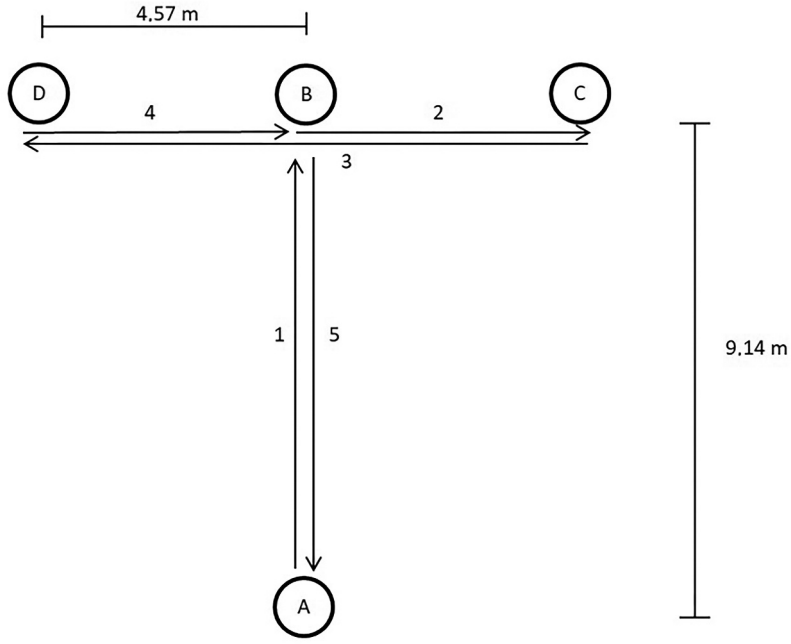

Figure 1. Graphical representation of Agility T-Test.

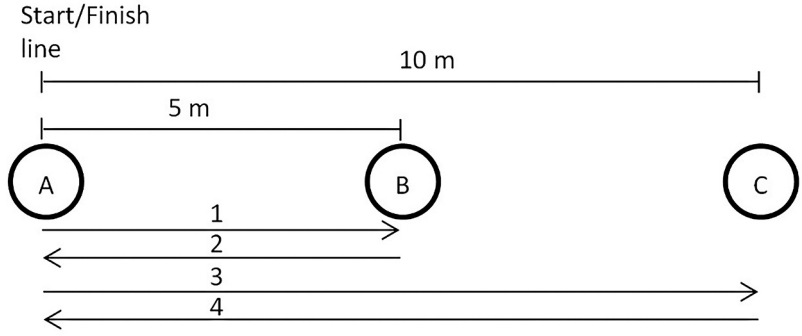

Figure 2. Graphical representation of Shuttle Dribble Test.

the suitability of the covariate as a continuous variable, and the independence of levels within the qualitative variable were confirmed. Attention was given to establishing a linear relationship between the dependent variable and covariate, with considerations for non-linearity. The homogeneity of regression slopes was assessed by scrutinizing the correlation coefficient's consistency across levels of the qualitative variable. The significance level was set at $p < .05$ to establish statistical significance. The statistical analyses were performed using The Jamovi Project's software, version 1.6 for Mac, retrieved from https://www.jamovi.org on 5 May 2022.

Results

Table 1 presents the descriptive statistics for Height (cm), Weight (kg), Peak Height Velocity (PHV).

The ANCOVA comparison between the two player level while controlling for height, weight and PHV is shown in Table 2.

The analysis showed that the performance in the T-test does not significantly differ between the two categories, as indicated by the non-significant F-value (0.537, $p > .05$). However, the weight of the players significantly influences T-test performance (F-value = 18.425, $p < .001$), explaining a substantial portion of the variance (Eta-Squared = 0.172). Additionally,

Table 1. Descriptive statistics of soccer players.

	Elite	Sub-Elite
Weight (kg)	30.24 ± 3.66	32.25 ± 5.92
Height (m)	1.34 ± 0.05	1.34 ± 0.06
PHV	−3.19 ± 0.47	−3.13 ± 0.53
T-test (s)	13.9 ± 0.80	13.9 ± 0.74
Shuttle dribble test (s)	13.1 ± 1.12	14.1 ± 1.71

Note. All outcomes are presented as mean ± SD. kg = kilograms, *m* = meters, s = seconds.

Table 2. ANCOVA comparison of performance tests between players level considering height, weight, and PHV.

	Players level		Height		Weight		PHV	
	F-value	Eta-Squared	*F*-value	Eta-Squared	*F*-value	Eta-Squared	*F*-value	Eta-Squared
T-Test	0.537	0.005	0.146	0.001	18.425***	0.172	10.099**	0.094
Shuttle Dribble Test	5.207*	0.057	0.042	0.000	4.324*	0.048	3.100	0.034

Note. * = significant at 0.05; ** = significant at 0.01; *** = significant at 0.001.

player's PHV also has a significant impact on T-test performance (F-value = 10.099, $p < .01$, Eta-Squared = 0.094). The Shuttle Dribble Test performance exhibits a significant difference between the two groups, as evidenced by the significant F-value (5.207, $p < .05$). This performance difference is associated with a moderate effect size (Eta-Squared = 0.057). Notably, the weight of the players plays a significant role in explaining the performance variation in this test (F-value = 4.324, $p < .05$, Eta-Squared = 0.048), while height and PHV do not contribute significantly.

Discussion

This research aimed to gather valuable insights for talent identification, focusing specifically on the influence of PHV and anthropometric characteristics on CoD performance, with and without the ball, in U12 teams. Regarding CoD performance without the ball (T-test), our analysis did not reveal any differences between groups. Despite this, weight and PHV had a great influence (Eta-Squared, respectively, 0.172 and 0.094) on the T-test. Moreover, while PHV was not considered as a determinant for SDT performance, weight remained the primary factor related to lower time to complete this test. The time recorded for the SDT varied between the two categories, with elite players achieving a better performance compared to the sub-elite players. Similar to our findings, Giuriato, Codella et al. (2021) observed that the optimal body shape for CoD performance tends to be taller with a lighter body mass. Additionally, Nevill et al. (2019) noted that elite soccer players, particularly in their early ages, are exhibiting a trend toward becoming lighter and more ectomorphic. Our results further confirm that players with lower body weight, regardless of their skill level, show improved CoD performance. This suggests that in young soccer players, a lower body weight and early maturation stage (pre-PHV) could be predictive of better CoD performance, especially when assessed without the ball. Due to these findings, soccer teams should factor in these aspects during their selection process, taking into consideration the potential impact of these abilities.

Moreover, our findings underscore that the predominant distinctions between the two groups, elite and sub-elite young players, were not in the athletic performance but rather in the technical aspects, particularly ball control. The systematic review conducted by Sarmento et al. (2018). showed that the technical factor are huge determinants of performance in young soccer players. Additionally, Waldron and Murphy (2013) demonstrated that elite players, during a soccer match, performed more dribbling with a higher success rate and were also faster dribblers than sub-elite players. The findings suggest that success in CoD, especially when executed with the ball, should be taken into account in the talent identification process. The biomechanical differences that justify the higher dribble performance have been explained by a previous study by Zago et al. (2016). Faster dribblers had reduced vertical and mediolateral Centre of Mass range of motions, reduced hip and knee flexion and higher football cadence. However, there are contrasting studies that diverge from our findings. For instance, Unnithan et al. (2012) found that crucial performance indicators for distinguishing between elite and sub-elite groups of young soccer players include CoD and sprinting performance. Consequently, additional research is essential to conclusively determine the optimal parameters for talent identification. The significance of sport-specific skills in predicting success in soccer has been consistently documented over the years, Huijgen et al. (2010). Our analysis highlights that the maturity stage specifically influences the T-test, revealing that a lower peak height velocity (PHV) corresponds to a higher time in the test. Interestingly, our findings contradict the prevailing literature on the subject. Notably, Negra et al. (2022) and Giuriato, Kawczynski, et al. (2021) illustrated that youth with greater maturity, indicated by a positive maturity offset, exhibit better CoD performance. Additionally, Asimakidis et al. (2022) demonstrated a noteworthy distinction in the 505-agility test, whether conducted with the dominant or non-dominant foot in relation to PHV. The positive PHV group exhibited better performance compared to the negative PHV group. The observed variation from previous studies could likely be attributed to differences in our sample. It is noteworthy that both elite and sub-elite players in our study were quite young, and perhaps the impact of maturity did not significantly influence our outcomes for this specific reason. Our findings indicate that during the U-12 age period, technical skills emerge as a crucial parameter influencing performance in soccer players. It is recommended to maintain control over the mentioned variables. The dynamic nature of talent development underscores the need for ongoing monitoring and adaptation. Coaches and talent development programs should stay abreast of emerging research, trends, and evolving methodologies to ensure that they are providing the most effective and relevant training and growth to their young talents. Trainers must have a more holistic approach to talent development, acknowledging the multifaceted nature of success in soccer. This includes a focus on both physical attributes and sport-specific skills, fostering a more inclusive environment for diverse player profiles. Our research highlights the essential role of sports scientists in enhancing athlete performance. Our findings also indicate a shift toward emphasizing sport-specific skills, with a particular focus on dribbling, as a pivotal factor for predicting success in young soccer players.

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