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Research article

CHANGE OF DIRECTION AND DRIBBLE DEFICIT IN SOCCER: IS THERE ANY DIFFERENCE RELATED TO AGE CATEGORY?

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Abstract. *Change of direction (COD) and technical skills are considered key parameters of performance in youth soccer, as they are highly demanded during a match. The aim of this study was to examine whether change of direction and Dribble deficit (DD) differ between younger soccer players from various consecutive age categories. Ninety young soccer players (mean age: 11.67 ± 1.29 years; body height: 154.84 ± 10.82 cm; body weight: 43.95 ± 9.62 kg) participated in the study and were divided into 5 age categories (Under 10, Under 11, Under 12, Under 13, and Under 14). All the participants performed change-of-direction tests (the Slalom and Zig-zag) with and without a ball. The DD is determined indirectly by reducing the time variation between the fastest trials with and without a ball. The results revealed that the U14 group is significantly better in the Slalom with and without a ball compared to the other groups, in the Slalom DD compared to the U12 group, and Zig-Zag DD compared to the U13 group ($p < 0.05$). On the other hand, as expected, the U10 group showed the lowest results, with the Slalom test results significantly lower compared to the other categories ($p < 0.05$). In conclusion, as was expected, the oldest group (U14) showed better results in both COD tests and in DD compared to their younger peers, with the youngest group (U10) exhibiting the lowest values in almost all the tests.*

Key words: *agility, football, dribbling, movement, technical proficiency*

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1. INTRODUCTION

Change of direction (COD) and technical skills are considered key parameters of performance in youth soccer, as they are highly demanded during a match. Soccer is distinguished by a series of actions which involve constantly modifying patterns of movement, with and without a ball based on sport-specific requirements (Morral-Yepes, Gonzalo-Skok, Dos Santos, & Moras Feliu, 2023). COD plays a key role in determining these patterns in young soccer players, which are increasingly explored by scientists and coaches (Stanković, Đorđević, Aleksić, Lazić, & Trajković, 2022). Besides that, technical skills can provide a better understanding of overall performance (Krolo, Gilic, Foretic, Pojskic, & Sekulic, 2020). Interestingly, these components often occur simultaneously in real-match situations, indicating the need for integrated performance metrics (Aquino, Puggina, Alves, & Garganta, 2017). Although there is research about their correlation, limited literature is available on factors that make differences in skills with and without a ball. Therefore, exploring combined measures of COD and technical ability may offer a more realistic assessment of a player's game-relevant physical proficiency.

In order to achieve optimal development in young soccer players, physical profiling in soccer plays a significant role in choosing training methods, particularly in younger categories (Waskita, Hariono, Paryadi, & Yudhistira, 2023). COD movements are not only frequent in matches but also occur at decisive moments, such as goal-scoring opportunities or transitions in play (Nimphius et al., 2016). In developing players, COD ability reflects a combination of strength, power, balance, and coordination, the physical attributes that evolve with age and training. Its importance lies in the ability to quickly decelerate, reorient the body, and accelerate again in a new direction. Those movements are strongly dependent on high levels of neuromuscular control (Chaouachi et al., 2012). While COD provides valuable insights into movement efficiency and explosiveness, it often overlooks the influence of technical skills, such as dribbling, which frequently occur during directional changes in actual gameplay. Therefore, to fully understand a young player's effectiveness on the field, it becomes necessary to also examine how COD interacts with ball control and technical execution under pressure.

Technical skills (e.g., passing, dribbling, and shooting) are among the most commonly completed acts during soccer matches (Williams, Ford, & Drust, 2023). The DD parameter, recently introduced as a novel method to measure dribbling speed independent of sprinting speed (Scanlan et al., 2018), provides a reliable assessment of COD ability without bias from linear sprint capacity. To determine the Dribble Deficit, subtract the outcome time in a specified linear sprint test over a specific distance from the entire running time of a COD test over an identical length. Evaluating young soccer players' agility and DD may be a useful tool for improving performance and tailoring training regimens to their age and skill levels. Dribble Deficit is a more dependable and appropriate criterion for measuring dribbling efficiency, as it is not affected by acceleration or technical competence (Ramirez-Campillo, Gentil, Moran, Dalbo, & Scanlan, 2021).

Although the apparent importance of evaluating DD has been established, research has focused on a wide variety of sports, such as basketball, handball and futsal (Pavlović, Lazić, Čović, Pišot, & Milanović, 2025; Conte, Scanlan, Dalbo, Gang, & Matulaitis, 2020; Oliveira, Marinho, Sampaio, Carvalho, & Morais, 2025). Limited studies have examined how DD evolves and differs across ages in youth soccer. For instance, some findings suggest that COD ability measured by COD asymmetry did not change across different age (U15,

U16, U17, U18) categories (Trecroci, Rossi, Dos'Santos, Formenti, & Alberti, 2020). On the other hand, Loturco et al. (2019) found that senior players exhibit slower COD speed than younger groups, while U15 had the lowest COD deficit. It is also recorded that U17 outperformed U20 and senior players in COD deficit, indicating better movement efficiency in younger age groups. On the contrary, Conte et al. (2020) identified trivial-to-moderate associations between sprinting time and DD in all age groups of basketball players (U9, U10) using linear and COD pathways. Further, Pavlovic et al. (2024) reported that the DD accurately assesses handball players' dribbling abilities, regardless of sprinting ability. However, there is still a lack of comprehensive data comparing multiple age categories, which restricts the overall understanding of how maturation affects performance. Given the dynamic development of motor abilities in young soccer players, examining differences in DD can offer valuable insights for coaches and practitioners.

Although previous studies have laid important ground for understanding dribble-related performance, a gap in the literature remains regarding age-specific trends in DD during youth development. To the best of the authors' knowledge, only one study (Loturco et al., 2019) examined differences in DD across different age categories, but research remains limited to adolescent and senior soccer players without examining differences between preadolescent and adolescent categories. To address this, our research aimed to examine whether DD differs between younger soccer players from various consecutive age categories.

2. METHODS

2.1. Participants

Ninety youth soccer players (mean±SD age: 11.67 ± 1.29 years; body height: 154.84 ± 10.82 cm; body weight: 43.95 ± 9.62 kg), aged 10-14 years, with different prior soccer playing experiences, participated in this study. The basic descriptive characteristics of the participants are presented in Table 1. Participants were included if they were aged between 10 and 14 years, actively participated in youth soccer training on a regular basis, and were selected by regional soccer instructors for the soccer camp. Exclusion criteria were as follows: players who had a history of injury in the last six months, were involved in other sports that may interfere with soccer training, or had any medical conditions that would contraindicate participation in physical testing. To ensure diversity in skill level, the participants were selected from teams classified as both elite and subelite based on their performance within their respective leagues. All participants and their parents/guardians were informed about the experimental procedures and provided written informed consent prior to participation. The protocol was approved by the Ethics Committee of the Faculty of Sport and Physical Education with all procedures conducted in accordance with the Declaration of Helsinki.

Table 1 Basic descriptive statistics for each group (Mean ± SD)

Variable	U14 (n=11)	U13 (n=21)	U12 (n=33)	U11 (n=17)	U10 (n=8)	Total (n=90)
Age (years)	13.42 ± 0.21	12.73 ± 0.17	11.62 ± 0.19	10.56 ± 0.20	9.08 ± 0.39	11.67 ± 1.29
Height (cm)	171.4 ± 9.18	160.37 ± 7.00	153.59 ± 6.71	146.13 ± 5.41	141.14 ± 4.88	154.84 ± 10.82
Weight (kg)	58.43 ± 6.74	48.16 ± 7.32	42.39 ± 7.61	36.75 ± 5.51	34.68 ± 2.23	43.95 ± 9.62

2.2. Procedures

Individual change-of-direction sprint and dribble times were measured during a single session in the cross-sectional study design while the Dribble Deficit was computed indirectly. Each player completed the Slalom and Zig-Zag tests firstly as sprint time without a ball, followed by dribble time with a ball. Before the test, each player completed a 20-minute standardized warm-up that included moderate-intensity jogging and skipping (5 minutes), specific ball movements (7 minutes), static and dynamic stretches (5 minutes), and high-intensity acceleration and deceleration runs (3 minutes). The players were instructed to abstain from alcohol, excessive caffeine consumption, and any strenuous physical activity at least 24 hours before the test.

2.3. Slalom test with and without a ball

The Slalom test was performed according to the previously described procedures (Sporiš et al. 2010). Briefly, six cones were positioned two meters apart for the test, with the first cone being positioned one meter from the starting line. The feet of each participant were placed 5 cm behind the starting line at the beginning of the test. They started slalom running from point to point as soon as the sound signal was given. The participant's right side received the second point. Until they reached the final destination, they kept running as quickly as they could, switching between the right and left. The participants turned around and slalomed back to the starting line after reaching the last cone. The Slalom test with a ball had the same structure as the original Slalom test but required participants to dribble a ball while performing it.

2.4. Zig-Zag test with and without a ball

The Zig-Zag test was performed according to previously described procedures (Sporiš et al. 2010). Cones were positioned at 100° angles along four 5-meter segments, for a total test length of 20 meters. The participants had to accelerate and decelerate as quickly as they could around each cone from different starting and finishing points in order to measure performance using two pairs of photocells (Witty, Microgate, Bolzano, Italy). They began by standing with their front foot 5 cm behind the first set of timing gates. The participants had to complete the Zig-Zag test while dribbling a ball, but the structure of the test remained the same as the original Zig-Zag test.

2.5. Dribble deficit

The Slalom Dribble Deficit and Zig-Zag Dribble Deficit were calculated by subtracting the time difference between the best change-of-direction sprint trial without a ball and the best change-of-direction trial while dribbling for the Slalom and Zig-Zag COD tests (Scanlan et al. 2018).

2.6. Statistical analysis

Data analysis was performed using the Statistical Package for the Social Sciences (v13.0, SPSS Inc., Chicago, IL, USA). Means and standard deviations (SD) with 95% confidence intervals (95% CI) were calculated for each variable. Differences among age category groups were compared using univariate analysis of variance (ANOVA). Statistical significance was set at $p<0.05$.

3. RESULTS

In Table 2, the mean differences indicate that older age groups generally perform better, with the largest negative values observed between U14 and U10, such as -1.37 for the Slalom ($p \leq 0.00$) and -2.02 for the Slalom with a Ball ($p \leq 0.02$). Furthermore, the results from the table indicate that for the Slalom category, significant improvements are seen in most comparisons between U14 and the older age groups. The comparison between U14 and U11 shows a mean difference of -0.71 ($p \leq 0.00$), reinforcing the trend of improvement. In the Slalom with Ball, notable differences include -1.40 ($p \leq 0.02$) between U14 and U12. Zig-Zag performance also shows a significant progression, particularly between U14 and the older age groups, such as a mean difference of -0.42 ($p \leq 0.01$) between 2010 and 2012. The Zig-Zag with a Ball category reflects similar improvements, with -1.18 ($p \leq 0.07$) between U14 and U10, demonstrating better ball control and agility in older children. In the Dribbling Deficit Slalom and Dribble Deficit Zig-Zag, the differences are smaller but still indicate improvement, such as -0.62 ($p \leq 0.005$) for the Dribble Deficit Slalom (U14 and U10) and -0.38 ($p \leq 0.01$) for the Dribble Deficit Zig-Zag (U14 and U13). In the Slalom Dribble Deficit we found statistically significant differences ($p \leq 0.05$) with mean differences (-0.68) only between the U14 and U12 age groups. Similar results were shown in the Zig-Zag Dribble Deficit with statistically significant differences ($p \leq 0.05$) and mean differences (-0.39) between the U14 and U12 age groups.

Table 2 Differences between groups and 95% Confidence Interval (95% CI)

Variable	U14[a]	U13[b]	U12[c]	U11[d]	U10[e]	p value
	Mean ± SD (95% CI)	Mean ± SD (95% CI)	Mean ± SD (95%CI)	Mean ± SD (95%CI)	Mean ± SD (95%CI)	
Slalom (s)	6.16 ± 0.17[bcde] (6.05 - 6.27)	6.85 ± 0.71[ae] (6.52 - 7.17)	6.89 ± 0.39[ae] (6.75 to 7.03)	6.88 ± 0.17[ae] (6.79 to 6.97)	7.53 ± 0.61[abcd] (7.02 to 8.03)	0.00
Slalom with a ball (s)	10.22 ± 0.52[bcde] (9.87 to 10.57)	11.53 ± 1. 29[a] (10.94 to 12.12)	11.63 ± 1.23[a] (11.19 to 12.06)	11.38 ± 0.77[a] (10.99 to 11.78)	12.24 ± 1.39[a] (11.08 to 13.41)	0.02
Zig-Zag (s)	5.64 ± 0.21[bcde] (5.51 to 5.78)	5.95 ± 0.61[ac] (5.67 to 6.23)	6.21 ± 0.29[abd] (6.1 to 6.31)	5.96 ± 0.21[ac] (5.86 to 5.07)	6.37 ± 0.43[abd] (6.01 to 6.73)	0.00
Zig-Zag with a ball (s)	7.12 ± 0.24[bcde] (6.95 to 7.28)	7.82 ± 0.69[ae] (7.5 to 8.14)	7.96 ± 0.43[a] (7.81 to 8.11)	7.78 ± 0.38[ae] (7.59 to 7.98)	8.26 ± 0.71[abd] (7.67 to 8.85)	0.00
Slalom Dribble deficit	4.06 ± 0.53[c] (3.71 to 4.42)	4.68 ± 1.15 (4.16 to 5.21)	4.74 ± 1.06[a] (4.36 to 5.11)	4.51 ± 0.76 (4.12 to 4.9)	4.72 ± 0.94 (3.93 to 5.5)	0.36
Zig-Zag dribble deficit	1.47 ± 0.34[b] (1.24 to 1.7)	1.87 ± 0.63[a] (1.58 to 2.16)	1.76 ± 0.39 (1.62 to 1.89)	1.83 ± 0.33 (1.66 to 1.99)	1.88 ± 0.64 (1.35 to 2.42)	0.19

[a] Significant difference compared to U14; [b] Significant difference compared to U13; [c] Significant difference compared to U12; [d] Significant difference compared to U11; [e] Significant difference compared to U10

4. DISCUSSION

The main goal of this study was to examine the differences in Dribble Deficit (DD) between age categories among youth soccer players. Our findings confirmed our hypothesis that as soccer players get older, they generally get better at moving quickly with the ball, and the differences were evident when looking at both COD and DD. The improvements cannot

be attributed only to faster running but also to becoming more efficient and composed in high-speed situations with the ball.

As a fundamental movement in soccer, especially during tight situations, COD plays a big part in young soccer players, directly impacting key game situations. In our study, the oldest players (U15) performed significantly better on the Slalom and Zig-Zag tests both with and without a ball ($p < 0.05$) compared to the other groups, which backed up previous research from Hammami et al. (2018), where COD was linked with strength and coordination development during adolescence. Also, Trecroci et al. (2020) highlighted how asymmetries in COD tests could be an important factor at this stage of development, which can be indirectly noticed through the variability in groups examined in our research. Further, Dellal & Wong (2013) revealed significantly slower time in COD tests in the U15 group compared to the U17, U19 and senior groups ($p < 0.05$). Similarly, Andrašić et al. (2021) found significant differences in young soccer players, with the U15 group showing significant differences compared to the U17 and U19 groups, and with the best results determined for U19 ($p <0.05$). All these findings are in accordance with our obtained results, indicating clear differences in favor of older age groups. The additional insight provided by this research, by including tests both with and without a ball, makes it even more applicable since physical action is rarely separated from technical execution during a soccer match. These COD trends can set the stage for understanding how well players handle the ball at high speed. The observed differences between categories may reflect biological maturation and/or training experience, as these factors are proven to influence performance independently of chronological age (Lloyd et al., 2013). Overall, our findings underline the need for age-appropriate COD training programs and monitoring, particularly during these critical periods of development.

In addition to COD, DD becomes of special interest by presenting a simple but powerful way to assess how much speed a player loses when adding a technical task, such as dribbling (Scanlan et al., 2018). Ramirez-Campillo et al. (2021) observed that DD is a reliable way to separate pure speed from technical control and that it improves with age and experience. Our results revealed that in DD, the oldest players (U15) were more efficient, with lower values of DD compared to other groups, with statistically significant differences in both the Slalom and Zig-Zag tests, indicating better speed control and ball-handling efficiency with age. This aligned with Conte et al. (2020), where statistically significant differences were observed in favor of the U10 group compared to U9 in DD during COD in young basketball players. Although a direct comparison with previous research is lacking, these results are in contrast to findings presented by Loturco et al. (2019), who found the lowest COD deficit in the U15 group compared to the U17, U20, and senior groups (0.34, 0.81, and 1.12, respectively). U17 players also outperformed U20 ($d = 0.54$) and senior players ($d = 0.90$), while Seniors had a greater COD deficit than U20 ($d = 0.40$). What is unique about our approach is applying it to soccer-specific movement patterns and across multiple age groups, which adds to a growing body of work validating the use of DD as one of the key developmental metrics. That said, some differences compared to earlier studies may come down to the structure of the drills. Additionally, it is believed that the decrease in DD values in older players can be explained by a combination of both physiological and technical factors. With age and experience, better neuromuscular control and more efficient body control during changes of direction occur, which allows for easier integration of dribbling at higher speeds (Huijgen, Elferink-Gemser, Post, & Visscher, 2010). The technical performance of dribbling becomes automatic, so players can maintain running

speed with minimal loss of ball control. Also, biomechanical stability and better movement economy contribute to less deceleration when passing a technical task, while continued exposure to realistic, game-specific situations further improves this ability. One of the possible reasons for the importance of DD and technical skills can be found in the study by Pavlović et al. (2025) which was conducted on professional female handball players, and where strong correlations were found between dribbling performance and COD speed (r = 0.66–0.88), as well as between dribbling performance and DD (r = 0.46–0.93). However, no significant relationship was found between sprinting ability and DD (r = −0.51 to 0.21), indicating that DD reflects technical skill rather than raw speed. These results complement each other and suggest that the DD can be a reliable and discriminative tool for evaluating technical ball control skills, with our study highlighting the important role of accumulated playing experience in its improvement.

A key strength of this study lies in its effort to measure soccer performance in a way that actually reflects how the game is played, not just isolated drills, but movements that combine speed, coordination, and ball control. Also, the inclusion of players from several age groups gave us a better sense of developmental trends, not just an overview of one group. Still, we recognize some limitations. This was a cross-sectional study, meaning we looked at different players at one point in time rather than tracking them over time. Also, we did not account for biological maturity, which can differ a lot between two players of the same age. Future research would benefit from longitudinal designs and from looking at how DD interacts with decision-making or game intelligence since dribbling is not just about mechanics but also timing and awareness.

5. Conclusion

The studied confirmed that older age groups of soccer players were faster both with and without a ball and exhibited lower DD values compared to their younger counterparts, it can be concluded that there are factors influencing both physical development and technical ability during this period. By implementing COD with a ball our approach provides a more realistic evaluation of performance relevant to actual game demands. These findings further support the use of DD as a developmental marker in youth soccer by pointing out the importance of designing training programs that simultaneously target COD and ball control. Understanding these can help coaches tailor age-specific interventions and with better monitoring of a player's progress.

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DEFICIT U PROMENI PRAVCA KRETANJA I DRIBLINGU U FUDBALU: POSTOJE LI RAZLIKE U ZAVISNOSTI OD STAROSNE KATEGORIJE?

Promena pravca kretanja (COD) i tehničke veštine se smatraju ključnim parametrima mladih fudbalera, jer jer se često ispoljavaju tokom utakmice. Cilj ove studije bio je da utvrdi da li se parametri promene pravca kretanja i dribbling deficita razlikuju kod mladih fudbalera uzastopnog godišta. Devedeset mladih fudbalera (mean godine: 11.67 ± 1.29; visina tela: 154.84 ± 10.82 cm;

masa tela: 43.95 ± 9.62 kg) koji su bili podeljeni u pet staronih kategorija je učestvovalo u ovoj studiji. Svaki ispitanik je uradio Slalom i Cik-cak test sa i bez lopte. Dribling deficit je indirektno izračunat tako što je ostvareno vreme na testu sa loptom oduzeto od ostvarenog vremena na istom testu ali bez lopte. Rezultati su pokazali da je grupa U14 značajno bolja u slalomu sa i bez lopte u odnosu na sve ostale grupe kao i u dribbling deficitu slalom testa u odnosu na grupu U12 ($p < 0.05$). S druge strane, očekivano, grupa U10 pokazala je najslabije rezultate, sa značajno nižim vrednostima na slalom testu u odnosu na sve ostale kategorije ($p < 0.05$). Zaključak je da je najstarija grupa (U14) pokazala bolje rezultate u testovima promene pravca kretanja i u parametrima dribbling deficita u odnosu na svoje mlađe vršnjake, pri čemu je najmlađa grupa (U10) pokazala najniže vrednosti u skoro svim testovima.

Ključne reči: *agilnost, fudbal, dribling, pokret, tehničke sposobnosti*