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Change of Direction Deficit: A Promising Method to Measure a Change of Direction Ability in Adolescent Basketball Players

by
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The aims of this study were to determine the relationship between vertical jumping performance, linear speed, change of direction speed (CODs) time and the COD deficit (CODD) in adolescent basketball players and to analyze the CODD between faster and slower players based on linear speed performance. Thirty-eight male basketball players (age: 15.47 ± 0.51 years; body height: 185.19 ± 5.67 cm; body mass: 71.87 ± 7.29 kg) completed countermovement jumps (CMJ) with and without an arm swing, squat jumps (SJs), linear sprints at 20 m with split times at 5 and 10 m, the pro–agility test and the zig-zag tests. Furthermore, the CODD was calculated as the difference between the 20 m linear speed result and CODs time in both COD tests. Pearson and Spearman analyses were used to determine the correlations between power-speed-related variables and the CODD. Moreover, independent t-tests and Cohen's d effect size (ES) were used to analyze the differences between the faster and slower players in the CODD. Moderate to strong significant negative correlations were observed between the CODD in the pro-agility test and linear speed at 5 m, 10 m, and 20 m (r = –0.55 to –0.46), while moderate negative significant correlation was found between the zig-zag CODD and SJs (r = –0.37) as well as small positive significant correlation between the CODD in the zig–zag test and the eccentric utilization ratio (EUR) (r = 0.23). Additionally, faster basketball players displayed significantly higher CODD values performing the pro-agility test. In summary, these findings underline the complexity of COD performance and the importance of remodeling traditional training programs in basketball players.

Key words: *team sport, agility, cutting, performance, ball game, speed.*

Introduction

Basketball is a multifactorial game and performance implies a large volume of high-intensity movements followed by a short period of low-intensity activities (Stojanović et al., 2018). More specifically, during a basketball match, around 991 m are covered when performing high-intensity activities which include 50–60 movements related to changing direction and sprinting (Balčiūnas et al., 2006; McInnes et al., 1995). Additionally, change of direction (COD) movements contain 20.7% of sprint activity (Conte et al., 2014), which means that every 1–3 s on average, players are required to execute sudden accelerations and decelerations in combination with changes of direction (Mathew and Delextrat, 2009; Scanlan et al., 2011; Stojanović et al., 2018). The previously highlighted facts indicate that COD speed (CODs) is one of the most important determinants of basketball success (Stojanović et al., 2019).

CODs performance in basketball players has been measured by numerous tests (Stojanović et al., 2019; Sugiyama et al., 2021). The limiting factor for adequately measuring CODs is the duration of each test (Cuthbert et al., 2019; Ignatjeva et al., 2021), where the performance is

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Authors submitted their contribution to the article to the editorial board.
Accepted for printing in the Journal of Human Kinetics vol. 85/2022 in December 2022.

affected by anaerobic capacity and linear sprinting speed rather than COD ability (Nimphius et al., 2016). As a consequence, the results obtained may not be valid and accurate indicators of COD ability. In favor of this finding, Nimphius et al. (2013) concluded that during the 505 test, only 31% of the time is explained by COD movements. Subsequently, Sayers (2015) found that COD is influenced by linear sprinting speed; however, the correlation was weaker when COD was measured 0.3 m and 0.5 m before and after the turn compared to the distance of 1 m.

Taking into account the importance of COD performance in basketball, over the years, researchers (Delextrat et al., 2015; Scanlan et al., 2014; Spiteri et al., 2014) have become increasingly interested in determining the predictors that affect this ability. However, most studies (Delextrat et al., 2015; Garcia-Gil., 2018; Scanlan et al., 2014; Spiteri et al., 2014) conclude that COD performance depends on several factors. Spiteri et al. (2014) highlighted the importance of eccentric strength as a predictor of COD, while Scanlan et al. (2014) observed that linear sprinting speed at 5, 10, and 20 m correlated with COD. Similarly, Delextrat et al. (2015) found that 74.8% of variance of COD was explained by linear sprinting speed at 20 m in young female basketball players. However, according to recent studies in soccer (Loturco et al., 2018) and handball (Pereira et al., 2018), it is known that athletes who achieve better results in linear sprinting speed are less successful in changing direction tasks. The possible explanation was provided by Nimphius et al. (2016) who explained that the less efficient results in COD tests are a consequence of the higher value of the COD deficit.

The COD deficit (CODD) is a relatively new variable originally constructed by Nimphius et al. (2013) that represents the value obtained by subtracting time on linear sprinting time from the adequate COD test. The importance of the CODD was confirmed by Dos'Santos et al. (2019) who showed that the CODD better in detected interlimb asymmetries than the total time during COD tests. Specifically, one study (Nimphius et al., 2013) found that the CODD and 10-yard sprint were not related, but there was a moderate correlation (r = 0.61) between time in the pro-agility test and the CODD time. Similarly, Nimphius et al. (2016) found a strong correlation between the CODD and the 505 test (r = 0.74–0.81), but not between the CODD and 10-yard sprinting cricket athletes. Based on the obtained results, Nimphius et al. (2016) claimed that the CODD is independent of linear sprinting speed.

In summary, the association between the CODD and physical performance is still poorly understood, and previous studies are limited with small sample sizes, specific populations and different tests involved. Moreover, due to the fact that COD activities are very common during a basketball game, with more than 450 lateral maneuvers per game (Taylor et al., 2017), there is a whisperer call for additional studies in basketball. To date, little attention has been paid to the CODD in basketball players and its relationship with the most important physical performance variables. Nonetheless, further understanding of COD ability in team sport athletes is of great importance for coaches to design and monitor training programs. Therefore, the aim of this study was twofold. The first was to evaluate the relationship between linear speed, vertical jumping performance, CODs time, and the CODD in adolescent basketball players. The second was to analyze the CODD between faster and slower players according to the linear speed test. It was hypothesized that a non-significant relationship between linear speed and the CODD would be observed. Moreover, we expected small to moderate associations with COD performance and that faster players would achieve higher CODD values.

Methods

Participants

A total of 38 adolescent male basketball players (age: 15.47 ± 0.51 years; body height: 185.19 ± 5.67 cm; body mass: 71.87 ± 7.29 kg) volunteered to participate in the study. All participants were members of various basketball clubs competing in youth categories in the Regional League of Serbia. Participants were free of injuries and medical conditions that could prevent them from safe participation in the study. All participants were informed of the study procedures and provided written parental consent prior to participation. Procedures were conducted with the requirements and approval of the Ethical Committee Faculty of Economics in Subotica, University of Novi Sad (ref. 14/1041; approval date 15 May 2020).

Design and procedures

A cross-sectional design was used in this study to examine the relationship between selected variables and the calculated CODD.

Anthropometric characteristics were measured at 9 a.m. under laboratory conditions, while physical performance testing was performed from 10 a.m. to 12 p.m. Each participant completed the testing procedures on an indoor, hardwood basketball court in randomized order. Before the testing procedure, all participants were familiarized with all tests and performed a standardized warm-up, consisting of moderate-intensity jogging, COD movements (5–10 min), and dynamic stretching (5 min). Participants were advised to avoid strenuous physical activities 24 hours before testing and not to consume potential stimulants that could affect their physical performance during testing.

Body composition

Anthropometric characteristics (body height and body mass) were measured in minimal clothing and barefoot. Body height was measured with the use of a stadiometer (SECA Instruments Ltd, Hamburg, Germany) with 0.1 cm measurement accuracy. Body mass, body mass index (BMI), body fat percentage (%), body fat (kg), and lean muscle mass were analyzed using a standardized InBody230 body composition analyzer (InBody Co. Ltd, Cerritos, CA, USA) (McLester, 2020). Body height and body mass were used in further statistical analysis.

Vertical jump assessment

Three tests were used to examine the vertical jump (VJ) height: countermovement jump (CMJ), countermovement jump with an arm swing (CMJa), and a squat jump (SJ), which are commonly used in the evaluation of the VJ in basketball players (Wen et al., 2018). Additionally, the eccentric utilization ratio (EUR) was calculated as the ratio of the CMJ and the SJ (%). The protocol used to evaluate the VJ height as well as reliability and validity was described previously (Stojanović et al., 2019). Briefly, the CMJ and the CMJa were measured from an upright position, with equal weight distribution on both feet. During the CMJ, arms were fixed on hips in order to avoid their influence on jump height, while when the CMJa was performed, the hands were free to move. Participants then descended to a semi-squat position (90-degree flexion) and performed a maximum vertical jump without stopping at the point of change of direction. Participants performed the SJ from a semi-squat position, with knees bent at 90 degrees and with arms placed on their hips, to avoid additional swings during the jump. Participants held this position for 1–3 s and then performed a maximal vertical jump. Each participant was instructed to jump naturally and as high as possible performing all jumps with maximal effort. Each jump was performed three times, and the best result was taken for further analysis. Intraclass correlation coefficients (ICCs) and coefficients of variation (CV) showed excellent reliability for vertical jump performance measures (ICC range: 0.88–0.95; CV range: 1.71–2.20%). Th Optojump system (Optojump, Microgate, Bolzano, Italy) was used to estimate VJ height; its validity and reliability were confirmed previously (Glatthorn et al., 2011).

Linear speed assessment

Linear speed was evaluated from a standing position at 5 m, 10 m, and 20 m, in accordance with previous instructions (Scanlan et al., 2014). Performance was measured using the Witty photocell system (Witty, System, Microgate, Bolzano, Italy). Photocells were placed at a distance of 5 m, 10 m, and 20 m from the starting line, 0.4 m above the ground with accuracy of 0.001 m/s to minimize the effect of the hand swing when passing through the gate (Yeadon et al., 1999). Participants were instructed to perform the test through all gates with maximal effort. The procedure was repeated three times, and the best result was registered for further analysis. Test-retest reliability values for the 5 m, 10 m and 20 m sprint were excellent (ICC range: 0.92–0.96; CV range: 1.3–1.6%)

COD assessment

COD performance was measured using pro-agility and zig-zag tests. The pro-agility test was performed according to the Lockie et al.'s (2011) protocol. Briefly, from a standing position, each participant turned and started running as fast as possible 4.57 m to the first line which had to be touched with one hand, then ran 9.14 m to the second line and touched the second line with the other hand, then performed another turn, and ran back to the starting/finishing line where the time was automatically stopped. Participants were returned to the starting position if they did not touch the line with their hand, and when the choice of hand was voluntary. The zig-zag test procedures were in accordance with Villarreal et al. (2021). When a participant was ready, he started shuffling towards the right cone set at the distance of 1.5 m and touched the base of the cone with the right hand, then shuffled left and touched the base of the cone with the left hand, continuing the same procedure on three more cones. The time was stopped when the finishing photocell was passed. Participants repeated both tests three times and the best times were included in further analysis. COD tests proved to be reliable (ICC range: 0.84–0.91; CV range: 1.2–2.41%). Both tests were measured with the Witty photocells system (Witty, System, Microgate, Bolzano, Italy). The CODD for both tests was calculated according to the formula: the fastest CODD time in the pro-agility/zig-zag test – 20 m linear speed time.

Statistical analysis

Statistical analysis was performed sing the IBM SPSS statistics program (version 26.0; Inc., Chicago, IL, USA). The normality of the data was confirmed by the Kolmogorov-Smirnov test. Pearson's two-tailed correlations were used to calculate relationships between vertical jump performance (CMJ, CMJa, SJ, and EUR), linear sprinting speed (5 m, 10 m, and 20 m), COD (zig-zag and pro-agility test) variables, and the CODD (zig-zag deficit and pro-agility deficit). Correlation strength was interpreted as: r = 0 to 0.3, or 0 to –0.3, small; 0.31 to 0.49, or –0.31 to –0.49, moderate; 0.5 to 0.69, or –0.5 to –0.69, large; 0.7 to 0.89, or –0.7 to –0.89, very large; and 0.9 to 1, or –0.9 to –1, perfect correlation (Hopkins, 2004). Data are presented as mean ± standard deviation (SD) and statistical significance was set at $p \leq 0.05$. Furthermore, median split analysis was used to divide players into two groups according to linear speed time at 5, 10, and 20 m. Additionally, the independent *t*-test was used to calculate differences in the CODD between faster and slower basketball players. The magnitude of difference between faster and slower players in the CODD was calculated with Cohen's d effect size (ES) analyses and interpreted according to Cohen (2013) as: trivial ≤ 0.20; small = 0.20–0.49; moderate = 0.50–0.79; large ≥ 0.80.

Results

Table 1 presents basic descriptive statistics (mean ± standard deviation) of vertical jump performance (CMJ, CMJa SJ, and EUR), linear speed (5 m, 10 m, and 20 m), CODs (pro-agility test and zig-zag), and CODD (pro-agility and zig-zag) variables with 95% confidence intervals.

The results of Pearson's correlation for normally distributed data and Spearman's correlation for the CMJ and linear speed at 10 m are presented in Table 2. Moreover, Figure 1 is a graphic summary of standardized mean differences for comparisons between faster and slower players regarding CODD values.

Significant moderate to strong negative correlations were observed between CODD in the pro-agility test and linear speed at 5 m (r = –0.48, *p* = 0.02), 10 m (r = –0.46, *p* = 0.01) and 20 m (r = –0.55, *p* = 0.02), while significant, strong positive correlation was obtained between the CODD and the pro-agility test (r = 0.88, *p* = 0.01). Moreover, non-significant, trivial correlations were found between the CODD in the pro-agility test and the CMJ (r = –0.08, *p* = 0.62), CMJa (r = –0.07, *p* = 0.70), SJ (r = –0.19, *p* = 0.24) and the zig-zag test (r = 0.05, *p* = 0.78). On the contrary, moderate negative statistically significant correlation was found only between the zig-zag CODD and the SJ (r = –0.37, *p* = 0.02), small positive significant correlation between the EUR and the zig-zag CODD (r = 0.35, *p* = 0.03) and positive, nearly perfect correlation between the zig-zag CODD and the zig-zag test (r = 0.88, *p* = 0.01). However, non-significant correlations were obtained between the CODD in the zig-zag test and linear sprinting speed variables and the CMJ, the CMJa and the EUR. More precisely, negative, trivial to small correlations were found between the zig-zag CODD and the CMJ (r = –0.015, *p* = 036), the CMJa (r = – 0.14, *p* = 0.40), linear speed at 10 m (r = –0.07, *p* = 0.69), and at 20 m (r = 0.23, *p* = 0.17) and the pro-agility test (r = 0.23, *p* = 0.17), while positive but small correlation was found between the EUR and the CODD in the pro-agility test (r = 0.23, *p* = 0.17). In addition, moderate to large significant differences were observed in the CODD in the pro-agility test when comparing faster and slower groups of participants (ES ranged from 0.58 to 1.21), while small to moderate non-significant diffferences were found in the CODD in the zig-zag test (ES ranged from 0.21 to 0.40) for the same groups of participants.

Discussion

The aim of this study was to evaluate the relationships between linear speed, vertical jumping performance, CODs time, and the CODD in adolescent basketball players. The main findings of this study showed that a significant negative relationship existed between the CODD and linear speed when participants performed the pro-agility test and between the CODD and the SJ in the zig-zag test. Additionally, the CODD was strongly positively correlated with both COD tests. Moreover, after dividing players according to linear speed, the results provided convincing evidence that faster basketball players produced significantly higher CODD values while performing the pro-agility test.

Table 1. *Descriptive statistics with 95% CI*

Variable	Mean ± SD	95% CI	
		Lower	Upper
Age (y)	15.50 ± 0.51	15.33	15.67
Height (cm)	185.42 ± 5.74	181.48	187.36
Body mass (kg)	71.86 ± 7.29	69.39	74.33
CMJ (cm)	36.93 ± 6.62	35.37	38.49
CMJa (cm)	41.26 ± 5.87	39.27	43.25
SJ (cm)	36.44 ± 3.66	35.20	37.68
EUR	1.02 ± 0.11	0.98	1.05
Sprint 5 m (m/s)	1.20 ± 0.09	1.17	1.23
Sprint 10 m (m/s)	1.99 ± 0.11	1.73	2.15
Sprint 20 m (m/s)	3.35 ± 0.15	3.29	3.40
Pro–agility test (m/s)	5.54 ± 0.23	5.47	5.62
Zig–zag test (m/s)	2.65 ± 0.30	5.90	6.10
Pro–agility deficit (m/s)	2.20 ± 0.27	2.11	2.29
Zig–zag deficit (m/s)	2.65 ± 0.29	2.55	2.75

CMJ – countermovement jump; CMJa – countermovement jump with an arm swing; SJ – squat jump; EUR – eccentric utalization ratio; 95%CI – confidence interval (95%)

Table 2. *Correlation coefficients between power-speed variables and the CODD*

Variable	**Pro-agility deficit**		**Zig-zag deficit**	
	r	***p***	**r**	***p***
CMJ (cm)	–0.08	0.62	–0.15	0.32
CMJa (cm)	–0.07	0.70	–0.14	0.40
SJ (cm)	–0.19	0.24	**–0.37**	**0.02**
EUR	0.23	0.17	**0.35**	**0.03**
Sprint 5 (m/s)	**–0.48**	**0.02**	–0.80	0.64
Sprint 10 (m/s)	**–0.46**	**0.00**	–0.07	–0.69
Sprint 20 (m/s)	**–0.55**	**0.00**	–0.23	0.17
Pro–agility test (m/s)	**0.84**	**0.00**	0.23	0.16
Zig–zag test (m/s)	0.05	0.78	**0.88**	**0.00**

CMJ – countermovement jump; CMJa – countermovement jump with an arm swing; SJ – squat jump; p-value – significant correlation ($p < 0.05$); EUR – eccentric utilization ratio

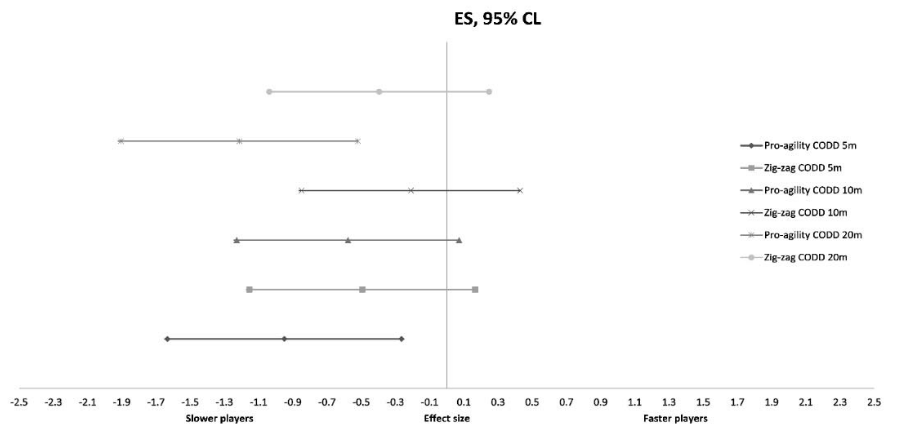

Figure 1. *Standardized mean differences for the comparisons between faster and slower athletes in the linear speed at 5, 10, 20 m and the CODD*

Although CODs is an independent ability (Arboix-Alió et al., 2021; Salaj and Marković, 2011; Young et al., 2011;), it is strongly influenced by linear speed, which can be a major problem for coaches and sports experts in the sense that any deficiency that exists when performing a COD task, may be disguised (Sayers, 2016). Nonetheless, the study carried out by Sayers (2016) revealed that CODs should be measured at shorter distances in order to avoid the influence of linear speed. Consequently, due to the progress in sports science and practice, and the fact that a majority of clubs use timing gates which have specific practical issues what may lead to questionable accuracy of results over short distances, sports experts are encouraged to use traditional COD tests in combination with the CODD to avoid the misinterpretation of the data (Nimphius et al., 2016). However, the original hypothesis that the CODD would not be related to linear speed is partially accepted. More precisely, the results of this study yielded only a significant correlation between the CODD and linear speed in the pro-agility test, but we failed to show significant correlations between the CODD and linear speed in the zig-zag test. A possible reason for this discrepancy might be that although the pro-agility test is used for evaluating COD ability, it is strongly influenced by linear speed. Essentially, when performing this test, it was noticed that linear sprinting consisted of 18.3 m, and the only changes in direction were turns of 180 degrees (Foster et al., 2021) with 29% of total time spent in COD movements (Nimphius et al., 2013), while the zig-zag test included mostly multiple accelerations and decelerations over short distances (Loturco et al., 2017) without linear sprinting maneuvers. Additionally, the CODD was strongly correlated with both COD tests, which means that the CODD has a tendency to be a useful variable in the evaluation of isolated COD ability. Previous studies (Cuthbert et al., 2019; Nimphius et al., 2013, 2016) suggested that the CODD as a variable can be used regardless of linear speed during complex COD tasks. However, from this standpoint, authors are not in a position to make a parallel between the results of this study and previously reported outcomes due to the lack of CODD research in basketball players, as well as the complexity of movements during the game and variety of different tests which would be more appropriate for isolating and assessing COD ability in adolescent basketball players. Notably, the pro-agility test may not represent the real nature of movements during basketball games, but some authors (Stojanović et al., 2019; Sugiyama et al., 2021) provided a battery of tests that would be more relevant for assessing this multidirectional ability.

Moreover, we observed moderate negative correlations between the CODD and the SJ. These findings are less surprising if we consider technique from a biomechanical aspect. Namely, COD tasks are strongly affected by the angle (Dos' Santos et al., 2018), which is reflected in the different technique of movement performance (Hawens and Sigward, 2015), and different acceleration and re-acceleration requirements (Hader et al., 2015; Hawens and Sigward, 2015). Specifically, during the pro-agility test, players perform 180-degree turns that are similar to the backdoor situation (Stojanović et al.,

2019) and during the transition from defense to offense. In order to successfully perform this movement, it is necessary for the player to descend to the half-jump position during the deceleration phase, while the velocity decreases rapidly by eccentric contraction (Sheppard and Young, 2006; Spiteri et al., 2015). Furthermore, in order to accelerate forward again in the shortest possible period of time, it is necessary to apply great force to the ground by the concentric phase of contraction (Sheppard and Young, 2006; Spiteri et al., 2015). In contrast, during the zig-zag test due to the reduction of the angle of COD movement (100 degrees), a more upright position of the body is required, and thus the range of motion required to perform the movement decreases (Sasaki et al., 2011). Additional findings of Spiteri et al. (2015), who used two tests in female basketball players, support our findings. In particular, the T test comprises 90 degrees COD movements, which together with the zig-zag test include less sharp maneuvers compared to the 505 test and the pro-agility test used in this study.

Furthermore, we found a small but positive significant correlation between the EUR and the CODD in the zig-zag test. According to McGuigan et al. (2006), the EUR is one of the most important performance indicators, since it defines the reserve of elastic energy that exists during the braking phase when performing the CMJ, which is later used in the propulsive phase (Flanagan and Comyns, 2008). In accordance with this finding, it was observed that lower values of the EUR in athletes indicate that in training processes, they should pay greater attention to explosive power-oriented exercises (Kozinc et al., 2021). However, previous research (Van Hooren and Zolotarjova, 2017) provides strong evidence that higher EUR values do not actually represent benefits for all athletes, especially considering sports disciplines where jumping performance is crucial (Kozinc et al., 2021). The results of our research are congruent with this approach, due to the fact that higher EUR values determine the higher CODD in the zig-zag test. A possible explanation is that the CODD is negatively correlated with the SJ. Also, a recent study conducted by Kozinc et al. (2021) corroborates our finding, suggesting that higher values of the EUR actually represent inferior SJ results, due to poor ability to develop power rapidly (Bobbert and Casius, 2005), and higher muscle slackness (Van Hooren and Bosch, 2006). It is still unclear whether the EUR variable should be used in the evaluation of performance, due to very weak or no correlations with the most important variables related to performance, as well as its scarce use in basketball players. However, considering that basketball involves frequent dynamic movements where the sufficiency to optimize the re-utilization of elastic energy is an important and favorable quality in basketball players (Wen et al., 2018), this is the first study to examine the relationship between the EUR and the CODD; therefore, further research is required to clarify the mechanisms of this relationship, especially considering that it was not the primary aim of our study.

Subsequently, players who were faster in linear speed tests were less efficient in CODD tasks with an emphasis on the higher CODD in the pro-agility test. This finding is in line with previous research in team sports where participants were rugby (Freitas et al., 2019a, 2021), soccer (Freitas et al., 2019b; Loturco et al., 2018) and handball players (Pereira et al., 2018). More precisely, Loturco et al. (2108) on a sample of 25 male soccer players, after dividing them into groups of faster and slower players, found that faster players had higher CODD values. In a similar vein, Loturco et al. (2019) found that after comparing the players' acceleration rate, those players who were able to accelerate faster produced a greater CODD. These findings are congruent with the work of Freitas et al. (2019a, 2019b), which indicated that faster and more explosive soccer and rugby players were less efficient in COD tasks. Furthermore, it can be concluded that the transition from linear speed into CODs is a common problem in team sports (Freitas et al., 2019a). Taking into account the area of investigation, some authors (Freitas et al., 2019, 2021; Loturco et al., 2018) openly questioned whether the COD was trained in an adequate way. Freitas et al. (2019a) found evidence that in team sports training processes, attention was most often paid to the development of linear speed and actions related to linear speed, while the significance of CODs was underestimated. For that purpose, Loturco et al. (2018) underlined the implementation of specific training programs, where the focus would be on imitating situations similar to those in real games. Also, it was noted that training programs based on the development of an eccentric type of strength (de Hoyo et al., 2016; Dos'Santos et al., 2018; Jones et al., 2017) have a positive effect on reducing the CODD, emphasizing that the athlete must apply considerable forces to the ground in the shortest period of time, both horizontally and vertically, in order to continuously and efficiently perform the accelerations and decelerations (Condello et al., 2016; Dos' Santos et al., 2017; Hawens and Sigward, 2015).

We acknowledge that our research had some limitations. Firstly, our dataset was limited to the number of participants and gender. Also, the limiting factor was the sports level for participants were semi-professional adolescent basketball players. Therefore, these findings are not generalizable to professional and female basketball populations. Another limitation is the number and the selection of tests. More precisely, three groups of tests should be used to assess the COD ability taking into account the variations present during real games. For example, shuffling is the most frequent and important COD movement during defense, 180-degree turns are used during the transition from defense to offense, and cutting movements are most frequent in offense (Sugiyama et al., 2021). Subsequently, this study did not consider players according to their position in the team. Finally, taking into account the little number of scientific papers on the CODD in basketball players, the discussion could not be more developed. However, our findings suggest a need for a greater interest in COD evaluation, using the CODD with more specific tests and in a larger number of participants. Also, further investigations should pay attention to previous specific training programs and try to assess their effects on specific COD ability in order to improve overall basketball performance.

Conclusion and practical implications

In summary, the results of this study indicate that some correlations exist between linear speed, the explosive power of the lower extremities, COD, and the CODD in adolescent basketball players, but also that these correlations strongly depend on the task and tests used. However, with the exception of strong correlations found between the CODD and COD, other variables that have reached statistical significance indicate a moderate correlation. These findings highlight the complexity of this ability and the presence of other factors that may affect specific COD performance. Also, faster basketball players produced a higher CODD, which indicates the impossibility of using the potential acquired in the linear speed test during COD tasks. Thus, traditional training processes may not be applicable to the development of COD ability. This study provides data that encourage basketball experts, coaches, and players to remodel existing exercises to more task-specific, based on eccentric training and basketball-oriented drills.

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