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Section III – Sports Training

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On-Court Change of Direction Test: An Effective Approach to Assess COD Performance in Badminton Players

by

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The aim of this research was to assess the reliability of a specific change of direction test (i.e., "On-Court COD test") in youth badminton players, evaluate the effect of age on On-Court COD performance, and examine its correlations with linear speed, change of direction speed, and vertical jump tests. Forty-two young badminton players (27 males and 15 females; age: 17.3±1.6 years, body height: 170.3±7.5 cm, body mass: 59.0±9.7 kg) were divided into two age groups (Under 17 years and under 19 years). Tests included: linear sprints (5, 10, and 20-m), bilateral/unilateral countermovement jumps, a hexagon test, traditional and modified 505 change of direction tests; and On-court COD. Results showed an excellent intraclass correlation coefficient score (0.90) and a very low coefficient of variation values (1.6%) for the On-Court COD test. Comparing age groups, under 19 players were significantly faster in linear sprints (i.e., 5, 15 and 20-m; small to moderate effect sizes) and in all change of direction tests (moderate to large effect sizes). Moreover, the On-Court COD test showed moderate to large (r=.513-.779) relationships with both acceleration and COD abilities in under 17 players, and with linear sprints, COD, and jump performances in under 19 players. These data indicate that the On-Court COD test is a useful and reliable means to assess COD performance in youth badminton players and it is associated with acceleration, sprint and jump performance.

Key words: *racket sports, specific movement, neuromuscular performance, testing.*

Introduction

As an intermittent sport, badminton is characterized by repetitive short periods of exercise (i.e., 1-9 s) and recovery (i.e., low intensity activities such as standing and walking for 6-15s) interspersed with longer breaks in play (i.e., "time outs" of 120s between games) (Phomsoupha and Laffaye, 2015). Although every badminton point can be different due to the unpredictability of the game, players complete approximately one shot every two seconds (Faude et al., 2007). Changes of direction (COD), including deceleration followed immediately by reacceleration of the entire body or individual body segments (Nimphius et al., 2018), occur nearly every point. Thus, players must change direction toward the center of the court and then toward the opponents' return (Paterson et al.,

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2016), highlighting the crucial importance of COD for this sport. Accordingly, Tiwari et al. (2011) reported a significant relationship (r=−.83) between COD speed and the winning percentage in national-level players. Thus, this physical quality can be considered as one of the most important athletic skills needed to be a successful badminton player at any level. Consequently, the assessment of COD should be included within badminton players' testing batteries.

Although COD ability has been considered an important performance-related variable in numerous sports such as soccer, handball, and tennis (Loturco et al., 2019; Madruga-Parera et al., 2019a; Nakamura et al., 2016), information about COD in badminton is scarce, with few studies analyzing this physical quality (Maloney et al., 2014; Paterson et al., 2016; Phomsoupha et al., 2018; Bilgic and Devrilmez 2021). Moreover, in terms of testing, a wide variety of COD tests are employed in different sports, and although protocols differ in terms of complexity and duration, one of the most frequently used tests is the 505 test (Nimphius et al., 2016). In the traditional 505 test, the player must accelerate as quickly as possible to a turning point (placed 15 m away from the start), turn 180° and then sprint back to the finish line (placed 10 m from the start line) (Jones and Nimphius, 2019). Alternatively, in the modified 505 test, the player must cover a 5-m distance, turn 180º and sprint back to the finish line placed at 5 m. Based on the difference in completion times between the traditional 505 test and a 10-m linear sprint test, the concept of the COD deficit (COD_{DEF}) was initially introduced (Loturco et al., 2019; Nimphius et al., 2016). In summary, the COD_{DEF} represents the additional time that a COD maneuver requires when compared to a linear sprint over an equivalent distance (e.g., 10-m time vs. 505 time) (Fernandez-Fernandez et al., 2020; Nakamura et al., 2017). Analysis of the COD_{DEF} is justified based on previous research suggesting that COD and the linear sprint are different abilities (Little and Williams, 2005). Despite the usefulness and the widespread use of the traditional 505 test, due to the small dimensions of a badminton court, this test does not mimic the movement patterns of badminton play. Thus, tests including more specific movements and distances covered are worthy. In this regard, a few tests were identified in the literature, including the "four corners", "sideways" (Ooi et al., 2009) and, more recently, the "Badcamp agility test" (De França Bahia Loureiro and De Freitas, 2016). Although these tests can be considered specific to badminton play requirements, data about their reliability are scarce. In addition, some of them require expensive and non-available devices, which negatively impacts their practical application.

Previous research has suggested that acceleration, linear speed, and COD speed may be considered independent abilities (Little and Williams, 2005; Pereira et al., 2018). Thus, the precise evaluation of performance during specific on-court COD maneuvers can serve as a powerful tool for developing more effective strategies to improve COD ability in badminton players. Moreover, in a sport characterized by a long competitive period (i.e., >8 months, even in youth elite players), the implementation of simple, reliable, and timesaving tests, especially during time-restricted sessions, would be highly advisable. Therefore, the main goal of the present study was to assess the reliability and validity of a new specific badminton test aiming to evaluate COD performance. To achieve this goal, we: (1) assessed the reliability of a specific COD test (i.e., "On-Court COD test") in youth badminton players, and (2) examined its correlations with linear speed, COD speed, and vertical jump tests.

Methods

Participants

Forty-two young badminton players took part in this study. For the purposes of the study, players were divided into two age groups: U17 years (15 males and 6 females; age: 15.7±0.5 years, bod height: 165.1±7.2cm, body mass: 52.5±8.3kg) and U19 (12 males and 9 females; age: 18.6±1.0 years, body height: 175±4.7cm, body mass: 64.2±7.4kg). Participants comprised talented players selected by the regional/national badminton federation coaching staff based on technical-tactical abilities and competitive performance. All players participated, on average, in ~18 hours of combined badminton and physical training per week and had a minimum of 6 years of badminton training experience. None of the players reported history of any orthopedic injuries during the previous 12 months. Before taking part in the study, participants and their parents/guardians were fully informed about the protocol and provided their written informed consent. The Institutional Ethics committee approved the procedures in accordance with the latest version of the Declaration of Helsinki.

Measures

All athletes were previously familiarized with procedures and assessment routines, which took place on two different days (i.e., day 1: bilateral and unilateral counter-movement jumps (CMJ), a hexagon test, linear sprints (5, 10, 15 and 20m); day 2: traditional and modified 505 COD tests, an On-Court COD test), separated by 24h. Participants were required to refrain from any intense physical workout for 24h before the tests and to be in a fasting state for at least 2h. Prior to the physical tests, athletes performed a standardized warm-up (i.e., 8-10min), which consisted of jump rope activation, general dynamic mobility, multi-directional acceleration runs, and jumps of progressive intensity.

Countermovement Jump (CMJ) test

Bilateral and unilateral (e.g., dominant and non-dominant side) CMJ without an arm swing were performed on an infrared plate Optojump (Microgate, Bolzano, Italy), according to procedures previously described (Madruga-Parera et al., 2019b). Briefly, players performed the jumps starting in a standing position with their hands on the hips; subsequently, they flexed their knees using a self-selected depth and then jumped as high as possible. Each player performed three maximal CMJs of each type (i.e., bilateral and unilateral) interspersed with 45s of passive recovery. The highest jump height was recorded for each athlete and used for further analysis.

Hexagon test

The hexagon test requires the player to stand facing forwards, in the middle of a hexagon measuring 60cm per side and with 120-degree angles. With feet together and hips facing forward throughout the test sequence, players hopped forwards and backwards in a clockwise manner, over each of the six sides of the hexagon, completing three sequences (Beekhuizen et al., 2009). Each repetition was recorded using a mobile phone (iPhone XS; Apple Inc., Cupertino, CA, USA) running iOS 13.7 that was secured to a small tripod with a mount (GripTight Mount Pro, Joby, USA) and positioned 1m from the hexagon. All trials were recorded at 240Hz and the time to complete three sequences was later evaluated with video analyses software (Kinovea version 0.8.15, available for download at: http://www.kinovea.org). A penalty of 0.5s was given each time the player touched a line, and a 1.0s penalty was given if the player failed to follow the correct sequence (Beekhuizen et al., 2009). A practice attempt was allowed prior to the three attempts used for analyses, with a 45s rest interval in between. The fastest time of three attempts was used for analysis.

Sprint test

Time during a 20m dash (with 5, 10, 15 and 20m split times) in a straight line was measured by means of single beam photocell gates placed 1.0m above the ground level (Microgate, Bolzano, Italy). Each sprint was initiated 50cm behind the photocell gate, which then started a digital timer. Each player performed three maximal 20m sprints with at least 2min of passive recovery between the three trials. The best performance was recorded for further analysis.

Traditional 505 COD test

The 505 COD test requires players to sprint 5m, turn 180°, and sprint further 5m (Barber et al., 2016). A flying start allows the subject a 10m run-up before crossing the start line and timing commencement. Players started in a standing position with their preferred foot 0.5m behind the starting line. They were asked to plant their preferred (i.e., considered as the dominant side) foot on executing the turn. Three trials were completed and the best time was recorded (Microgate, Bolzano, Italy). Two minutes of rest were allowed between trials.

Modified 505 COD test

The abilities of players to perform a single, rapid 180° change of direction over a 5m distance was measured using a modified version (stationary start) of the 505 COD test (Fernandez-Fernandez et al., 2016). Players started in a standing position with their preferred foot 0.5m behind the starting line. They were asked to plant their preferred (i.e., considered as the dominant side) foot on executing the turn. Three trials were completed and the best time was recorded (Microgate, Bolzano, Italy). Two minutes of rest were allowed between trials. The COD_{DEF} for the

505 test was calculated using the following formula: COD_{DEF}=*(modified 505 time–10m time)* (Nimphius et al., 2013).

On-Court COD test

Players performed an adapted version of a previously published footwork test (Chin et al., 1995) and it was executed on one half of a regular badminton court. Five pairs of photocells (Microgate, Bolzano, Italy) were mounted on supports at a height of 0.5 and 1m, as described in Figure 1. Players were instructed to run as fast as possible from the central point (marked with an X in Figure 1) towards the pair of photocells placed on the right-side of the forecourt (#1 in Figure 1) and return to the centre before they consecutively ran to the next pairs of photocells (i.e., 2, 3, 4, and 5). Players had to cross the photocells with their waist (e.g., visually checked by the researchers), using sport-specific displacements (i.e., lateral sidestepping, cross-over stepping motions, and/or forward lunges), before returning to the center court. The test was finished when players returned to the central point. Each player performed three trials and the best time was recorded. Two minutes of rest were allowed between trials.

Design and procedures

This is an observational descriptive study examining the reliability of the On-Court COD test as a measure of COD ability and its relationships with a series of speed-power related variables in youth badminton players. Testing protocols were conducted over a 1-week period beginning at the end of September, 2020. Test sessions were undertaken between 10:00 and 14:00 h, and players were tested at their training facility. All tests were performed in the same order, using the same testing devices, measurement protocols, and experienced evaluators. Testing took place in an indoor facility (polyurethane floor, 22.6-23.2°C; relative humidity, 52–55%; Kestrel 4000 Pocket Weather Tracker, Nielsen Kellerman, Boothwyn, PA). Participants were required to withdraw all sources of caffeine for 24h before testing and to have their habitual breakfast at least 3h before the onset of the measurements. Test-retest reliability was assessed in a subsample of 18 players (10 males and 8 females) who were tested twice on 2 different days.

Statistical analysis

Data are presented as means ± standard deviation (SD). The statistical analysis was performed using the SPSS® software package version 22.0. (SPSS, Inc., Chicago, IL, USA). Data normality was confirmed using the Kolmogorov-Smirnov test. To assess within session relative reliability, intraclass correlation coefficients (ICCs) were calculated with the corresponding 95% confidence intervals (95%CIs), alongside the coefficient of variation (CV). The ICC values were interpreted as follows: excellent (>0.90), high (0.70-0.90), moderate (0.50-0.69) and low (<0.50). Absolute reliability was calculated using the standard error of measurements (SEM), which was calculated as $SD\times\sqrt{1-ICC}$, where SD is the SD of all scores from the subjects (Weir, 2005). The SEM was used for calculating the minimal detectable change (MDC) and was calculated as $SEM\times1.96\times\sqrt{2}$ to construct a 95%CI (Weir, 2005). Pearson' product correlation (*r*) was computed between the tests. The strength of the correlation was interpreted as trivial (<0.30), small (0.30-0.49), moderate (0.50-0.70) and large (>0.70). Independent student's *t*-tests were used to identify differences in performance tests between the two groups (inter-group comparisons). The magnitudes of the differences were measured by the effect size (ES) calculation and interpreted using the thresholds proposed by Rhea (2004) for recreationally trained subjects as follows: <0.35, 0.35–0.80, 0.80–1.5, and >1.5 for trivial, small, moderate, and large effect sizes, respectively (Rhea, 2004). Statistical significance was set at $p<0.05$.

Results

The reliability data of the tests conducted in the present study are shown in Table 1. The 5m and 10m sprint tests showed high ICC values (>0.80), with the other tests showing excellent reliability scores (ICC>0.90). CV values for all tests were below 5%.

Table 2 shows performance in all tests by the age group. For linear sprint time, U19 players were significantly faster at 5, 15 and 20m distances (*small* to *moderate* ES). Except for the Hexagon test (p=0.085), all COD tests showed significant differences between age groups, with ES of moderate (Modified 505) and large (Traditional 505 and On-Court COD) magnitudes. For jumping tests, a non-significant trend for better performance was found in U19 groups (ES=*small*).

Relationships between all tests used in the study are shown in Table 3. In the U17 group, the On-Court COD test showed significant moderate relationships with measures of acceleration (Sprint 5) and both modified and traditional 505 tests, while the relationship with speed (Sprint 15m) was small. In the U19 group, the On-Court COD test was moderately to largely related to measures of speed (Sprint 10, 15 and 20m) and COD (modified and traditional 505, hexagon agility). In addition, the On-Court COD test showed large correlations (from -.723 to -.834) with CMJ performance.

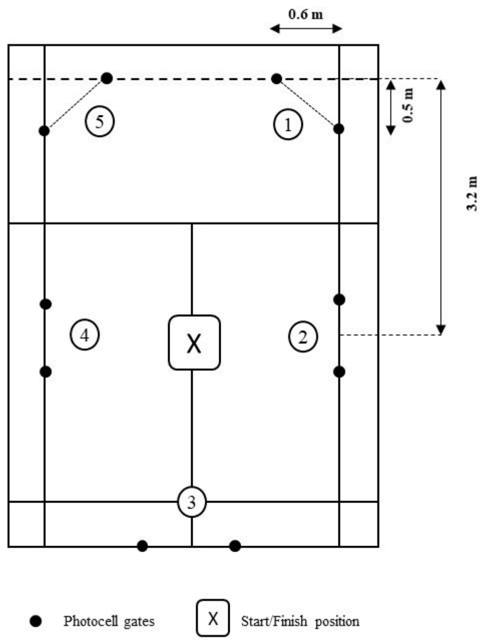

Figure 1

Schematic representation of the On-court COD test.

Table 1

Reliability data of the tests conducted in the study.

	CV	ICC	95% Confident interval Lower Bound	95% Confident interval Upper Bound	SEM	MDC
On-Court COD	1.6	0.90	0.72	0.96	0.21	0.57
Sprint5	2.8	0.87	0.65	0.96	0.03	0.09
Sprint10	2.3	0.86	0.63	0.95	0.05	0.13
Sprint15	1.8	0.94	0.83	0.98	0.04	0.12
Sprint20	1.5	0.93	0.81	0.98	0.06	0.17
T-505	2.6	0.97	0.92	0.99	0.03	0.08
M-505	1.8	0.92	0.72	0.97	0.05	0.13
Hexagon	2.2	0.91	0.72	0.97	0.17	0.46
CMJ	3.6	0.96	0.86	0.99	1.12	3.10
CMJ-D	4.6	0.95	0.85	0.98	0.81	2.25
CMJ-ND	4.7	0.93	0.81	0.98	0.97	2.69

COD: change of direction; T: traditional; M: modified; CMJ: countermovement jump; D: dominant; ND: non-dominant.

Table 2

Performance in all tests conducted by the age group.

Measures	U17 (n=21)	U19 (n=21)	*p* value	*Effect Size*
Linear Sprints				
Sprint 5m (s)	1.18(0.08)	1.09(0.07)	0.001	1.13(0.48;1.13)
Sprint 10m (s)	1.87(0.09)	1.81(0.1)	0.113	0.50(-0.11;1.11)
Sprint 15m (s)	2.61(0.1)	2.51(0.2)	0.050	0.62(0.00;1.24)
Sprint 20m (s)	3.35(0.2)	3.20(0.3)	0.033	0.68(0.06;1.30)
COD tests				
T-505 (s)	2.67(0.1)	2.46(0.1)	0.000	1.57(0.88;2.26)
M-505 (s)	2.86(0.2)	2.72(0.1)	0.004	0.94(0.30;1.58)
Hexagon (s)	10.21(0.5)	9.92(0.6)	0.085	0.54(-0.07;1.16)
On-Court COD (s)	11.94(0.4)	11.07(0.7)	0.000	1.64(0.94;2.33)
COD_Def (s)	0.99(0.1)	0.91(0.1)	0.021	0.74(0.12;1.37)
Jump tests				
CMJ (cm)	28.83(4.9)	32.15(5.8)	0.053	0.62(0.00;1.24)
CMJ_D (cm)	16.37(1.9)	18.40(4.9)	0.082	0.55(0.07;1.17)
CMJ_ND (cm)	15.06(2.3)	17.09(4.3)	0.063	0.59(0.03;1.21)

CMJ=countermovement jump; COD=change of direction; Def=deficit; D=dominant; ND= on-dominant; M-505=modified 505; T-505=traditional 505.

Table 3

Correlations between speed, agility, and jumping performance tests in under 17 (top-right) and in under 19 (left-bottom).

	Sprint 5m	Sprint 10m	Sprint 15m	Sprint 20m	T-505	M-505	Hexagon	On-court COD	COD_Def	CMJ	CMJ_{D}	CMJ_{ND}
Sprint 5m		.465*	.591**	.481*	.427	.478*	.352	.562**	.262	-.327	-.553**	-.467*
Sprint 10m	.805**		.970**	.963**	.674**	.576**	.366	.361	.010	-.635**	-.361	-.753**
Sprint 15m	.803**	.984**		.953**	.744**	.675**	.489*	.447*	.153	-.627**	-.406	-.715**
Sprint 20m	.810**	.974**	.987**		.646**	.549**	.412	.362	.003	-.618**	-.361	-.756**
T-505	.700**	.606**	.669**	.738**		.864**	.374	.594**	.589**	-.332	-.517*	-.425
M-505	.624**	.846**	.883**	.893**	.725**		.436*	.513*	.824**	-.209	-.447*	-.347
Hexagon	.432	.658**	.708**	.708**	.397	.678**		.082	.280	-.301	.219	-.025
On-court COD	.388	.636**	.667**	.703**	.540*	.779**	.717**		.380	-.154	-.462*	-.219
COD_Def	-.385	-.353	-.259	-.223	.157	.200	-.019	.197		.184	-.296	.098
CMJ	-.774**	-.827**	-.862**	-.910**	-.896**	-.854**	-.617**	-.723**	.021		.530*	.297
CMD_{D}	-.749**	-.828**	-.852**	-.882**	-.685**	-.840**	-.682**	-.834**	.048	.866**		.477*
CMJ_{ND}	-.796**	-.897**	-.907**	-.923**	-.683**	-.826**	-.754**	-.723**	.199	.900**	.903**	

**p<0.05; ** p<0.01 ; m=meters ; CMJ=countermovement jump; COD=change of direction; Def=deficit; D=dominant; ND=non-dominant; M-505=modified 505; T-505=traditional 505.*

Discussion

The aims of this study were to assess the reliability of a specific COD test in youth badminton players and examine its relationships with linear sprints, COD, and vertical jump tests. Our data indicated that the On-Court COD test is a highly reliable measurement, as showed by the excellent ICC score (0.90) and very low CV values (1.6%). In addition, performance in the On-Court COD test showed differences of large magnitude between U17 and U19 players, suggesting the test is highly sensitive to discriminate between players of different age. Regarding correlation analysis, the On-Court COD test showed moderate relationships with both, acceleration and COD abilities in U17 players, and moderate-to-large relationships with sprint, COD, and jump performance in U19 players. These results highlight the reliability of the specific On-Court COD test for badminton players and its relationships with some variables linked to players' performance (i.e., jumping, acceleration ability). Thus, we can suggest the suitability of this test to be included in badminton player's fitness assessment.

The regular assessment of physical and technical capacities considered crucial for sporting success is critical for developing tailored and effective training programs (Fernandez-Fernandez et al., 2014). For this reason, the implementation of practical tests able to provide valid and reliable measures is highly recommended. The present study showed that the On-Court COD test is a highly reliable measurement (i.e., ICC=0.90 and a CV=1.6%), with similar scores to those of the one of the most frequently used COD tests (i.e., 505 COD test, Table 1). The excellent reliability of the On-Court COD test agrees with previous research revealing that certain specific badminton COD tests are highly reproducible (De França Bahia Loureiro and De Freitas, 2016; Phomsoupha et al., 2018), supporting its use in badminton fitness testing batteries. It should be highlighted that differences between U17 and U19 players in the On-Court COD test were greatest among all measurements used herein ($p<0.001$; ES=1.62), indicating that this test is highly sensitive to discriminate between athletes from different age groups. For this reason, the abilities involved in the On-Court COD test seem to be stronger indicators of badminton-specific fitness than those assessed in generic tests. From these data, it can be speculated that the On-Court COD test might be sensitive to differentiate between badminton players from different levels. Therefore, this test could be a viable tool for talent identification. This hypothesis should be tested in future studies, as previous research has already shown that other specific badminton tests may be able to differentiate between players from different technical levels and ranking positions (Chin et al., 1995; Phomsoupha et al., 2018).

In both U17 and U19 players, the On-Court COD test showed significant moderate to large (.513-.779) relationships with the 505 COD test, although the On-Court COD test included sport-specific displacements (i.e., lunges). In this regard, similarities with the 505 COD test, including the leg used to perform the directional change and the angle of these CODs (180º), may account for the correlations identified. These results are in line with De França Bahia Loureiro and De Freitas (2016) who also showed significant correlations between specific badminton tests and a non-specific COD test. Although not measured in the present study, both higher levels of muscular strength and muscle-tendon unit stiffness (Abdelsattar et al., 2018; Freitas et al., 2019) can be suggested as responsible for greater performance in both On-Court and 505 COD tests. In addition, shared mechanical determinants for better 180º COD performance, such as greater horizontal braking and propulsive forces (Dos'Santos et al., 2017) can also explain the interrelationships between these respective COD tests.

Due to the specific sport requirements, both COD and jumping performances are determinants of superior badminton performance (Jeyaraman et al., 2012). Nonetheless, relationships between COD and jumping performance in badminton players are unclear (Paterson et al., 2016). While some authors have found significant relationships between COD and jump tests in badminton players (Hughes, 2009; Phomsoupha et al., 2018), others have failed to find significant correlations (Hughes and Bopf, 2005). The present study does not clarify these inconclusive results as we detected significant associations between COD and bilateral jump tests only in U19 ($r=-.723$), but not in U17 players ($r=-.154$). In contrast, significant relationships between unilateral CMJ (performed with the dominant leg) and On-Court COD tests were observed for both U17 and U19 groups (Table 3). As previously mentioned, the On-Court COD test requires athletes to perform COD actions with the dominant leg. Hence, similarities in movement patterns, along with the great influence of muscular strength on both, unilateral CMJ and lunge performance (Cronin et al., 2003; Murtagh et al., 2018) are potential factors explaining these relationships.

The present study revealed that moderate to large relationships exist between sprint over short distances (10-20 m) and On-Court COD test performance in U19 badminton players. However, performance in early sprint phases (i.e., first 5 m) showed significant correlations with On-Court COD performance solely in the U17 group. These results were not expected, as short distances covered during the On-Court COD test should be better linked to short sprint performance. The different relationships of short and long sprint distances with the On-Court COD test in different age groups support the hypothesis that acceleration, speed, and COD are, to some extent, different physical qualities (Little and Williams, 2005; Loturco et al., 2018). Furthermore, in the present study, the sprint test was better linked to traditional COD tests (i.e., 505) than to the On-Court COD test, suggesting than the inclusion of specific lower-limb movements along with badminton mock shots makes the On-Court COD test a very specific COD measurement.

A number of study limitations are worth mentioning. The number of female players included in the study was limited, and therefore, more research is needed to analyze differences between males and females in more detail (i.e., calculating the minimal sample size needed). Moreover, the assessment of biological age (i.e., peak height velocity (PHV)) and the inclusion of players with different maturity levels (i.e., pre-, around, and post-PHV), and/or higher competitive levels warrant future studies. Future studies should also assess whether performance in the On-Court COD test is linked to badminton performance (e.g., players ranking). We are confident that the present study shows high levels of ecological validity and may offer a starting point to suggest practical applications to strength and conditioning as well as to badminton testing and training.

Conclusions and practical implications

The present study demonstrates that the On-Court COD test is a highly reliable measurement, with both excellent ICC values and very low CV scores. In addition, performances in the test were different between U17 and U19 players, suggesting that this test is sensitive to discriminate between players of different age. These results could have significant practical implications for talent identification and selection, although this hypothesis should be tested in future studies. Finally, correlations analysis showed that relationships between the On-Court COD test and sprinting and jumping performance are stronger for U19 athletes, which may suggest that specific badminton displacements are benefited from other physical qualities in players with more extensive training experience. In addition, although this test should not be used to substitute the more traditional speed-power related testing (i.e., CMJ), it could be implemented and used as a monitoring tool, especially during time-restricted sessions (i.e., in-season period). In this regard, younger players can compete almost every week for at least three consecutive months, with little time available for testing and fitness training. Thus, the On-Court COD test can provide coaches and trainers with a good reference related to the players´ specific COD ability, and therefore, adjusting the training contents accordingly.

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