Gender-Specific Association of the Sprint Mechanical Properties With Change of Direction Performance in Basketball

Andrés Baena-Raya,[1,2] Pedro Jiménez-Reyes,[3] Enrique Salinas Romea,[4] Alberto Soriano-Maldonado,[1,2,*] and Manuel A. Rodríguez-Pérez[1,2,*]

[1]Department of Education, Faculty of Education Sciences, University of Almería, Almería, Spain; [2]SPORT Research Group (CTS-1024), CERNEP Research Center, University of Almería, Almería, Spain; [3]Center for Sport Studies, Rey Juan Carlos University, Madrid, Spain; and [4]National Basketball Team, Spanish Basketball Federation and Basketball Club Unicaja, Málaga, Spain

Abstract

Baena-Raya, A, Jiménez-Reyes, P, Romea, ES, Soriano-Maldonado, A, and Rodríguez-Pérez, MA. Gender-specific association of the sprint mechanical properties with change of direction performance in basketball. *J Strength Cond Res* XX(X): 000–000, 2020—We evaluated the gender-specific associations between the mechanical variables derived from the horizontal force-velocity (FV) profile (i.e., theoretical maximal force [F_0], velocity [V_0], maximal power output [$Pmax$], peak ratio of the effective horizontal component [RF_{peak}], and the force application technique index [D_{RF}]) and the change of direction (COD) performance for basketball players. Seventy-one players (23 women and 48 men) were assessed for the horizontal FV profile and COD using the modified 505 and V-cut tests. The FV profile parameters were significantly higher for the men than those for the women. The F_0, RF_{peak}, and $Pmax$ were strongly associated with performance in the 505 test (women $r_{range} = -0.72$ to -0.82; men: $r_{range} = -0.67$ to -0.75; $p < 0.001$) and the V-cut test (women $r_{range} = -0.68$ to -0.76; men $r_{range} = -0.45$ to -0.50; $p < 0.001$), as well as with a lower COD deficit (women $r_{range} = 0.58$ to 0.75 ($p < 0.01$); men $r_{range} = 0.49$ to 0.54; all $p < 0.001$). For the women, a 1 $N \cdot kg^{-1}$ increase of the F_0 was associated with -0.20 seconds and -0.56 seconds in the 505 and V-cut tests, respectively, and 0.16 seconds for the COD deficit. In the men, it was associated with -0.13 seconds and -0.37 seconds in the 505 and V-cut tests, respectively, and 0.10 seconds for the COD deficit. F_0, RF_{peak}, and $Pmax$ are the most determinant sprint mechanical properties to successfully COD and reduce the COD deficit. The horizontal FV profile assessment is recommended for diagnosing and prescribing a training program for basketball players.

Key Words: force, power, velocity, profile, acceleration

Introduction

The intermittent nature of basketball is predominantly characterized by high-intensity accelerations ($\geq 2\ m \cdot s^{-2}$), decelerations ($\leq 2\ m \cdot s^{-2}$), and short sprints at high speed ($>18\ km \cdot h^{-1}$) (7). Throughout a game, basketball players are required to perform repeated high-intensity changes of direction (CODs) and sprints, both with and without the ball, during offensive and defensive actions, regardless of the playing position (3,31). Evidence indicates that an efficient execution of COD and sprint strongly determines both female and male basketball players' performance, which implies that optimizing these complex actions is central for basketball practitioners.

Change of direction ability requires that an athlete has sufficient force production at different velocities so that they can shift their momentum during braking, planting, and subsequent propulsive phases (27). Thus, basketball players with greater vertical eccentric and isometric strength capabilities have reported faster COD times because of a faster transition into the propulsive phase of the movement by a successful transfer of force toward the new direction (28). Similarly, Dos'Santos et al. (1) observed greater horizontal mean and peak propulsive forces over the penultimate and final foot contact in players with faster COD. In this regard, differences in ground reaction force (GRF) application during COD maneuvers have been reported between genders, with male players showing a greater ability to apply force and impulse, resulting in a faster COD (25,26). However, very few athletes and teams have access to a force platform, which makes it difficult to transfer these observations into field practice and common sports scenarios (16). With the aim of overcoming this limitation, Samozino et al. (22) proposed a method based on an individual linear force-velocity (FV) relationship (i.e., FV profile) that describes the ability to apply high amounts of GRF in the horizontal direction at various speeds during sprinting. This individual FV profile may be summarized through the theoretical maximal force (F_0), theoretical maximal velocity (V_0), and maximal power output ($Pmax$). The FV profile also integrates the ability to apply and maintain horizontal force production, despite increasing sprint running velocity, which is quantified by the peak in the ratio of the horizontal component (RF_{peak}) and the index of force application technique (D_{RF}). These integrative parameters characterize the mechanical limits of the entire lower limb neuromuscular system to produce force during sprinting (22).

Interestingly, Haugen et al. (10) recently presented descriptive data for the horizontal FV variables (i.e., sprint mechanical properties) in male basketball players during a high-intensity level of practice, whereas Jiménez-Reyes et al. (12) previously showed horizontal FV

*A. Soriano-Maldonado and M.A. Rodríguez-Pérez contributed equally to this work.

Address correspondence to Andrés Baena-Raya, andresbaenaraya@gmail.com.

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variable data for female basketball players during a medium-intensity level of practice. Both sets of data may serve as useful background information for coaches working with basketball players. However, little is known about the influence of specific sprint mechanical properties on COD performance in either female or male basketball players. In that sense, previous studies have attempted to examine the influence of linear speed on COD performance and COD deficit (5,13,19) (i.e., the additional time required to perform a COD when compared with the time needed to cover the same distance in a linear trajectory) (17,18). However, the FV profile might provide more comprehensive information than just split times about the mechanical and muscular variables underpinning these complex abilities by assessing not only the final output (i.e., sprint time) but also the acceleration mechanical outputs that lead players to achieve a specific performance level (14,16).

The aim of this study was to evaluate the gender-specific associations of the mechanical variables derived from the horizontal FV profile using different COD tests in basketball players.

We hypothesized that F_0 and RF_{peak} would be the sprint mechanical properties more strongly associated with COD performance (i.e., faster time in either the 505 test or the V-cut test and less COD deficit) for both genders.

Methods

Experimental Approach to the Problem

We used a cross-sectional experimental design to determine the association between the mechanical variables obtained from the Hzt FV profile and performance in both COD tests. The testing procedures were part of the players in-season routine assessments. Therefore, no testing familiarization was included in this study. The FV profile, sprint, and COD testing procedures were performed on the same day for each group. Before the tests, all subjects performed a standardized warm-up protocol, including 5 minutes of jogging and 5 minutes of lower-limb dynamic stretching. To complete the specific warm-up, the players performed 3 progressive sprints (30 m each) at increased running velocities before the sprinting test and 3 trials (2 submaximal and 1 maximal effort) before the COD tests. The players recovered for 3 minutes between the end of each specific warm-up and the beginning of the next test.

Subjects

A total of 71 basketball players (23 women and 48 men) participated in this study. The characteristics of the subjects are presented as mean ± *SD* in Table 1. At the time of the study, both the women (age range: 16–36 years) and the men (age range: 16–30 years) were competing in the Spanish League second division. Of note, 27 of the male players were also competing at an elite level in their respective age categories (U18 to U20). All the players participated in an average of 10 hours per week of combined team practice, technical skills, and strength training, plus one competitive match per week. None of the subjects exhibited any type of injury or limitation that might affect their testing performance. All the subjects were informed of the risks and benefits of the study and gave their written consent before the initiation of the study. For the U18 subjects, both the players and their parents or guardians gave their written consent. This study was reviewed and approved by the ethics committee of the University of Almería and was performed in accordance with the Helsinki Declaration.

Procedures

Horizontal Force-Velocity Profile Tests. To determine the individual FV relationships, the subjects performed 2 maximal sprints (30 m) with 4 minutes of recovery between trials. All the data were collected using a Stalker Acceleration Testing System (ATS) II radar device (Model: Stalker ATS II Version 5.0.2.1; Applied Concepts, Dallas, TX). The radar device was attached to a tripod 10 m at the starting line at a height of 1 m, which corresponded approximately to the height of the subjects' center of mass. The radar device sampled the velocity-time data at 46.9 Hz. The subjects initiated the sprint from a crouching position (staggered stance). The velocity-time data were used to determine individual FV relationships (i.e., the theoretical maximum values: F_0, V_0, $Pmax$, RF_{peak}, and D_{RF}) using the inverse dynamic analysis applied to the body center of mass, as validated by Samozino et al. (22). The raw velocity data were fitted by a mono-exponential function using least squares regression. The horizontal acceleration GRF was calculated from the changes in velocity over time, combined with the body mass and aerodynamic friction force (22). Individual FV relationships were modeled to determine x-intercept and y-intercept (i.e., F_0 and V_0) and $Pmax$ ($F_0 \cdot V_0/4$). The FV profile parameters were normalized to the body mass.

Modified 505 Tests. The athletes began the test 0.3 m behind the pair of photocells placed at the starting line. A set of cones were set 5 m from the start position. The athletes were instructed to accelerate as fast as possible along the 5 m distance, placing either their right or left foot on the line, and then pivot and sprint through the finish line (i.e., the photocells placed at the starting position; Figure 1) (6,32). This test has been shown to be reliable and valid for measuring COD ability in young players during sport-specific movements, such as 180° turns (29,32). Two trials were completed for each pivot foot, and the fastest time from each of the trials was used for the statistical analyses. The data are presented according to the dominant (D) and nondominant (ND) sides.

V-cut Tests. The athletes began the test 0.3 m behind the pair of photocells placed at the starting line. The athletes performed a 25-m sprint with 4 CODs of 45° every 5 m. Two trials were completed for each athlete, and the fastest trial was used for the statistical analyses. The players had to pass the line (drawn on the floor) completely with one foot at every turn. A new trial was allowed if the previous trial was considered invalid. Each pair of cones was separated by 0.7 m. Another pair of photocells was placed at the finish line (Figure 2) (9). This test has been shown to be highly reliable and valid for measuring COD ability in young elite basketball players performing one of the most common on-court movements typically performed in basketball (side-step cutting) (9).

Statistical Analyses

The descriptive data are presented as mean + *SD*s. The distribution of the main variables was tested using histograms and the Shapiro-Wilk test for both groups. Student's *t*-test for independent samples was used to assess the differences in the mean descriptive characteristics between the female and male players groups. Pearson's correlation coefficients (*r*) were used to assess the association of the sprint mechanical variables with the COD tests. The following qualitative interpretations of the *r* coefficients

Table 1

Descriptive data (mean ± *SD*) of the horizontal FV profile mechanical variables and COD performance.*†

	Women ($n = 23$)	Men ($n = 48$)	p	Cohen's size (d)
Age (y)	23.61 ± 5.10	20.29 ± 3.76	< 0.001	−0.78
Height (cm)	178.57 ± 9.14	192.54 ± 7.09	< 0.001	1.79
Body mass (kg)	71.85 ± 12.01	86.98 ± 8.22	< 0.001	1.57
F_0 (N·kg^{-1})	6.37 ± 0.64	6.88 ± 0.76	0.005	0.70
Pmax (W·kg^{-1})	11.76 ± 1.50	15.34 ± 1.63	< 0.001	2.25
V_0 (m·s^{-1})	7.43 ± 0.45	8.96 ± 0.49	< 0.001	3.20
RF_{peak} (%)	45.00 ± 0.02	48.48 ± 0.03	< 0.001	1.23
D_{RF} (%)	−7.91 ± 0.82	−7.05 ± 0.89	< 0.001	0.99
505-D (s)	2.76 ± 0.18	2.59 ± 0.13	< 0.001	−1.15
505-ND (s)	2.77 ± 0.17	2.60 ± 0.11	< 0.001	−1.28
V-cut test (s)	7.31 ± 0.52	6.75 ± 0.56	< 0.001	−1.02
COD deficit (D) (s)	−0.66 ± 0.15	−0.75 ± 0.14	0.019	−0.63
COD deficit (ND) (s)	−0.67 ± 0.14	−0.75 ± 0.13	0.034	−0.90

*F_0 = theoretical maximal force; *Pmax* = maximal power output; V_0 = theoretical maximal velocity; RF_{peak} = the peak of the ratio of effective horizontal component; D_{RF} = index of force application technique; D = dominant; ND = nondominant.
†Differences between groups assessed with the Student *t*-test.

are provided as defined by Hopkins et al. (11): trivial (0.00–0.09), small (0.10–0.29), moderate (0.30–0.49), large (0.50–0.69), very large (0.70–0.89), nearly perfect (0.90–0.99), and perfect (1.00). In addition, a linear regression was used to estimate the expected change in COD performance associated with one additional unit for the variables derived from the FV profile (i.e., F_0, *Pmax*, and RF_{peak}). In separate models, we included the performance in the COD tests (i.e., 505-D, 505-ND, and V-cut) or the COD deficit as dependent variables and the variables derived from the FV profile as independent variables. The statistical significance was set at $p < 0.05$. All the statistical analyses were performed using SPSS version 25.0 (SPSS, Chicago, IL).

Results

Table 1 shows the Hzt FV parameters and COD performance. The men showed significantly greater values for the FV profile parameters and lower COD times than the women. Pearson's correlation coefficients for the sprint mechanical variables with COD performance for both genders are presented in Table 2. F_0 (women: $r = -0.75$, $p < 0.001$; men: $r = -0.75$, $p < 0.001$), *Pmax* (women: $r = -0.82$, $p < 0.001$; men: $r = -0.72$, $p < 0.001$), and RF_{peak} (women: $r = -0.72$, $p < 0.001$; men: $r = -0.67$, $p < 0.001$) were strongly associated with performance in the 505 test. Similarly, F_0 (women: $r = 0.75$, $p < 0.001$; men: $r = 0.54$, $p < 0.001$), *Pmax* (women: $r = 0.65$, $p < 0.001$; men: $r = 0.51$, $p < 0.001$), and RF_{peak} (women: $r = 0.58$, $p < 0.05$; men: $r = 0.49$, $p < 0.001$) were strongly associated with a lower COD deficit. Finally, F_0 (women: $r = -0.69$, $p < 0.001$; men: $r = -0.50$, $p < 0.001$), *Pmax* (women: $r = -0.76$, $p < 0.001$; men: $r = -0.45$, $p < 0.001$), and RF_{peak} (women: $r = -0.68$, $p < 0.001$; men: $r = -0.48$, $p < 0.001$) were strongly associated with performance in the V-cut test for both genders.

The linear regression analyses are presented in Table 3. For the women, one additional newton per kilogram of the F_0 was associated with −0.20 seconds to complete the dominant 505 test, −0.21 seconds to complete the nondominant 505 test, and −0.56 seconds to complete the V-cut test. Moreover, that additional newton per kilogram of the F_0 was associated with 0.16 seconds for a lower dominant COD deficit and 0.15 seconds for the nondominant. For the men, one additional newton per kilogram of the F_0 was associated with −0.13 seconds for the dominant 505 test, −0.07 seconds for the nondominant 505 test, −0.37 seconds to complete the V-cut test, and 0.10 seconds for a lower dominant COD deficit and 0.04 seconds for the nondominant COD deficit.

Discussion

This study was designed to evaluate the gender-specific associations of the sprint mechanical properties derived from horizontal FV profile with different COD tests for basketball players. The main findings indicate that greater F_0, *Pmax*, and RF_{peak} values are significantly associated with better

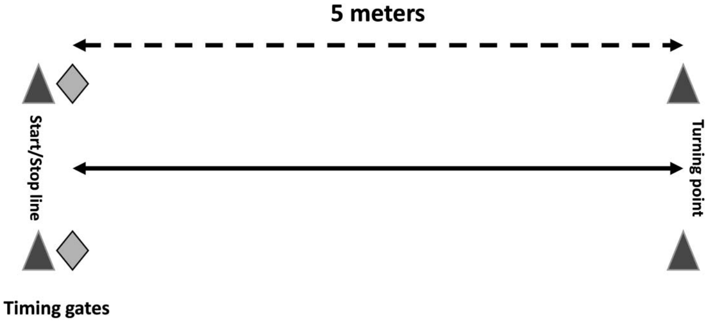

Figure 1. Schematic representation of the modified 505 test (32).

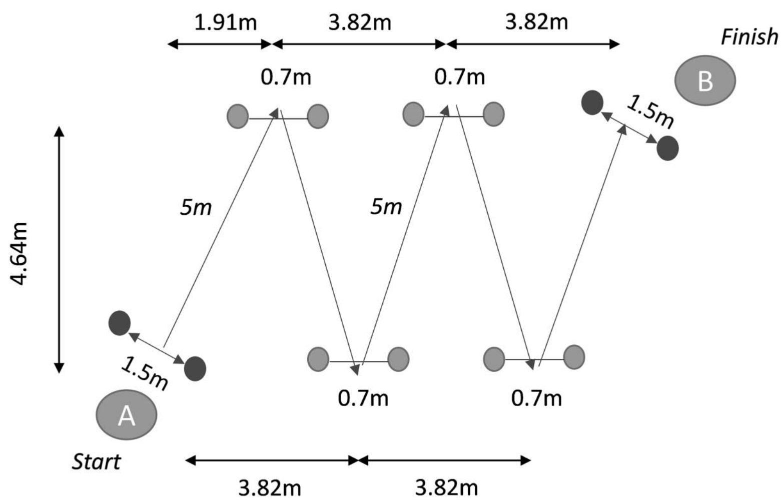

Figure 2. Schematic representation of the V-cut test (9).

performance in the 505 test and V-cut test for both genders. Another relevant finding is that a better performance for these sprint mechanical variables is also strongly associated with a lower COD deficit when performing a 180º COD. In addition, F_0 was the parameter that most significantly estimated the reduction of time for the different COD tests, as well as the higher COD efficiency in the 505 test for both women and men. Therefore, these results suggest that, in basketball, higher horizontal net force production and its effective application on the ground, together with a greater maximal power output during sprint acceleration, might determine performance in both 180° and 45° COD for men and women.

Horizontal force production and the ratio of effective horizontal components are determinant mechanical variables in the acceleration phase of sprinting (14,16,20). Similarly, superior force capacity and movement mechanics have been established to result in better COD performance (25,26), with faster athletes in the COD test showing greater horizontal GRF magnitudes and less contact time over the penultimate and ultimate foot contact, compared with their slower counterparts (1). In this regard, these results show that higher F_0 and RF_{peak} values during sprint acceleration are also strongly associated with faster performances in the 505 test and V-cut test for both genders. These findings support the data suggesting that COD performance is not only about how much force the player produces but also how effectively the force is horizontally transmitted onto the ground to accelerate the body during directional changes (1). This might be especially relevant for basketball players who need a rapid COD to evade or defend opponents in time-restricted scenarios throughout the game (4).

Interestingly, Dos'Santos et al. (2) recently reported that COD biomechanics are angle dependent, with significantly greater GRF magnitudes in sharper cuts. In that sense, we observed that F_0 and RF_{peak} were more strongly associated with performance in the 505 test rather than the V-cut test for both genders. This might be closely related to the players' forward leaning position during the 505 test that enables them to produce greater horizontal force during acceleration (15,20). Thus, the horizontal force application and its mechanical effectiveness during sprinting are more determinant during a 180° COD, where players need to apply greater horizontal forces during acceleration, braking (i.e., penultimate and final foot contact), and plant phases to overcome the inertia and transfer the impulse into the subsequent propulsive phase of the movement (1,23). Therefore, a

Table 2

Pearson's correlation between sprint variables and performance in different COD tests.*

	505-D	505-ND	V-cut	COD deficit (D)	COD deficit (ND)
Women (n = 23)					
F_0	−0.75‡ (−0.89 to −0.49)	−0.74‡ (−0.88 to −0.47)	−0.69‡ (−0.86 to −0.39)	0.70‡ (0.40 to 0.86)	0.71‡ (0.42 to 0.87)
$Pmax$	−0.82‡ (−0.92 to −0.62)	−0.81‡ (−0.92 to −0.6)	−0.76‡ (−0.89 to −0.51)	0.65‡ (0.32 to 0.84)	0.65‡ (0.32 to 0.84)
V_0	−0.49† (−0.75 to −0.10)	−0.49† (−0.75 to −0.10)	−0.53† (−0.77 to −0.15)	0.21 (−0.22 to 0.57)	0.20 (−0.23 to 0.57)
RF_{peak}	−0.72‡ (−0.87 to −0.44)	−0.73‡ (−0.88 to −0.45)	−0.68‡ (−0.85 to −0.37)	0.58† (0.22 to 0.80)	0.59† (0.23 to 0.81)
D_{RF}	0.37 (−0.05 to 0.68)	0.36 (−0.06 to 0.67)	0.29 (−0.14 to 0.63)	−0.50† (−0.76 to −0.11)	−0.52† (−0.77 to −0.14)
Men (n = 48)					
F_0	−0.75‡ (−0.85 to −0.59)	−0.47‡ (−0.67 to −0.21)	0.50‡ (0.25 to 0.69)	0.54‡ (0.3 to 0.71)	0.25 (−0.04 to 0.50)
$Pmax$	−0.72‡ (−0.83 to −0.55)	−0.53‡ (−0.71 to −0.29)	−0.45‡ (−0.65 to −0.19)	0.51‡ (0.26 to 0.69)	0.31† (0.03 to 0.55)
V_0	0.20 (−0.09 to 0.46)	−0.20 (−0.46 to 0.09)	−0.21 (−0.47 to 0.08)	−0.15 (−0.42 to 0.14)	0.05 (−0.24 to 0.33)
RF_{peak}	−0.67‡ (−0.80 to −0.48)	−0.44† (−0.64 to −0.18)	−0.48‡ (−0.67 to −0.23)	0.49‡ (0.24 to 0.68)	0.25 (−0.04 to 0.5)
D_{RF}	0.46‡ (0.20 to 0.66)	0.23 (−0.06 to 0.48)	0.33† (0.05 to 0.56)	−0.40‡ (−0.61 to −0.13)	−0.17 (−0.43 to 0.12)

*F_0 = theoretical maximal force; $Pmax$ = maximal power output; V_0 = theoretical maximal velocity; RF_{peak} = the peak of the ratio of effective horizontal component; D_{RF} = index of force application technique; D = dominant; ND = nondominant.
†Significant correlation ($p < 0.05$).
‡Significant correlation ($p < 0.001$).

Table 3
Linear regression analysis between mechanical variables and COD performance and COD deficit.*

	505 test (D)		505 test (ND)		V-cut test		COD deficit (D)		COD deficit (ND)	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
F_0										
B	−0.21‡	−0.13‡	−0.20‡	−0.07†	−0.56‡	−0.37‡	0.16‡	0.10‡	0.15‡	0.04
SE	0.04	0.02	0.04	0.02	0.13	0.10	0.03	0.02	0.03	0.02
95% CI	−0.29 to −0.12	−0.16 to −0.10	−0.28 to −0.12	−0.11 to −0.03	−0.82 to −0.29	−0.56 to −0.18	0.09 to 0.23	0.05 to 0.15	0.08 to 0.23	−0.01 to 0.10
Pmax										
B	−0.10‡	−0.06‡	−0.09‡	−0.04‡	−0.27‡	−0.15†	0.06†	0.04‡	0.06†	0.03†
SE	0.01	0.01	0.01	0.01	0.05	0.05	0.02	0.01	0.02	0.01
95% CI	−0.13 to −0.07	0.07 to −0.04	−0.12 to −0.06	−0.06 to −0.02	−0.37 to −0.17	0.25 to −0.06	0.03 to 0.10	0.02 to 0.07	0.03 to 0.09	0.00 to 0.05
RF_{peak}										
B	−0.05‡	−0.03‡	−0.05‡	0.02†	−0.14‡	−0.09†	0.03‡	0.02‡	0.03†	0.01
SE	0.01	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.01	0.01
95% CI	−0.07 to −0.03	−0.04 to −0.02	−0.07 to −0.03	−0.03 to −0.01	−0.21 to −0.07	−0.14 to −0.04	0.01 to 0.06	0.01 to 0.04	0.01 to 0.05	−0.00 to 0.02

*F_0 = theoretical maximal force; P_{max} = maximal power output; V_0 = theoretical maximal velocity; RF_{peak} = the peak of the ratio of effective horizontal component; D_{RF} = index of force application technique; D = dominant; ND = nondominant; B = beta coefficient; CI = confidence interval.
†Significant correlation ($p < 0.05$).
‡Significant correlation ($p < 0.001$).

higher F_0 and RF_{peak} might lead to a better performance in sport-specific movements, such as backdoor cuts in basketball, which involve precise sequencing of force transmission to rapidly decelerate and reaccelerate the body to maintain a defensive ready position (26,33).

For the women, however, *Pmax* (i.e., the product of F_0 and V_0) was the FV profile-derived variable most strongly associated with both 505 test and V-cut test performance (Figure 3). Moreover, we found that one additional $W\cdot kg^{-1}$ of the P_{max} is associated with a superior reduction in COD time for women than that of men (Table 3), which helps to clarify the gender-specific association between the sprint mechanical properties and COD in basketball. Previous research has shown significant differences in lower-limb strength capacity and GRF produced during the braking phase for male players (26), which is supported by the greater F_0 values for the men observed in the current study (Table 1). However, women's ability to produce force rapidly (i.e., *Pmax*) might be advantageous for on-court physical performance and injury prevention (26). This ability may be especially relevant when players need to shift their momentum in a lateral direction during 45° cuts because they do not need to decelerate as much in the braking phase before side-step cutting, allowing them to maintain a higher velocity and reduce knee joint loading (2,24).

Previous studies have reported that athletes who are faster in linear sprints tend to be faster in COD tests but less efficient

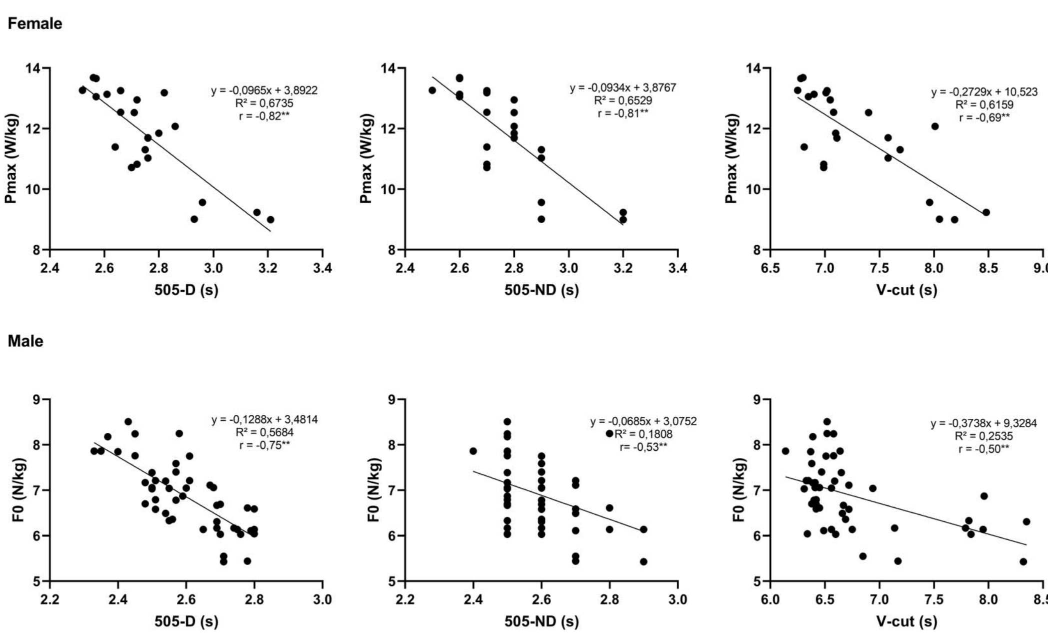

Figure 3. Strongest associations observed between the FV profile variables and performance for the modified 505 and V-cut tests. F_0 = theoretical maximal force; *Pmax* = maximal power output; FV = force-velocity.

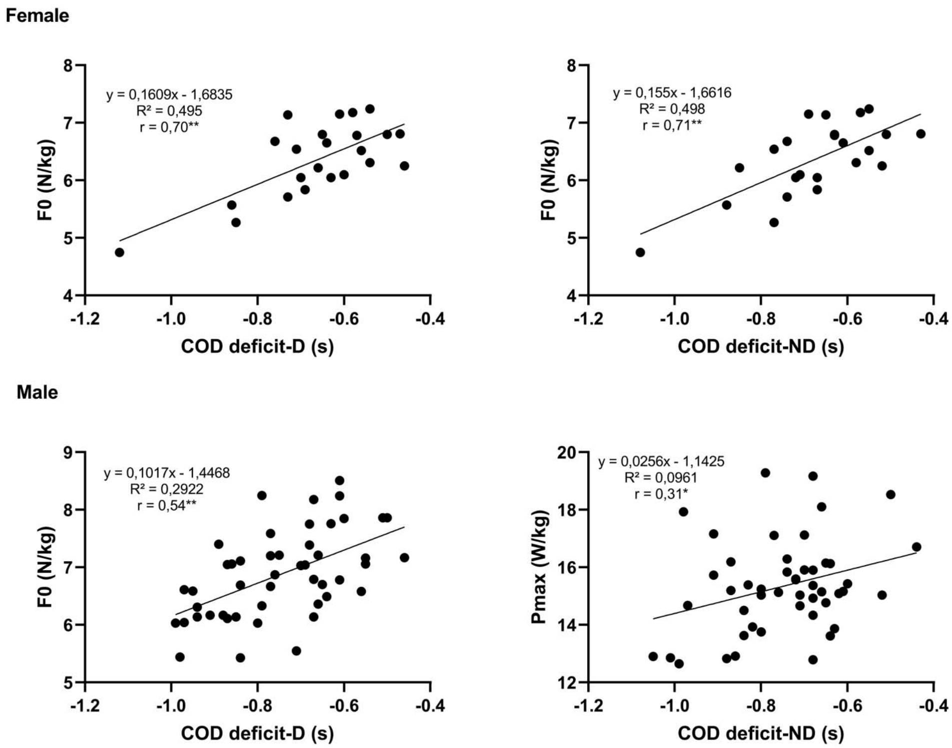

Figure 4. Strongest association observed between the FV profile variables and the COD deficit with both legs. F_0 = theoretical maximal force; *Pmax* = maximal power output; FV = force-velocity.

when covering the same distance with a directional change (5,30). However, this study makes a novel contribution to the literature by showing that the underlying sprint mechanical properties (F_0, RF_{peak}, and *Pmax*) are significantly associated with lower COD deficits (Figure 4), whereas a higher D_{RF} is associated with a higher COD deficit. The linear regression analyses presented in Table 3 display the estimated improvements in the 505 (i.e., D and ND) test, V-cut test, and COD deficit as F_0, RF_{peak}, and *Pmax* increases. Although they need to be confirmed or contrasted in future prospective studies, these results suggest the importance of high horizontal force application (8) and effectiveness to maximize acceleration capabilities, which, in turn, may result in improved COD performance and reduced COD deficit.

This study has limitations that must be acknowledged. The cross-sectional study design precludes concluding on the causality of the results, and the athletes were recruited from second division teams. Thus, assessing whether maximizing the FV profile parameters through specific training programs translates into improved COD performance in top-level basketball players is a matter of future prospective and experimental research. Moreover, further research, including time-motion analysis, should be conducted to assess movement mechanics and technical components to examine whether specific FV profile-based training programs also optimize these qualitative aspects. Although this is the first evidence available on the potential influence of the sprint FV profile on COD in basketball players, further research is needed to corroborate or contrast our findings.

In conclusion, the results of this study suggest that the mechanical variables derived from the horizontal FV profile, particularly F_0, RF_{peak}, and *Pmax,* are strongly associated with COD performance for both male and female basketball players.

Practical Applications

Our estimations suggest that each unit change in F_0, RF_{peak}, and *Pmax* is associated with significantly lower COD times and COD deficits. From a practical perspective, these results indicate that assessing the horizontal FV profile provides unique information for coaches to understand the sprint mechanical properties underlying the sprint acceleration and COD performance of male and female basketball players. It should be noted that the FV profile is easily evaluated on the field using easily accessible practical devices (21), which helps to bridge the gap between the laboratory and field practice settings. As COD is a key action that needs optimization to maximize athlete performance in basketball, our results will spur further prospective research to understand the extent to which improving these mechanical parameters through specific training programs might result in COD enhancement.

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