Journal of Human Kinetics volume 60/2017, 199-207 DOI: 10.1515/hukin-2017-0103 199
Section III – Sports Training

Sprinting, Change of Direction Ability and Horizontal Jump Performance in Youth Runners According to Gender

by
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The purpose of the study was to assess straight sprinting, change of direction ability and horizontal jump performance in youth runners according to age and gender. Two hundred and fifty-five youth runners (116 boys and 139 girls) participated in this study. The athletes were divided according to their age into five groups: under 8 yr (U8), under 10 yr (U10), under 12 yr (U12), under 14 yr (U14) and under 16 yr (U16). Significant differences ($p < 0.01$) were found between U8 and U10 in the 5 m sprint ($d = 1.22$), 505 agility test (505, $d = 0.96$), modified agility test (MAT, $d = 1.43$), horizontal countermovement jump (HCMJ, $d = 1.06$) and arm swing HCMJ (HCMJAS, $d = 1.44$); between U10 and U12 in the 505 ($d = 0.39$), MAT ($d = 0.74$), HCMJ ($d = 0.96$) and HCMJAS ($d = 0.75$); and between U12 and U14 in 5 m ($d = 0.84$), HCMJ ($d = 0.88$) and HCMJAS ($d = 0.79$). However, no significant differences ($p > 0.05$, $d = 0.29$-1.17) between U14 and U16 were observed in any of the tests. With regard to age and gender, in U8 and U10 groups there were no significant differences ($p > 0.05$, $d = 0.02$-0.76) between boys and girls in any test. However, in U12 and U14 groups, significant gender differences ($p < 0.05$, $d = 0.85$-1.24) were found in the MAT. Likewise, the boys obtained better results than girls in the horizontal jump tests ($p < 0.05$, $d = 1.01$-1.26). After the classification by age, some differences were observed between both genders, depending on the fitness variable evaluated.

Key words: *field test, maturity, agility, strength, acceleration, athletes.*

Introduction

Physical activity and fitness play a significant role in prevention of overweight and obesity in children and adolescents (Ortega et al., 2013, 2015). Some recommendations indicate that children should get involved in 60 min of moderate to vigorous physical activity at least three days a week, in order to prevent overweight and obesity during puberty (Lätt et al., 2015). It has been also reported that the fitness level of children and teenagers has declined over the last three decades (Catley and Tomkinson, 2013). To solve this issue, some researchers have studied physical capacities in children and adolescents using field condition tests (Lopes et al., 2011; Malina et al., 2004; Vescovi et al., Yanci et al., 2013). Yet, these tests seem to be more age-related and moreover, young athletes are familiar with them. It seems that a high level of fitness during childhood and adolescence may be associated with better health in adulthood and indeed with lower total and central adiposity at this age and later in life (Ortega et al., 2015).

Several distances of straight line sprinting, change of direction ability (CODA) and horizontal jump tests have been carried out in children and adolescents engaged in team sports (Meylan et al., 2014; Spencer et al., 2011) and individual sports (Eisenmann and Malina, 2003). Furthermore, physical fitness performance has been examined over a 10-12 year period that included puberty and adolescence in various sports (Castro-Pinero et al., 2010; Vescovi et al., 2011). Physical fitness performance is considered a relevant key to assess the level of physical conditioning in different sports in youth athletes and is a powerful health marker in childhood and

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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. 60/2017 in December 2017.

adolescence (Ortega et al., 2015). There is, as yet, no consensus about the number and the kind of field tests that young athletes should perform.

Some studies have examined physical characteristics in youth runners (Eisenmann and Malina, 2003; Jaric et al., 2002). The differences in agility and explosive-power between genders were attenuated before 13 years of age in youth runners. However, during the adolescent growth spurt, differences between the gender emerged as a result of a continued increase in males and a plateau in females (Eisenmann and Malina, 2003). Since we did not find studies analyzing acceleration capacity, CODA and horizontal jump ability in young runners, it seemed that it would be interesting to assess fitness performance at a younger age in this population. Likewise, in spite of the fact that age and gender seem to be highly related to physical fitness performance in childhood and adolescence in team sports (Mendez-Villanueva et al., 2011; Sekulic et al., 2013; Spencer et al., 2011), more scientific studies are necessary regarding these physical capacities in individual sports, particularly in youth runners.

Therefore, the purposes of the study were first, to assess sprinting, change of direction ability and horizontal jump performance in youth runners, secondly, to determine the differences according to age and gender, and thirdly, to analyze the relationships among these abilities.

Methods

Participants

Two hundred and fifty-five youth runners (116 boys and 139 girls) from an athletic training school participated in this study. Athletes were divided according to their age into five groups: under 8 yr (U8, n = 75), under 10 yr (U10, n = 68), under 12 yr (U12, n = 48), under 14 yr (U14, n = 41) and under 16 yr (U16, n = 23) (Table 1). They all had training experience of at least one year (range = 1-7 years). All athletes performed regular endurance, sprint and specific running training ranging from 2 to 4 days per week. All parents or tutors of participants gave their written informed consent before their inclusion in the study in accordance with the Declaration of Helsinki (2013). They were also informed of their right to voluntarily withdraw from the study at any given time. The study was approved by both the Basque Country ethics committee and the Hiru Herri club to which the athletes belonged.

Procedures

In this study, we examined sprinting, CODA, and horizontal jumping abilities in youth athletes on two consecutive days. Tests were carried out during the competitive season and all athletes were required to attend the exercise-testing session on two separate occasions. Physical performance was determined by testing performance qualities that are usually evaluated in athletes (Hoare and Warr, 2000; Maulder and Cronin, 2005; Yanci et al., 2013). Prior to the testing session, the researchers provided the participants with graphic and direct instructions about how to successfully perform the test. Two test sessions were performed to practice the tests and to ensure that the participants performed both tests correctly.

During the first test session, the runners were informed about the testing protocol and anthropometric measurements were taken followed by a 15 m straight sprint test. The modified agility test (MAT) and the 505 agility test (505) were also performed during the first session to determine CODA. The second testing session took place 48 h after the first session. During the second session runners performed the horizontal jump (HJ). Always before testing, a warm-up was performed and it consisted of 5 min self-paced low-intensity running, skipping exercises, strides, two 15 m sprints with and without changes of direction and two vertical and horizontal jumps.

Measures

Straight Sprint test

Each athlete performed an acceleration test consisting of three maximal sprints of 15 m, with a 2 min rest period between each sprint, giving enough time to walk back to the start and wait for another turn as previously described by Yanci et al. (2013). The participants were placed at 0.5 m behind the starting point, and began when they felt ready. Split time at 5 m and the time to cover the 15 m were measured. Time was recorded using photocell gates (Microgate™ Polifemo, Bolzano, Italy). The timer was automatically activated as the participants passed the first gate at the 0 m mark.

Change of direction ability (CODA)

Modified agility test (MAT): Athletes

completed the protocol previously described by Yanci et al. (2013). All participants performed the test three times with at least 3 min rest between each performance. The total distance covered was 20 m. A photocell (Microgate™ Polifemo, Bolzano, Italy) was used to record the time.

505 agility test (505): Athletes sprinted forward to a line 5 m ahead and pivoted 180º before returning to the start position (Hoare and Warr, 2000; Sheppard and Young, 2006). A photocell (Microgate™ Polifemo, Bolzano, Italy) located over the start/finish line was used to record the time. Time measurement started and finished when the subject crossed the line between the tripods.

Horizontal jump (HJ) tests

Following the procedures previously proposed by Maulder and Cronin (2005) and Yanci et al. (2014), runners performed 3 horizontal countermovement jumps (HCMJ), and 3 arm swing countermovement jumps (HCMJAS). Recovery time between jumps was 20 s and recovery time between each type of the jump was 4 min.

Statistical Analysis

The results are presented as mean ± standard deviation (SD). All the variables were normally distributed and satisfied the equality of variance according to the Shapiro-Wilk and Levene's tests, respectively. Only the maximum score for each test was included in the data analysis. Independent paired t-tests were used to determine if any significant differences existed between the boys' and girls' groups. One-way ANOVA was used to determine if any significant differences existed between the five age groups (U8-U16) and a two (male and female) x five (different age groups) ANOVA to explore sex differences. Bonferroni post-hoc analysis was applied to any set of hypothesis tests. Practical significance was assessed by calculating Cohen's d effect size (Cohen, 1998). Effect sizes (d) of above 0.8, between 0.8 and 0.5, between 0.5 and 0.2 and lower than 0.2 were considered as large, moderate, small, and trivial, respectively. Pearson product-moment correlation coefficients (r) and simple regression models were calculated to determine the relationships among the variables obtained from the sprint, CODA and horizontal jump testing. The magnitude of correlation between test measures was assessed with the following thresholds: < 0.1, trivial; = 0.1–0.3, small; < 0.3–0.5, moderate; < 0.5–0.7, large; < 0.7–0.9, very large; and < 0.9–1.0, almost perfect (Hopkins et al., 2009). Data analysis was performed using the Statistical Package for Social Sciences (version 20.0 for Windows, SPSS™ Inc, Chicago, IL, USA) for Windows. Statistical significance was set at $p < 0.05$.

Results

The results of the physical performance in sprint, CODA and HJ tests of the total sample, boys and girls are described in Table 2. The CV of all the physical tests were between 1.9 and 4.9%. No significant differences ($p > 0.05$, d < 0.10, trivial) were observed between boys and girls in any of the variables.

The results of the physical tests according to the age groups between U8 and U16 are presented in Table 3. Significant differences were found between U8 and U10 considering the 5 m sprint, 505, MAT, HCMJ and HCMJAS; between U10 and U12 in the 505, MAT, HCMJ and HCMJAS; and between U12 and U14 in the 5 m sprint, HCMJ and HCMJAS. However, no significant differences between U14 and U16 were observed in any of the physical tests. Only a large (d = 1.17) and moderate (d = 0.78) effect size in the 15 m sprint and MAT, respectively, were found between U14 and U16.

With regard to age and gender (Table 4), no significant differences ($p > 0.05$, d = 0.02-0.76) were observed between boys and girls in the U8 and U10 in any test. However, in U12 and U14 groups, significant gender differences ($p < 0.05$, d = 0.85-1.24) were observed in the MAT. Likewise, U16 boys obtained better results than U16 girls in the horizontal jump tests ($p < 0.05$, d = 1.01-1.26).

The relationship between the straight sprint, CODA and HJ test of the total sample is described in Table 2. Significant correlations were found among all of the tests in all athletes. A negative correlation (r = -0.711, $R^2 = 0.529$, $p < 0.01$, very large, y = 1.978 – 0.345x + 0.071) was found between the 5 m sprint test and HCMJAS. Furthermore, the MAT values correlated negatively with the HCMJ (r = -0.782, $R^2 = 0.529$, $p < 0.01$, very large, y = 1.978 – 0.345x + 0.071).

Table 1

Anthropometric characteristics of the young runners

	Age (yr)	Body mass (kg)	Body height (m)	BMI (kg/m²)	Training experience (yr)
Boys (n = 116)	10.22 (2.73)	37.54 (12.14)	1.37 (0.28)	17.76 (2.06)	2.25 (1.81)
Girls (n = 139)	10.43 (2.62)	37.94 (11.38)	1.40 (0.30)	17.86 (2.64)	2.47 (2.03)
U8 (n = 75)	7.33 (0.55)	26.38 (4.48)	1.09 (0.15)	16.34 (1.63)	1.25 (0.44)
U10 (n = 68)	9.47 (0.68)	34.38 (6.85)	1.39 (0.08)	17.41 (2.23)	2.13 (1.12)
U12 (n = 48)	11.27 (0.71)	41.81 (8.15)	1.52 (0.42)	18.36 (2.46)	2.65 (1.80)
U14 (n = 41)	13.44 (0.59)	49.78 (7.78)	1.60 (0.07)	19.40 (2.12)	3.15 (2.30)
U16 (n = 23)	15.22 (0.60)	54.70 (5.96)	1.66 (0.08)	19.90 (1.71)	4.74 (3.26)
Sample (n = 255)	10.34 (2.67)	37.76 (11.71)	1.39 (0.29)	17.81 (2.39)	2.37 (1.94)

Data are presented as mean (SD, standard deviation), BMI = body mass index, U8 = under 8 years group, U10 = under 10 years group, U12 = under 12 years group, U14 = under 14 years group, U16 = under 16 years group

Table 2

Straight sprint, change of direction ability and horizontal jump test performance for total sample (n = 255), boys (n = 116) and girls (n = 139).

	Sample	Boys	Girls	Mean dif. (%)	Cohen d
Sprint (s)					
5 m	1.25 (0.11)	1.25 (0.12)	1.25 (0.11)	-0.34	0.04
15 m	2.76 (0.42)	2.78 (0.44)	2.74 (0.41)	-1.51	0.10
CODA (s)					
505	2.88 (0.28)	2.89 (0.33)	2.87 (0.24)	-0.38	0.03
MAT	7.67 ± 1.18	7.65 (1.40)	7.68 (0.99)	0.47	0.03
Horizontal jump (m)					
HCMJ	1.23 (0.22)	1.21 (0.26)	1.24 (0.19)	1.82	0.08
HCMJAS	1.49 (0.30)	1.51 (0.35)	1.48 (0.26)	-2.01	0.09

Data are presented as mean (SD, standard deviation), CODA = change of direction ability, 505 = 505 agility test, MAT = modified agility test; HCMJ = horizontal countermovement jump, HCMJAS = horizontal arm swim countermovement jump

Table 3

Physical test results according to age groups between U8 and U16

	U8	U10	U12	U14	U16	U8-U10 d	U10-U12 d	U12-U14 d	U14-U16 d
Sprint (s)									
5 m	1.35 (0.07)	1.26 (0.10)	1.24 (0.09)	1.16 (0.08)	1.13 (0.08)	1.22 (**)	0.18 (NS)	0.84 (**)	0.43 (NS)
15 m	2.82 (0.52)	2.85 (0.39)	2.67 (0.40)	2.76 (0.25)	2.47 (0.31)	0.05 (NS)	0.44 (NS)	0.21 (NS)	1.17 (NS)
CODA (s)									
505	3.13 (0.26)	2.87 (0.27)	2.77 (0.16)	2.75 (0.24)	2.66 (0.15)	0.96 (**)	0.39 (**)	0.07 (NS)	0.39 (NS)
MAT	8.96 (0.69)	7.99 (1.15)	7.13 (0.49)	6.79 (0.59)	6.32 (0.47)	1.43 (**)	0.74 (**)	0.70 (NS)	0.78 (NS)
Horizontal jump (m)									
HCMJ	1.04 (0.11)	1.15 (0.16)	1.31 (0.16)	1.45 (0.20)	1.51 (0.13)	1.06 (**)	0.96 (**)	0.88 (**)	0.29 (NS)
HCMJAS	1.21 (0.15)	1.43 (0.19)	1.56 (0.21)	1.73 (0.26)	1.86 (0.24)	1.44 (**)	0.75 (*)	0.79 (**)	0.52 (NS)

Data are presented as mean (SD, standard deviation), U8 = under 8 years group, U10 = under 10 years group, U12 = under 12 years group, U14 = under 14 years group, U16 = under 16 years group, CODA = change of direction ability, 505 = 505 agility test, MAT = modified agility test; HCMJ = horizontal countermovement jump, HCMJAS = horizontal arm swim countermovement jump.
*Significant difference (** p < 0.01, * p < 0.05) with the previous category.*
NS = no significant differences with the previous category.

Table 4

Physical test results according age groups (U8-U16) and gender (boys and girls)

	U8	U10	U12	U14	U16	U8-U10 d	U10-U12 d	U12-U14 d	U14-U16 d
Sprint 5 m (s)									
Boys	1.35 (0.08)	1.25 (0.09)	1.23 (0.07)	1.18 (0.10)	1.11 (0.06)	1.27 (**)	0.23 (NS)	0.77 (NS)	0.70 (NS)
Girls	1.34 (0.07)	1.26 (0.10)	1.24 (0.10)	1.15 (0.06)	1.15 (0.09)	1.16 (**)	0.15 (NS)	0.88 (NS)	0.03 (NS)
d	0.23	0.02	0.10	0.25	0.71	-	-	-	-
Sprint 15 m (s)									
Boys	2.85 (0.55)	2.86 (0.41)	2.71 (0.40)	2.81 (0.29)	2.49 (0.28)	0.02 (NS)	0.36 (NS)	0.26 (NS)	1.11 (NS)
Girls	2.80 (0.49)	2.84 (0.39)	2.65 (0.41)	2.72 (0.21)	2.45 (0.35)	0.08 (NS)	0.48 (NS)	0.18 (NS)	1.31 (NS)
d	0.09	0.06	0.16	0.32	0.14	-	-	-	-
505 agility test (s)									
Boys	3.14 (0.31)	2.92 (0.37)	2.76 (0.17)	2.68 (0.17)	2.62 (0.16)	0.70 (*)	0.42 (NS)	0.46 (NS)	0.37 (NS)
Girls	3.12 (0.21)	2.84 (0.16)	2.77 (0.16)	2.80 (0.27)	2.71 (0.14)	1.33 (**)	0.43 (NS)	0.22 (NS)	0.34 (NS)
d	0.06	0.21	0.03	0.72	0.56	-	-	-	-
MAT (s)									
Boys	8.96 (0.70)	8.02 (1.61)	6.96 (0.35)	6.40 (0.47)	6.20 (0.54)	1.33 (**)	0.66 (**)	1.61 (NS)	0.43 (NS)
Girls	8.97 (0.68)	7.96 (0.70)	7.25 (0.55)#	6.98 (0.56)##	6.47 (0.35)	1.49 (**)	1.01 (**)	0.49 (NS)	0.91 (NS)
d	0.02	0.04	0.85	1.24	0.50	-	-	-	-
HCMJ (m)									
Boys	1.00 (0.11)	1.13 (0.19)	1.33 (0.17)	1.51 (0.25)	1.58 (0.13)	1.32 (*)	1.03 (**)	1.05 (*)	0.29 (NS)
Girls	1.08 (0.10)	1.17 (0.13)	1.29 (0.16)	1.42 (0.17)	1.42 (0.08)##	0.93 (**)	0.92 (**)	0.81 (**)	0.02 (NS)
d	0.76	0.18	0.23	0.37	1.26	-	-	-	-
HCMJAS (m)									
Boys	1.18 (0.14)	1.48 (0.21)	1.61 (0.21)	1.81 (0.35)	1.98 (0.25)	2.17 (**)	0.62 (NS)	1.00 (NS)	0.48 (NS)
Girls	1.24 (0.16)	1.37 (0.14)	1.53 (0.21)	1.69 (0.20)	1.73 (0.15)#	0.83 (NS)	1.21 (NS)	0.73 (**)	0.21 (NS)
d	0.45	0.51	0.37	0.37	1.01	-	-	-	-

Data are presented as mean (SD, standard deviation), U8 = under 8 years group, U10 = under 10 years group, U12 = under 12 years group, U14 = under 14 years group, U16 = under 16 years group, CODA = change of direction ability, 505 = 505 agility test, MAT = modified agility test; HCMJ = horizontal countermovement jump, HCMJAS = horizontal arm swim countermovement jump.
*Significant difference (** p < 0.01, * p < 0.05) with the previous category.*
Significant difference (## p < 0.01, # p < 0.05) between boys and girls.
NS = no significant differences with the previous category

Table 5

Relationship between straight sprint (5 and 15 m), change of direction ability (505 and MAT) and horizontal jump (HCMJ and HCMJAS) tests in all youth athletes

	505 (s)	MAT (s)	HCMJ (m)	HCMJAS (m)
Sprint 5 m (s)	0.617**	0.709**	-0.727**	-0.711**
Sprint 15 m (s)	0.312**	0.289**	-0.229**	-0.171*
505 (s)	-	0.764**	-0.600**	-0.617**
MAT (s)	-	-	-0.762**	-0.782**

*505 = 505 agility test, MAT = modified agility test; HCMJ = horizontal countermovement jump, HCMJAS = horizontal arm swim countermovement jump. Significant correlation (** $p < 0.01$).*

Discussion

The objectives of this study were threefold, to assess sprinting, change of direction ability and horizontal jump performance in youth runners, to determine the differences according to age and gender and to analyze the relationship among these abilities. Even though the influence of age and gender on physical performance has been widely analyzed in many sports (Doré et al., 2008; Jaric et al., 2002; Kugler and Janshen, 2010; Malina et al., 2004), to our knowledge no study has determined sprinting capacity, CODA and horizontal jump capacity in an athletic training school in youth athletes. This information could help coaches develop specific training programs adapted to the physical characteristics of the athletes.

Our results show significant differences between U8-U10 and U12-U14 in the 5 m sprint and between U8-U10 and U10-U12 in CODA (505 and MAT). Moreover, the HCMJ and HCMJAS also differed between U8-U10, U10-U12 and between U12-U14. These results coincide with a previous study where differences in strength between particular ages were shown to be maintained until the age of 18 yr (Taeymans et al., 2009). In spite of the observed differences across ages in participants under 14, no significant differences were found between U14-U16 in any of the physical tests. Only a large (d = 1.17) and moderate (d = 0.78) effect size was found between U14 and U16 in youth runners in the 15 m and MAT. Considering, on the one hand, that peak height velocity occurs at the age of 13 yr and that from the age of 15 to 16 an increase of 20% has been observed in maximal power output in a group of boys (Kugler and Janshen, 2010), and on the other hand, that peak fiber size does not plateau until the age of 16 years (Eisenmann and Malina, 2003), we expected significant differences in jumping, sprinting and CODA in the participants between U14 and U16. Furthermore, taking into account that chronological age itself exerts a positive influence on short term power output (Armstrong et al., 2001) and that the tests performed in this study are positively related to this characteristic, we cannot explain why the observed differences in younger ages were not maintained above 14 yr. Further studies are required in order to gain a deeper insight into the study of the evolution of short term power performance across ages above 14 yr. The lack of significant differences observed in the present study in sprinting, jumping capacity and CODA in athletes over 14 suggests the need to train short term power output specifically above this age.

We did not find statistical (p = 0.05) nor practical differences (d = trivial) in the physical performance tests between boys and girls (Table 2). However, after the classification by age, some differences were observed between both genders. Therefore, as previous studies have reported (Eisenmann and Malina, 2003; Yanci et al., 2014a), the maturation process may affect fitness variables differently and, in consequence, differences between both genders should be expected. Specifically, while the practical differences in acceleration capacity (i.e. 5 m and 15 m) were trivial or small in all age groups except for U16 group in the 5 m test (d = 0.71) and CODA (i.e. 505 and MAT), moderate practical differences were found between genders in both tests for the older two groups (i. e., U14 and U16) and in the MAT for the U12 age group (Table 4). In general, the differences in acceleration and sprinting capacities between boys and girls seem more relevant in older than in younger athletes (Amusa et al., 2010; Eisenmann and Malina, 2003; Lam and Schiller, 2001; Yanci et al., 2014b) also in CODA (Eisenmann and Malina, 2003; McKenzie et al., 2002; Yanci et al., 2014a), independently of the impact of the test characteristics (Brughelli et al., 2008; Chaouachi et al., 2012; Yanci et al., 2014a) and these differences between the genders are emphasized during the adolescent growth spurt (Eisenmann and Malina, 2003). In contrast to these two abilities, moderate practical differences were found between genders in horizontal jump performance (i. e., HCMJ and HCMJAS) independently of age. This result again implies that the differences between boys and girls at different ages may also vary depending on the fitness variable tested. Only few studies have analyzed horizontal force (Eisenmann and Malina, 2003) in athletes, and compared results according to gender, even though it is an important variable during the accelerative and later stages of sprinting (Kugler and Janshen, 2010; Mero, 1998). In youth long distance runners, Eisenmann and Malina (2003) found differences between genders in standing long jump performance in athletes over 13 years of age. Yet, these differences were not observed in younger athletes. Even though their results differ with ours, although not dramatically, we suggest that the differences between boys and girls in acceleration and horizontal jump abilities were not equal for all of the age groups.

The association values among the performance variables varied depending on the tests (Table 5). The correlation between CODA and HJ performance was positive and large-very large for all tests (r = 0.60 – 0.78). Conversely, the relationships between the performance in the acceleration and in the rest of the capacities, positive in all cases, were considerably lower with respect to the 15 m test (r = 0.17 - 0.31, small) in comparison with the 5 m test (r > 0.62, large-very large). Contrary to our results, Yanci et al. (2014b) found the same moderate relationship (r = 0.53) between both acceleration tests (i.e. 5 m and 15 m) and the MAT in young children (age = 7.6 ± 0.8 years). Thus, the issue of the relationships among the acceleration and CODA abilities in children remains unresolved. Even though some large-very large relationships have been described between some fitness tests, the association among motor abilities remains unclear not only for adults (Salaj and Markovic, 2011; Yanci et al., 2014a), but also for children (Yanci et al., 2014b). Moreover, it has been suggested that these motor abilities are independent (Salaj and Markovic, 2011). The reason may be found in the use of different tests to assess the same fitness variable, and the age and gender of the athletes (Vescovi and McGuigan, 2008; Yanci et al., 2014b). Among other factors, it would be interesting to know the impact of the maturation process (Malina et al., 2004) and the effects of training of each sport modality on these associations.

Conclusions

Our results show significant differences between U8-U10 and U12-U14 in the 5 m sprint and between U8-U10 and U10-U12 in CODA (505 and MAT). Moreover, the HCMJ and HCMJAS also differed between U8-U10, U10-U12 and between U12-U14. However, no significant differences between U14-U16 were observed in any of the physical tests.

Considering the age and gender interaction, the results obtained in this study indicate that there are no differences between boys and girls in the physical performance level in U8 and U10 categories. However, in U12 and U14 categories, the boys showed better performance than the girls in the MAT. Horizontal jump performance was better in the U16 boys than in the U16 girls. Possibly gender differences in sprinting, CODA, vertical jumping and horizontal jumping do not occur until after the age of 10 years and thus, they might have a different outcome depending on the analyzed capacity.

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