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Quantitative assessment of the effects of official match on physical performance factors on under-16 and under-18 female basketball players at national league level

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Abstract: This study aimed to analyze and quantify relevant effects of competition on performance factors in female basketball players (16.45±0.92 years) according to age (under-16 and under-18) and playing positions: guards (n=19), forwards (n=27) and centres (n=22). Participants completed tests to measure jump capacity (countermovement jump-CMJ) and sprint times (10 m and 20 m) at three moments: just before the match (T1), at half-time (T2) and after the match (T3). Associated with the increases of perceived effort, results showed "very likely" negative effects with performance decreased from T1-T3 in 20 m (4.03% and 3.51% for guards under-16 and under-18, respectively) and CMJ (15.17% and 13.7% for guards under-16 and forwards under-18, respectively). We only found a "large" ES in T2-T3 in guards under-16 in CMJ. Findings highlight the necessity to customize training, considering requirements and demands of different ages and playing positions to decrease the impact of fatigue after match.

Keywords: fatigue; countermovement jump; perceived effort, sprint capacity.

1. Introduction

In recent decades, the emergence of the need to further understand the demands (for example, those of a technical, tactical and physical nature) of basketball training load (Scanlan et al. 2018) and match play has led researchers to analyse several dimensions of the requirements of high-level players and team performances (Abdelkrim et al., 2007). As a team sport, basketball requires jumping power, agility with and without the ball, and speed of cyclic or acyclic movements (Erculj et al., 2010; Ziv and Lidor, 2009).

The assessment of adolescent basketball players is important as it creates the basis for the transition from a promising junior player to an established senior one (Delextrat and Cohen, 2008; Drinkwater et al., 2008). This period is characterized by tolerance of high training loads and demands in competition, as well as improvement of their levels of technical and tactical performance (Fort et al., 2016). During puberty, female basketball players' growth follows a pattern which is genetically determined, despite substantial variations among players in both tempo and timing (Carvalho et al., 2019). Thus, growth and maturation can be also linked to these improvements, as it has been suggested that an adolescent performance spurt in strength and power development occurs about 1.5 years before PHV (Meylan & Malatesta, 2009).

Research describing women's basketball matches is particularly scarce (Delextrat et al., 2015; Matthew and Delextrat, 2009; Narazaki et al., 2009; Reina et al., 2020; Reina et al., 2019). Thus, physical conditioning in the case of female basketball players is often informed by male data, despite the previously reported major gender differences in match activities (Scanlan et al., 2012; Portes et al., 2020).

The study of the physical fitness of basketball players by means of specific field tests provides objective and reliable information to the coach and the physical coach (Mancha-Triguero et al., 2020). However, very few studies have assessed the effects of physical exertion made in a match on sprinting ability (Caprino et al., 2012; Cortis et al., 2011; Meckel et al., 2009). They reported quantity of sprints ranged from 49 to 108 (1.7 to 2.7 per min), while there were 52 to 295 runs (1.7 to 7.3 per min) and 67 to 551 jogs (2.2 to 13.6 per min). Oliveira et al. (2013) showed the anaerobic capacity seems to be a better predictor of female basketball performance; and only guards seem to show a specific movement pattern different from that of centres or forwards. In this line, the shooting guard and power forward experience higher match loads than the rest of the team (Reina et al., 2019). Cortis et al. (2011) concluded that there was a relevant reduced performance in 10 m sprint with and without the ball after compared to before a junior match. Scanlan et al. (2012) logged the duration of the movements carried out in female basketball, showing a result of an average sprint duration of 2.43 s. Accordingly, the appropriate testing distances in basketball are 20 m and 10 m (Cortis et al., 2011; Pliauga et al., 2015). With regard the sprint test pre-, half-time and post-match, Meckel et al. (2009) concluded that ideal and total sprint times values were significantly better at half time compared to prematch ones, without significant difference between pre- and post-match measurement. Nevertheless, they did not report a meaningful variation in the performance reduction between measurements.

On the other hand, the height of a vertical jump is paramount in shooting at the basket and in rebounds. Rodríguez-Rosell et al. (2017) suggest that countermovement jump is one of the most reliable tests to assess explosive strength in basketball players in different age divisions. Some research showed that university- and state-level female basketball players made between 35 and 43 jumps per match, that is to say, about 1 jump per minute (Matthew and Delextrat, 2009; Narazaki et al., 2009). The severe effect of fatigue on jumps after a match was verified in several different sport disciplines, but not in basketball (Cortis et al., 2011; Pliauga et al., 2015).

In sports, especially in exercise testing, the classification of perceived exertion (RPE), as measured by ranks of perceived exertion (RPE scale), is a widely used quantitative measure of perceived exertion while practising physical activity. In the case of basketball, recent studies have analysed the relationships between fitness variables and perceived exertion during full-sided and small-sided games (Clemente et al., 2019; Scanlan et al., 2017).

Sprint action and the vertical jump are acyclic actions which measurement can be easily done due to the fact that they are not difficult to execute and reproduce. While these actions affect performance considerably in basketball, their fluctuations have not yet been analysed in the context of competition. Thus, we anticipated an overall decline on these parameters related to players' performance due to load demands in different moments of the match. Having said that, our aim was to assess critical effects of a basketball match on perceived exertion, sprint times and jump capacity in under-16 and under-18 female players, contrasting the results according to age and playing position. In the light of the above considerations, our hypothesis was that match fatigue would bring about lower values for the variables analysed in guards and forwards, with a shift in the results according to the female players' age.

2. Materials and Methods

It was employed a unified pattern to verify the effects of usual basketball matches according to different performance factors in young female players. For the purpose of quantifying the impact of accumulated fatigue in the course of a match, the assessment was carried out during the second half of the season and always studying official federated matches. The principles of the Helsinki Declaration were always complied with throughout this research. In the abovementioned Declaration establishes a fundamental basis to carry out researches involving human beings and it was approved by the ethics review committee of the authors' institution.

Subjects — The participants were 68 healthy female basketball players average age 16.45±0.92 and a mean of 7.04±2.48 years of experience participating in federated basketball teams. Participants belonged to 6 Spanish youth teams from the same region (Castilla y León, Spain). Three of the teams were under-16 (u-16) teams (n=31) and 3 were under-18 (u-18) teams (n=37); each competes in the same Spanish national youth category and engages in regular training. All subjects were healthy and not taking medication nor nutritional supplements that could impact the test results. For every age group, Participants were divided by their coaches into three groups based on playing position, player abilities and according to their predominant role in the game: guards u-16 (n=8), forwards u-16 (n=12), centres u-16 (n=11), guards u-18 (n=11), forwards u-18 (n=15) and centres u-18 (n=11). The characteristics of the players according to the field position are described in Table 1. To estimate the maturity status of players, the peak-height-velocity (PHV) was calculated according to Mirwald et al. (2002). Years from PHV ranged from 3.16 to 4.86 Study involvement was voluntary. All players, her parents and coaches were informed of research procedures, requirements, benefits and risks before giving their written informed consent.

Methodology — Before proceeding to collect data relevant to the match, players were already knowing what the test involved, as they already did it while training. Considering the high multidimensional correlation between field tests and match performance index (Zarić et al., 2018), tests were carried out during twelve matches, with the total sample, played during the second part of the season concerned to this investigation. We chose players who would play for the maximum number of minutes; such players were identified after a conversation with the coach. In order to ensure efficiency and to interfere as little as possible in match preparation, tests were conducted with 7 players for each match, including a minimum of 2 players for each of the 3 positions analysed. In addition, player data were included for analysis provided they met the following criteria: they did not suffer injury during the game and they played in the same position throughout the entire game (Vázquez-Guerrero et al., 2018). In order to unify the procedure, the same protocol and order were applied before, during and after the match. As can be seen in Figure 1, these tests began after warming up prior to the start of the match (T1), at half time (T2) and once the match was finished (T3). If a player did not play at least 50% of each half, she was not included in the data testing. None of the matches analysed required extra time to be played. All matches were played on and all testing measures were carried out on a wood surface.

Perceived exertion (RPE) — The reporting of player RPE was used as a subjective parameter of exercise intensity and was employed using the protocols described by Foster (1995). The RPE scale is divided into several categories and it is characterized by scores and verbal links (i.e., from "rest" to "maximal"), matching athlete's perception of efforts with a numerical score between 0 (rest) and 10 (maximal). Assessments taken used a chart into Spanish and an oral response by each player. Pre-, during and post- exercise RPE measurement has been previously assess as a way of obtaining information about the self-regulated physical effort and the prediction perceived effort (Kilpatrick et al., 2009).

Table 1. Demographic and anthropometric data of the players. Values are given as mean ±SD.

	N	Age (y)	Maturity Age (y)	Height (cm)	Weight (kg)	Body Mass Index (kg/m^2)	Experience (y)
All players	68	16.45±0.92	4.12±0.72	177.01±5.51	67.54±7.26	21.54±1.97	7.04±2.48
Guards-u-16	8	15.53±0.23	3.16±0.24	171.25±2.25	65.50±2.50	22.33±0,84	6.87±1.24
Forwards-u-16	12	15.56±0.23	3.42±0.36	175.16±4.98	67.08±6.21	21.86±1.74	6.33±1.96
Centres-u-16	11	15.50±0.30	3.80±0.31	181.45±4.05	71.13±6.94	21.58±1.72	6.27±2.24
Guards-u-18	11	17.16±0.44	4.40±0.29	172.63±2.80	63.5±6.40	21.32±2.34	6.90±2.98
Forwards-u-18	15	17.36±0.44	4.67±0.54	177.46±5.09	66.76±9.02	21.15±2.47	7.73±3.19
Centres-u-18	11	17.06±0.42	4.86±0.41	182.54±2.25	71.04±7.28	21.31±2.03	7.90±2.21

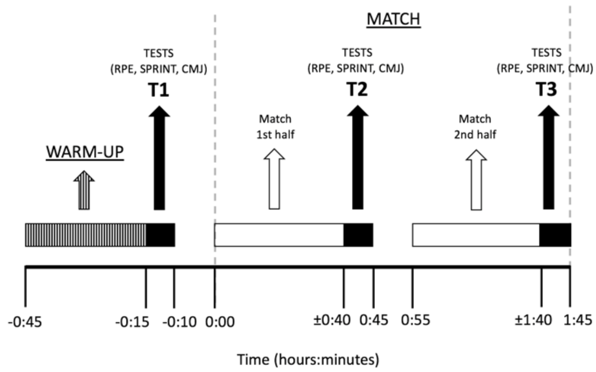

Figure 1. Timing and order of the tests.

Sprint capacity — A 20-meter sprint test was employed to assess sprint capacity. The assessment was completed in a nearby court with exactly the same type of surface used in the court where the match was played, and it was timed using a single beam photocell system (DSD Laser System, León, Spain). Two photocells were located at the start, two at 10 m and two at 20 m. Players began the sprint test half a meter behind the first two photocells (García López et al., 2012). There was a visual sign indicating the moment the cells were ready to start measuring. After that, players could start a 20-meter sprint at peak intensity. According to Izquierdo et al. (2020) each player performed only one maximal sprint for performance efficiency considerations and the values for the first 10 meters and the total 20 meters were recorded.

Explosive force-jump capacity — Players' jump capacity was measured making use of a laser platform (SportJUMP System PRO, DSD Inc., Spain), located in a small area next to the corner of the court on a surface with similar characteristics to the official court. With their hands on the waist, players had three opportunities to attempt the CMJ (Garcia-Lopez et al., 2005), with a rest of 45 to 60 seconds between jumps. The best result, in centimeters, was analysed for the CMJ variable.

Statistical Analysis — Descriptive results are presented as mean ± SDs. All analyses were performed using a custom-made spreadsheet (Hopkins, 2007). All data were log- transformed for analysis to reduce bias arising from non-uniformity error and then analysed for practical significance using magnitude-based inferences (Hopkins et al., 2009b). Practical significance was assessed by calculating Cohen's d effect size (Cohen, 1988). Effect sizes (ES) between ,0.2, 0.2–0.6, 0.6–1.2, 1.2–2.0, and 2.0–4.0 were considered as trivial, small, moderate, large, and very large, respectively (Hopkins et al., 2009a). Probabilities were also calculated to establish whether the true (unknown) differences were lower, similar, or higher than the smallest worthwhile difference or change [using standardized difference (0.2) and its 90% confidence limits (CL), based on Cohen's effect size principle]. Qualitative assessment of the magnitude of change was also included. Quantitative changes of higher or lower differences were evaluated qualitatively as follows: <1%, almost certainly not; 1–5%, very unlikely; 5–25%, unlikely; 25–75%, possible; 75–95%, likely; 95–99%, very likely; >99%, almost certain (Hopkins, 2007). If the 90% confidence limits (CL) overlapped, indicating smaller positive and negative values, the magnitude of the correlation was termed "unclear"; otherwise, it was deemed as the observed magnitude. Changes in the performance variables presented as positive (i.e., increased time in a sprint test) or negative differences (i.e. reduced CMJ height) are in the opposite direction although both represent a performance decrease.

3. Results

Tables 2 and 3 show changes within the group in the performance variables tested. On one hand, the u-16 group showed negative effects from T1–T2, T2–T3 and T1–T3 test measures in all variables, with standardized differences ranging, in absolute value, from ES=0.02 to 1.09. On the other hand, the u-18 group showed similar negative effects from T1–T2, T2–T3 (except in 10 m) and T1–T3 test measures in all variables, with standardized differences ranging, in absolute value, from ES= 0.12 to 1.13. The RPE results expressed on average were 0.5, 4 and 7 in T1, T2 and T3 respectively.

Table 2. Results and practical differences in the fitness parameters between Test 1 (T1), Test 2 (T2) and Test 3 (T3) and between the u-16 and u-18 players. Values are presented as mean±*SD*.

Variables	T1	T1 vs. T2 and MBI ES (90% CL)			T2	T2 vs. T3 and MBI ES (90% CL)			T3	T1 vs. T3 and MBI ES (90% CL)		
u-16												
RPE	0.55±0.51				4.35±1.11				7.35±1.02			
10 m	2.13±0.14	0.77 (-0.23;1.78)	83/12/6	likely	2.24±0.45	-0.13 (-0.45;0.18)	4/60/36	possibly	2.18±0.17	0.34 (-0.11;0.8)	70/28/2	possibly
20 m	3.48±0.19	0.58 (0;1.17)	86/12/1	likely	3.59±0.32	0.02 (3.59;0.32)	18/68/13	possibly	3.6±0.16	0.62 (0.23;1.01)	96/4/0	very likely
CMJ	30.06±3.19	-0.39 (-0.82;0.03)	1/22/77	likely	28.78±3.38	-0.66 (-1.07;-0.25)	0/3/97	very likely	26.49±3.3	-1.09 (-1.51;-0.67)	0/0/100	almost certain
u-18												
RPE	0.51±0.51				4.32±1.03				7.19±1			
10 m	1.91±0.11	-0.16 (-0.61;0.28)	9/47/44	possibly	1.9±0.14	0.31 (-0.09;0.71)	67/31/2	possibly	1.94±0.15	0.23 (-0.23;0.7)	55/39/6	possibly
20 m	3.2±0.13	0.13 (-1.46;-0.61)	40/50/10	possibly	3.21±0.17	0.51 (-0.42;0.26)	89/11/0	likely	3.3±0.19	0.76 (0.28;1.24)	97/3/0	very likely
CMJ	32.84±3.37	-1.03 (-1.46;-0.61)	0/0/100	almost certain	29.29±4.04	-0.08 (-0.42;0.26)	8/63/28	possibly	28.94±2.97	-1.13 (-1.49;-0.77)	0/0/100	almost certain

CMJ= counter-movement jump; RPE= rating of perceived exertion; ES = standardized difference; MBI = magnitude-based inference; CL= confidence limits.

Between playing position comparisons it can observed (Table 3) that a likely to almost certain effect is shown regarding 10 m: T1 vs T2 in centres u-16 (ES = 0.85) and T1 vs T3 in forwards u-18 (ES = 0.66) and centres u-16 (ES = 0.8). With regard to 20 m: T2 vs T3 in guards u-16 (ES = 0.53) and forwards u-18 (ES = 0.53) and in T1 vs T3 in guards u-16 (ES = 0.63) and u-18 (0.76), forwards u-16 (ES = 0.61) and u-18 (ES = 0.72) and centres u-18 (ES = 0.69). Lastly, with regard to CMJ: T1 vs T2 in guards u-18 (ES = -0.94), forwards u-16 (ES = -0.84) and u-18 (ES = -1.03) and centres u-18 (ES = -0.75); T2 vs T3 in guards u-16 (ES = -1.77) and centres u-16 (ES = -0.56) and regard T1 vs T3 were observed likely to almost certain effect in all playing positions and every age group with standardized ES differences ranging from -0.61 to -2.28.

Regarding the performance decrease quantification between prematch and postmatch test, it can observe (Figure 2) that the highest values were found in CMJ in guards u-16 (15.17%) and forwards u-18 (13.70%). With regard to 10 m in centres u-16 (4.28%) and forwards u-18 (3,28%) and finally in 20 m in guards u-16 (4.03%) and u-18 (3.51%).

Table 3. Results and practical differences in the fitness parameters between Test 1 (T1), Test 2 (T2) and Test 3 (T3) and between the u-16 and u-18 players for each playing position. Values are presented as mean±*SD*.

	Variables	T1	T1 vs. T2 and MBI ES (90% CL)			T2	T2 vs. T3 and MBI ES (90% CL)			T3	T1 vs. T3 and MBI ES (90% CL)		
GUARDS													
u-16	RPE	0.38±0.52				5.38±0.74				8±1.07			
	10 m	2.16±0.16	-0.19 (-0.99;0.61)	20/31/49	possibly	2.12±0.16	0.36 (-0.34;1.06)	65/26/9	possibly	2.19±0.13	0.18 (-0.53;0.89)	48/34/18	possibly
	20 m	3.46±0.2	0.19 (-0.54;0.91)	49/33/18	possibly	3.5±0.16	0.53 (-0.18;1.24)	79/17/5	likely	3.6±0.13	0.63 (-0.04;1.3)	86/11/2	likely
	CMJ	29.98±1.77	-0.39 (-1.21;0.42)	11/23/66	possibly	29.2±1.89	-1.77 (-3.18;-0.36)	2/2/96	very likely	25.44±4.21	-2.28 (-3.76;-0.79)	1/1/98	very likely
u-18	RPE	0.55±0.52				4±0.77				7.27±1.1			
	10 m	1.9±0.11	0.01 (-0.99;1.01)	37/27/36	possibly	1.9±0.18	0.11 (-0.66;0.88)	42/33/24	possibly	1.92±0.21	0.2 (-0.92;1.33)	50/23/27	possibly
	20 m	3.15±0.14	0.28 (-0.46;1.02)	57/29/14	possibly	3.19±0.15	0.45 (-0.45;1.35)	68/20/11	possibly	3.26±0.22	0.76 (-0.18;1.7)	84/11/5	likely
	CMJ	31.95±3.12	-0.94 (-1.82;-0.06)	2/6/92	likely	28.75±4.45	-0.17 (-0.73;0.39)	13/41/46	possibly	27.94±1.91	-1.18 (-1.77;-0.58)	0/1/99	very likely
FORWARDS													
u-16	RPE	0.58±0.51				4.08±1.08				7.17±1.03			
	10 m	2.11±0.16	0.79 (-0.99;2.58)	72/11/17	possibly	2.25±0.58	-0.19 (-0.68;0.31)	10/42/48	possibly	2.13±0.16	0.13 (-0.52;0.78)	42/38/20	possibly
	20 m	3.45±0.18	0.56 (-0.24;1.36)	78/16/6	likely	3.56±0.25	0.04 (-0.51;0.58)	30/47/23	possibly	3.57±0.14	0.61 (0.02;1.21)	88/11/1	likely
	CMJ	29.91±2.86	-0.84 (-1.47;-0.21)	0/4/95	very likely	27.33±2.64	-0.34 (-1.06;0.39)	11/27/63	possibly	26.37±3.18	-1.15 (-1.84;-0.46)	0/1/99	most likely
u-18	RPE	0.6±0.51				4.47±1.13				7.2±1.08			
	10 m	1.92±0.09	-0.15 (-0.91;0.6)	22/33/46	possibly	1.9±0.14	0.54 (-0.03;1.12)	84/14/2	likely	1.98±0.13	0.66 (-0.07;1.39)	85/12/3	likely
	20 m	3.21±0.14	0.05 (-0.63;0.73)	35/38/27	possibly	3.22±0.17	0.53(-0.09;1.14)	81/16/3	likely	3.32±0.19	0.72 (0;1.44)	89/9/2	likely
	CMJ	33.86±3.71	-1.03 (-1.64;-0.41)	0/1/99	very likely	29.82±4.03	-0.14 (-0.67;0.39)	14/43/43	possibly	29.22±3.19	-1.18 (-1.73;-0.63)	0/0/100	almost certain
CENTRES													
u-16	RPE	0.64±0.5				3.91±0.94				7.09±0.83			
	10 m	2.13±0.14	0.85 (-0.21;1.91)	85/10/5	likely	2.23±0.2	-0.03 (-0.69;0.64)	28/39/33	possibly	2.22±0.2	0.8 (-0.23;1.82)	84/11/5	likely
	20 m	3.54±0.19	0.56 (-0.45;2.03)	79/12/9	likely	3.7±0.45	-0.13 (-0.67;0.41)	15/44/41	possibly	3.64±0.2	0.5 (-0.2;1.19)	77/18/5	likely
	CMJ	30.29±4.4	-0.05 (-0.73;0.63)	27/38/35	possibly	30.06±4.43	-0.56 (-1.13;0.01)	2/13/86	likely	27.37±2.73	-0.61 (-1.18;-0.04)	1/10/89	likely
u-18	RPE	0.36±0.5				4.45±1.13				7.09±0.83			
	10 m	1.93±0.14	-0.26 (-0.91;0.38)	11/32/57	possibly	1.89±0.13	0.15 (-0.53;0.83)	45/36/19	possibly	1.91±0.13	-0.13 (-0.77;0.51)	19/38/43	possibly
	20 m	3.21±0.13	0.05 (-0.78;0.93)	40/31/29	possibly	3.22±0.19	0.42 (-0.27;1.11)	71/22/7	possibly	3.31±0.19	0.69 (-0.18;1.56)	83/13/5	likely
	CMJ	32.28±3	-0.75 (-1.48;-0.01)	2/9/89	likely	29.04±3.95	0.1 (-0.54;0.74)	40/39/21	possibly	29.49±3.46	-0.86 (-1.59;-0.12)	1/6/93	likely

CMJ= counter-movement jump; RPE= rating of perceived exertion; ES = standardized difference; MBI = magnitude-based inference; CL= confidence Limits

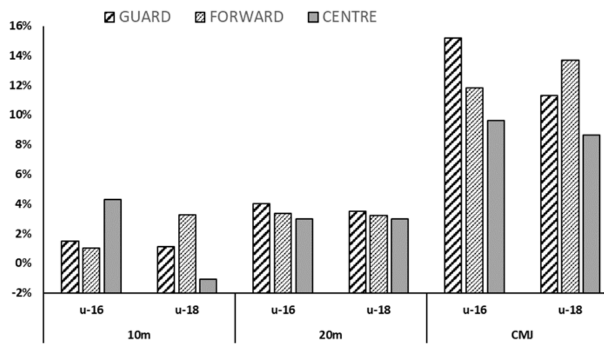

Figure 2. Percentage of change in performance between prematch and postmatch. Sprint tests (10 m and 20 m); CMJ: counter movement jump.

4. Discussion

In response to the scarcity of investigations run in the context of competition, the main focus of this study was to assess critical effects of a basketball match on perceived exertion, sprint times and jump capacity in under-16 and under-18 female players. We anticipated an overall decline of performance due to muscle fatigue as a consequence of match demands (Enoka and Duchateau, 2008). We also predicted that the consequence of this fatigue would fluctuate according to playing position, since each position entails specific requirements and functions (Scanlan et al., 2011; Scanlan et al., 2012). Our investigation confirmed both assumptions: performance declined over time for the parameters analyzed and this decline was related with particular moments during the match and with particular playing positions.

Although the findings of researches on physical fitness in female basketball populations vary considerably, our subjects obtained similar results in physical fitness tests to those previously reported (Erculj et al., 2010; Fort-Vanmeerhaeghe et al., 2016). Regarding differences between u-16 and u-18 players that we observed, for sprint test and CMJ the gaps differed significantly. In CMJ we detected negative associations between the load of the match changes for u-16 at all times: T1–T3 (ES=-1.09, almost certain), in T2–T3 (ES=-0.66, very likely) and T1–T2 (ES=-0.39, likely). For u-18s, the negative associations were only in T1–T3 (ES=-1.13, almost certain) and T1–T2 (ES=-1.03, almost certain). In the case of sprint performance, for the u-16s, our results showed negative changes in 10 m between T1 and T2 (ES=0.77, likely) and in 20 m between T1 and T2 (ES = 0.58, likely) and T1 and T3 (ES=0.62, very likely). However, in the case of the u-18s the negative data associations for 20 m that we collected occurred in T2 and T3 (ES = 0.51, likely) and T1 and T3 (ES=0.76, very likely). This finding was foreseeable and can be explained by players' age. Players under 18 were at a later stage of pubertal development, condition that would account for the greater levels of strength measured (Pearson et al., 2006). Nevertheless, it is important to note that the relationship between match performance and physical fitness may vary according to multiple factors including age, the level of performance, sex and experience (Fort-Vanmeerhaeghe et al., 2016).

Postmatch fatigue has been demonstrated to affect jump capacity in the case of basketball (Cortis et al., 2011), since basketball players regularly need to jump: each player on average performs 50 jumps per game (Drinkwater et al., 2008). With regard to this, it has been demonstrated that eccentric overload training of bilateral or unilateral squat can be a good choice to improve physical performance, with different benefits in power and triple hop test (Hernández-Davó et al., 2018). Furthermore, running and jump performance were related to body mass by Nikolaidis et al. (2015), and these findings were observed too in our results. The latter study concluded that an excess of body mass might have different implications for u15 basketball players than it does for u-18 players (Nikolaidis et al. 2015). In our study, we also found a relevant fall in CMJ and 20 m sprint performance at the end of the match. It does emerge that, as for the CMJ, shifts associated to muscle fatigue were long lasting and appeared without delay at the end of the match (Gathercole et al., 2015). However, sprints showed different rates of recovery between sprinting and jumping, a fact that could be related to biomechanical behaviour (duration of concentric and eccentric phases), originating neuromuscular fatigue that further impacts jump performance (Gathercole et al., 2015). Previously, it has been indicated that there are meaningful relationships between sprint times over 10 m and 20 m and all jump height measure (McBride et al., 2002). In female basketball players, Delextrat et al. (2012) showed the relationship between the fatigue effects of CMJ and 20 m sprint during a typical in-season week. Both variables induced significant decreases. With regard to these two capacities, it has been demonstrated that in young footballers, mixed training programmes which include general and specific strength exercises improve their performance and may help combat performance loss due to fatigue (Maio Alves et al., 2010).

Data on the match activities of young female basketball players by positions are very limited. Nonetheless, in our research, the number of participants from two age categories allowed us to obtain a more detailed picture of the physical requirements of three playing positions. all players showed fatigue after the match in our research. The results showed that guards´ performance decreased (4.03% and 3.51% in u-16 and u-18 respectably) more than forwards´ and centres´ performance in terms of 20 m at the end of the match. The interpretation of the match effects allows us to determine that guards perform more movements than all the other positions, as well as more sprints than forwards and centres (Delextrat et al., 2015). Under this hypothesis, among female players Scanlan et al. (2012) found guards performed more dribbling actions than those in other positions did. However, the acceleration:deceleration ratio is lower in players on the perimeter (guards) than in forwards and centers (Vázquez-Guerrero et al., 2018).

In the case of forwards, the ES showed "moderate" performance decreased at the end of the match for u-16s in 20 m (3.36%; ES= 0.61; likely) and CMJ (11.82%; ES = -1.15; very likely). For u-18s, the ES was also identified as a "moderate" performance decreased: 10 m (3.28%; ES = 0.66, likely), 20 m (3.23%; ES = 0.72, likely) and CMJ (13.70%; ES = -1.18, almost certain). These results show that in women's basketball, forwards can do special physical efforts in the game in comparison with players in other positions. Accordingly, some authors argue that female forwards perform a larger number of runs (Scanlan et al., 2012) and are heavily involved in fast breaks, offence without the ball, and transition offence and defence (Trninić and Dizdar, 2000). In addition, the forwards play for more minutes, covering a greater distance and performing more sprints and high intensity (Reina et al., 2020), but also the action movements that involve less running, inside shots, defensive and offensive rebound efficiency and screening are crucial for forwards (Delextrat et al., 2015).

When we contrasted results from the first half of the match with those of the second half, we only found a "large" ES (-1.77; very likely) between half time and when it the match finished in our guards u-16 in the case of CMJ. However, we found more "moderate" and "large" ES between T1 and T2 than we did between T2 and T3 in our forwards and centres in sprints and CMJ. In this area, Matthew and Delextrat. (2009) and Scanlan et al. (2012) did not report significant differences between quarters in female players. Thus, female players studied by Delextrat et al. (2015) were recorded to have spent less time on running, sprinting and performing high-intensity actions during the fourth quarter compared to the actions performed during the first quarter in all playing positions. It is worth noting that during the fourth quarter of a match players have more time to rest due to the large number of breaks that take place in this quarter compared to other quarters (Vázquez-Guerrero et al., 2019). In this sense, the physical demands achieved during the first quarter of a match are probably due to the intense activity maintained by the starter players. This activity is aimed at making bigger differences on the score with fast transitions of short possessions (Vázquez-Guerrero et al., 2019). In this sense, we can suggest that last quarter does not reveal the real decrease of physical performance of players due to the structure of the match and strategic decisions taken by coaches (i.e., timeouts, fouls and free throws) in order to win the match.

Although certain limiting factors may provide an answer for these findings, we do believe that present design is more reasonable and shows a need to research, in order to identify and quantify physical requirements—and their interrelationships—of the five playing positions (point guard, shooting guard, forward, power forward and centre) and to increase the sample size in each playing position group. It must be taken into consideration that our sample was not aimed at assessing the nature of the game itself (relevance of the game or advantage of the opponent). Further to this, exploring other playing profiles, levels and categories, or even male basketball players, would be beneficial to investigate the effects at different points of the season, for example, in the final matches of the last competitive mesocycle (a key moment of the season), when the cumulative load of training and competition may show different types of effects in the loads corresponding to other periods. In addition, it might be very interesting to analyze the influence of game outcome in each match quarter according the results in physical tests. Nevertheless, it is important to note that there are some limitations associated with this study. Thus, only one repetition of the sprint test was performed; no physiological measurements were taken (e.g., cortisol, oxygen consumption), only speculations are possible, and fatigue effects remain hypothetical. Finally, PHV estimation is especially accurate in boys from 12 to 16 years old with an "on average" maturation (Malina and Koziel, 2014). Estimating the PHV in girls 3.16 to 4.86 years from their PHV may increase the error of the measurement.

5. Conclusions and Practical Applications.

In this study, via tests of jump capacity and sprint times we have quantified performance decline produced in the aftermath of the demands of a basketball match in the case of u-16 and u-18 female players. In the u-18 group there was less reduction in performance than there was in the u-16 group, very possibly because u-18 players had more years of experience of systematic training and strength-related physiological adaptations.

The different playing positions showed different levels of performance, demonstrating the necessity for individualized fitness training. At the end of the match, guards u-16 and forwards u-18 showed more performance decrease than in other playing positions. Nevertheless, the negative effects founded were higher in the first half than in the second one.

Our findings provide valuable data for trainers and coaches regarding the way of organizing training sessions. So as to achieve good levels of physical performance, it is essential to diminish the effect of match fatigue and speed up postmatch recovery. This can be accomplished by adapting training programs and strategies to cover the specific needs of the players.

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