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Relationships between Physical Fitness Attributes, Food Habits and Nutritional Knowledge in Youth Basketball Players

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Abstract

Understanding food habits and nutritional knowledge in youth athletes could contribute to optimal recovery and improving performance in basketball. Therefore, the aim of this study was to assess the relationships between physical fitness, with food habits and nutritional knowledge in basketballers. Twenty-three healthy youth players to the same elite basketball academy participated in this study. Basketballers performed a basketball fitness test battery including jumping tests [countermovement jump (CMJ) and drop jump (DJ)]; 5, 10 and 20 m-linear sprints; change of direction (COD) tests [Lane Agility Drill test and 505 test], and repeated change-of-direction (RCOD) sprint and completed a Turconi questionnaire based on eating habits and nutritional knowledge. While no significant ($p>0.05$) correlations were found between physical fitness attributes and total score obtained in sections C and H in dietary questionnaire, significant correlations ($r=0.606–0.971$; large - nearly perfect; $p<0.001 – 0.003$) were found among jumping, COD, RCOD and LSST tests. These findings suggest that physical performance of youth basketball players is not influenced by their level of dietary behaviors and nutritional knowledge.

Keywords: *associations, nutrition, conditioning, dietary behavior, team sport*

Introduction

Basketball is an intermittent team-sport involving repeated transitions between offence and defense and frequent changes in movement, which require performing a great number of high-intensity actions such jumps and short-term and high intensity actions during match-play (Castillo et al., 2021). Specifically, basketball players cover 200 m at speeds exceeding 24.1 $km·h^{-1}$ per minute, reaching peak speeds of over 19 km·h-1. In addition, approximately 16 accelerations, 16 decelerations and 0.1 jumps occur per minute during match-play (Vazquez-Guerrero et al., 2019). Since these high-intensity actions are strongly associated with successful on-court performance (Mancha-Triguero, García-Rubio, Gamonales, & Ibáñez, 2021), adequate physical conditioning is required.

To optimize the training process, it is necessary to consider the specific characteristics of each population (Latzel et al., 2018). During adolescence (i.e., 12–14 years old), young basketball players undergo dramatic body changes, such as sudden increases in height and body mass, as well as alterations in motor control (Faigenbaum et al., 2009), so special attention must be focused on these groups to understand the motor abilities. Several laboratory and field test are available

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to assess the fitness of young basketball players (Drinkwater, Pyne, & McKenna, 2008). When selecting the test battery to use, relevant factors must be considered, such as the specific physical capacity to be assessed, the time required to conduct the test, and the necessary material and their cost (Morrison et al., 2022). Therefore, it is essential to understand the relationships between the different tests to carry out a comprehensive and efficient assessment of young basketball players in a short time and with limited resources. However, to date, no studies have been conducted with this purpose in young basketball players.

Nevertheless, there are certain variables that indirectly could influence in physical fitness, which are related to healthy lifestyle habits (Sánchez-Díaz, Yanci, Raya-González, Scanlan, & Castillo, 2021). Among them, the food habits of basketballers are considered relevant parameters for contributing to optimal recovery, performance, and injury risk in young athletes (Jeukendrup & Cronin, 2010), positively affecting to psychological variables such as self-concept and self-efficacy (Zaccagni, Rinaldo, Bramanti, Mongillo, & Gualdi-Russo, 2020). However, several factors may contribute to poor food habits in young athletes, so education strategies for improvement are necessary. In this regard, nutritional knowledge has been considered a key modifiable determinant of food habits (Trakman, Forsyth, Devlin, & Belski, 2016). Despite the presumed negative impact of food habits have on the physical fitness of young basketball players, and previous research have confirmed the association between nutrition knowledge and physical fitness (Nikolaidis & Theodoropoulou, 2014). Therefore, future research that explores the relationships between food habits and nutritional knowledge, with physical fitness attributes will enable practitioners to individualize the strategies used to optimize the performance of young basketball players.

To overcome the limitations and gaps in the literature, we assessed physical fitness attributes, food habits and nutritional knowledge during the in-season period. Specifically, the main aim of this study was to assess the relationships between physical fitness, with food habits and nutritional knowledge in U-14 basketball players. We hypothesized that physical fitness performance will be related with the scores obtained on the nutritional knowledge questionnaire.

Methods

Study design

An observational study design employing a cross-sectional approach was implemented. The participants underwent anthropometric measurements, performed a basketball fitness test battery, and completed a questionnaire on eating habits and nutritional knowledge. These assessments were conducted sequentially within a single testing session during the in-season phase (October) of a competitive season. The test battery included jumping tests [countermovement jump (CMJ) and drop jump (DJ)]; 5, 10 and 20 m-linear sprints; change of direction (COD) tests [Lane Agility Drill test and 505 test], and repeated change-of-direction (RCOD) sprint on an indoor basketball court (15–18 °C, 60–70% relative humidity). Five min of passive, standing recoveries were administered between tests. A month before the start of the study, players were familiarized with the physical tests by performing them during training. Prior to starting the physical test, participants performed a standardized ≈20-minutes warm-up protocol, including running at a moderate intensity, jumps, dynamic stretching exercises and 20-m running bouts (Sánchez-Díaz et al., 2021). All tests were conducted between 4:00 and 7:00 pm three days after the official match. Players were advised to refrain from physical activity for two days prior to the test and were advised to arrive at the test to ensure adequate hydration and nutritional status. Fitness tests were conducted in groups of 3-4 players to ensure consistent recovery times between tasks for all players can be managed throughout the test.

Participants

The subjects were 23 healthy players (13.80±0.66 years; height, 167.45±9.35 cm; weight, 55.86±10.71 kg); body fat composition, 15.37±7.40%; muscle composition, 37.22±3.80%; body mass index, 20.04±2.21 kg·m^{-2}) to the same elite basketball academy (i.e., Spanish Asociación de Clubes de Baloncesto [ACB] League) being members of teams competing in the first Spanish basketball Under 14 division. Players met the following inclusion criteria: a) completed all fitness assessments and the questionnaires, b) had exercised for than four consecutive weeks in the two months preceding the test, and c) were not taking any drugs, medications or ergogenic supplements that could alter performance. All players completed on-field team training three times a week, including pre-match training and physical training. Each session usually lasting 75 to 90 minutes, and players participated in an official game a week during the test period.

Before providing written informed consent, players and their legal guardians were informed of the procedures, potential risks, and benefits of participating in this research. This research was performed in accordance with the 2013 Declaration of the World Medical Association of Helsinki and was approved by the University Ethics Committee on July 30, 2020 (code: FUi1-P007).

Physical fitness tests

Jumping tests

A photocell system (Optojump, Microgate™, Bolzano, Italy) was used to measure the lower limb performance. Players performed two trials each of the CMJ and DJ with a 45-s of passive, standing recovery, and the highest jump was used for subsequent analysis in each test (Mancha-Triguero et al., 2021; Sánchez-Díaz et al., 2021). For CMJ, players performed unilateral and bilateral jumps and were instructed to perform a downward movement followed by a complete, explosive extension of the lower limb, maintaining their hands on their hips while jumping as high as possible (Heishman et al., 2020). For DJ trials, players were instructed to step from a wooden box (30 cm high) and immediately following ground contact, jump for maximal height as quickly as possible. The between-trial intraclass correlation coefficients (ICCs) for jump height attained during both tests was 0.91.

Change-of-direction (COD) speed tests

To assess COD speed, we used the Lane Agility Drill test and the 505 COD test according to the protocols described by Castillo et al. (Castillo et al., 2021). Players completed two trials of each test with 90 s of passive, standing rest between trials. On both test a photocell system (Microgate™ Polifemo, Bolzano, Italy) was used and the fastest trial was registered for further analysis in each test. The ICCs were 0.88 for the Lane

Agility Drill test and 0.74 for the 505 COD test in the current sample of players.

Repeated change-of-direction (RCOD) sprint test

Players performed a single attempt of the RCOD sprint test consisting of 5 × 30-m shuttle sprints (15 m + 15 m) interspersed with 30 s of passive recovery between each sprint, according to the protocol described by Castillo et al. (2021). A single pair of photoelectric cells (Microgate™ Polifemo, Bolzano, Italy) were placed at the start line to record performance time (s) during each shuttle. The sum of all shuttle sprint times (total performance time) was calculated and the value obtained was used for subsequent analysis.

Linear straight sprint test (LSST)

Linear speed was assessed by means two trials of a 20-m linear sprint using four pairs of photoelectric cells (Microgate™ Polifemo, Bolzano, Italy) to record sprint split times at 5 m, 10 m and 20 m. Players started the sprint test half a meter behind the first timing gate on their own volition. The fastest time (s) for each split (irrespective of the trial) was used for subsequent analysis. The ICCs were higher than 0.87 for all sprint distances.

Questionnaires

The questionnaires were conducted following a typical week in which players maintained their normal daily routines involving attendance at school on five days, three on-court training sessions, and participation in an official match during the weekend.

Dietary questionnaire

The food habits and nutritional knowledge of players were evaluated through the utilization of a dietary questionnaire (Turconi et al., 2003). Originally comprising ten sections but only two sections (i.e., C and H) were considered pertinent to this study (Turconi et al., 2003). In addition, slight modifications were made to each section, incorporating a 'non-reported' option for every item. This allowed players to indicate instances where they did not feel obliged, lacked comfort, or possessed incomplete information regarding specific quantities when responding to a question. The two sections from the dietary questionnaire used included:

Section C pertains to the examination of breakfast constituents, the frequency of daily meals, the consumption of fruits and vegetables, as well as the intake of soft drinks and alcoholic beverages. This section comprises 14 questions, but we used 13 items to capture the perceived frequency of consumption. The maximum attainable score for this section was 52.

Section H delves into nutritional knowledge and encompasses 11 questions. Each question revolves around crucial nutritional aspects, such as the functions of specific macronutrients and micronutrients, as well as the significance of nutrition. For each question, players are provided with four answer choices, of which only one is correct. A point is awarded for each accurate response, while no points are granted for incorrect answers. The maximum total score achievable in this section was 11.

Statistical analysis

Data are presented as mean ± standard deviations (SD) for quantitative variables or frequencies and percentages for qualitative variables. After performing Shapiro-Wilk test, the Spearman correlation test was used to assess the correlation between physical fitness attributes, and the total scores in sections C and H in the dietary questionnaire for each group of males and females. The following scale of magnitudes was used to interpret the correlation coefficients: <0.1, trivial; 0.1 to 0.3, small; 0.3 to 0.5, moderate; 0.5 to 0.7, large; 0.7 to 0.9, very large; >0.9, nearly perfect (Hopkins, Marshall, Batterham, & Hanin, 2009). Data analysis was carried out using the JASP 0.16.3.0 software (University of Amsterdam, Amsterdam, Netherlands). Statistical significance was established at $p<0.05$.

Results

Tables 1, 2 and 3 shows the descriptive results of physical fitness attributes, food habits and nutrition knowledge in youth basketballers, respectively.

Table 1. Descriptive results of physical fitness attributes in youth basketballers.

Variables	Mean	Standard deviation	Minimum	Maximum
Jumping test				
CMJ (cm)	27.67	6.93	18.30	49.10
CMJr (cm)	13.62	4.11	6.50	21.80
CMJl (cm)	14.17	4.29	6.90	24.20
DJ (cm)	27.00	6.34	17.10	41.70
Change of Direction Ability (CODA) test				
Lane Agility Drill (s)	14.29	0.82	12.80	16.45
505-COD (s)	2.63	0.17	2.20	2.93
Repeated change-of-direction (RCOD) sprint test				
RCODtotal (s)	33.23	1.75	29.16	37.02
Linear Sprint Straight Test (LSST)				
5 m sprint (s)	1.19	0.28	0.99	2.40
10 m sprint (s)	2.00	0.14	1.72	2.33
20 m sprint (s)	3.56	0.26	3.00	4.14

ES: effect size; CI: confidence limit; CMJ: countermovement jump; CMJr: countermovement jump with right leg; CMJl: countermovement jump with left leg; DJ: drop jump.

Table 2. Descriptive results of food habits (%) in youth basketballers.

Items	Frequency consumption in percentage (%)				
C1 Breakfast	Never	Sometimes	Often	Always	NR
	0	0	4.76	95.24	0
C2 Beverage breakfast	Tea	Juice	Chocolate	Milk	NR
	5	0	5.00	90.00	0
C3 Eat breakfast	Cheese	Pizza	Bread	Fruit	NR
	0	0	90.48	9.52	0
	Never	Sometimes	Often	Always	NR
C4 Fruit	14.29	14.29	28.57	42.86	0
C5 Vegetables	14.29	42.86	28.57	14.29	0
C6 Cake	33.33	42.86	19.05	4.76	0
C8 Three meals	0	0	9.52	90.48	0
C9 Diet	Monotony	Different on weekend	Different sometimes	Different all days	NR
	4.76	4.76	14.29	76.19	0
C10 Diet based on	Different all days	Carbohydrate	Lipids	Protean	NR
	76.47	5.88	5.88	11.77	0
C11 Snacks	Sweets	Fried	Bread	Fruit	NR
	10.00	15.00	20.00	55.00	0
C12 Beverages	Juice	Wine, beer	Refresh	Water	NR
	0	0	4.76	90.48	4.76
	Never	Sometimes	Often	Always	NR
C13 Milk	0	0	9.52	90.48	0
C14 Water	0	9.52	9.52	80.95	0
C Total	41.48 ± 2.96				

Note: All questions were obtained from section C in the Turconi questionnaire; total score is presented as mean ± standard deviation; NR = not reported.

Table 3. Descriptive results of nutrition knowledge (%) in youth basketballers.

	All	
	Correct (%)	Incorrect (%)
H1 Carbohydrates	60	40
H2 Fibre	50	50
H3 Fat	35	65
H4 Protein	85	15
H5 Calories	45	55
H6 Energy	50	50
H7 Vitamins and minerals	45	55
H8 Balanced diet	65	35
H9 Daily energy expenditure	65	35
H10 Biological foods	65	35
H11 Transgenic foods	40	60
H Total	6.05 ± 2.16	

Note: All questions were obtained from section H in the Turconi questionnaire; total score is presented as mean ± standard deviation for the number of correctly answered questions.

Table 4 presents the relationships among physical fitness attributes, with food habits, and nutrition knowledge in youth basketballers. While no significant ($p>0.05$) correlations were found between physical fitness attributes and total score obtained in sections C and H in dietary questionnaire, significant correlations ($r=0.606$–0.971; large - nearly perfect; $p<0.001$–0.003) were found among jumping, COD, RCOD and LSST tests.

Table 4. Relationships between physical fitness attributes, and total scores in sections C and H in the dietary questionnaire for youth basketballers.

		CMJ	CMJr	CMJl	DJ	Lane Agility Drill	505-COD	RCODtotal	5 m sprint	10 m sprint	20 m sprint
CMJr	Spearman's rho	0.840									
	p-value	< 0.001									
CMJl	Spearman's rho	0.878	0.818								
	p-value	< 0.001	< 0.001								
DJ	Spearman's rho	0.875	0.754	0.890							
	p-value	< 0.001	< 0.001	< 0.001							
Lane Agility Drill	Spearman's rho	-0.702	-0.633	-0.740	-0.775						
	p-value	< 0.001	0.002	< 0.001	< 0.001						
505-COD	Spearman's rho	-0.623	-0.730	-0.636	-0.630	0.782					
	p-value	0.002	< 0.001	0.001	0.002	< 0.001					
RCODtotal	Spearman's rho	-0.724	-0.719	-0.745	-0.787	0.785	0.717				
	p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
5 m sprint	Spearman's rho	-0.840	-0.828	-0.734	-0.766	0.606	0.627	0.756			
	p-value	< 0.001	< 0.001	< 0.001	< 0.001	0.003	0.002	< 0.001			
10 m sprint	Spearman's rho	-0.808	-0.810	-0.790	-0.805	0.720	0.681	0.836	0.928		
	p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
20 m sprint	Spearman's rho	-0.779	-0.739	-0.779	-0.799	0.754	0.696	0.804	0.871	0.971	
	p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
C Total	Spearman's rho	-0.121	-0.158	0.091	0.120	0.111	0.102	-0.030	0.132	0.066	0.035
	p-value	0.623	0.518	0.711	0.624	0.650	0.678	0.901	0.589	0.789	0.887
H total	Spearman's rho	-0.148	-0.051	-0.163	-0.269	0.292	0.304	-0.102	-0.051	0.003	0.020
	p-value	0.557	0.840	0.517	0.281	0.239	0.220	0.687	0.841	0.992	0.936

Note: Correlation stablished at $p<0.05$

Discussion

The main aim of this study was to assess the relationships between physical fitness, nutritional knowledge, and nutritional habits in U-14 basketball players. We hypothesized that physical fitness performance will be related with the scores obtained on the nutritional knowledge questionnaire. However, no significant correlations were found between physical fitness attributes, food habits and nutritional knowledge since the different physical fitness attributes only correlated significantly between them.

The current findings show significant negative correlations among jumping performance and COD, RCOD and LSST tests. These findings are somewhat expected. Previous studies with adult basketball players reporting significant negative correlations between CMJ performance and repeated sprint ability (RSA) total time ($r=-0.74$; $p<0.01$) (Stojanovic, Ostojic, Calleja-González, Milosevic, & Mikic, 2012) and COD performance ($r=-0.594$; $p<0.01$) (Alemdaroğlu, 2012). Likewise, youth male basketball players showed significant negative correlations between both bilateral and unilateral CMJ height and COD performance ($r=-0.777$–-0.656; $p<0.05$) (Pérez-Ifrán et al., 2022). On the other hand, the current relationships are similar to previous findings with youth basketball players indicating that COD performance is positively related to RSA total time and RSA best time ($r=0.720$–0.805; $p<0.05$) (Pérez-Ifrán et al., 2022) and to 10- ($r=0.53$; $p<0.05$) (Scanlan et al., 2021) and 15-m sprint times ($r=0.814$; $p<0.05$) (Pérez-Ifrán et al., 2022). The relationships between jumps performed in the vertical axis and short-distance sprinting, COD and RCOD performed in the horizontal axis is due to the similarity of biomechanical and neuromuscular prerequisites and energy systems involved in the acceleration and the application of force in different axes. However, the magnitude of the relationships varies depending on the test characteristics (e.g., unilateral vs bilateral actions, sprint distance, the number of turns and turning angles associated with each COD test) or individual performance (e.g., jumping mechanics, running mechanics – forward vs. lateral-shuffles –, adjustments in stride pattern to decelerate and reaccelerate, COD technique – sharp vs. rounded –) (Suarez-Arrones et al., 2020). Therefore, youth basketball strength and conditioning coaches should consider these results when select tests to monitor physical performance of players depending on their physical fitness attributes. This information may help them to develop the most efficient, cost-effective, and practical testing procedure.

A balanced and appropriate diet in youth athletes is especially important to cope with physiological maturation needs and their athletic (Bergeron et al., 2015). In fact, the sports nutrition practices of U-18 Spanish basketball players have been reported to be deficient and inadequate, which may interfere with their health and performance (Escribano-Ott, Mielgo-Ayuso, & Calleja-González, 2022). In this regard, nutrition knowledge is a key factor for youth basketball players development, being highly relevant to establish correct nutritional habits, because consolidates the rationales to improve dietary behavior and grant the required competencies to make adequate food choices (Vázquez-Espino, Rodas-Font, & Farran-Codina, 2022). However, no significant relation was found between nutrition knowledge and physical fitness attributes in youth basketball players. Measurement of nutrition knowledge is challenging due to limitations in the adequacy, validity and precision of the tools used, which this could affect the reliability of the results. Thus, the absence of relationships could be explained by the lack of connectedness between the theoretical and declarative aspects inquired in the nutrition knowledge questionnaire and the objective fitness data obtained with the physical fitness tests.

A lower level of nutritional knowledge may contribute to poor nutritional habits (e.g., food choices and dietary behavior) (Vázquez-Espino et al., 2022). However, association between nutritional knowledge and food habits has previously been reported either as weak or lacking (Spronk, Kullen, Burdon, & O'Connor, 2014). Nutritional knowledge is only one factor that influences food habits, and other factors may be more important. Cultural factors, appetite, taste predilections or attitude towards nutrition have been reported to motivate food choices and dietary behavior in both general population and athletes (Birkenhead & Slater, 2015). Other related factors are changes in body composition or aesthetics (Byrne & McLean, 2002; Sundgot-Borgen & Torstveit, 2004) and peer pressure and teammates' choices. The complex interaction between these factors and the lack of connectedness between the theoretical and declarative aspects inquired in the food habits questions and the fitness attributes measured by the physical fitness tests may explain the absence of relationships. In addition, youth athletic performance not only relies on optimal eating patterns, but also depends on coaching styles and physical conditioning programs (Bergeron et al., 2015) and genetic variation (Guth & Roth, 2013). Thus, the relationships between food habits and physical fitness tests may also be influenced by other training- or genetic-related factors that were not measured in this study.

Some limitations should be acknowledged. Firstly, participants recruited were U-14 players of the same elite basketball academy, so the generalization of the findings is restricted. Thus, further studies involving a larger sample and using a wider range of age categories and levels of play (i.e., regional, international) are required. Secondly, sample include both males and female basketball players, so gender-related differences in physical fitness may influence the relationships obtained. Sánchez-Díaz et al. (2021) reported that U-14 male players outperformed female basketball players in jump, sprint, CODA and RCOD tests, and Mancha-Triguero et al. (2021) reported higher performance in jumping tests among U-14 male players compared with their female counterparts. Additionally, it is plausible that gender-related differences in nutritional knowledge influenced the magnitude of relationships, since female senior athletes who were involved in different sports, including basketball, reported greater nutritional knowledge compared to senior male athletes (Ali, Al-Siyabi, Waly, & Kilani, 2015). Thus, future studies should analyze whether the relationships between physical fitness, food habits and nutritional knowledge are influenced by the players' gender. Thirdly, the maturity status performance was not measured in the current study. This information could help practitioners to have a better understanding of the relationships between different physical fitness attributes in youth basketball players. Accordingly, the maturity status should also be measured in future studies. Finally, potential social desirability and self-reporting biases may be considered when interpreting the self-reported data collected with the questionnaire (Althubaiti, 2016), so the current findings should be analyzed with caution.

Conclusion

The findings of the current study indicate that no significant relationships exist between physical fitness attributes, food habits and nutritional knowledge in youth basketball players. The different physical fitness attributes only were significantly related between them. This suggest that physical performance of youth basketball players is not influenced by their level of dietary behaviors and nutritional knowledge.

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Conflicts of interest
The authors certify that they have no conflicts of interest.

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