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Master's Thesis

A transversal pilot study of the sports nutrition awareness in basketball. From the academic to the elite.

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A transversal pilot study of the sports nutrition awareness in basketball.

From the academic to the elite.

Final Master's Thesis for the Master's Degree in Physical Activity and Sport Sciences.

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Title: A transversal pilot study of the sports nutrition awareness in basketball. From the academic to the elite.

Abstract:

Despite the fact that nutrition represents an accessible recovery method for most basketball teams and players, it is usual to observe nutritional behaviour mistakes among them. It has been theorised that this behaviour is influenced by the habits acquired based on the individual's knowledge. In addition, age seems to be a direct factor influencing this behaviour. We have not found any previous studies carried out on this topic, specifically in basketball. Therefore, the main aim of this study was to carry out a descriptive, cross-sectional and observational analysis of the knowledge and practices of sports nutrition in basketball players, in categories of under 18 (n=69), elite (n=21), and non-elite (n=14), offering a diagnosis and a practical proposal for future intervention strategies. The participants (n=104) completed an anonymous online survey to analyse their sports nutrition knowledge and practices. Results are as follows nutrients (U-18: 5.15 vs NON-ELITE: 5.95 vs ELITE: 5.12), hydration (U-18: 4.72 vs NON-ELITE: 5.79 vs ELITE: 5.18), recovery (U-18: 4.19, vs NON-ELITE: 5.52 vs ELITE 4.5), body mass management (U-18: 4.77 vs NON-ELITE: 5.14 vs ELITE: 4.79) and supplementation (U-18: 2.57 vs NON-ELITE: 2.53 vs ELITE: 3.38). Related to nutrient block, significant differences in correlation model were found between categories ($p=0.03$) with a high effect size ($d=0.82$). Regarding nutritional practices, nutritional training adjustment (U-18: 81.16% vs NON-ELITE: 78.57% vs ELITE: 76.19%), pre-training (U-18: 66.66% vs NON-ELITE: 21.42% vs ELITE: 19.04) post-training (U-18: 57.97% vs NON-ELITE: 71.42% vs ELITE: 71.42), pre-competition (U-18: 10.45% vs NON-ELITE: 28.57% vs ELITE: 38.89%) post competition (U-18: 46.38% vs NON-ELITE: 35.71% vs ELITE: 47.62%). In view of the results obtained, we can conclude that the knowledge of sport-specific nutrition in U-18 and senior basketball players is insufficient through all the categories.

Keywords

Recovery; Sports performance, Health, Education

FORMAT AND STRUCTURE

In accordance with point IB of the section "FORMAT", of ANNEX 1:

This master's thesis is presented as an article format, with the intention of being published in the journal *Nutrients*, indexed in JCR (Q1). The following link provides the guide for authors:

<https://www.mdpi.com/journal/nutrients/instructions>.

A QR code is also attached.



A transversal pilot study of the sports nutrition awareness in basketball. From the academic to the elite.

Abstract: Despite the fact that nutrition represents an accessible recovery method for most basketball teams and players, it is usual to observe erroneous nutritional behaviour among them. It has been theorised that this behaviour is influenced by the habits acquired based on the individual's knowledge. In addition, age seems to be a direct factor influencing this behaviour. We have not found any previous studies carried out on this topic, specifically in basketball. Therefore, the main aim of this study was to carry out a descriptive, cross-sectional and observational analysis of the knowledge and practices of sports nutrition in basketball players, in categories of under 18 (n=69), elite (n=21), and non-elite (n=14), offering a diagnosis and a practical proposal for future intervention strategies. The participants (n=104) completed an anonymous online survey to analyse their sports nutrition knowledge and practices. In view of the results obtained, we can conclude that the knowledge of sport-specific nutrition in under18 and senior basketball players is insufficient through all the categories. The lack of professional support and time management difficulties have been identified as some of the main barriers.

Keywords: recovery; sports performance, health

1. Introduction

Basketball is a team sport with many fans and practitioners Worldwide [1], whose media impact can be partially explained by the impressive expansion and globalisation phenomena experienced over the last 30 years [2]. It is a dynamic and constantly evolving game that has undergone numerous modifications since James Naismith created it in 1891 [3]. Changes introduced during the last decade had a huge impact on the game, morphing it into a faster and more spectacular sport [4], increasing the physical, psychological, and physiological demands on the player [5,6]. Furthermore, the number of games played in elite basketball has increased considerably [7,8] such that players can accumulate up to 70 games in approximately 34 weeks (FIBA), which implies up to three games per week with less than 72 hours of recovery between them [9,10].

As a result of these changes, sports performance scientists highlight the need for a deeper understanding of the game [11] and the main demands experienced by the players [12]. Although most existing knowledge refers to men's basketball [13,14], there is also an emerging trend to explore the singularity of female players in depth. However, more studies are needed, especially in the area of training. [15].

The youngest athletes must also face numerous challenges [16,17], especially those participating in high-performance training programs [18]. For this reason, the special demands of the adolescent population have also attracted the interest of the scientific community [19-20].

As a consequence of these high levels of fatigue and the limited time to recover between games [11,12], teams have been pushed to incorporate strategies to accelerate and optimise the recovery processes [21] in their plans. This challenge determines strategies representing a decisive competitive advantage [9].

Among these factors, nutrition plays a key role [22-24], covering the demands of the game, maintaining physical and psychological performance, and optimising the athlete's potential [25]. There is widespread knowledge that carbohydrates and proteins must be provided with specific timing, quantity, and rhythm of administration [26] to enhance recovery. Although it is difficult to establish a valid guide for all players, we suggested in a previous review [4] a theoretical-practical one, covering the key points that should be considered to optimise the player's recovery through food. Despite the availability and accessibility of this theoretical knowledge for the majority of teams and their coaches, it is common to observe (in basketball and other team sports) that players still display erroneous behaviours, attitudes, and beliefs [27,28] that ultimately lead them to make undesirable food choices that can directly interfere with their performance and health [29]. It has been theorised that this behaviour is influenced by the habits acquired based on personal knowledge [30]. In addition, age seems to be a direct factor influencing this choice behaviour [31]. Although the scientific literature has previously investigated athletes and coaches' nutritional knowledge [24,32,33], we have not found any previous studies carried out specifically for basketball, neither longitudinally nor transversally, that analyse different age categories, including elite players, relating these to the main nutritional recovery methods [9]. Therefore, the main aim of this study was to carry out a descriptive, cross-sectional and observational analysis of the knowledge and practices of sports nutrition in basketball players under 18 (U-18) (15-16 years and 17-18 years) and adult (elite and non-elite) categories, offering a diagnosis and a practical proposal to establish future intervention strategies.

2. Materials and Methods

This study is an observational, cross-sectional, descriptive study conducted from January to April 2021. All participants (Table 1) completed an anonymous online questionnaire sent by their coaches, managers, or other players, guaranteeing their confidentiality.

Table 1. Description of the sample

	CATEGORY	MEN	WOMEN
U-18	U-16	17	25
	U-18	15	12
NON-ELITE	EBA LEAGUE	6	-
	1 st NATIONAL FEMININE	-	8
ELITE	LEB SILVER LEAGUE	5	-
	ACB LEAGUE	6	-
	FEMININE LEAGUE 2	-	2
	FEMININE LEAGUE 1	-	8

Participants

The study sample consisted of 49 men and 55 women of U-18 categories corresponding to 15-16 years of age and 17-18 years of age corresponding to cadet and juvenile stages (32; 37) and adult (17; 18). Within the senior category, 21 played in elite competitions, 10 in women's leagues (LF1, LF2), and 11 in men's leagues (*ACB*, *LEB*). The rest of the senior participants belonged to teams playing in other federative divisions in Spain, eight women in the *Primera Nacional Femenina* (3rd Division) and six men in the *Liga EBA* (4th Division). The inclusion criteria were: 1) to be players aged between 15 and 18 years with Spanish federation licence, or if they were older than 18 to compete in elite or non-elite category (FEB); 2) participation in at least 75% of the annual training sessions; 3) regular participation in the competition. The following exclusion criteria were established: 1) lack of fluency in the language in which the questionnaire was delivered (Spanish).

Ethical issues

Approval was obtained from the responsible clubs and federations. They were informed of the purpose of the study and its potential benefits, its methodological nature, and the methodology used. This study was approved by the Ethics Committee for Human Research (CEISH) of the University of the Basque Country (UPV/EHU) with code M10_2020_259 and carried out under the ethical principles of the Helsinki Code [34].

Procedure

An ad-hoc questionnaire was designed to collect the following information: category of play, gender, sports nutrition knowledge, and sports nutrition practices. The following sections consisted of specific questions:

- **Sports nutrition questionnaire:** it was validated previously and is considered a simple yet applicable tool to be administered [35]. It contains 23 questions grouped into six sections: a) *nutrients*: includes questions (7 items) about the degree of agreement on experts' recommendations and the profile of certain foods according to their predominant content of a nutrient; b) *hydration*: includes questions (5 items) on rehydration strategies and the profile of a sports drink; c) *recovery*: includes questions (5 items) on which foods may represent a suitable choice in terms of quantity and presence of certain nutrients, as well as the timing of intake; d) *body mass management*: includes questions on strategies for healthy weight gain (2 items) and weight loss (2 items); e) *supplementation*: includes questions (2 items) about the degree of agreement on experts' recommendations on supplementation. Each categorical and total knowledge characteristic was assessed by transforming the results obtained into a scale equivalent to the school grading system in Spain, where 0 was the minimum value and 10 the maximum value (Table 1).
- **Sports nutrition practices:** a questionnaire was configured to assess the sports nutrition practices by adapting the existing questionnaires of Heikura et al. [36] and Altarriba-Bartes et al. [27]. It contained a total of 36 items. Depending on the answer (yes or no), the questionnaire continued to the following question or jumped to the next section, so the total number of questions to be answered could be reduced. Items were grouped into the following thematic blocks: training adjustment according to competition objectives (7 items), pre- and post-training nutritional strategies (14 items), pre- and post-match nutritional strategies (15 items). Each of these blocks contained questions about the main reasons for adhering or not to the strategies and the influence of other people on their behaviour to follow the recommendations.

Statistical analysis

The present study follows an observational, cross-sectional, descriptive design. The data was exported from the online survey (Google Forms[®]) to a spreadsheet (Microsoft[®] Excel for Windows 10) and analysed with the statistical package SPSS for Windows version 26.0, SPSS INC, Chicago, USA) and in the R (1.4 version) programming environment. The results are presented as means, standard deviation (SD), and frequencies. Normal distribution and homogeneity of variances were tested using the Kolmogorov–Smirnov when the sample was greater than 30. The comparison of means among independent samples was performed with the ANOVA test, and Bonferroni ad hoc analyses were conducted to find differences among groups. Categorical variables were analysed using the Chi-square test, and these analyses were stratified by level of competition. Effect size, from Cohen's D, was considered as trivial ($r < 0.1$), small ($0.1 < r < 0.3$), moderate ($0.3 < r < 0.5$), high ($0.5 < r < 0.7$), very high ($0.7 < r < 0.9$), near-perfect ($r > 0.9$) and perfect ($r = 1$) [37]. Logistic regression analyses were used to determine the association between category-knowledge-behaviours. The magnitude of the correlation coefficients was determined as trivial ($r < 0.1$), small ($0.1 < r < 0.3$), moderate ($0.3 < r < 0.5$), high ($0.5 < r < 0.7$), very high ($0.7 < r < 0.9$), nearly perfect ($r > 0.9$), and perfect ($r = 1$) (Hopkins et al., 2009). In all statistical tests, the statistical significance level $p < 0.05$ was used for bilateral contracts.

3. Results

A sample (Table 1) of 49 men and 55 women of U-18 categories was obtained, corresponding to 15-16 years old and 17-18 years old corresponding to cadet and juvenile stages (32; 37), and adult (17; 18). Within the senior category, 21 played in elite competitions, 10 in women's leagues (*LF1*, *LF2*) and 11 in men's leagues (*ACB*, *LEB*). The rest of the senior participants belonged to teams playing in other federative divisions in Spain, eight women in the *Primera Nacional Femenina* (3rd division) and six men in the *Liga EBA* (4th division).

Nutritional knowledge

A total of 104 participants (100% participation rate) completed a sports nutrition knowledge questionnaire (Table 2) previously validated in other works. The following thematic blocks (Figure 1) were analysed: nutrients (U-18: 5.15 *vs* NON-ELITE: 5.95 *vs* ELITE: 5.12), hydration (U-18: 4.72 *vs* NON-ELITE: 5.79 *vs* ELITE: 5.18), recovery (U-18: 4.19 *vs* NON-ELITE: 5.52 *vs* ELITE: 4.5), body mass management (U-18: 4.77 *vs* NON-ELITE: 5.14 *vs* ELITE: 4.79) and supplementation (U-18: 2.57 *vs* NON-ELITE: 2.53 *vs* ELITE: 3.38) (Figure 2). With respect to the nutrient block, significant differences in logistic regression were found between categories ($p=0.03$) with a high effect size ($d=0.82$).

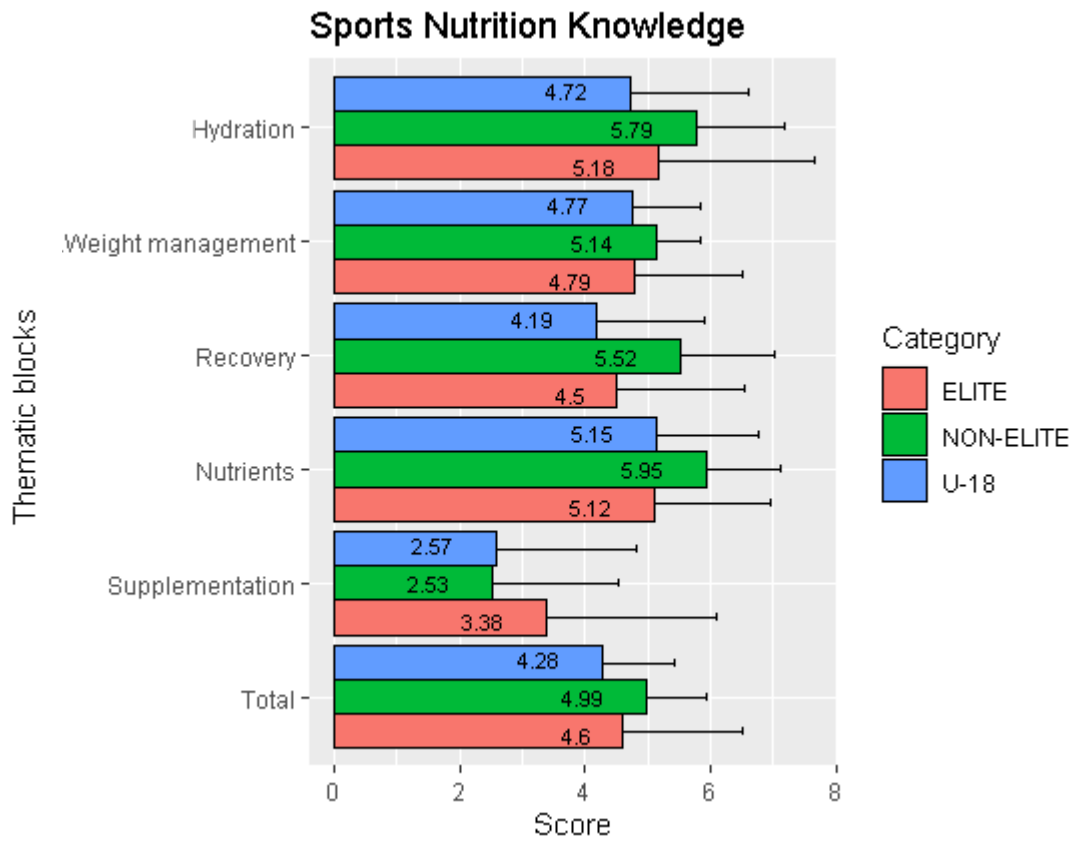


Figure 1: Sports nutrition knowledge (thematic blocks)

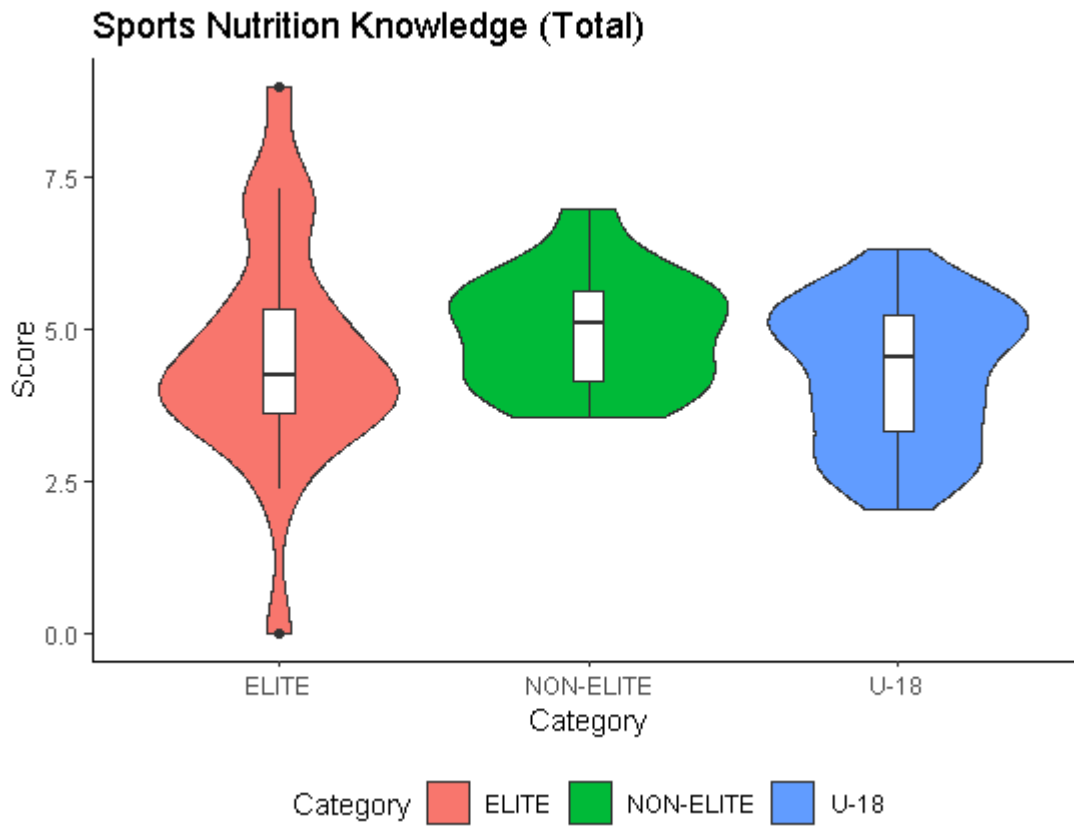


Figure 2: Sports nutrition knowledge (total)

Table 2. Sports nutrition knowledge by category, gender, and thematic blocks

CATEGORY		n	Nutrients ¹	Hydration ¹	Recovery ¹	Mass management ¹	Supplementation	Total ¹
			x(SD)	x(SD)	x(SD)	x(SD)	x(SD)	x(SD)
U-18	MEN	32	5.3(1.97)	5.07(2)	4.66(1.63)	4.83(1)	2.79(2.18)	4.53(1,1)
	WOMEN	37	5.01(1.22)	4.41(1.75)	3.79(1.69)	4.72(1.13)	2.38(2.32)	4.06(1.15)
	TOTAL	69	5.15(1.61)	4.72(1.88) ¹	4.19(1.71) *	4.77(1.06)	2.57(2.25)	2.28(0.54)
NON-ELITE	MEN	6	5.6(1.54)	5.74(1.48)	4.85(1.24)	5.22(0.65)	2.43(1.79)	4.77(0.93)
	WOMEN	8	6.22(0.82)	5.83(1.43)	6.02(1.53)	5.08(0.79)	2.62(2.25)	5.15(1)
	TOTAL	14	5.95(1.17)	5.79(1.39)	5.52(1.49) *	5.14(0.71)	2.53(1.99)	2.43(0.65)
ELITE	MEN	11	4.81(2.11)	4.64(2.57)	4.05(2.2)	4.18(1.93)	2.65(2.49)	4.07(2.04)
	WOMEN	10	5.48(1.53)	5.78(2.33)	5(1.83)	5.47(1.25)	4.18(2.88)	5.18(1.68)
	TOTAL	21	5.12(1.84)	5.18(2.47)	4.5(2.04)	4.79(1.73)	3.38(2.73)	2.35(0.81)
TOTAL	MEN	49	5.23(1.94)	5.06(2.07)	4.55(1.72)	4.74(1.26)	2.71(2.17)	4.46(1.34)
	WOMEN	55	5.27(1.29)	4.87(1.91)	4.33(1.87)	4.91(1.13)	2.74(2.47)	4.43(1.32)
	TOTAL	104	5.25(1.62)	4.96(1.98)	4.43(1.79)	4.83(1.19)	2.73(2.32)	4.44(1.32)
p-value	-	-	0.221	0.151	0.0386	0.567	0.361	0.151
d Cohen	-	-	-	-	0.82	-	-	-

Legend: SD Standard deviation; d, Cohen's d (low effect size: $d \geq 0.10$; medium effect: $d \geq 0.30$; high effect: $d \geq 0.50$); Normal distribution 1; Non-normal distribution; * statistically significant differences ($p < 0.05$).

Nutritional practices and strategies

To analyse the nutritional practices and behaviours (Table 3), all the participants completed an adapted questionnaire used in previous and similar work. Results (Figure 3, Figure 4) shows that 83% of participants do not adjust their nutrition for the work required (U-18: 81.16% vs NON-ELITE: 78.57% vs ELITE: 76.19%). However, 71.15% of participants (U-18: 66.66% vs NON-ELITE: 21.42% vs ELITE: 19.04) reported paying attention to their pre-training nutrition and 62.5% (U-18: 57.97% vs NON-ELITE: 71.42% vs ELITE: 71.42%) to post-training nutritional recovery. These frequencies decreased when they were asked about their match-day practices, where 18.18% of participants reported paying attention to pre-competition nutrition (U-18: 10.45% vs NON-ELITE: 28.57% vs ELITE: 38.89%) in contrast to 54.81% (U-18: 46.38% vs NON-ELITE: 35.71% vs ELITE: 47.62%) of those who did so at the end of the match. No differences were found in logistic regression

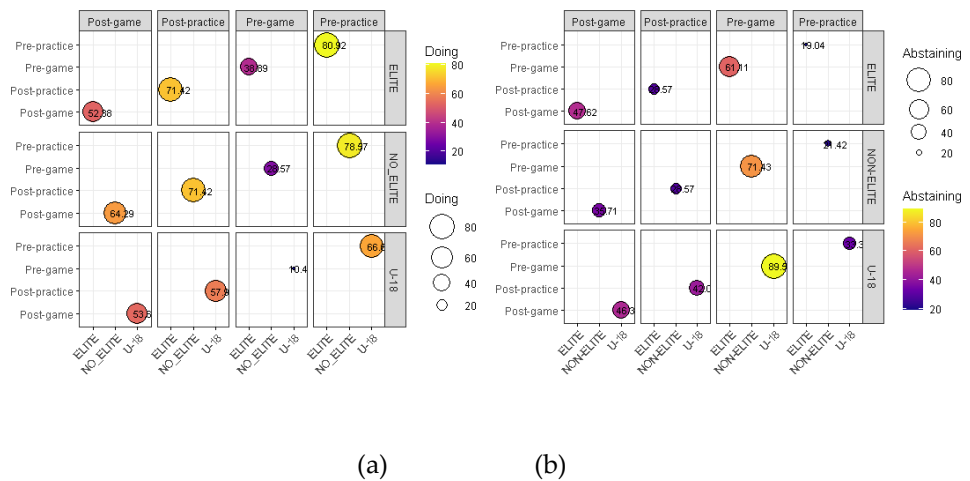


Figure 3: Sports nutrition practices

Perceived barriers

Although the correlation magnitude was small, we found a positive association among knowledge levels and adherence to the practices recommended by the experts ($p=0.035$; $r=0.207$; small) and a better fit to these as the categories increase ($p=0.14$; $r=0.241$; small).

Table 3. Sports nutrition practices by category, gender, and thematic blocks

	Training¹ adjustment*		Pre¹ practice		Post¹ practice		Pre¹ game		Post¹ game*	
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
	fi(%)	fi(%)	fi(%)	fi(%)	fi(%)	fi(%)	fi(%)	fi(%)	fi(%)	fi(%)
ELITE	5(23.81)	16(76.19)	17 (80.92)	4 (19.04)	15 (71.42)	6 (28.57)	7(38.89)	11(61.11)	11(52.38)	10(47.62)
Men	3(27.27)	8(72.73)	9 (81.81)	2 (18.18)	8 (72.72)	3 (27.27)	4(50)	4(50)	8(72.73)	3(27.27)
Women	2(20)	8(80)	8 (80)	2 (20)	7 (70)	3 (30)	3(30)	7(70)	3(30)	7(70)
NON-ELITE	3(21.43)	11(78.57)	11 (78.57)	3 (21.42)	10 (71.42)	4 (28.57)	4(28.57)	10(71.43)	9(64.29)	5(35.71)
Men	1(16.67)	5(83.33)	5 (83.33)	1 (16.66)	5 (83.33)	1 (16.67)	1(16.67)	5(83.33)	3(50)	3(50)
Women	2(25)	6(75)	6 (75)	2 (25)	5 (62.5)	3 (37.5)	3(37.5)	5(62.5)	6(75)	2(25)
U-18	13(18.84)	56(81.16)	46 (66.66)	23 (33.33)	40 (57.97)	29 (42.02)	7(10.45)	60(89.55)	37(53.62)	32(46.38)
Men	9(28.13)	23(71.88)	25 (78.12)	7 (21.85)	23 (71.87)	9 (28.12)	4(13.33)	26(86.67)	19(59.38)	13(40.63)
Women	4(10.81)	33(89.19)	21 (56.75)	16 (43.24)	17 (45.94)	20 (54.05)	3(8.11)	34(91.89)	18(48.65)	19(51.35)
TOTAL	21(20.19)	83(79.81)	74 (71.15)	30 (28.84)	65 (62.5)	39 (37.5)	18(18.18)	81(81.82)	57(54.81)	47(45.19)
Men	13(26.53)	36(73.47)	39 (79.59)	10 (20.40)	36 (73.46)	13 (26.53)	9(20.45)	35(79.55)	30(61.22)	19(38.78)
Women	8(14.55)	47(85.45)	35 (63.63)	20 (36.36)	29 (52.72)	26 (47.27)	9(16.36)	46(83.64)	27(49.09)	28(50.91)
Chi square	0.877		0.362		0.408		0.362		0.817	

Legend: Frequency (fi) Normal distribution 1; Non-normal distribution; * statistically significant differences (p<0,05).

Table 4. Perceived barriers by category

CATEGORY	TYPE	Training adjustment	Pre practice	Post practice	Pre game	Post game
U-18	Barrier	I was told it was not necessary	I was not aware of this recommendation	I was not aware of this recommendation	I don't know if I need a specific plan	I was not given this recommendation
	Frequency (%)	6.12	31.25	46.51	35	64.52
ELITE	Barrier	I don't feel that I need more energy when I have intense training or less when I have light training.	I find it difficult to follow these strategies due to my living situation (I live with my parents, partner, colleagues, etc.).	I find it difficult to follow these strategies due to my living situation (I live with my parents, partner, colleagues, etc.).	I don't know	I have not been given this recommendation
	Frequency (%)	42.86	25	33.33	36.36	44.44
NON-ELITE	Barrier	I don't feel that I need more energy when I have intense training or less when I have light training.	I was not aware of this recommendation	It is difficult for me to follow these strategies due to my living situation (I live with my parents, partner, colleagues, etc.).	I don't think I need to follow a special plan	It is not necessary
	Frequency (%)	57.14	66.67	40	40	40
COMMON	Barrier	I don't think it is necessary for my weight/body composition goals.	I was not aware of this recommendation	It is difficult for me to follow these strategies due to my living situation (I live with my parents, partner, colleagues, etc.).	I don't know if I need a specific plan	I have not been given this recommendation

4. Discussion

This descriptive research aimed to describe the nutritional knowledge and behaviour of basketball players of different categories and levels and make a diagnosis and intervention proposal that allows this population to adhere to better practices that will have a positive impact on their health and performance. In view of the results obtained, we can conclude that their sports nutrition knowledge is insufficient, resulting in inadequate eating practices. In addition, there are barriers such as lack of professional support and time management difficulties that make it difficult for players to optimise their nutrition.

1. Nutritional knowledge and practical management of nutrients

Sports nutrition is a rapidly growing and evolving science [38]. There is strong agreement that nutrients play a key role in the acute, adaptive, and chronic response to exercise and the availability and functioning of energy systems [22,38]. The type of nutrient, knowledge and management of the timing and amount of intake is critical [39]. Likewise, this selection must respond to the specific mechanisms that generate fatigue [4] and the fatigue profiles generated by each playing position [40]. Our study found no significant differences in the theoretical knowledge of nutrients among categories (U-18: 5.15 *vs* NON-ELITE: 5.95 *vs* ELITE: 5.12), obtaining an average score for the three groups of 5.25 out of 10 maximum total points. Although to the best of our knowledge, this is the first study that specifically addresses this variable in basketball, also including elite players, these scores follow the direction of work done in other sports disciplines where other athletes also scored similarly [24, 41-43]. In addition to describing knowledge, our description also addressed the practical handling of knowledge by the athletes. Adjusting the availability and supply of nutrients, especially carbohydrates, to the daily demands is an aspect that is arousing great interest inside the specialised scientific community [39,44,45], highlighting the need not to adopt nutritional practices exclusively oriented towards competition [46]. Our study found significant differences between those who did adjust their diet according to training, with the group of athletes who did not do so being larger (YES: 20.19% *vs* NO: 79.81%). This fact highlights that despite the speed with which theoretical knowledge on nutritional periodisation is emerging [47-49], only in very specific cases, such as those recorded by Heikura in 2018 [36], is it being transferred to practice. In this sense, future research lines could explore which characteristics are fundamental to adjust nutritional periodisation to each sporting context or the main barriers that limit the transfer of this theoretical knowledge to field practice.

2. Nutritional knowledge and practical management of supplementation strategies.

Sports supplements are becoming increasingly popular among athletes, with a broad and accessible range of products available [23]. The research carried out by our research group found that some of them could be of interest for health [50], while others, due to their proven ergogenic effect, could be beneficial for sports performance [51-53]. This wide and complex supplementation offer makes it necessary for the basketball players to tailor their supplementation menus individually [54], selecting those that are genuinely beneficial for their practice [4], and considering their own individual parameters [55]. Particularly important are those related to the sex variable, since most of the published studies have been carried out on men [51], and exhaustive research is needed on the female population that considers their physiological peculiarities, mainly hormonal [52]. To apply these strategies accurately, it is necessary for players to have enough knowledge that will allow them to optimise their performance and protect their health and their sporting careers [56]. In this sense, our research has shown that basketball players' knowledge of sports supplementation does not reach the "pass" category, registering a value of 2.73 out of a maximum value of 10. These records are repeated in the three categories that we analysed (U-18: 2.57 *vs* NON-ELITE: 2.53 *vs* ELITE: 2.74).

In particular, in the case of the U-18 category, these scores could be justified because, initially, this group should not require their use, as a varied, balanced diet that adheres to a Mediterranean style could theoretically be sufficient [57,58]. However, the team of Chiba et al. [59] found that as young people progress in their development, their consumption of nutritional supplements also increases, most of the time incorrectly used, so that early educational interventions could be a measure of interest. With regard to the senior population, our results are in line with other similar studies that have found that athletes have a low level of knowledge [25,60] or that they are unaware of the need for an independent laboratory to guarantee the purity and safety of a product [61-62]. This lack of knowledge demonstrates how exposed athletes are to brands' promises of product improvements [54] and cannot protect themselves from these attractive messages by asking basic questions about the safety, efficacy, or risks of using them [63].

3. Nutritional knowledge and practical management of hydration strategies.

One factor that directly affects the onset of fatigue is dehydration [4,64], so it is essential to achieve a homeostatic balance between fluid losses and exogenous fluid replacement [64-65]. Hydration plays a vital role in reducing explosive performance during basketball competition [66] and should be a key focus of recovery strategies [66]. In 2018, the team of Scanlan et al. [12] analysed the physical performance of basketball players in a simulated game. This work allowed them to theorise that when a significant amount of body water is temporarily lost due to physical exertion, a greater reliance on anaerobic metabolism occurs, thus explaining some of the negative effects of fatigue [12]. On the other hand, very high or sustained losses over time, in addition to negatively affecting athletic performance, can put health at serious risk, so a widely accepted rehydration strategy is to ingest an amount of fluid equivalent to twice the weight lost [22-65]. Adult players showed better knowledge about hydration management (U18: 4.72 *vs* NON-ELITE: 5.79 *vs* ELITE: 5.18). However, we did not find significant differences comparing their practices to U-18's. This lack of theoretical knowledge could also be reflected in subsequent hydration behaviour, as has been described in other studies [66-67]. Although it is difficult to establish a relationship that explains these differences, it could be theorised that older players may have received a greater number of messages about the importance of following adequate hydration. In the last two decades, it has been a subject that has been widely addressed by the scientific community [68] so that transferring and communicating these recommendations into practice is relatively easy for coaches [69].

4. Nutritional knowledge and practical handling for weight management

Adequate body composition plays a fundamental role in sporting performance [51]. In basketball, it can also determine playing position [70] or serve as a screening variable for the identification of sporting talent [71,72]. Numerous dietary strategies are currently used in the sporting context [73] to intervene in body composition [74]. In any case, these diets must provide sufficient nutrients and energy to maintain adequate levels of fat and muscle [73]. Our study found no significant differences by category, recording a mean value of 4.83 (U-18: 4.77 *vs* NON-ELITE: 5.14 *vs* ELITE: 4.79) with 10 being the maximum possible. This lack of knowledge about the management of body composition could be related to an inadequate diet that does not comply, either by excess or deficiency, with the experts' recommendations [75,76]. In the case of female athletes, and particularly female basketball players, there is a profound need to know more precisely which nutritional strategies are the most appropriate to achieve optimal body composition. Their specific hormonal profile, as well as the fluctuations that occur in them during the menstrual cycle [77], mean that physiological complications derived from a prolonged state of energy efficiency can end up putting their health at risk [78].

5. Nutritional knowledge and practical handling of recovery strategies.

The organic and psychological recovery of the athlete is a task that requires high precision and individualisation [21] and depends directly on the complex, interconnected, and specific dimensions of each sport [9,79-81]. Among these tasks, nutrition plays a determining role in accelerating and optimising recovery [82,83]. It is one of the main methods used by teams [82], although this knowledge needs to be further expanded to design specific strategies for the female population [84]. Our study found significant differences in knowledge related to nutritional recovery strategies between younger and adult players ($p=0.03$). This may be due to a better perception by the players themselves or their teams of the need to recover more quickly and efficiently [4-5] and thus cope with the demands of training and matches, or to have learned in structures where nutritional recovery practices are imposed by the sporting structure itself [27]. However, in contrast, it was observed in a recent study by Bird and Rushton [85] that the mean value of this knowledge did not reach the cut-off of 5 out of 10 (U-18: 4.19 *vs* NON-ELITE: 5.52 *vs* ELITE: 4.5), so in addition to facilitating and promoting practical access to nutritional recovery methods [4], these could be accompanied by training strategies that would give them greater autonomy, positively impacting their performance and their lives [55]. In addition to describing their knowledge, we also analysed their nutritional practices in training and matches in our study. These have a direct impact on recovery, completing it, and reaching a state of optimal preparation before exercise or starting the recovery process itself [86]. Although their knowledge reflected a lack of mastery of sport-specific recommendations, in their behaviour, they reported paying attention to their nutrition before (YES: 71.15% *vs* NO: 28.84%) and after (YES: 62.5% *vs* NO: 37.5) training. With this finding, it could be theorised that, over and above the recommendations based on scientific evidence, athletes' behaviour is more influenced by their perception of how easy it is to carry out these strategies, [87] or the sense of individual well-being that they generate [55].

6. Perceived barriers to nutritional knowledge and practices

Lack of professional support, difficulties in time management, and lack of knowledge are some of the main barriers perceived by athletes and coaches, which, in addition to compromising their performance, expose them to numerous agents that put their protection at risk [88]. These difficulties coincide with those found in our research where the lack of knowledge offered by a professional was recorded as a common variable in all age categories for pre-match (U-18: 35% *vs* NON-ELITE: 40% *vs* ELITE: 36.36%) and post-match (U-18: 64.52% *vs* NON-ELITE: 40% *vs* ELITE: 44.44%) practices. On the other hand, time management depending on the residence situation observed as a predominant barrier in the elite category (PRE: 25% *vs* POST: 33.33%). These results are in line with those obtained by Sekulic et al. (2019), where athletes reported not enough knowledge to obtain it on their own. Our results point in the same direction, where we found a positive association among levels of knowledge and adherence to the practices recommended by the experts ($p=0.035$) and a better adjustment to these as they scale the categories ($p=0.14$). Thus, it seems essential that clubs and federations make available to players the assistance of a professional nutritionist to help them and coordinate their personal circumstances [89] with those based on nutritional demands of basketball [90].

5. Conclusions

In view of the results obtained, we can conclude that the knowledge of sport-specific nutrition in cadets, juniors, and senior basketballers is insufficient and results in inadequate nutritional practices that may compromise their performance and health. In addition, the lack of professional support, time management difficulties, and the lack of knowledge have been identified as some of the main barriers that prevent basketball players from developing healthy behaviour in line with expert recommendations. Future studies should investigate sports nutrition knowledge and practices in a larger sample and other basketball agents such as coaches, strength and conditioning staff, or referees. It may also be of interest to investigate the possible effects of nutrition education interventions on physical performance.

Supplementary Materials: The following are available online at www.mdpi.com/xxx/s1, Figure S1: title, Table S1: title, Video S1: title.

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Appendix A

PRACTICAL APPLICATION

Based on the findings, our research team proposes some ideas that could help to build bridges between the theoretical knowledge and players' practices:

Nutritional education strategies to increase knowledge

The dietary education of athletes is a key aspect that can promote appropriate eating behaviour, with adolescence being an ideal time for its development. Although many possible interventions can be carried out, most of which are sufficient to achieve a positive impact, short interventions at specific times of the season (training camps, technical improvement, pre and post-season) using new technologies (such as mobile applications) could be a strategy that could quickly increase the knowledge of nutrition. It could also be beneficial for coaches and technical staff to participate in this training due to the high impact that their behaviour and nutritional knowledge have on athletes.

Quick ideas to boost nutritional practices

Facilitating practical solutions through popular forms of communication such as infographics made by recognised professionals in our field (<https://ylmsportscience.com/>) and making them visible in training areas or providing them directly to players could be an effective strategy to provide visual examples that can be quickly assimilated and implemented. These designs could show: 1) foods, preparations or menus that integrate the amount and type of nutrients needed for basketball practice as well as when to take them; 2) hydration strategies through foods with a high hydration index, as well as ways to evaluate and measure their degree of dehydration and rehydration rate; 3) diagrams that help in the decision to decide and choose whether to follow a supplementation pattern as well as facilitating the ways to consult about the safety of a product.

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GIZAKIEKIN ETA HAUEN LAGIN ETA DATUEKIN EGINDAKO IKERKETEI BURUZKO ETIKA BATZORDEAREN (GIEB-UPV/EHU) TXOSTENA

M^a Jesús Marcos Muñoz andreak, Universidad del País Vasco/Euskal Herriko Unibertsitateko (UPV/EHU) GIEBeko idazkari gisa,

ZIURTATZEN DU

Ezen gizakiekin egindako ikerkuntzaren etika batzorde honek, GIEB-UPV/EHU, (2014/2/17ko 32. EHAA)

Balioetsi duela ondoko ikertzailearen proposamen hau:

Ignacio Escribano Ott jaunak, M10_2020_259, honako ikerketa proiektu hau egiteko:

"FACTORES DETERMINANTES EN LA ELECCIÓN DE ALIMENTOS Y COMPORTAMIENTOS ALIMENTARIOS"

Eta aintzat hartuta ezen

1. Ikerketa justifikatuta dago, bere helburuei esker jakintza areagotu eta gizarteari onura ekarriko baitio, ikerlanak lekartzakeen eragozpen eta arriskuak arazoizko izanik.
2. Ikertzaile taldearen gaitasuna eta erabilgarri dituzten baliabideak aproposak dira proiektua gauzatzeko.
3. Ikerketaren planteamendua bat dator era honetako ikerkuntza egin ahal izateko baldintza metodologiko eta etikoekin, ikerkuntza zientifikoaren praktika egokien irizpideei jarraiki.
4. Indarreko arauak betetzen ditu, ikerketa egin ahal izateko balmenak, akordioak edo hitzarmenak barne.

Aldeko Txostena eman du 2020ko abenduaren 17an egin duen bileran (132/2020akta) aipatutako ikerketa proiektua ondoko ikertzaileek osatutako taldeak egin dezan:

Ignacio Escribano Ott
Julio Calleja González
Juan Mielgo Ayuso

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MARCOS
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Verificado digitalmente por MARIA JESUS MUÑOZ MUÑOZ
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GIEB-UPV/EHUko idazkari teknikoa
Secretaria Técnica del CEISH-UPV/EHU

INFORME DEL COMITÉ DE ÉTICA PARA LAS INVESTIGACIONES CON SERES HUMANOS, SUS MUESTRAS Y SUS DATOS (CEISH-UPV/EHU)

M^a Jesús Marcos Muñoz como Secretaria del CEISH de la Universidad del País Vasco/Euskal Herriko Unibertsitatea (UPV/EHU)

CERTIFICA

Que este Comité de Ética para la Investigación con Seres Humanos, CEISH-UPV/EHU, BOPV 32, 17/2/2014, **Ha evaluado** la propuesta del investigador:

D. Ignacio Escribano Ott, M10_2020_259, para la realización del proyecto de investigación: "**FACTORES DETERMINANTES EN LA ELECCIÓN DE ALIMENTOS Y COMPORTAMIENTOS ALIMENTARIOS**"

Y considerando que,

1. La investigación está justificada porque sus objetivos permitirán generar un aumento del conocimiento y un beneficio para la sociedad que hace asumibles las molestias y riesgos previsibles.
2. La capacidad del equipo investigador y los recursos disponibles son los adecuados para realizarla.
3. Se plantea según los requisitos metodológicos y éticos necesarios para su ejecución, según los criterios de buenas prácticas de la investigación científica.
4. Se cumple la normativa vigente, incluidas las autorizaciones, acuerdos o convenios necesarios para llevarla a cabo.

Ha emitido en la reunión celebrada el 17 de diciembre de 2020 (acta 132/2020), **INFORME FAVORABLE** a que dicho proyecto de investigación sea realizado, por el equipo investigador:

Ignacio Escribano Ott
Julio Calleja González
Juan Mielgo Ayuso

Eta halaxe sinatu du Leioan, 2021ko otsailaren 8an

Lo que firmo en Leioa, a 8 de febrero de 2021