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Assessment of Moroccan swimming coaches' nutritional knowledge and self-reported nutrition recommendations: A cross-sectional study

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Abstract

Background: Sports nutrition plays an important role in recovery, injury prevention, and athletic performance. Coaches often provide nutritional guidance that may influence athletes' dietary practices.
Aims: This study aimed to assess sports nutrition knowledge among Moroccan swimming coaches, identify their primary sources of nutrition information, and describe their self-reported nutrition recommendations.
Methods: This cross-sectional study included 110 Moroccan swimming coaches from five regional leagues. Data were collected using an online questionnaire covering sociodemographic characteristics, the adapted 49-item Sports Nutrition Knowledge Instrument (49-SNKI), self-reported nutrition recommendations, and sources of nutrition information. Knowledge scores and recommendation counts were compared across gender, age, educational level, coaching experience, and nutrition training using appropriate parametric or non-parametric tests. Holm adjustment was applied for multiple comparisons.
Results: The overall nutrition knowledge score was 30.13 ± 10.29/49 among coaches with complete responses (n = 106), corresponding to a normalized net score of 61.5%. Knowledge varied across domains, with the highest normalized score for micronutrients (82.9%) and the lowest for hydration (52.7%). No statistically detectable differences in overall knowledge were observed by gender, educational level, nutrition training, age, or coaching experience. Most coach characteristics were also not associated with detectable differences in self-reported carbohydrate, protein, fluid, or fat recommendation counts. Nominal differences by nutrition training for carbohydrate and fluid recommendations were no longer significant after Holm adjustment. The Internet was the most frequently reported information source (61.8%), followed by club or federation documents (27.3%).
Conclusion: Hydration showed the lowest normalized net score and may warrant particular attention in future continuing education. Most sociodemographic and professional characteristics were not associated with detectable differences in overall knowledge or self-reported recommendations. The predominant use of the Internet highlights the need for continuing education, particularly on hydration and critical appraisal of online information. The quality and adherence of self-reported recommendations to established sports nutrition guidelines could not be determined.

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INTRODUCTION

Nutrition is a fundamental determinant of athletic performance and plays a critical role in maintaining athletes' health (Kim & Kim, 2019). Over the past few years, several studies have highlighted the important role of nutrition in enhancing athletic performance, promoting post-exercise recovery, and supporting training-induced physiological adaptations. (Carey et al., 2023; Kaufman et al., 2023). In swimming, these considerations are particularly important due to the high physiological demands of the sport, which is characterized by large training volumes, frequent twice-

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daily training sessions, and substantial energy expenditure. Accordingly, an appropriate nutritional strategy is essential to meet swimmers' energy requirements, maintain their health, promote recovery, and optimize training adaptations (Domínguez et al., 2017). Although nutrition information is now widely available in the digital era, accessing accurate and evidence-based nutrition information remains challenging. Consequently, athletes, particularly those competing at the elite level, often rely on their coaches for nutrition guidance, making coaches a key source of nutrition information (Bakhtiar et al., 2021). Beyond their potentially significant influence on athletic performance (Choi et al., 2020), coaches also play a crucial role in providing nutritional support to athletes. They represent a primary source of nutrition information by providing dietary guidance to their athletes (Couture et al., 2015; Danaher & Curley, 2014), particularly recommendations regarding carbohydrate and protein intake, hydration practices, and weight management among swimmers (Boumosleh et al., 2021; Eskici et al., 2016; Sung et al., 2024).

Due to the trust-based relationship between coaches and athletes in the sporting environment, as well as the expertise coaches have developed in their field, athletes often prefer to receive nutritional advice from their coaches (Torres-McGehee et al., 2012). Appropriate dietary behaviors can optimize athletic performance, whereas a high level of nutrition knowledge may promote more appropriate dietary choices among athletes.(Aka, 2020; Bentley et al., 2020) Despite their central role in decisions regarding athletes' diets, coaches often lack sufficient nutritional knowledge, which can compromise the relevance and quality of the advice they provide (Jagim et al., 2021; Janiczak et al., 2022; Klein et al., 2021). A high level of reliance on coaches for nutritional recommendations may negatively affect athletes' sports performance (Sung et al., 2024)Furthermore, inappropriate dietary practices or nutrition recommendations based on non-evidence-based sources may have detrimental physical and psychological consequences for athletes. They may lead to nutritional deficiencies, compromise growth, limit athletic development, impair short-term sports performance, and negatively affect long-term health. Moreover, they may contribute to the development of disordered eating behaviors and eating disorders (Heikkilä et al., 2019; Voelker et al., 2022).

Several studies have attempted to identify the factors that may influence coaches' nutrition knowledge, including their individual characteristics and the type of sport they coach. (Smith-Rockwell et al., 2001) reported a mean score of 67% for coaches' nutrition knowledge using a questionnaire designed to assess their level of nutritional knowledge. The authors found no significant differences in this score among the different sports represented. In another study conducted by (Juzwiak & Ancona-Lopez, 2004). Among 55 coaches working with adolescent athletes, a mean score of 70% was observed for knowledge related to common nutrition myths, protein intake, and low-fat diets. Some research suggests a link between better nutritional knowledge and improved dietary practices, while other studies point to the impact of factors related to social pressures, peer behavior, and mental stress (AlKasasbeh & Akroush, 2024; Fernandes et al., 2023; Noronha et al., 2020). Several studies have reported insufficient nutrition knowledge among coaches, raising concerns about the appropriateness of the dietary advice they provide (Jagim et al., 2021; Janiczak et al., 2022; Klein et al., 2021).

However, evidence remains limited regarding the simultaneous assessment of nutrition knowledge, sources of nutrition information, and self-reported nutrition-related recommendations among swimming coaches in Morocco. To our knowledge, few studies have examined these three dimensions together in this population, highlighting an important gap in the literature. The novelty of the present study lies in the simultaneous assessment of sports nutrition knowledge, sources of nutrition information, and self-reported nutrition recommendations among Moroccan swimming coaches within the same national context. Therefore, the present study aimed to assess the nutrition knowledge of Moroccan swimming coaches, identify their main sources of nutrition information, and examine the nutrition-related recommendations they reported providing to their swimmers.

METHOD

Research Design

This cross-sectional study involved 110 coaches from five regional leagues in the cities of Casablanca, Rabat, Marrakech, Laayoune, and Fez. The study was coordinated from Oujda, Morocco,

between December 2025 and June 2026, while data were collected simultaneously through an online questionnaire from coaches across the five regional leagues.

Participant

The target population consisted of 153 eligible swimming coaches from five regional leagues. All eligible coaches were invited to participate using a census-invitation approach. Yamane's formula was used only as a planning reference and indicated a target sample size of approximately 111 coaches at a 95% confidence level and 5% margin of error. A total of 110 coaches (86 male and 24 female) completed the questionnaire, corresponding to a response rate of 71.9%. Therefore, the final sample consisted of respondents to the census invitation rather than a probability sample.

$$n = \frac{N}{1 + N(e^2)} = \frac{153}{1 + 153(0.05^2)} = \frac{153}{1.3825} \approx 110{,}7$$

Data were collected from Moroccan swimming coaches in accordance with procedures approved by the ethics committee. The overall study design and sampling process are summarized in Figure 1**.**

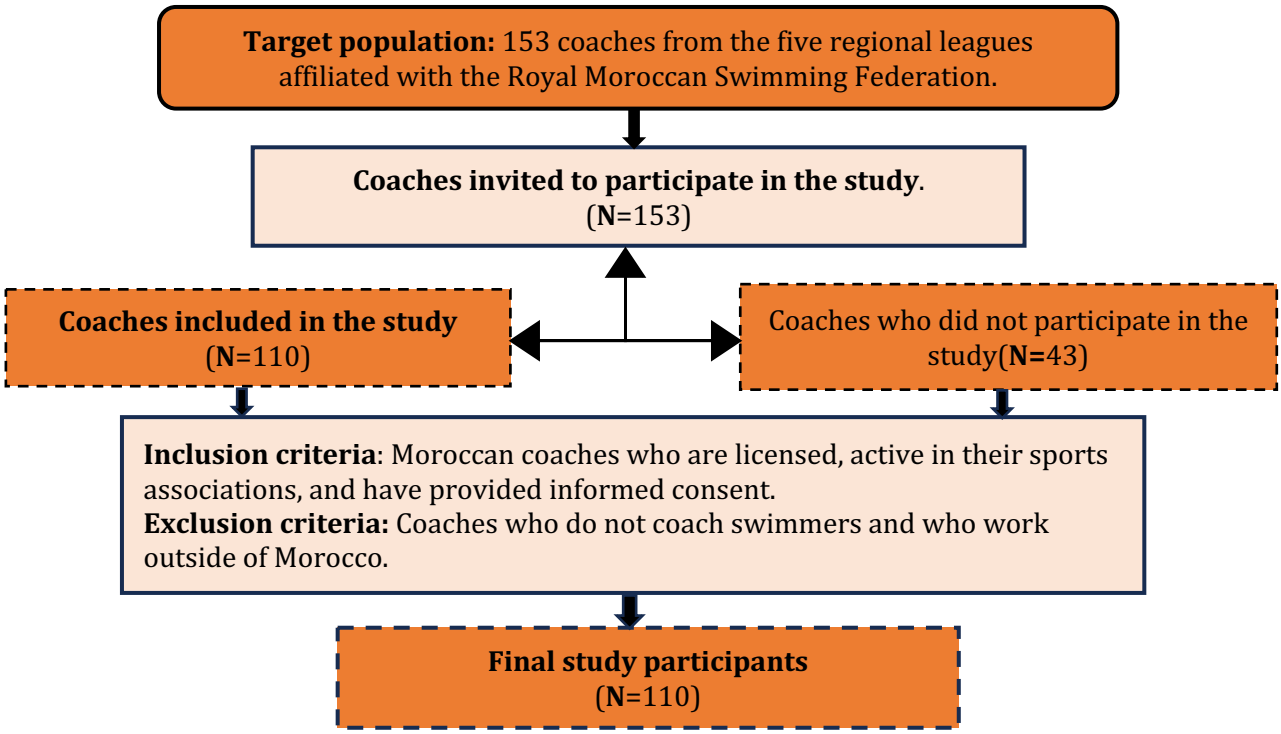

Figure 1. Design and Study Sample

Instrumentation

Data were collected using a self-administered questionnaire designed to assess sports nutrition knowledge among Moroccan swimming coaches and to evaluate the self-reported nutrition-related recommendations they provide to their swimmers. The questionnaire was developed based on previously validated instruments for assessing nutrition knowledge, particularly those developed by (Parmenter & Wardle, 2000) as well as the study by (Karpinski et al., 2019). Additional items and concepts were incorporated from relevant scientific literature on sports nutrition, including studies by (Couture et al., 2015; Zinn et al., 2006) .

The original questionnaire, developed in English, was translated into French by the research team. The French version was subsequently reviewed by an expert in sports nutrition and sports sciences to assess the clarity and contextual appropriateness of the items within the Moroccan setting. This process was considered a limited linguistic and contextual adaptation, as full construct and cultural validation among Moroccan swimming coaches has not yet been established. Minor modifications were made to some items to improve their comprehensibility and suitability for Moroccan swimming coaches. Internal consistency was assessed for the knowledge domain only, which comprised 49 items. Each knowledge item was scored as 1 for a correct response, 0 for an "I don't know" response, and −1 for an incorrect response. Because the knowledge items were scored

using three response categories rather than dichotomously, Cronbach's alpha was used to assess internal consistency. The resulting Cronbach's alpha coefficient was 0.865, indicating good internal consistency. The final questionnaire consisted of 70 questions divided into three sections. The first section collected sociodemographic and professional characteristics of the coaches, including sex, age, educational level, nutrition training, years of coaching experience, and other relevant characteristics, through nine questions. The second section assessed sports nutrition knowledge using 49 items derived from the questionnaire developed by (Karpinski et al., 2019).

These items covered six domains: carbohydrates (11 items), proteins (9 items), fats (7 items), hydration (7 items), micronutrients (7 items), and weight management (8 items). Each item was assessed using three response options: correct answer (+1 point), incorrect answer (−1 point), and "I don't know" response (0 points). The overall nutrition knowledge score was calculated by summing the points assigned to the 49 items, with a theoretical score range from −49 to +49. Higher scores indicated a greater level of sports nutrition knowledge. Some questionnaire items included multiple sub-items, particularly food examples within the carbohydrate section. For items containing multiple sub-items, each sub-item was scored separately; however, these sub-items were part of the original 49 scoring units and did not create additional scoring units. Therefore, the score calculation procedure incorporated the hierarchical structure of the questionnaire to reflect the different levels of nutrition knowledge assessment accurately. The third section examined the self-reported nutritional recommendations provided by coaches to their swimmers. This section was developed based on the work of (Parmenter & Wardle, 2000) supplemented by additional references in sports nutrition (Couture et al., 2015; Zinn et al., 2006) and subsequently adapted following expert consultation to ensure its relevance to the context of Moroccan swimming.

It consisted of 12 questions covering three main domains: (1) recommendations related to macronutrient intake; (2) hydration-related recommendations; and (3) the main sources of nutrition information used by coaches. Self-reported nutrition recommendation practices were assessed by asking coaches to report the number of swimmers to whom they had recommended increasing carbohydrate, protein, fluid, or fat intake during the previous 12 months. For each nutrient category, the recommendation score corresponded to the number of swimmers whom the coach reported as having received the respective recommendation. These scores were treated as count variables, with a theoretical minimum of zero. Because the total number of swimmers coached by each coach was not collected using a standardized denominator, recommendation scores were interpreted as absolute counts rather than as proportions or percentages of the swimmers receiving these recommendations. Sources of nutrition information were assessed using a single-choice question with the following response categories: Internet, scientific articles, club or federation documents, fellow coaches, and nutritionists.

Analysis Plan

The data were entered and analyzed using SPSS software (version 21.0). Qualitative variables were described using frequencies and percentages, whereas quantitative variables were presented as mean ± standard deviation or median and interquartile range (IQR), depending on the distribution of the data. Although 110 coaches participated in the study, the sample size varied across analyses because of missing data for some variables. Descriptive analyses were based on available data, whereas analyses requiring complete data were conducted using complete cases. The normality of continuous variables was assessed using the Shapiro–Wilk test, complemented by visual inspection of histograms and Q–Q plots. Homogeneity of variances was assessed using Levene's test. When the assumptions for parametric tests were met, the independent-samples Student's t-test was used for comparisons between two groups, and one-way ANOVA was used for comparisons among three or more groups. When these assumptions were not met, the corresponding non-parametric tests were used: the Mann–Whitney U test for comparisons between two groups and the Kruskal–Wallis H test for comparisons among three or more groups. When statistically significant overall differences were observed using ANOVA or the Kruskal–Wallis test, appropriate post-hoc pairwise comparisons were performed, where applicable.

For self-reported nutrition recommendation practices, given their non-normal distribution, the results were presented as the median (P50) and interquartile range (IQR; P25–P75). The Mann–Whitney U test was used for comparisons according to gender, educational level, and nutrition

training, whereas the Kruskal–Wallis H test was used for comparisons according to age and years of coaching experience. Depending on the test used, the U statistic, standardized Z value, H statistic, degrees of freedom (df), and P value were reported. Missing data were handled using a complete-case approach for each analysis. Participants with missing values for variables required for a specific analysis were excluded only from that analysis, while their available data were retained for other analyses. Given the number of subgroup comparisons performed, the potential for inflation of the Type I error rate due to multiple testing was acknowledged, and the statistical findings were interpreted cautiously. Statistical significance was set at a P value < 0.05. To control the family-wise Type I error rate across the self-reported nutrition recommendation analyses, Holm adjustment was applied to the 20 subgroup comparisons comprising four recommendation outcomes (carbohydrate, protein, fluid, and fat) across five coach characteristics (gender, age, educational level, coaching experience, and nutrition training). Both nominal and Holm-adjusted p-values were considered when interpreting the findings.

RESULTS AND DISCUSSION

Results

Sociodemographic Characteristics of the Participants.

A total of 110 Moroccan swimming coaches were surveyed in this study. The sociodemographic data of the participants are presented in Table 1.

Table 1. Sociodemographic Characteristics of Moroccan Coaches**(N=110)**

Variable	Category	N	(%)
Gender	Male	86	78.2
	Female	24	21.8
Age	Under 40	60	54.5
	Between 40 and 50	25	22.7
	51 and above	25	22.7
Education Level	University	99	90.0
	Secondary	11	10.0
Gender of the trained swimmers	Male	8	7.3
	Female	7	6.4
	Male/Female	95	86.3
Level of the trained swimmers	Regional	37	33.6
	National	54	49.1
	International	19	17.3
Coaches' nutrition training	No	45	40.9
	Yes	65	59.1
Coaches' perceived nutrition competencies	Beginner	37	33.6
	Intermediate	59	53.6
	Advanced	14	12.7
Years of coaching experience	Under 10	57	51.8
	Between 10 and 20	38	34.5
	21 and above	15	13.6

Note: Data are presented as n (%). n, number of participants; %, percentage. Nutrition training refers to previous formal training in sports nutrition. Perceived nutrition competency was self-rated as beginner, intermediate, or advanced.

A total of 110 Moroccan swimming coaches were included in the study. The results showed a high proportion of male coaches (78.2%), who were relatively young (39.68 ± 13.14 years) and generally highly educated (90%). Most coaches (86.3%) coached both male and female swimmers. Regarding the competitive level of the swimmers they coached, 49.1% of coaches worked at the national level, 33.6% at the regional level, and 17.3% at the international level. Nutrition training was reported by 59.1% of the coaches, while 40.9% had received none. Regarding perceived nutritional competencies, 53.6% of participants considered themselves at an intermediate level, 33.6% at a

beginner level, and 12.7% at an advanced level. Finally, 51.8% of coaches had less than 10 years of experience, 34.5% had 10 to 20 years of experience, and 13.6% had 21 or more years of experience.

Analysis of Sports Nutrition Knowledge Scores Among Coaches

Table 2 presents the coaches' nutrition knowledge scores across the six assessed domains, as well as the overall nutrition knowledge score.

Table 2. Mean Scores for Coaches' Nutrition Knowledge by Domain and Overall

Gender	N	Nutrition knowledge domain	No. of items	Maximum possible net score	Mean ± SD	Normalized net score (%)	95% CI for the mean
Female	24	Carbohydrate	11	11	4.80 ± 3.69	43.64	[3.32; 6.28]
		Protein	9	9	5.15 ± 2.17	57.22	[4.28; 6.02]
		Fat	7	7	4.26 ± 2.76	60.86	[3.16; 5.36]
		Hydration	7	7	2.71 ± 3.35	38.71	[1.37; 4.05]
		Micronutrients	7	7	5.46 ± 1.72	78.00	[4.77; 6.15]
		Weight management	8	8	4.47 ± 2.46	55.88	[3.49; 5.45]
	24	Overall nutrition knowledge score	49	49	26.84 ± 11.87	54.78	[22.09; 31.59]
Male	86	Carbohydrate	11	11	6.51 ± 2.70	59.18	[5.94; 7.08]
		Protein	9	9	5.71 ± 2.05	63.44	[5.28; 6.14]
		Fat	7	7	4.50 ± 2.12	64.29	[4.05; 4.95]
		Hydration	7	7	3.91 ± 2.50	55.86	[3.38; 4.44]
		Micronutrients	7	7	5.89 ± 1.61	84.14	[5.55; 6.23]
		Weight management	8	8	4.56 ± 2.91	57.00	[3.94; 5.18]
	82	Overall nutrition knowledge score	49	49	31.09 ± 9.66	63.45	[29.05; 33.13]
Total	110	Carbohydrate	11	11	6.16 ± 3.04	56.00	[5.59; 6.73]
		Protein	9	9	5.56 ± 2.06	61.78	[5.18; 5.95]
		Fat	7	7	4.48 ± 2.26	64.00	[4.06; 4.90]
		Hydration	7	7	3.69 ± 2.75	52.71	[3.18; 4.20]
		Micronutrients	7	7	5.80 ± 1.62	82.86	[5.50; 6.10]
		Weight management	8	8	4.59 ± 2.77	57.38	[4.07; 5.11]
	106	Overall nutrition knowledge score	49	49	30.13 ± 10.29	61.49	[28.15; 32.11]

Note. *Values are presented as mean ± SD. Normalized net scores (%) were calculated as (mean net score / maximum possible net score) × 100. Nutrition knowledge was scored as +1 for correct, -1 for incorrect, and 0 for "I don't know" responses. Domain scores were calculated using all available observations (N = 110), whereas the overall score was calculated from complete responses to all 49 items (N = 106). Thus, domain-specific and overall scores are based on different analytical samples.*

Among the 110 coaches, normalized net scores ranged from 52.71% for hydration to 82.86% for micronutrients**.** The corresponding scores were 64.00% for fat, 61.78% for protein, 57.38% for weight management, and 56.00% for carbohydrates. Descriptively, male coaches had higher mean scores than female coaches across all six domains. The mean overall nutrition knowledge score among

the 106 coaches with complete data was 30.13 ± 10.29 out of 49 (95% CI: 28.15–32.11), corresponding to a normalized net score of 61.49%**.** The mean overall score was 26.84 ± 11.87 among female coaches (*N* = 24) and 31.09 ± 9.66 among male coaches (*N* = 82). Statistical comparisons between groups are presented in Table 3**.**

Comparison of Sports Nutrition Knowledge Scores According to Gender, Level of Education, and Nutrition Training

The results of the analysis of the differences in nutrition knowledge scores and the sociodemographic characteristics of the coaches are summarized in Table 3.

Table 3. Comparison of Overall Nutrition Knowledge Scores by Gender, Educational Level, and Nutrition Training

Variable	Category	N	Mean ±SD	Test	t(df)	Cohen's d [95% CI]	*P*-value
Gender	Female	24	26.84 ± 11.87	Student's t-test	-1.79 (104)	−0.42 [-0.87 ;0.04]	0.07
	Male	82	31.09 ± 9.66				
Education Level	University	95	31.01 ± 9.41	Welch's t-test	-1.46 (9.96)	0.65 [−0.01 ;1.30]	0.17
	Secondary	10	24.67 ± 13.32				
Coaches' nutrition training	No	45	29.08 ±11.01	Student's t-test	-0.89 (104)	−0.18 [−0.56 ;0.21]	0.37
	Yes	61	30.90 ± 9.75				

Note. N denotes participants with complete data for the knowledge score and grouping variable. Of 110 coaches, 106 had complete knowledge scores; 105 were included in the education comparison due to one missing value. Student's t-tests were used for gender and nutrition training, and Welch's t-test for education (Levene's P = 0.049). Cohen's d represents the mean difference between the first- and second-listed categories; positive values indicate higher scores in the first category.

The results showed that none of the three characteristics examined (gender, education level, and nutrition training) was associated with a statistically detectable difference in the total nutrition knowledge score. The difference by gender was close to, but did not reach, the conventional threshold for statistical significance (p = 0.07). In contrast, the difference by education level showed a larger effect size but with substantial uncertainty.

Comparison of Sports Nutrition Knowledge Scores According to Age and Years of Experience

Table 4 presents the comparison of nutrition knowledge scores according to coaches' age and years of coaching experience using the Kruskal–Wallis test.

Table 4. Comparison of Sports Nutrition Knowledge Scores by Age and Years of Coaching Experience (N=106)

Kruskal-wallis Test		Median	IQR 25-75	H(df)	*p*-value
Variable	**Category**				
Age	Under 40	32.14	[25.42;38.71]	4.376 (2)	0.11
	Between 40 and 50	32.71	[23.14;41.57]		
	51 and above	26.64	[18.71;33.21]		
Years of coaching experience	Under 10	31.57	[25.42;36.14]	1.704 (2)	0.42
	Between 10 and 20	32.21	[22.03;41.39]		
	21 and above	27.28	[15.25;35.60]		

Note. Sports nutrition knowledge scores are presented as median [interquartile range (IQR)]. Differences between age and coaching experience groups were assessed using the Kruskal–Wallis H test. A p-value < 0.05 was considered statistically significant. N = 106; four of the 110 participants had missing knowledge-score data and were excluded from these analyses.

Overall, neither age nor years of coaching experience was associated with statistically detectable differences in total nutrition knowledge scores. Although older coaches and those with more coaching experience had lower median scores, these differences should be interpreted cautiously given the lack of statistical significance.

Nutritional practices recommended by coaches to swimmers

Moroccan coaches were asked about the recommendations they gave to swimmers in Section 3 of the questionnaire. Recommendations for Carbohydrate Intake**:** Table 5 presents the self-reported carbohydrate intake recommendation practices according to coaches' sociodemographic characteristics.

Table 5. Self-Reported Carbohydrate Intake Recommendation Practices by Coaches' Characteristics

Parameters	Variable	Category	N	Median	IQR	Test statistic	*p*-value	*p*-Holm
Self-reported Carbohydrate intake recommendation practice	Gender	Female	23	6.00	[3.00 ;14.00]	U = 923.00; Z = −0.493	0.62	1.00
		Male	86	5.00	[1.50 ;11.50]			
	Age	Under 40	59	5.00	[2.00 ;12.00]	H = 0.594; df = 2	0.74	1.00
		Between 40 and 50	25	8.00	[0.00 ;13.00]			
		51 and above	25	4.00	[0.50 ;10.50]			
	Education Level	University	98	4.50	[3.25 ;7.50]	U = 489.00; Z = −0.011	0.99	1.00
		Secondary	10	5.00	[1.75 ;12.00]			
	Years of Coaching Experience	Under 10	56	4.00	[2.00 ;10.00]	H = 2.161; df = 2	0.34	1.00
		Between 10 and 20	38	5.00	[0.00 ;14.00]			
		21 and above	15	10.00	[1.00 ;20.00]			
	Coaches' nutrition Training	No	44	3.00	[0.25 ;9.50]	U =1761.00; Z = 2.057	0.04	0.76
		Yes	65	6.00	[2.00 ;20.00]			

Note. Values are presented as median (IQR). Mann–Whitney U tests were used for two-group comparisons, and Kruskal–Wallis H tests were used for comparisons involving more than two groups. Holm adjustment was applied across the 20 subgroup comparisons to control the family-wise Type I error rate. Both nominal and Holm-adjusted p-values are reported. Statistical significance after multiple-comparison correction was defined as an adjusted p-value < .05.

Most sociodemographic characteristics were not associated with detectable differences in the number of self-reported carbohydrate-intake recommendations. Nutrition training was the only characteristic showing a nominally significant difference; however, this association did not remain significant after Holm correction for multiple comparisons. Overall, these findings suggest that sociodemographic characteristics had limited influence on coaches' reported carbohydrate-recommendation practices.

Recommendations for Protein Intake

Table 6 presents the self-reported protein intake recommendation practices according to coaches' sociodemographic.

Table 6. Self-Reported Protein Intake Recommendation Practices by Coaches' Characteristics

Parameters	Variable	Category	N	Median	IQR	Test statistic	*p*-value	*p*-Holm
Self-reported protein intake recommendation practice	Gender	Female	24	6.00	[6.00; 10.00]	U = 1063.00; Z = 0.226	0.82	1.00
		Male	86	5.00	[5.00 ;12.00]			
	Age	Under 40	60	6.00	[2.00 ;12.00]	H = 2.015; df = 2	0.36	1.00
		Between 40 and 50	25	4.00	[1.00 ;10.50]			
		51and above	25	4.00	[0.50 ;8.50]			
	Education Level	University	99	4.00	[4.00; 6.50]	U = 570.00; Z = 0.792	0.43	1.00

Parameters	Variable	Category	N	Median	IQR	Test statistic	*p*-value	*p*-Holm
		Secondary	10	5.00	[5.00; 12.00]			
	Years of Coaching Experience	Under 10	57	5.00	[2.00;10.00]	H = 1.169; df = 2	0.56	1.00
		Between 10 and 20	38	7.00	[2.00;12.25]			
		21 and above	15	6.00	[0.00;15.00]			
	Coaches' nutrition Training	No	45	4.00	[4.00; 10.00]	U = 1748.50; Z = 1.748	0.08	1.00
		Yes	65	6.00	[6.00; 12.00]			

Note. Values are presented as median (IQR). Mann–Whitney U tests were used for two-group comparisons, and Kruskal–Wallis H tests were used for comparisons involving more than two groups. Holm adjustment was applied across the 20 subgroup comparisons to control the family-wise Type I error rate. Both nominal and Holm-adjusted p-values are reported. Statistical significance after multiple-comparison correction was defined as an adjusted p-value < .05.

Most coaches' characteristics were not associated with detectable differences in the number of self-reported protein-intake recommendations. Although coaches with nutrition training reported a higher number of recommendations than those without training, this difference did not reach statistical significance. Overall, these findings suggest that sociodemographic and training characteristics had limited influence on coaches' reported protein-recommendation practices. Recommendations for liquids intake*:* Table 7 presents the self-reported fluid intake recommendation practices according to coaches' sociodemographic characteristics.

Table 7. Self-Reported Liquid Intake Recommendation Practices by Coaches' Characteristics

Parameters	Variable	Category	N	Median	IQR	Test statistic	*p*-Value	*p*-Holm
Self-reported Liquids intake recommendation practice	Gender	Female	24	3.50	[0.00 ;10.75]	U =1193,00 Z=1,175	0.24	1.00
		Male	86	5.00	[1.00 ;15.50]			
	Age	Under 40	60	5.00	[1.00 ;15.00]	H = 0.331; df = 2	0.85	1.00
		Between 40 and 50	25	7.00	[1.00 ;16.00]			
		51 and above	25	4.00	[0.50 ;15.00]			
	Education Level	University	99	3.00	[0.75 ;6.75]	U = 581.00; Z = 0.910	0.36	1.00
		Secondary	10	5.00	[0.00 ;15.00]			
	Years of Coaching Experience	Under 10	57	4.50	[1.00 ;13.75]	H = 0.332; df = 2	0.85	1.00
		Between 10 and 20	38	5.00	[0.00 ;17.00]			
		21 and above	15	6.00	[0.00 ;20.00]			
	Coaches' nutrition Training	No	45	3.00	[0.00 ;10.00]	U = 1809.50; Z = 2.127	0.03	0.60
		Yes	65	6.00	[2.00 ;19.25]			

Note. Values are presented as median (IQR). Mann–Whitney U tests were used for two-group comparisons, and Kruskal–Wallis H tests were used for comparisons involving more than two groups. Holm adjustment was applied across the 20 subgroup comparisons to control the family-wise Type I error rate. Both nominal and Holm-adjusted p-values are reported. Statistical significance after multiple-comparison correction was defined as an adjusted p-value < .05.

Most sociodemographic characteristics were not associated with detectable differences in self-reported fluid recommendation counts. Nutrition training showed a nominal difference (p = .03); however, this difference was no longer statistically significant after Holm correction for multiple

comparisons (adjusted p = .60). Therefore, the findings do not provide evidence of a statistically detectable difference in fluid recommendation practices according to nutrition training after correction.

Recommendations for Fat Intake

Table 8 presents the self-reported fat intake recommendation practices according to coaches' sociodemographic.

Table 8. Self-Reported Fat Intake Recommendation Practices by Coaches' Characteristics

Parameters	Variable	Category	N	Median	IQR	Test statistic	*p*-Value	*p*-Holm
Self-reported Fat intake recommendation practice	Gender	Female	24	4.50	[0.00 ;11.50]	U = 1038,50 Z=0.047	0.96	1.00
		Male	86	4.00	[1.00 ;10.00]			
	Age	Under 40	60	4.00	[1.00 ;10.00]	H = 0.043; df = 2	0.98	1.00
		Between 40 and 50	25	4.00	[0.00 ;10.00]			
		51 and above	25	4.00	[1.00 ;12.00]			
	Education Level	University	99	3.00	[0.00 ;6.25]	U = 578.00; Z = 0.879	0.38	1.00
		Secondary	10	4.00	[1.00 ;12.00]			
	Years of Coaching Experience	Under 10	57	4.00	[1.00 ;10.00]	H = 0.282; df = 2	0.87	1.00
		Between 10 and 20	38	3.50	[0.00 ;10.50]			
		21 and above	15	5.00	[0.00 ;14.00]			
	Coaches' nutrition Training	No	45	3.00	[0,00 ;10,00]	U = 1720.00; Z = 1.578	0.11	1.00
		Yes	65	5.00	[1.25 ;12.00]			

Note. Values are presented as median (IQR). Mann–Whitney U tests were used for two-group comparisons, and Kruskal–Wallis H tests were used for comparisons involving more than two groups. Holm adjustment was applied across the 20 subgroup comparisons to control the family-wise Type I error rate. Both nominal and Holm-adjusted p-values are reported. Statistical significance after multiple-comparison correction was defined as an adjusted p-value < .05.

Overall, none of the sociodemographic or training-related characteristics examined were associated with statistically detectable differences in self-reported fat-intake recommendation practices. Although a slightly higher median was observed among coaches who had received nutrition training, this difference did not reach the conventional threshold for statistical significance.

Sources of Nutritional Information

More than half of the coaches reported the Internet as their primary source of nutrition information (61.8%), followed by club or federation documents (27.3%). Scientific journals (5.5%), fellow coaches (3.6%), and nutritionists (1.8%) were reported less frequently.

Table 9. Coaches' Sources of Nutritional Information

Source of Nutritional Information	N	%
Internet	68	61.8%
Club or Federation documents	30	27.3%
Scientific journals	6	5.5%
Coach colleagues	4	3.6%
Nutritionist	2	1.8%

Note: Data are presented as n (%). Participants reported their primary source of nutrition information.

Discussion

To our knowledge, this study is one of the first to assess nutrition knowledge and self-reported nutrition-related recommendations among swimming coaches in Morocco. This study examined coaches' sports nutrition knowledge and the self-reported nutrition recommendations they provided to their swimmers. The results showed a high proportion of male coaches (78.2%), who were relatively young (39.68 ± 13.14 years) and generally highly educated (90%). The coaches' mean overall nutrition knowledge score was 30.13 ± 10.29 out of a maximum possible net score of 49, corresponding to a normalized net score of 61.49%. After normalization of the scores according to the number of items in each domain, micronutrients showed the highest normalized net score (82.9%), whereas hydration showed the lowest (52.71%). This pattern is broadly consistent with Hulland et al. (2024), who identified hydration as one of the less well-understood areas of sports nutrition. However, because the present study used normalized net scores and the adapted instrument has not been fully validated among Moroccan swimming coaches, the hydration result should be interpreted as the lowest-performing domain rather than as evidence of a confirmed knowledge deficiency. Accordingly, hydration-related knowledge may warrant further investigation and particular attention in future educational initiatives.

The questionnaire administered covered nearly the same topics as those used in previous studies but assessed the coaches' knowledge in greater detail. These findings are broadly comparable to those reported by (Couture et al., 2015). Similarly, the study by (Torres-McGehee et al., 2012) reported an average score of (65.9%) among 131 coaches. A similar study by (Smith-Rockwell et al., 2001) found an average score of (67%) among coaches with a college education. However, despite the coaches' high level of education, their nutrition knowledge is reflected by the scores obtained among men and women (31.09 ± 9.66 vs. 26.84 ± 11.87 out of 49 points) and does not allow conclusions to be drawn regarding mastery of sports nutrition. Recent studies suggest that greater coaching experience facilitates the acquisition of nutrition knowledge and enhances the relevance of the nutritional recommendations provided by coaches. (Alahmadi & Albassam, 2023; Hamer et al., 2023). Our results suggest no significant difference in average nutritional knowledge scores between Female and Male coaches. These findings are consistent with previous studies by (Couture et al., 2015). Furthermore, no significant difference was observed between nutritional knowledge, educational level, and nutrition training. The absence of an association between previous nutrition training and nutrition knowledge in the present study may be explained by differences in the quality, content, and recency of the training received. (Altınok & Baş, 2025) emphasized that nutrition education should be continuous, as sports nutrition recommendations evolve rapidly, and highlighted the importance of regular professional development and access to reliable, evidence-based nutrition information. Participation in nutrition training may contribute to improving nutrition knowledge and enhancing the understanding of healthy dietary practices. A systematic review of the literature has confirmed that nutrition education interventions lead to significant improvements in nutrition knowledge (Tam et al., 2019). These findings are consistent with those reported by Altınok and Baş (Altınok & Baş, 2025)who found no statistically significant differences in nutrition knowledge across age categories. Similarly, in the present study, nutrition knowledge did not differ significantly according to age. This observation is also consistent with previous research suggesting that coaches' nutrition knowledge is not necessarily systematically associated with sociodemographic characteristics such as age (Lynch et al., 2024).

Regarding coaches' self-reported nutrition recommendation practices, no statistically detectable differences were observed according to gender, age, educational level, or years of coaching experience for recommended carbohydrate, protein, fluid, or fat intake. These findings are consistent with those of a recent study by (Altınok & Baş, 2025) suggesting that coaches' nutrition knowledge or sociodemographic characteristics do not necessarily translate into differences in their self-reported recommendation practices. Although nominal differences were observed according to previous nutrition training for carbohydrate and fluid recommendations, these associations were no longer statistically significant after adjustment for multiple comparisons. These findings should be interpreted cautiously and do not support the conclusion that nutrition training necessarily leads to more frequent or higher-quality recommendations. This interpretation is consistent with the broader literature, which suggests that nutrition education may contribute to the development of coaches'

nutrition-related practices, while the extent to which such training translates into improvements in the quality or accuracy of recommendations requires further investigation (Jacob et al., 2016).

Taken as a whole, these findings suggest that sociodemographic characteristics have a limited influence on coaches' nutritional recommendation practices. Although some differences in self-reported recommendation patterns were observed according to nutrition training, these findings should be interpreted cautiously. The present study assessed the number of athletes for whom coaches reported recommending increased carbohydrate, fat, protein, or fluid intake; however, it did not assess whether these recommendations were consistent with established sports nutrition guidelines or tailored to athletes' individual needs. Therefore, nutrition training should not be interpreted as an indicator of more evidence-based or appropriate nutritional recommendations. Rather, these findings indicate that nutrition training may be associated with differences in reported recommendation practices, without allowing conclusions to be drawn regarding the quality or evidence base of those recommendations.

Our findings indicate that the Internet was the primary source of nutritional information among coaches (61.8%), consistent with previous studies (Couture et al., 2015; Smith-Rockwell et al., 2001; Zinn et al., 2006). Although online resources provide convenient access to nutrition information, their scientific quality and credibility vary, potentially exposing coaches to inaccurate or insufficiently evidence-based information. Federation and club documents were the second most frequently reported source, whereas scientific journals were used relatively infrequently despite the high proportion of coaches with university-level education. Similarly, (Elsahoryi et al., 2021) reported limited use of scientific publications and specialized books among coaches. These findings suggest that formal education alone may not ensure adequate evidence-appraisal skills. Strengthening sports nutrition education, promoting evidence-based resources, and encouraging collaboration with qualified nutrition professionals may therefore improve the quality of nutritional advice and support athletes' health and performance (Burger et al., 2024; Lambert et al., 2022; Voelker et al., 2022)

Implications

These findings highlight the need for targeted continuing education for Moroccan swimming coaches, particularly in areas where nutrition knowledge could be strengthened. Hydration may warrant particular attention in future continuing education because it showed the lowest normalized net score among the nutrition domains assessed; however, this finding should not be interpreted as evidence of a confirmed knowledge deficiency. Given that the Internet was the most frequently reported source of nutrition information, strengthening coaches' digital nutrition literacy and their ability to critically evaluate information available online may also be valuable. In addition, continuing education could promote appropriate collaboration with qualified sports nutrition professionals when more specialized nutritional guidance is required. These implications should be considered primarily in terms of education, critical appraisal of nutrition information, and professional collaboration, as the present study did not assess athletes' actual dietary intake, hydration status, or performance outcomes.

Research Contribution

This study provides context-specific descriptive and exploratory evidence on sports nutrition knowledge, sources of nutrition information, and self-reported nutrition recommendations among Moroccan swimming coaches. By examining these three dimensions within the same national and sport-specific context, the study extends the limited literature on sports nutrition practices among coaches in Morocco and provides baseline evidence for future comparative and longitudinal research. In particular, the identification of hydration as the lowest-scoring knowledge domain and the Internet as the predominant source of nutrition information provides practical direction for the development of targeted continuing education and digital nutrition literacy initiatives. The findings may also support swimming organizations, federations, and coach-education providers in identifying areas that warrant greater attention in professional development programs. However, the study does not

establish that nutrition training leads to better recommendations, nor does it assess the quality, appropriateness, or adherence of these recommendations to established sports nutrition guidelines. Therefore, its primary contribution lies in providing empirical baseline evidence that can guide future research and the development of more evidence-based nutrition education for swimming coaches.

Limitations

Several limitations should be considered. The voluntary online survey may have introduced selection and non-response bias, while the unequal gender distribution may limit comparisons between male and female coaches. Although the adapted 49-SNKI showed good internal consistency, its cultural and construct validity has not been fully established among Moroccan swimming coaches. In addition, recommendation practices were measured as absolute self-reported counts without accounting for the total number of swimmers coached, which may have affected comparisons between coaches. Complete-case analyses slightly reduced the analytical sample, and multiple subgroup comparisons increased the possibility of chance findings despite Holm adjustment. Finally, self-reported recommendations were not independently verified or evaluated against established sports nutrition guidelines. Therefore, the findings should be interpreted primarily as descriptive and exploratory evidence rather than as indicators of actual nutrition competence or recommendation quality.

Suggestions

Future research should first focus on the comprehensive validation of the adapted 49-SNKI Future studies should further validate the adapted 49-SNKI within the Moroccan swimming context and include larger, more representative samples from different regions and swimming organizations. Recommendation practices should be standardized according to the number of athletes coached and evaluated against established sports nutrition guidelines rather than assessed only by frequency. Future research should also incorporate objective measures of swimmers' dietary intake, hydration status, and relevant performance indicators. Given the predominant use of the Internet as a nutrition information source, coaches' digital nutrition literacy and ability to critically evaluate online information should also be examined. Finally, controlled nutrition-education interventions, particularly addressing hydration, evidence-based information appraisal, and collaboration with qualified nutrition professionals, are recommended to determine whether structured education can improve coaches' knowledge and recommendation practices.

CONCLUSION

This study provides baseline evidence on sports nutrition knowledge, sources of nutrition information, and self-reported recommendation practices among Moroccan swimming coaches. Nutrition knowledge varied across the assessed domains, with hydration emerging as the area requiring the greatest attention, while knowledge of micronutrients was comparatively stronger. Overall, demographic and professional characteristics were not associated with statistically detectable differences in nutrition knowledge or self-reported recommendation practices. The predominant reliance on the Internet as a source of nutrition information further emphasizes the importance of strengthening coaches' ability to identify, critically evaluate, and apply evidence-based nutrition information. Taken together, these findings support the development of structured continuing education for swimming coaches, with particular emphasis on hydration and the critical appraisal of online nutrition information. Such initiatives may help strengthen the evidence base and consistency of nutrition guidance provided to swimmers. Nevertheless, because the recommendations were self-reported, their quality, appropriateness, and consistency with established sports nutrition guidelines could not be determined. Future research should therefore evaluate coaches' recommendations against established guidelines and examine how they are tailored to the individual needs of swimmers.

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AUTHOR CONTRIBUTION STATEMENT

In this manuscript, HM contributed to conceptualization, investigation, writing the original draft, and project administration. LA contributed to methodology, validation, supervision, and project administration, while AN contributed to methodology, validation, writing—review and editing, and project administration. MM contributed to formal analysis and data curation, and HR contributed to investigation and data curation.

AI DISCLOSURE STATEMENT

The authors used ChatGPT and Grammarly solely to assist with language editing and manuscript organization. These tools were not used to generate, modify, or analyze the research data. All scientific content, statistical results, citations, and references were independently verified by the authors, who take full responsibility for the final manuscript.

CONFLICT OF INTEREST

The authors declare no financial, professional, or personal conflicts of interest that could have influenced the conduct or reporting of this study.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Biomedical Research Ethics Committee of Oujda (CERBO), Morocco (Approval No. 06/2026; approved on 3 April 2026). The study was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki. Before participation, all participants were informed about the study objectives, procedures, confidentiality measures, and their right to withdraw from the study. Electronic informed consent was obtained from all participants prior to completion of the questionnaire.

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