Validity and reliability of the Sports Nutrition Knowledge Questionnaire for the Turkish athletes

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ABSTRACT

Objective: The aim of this research is to determine validity and reliability of Sports Nutrition Knowledge Questionnaire (SNKQ) for the Turkish athletes.

Materials and Methods: A total of 210 participants (n = 125 elite athletes and n = 85 Nutrition and Dietetics Department senior students) aged 19-30 years were enrolled in the research. SNKQ was evaluated utilizing the psychometric criteria to determine the reliability of items, test-retest reliability and known groups validity, by significance test (Independent Samples t-Test) of the difference between the two groups. After two weeks, SNKQ was applied again to some participants (n = 42) with the purpose of assuring test-retest reliability.

Results: The Sports Nutrition Knowledge Questionnaire was detected as valid and reliable according to the high internal consistency value (Kuder Richardson-20 (KR-20) = 0.927) and high test-retest reliability intraclass correlation coefficient (ICC = 0.974). The difference between SNKQ total scores of athletes (36.0 ± 8.1) and Nutrition and Dietetics Department students (59.1 ± 5.98) was statistically significant; thus, the known groups validity was obtained (p < 0.001).

Conclusion: The Sports Nutrition Knowledge Questionnaire is valid and reliable. It can be easily used to determine the nutrition knowledge level of the Turkish athletes.

Keywords: Sports nutrition, Knowledge, Reliability and validity, Athletes

1. INTRODUCTION

Adequate and balanced nutrition is essential for athletic performance [1]. In addition, special nutritional strategies may increase performance by supporting adaptations in exercise [2,3]. However, some nutrients are inadequate in diets of the athletes who do not consume a sufficient amount of fruits, vegetables, and dairy products. [4-8]. Nutrition knowledge is one of the factors that influence food choice. Knowledge has defined both consciousness and the facility to practice this consciousness when it comes to people opting for healthy food on a daily basis [9]. It has been observed that athletes are misinformed about the roles of proteins, vitamins and mineral supplements [10], as well as current recommendations on carbohydrate intake [11]. Coaches also lack knowledge about the energy density of nutrients, supplementation and the role of proteins [12]. The inadequacy of athletes' nutrition knowledge may affect their performance negatively [13]. Thus, assessing nutrition knowledge properly is crucial yet challenging.

Therefore, designing measurement instruments are required to assess nutrition knowledge. Content validity, known groups validity and reliability – named psychometric criteria – of the questionnaire should be identified. The questionnaire should include all directions [hydration, recovery, supplements, etc.] of the subject [sports nutrition knowledge] to be measured to ensure content validity. Known groups validity assesses whether the questionnaire designates dissimilar scores between groups. Reliability means that the questionnaire can be used in different times. Test-retest method is used to guarantee reliability [14-16]. There are valid and reliable instruments measuring general or sports nutrition knowledge of athletes and coaches in different countries [4, 17-22]. Some of these were developed for the athletes who were in different branches, such as cross-country runners [4], track and field athletes [18], ultra-endurance athletes [19]. Calella et al., developed a questionnaire for Italian adolescent and adult athletes. De Souza et al., designed a tool for

German adolescent athletes [20, 21]. Trakman et al., developed a questionnaire consisting of 6 subdivisions [weight management, macronutrients, micronutrients, sports nutrition, supplements, and alcohol] by using different statistical analysis method from other studies [22]. Although, some of the questionnaires used in studies in the sports field in Turkey were developed or modified, none of them had enough psychometric measurements. Therefore, they were not valid or reliable [23-32]. Sports Nutrition Knowledge Questionnaire (SNKQ) was developed by Zinn et al.for the rugby coaches in New Zealand [17]. SNKQ was also used in other samples such as rugby coaches [33], college students in Iran [34], coaches in England and the USA [35, 36]. Blennerhassett et al., modified and validated the questionnaire for ultra-endurance athletes [19].

A valid and reliable sports nutrition knowledge questionnaire is considered essential in determining the nutrition level of the Turkish athletes. Inadequate nutrition knowledge can negatively affect sports performance. Hence, by taking questionnaire results of the athletes into consideration, the athletes can be provided with the required nutritional recommendations so as to support their performance. Currently, no sports nutrition knowledge instrument with enough psychometric measurements exists in Turkey. This is why, this study aims to assess validity and reliability of the Sports Nutrition Knowledge Questionnaire (SNKQ) for the Turkish athletes.

2. MATERIALS and METHODS

Participants

Two hundred and ten participants were enrolled in the study. Of the participants, one hundred and twenty-five athletes (X ± SD = 20.2 ± 2.07 years) were recruited from the Center of Athlete Training and Health Research of the Ministry of Youth and Sports alongside 85 Nutrition and Dietetics senior students (X ± SD = 22.5 ± 1.20 years) were recruited from two universities in Ankara, Turkey. For the purpose of evaluating the known groups validity, Nutrition and Dietetics senior college students known to have a high level of nutrition knowledge were included. The athlete group participating in the study consisted of different sports branches such as martial arts and technical sports; wrestling (n = 23), archery (n = 15), fencing (n = 7), team sports and aerobic sports; basketball (n = 7), volleyball (n = 16), athletics long distance (n = 2), futsal (n = 12), anaerobic sports; weightlifting (n = 4), track and field (n = 24), gymnastics (n = 5), canoe (n = 10). The participants signed the informed consent form before partaking in the study. The inclusion criteria for the participants were to be healthy and not to be following a special diet. Participants with any eating disorders and chronic diseases were excluded. The remaining participants completed a personal information questionnaire and SNKQ with face to face interview method. This project was approved by the Hacettepe University Ethics Board and Commission (approval no: GO 17/788).

Table I. Characteristics of the participants

Variables	Athletes (n = 125)		Nutrition and Dietetics Students (n = 85)		
Age (years), X ± SD	20.2 ± 2.07		22.5± 1.20		p=0,001**
Gender	n	%	n	%	p<0,001*
Male	83	66.4	4	4.7	
Female	42	33.6	81	95.3	
Education level	N	%	N	%	p<0,001*
Secondary school	32	25.6	-	0.0	
High School	83	66.4	85	100.0	
University	10	8.0	-	0.0	

SD = standard deviation, X = mean, *chi square test **student t test, Mann-Whitney U test

Adaptation of Sports Nutrition Knowledge Questionnaire

In this study, SNKQ consisting of 88 items was adapted for the Turkish population [17]. SNKQ was translated into Turkish, ensuring translation validity by using standard back translation method. According to a group of 5 registered dietitians' suggestions, the foods that are non-consumable in Turkey were adjusted to conform to the eating habits of Turkish society regarding their suitable equivalents. To serve this purpose, "creamed rice" was converted into "rice pudding". Vitamin water and some brand names of some energy drinks were changed as they are not common in Turkey. "Edam cheese" was replaced "white cheese". "Cheddar cheese" was changed as "fresh kassari cheese". "Margarine containing polyunsaturated fat" was switched to "margarine". "Marmite" a kind of yeast paste consumed in New Zealand, was replaced with "jam". Some unfamiliar food brands were not included in the questionnaire. Instead of the word "player", the word "athlete" was preferred. Eventually, researchers applied SNKQ to 25 athletes as a pilot study. The feedbacks were evaluated and the final version of the questions was formed in accordance with the written and verbal notifications. The study expert group reevaluated the content validity of the questionnaire. The questionnaire consisted of five subsections related to general and sports nutrition, "nutrients", "fluids", "recovery", "weight management", "supplements". All participants completed the personal information questionnaire and SNKQ. Items were scored as "1" for each item answered as "correct", and "0" for items that were answered "incorrectly" or "not sure". The difference between the mean scores of athletes and Nutrition and Dietetics students was statistically evaluated. For the reliability of the questionnaire, the internal consistency of the subsections and the entire SNKQ, and the test-retest reliability were evaluated. SNKQ was applied to some of the participants (n=24 athletes, n=18 students) after 2 weeks (the best time period not to remember the answers and make big changes in the responses for test-retest) [14].

Statistical Analysis

In the statistical evaluation of the data obtained from the research, IBM SPSS Statistics for Windows version 23.0 program was used. Distribution of the numerical data were checked by applying Kolmogorov-Smirnov test. The Independent Samples t-Test was used to test the significance of the difference between the two means. The data was summarised by using number (n) and percentage (%) for categorical variables, and average ($\overline{X}$), standard deviation (SD), median (M) and minimum – maximum values (min-max) for numerical variables. To determine the items incompatible with the questionnaire, the item-total correlation was used. Kuder-Richardson-20 (KR-20) coefficient, a special case of Cronbach's Alpha in which the items are binary variables (usually scored as 0 or 1), was used to determine the internal consistency [37]. Kuder Richardson-20 value > 0.70 was considered to be acceptable. The test-retest reliability was evaluated by using intraclass correlation coefficient (R_1-ICC). R_1-ICC was evaluated as 0.95-1.00 excellent, 0.85-0.94 high, 0.70-0.84 moderate, 0.00-0.69 unacceptable [38]. The validity of the scale was evaluated with known groups validity by the significance test (Independent Samples t-Test) of the difference between the two groups [15, 16]. The results were considered as statistically significant when the p-value was below 0.05 [38].

3. RESULTS

Characteristics of the Participants

The characteristics of the participants are presented in Table I. Athletes (n = 125) and Nutrition and Dietetics senior students (n = 85) completed the SNKQ. The majority in the study consisted of male athletes (n = 83, 66.4%) and female Nutrition and Dietetics students (n = 81, 95.3%). The mean age of the athletes was 20.2 ± 2.07 years and the mean age of the Nutrition and Dietetics students was 22.5 ± 1.20 years. Sixty-six point four percent of the athletes and all students are high school graduates.

Adaptation of Sports Nutrition Knowledge Questionnaire

The ability of each individual item to discriminate between people with different levels of knowledge was measured by correlating the score on each item with the overall test score. The item-total correlation revealed that 10 items were completely incompatible with the questionnaire. As a result, 10 items with the item-all correlation value of – 0.10-0.10, not contributing to the questionnaire, were excluded with expert (biostatistician) advice. Internal reliability was calculated separately for the different subsections by using Kuder Richardson-20. Nutrients: 0.924; fluids: 0.402; recovery: 0.643;

weight management: 0.599; supplements: 0.730 values were obtained. Intraclass correlation coefficient was applied for the test-retest reliability to 42 participants retaking SNKQ after two weeks (Table II).

***Table II.** Total and subsections of Sports Nutrition Knowledge Questionnaire (SNKQ) internal reliability (KR-20) and test-retest reliability coefficient (R1-ICC).*

SNKQ sections	Internal reliability (KR-20)	Test-retest Reliability (R1-ICC)		
	All participants (n= 210)	Athletes (n= 24)	Nutrition and Dietetics Students (n= 18)	All (n= 42)
Total	0.927	0.909	0.823	0.974
Nutrients	0.924	0.634	0.798	0.946
Fluids	0.402	0.676	0.760	0.735
Recovery	0.643	0.860	0.881	0.916
Weight management	0.599	0.799	0.729	0.904
Supplements	0.730	0.834	0.879	0.888

There were strong, positive correlations in all subsections (ranging 0.735-0.946) and the whole questionnaire (0.974). Therefore, the 78 item SNKQ was found reliable. The SNKQ total scores of Nutrition and Dietetics senior students (59.1 ± 5.98) and athletes (36.0 ± 8.1) were found to be statistically different (p < 0.001) ; thereby demonstrating that the known groups validity was confirmed. Nutrition and Dietetics senior students scored better than the athletes in the subsections of nutrients, recovery, weight management, and supplements subsections (Table III) (p < 0.001).

***Table III.** SNKQ total score and subsections scores*

SNKQ scores (maximum)	Athletes (n=125)			Nutrition and Dietetics Students (n=85)			
	X ± SD	M	(Min- max)	X ± SD	M	(Min-max)	p value*
Nutrients (40)	18.7 ± 5.16	19	(6-31)	35.5 ± 2.78	36	(41-73)	<0.001
Fluids (7)	3.7 ± 1.47	4	(0-7)	3.9 ± 1.77	4	(28-41)	0.214
Recovery (8)	3.8 ± 1.60	4	(0-8)	6.2 ± 1.28	6	(0-7)	<0.001
Weight management (14)	8.0 ± 1.89	8	(3-12)	10.8 ± 1.83	11	(2- 8)	<0.001
Supplements (9)	1.5 ± 1.71	1	(0-9)	2.8 ± 2.33	2	(0- 9)	<0.001
Total score (78)	36.0 ± 8.1	36	(14-57)	59.1 ± 5.98	59	(41-73)	<0.001

*SD = standard deviation, M = median, *Student t test was used for analysis.*

4. DISCUSSION

Adequate nutrient intake and healthy food habits are crucial for athletes to ensure optimal performance. Therefore, the main point of the assessment of SNKQ is to raise the awareness of healthy dietary habits and improve nutritional knowledge in Turkish athletes. Therefore, professional athletes must have a high sports nutrition knowledge level. In Turkey, no sports nutrition knowledge instrument with enough psychometric measures exists. Since, a questionnaire needs to be valid, reliable and capable of accurate measurement, psychometric criteria are important [16]. Thereby, SNKQ in this study meets the basic psychometric criteria for reliability and validity. Therefore, this study is expected to set an example for many future studies.

This study aims to improve validity and reliability of the SNKQ for the Turkish athletes. To begin with, the wording of the questions ensured by the expert study group (dietitians) clarified for content validity. Some items with low item total correlation coefficient were excluded from the questionnaire due to their insufficient contribution to measuring nutrition knowledge. It was considered that participants could misinterpret or misperceive these items.

In our study, as observed in Table II, the internal reliability value (K-20: 0.927) was found high and test-retest reliability coefficient value (R1-ICC: 0.974) was found excellent in the overall questionnaire. Kuder Richardson-20 (KR-20) coefficient, a special case of Cronbach's alpha, was used to determine the internal reliability of the information survey which had only one correct answer. Kuder-Richardson value > 0.70 was considered acceptable. R_1-ICC was evaluated as 0.95-1.00 excellent, 0.85-0.94 high, 0.70-0.84 moderate, 0.00-0.69 unacceptable [38]. Considering these results, SNKQ measures nutrition knowledge properly and consistently.

In our study, internal consistency values of the subsections ranged between 0.402-0.924. Whereas, internal reliability for the "nutrients" (0.924) and "supplements" (0.730) subsections were acceptable, "weight management" (0.599) and "recovery" (0.643) subsections were under 0.7. Similarly, it is observed that the internal consistency values are within the range of 0.34-0.97 in other studies [19, 39, 40]. In a study investigating the validity and reliability of the general nutrition knowledge questionnaire in Turkey, the internal consistency values of the subsections were found to be between 0.43-0.89 [39]. Likewise, in Spendlove et al.'s study, the internal consistency values were determined between 0.4-0.95 [40]. Thus, it is common for some subsection values to be under 0.7 in nutrition knowledge questionnaires [19, 39, 40].

In this study, the internal consistency value in "fluids" subsection (0.402) was low, which is attributed to the low number of items (7 items) as well as different content (exact knowledge questions-practical questions) in multiple choice questions. It is stated that when the number of items increases, the internal reliability is affected; and thus, it also increases [38]. Moreover, individuals' disinterest in the subject of fluids and their lack of knowledge on this subject – such as sports drinks and basic hydration techniques – are believed to have lead these results. Additionally,

in other studies the SNKQ scores in the fluid subsection were found to be low [19, 34, 35]. In another study, the mean percentage of correct responses about fluids was only 47.3% in coaches [35]. To ensure content validity, the instrument must have subsections dealing with different subjects [14]. A person knowledgeable about one of the subjects may not be sufficiently versed in another subject; therefore, some subsections with low values can be regarded acceptable. Also, the necessity of a high internal consistency value in the evaluation of structures such as attitudes and opinions rather than knowledge is emphasized [41].

As observed in Table II, test-retest correlation coefficient values which are very close to 1.00 indicate a perfect correlation in the overall questionnaire (0.974) and "nutrients" (0.946) subsection of our study. Test-retest correlation coefficient values are high in "recovery" (0.916), "weight management" (0.904) and "supplements" (0.888) subsections and moderate for the "fluids" (0.735) subsection.

The two groups (athletes and Nutrition and Dietetics students) with different levels of nutrition knowledge were included in our study to evaluate known groups validity. Nutrition and Dietetics students were included in the study as the known group, in order to determine the validity of the SNKQ. Similarly, there are many studies using known groups validity method which includes Nutrition and Dietetic students or dietitians [17, 20, 39, 40, 42-44].

As displayed in Table III, the total SNKQ scores of Nutrition and Dietetics students and athletes were found to be statistically different, with Nutrition and Dietetics senior students achieving a statistically higher score than professional athletes (p< 0,001). Consequently, the known groups validity was obtained. In Turkey, Nutrition and Dietetics students have practical training in their senior year following a three-year-theoretical training. Yet, not all professional athletes are able to receive an education on nutrition. Athletes studying at the Physical Education and Sports College or Faculty of Sports Science have a chance to attend a limited number of courses on nutrition. In line with these results, it is also possible to consider that athletes prioritize improving their fitness, strength and attention while ignoring importance of nutrition. Similarly, in the study of Zinn and colleagues, the total SNKQ scores were statistically significant in 5 different groups of dietitians (74.6 points), university employees (51.7 points), nutrition and dietetics students (71.6 points) and sports students (49.7 points) [p <0.001]. Nutrition and Dietetics students and dietitians achieved the highest scores [17]. In other studies, the scores of the students of the Nutrition and Dietetics department and/or the dietitian group were discovered to be considerably higher than the rest [17, 20, 39, 40, 42-44].

As seen in Table III, Nutrition and Dietetics senior students achieved statistically higher scores than professional athletes in "nutrients", "recovery", "weight management" and "supplements" subsections. The scores were not statistically different in the fluids subsection. Fluids are one of the specific subjects concerning sports nutrition. Some Nutrition and Dietetics students are thought not to have taken the elective sports nutrition course in

the Nutrition and Dietetics Department in Turkey. In addition, all professional athletes may not be able to receive education on nutrition. These conditions are considered to have prevented the participants from accessing current knowledge about liquids and hydration.

Some limitations which may influence the results of the study exist. Firstly, since the questionnaire contains different types of questions, it was not suitable for factor analysis, which is one of the methods of construct validity. Likewise, factor analysis was absent in the study of Zinn et al., from which the questionnaire was taken, as well as the study of Blennerhassett et al. that validate SNKQ [17, 19]. Secondly, the convergent validity method was not utilized due to the fact that there was not a valid and reliable sports nutrition knowledge questionnaire in Turkey to be compared with the SNKQ. The results of the psychometric measurements were limited to the conditions under which the data were collected. Future studies are needed to test the validity of the questionnaire in different sports branches and various levels of athletes. When collecting data, participants completed the sports nutrition knowledge questionnaire without intervention. The possibility that participants' guessing the answers to the questions can be another limitation even though the "not sure" option was included to minimize it.

Conclusion

Sports Nutrition Knowledge Questionnaire was found to be valid and reliable. The final questionnaire has 78 questions and five subsections (nutrients, fluids, recovery, weight management, and supplements). It can be applied to the Turkish athletes performing in different sports branches so as to correctly determine their sports nutrition knowledge. It can be employed in future studies to investigate the relationship between nutrition knowledge and sports performance. Experts in the fields of sports and nutrition can easily use SNKQ.

Compliance with Ethical Standards

Ethical Approval: This project was approved by the Hacettepe University Ethics Board and Commission (approval no: GO 17/788).

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