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VALIDATION AND IMPLEMENTATION OF GENERAL AND SPORT NUTRITION KNOWLEDGE QUESTIONNAIRE FOR UNIVERSITY STUDENTS AND ATHLETES

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[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation

Abstract The aim of the present study was to validate and implement a nutrition questionnaire to measure nutrition knowledge of university students, and athletes. Male, and female students (N = 476) voluntarily participated in the survey in 2019. Non-health related (n = 156), nutrition students (n = 163), and varsity athletes (n = 157) responded to the questionnaire, twice with 15 days' interval between. In this study, new "General and Sport Nutrition Knowledge" (GSNK) and, two other "Short General Nutrition Knowledge" (SGNK) and, "Short Sport Nutrition Knowledge" (SSNK) questionnaires were used to determine the validation of the survey. One-way ANOVA, t Test, Pearson correlation coefficient, and Cronbach's α statistics were used to evaluate validity and reliability ($p < 0.05$). The Internal consistency, test-retest reliability, concurrent validity with two similar tools, and construct validity among the groups of students for nutrition knowledge were employed throughout the data analysis. Nutrition students outperformed in all nutrition knowledge sections. Respectively, athletes were the second, and non-nutrition related students were the third in sport nutrition ($p < 0.05$). With regard to general and total nutrition knowledge scores, female students performed significantly better than males ($p < 0.01$). Modified questionnaire was found to be valid, reliable, and suitable tool for Eurasian university students, and athletes. Results also illustrated that the intermittently nutrition educations are required for athletes, as it is recommended in related literature.

Key words nutrition knowledge, modified survey, validation, university athletes

Introduction

An increased level of nutrition knowledge can have a positive effect on having appropriate nutrition behaviours and dietary habits and may be effective in preventing unbalanced and unhealthy diets caused by various reasons (Alkaed, Ibrahim, Ismail, Barake, 2018; Spronk, Kullen, Burdon, O'Connor, 2014). Because of the particular needs in sport such as increased energy requirements, sports players have been in search for a diversity of food, utilizing different types of diets, and taking supplements in able to increase their sporting performance. Such situations demonstrate the importance of having a good nutritional knowledge for both a general healthy life, and for long-term sport life of athletes (Calella, Iacullo, Valerio, 2017; Potgieter, 2013).

Increasing the level of awareness in nutrition knowledge will affect young and adult athletes in a positive way (Dascombe, Karunaratna, Cartoon, Fergie, Goodman, 2010). In this context, there is a need for scientific measurement tools that will measure and determine the level of nutritional knowledge of persons, according to their related cultures and environment (such as; religions, nationalities, geography). Most previous scales have not been fully validated taking into account these cultural respects (Alkaed et al., 2018; Bradette-Laptante et al., 2017; Calella et al., 2017; Guadagnin, Nakano, Dutra, Carvalho, Ito, 2016; Karpinski, Dolins, Bachman, 2019; Trakman, Forsyth, Devlin, Belski, 2016).

Unlike the previous questionnaires which are either for general nutrition knowledge or sport nutrition knowledge (Karpinski, et al., 2019; Hendrie, Cox, Coveney, 2018; Zinn, Schofield, Wall, 2005) a more comprehensive and psychometrically developed and validated questionnaire including both general and sport nutrition knowledge (GSNK) was administered as of the high school level population in Italy (Calella et al., 2017). Yet this tool was not validated within university athlete populations up to now, thus whether or not the scores are truly indicative, and suitable in this population is under scrutiny. However, that questionnaire was the best available option at the time of research, and contained both general and sport nutrition sections (Werner, Guadagni, Pivarnik, 2020).

The development of a new questionnaire modified from the general and sport nutrition questionnaire previously mentioned could be a more useful tool for Eurasian countries' athletes, scientists, nutritional professionals, and coaches who mostly have Islamic cultures.

The purpose of this study, therefore, was to establish, and test a more valid, and reliable nutrition knowledge instrument for university students, and athletes, so it will have been used not only for common in Western, but also Eastern countries.

Material and methods

Participants

The study sample consisted of students from the "University of Istanbul Sabahattin Zaim" (private university) "University of Istanbul Gelisim" (IGU, private university), "Marmara University" (MU, state university in Istanbul), "Istanbul University" (IU, state university), and "Kirikkale University" (KU, state university in middle Anatolia), mean age 22 ±1,8 (17–35) years, who volunteered to participate in the study without receiving any payment. The students (N = 476) were selected based on their educational disciplines (non-health related and nutrition), and whether or not they were competitive athletes. All the subjects who participated in the study voluntarily were not given any special nutrition education before the questionnaire applications.

Besides the comparisons among the results of questionnaire between the three different groups, (nutrition-educated, non- nutrition educated student, and athletes); one other comparison was also made between the students of team sports (n = 101) and individual sports (n = 56). Moreover, an additional comparison was done between the dietitian students of first year, (n = 77), and fourth years (n = 86) for construct validity (n = 163) (Table 1).

Table 1. Demographic Characteristics of Study Groups, by Social, Sports and Academic Background Status. N, (%), (Means ± SD), M (Male), F (Female)

Groups characteristics		Non-Health university students (n = 156)	Nutrition/Diet students (n = 163)	Varsity athletes (n = 157)	All subjects total (n = 476)
Age (year)		21.7 ±1.8	21.3 ±2.2	21.8 ±2.2	21.5 ±2.1
Sport experience (year)		–	–	7.3 ±4.5	–
Height (cm)	M	178 ±10	176.9 ±4	180.3 ±9	179.2 ±8*
	F	164 ±11	164.5 ±5	166.0 ±7	164.7 ±6
Weight (kg)	M	75.6 ±13	74.4 ±10	78.1 ±12	76.9 ±12*
	F	58.1 ±9	56.1 ±7	60.4 ±8	57.3 ±8

Nutrition Training Come from (%): 1; School programs, 2; My Teachers, 3; Outside the school, 4; My family 5; My Coaches, 6; TV Watches, 7; Internet, 8; My friends, 9; Others; 10; No training and knowledge.

* Significant Differences among groups $p < 0.05$.

Expert panel evaluation

"General Nutrition Knowledge" and "Sport Nutrition Knowledge" items were developed by modifying an existing questionnaire for athletes, and general students (Calella et al., 2017).

A preliminary item pool was generated from an expert panel composed of three registered dieticians, and two sport scientists with expertise in nutrition and sport. The panel was then extended to include a food engineer, a food scientist, and finally one psychologist selected to assess the items.

Procedures

The panel evaluated the questionnaire for content validity with rigorous assessment of the items for representation of nutrition knowledge. The acceptable level for content validity was set >80 percentage, as considered the minimum value (Bradette-Laptante et al., 2017). Expert panellists reviewed the last version of the questionnaire; they discussed and approved the pilot version of the questionnaire.

Internal Consistency Phase – The internal consistency for each section was calculated using the Cronbach's alpha, which is recommended as score of above the 0.7 for the minimum requirement (Dascombe et al., 2010).

Test – Retest Reliability Phase – To determine the reliability of the GSNK questionnaire, test-retest analysis was conducted by getting the same subjects to complete the same questionnaire two weeks after the initial questionnaire (Dascombe et al., 2010). Pearson's correlation was used to determine the test retest reliability. From the initial subject of 320 students, only 254 (79.3%) of them completed the GSNK questionnaire twice.

Concurrent Validity Phase – In addition, concurrent validity was computed using Pearson's correlation between the GSNK, and the two other questionnaires for "Short General Nutrition Knowledge" (SGNK), (Islamoglu et al., 2019) and, for athletes' "Short Sport Nutrition Knowledge" (SSNK) (Dascombe et al., 2010).

Construct Validity Phase – Construct validity was assessed by administering the GSNK questionnaire to three groups of university students who were expected to differ in their nutrition and sport nutrition knowledge. Dietetics/

Nutrition students, Athletes, and non-health related students (From the universities of MU, KU, IZU, IGU, and IESU). No incentives were given and the recruitment was performed at a suitable time at the end of a lecture. All three questionnaires were administered at a single session. The flow chart illustrating our analytical strategy and the details of the validity procedure were presented in Figure 1.

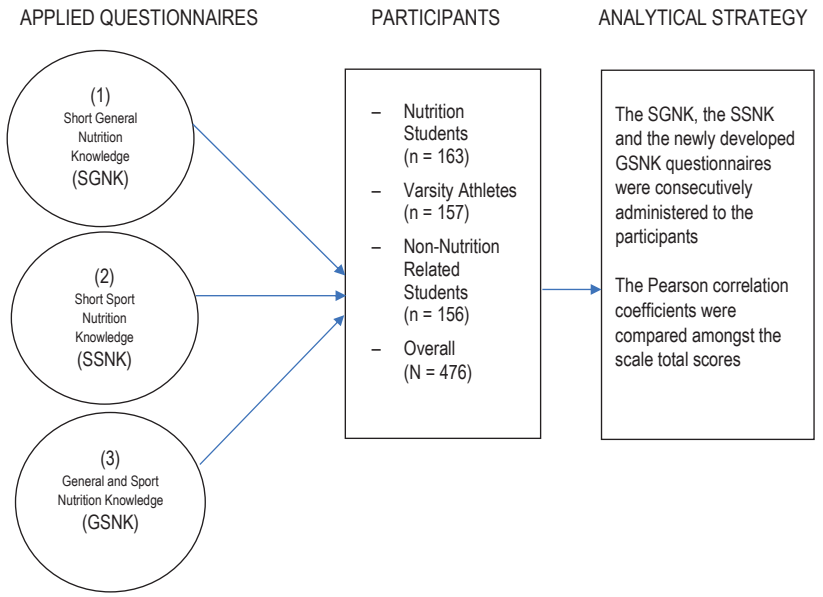

Figure 1. The flow chart of the questionnaire for validity procedures

Pointing the Questionnaires, Test results – All scores were coded in questionnaire as "1" for a correct answer and "0" for incorrect or the 'I don't know' reply. There were a total of 103 items in the Questionnaire (GSNK); 69 items in the general nutrition section and 34 items in the sport nutrition section. The maximum score of questionnaire was 103, and the minimum was 0.

Minor changes and additions done on the new questionnaire of the (Calella et al., 2017) – A question to determine the "sport experience" had not been included in the personal information section of original questionnaire was added in new one, so that it would be possible to determine the relationships between years of experiences on nutritional knowledge of persons'. Several other questions were revised or added to reflect the dietary habits of the Predominantly Islamic and Middle Eastern populations. One question (question 1, option 1) was revised inquired about the use of swine-related meat products. The reference to such meat products ("boiled ham" or "jambon") was replaced with meat products more extensively utilized by this population. Questions that were added include one (question 7) related to spinach that is abundantly used as source of plant food and one (question 8) about 'banana', which is a source of potassium.

Statistics

Group comparisons were done via one-way ANOVA test, on the knowledge scores of subjects for total general nutrition knowledge and sport nutrition sections to assess the three groups. Internal consistency of the adapted new instrument was measured using Cronbach-α reliability coefficient to evaluate how consistently items within each section of the instrument and overall score assess the knowledge. Cronbach- α values range from 0 to 1, with this scale indicating the consistency of responses. Pearson's correlation was used to assess the test-retest reliability of the GSNK. A score of 0.7 or greater is considered satisfactory for both internal consistency and reliability. The concurrent validity was also determined, via Pearson Correlation between GSNK questionnaire and the other two short but similar questionnaires (SGNK and SSNK). It was also used to determine the relationship of years of experiences and sport nutrition knowledge of athletes. Independent samples t-test and paired samples t-test were also used for comparison of independent binary groups (between team and individual sport athletes) and comparison of test-retest mean scores of the participants. Statistical tests were two-sided and differences at $p < 0.05$ were considered significant. All statistical analyses were performed using the Statistical Package of Social Sciences (SPSS, Chicago, IL, USA) for Windows software program (version 25.0).

Ethics Approval

The researchers obtained approval from the Ethics Committee of the Istanbul Sabahattin Zaim University for the study protocol, and written informed consents were obtained from the participated subjects complied with the Helsinki Declaration.

Results

The extended experts' panel received the questionnaire by hand and reviewed the items according to guidelines in Appendix A to meet the minimum required for clarity, interpretability, content importance, and pertinence. After this qualitative review, a face-to-face meeting was performed on the whole questionnaire. After discussing the items, a final version of the questionnaire composed of 103 items was approved.

Twenty questionnaires were not taking into consideration in the research by the investigators, as they did not complete questionnaire as directed. As it stands, the total sample was composed of 476 students (Female: 262; Male: 214).

There were no significant differences between male and female students in the section of sport nutrition knowledge ($p > 0.05$). However, general, and total nutrition knowledge scores of female students were significantly better than males ($p = 0.001$) (Table 3). There was no significant difference in terms of nutrition knowledge in both general knowledge section ($p = 0.55$), and sport nutrition section ($p = 0.71$) between individual sports athletes and team sports athletes.

There were no significant high-level correlations between sports years of experience, and nutrition levels of athletes ($r = –0.14$; $r = –0.16$) ($p < 0.05$) (Table 2). According to correlation calculations, the education level of parents did affect the nutritional knowledge of the subjects significantly ($r < 0.15$) ($p < 0.05$).

Total knowledge scores of all subjects in correctly answered items were averaged at 60 ±18 % as the evaluation of success rate. Scores of success as percent were 74 ±12% for nutrition students, 52 ±10% for university social science students, and 53 ±9% for varsity athletes differing significantly ($p = 0.04$). At each knowledge section,

correct responses as a percentage, ranged from 50 ±14% to 74 ±12% in total, with no significant differences between varsity athletes, and control students in general nutrition section. However, athletes had better results than control group of non-nutrition related students ($p < 0.05$).

Internal Consistency – Cronbach's alpha values of questionnaire items were calculated at 0.89 for total questions (both of general and sports knowledge sections), 0.88 for general nutrition section, and 0.72 for sport nutrition sections ($p = 0.12–0.90$).

Test-Retest Reliability – Pre and post-test reliability for the general nutrition section of questionnaire was 0.90, and sport nutrition was 0.89, and reliability for the total questionnaire was 0.92. These coefficients of "r" were not only higher than the reported statistical acceptance of >0.70, but also as high as some other reported related studies (Dascombe et al., 2010).

Concurrent Validity – Correlations were determined between two other similar questionnaires with our general and sport knowledge results were shown in Table 2.

Table 2. Correlations of Developed GSNK Questionnaire with two Different Questionnaires on Nutrition Knowledge

n = 296	GSNK general nutrition	GSNK sport nutrition	GSNK total
Short general nutrition knowledge questionnaire (SGNK)	0.70*	0.51*	0.70*
Short sport nutrition knowledge questionnaire (SSNK)	0.55*	0.45*	0.56*
General nutrition knowledge questionnaire (GNK)	0.71*	0.51*	0.70*
Sports years of experience	–0.14	–0.16	–0.15

* Correlation is significant at the *p < 0.01* level (2-tailed).

Source: Zawilla et al. (2003); Islamoglu et al. (2019).

High correlation coefficients were found between the Zawila, Steib, Hoogenboom (2003), and our sport nutrition knowledge result. Additionally, there were high correlation between the sport knowledge scores, and the short questionnaire by Islamoglu, Basoglu, Ozbey, Tosya, Gunes (2019). Correlations in this study were also higher than the study of Calella et al. (2017).

Construct Validity – Construct validity results were shown in Table 3. Knowledge scores of nutrition students were significantly better then two other groups, however there was no significant differences between athletes, and non-nutrition related students in general nutrition knowledge ($p = 0.001$), according to statistical difference tests of One – Way ANOVA and Tukey. The group of dietetics showed significant highest mean results both in

Table 3. Nutrition knowledge scores of tested university students and athletes

Groups	Sport Nutrition Score	General Nutrition Score	Total Nutrition Score
Nutrition Students n = 163	21.6 ±4.3*	55.1 ±8*	76.7 ±11*
Varsity Athletes n = 157	18.1 ±4.8*	39 ±10	57.1 ±14*
Non-Nutrition Related Students n = 156	15 ±5.6*	37 ±11	52 ±14*
Males n = 214	17.8 ±5.4	39 ±12**	56.8 ±16**
Females n = 262	18.7 ±5.7	48 ±12	66.5 ±17
Total subjects N = 476	18.3 ±5.6	44 ±12	62.1 ±17

* Significant differences among groups according to One Way Anova Test calculator ($p < 0.05$).
** Significant differences between groups according to Independent T Test calculator ($p < 0.05$).

general, and sport nutrition sections of the GSKN scores ($p = 0.001$). However, athletes' sport nutrition scores were significantly higher than non-health related university students ($p < 0.05$). These results support the hypothesis that sport nutrition section of the questionnaire measures the nutrition knowledge of the competitive athletes effectively when applied to the athletes (see Table 3). Therefore, our nutrition knowledge questionnaire can be accepted as valid to measure for all type of university student.

Discussion

The aim of this study was to validate a general and sport nutrition knowledge questionnaire modified from the recent comprehensive GSNK questionnaire for both general university students and athletes (Calella et al., 2017).

The questionnaire used in this study reported a high level of acceptance for validity, and showed high level of reliability when using for university students and competitive university athletes in general nutrition sport nutrition, and total knowledge. Results were comparable to those of observed in similar studies (Alsaffar, 2012; Matsumoto, Tanaka, Ikemoto, 2017).

After thorough investigation of the literature, it was discovered that the sample size used in this study had the largest number of subjects, amongst similar studies (Table 1). So, the demographic population used in this study can be accepted as highly representative level for all type of university students and athletes in all over the world. Although the version of the questionnaires used were in the Turkish language, an English version of it was also prepared by the researchers, experts have been found it also as useful for the similar countries populations all over the world.

This research is found important in that it present a comprehensive and validated tool, to determine the general nutrition and sport nutrition knowledge of university students, and athletes. In addition, is not only for Western Cultures, but can also be beneficial for Asian countries as well, due to being modified to be relevant to their specific culture (Dascombe et al., 2010).

By means of this tool, researchers, practitioners and coaches can make tests to determine and assess the nutrition knowledge. They can also search the relations between knowledge, and behaviours of different level of populations and groups. Based on these types of studies, researchers can also develop similar new tools for different populations; such as for elite and amateur athletes, elderly peoples, obese, and disease people (Leavey, Strawderman, Jones, Port, Held, 1998).

In a recent review article, Trakman et al. (2016) analyzed 36 studies related with nutrition knowledge, and reported that none of them covered all sections of nutrition. However, the recently developed tool in Europe was found to be one of the most comprehensive questionnaires with exception of knowledge regarding alcohol, especially within Islamic cultures. Because of this, we used it as reference, and covered the most of the psychometric validation process, and requirements inside it (Dascombe et al., 2010).

We have added to our new questionnaire some items of food related with green leafy vegetables for diet fibres content, processed meat for salt content, and cheese for calcium content, spinach for iron content and banana for potassium content. We used also some common cultural expressions with some changes, from the original. Terms such as "salami, soujouk, and sausage, without ingredient of pork product" were used instead of "boiled ham, or jambon", and "whey cheese" instead of "ricotta".

As we hypothesized, the nutrition group acquired significantly the highest score out of all other groups in general, sport and, total knowledge ($p < 0.01$). General nutrition knowledge of the athletes, was not differing

significantly then general students ($p > 0.05$), it was found notable. In according to group-based comparisons showed that, values of the nutrition related students have better results than social students, and athletes, in all knowledge categories with a significant difference.

These informative results are similar with previous investigations related to nutritional knowledge in US, and Germany (Silveira et al., 2015). However, some of the values in these studies were better than what we discovered. These findings may be the result that our population may have lowers years of experience than in the other papers, or that our population was found to be younger than those of the adult subjects were.

In our sample, females scored significantly higher than males for both the total survey, and general nutrition section (Table 3). However, in sport nutrition scores, there were no significant differences between genders. There is current information in the literature about whether there are significant differences in nutrition knowledge between sexes (Dascombe et al., 2010). In athlete populations, some studies have reported that female athletes have higher nutrition knowledge than males, while others have reported no significant differences between the sexes similar to ours (Dascombe et al., 2010). These conflicting results could be attributed to both the different knowledge assessment tools being used, as well as their passed education, and interest differences to nutrition, between the two sexes. The percent success rate of this study indicates that, university athletes, and students sometimes showed low knowledge, some are medium, and some of the results were the higher in nutrition knowledge, comparing to the reported literatures in elite, and college athletes (Dascombe et al., 2010). However, inter-student and inter-athletes' different variability suggests a need for a specified nutrition education.

Fourth-year students of dietetics and nutrition department in this study had also significantly successful than first-class students. These findings also supported our conclusion that the questionnaire is selectable, and able to differentiate the level of nutrition knowledge, as like in the similar studies (Dascombe et al., 2010).

Reliability calculations in this study ($r = 0.89–0.92$) were done by using large samples demonstrated satisfactory performance. These results suggest that new GSNK questionnaire had good external reliability, similar to the related literature (Calella et al., 2017; Trakman et al. 2016, Bukenya et al., 2017).

Our developed questionnaire showed moderate and high correlation with two chosen nutritional knowledge questionnaires from the literature ($r = 0.45$ to 0.71) to assess concurrent validity (Table 2). However, Correlation coefficients between two different tested tools were not found to be high. It could infer from this result that different measurement tools used in validity research have measured nutrition knowledge, in different levels, owing to their characteristics (Dascombe et al., 2010).

Nutrition knowledge levels of university athletes were found not different from the control group of non-nutrition related students ($p > 0.05$). Additionally, nutrition knowledge was not related with the sport experience of them ($r = 0.14$ for general nutrition; $r = 0.16$ for sport nutrition) ($p < 0.05$). From these results, it was concluded that the intermittently nutrition educations are required of athletes, as recommended in related literature (Blennerhassett, McNaughton, Cronin, Sparks, 2019; Birkenhead, Slater, 2015; Zieff, Veri, 2009; Torres-Mcgehee et al., 2012).

Conclusion (practical applications)

This up to date and scientifically confirmed comprehensive questionnaire (GSNK) can be used as test tool in Euro-Asian countries. It can be also used into determine the relationship between general, and sport nutrition knowledge, as well as sport experience, education level, socio-economic properties, physical fitness characteristics, sports performance, and dietary behaviours for future research studies. By means of this new developed tool,

coaches, and dieticians can assess the subjects' nutritional knowledge status. Tool may also assist, in the planning of nutrition education programs for different groups of students and athletes.

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