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Determining the nutrition knowledge of junior athletes in Austria

Translation and adaptation of the "Adolescent Sport Nutrition Knowledge Questionnaire"

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Summary

It has been found in practice that adolescents know very little about sports nutrition. It has therefore been attempted to develop a validated German language questionnaire, that could be used to identify the greatest deficits and to show where additional information must be supplied. The questionnaire was developed on the basis of a questionnaire from the USA. Five experts in sport nutrition then helped to validate this in the German speaking area. The reliability was checked with the test-retest method, in which 100 young athletes (15.9 ± 1.4 years) were tested. Cronbach's alpha correlation coefficient for the whole questionnaire was 0.825. The overall knowledge score was 36 (± 7.9) of 63 correctly answered questions, corresponding to 57 %. It was concluded that the developed questionnaire is a good instrument for measuring nutritional knowledge.

Key words: Sports nutrition, nutritional knowledge, adolescents, nutritional education, questionnaire development

Introduction

There is hardly an area in which the consequences of correct or faulty nutrition can be more rapidly recognised than in sport [1]. However, studies with various questionnaires have shown that athletes – particularly young athletes – know very little about nutrition [2, 3]. On the other hand, it has been shown that there are positive correlations between the level of physical activity and nutritional knowledge [3, 4] and between nutritional education and nutritional knowledge [5], which suggests that much more emphasis should be laid on nutrition and nutritional education for young athletes. However, the essential instruments are missing.

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Methods

Developing the questionnaire

There is currently no validated German language questionnaire that evaluates the nutritional knowledge of young athletes. Dvorak et al. [6] developed the English language questionnaire "The Adolescent Sport Nutrition Knowledge Questionnaire" with American athletes. This draft has been initially evaluated by ten experts in sports nutrition from the USA (content validity). The questionnaire exhibited generally good validity and reliability (test-retest) and has encouraged interest in a possible German language version for use in applied sports nutrition. This has now been developed and tested. This questionnaire is divided into three sections:

- The first section asks about demographic data, such as age, sport type, competitive level, parents' level of education or the most important source of information on nutrition.
- The second section covers questions on nutritional habits and behaviour.
- The third and most important section covers 63 questions on nutritional knowledge, classified into seven subscales.

The first subscale in the third section covers questions on energy balance, athletes' energy requirements and the energy content of individual macronutrients. Three other subscales evaluate knowledge related to macro- and micronutrients and fluid intake. The fifth subscale covers questions to evaluate meals for

Glossary

Cronbach's Alpha: This value indicates how precisely the items of a test measure a construct. The coefficient can lie between minus infinity and plus 1. High positive values arise when there is a high positive correlation between the items. Negative inter-item correlations reduce the value of α and can give rise to negative values in extreme cases. α > 0.65 is desirable [10].

Test-retest reliability: This indicates how well the results of the data collection for the same sample correlate at two different time points [11].

Internal consistency: Internal consistency is a form of reliability. It corresponds to the extent to which the results of the individual parts of a test procedure are mutually correlated.

training and competition. More specifically, there are questions on the right time point for the meal and the purpose of meals before training or competition. The sixth subscale includes questions about performance enhancing food supplements. The seventh and last subscale covers the ability of the subjects to implement their knowledge in practice.

◆ Table 1 shows examples of questions from each of the scales.

In the first step of the questionnaire development, the English version of the questionnaire was translated into German. Emphasis was laid on retaining the meaning during the translation and some questions had to be adapted to Austrian conditions. For example, the classification of the demographic data, the distribution of the school types and the patients' levels of education were changed. There were also adaptations to special Austrian foods and eating habits (e.g. Weckerl [breadroll], Extrawurst [a type of wurst or sausage], Marmeladensemmel [jam bun], etc.).

Test of validity

The validity of the third section of the questionnaire was tested. For this purpose, five experts were selected who were active in (sport) nutrition, sport psychology or medical sport therapy and who actively work with athletes. To evaluate the validity, the experts were sent the questionnaire in a form that allowed allocation of the subscales. The experts were instructed to evaluate the individual questions with respect to relevance for the individual subscales, legibility and suitability for 14- to 19-year old adolescents. If appropriate, they were allowed to propose that the question should be reassigned to another subscale. The comments and suggestions were then incorporated into the questionnaire [6, 7].

Test of reliability

The test-retest method was used to test reliability. A total of 100 pupils of a Salzburg Sports Grammar School aged 14 to 19 were selected to participate in this study and their parents (or guardians) had to sign a consent form for this study. Within a period of 2 to 4 weeks, 75 of these pupils were given the same questionnaire a second time.

Data processing

The evaluation and statistical calculations were performed with the statistics program SPSS, Version 14.0. For all analyses, the level of significance was set at $p < 0.05$. Initially the individual subscales energy, macronutrients, micronutrients, fluid, training, supplements and practice were formed and the appropriate questions were assigned to these. In the next step, the data from the 63 questions in the third section were recoded and assigned to the figures for "correct", "wrong" or "don't know". In the next step, an overall knowledge score was calculated over all seven subscales. For this purpose, the values of the individual subscales were added up and presented as a total value. In the next step, an overall knowledge score is calculated for all seven subscales.

Using descriptive statistics with frequency distributions and cross tabulation, parameter values, distributions and correlations between the variables were presented as percentages.

To check the test-retest reliability and internal consistency, the correlation coefficient based on Cronbach's alpha was determined for each subscale and for the total score. In order to determine predictive values for nutritional knowledge, a Pearson correlation was calculated between the independent variables of the test – e.g. age, school type, parent's level of education etc. – and the overall knowledge score. On the basis of all pairs of variable, a regression was calculated, in order to express the strength of the predictive value of the independent variables. For the individual difference hypotheses, Student's t-test for independent samples or single factor analysis of variance and the Wilcoxon-test were carried out.

Results

Validity

The comments from the five experts on the individual questions were less related to the correct allocation to the different areas than to the formal ex-

	C	R	DK
Vegetarian athletes should take a daily protein supplement, as their requirements are not fully met by normal nutrition.	☐	☐	☐
All athletes should take protein preparations as nutritional supplements.	☐	☐	☐
For an intensive training phase of 60-90 minutes, it is important to take sports beverages.	☐	☐	☐
B vitamins are important to convert food into energy.	☐	☐	☐
Carbohydrates are stored as muscle glycogen and are the most important source of energy in extreme sport.	☐	☐	☐
An athlete‘s meal before training or a competition should be rich in protein.	☐	☐	☐
Lack of fluid can have an unfavourable effect on performance.	☐	☐	☐
There are no side effects when anabolic steroids are taken for a short period.	☐	☐	☐
Sport beverages can improve performance and accelerate recovery.	☐	☐	☐
To support recovery, an athlete should eat a meal 1-2 hours after sport.	☐	☐	☐
The amount of sweat lost by an athlete during sport can be determined from the change in weight – weight before and after sport.	☐	☐	☐
Athletes should restrict their salt intake.	☐	☐	☐
Oils from plants, fish, nuts and seeds are regarded as valuable fats.	☐	☐	☐
The following physical functions consume energy (calories): growth, sleep, heart beat, maintenance of body temperature and cell renewal.	☐	☐	☐
Vegetarian athletes should take a daily protein supplement, as their requirements are not fully met by normal nutrition.	☐	☐	☐
Creatine is an effective and safe supplement for athletes of all ages.	☐	☐	☐
Fruit juice, fruit, vegetables and soups are foods that contain high levels of fluid.	☐	☐	☐
White bread contains the same levels of vitamins and minerals as coarse wholemeal bread.	☐	☐	☐
Carbohydrates are the most important nutrient for mental performance.	☐	☐	☐
Weight loss results from inadequate food uptake, too much movement or both.	☐	☐	☐
Athletes should mostly eat a low fat diet.	☐	☐	☐
Water helps to regulate body temperature.	☐	☐	☐
Doing without breakfast does not impair physical or mental performance.	☐	☐	☐
The purity and safety of food supplements are tested before sale.	☐	☐	☐
Fruit juice is an ideal source of carbohydrates during sport.	☐	☐	☐
If the body receives enough fluid, the urine should be clear or light yellow.	☐	☐	☐
Protein is used for both building up and regenerating muscles.	☐	☐	☐
Iron deficiency can be the cause of increasing tiredness.	☐	☐	☐
Iron is contained in meat, green vegetables, eggs and cereals.	☐	☐	☐
Fat is an important source of energy, both at rest and during protracted exertion.	☐	☐	☐
Performance and recovery are supported by adequate energy supply.	☐	☐	☐
Conventional high carbohydrate foods include noodles, potatoes, cereals and bread.	☐	☐	☐
A multivitamin and mineral preparation always improves performance.	☐	☐	☐
Sodium and potassium are the most important electrolytes to achieve good fluid balance.	☐	☐	☐

Tab. 1: **Selection of questions from the subscales to check nutritional**
C = correct, W = wrong, DK = don‘t know

Subscales	1. Questionnaire n = 100 Cronbach's alpha	2. Questionnaire n = 75 Cronbach's alpha
Energy	0.525	0.667
Fluid	0.547	0.554
Macronutrients	0.393	0.384
Micronutrients	0.477	0.652
Practice	0.328	0.284
Supplements	0.559	0.564
Training/ competition meal	0.581	0.527
Overall knowledge score	0.825	0.852

Tab. 2: **Reliability for the total questionnaire and the subscales**

	Energy	Fluid	Macro	Micro	Practice	Supplement	Training	Overall Knowledge Score
Energy		0.415**	0.429**	0.320**	0.362**	0.213*	0.595**	0.713**
Fluid			0.161	0.385**	0.378**	0.304**	0.459**	0.654**
Macronutrients				0.278**	0.256*	0.270**	0.440**	0.590**
Micronutrients					0.343**	0.418**	0.349**	0.675**
Practice						0.370**	0.414**	0.640**
Supplements							0.340**	0.632**
Training								0.779**

Tab. 3: **Intercorrelation of the individual scales of the questionnaire from the first interview**
** p < 0.01 (2-tailed), * p < 0.05 (2-tailed); n = 100

pression and incorporation of Austrian or European habits and foods into the design of the questionnaire. None of the questions had to be allocated to a new subscale.

Reliability

◆ Table 2 shows the values determined for the reliability of the overall questionnaire and the individual subscales. The correlation coefficient Cronbach's alpha for all 63 questions was 0.825. COHEN considered that when the coefficient is > 0.80, the instrument exhibits good reliability. If the subscales are considered, the alpha ranges from 0.393 to 0.581, which – according to COHEN – expresses very low reliability [8].

After two weeks, the pupils were interviewed again with the same questionnaire. The reliability for the whole questionnaire from this interview gave a Cronbach's alpha of 0.852.
On the average, 37.5 ± 9.1 (or 59.5 %) of the questions were answered correctly at the second interview, with a minimum of 7 and a maximum of 53 answers known.
It can be seen in ◆ Table 3 that the individual subscales all correlate significantly with each other, except those related to fluid and macronutrients. All subscales were highly significantly correlated with the overall knowledge score.
A regression model was calculated to find out which independent variables, such as age, gender, most important source for nutritional information, parental education, significance of healthy nutrition etc. were responsible for healthy education and to what extent. Firstly, all variables were correlated with the overall knowledge score. This gave

Variable	Significance
Type of school	0.010**
Age	0.001**
Number of daily portions of vegetables	0.023*

Tab. 4: **Variables responsible for the overall knowledge score**
**p < 0.01, *p < 0.05

	Non-standardised coefficients B	95 % confidence interval for B	
		Lower limit	Upper limit
(constant)[a]	-3.656	-23.540	16.229
Daily vegetable portions	2.744	0.690	4.798
Age	3.062	0.288	5.836
Type of school	-1.429	-4.722	1.863

Tab. 5: **Coefficients for overall knowledge score**
Dependent variable: Total_1
[a]The constant represents the expected mean value of y when all x = 0.

three variables from the first interview that were significantly correlated with the overall knowledge score (◆ Table 4).
All three variables explain 70 % (r^2 = 0.69) of the variance of the overall knowledge score. These three variables were inserted into a step-wise multiple regression equation. It then turned out that only two variables may make a reliable contribution to the overall knowledge score: the age and the quantity of vegetables eaten daily. However, both explain only 17 % (r^2=0.169) of the variance of the overall knowledge score (◆ Table 5).

The results of the second interview exhibited similar reliability values to the first interview.

Discussion

A questionnaire on nutritional knowledge for young athletes was translated from English and adapted. The reliability of the whole questionnaire (63 questions) can be rated as good. None of the individual seven subscales achieved good reliability. The reason for this may be that the scope of the questions in the subscales is too narrow and/or that the individual questions are too similar. However, the content of these questions is the same as in the original questionnaire from the USA [6], from which they were taken without any essential change. The original questionnaire from the USA too achieved good reliability, but the individual subscales only exhibited values of < 0.80. This may be explained by the homogeneity of the participants and also by the fact that some of the questions could not be unambiguously allocated to one subscale, i.e. there may be overlaps [6]. For further developments in the questionnaire, it must be considered whether the number of questions within the scales should be increased and whether those questions should be removed that are thought to be too difficult or too easy for the target group. The results of the second interview exhibited similar reliability values to the first interview, which indicates that the questionnaire was precise and that it was properly implemented.
The validity of the questionnaire was only checked by five expert evaluations, as the original American version had already employed ten experts. One possibility would be that an additional group of experts might consider the subscales again and whether this would lead to more precise validation. Another possibility would be to perform cross validation, as done by Dvorak [6]. In this case, an additional category of persons are interviewed, such as dieticians or nutritional scientists working in sport nutrition; their results would then be compared with those from the adolescents. Some questions may be too easy or difficult for the relevant target group, such as the formulations: "Lack of fluid can have an unfavourable effect on performance" (99 % correct answers) or "Conventional high carbohydrate foods include noodles, cereals and bread", which was correctly answered by 94 %. The statement, "Most athletes require four times as much protein as non-athletes" was recognised as wrong by only 5 %.
One limitation of this study lies in the reliability, as only 75 of the 100 pupils in the first interview also took

part in the second interview – due to illness and training camps.

The result of the regression calculation shows that the age and the quantity of vegetables eaten correlate with the total knowledge score. It may be assumed that individuals who frequently eat vegetables have already studied issues related to nutrition more intensively.

The positive correlation between helping in preparing dinner at home and high consumption of vegetables (data not shown) suggests that these adolescents were already interested in healthy nutrition and that this led to increased nutritional knowledge. This is similar to the finding of Lazzeri et al. that there is a correlation between low consumption of vegetables and irregular breakfasts in adolescents [9].

Individual young athletes exhibit deficiencies of various magnitudes in different areas. This instrument can be used to study individuals and expert intervention is then possible. Even at the highest level of sport, health remains the most important consideration.

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