

ACCEPTED: July 2015

PUBLISHED ONLINE: September 2015

DOI: 10.5960/dzsm.2015.190

De Souza Silveira R, Kratzstein S, Hain G, Mayer F, Carlsohn A. General Nutrition Knowledge Questionnaire – Modified and Validated for Use in German Adolescent Athletes. Dtsch Z Sportmed. 2015; 66: 248–252.

# General Nutrition Knowledge Questionnaire – Modified and Validated for Use in German Adolescent Athletes

*Modifizierung und Validierung des General Nutrition Knowledge Questionnaire für die Anwendung bei deutschen Nachwuchsathleten*

1. POTSDAM UNIVERSITY, *University Outpatient Clinic, Center of Sports Medicine, Potsdam, Germany*
2. UNIVERSITY OF EDUCATION SCHWABEBISCH GMUEND, *Department of Health Sciences, Schwabebisch Gmuend, Germany*

## Summary

- › **Adolescent athletes** are a vulnerable target group for nutritional education and nutritional interventions. Although the level of nutritional knowledge and food literacy should be known before conducting nutritional interventions, there is no valid tool available to assess the nutritional knowledge of German adolescent athletes.
- › **Thus, the aim of the study** was to modify and validate an internationally established nutrition knowledge questionnaire for adults for use in German adolescent athletes.
- › **The General Nutrition Knowledge Questionnaire (GNKQ)** was translated into German and subsequently tested in two phases. In total, 75 adolescent athletes (40 m/35 f; 14 ± 1 years) attending Elite Schools of Sports<sup>1</sup> participated. First, 34 participants answered 45 questions allocated into four knowledge sections. All questions correctly answered by ≥80% or ≤20%, were eliminated as part of the validation strategy (N=13 questions).
- › **The remaining questions** were then analyzed for internal and test-retest reliability, with 41 new participants completing the validated version. Overall, reliability values of the validated questionnaire were 0.86 (Cronbach's alpha) and 0.92 (Pearson's correlation coefficient). Taken together, participants answered 48 ± 21% of the questions correctly (males: 50 ± 11% vs. females: 45 ± 9%, p = 0.03).
- › **In conclusion**, with this modified GNKQ it is now possible to reliably assess the nutritional knowledge and food literacy of German adolescent athletes and to use this modified assessment tool to measure improvements evoked by nutritional education programs.

## Zusammenfassung

- › **Nachwuchsathleten** stellen eine vulnerable Zielgruppe für Ernährungsbildung und Ernährungsinterventionen dar. Obwohl die Kenntnis über das Ernährungswissen von Nachwuchssportlern Grundlage jeder Ernährungsintervention sein sollte, gibt es für deutsche Nachwuchsathleten kein validiertes Erfassungsinstrument des Ernährungswissens und kaum Untersuchungen hierzu.
- › **Ziel der vorliegenden Arbeit** war es daher, einen international etablierten und validierten Fragebogen zur Erfassung des Ernährungswissens von Erwachsenen für die Anwendung im deutschen Nachwuchsleistungssport zu modifizieren und zu validieren.
- › **Hierzu wurde der General Nutrition Knowledge Questionnaire (GNKQ)** zunächst ins Deutsche übersetzt und anschließend in einem Zwei-Phasen-Schema mit deutschen Nachwuchsathleten getestet. Insgesamt haben 75 Nachwuchsathleten verschiedener Eliteschulen des Sports (40 m/35 w; 14 ± 1 Jahre) teilgenommen. Zuerst haben 34 Teilnehmer den Fragebogen mit 45 Fragen, die in 4 Wissenssektionen unterteilt sind, ausgefüllt. Fragen, die von ≥80% oder ≤20% der Teilnehmer korrekt beantwortet wurden, wurden aufgrund der Validierungsstrategie eliminiert (N=13 Fragen).
- › **Anschließend wurden die verbleibenden Fragen**, die von 41 neuen Teilnehmern beantwortet wurden, mit Korrelationsanalysen auf die interne und Test-Retest-Reliabilität geprüft. Die interne Reliabilität des so modifizierten Fragebogens mit 32 Fragen betrug 0.86 (Cronbach's Alpha) und für die Test-Retest-Reliabilität 0.92 (Pearson-Korrelation). Insgesamt konnten die Nachwuchsathleten 48 ± 21% der validierten Fragen richtig beantworten (Jungen 50 ± 11%, Mädchen 45 ± 9%, p = 0,03).
- › **Zusammenfassend** steht mit diesem modifizierten GNKQ erstmals ein reliables Instrument für die Erfassung des Ernährungswissens von deutschsprachigen Nachwuchsathleten zur Verfügung, sodass der Interventionserfolg von Ernährungsbildungsmaßnahmen valide erfasst werden kann.

## KEY WORDS:

Nutritional Knowledge, Adolescent Athletes, Questionnaire, Validity and Reliability

## SCHLÜSSELWÖRTER:

Ernährungswissen, Nachwuchsathleten, Fragebogen, Validität und Reliabilität

## Introduction

The link between appropriate nutrition and the maintenance of an athlete's health and well-being is undeniable (4, 17, 9). Nevertheless, there is evidence that food literacy and knowledge of appropriate dietary choices is poor among athletes (23). As a result of poor knowledge, the main issues concerning athletes' diets vary from a general low energy intake to a combination of inappropriate consumption of

carbohydrates or fats (1). Athletes also tend to have a higher supplement use than non-athletes, although - or because of - their general dietary knowledge and habits may be inadequate (2, 3). In addition, female athletes have been reported to often have a deficient intake of micronutrients, especially iron, zinc and calcium (1, 19, 16). Poor dietary habits are associated with an increased risk of injuries and other serious



QR-Code scannen und Artikel online lesen.

## CORRESPONDING AUTHOR:

Raul De Souza Silveira  
Universität Potsdam, Hochschulambulanz  
Professur für Sportmedizin  
und Sportorthopädie  
Am Neuen Palais 10, Haus 12  
14469 Potsdam  
✉: desouzass@uni-potsdam.de

health conditions such as the female athlete triad (i.e. the association between low energy availability, menstrual dysfunctions and low bone mineral density) (6, 12).

Inapt dietary practices are often a result of one's own nutritional knowledge, misconceptions and frequently misguidance from coaches, trainers or peers (6, 24, 14, 8). In recent years, there has been an on-going effort to assess and improve the knowledge status of competitive athletes worldwide (i.e. college & professional level) (1, 18, 21, 13). However, little is known about the dietary knowledge of adolescent athletes in Germany (10-19 years). This is despite the fact that during adolescence, appropriate nutrition plays a crucial role due to the high nutritional requirements resulting from combined demands of growth, cognitive development, tissue maintenance and a constantly increasing competition and training load (4, 8). Moreover, although adolescent athletes are a vulnerable target group concerning nutritional guidance and nutritional education, no validated assessment tool to reliably assess nutritional knowledge and food literacy is available for German adolescent athletes. Therefore, the purposes of this study were: 1), to translate and adapt an internationally established and validated nutritional knowledge questionnaire for adults and to validate it in an adolescent athletic population in Germany; 2), to assess the reliability of the translated and validated questionnaire in adolescent athletes; 3), to provide a validated and reliable assessment tool that may be used to assess the nutritional knowledge of German adolescent athletes or to evaluate any interventions targeting to improve nutritional knowledge in adolescent athletes.

## Methods

### Original Questionnaire Characteristics and Adaptation Strategy

After reviewing the literature on nutritional knowledge questionnaires, the psychometric valid and reliable survey from Parmenter & Wardle (14) was nominated out of a pool of pre-selected articles. The chosen survey was formerly developed to assess the nutritional knowledge and its relation to dietary behavior among adults in the UK, and it was composed of four knowledge-specific sections (i.e. Dietary recommendations; Sources of nutrients; Choosing every day foods; Diet-disease relationship). A total of 45 items were translated from English to German and upon necessity, the content was adapted to regional (i.e. types of food & traditional dishes (see Table 1 for examples)) or cohort needs (e.g. simplifying and adapting the wording of sentences). A team of nutritionists, sports scientists and a physician conducted the adaptation strategy.

### Subjects

A total of 75 adolescent athletes (40 males, 35 females; 14 ± 1 years) from a variety of sports disciplines took part in the current investigation. All participants attended to elite sports schools and were recruited in two stages at the Outpatient Clinic from Potsdam University during their pre-participation examination or annual health evaluation as requested by the International Olympic Committee (11), or at the German Olympic Training Base from Potsdam. The local Ethics committee approved the study, with written informed consent being given by the athletes' parents or legal representatives.

### Validation (Stage 1)

At this stage, 34 participants were recruited and asked to respond all of the 45 translated items. In accordance to Kline (10),

Table 1

Example of questions having certain types of food or traditional dishes adapted to regional needs (see appendix 2 to read full items).

ITEM NUMBER	TYPE OF FOOD/ TRADITIONAL DISH (ORIGINAL QUESTIONNAIRE)	TYPE OF FOOD/ TRADITIONAL DISH (ADAPTED QUESTIONNAIRE)
6.6	Scotch egg	Fried egg
13.6	Quiche	Pizza
26.1	Shepherd's pie	Pizza

Table 2

Overview of questions not fulfilling the criteria for content validity.

KNOWLEDGE SECTIONS	N° OF QUESTIONS CORRECTLY ANSWERED BY ≤20%	N° OF QUESTIONS CORRECTLY ANSWERED BY ≥80%	EXCLUDED QUESTIONS
Dietary recommendations	-	-	-
Sources of nutrients	4	1	5
Choosing every day foods	2	2	4
Diet-disease relationship	4	-	4
Total	10	3	13

Table 3

Values for internal consistency and test-retest reliability.

KNOWLEDGE SECTIONS	INTERNAL CONSISTENCY (CRONBACH'S ALPHA)	TEST-RETEST RELIABILITY (PEARSON'S CORRELATION)
Dietary recommendations	0.71	0.81
Sources of nutrients	0.78	0.90
Choosing every day foods	0.53	0.86
Diet-disease relationship	0.80	0.91
Total	0.86	0.92

items answered correctly by more than 80% or less than 20% of respondents are not suitable as they are considered too easy or too hard for the target population. Therefore, items falling within these thresholds were excluded on the grounds of content validity.

### Reliability Assessment (Stage 2)

After validation, another 41 adolescent athletes who had not filled in the other version of the questionnaire took part in a test-retest assessment. Participants completed the newly validated survey twice, with one week in between. The survey was completed under supervision and usually within 25 minutes. During the test participants were given the possibility to post comprehension questions. Correlation analyses tested the agreement of answers within each of the knowledge sections (i.e. internal consistency or reliability) (7), as well as the agreement of answers over time (i.e. test re-test reliability) (14).

### Data Analysis

The internal consistency and test-retest reliability were calculated with Cronbach's alpha and Pearson's correlation coefficient, respectively (7, 14). The questionnaire results (knowledge assessment) were computed for all 75 respondents (validated items only). All values are descriptively presented as means ± SD. As the nutritional knowledge of adolescents has been shown to vary between genders (22), at stage 1, expressive differences could indicate a need for gender-based questionnaires. ➤

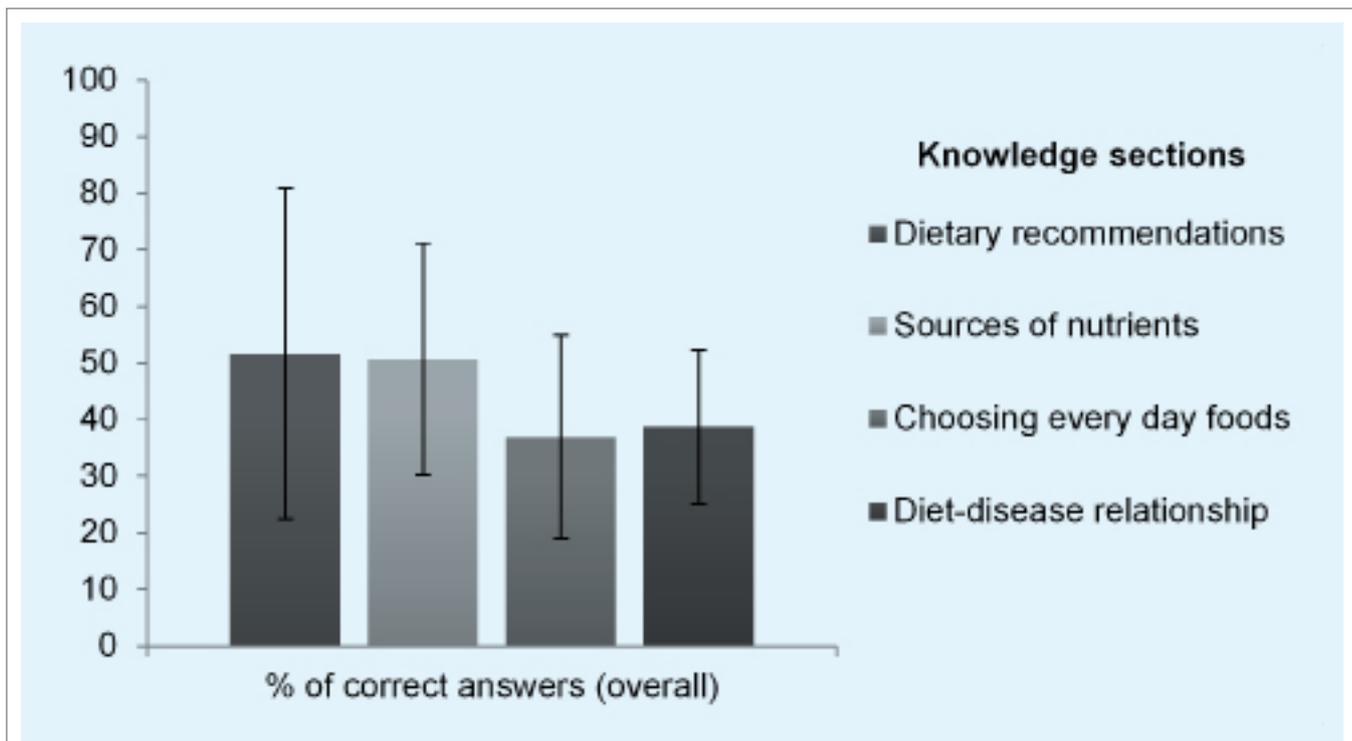


Figure 1

Average amount of correct answers per knowledge section (overall from 75 respondents).

Hence, a two sample t-test assessed possible gender differences at both stages ( $\alpha = 0.05$ ). Data analysis was performed with the software's SPSS 22, and Microsoft Excel 2011.

## Results

### Validation

As a result of the validation (step 1), 13 questions were eliminated from the questionnaire after being correctly answered by  $\geq 80\%$  or  $\leq 20\%$  of participants (Tab. 2). The 32 remaining questions were considered appropriate for the target population according to the above-mentioned criteria (10). The 13 excluded items are displayed in appendix 1 (see online additional material).

As no significant gender differences were computed for any of the knowledge sections, a new survey containing 32 items (see Appendix 2 / online additional material) has been established with no need for a gender-based compilation of questions.

### Internal Consistency & Test-Retest Reliability

As shown in table 3, correlations for the internal reliability of each section ranged from 0.53 to 0.80, with an overall value of 0.86. Values for the reliability of answers over time ranged from 0.81 to 0.91 with a total value of 0.92.

### Knowledge Assessment

Overall, correctly answered items averaged at  $48 \pm 21\%$ , with males ( $50 \pm 11\%$ ) and females ( $45 \pm 9\%$ ) differing significantly ( $p = 0.03$ ). At each knowledge section, correct responses ranged from  $39 \pm 14\%$  to  $52 \pm 29\%$  (overall), with no significant gender differences in any of the segments (Fig. 1, 2).

## Discussion

In the international literature it was shown that a considerable number of athletes has a poor or misguided understanding of

nutrition despite its major implications on health and well-being, especially during adolescence (23, 8). Poor nutrition, however, may adversely affect athletic performance (see the American Dietetic Association's position stand (17)).

Thus, intervention strategies to improve nutritional knowledge, food literacy and the resulting individual food choices should be conducted especially in adolescent athletes. To develop effective nutritional education programs for athletes, appropriate assessment tools to reliably evaluate the efficacy of any educational efforts are required. However, there was no nutritional knowledge assessment tool available for German adolescent athletes until now. Thus, a psychometric valid and reliable nutrition knowledge questionnaire (see Parmenter & Wardle (14) for a detailed appraisal on the importance of psychometric validity and reliability within a questionnaire) was adapted and retested for content validity and reliability upon a cohort of German adolescent athletes.

Questionnaire items not fulfilling the criteria for content validity were mostly too hard (about 2/3) and identified in 3 out of the 4 knowledge sections. Eventually, 29% of all questions needed to be excluded. As the amount of correct and incorrect answers was not affected by the gender factor, it can be inferred that the difficulty and specificity of items suits males and females equally.

The overall instrument had high correlation values computed for both internal and test-retest reliability. The majority of knowledge sections achieved the recommended value of 0.70 on the Cronbach's alpha (10). The only exception being segment Choosing every day foods, which as observed in a similar investigation can be attributed to the low amount and even similarity of questions composing the one specific section (7). However, it is unlikely that the content validity of the survey (i.e. the suitability of items for the topic and its composition within the sections) has been affected.

Regarding the evaluation of the nutritional knowledge in the test population ( $N=75$ ), moderate to low scores were ob-

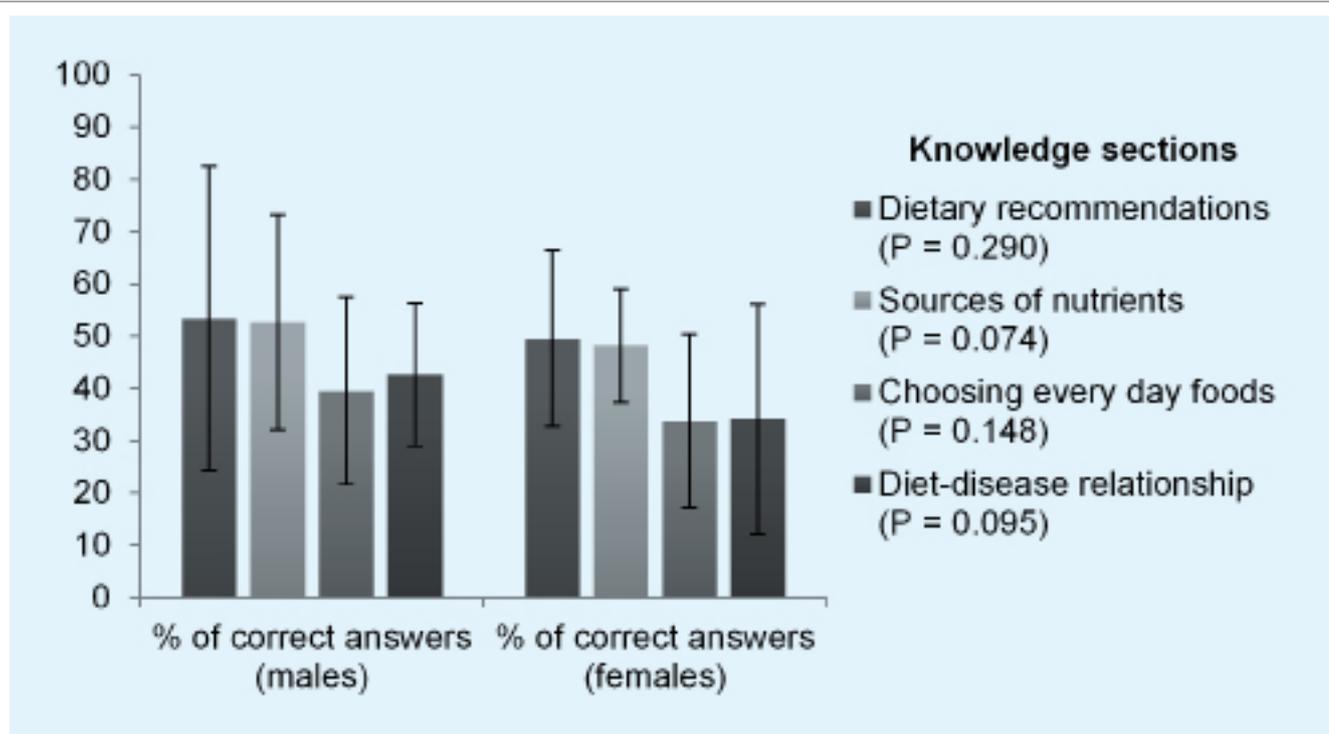


Figure 2

Average amount of correct answers per knowledge section (gender comparisons from 75 respondents).

served overall and across knowledge sections. Gender-based comparisons also revealed values within these boundaries, though males scored better than females in all knowledge sections with a significant overall difference. Some of these values are in agreement with previous investigations where the nutritional knowledge of US adolescents was assessed (5, 15). However, it is still about 20% worse from what other European studies report (20). Recently, the study group of Horvath et al. (7), reported on the nutritional knowledge of Austrian adolescent athletes, while proposing a new sport-oriented nutrition knowledge survey. Though this seems to be the first tool developed exclusively for the assessment of German-speaking adolescent athletes, in-depth comparisons are not possible as our questionnaire has considerably different aims, content and structure (see questionnaire appraisal). Moreover, their survey may still need further development as authors themselves acknowledge the necessity of improving inconsistent reliability and validity aspects (7). Comparisons between study results are anyway critical since most investigations differ in methodology and demographical characteristics. Besides, our modest cohort size only allows us to make preliminary inferences in regards to knowledge level. However, the presently observed values underline the necessity of specific nutrition education for adolescent athletes. Additionally, it would be interesting to further evaluate if the knowledge of adolescent athletes is worse than that of non-athletes. Consequently, larger cohorts should be assessed before comprehensive conclusions on nutritional knowledge can be drawn.

### Questionnaire Appraisal

The present survey allows testing the nutritional knowledge of adolescent athletes in different areas of nutrition (via the knowledge-specific sections), which thereafter enables a targeted development of interventions to address potential areas of knowledge deficiency. Most importantly though, is that all questions in the survey focus on basic nutritional requirements

and habits, as well as their primary health implications, rather than exclusively on sports. This in turn supports one central goal in sports nutrition, in which knowledge upon sound nutritional choices is primarily fostered instead of those around supplements or other sport-specific diets that may not be adequate for adolescents.

### Conclusion

After successfully translating, adapting and validating the original survey from Parmenter & Wardle (14), a new assessment tool containing 32 items (see Appendix 2 / online additional material) has been established. This knowledge questionnaire has shown to be reliable and may serve as valuable instrument when analyzing the nutritional knowledge of German-speaking adolescent athletes. In conclusion, with this modified GNKQ it is now possible to reliably assess the nutritional knowledge and food literacy of German adolescent athletes and to use this modified assessment tool to measure improvements evoked by nutritional education programs. ■

### Conflict of Interest

*The authors have no conflicts of interest.*

## References

- (1) **ABOOD DA, BLACK DR, BIRNBAUM RD.** Nutrition education intervention for college female athletes. *J Nutr Educ Behav.* 2004;36:135-139. doi:10.1016/S1499-4046(06)60150-4
- (2) **BRAUN H, KOEHLER K, GEYER H, KLEINER J, MESTER J, SCHANZER W.** Dietary supplement use among elite young German athletes. *Int J Sport Nutr Exerc Metab.* 2009;19:97-109.
- (3) **CARLSOHN A, CASSEL M, LINNÉ K, MAYER F.** How much is too much? A case report of nutritional supplement use of a high-performance athlete. *Br J Nutr.* 2011;105:1724-1728. doi:10.1017/S0007114510005556
- (4) **COTUGNA N, VICKERY CE, MCBEE S.** Sports nutrition for young athletes. *J Sch Nurs.* 2005;21:323-328. doi:10.1177/1059840505050210060401
- (5) **CUNNINGHAM-SABO LD, DAVIS SM, KOEHLER KM, FUGATE ML, DITUCCI JA, SKIPPER BJ.** Food preferences, practices, and cancer-related food and nutrition knowledge of southwestern American Indian youth. *Cancer.* 1996;78:1617-1622. doi:10.1002/(SICI)1097-0142(19961001)78:7<1617::AID-CNCR44>3.0.CO;2-#
- (6) **HOOGENBOOM BJ, MORRIS J, MORRIS C, SCHAEFER K.** Nutritional knowledge and eating behaviors of female, collegiate swimmers. *N Am J Sports Phys Ther.* 2009;4:139-148.
- (7) **HORVATH G, MEYER NL, KONRAD M, MÜLLER E.** Determining the nutrition knowledge of junior athletes in Austria. Translation and adaptation of the „Adolescent Sport Nutrition Knowledge Questionnaire. *Ernährungs Umschau.* 2014;61:138-143.
- (8) **JUZWIAK CR, ANCONA-LOPEZ F.** Evaluation of nutrition knowledge and dietary recommendations by coaches of adolescent brazilian athletes. *Int J Sport Nutr Exerc Metab.* 2004;14:222-235.
- (9) **KARPINSKI C.** Exploring the feasibility of an academic course that provides nutrition education to collegiate student-athletes. *J Nutr Educ Behav.* 2012;44:267-270. doi:10.1016/j.jneb.2011.09.004
- (10) **KLINE P.** *The Handbook of Psychological Testing.* London: Routledge; 1993.
- (11) **LJUNGQVIST A, JENOURE P, ENGBRETSSEN L, ALONSO JM, BAHR R, CLOUGH A, DE BONDT G, DVORAK J, MALOLEY R, MATHESON G, MEEUWISSE W, MEIJBOOM E, MOUNTJOY M, PELLICCIA A, SCHWELLNUS M, SPRUMONT D, SCHAMASCH P, GAUTHIER JB, DUBI C, STUPP H, THIL C.** The International Olympic Committee (IOC) Consensus Statement on periodic health evaluation of elite athletes March 2009. *Br J Sports Med.* 2009;43:631-643. doi:10.1136/bjism.2009.064394
- (12) **LOUCKS AB, KIENS B, WRIGHT HH.** Energy availability in athletes. *J Sports Sci.* 2011;29:S7-15. doi:10.1080/02640414.2011.588958
- (13) **NAZNI P, VIMALA S.** Nutrition knowledge, attitude and practice of college sportsmen. *Asian J Sports Med.* 2010;1:93-100.
- (14) **PARMENTER K, WARDLE J.** Development of a general nutrition knowledge questionnaire for adults. *Eur J Clin Nutr.* 1999;53:298-308. doi:10.1038/sj.ejcn.1600726
- (15) **PIROUZNI M.** The association between nutrition knowledge and eating behaviour in male and female adolescents in the US. *Int J Food Sci Nutr.* 2001;52:127-132. doi:10.1080/09637480020027000-8
- (16) **ROBINSON K, FERRARO FR.** The relationship between types of female athletic participation and female body type. *J Psychol.* 2004;138:115-128. doi:10.3200/JRLP.138.2.115-128
- (17) **RODRIGUEZ NR, DIMARCO NM, LANGLEY S.** Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. *J Am Diet Assoc.* 2009;109:509-527. doi:10.1016/j.jada.2009.01.005
- (18) **ROSENBLUM C, JONNALAGADDA SS.** Nutrition knowledge of collegiate athletes in a Division I National Collegiate Athletic Association institution. *J Am Diet Assoc.* 2002;102:418-420. doi:10.1016/S0002-8223(02)90098-2
- (19) **SHIFFLETT B, TIMM C, KAHANOV L.** Understanding of athletes nutritional needs among athletes, coaches and athletic trainers. *Res Q Exerc Sport.* 2002;73:357-362. doi:10.1080/02701367.2002.10609032
- (20) **SICHERT-HELLERT W, BEGHIN L, DE HENAUW S, GRAMMATIKAKI E, HALLSTRÖM L, MANIOS Y, MESANA MI, MOLNÁR D, DIETRICH S, PICCINELLI R, PLADA M, SJÖSTRÖM M, MORENO LA, KERSTING M.** Nutritional knowledge in European adolescents: results from the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) study. *Public Health Nutr.* 2011;14:2083-2091. doi:10.1017/S1368980011001352
- (21) **SOMERVILLE SJ, LEWIS M.** Accidental breaches of the doping regulations in sport: is there a need to improve the education of sportspeople? *Br J Sports Med.* 2005;39:512-516. doi:10.1136/bjism.2004.013839
- (22) **TALLARINI A, ZABEO A, FERRARETTO A.** Nutritional knowledge in an Italian population of children, pre-adolescents and adolescents. *Public Health Nutr.* 2013;17:708-714. doi:10.1017/S1368980013000311
- (23) **TORRES-MCGEEHEE TM, PRITCHETT KL, ZIPPEL D, MINTON DM, CELLAMARE A, SIBILIA M.** Sports nutrition knowledge among collegiate athletes, coaches, athletic trainers, and strength and conditioning specialists. *J Athl Train.* 2012;47:205-211.
- (24) **WOLINSKY I.** *Nutrition in Exercise and Sport.* Florida: Boca Raton; 1998.