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Development and validation of nutrition knowledge test for high school students using a novel study design: A Rasch analysis

Desarrollo y validación de una prueba de conocimientos sobre nutrición para estudiantes de secundaria utilizando un diseño de estudio novedoso: un análisis de Rasch

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ABSTRACT

Introduction: The creation of a high-quality, valid, and reliable knowledge test for high school students will contribute to establishing dietary programs more conscious, for individuals and society. The aim of the study is to develop a valid and reliable nutrition knowledge test for high school students.

Methodology: Data were collected from 346 high school students age from 14 to 18 years. Rasch modelling was used for validating the test. The expert group followed a five-step test developing process and developed 22 multiple-choice items.

Results: Findings indicated that 20 of 22 test items showed high internal consistency and reliability for both test items and person participating in this study. The wright map indicated a well distributed item difficulties and relatively good person abilities.

Conclusions: It is thought that the study findings obtained through the Rasch modelling and the knowledge test created will be a guiding tool in respect of multidimensionality, validity, and reliability for the concept, such as nutrition which is crucial in human life.

Keywords: Adolescent; Nutrition; Diet, Healthy; Surveys and Questionnaires.

RESUMEN

Introducción: La creación de una prueba de conocimientos de alta calidad, válida y confiable para estudiantes de secundaria contribuirá a establecer programas dietéticos más conscientes, para las personas y la sociedad. El objetivo del estudio es desarrollar una prueba de conocimiento nutricional válida y confiable para estudiantes de secundaria.

Metodología: Se recolectaron datos de 346 estudiantes de secundaria de 14 a 18 años. Se utilizó el modelado de Rasch para validar la prueba. El grupo de expertos siguió un proceso de desarrollo de pruebas de cinco pasos y desarrolló 22 ítems de opción múltiple.

Resultados: Los resultados indicaron que 20 de los 22 ítems de la prueba mostraron una alta consistencia interna y confiabilidad tanto para los ítems de la prueba como para la persona que participó en este estudio. El mapa de Wright indicó un elemento bien distribuido con dificultades y habilidades personales relativamente buenas.

Conclusiones: Se piensa que los hallazgos del estudio obtenidos a través del modelado de Rasch y la prueba de conocimiento creada serán una herramienta orientadora respecto a la multidimensionalidad, validez y confiabilidad del concepto, como la nutrición, que es crucial en la vida humana.

Palabras clave: Adolescente; Nutrición; Dieta Saludable; Cuestionarios.

KEY MESSAGES

- The development of a nutrition knowledge test specific to high school students and individuals at the developmental age is a requirement.
- Nutrition knowledge test created using Rasch modelling will be a guiding tool to evaluate knowledge level of adolescents.
- The test can lead a widespread using for researchers.

INTRODUCTION

In recent years, people's tendency towards a healthy lifestyle has increased the importance of having adequate knowledge about nutrition[1,2]. Changes in nutritional habits (i.e., harmful nutritional supplements, smoking and alcohol consumption) are shown as one of the main causes of chronic problems, which are common worldwide, such as cardiovascular diseases, different cancer types, osteoporosis, blood pressure and obesity, which is considered as the disease of the age[3]. Nutrition-related basic concepts and application methods should be learned and applied throughout life to prevent the occurrence of chronic diseases, which are highly associated with morbidity and mortality rates[4].

Youth is considered a transitional period in individuals' physiological and psychological development processes and has vital importance[5]. Because major changes in the body during this period directly influence nutritional and eating attitudes/habits. Meanwhile, it is a period when nutrition-based problems, which are expressed as eating disorders and often observed in young girls, are experienced[6]. The change in eating attitudes and nutritional habits during youth actually prepares the ground for possible health problems likely to arise in adulthood[7]. The main reason for the diseases that are mentioned above and quite common in society is the lack of adequate knowledge and understanding of nutrition since due importance is not given to this issue at young ages. From childhood until the completion of the development process, obtaining information about basic nutrients, food types, and eating habits comes into prominence as an inevitable situation for public and social awareness, specifically for individuals[8,9].

One of educational institutions' main duties is to guide society on how to access information. Particularly high school students can be seen as the target group with respect to forming the basis of nutritional understanding, which will direct the whole life, due to the high level of interaction resulting from strong friendship ties during their time at school and during adolescence[10,11]. The fact that students are usually open to positive guidance and being informed will contribute to the increase in the level of individual knowledge as well as the creation of social awareness. The age range with the highest obesity rate is 12-19 years[12] revealing that adolescents at high school need to be informed about nutrition. However, in high school curricula, nutrition is generally given in small sections within health information and physical education classes rather than being taught as a separate course[13]. Nowadays, reasons such as

the high number of boarding schools and the fact that students in most educational institutions must eat at least one main meal in school compel students to eat the meals given by the institution they study at. The meals given by educational institutions are rather shaped according to the cultural structure[12]. In this case, the consumption rate of products containing carbohydrates, fats and proteins, which are known as macronutrients and required to meet students' daily energy needs[14] also differs according to the structure of society. Therefore, it should be considered as an inevitable necessity for students to have basic nutritional knowledge.

There are many scales and tests that assess nutritional knowledge and eating attitudes[15-20].The Rasch analysis, which was used in this study to create the nutritional knowledge test (NKT), is a model with a high validity-reliability, and its use has increased in recent years. Unlike data collection tools such as scales and questionnaires, which have a high frequency of use, the analysis conducted in this model is performed by interpreting the difficulty of the questions and students' levels of knowledge. Moreover, it allows for the creation of alternative forms if there are questions that should not be used as a result of the test development process[21,22]. When the literature was reviewed, no studies using the Rasch modelling[23] to determine nutritional knowledge levels at high school were found.

From a scientific perspective, it is assumed that the creation of a high-quality, valid, and reliable knowledge test for high school students will contribute to establishing dietary programs, along with broad planning for individuals and society by determining the nutritional knowledge level. The aim of the study is to develop a valid and reliable NKT for high school students using the Rasch analysis.

METODOLOGY

Setting

Prior to higher education, Turkish high school students in must attend four-year teaching process in order to graduate. Through this process, they must follow 12-14 lessons for each year and 40 hours for each week. Nutrition knowledge is the knowledge that 9th grade students are expected to have during the health science lesson. It is also taught 10th and 11th grades high

school students following physical education and sport lessons. The necessity of having sufficient nutrition knowledge is pinpointed on Ministry of National Education Standards. High school students who successfully completed physical education and sport lesson should explain accurate sources of nutrition knowledge (standard 10.2.2.3.1) and explain basic principles of nutrition (standard 11.2.2.3.1)[24]. In health science curriculum, they should explain adequate and balanced nutrition (standard 1.3.2)[25]. Hence, high school students completed these two lessons are supposed to have sufficient nutrition knowledge. Schools were randomly selected to participate. In total, six public high schools involved in this study.

Participants

The participants were 346 (54.2% female, 45.8% male) 10th, 11th and 12th grade high school students who had successfully completed nutrition course. The participants had previously completed required "Health Sciences" course including nutrition knowledge context in their 9th grade (first year of high school). Students who did not complete nutrition context course in their first year's education period were excluded. Prior to taking the NKT test, the students completed a demographic questionnaire. The questionnaire revealed that our sample ranged in age from 14 to 18 years (M = 16.58, SD = 1.39; Female = 16.87, SD= 1.93; Male = 16.29, SD = 1.40). Participation was voluntary, with no monetary or nonmonetary incentives offered and all students had answered the test questions. This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by a local University Ethical Review Board (Approval ID= 2021/05/103). Written informed consent was obtained from all subjects.

Development of the test

To measure nutrition knowledge level of high school students, we checked literature and found some tests[15,16,18,20,26]. However we did not want to use them and decided to develop a NKT because of some reasons: a) Tests in literature were not useful (i.e. more questions than students can answer), b) insufficient for using it in high school context (i.e. questions were not related with high school nutrition knowledge requirements), c) Development and validation process was not reliable (i.e. No detailed information about development process).

We followed five steps development process of the NKT (Figure 1). First step, we aimed to create nutrition knowledge content aligned with Turkish high school nutrition curriculum[24,25]. Hence, a panel including an experienced curriculum developer, a professor following nutrition course in physical education teacher education department more than 10 years, a Turkish language expert, two nutrition and dietitian experts was constituted by the first author. The panel came together twice via zoom meeting (not face to face because of covid-19 pandemic) and discussed possible and expected outcomes of nutrition course in high school context (i.e., content validity). They decided 19 questions for essential nutrients and 11 questions for general nutrition knowledge sub-domains, totally 30 questions. In second step, questions were checked by Turkish language expert in order to make sure language appropriateness for high school students. Four high school students who had already completed nutrition course read and further assessed the questions in the third step (i.e., face validity). Then, the test was reviewed by five high school teachers who were experienced for teaching nutrition courses to check content validity. After four steps, eight questions were removed from the test because they were too easy or too difficult or inappropriate for high school nutrition curriculum. In the last step, draft test was given to another 10 high school students who followed and successfully completed nutrition course. They reported that all selected questions were understandable, and changes were not required. The final version of nutrition knowledge test consisted of 22 multiple-choice questions. Sub-domains of the test were seven questions for general nutrition knowledge and 15 questions for essential nutrients. There was only one correct answer from four possible answer options.

Figure 1. Development process of the NKT

Examples of questions from different subjects of the NKT were presented in Table 1.

Table 1. Examples of questions from different subjects of the NKT

Question 1- General nutrition knowledge
Which of the following is the concept of "taking the nutrients the body needs into the body as much as needed"?
A) Adequate diet
B) Balanced diet
C) Healthy diet
D) Proper diet
Question 2- General nutrition knowledge
Which of the following is the essential nutrient has the most calories per gram (9 kcal)?
A) Fat
B) Carbohydrate
C) Protein
D) Vitamins
Question 3- Essential nutrients
Which of the following is the most important essential nutrient in meeting daily energy needs?
A) Fat
B) Protein
C) Carbohydrate
D) Mineral
Question 4- Essential nutrients
Which of the following protein products has the highest digestibility?
A) Read meat
B) Chicken egg
C) Fish meat
D) Legumes
Question 5- Essential nutrients
Which of the following is not a type of mineral?
A) Glucose
B) Calcium
C) Iron
D) Magnesium
Question 6- Essential nutrients
Which of the following is false statement about water?
A) It is the most important substance in the human organism after oxygen.
B) It is responsible for the exchange of substances in the body.
C) It takes a role in metabolic activities.
D) It is made up of hydrogen and nitrogen.
Question 7- Essential nutrients
Which of the following is not a source of vitamin D?
A) Sunlight
B) Butter
C) Dark green leafy vegetables
D) Egg yolk

Procedures

The NKT was transferred to online Google form and an invitation sent to high school students via official school networks. This invitation included a unique web link to a web-based version of the NKT. School managers and teachers helped us to collect data. Total data collection process was 15 days. Collected data were entered to MS Excel spreadsheet and transferred to Winstep software Version 3.72.4.[27] This software was utilized for calibrating the data for Rasch modelling[23] which focuses on data to "fit the model" rather than traditional models' "fit the data" approaches[27]. Rasch modelling includes Wright Maps, separation and separation-reliability indices, item fit and person fit analyses.

Wright Maps/Person-Item: Wright maps also called person-item are the scale measurement method demonstrating distribution of item difficulties and distribution of answers of participants[27]. The right side of the map shows item difficulty rank. While the most difficult questions are at the top of the scale, the easiest questions take the lowest part of the side. Answers of the participants are demonstrated on the left side. The highest score of participants takes on the top of the side and lowest score takes the lowest part. Wright maps indicate teachers what high school students know and what they need to learn for nutrition.

Item Fit: Item fit analysis, including infit and outfit values, is used to measure appropriateness of items to the overall test model[28]. Infit values are sensitive where the model would anticipate the answer to be. If students with high nutrition knowledge answer difficult questions correctly, this demonstrates the data are good fit. Outfit statistics are sensitive to unexpected patterns in the answers[29]. If students with low nutrition knowledge answer difficult questions correctly, this indicates a poor fit the model. Infit and outfit statistics are determined with the standardized mean square residual (ZSTD) and mean square residual (MNSQ) values in the Rasch modelling[23]. To get a good model, MNSQ values should be ranging from 0.5 to 1.5[27] and ZSTD values should be ranging from +2 to -2[28].

Person Fit: Person-fit analysis is utilized to assess item-score pattern which is highly related with the appropriateness of the model[28]. Person-fit indices are checked with MNSQ values which should be ranging from 0.5 to 1.5[27].

Separation Index and Separation-Reliability Index: Item separation index, which distinguishes student with low and high scores, is used to determine construct validity of the

model. Separation indices are determined as: a) 1.5 or over is acceptable, b) 2.00 is a good level, and c) 3.00 or over is excellent level. Separation-reliability index value is used to check reliability of either person or item responses. If the value is close to 1.00, this demonstrates high confidence for responses[28].

RESULTS

Table 2 indicated infit and outfit statistics results. Infit results for MNSQ ranging from 1.39 to .72 showed that all items were within the acceptable range of 0.5-1.5. ZSTD results of all items were within acceptable values except item 13 and item 15. The outfit statistics for MNSQ results indicated that all items were acceptable, but only item 13 was over than acceptable value of 1.5. ZSTD values of outfit statistics were within acceptable range, except item 13 and item 15.

The wright map indicated well distributed item difficulties (M=1.44, SD=.69) and relatively good person abilities (M=11.3, SD=3.4). Map showed that the most difficult and the easiest items as well as person with the highest and the lowest scores were clearly demonstrated in Figure 2.

Person and item reliabilities can be determined whether "real" or "model" reliability estimate. Boone et al. proposed to use "real" estimate instead of "model" estimate because it is more conservative and appropriate estimate[30]. Person-separation index was 2.19, which is a good level for person participating in test. Reliability estimate level in Table 3 was ".86" which is high reliability level for determining person separation level.

Table 2. Item difficulty, standard error, fit and point-measure correlation.

Entry Number	Item Difficulty	Model SE	Infit		Outfit		PT-measure
			MNSQ	ZSTD	MNSQ	ZSTD	
13	**2.74**	**.74**	**1.39**	**2.9**	**2.08**	**4.1**	**.05**
16	2.46	.36	1.08	.5	1.41	1.5	.11
6	2.51	.88	1.22	1.5	1.40	1.4	.13
12	2.11	.62	1.10	1.0	1.27	1.3	.17
20	2.03	.54	1.06	.7	1.22	1.5	.23
10	1.97	.78	1.07	.5	1.19	.9	.18
21	1.98	.56	1.14	1.5	1.17	1.2	.17
11	1.92	.53	1.05	.6	1.16	1.2	.26
1	1.88	.59	1.10	1.0	1.06	.4	.22
22	1.74	.48	1.04	.5	1.07	.7	.31
3	1.46	.64	1.01	.1	1.06	.5	.34
5	1.15	.51	1.00	.1	.97	.0	.31
14	1.11	.33	.97	-.2	.96	-.1	.39
7	1.14	.46	.92	-.9	.88	-1.1	.46
9	1.02	.56	.92	-.7	.86	-1.0	.47
18	1.00	.52	.90	-1.1	.88	-1.1	.48
19	.98	.69	.87	-1.5	.85	-1.2	.51
8	.94	.42	.82	-1.4	.78	-1.3	.56
2	.74	.56	.79	-1.2	.58	-1.5	.59
4	.46	.41	.77	-1.0	.59	-1.2	.58
17	.23	.40	.77	-1.5	.67	-1.4	.64
15	**.21**	**.46**	**.72**	**-3.2**	**.67**	**-3.1**	**.69**
Mean	1.44	.54	.99	-.1	1.05	.0	
P.SD	.69	.14	.16	1.3	.36	1.7	

MNSQ: mean square residual; ZSTD: standardized mean square residual; PT-measure: Point-measure correlation.

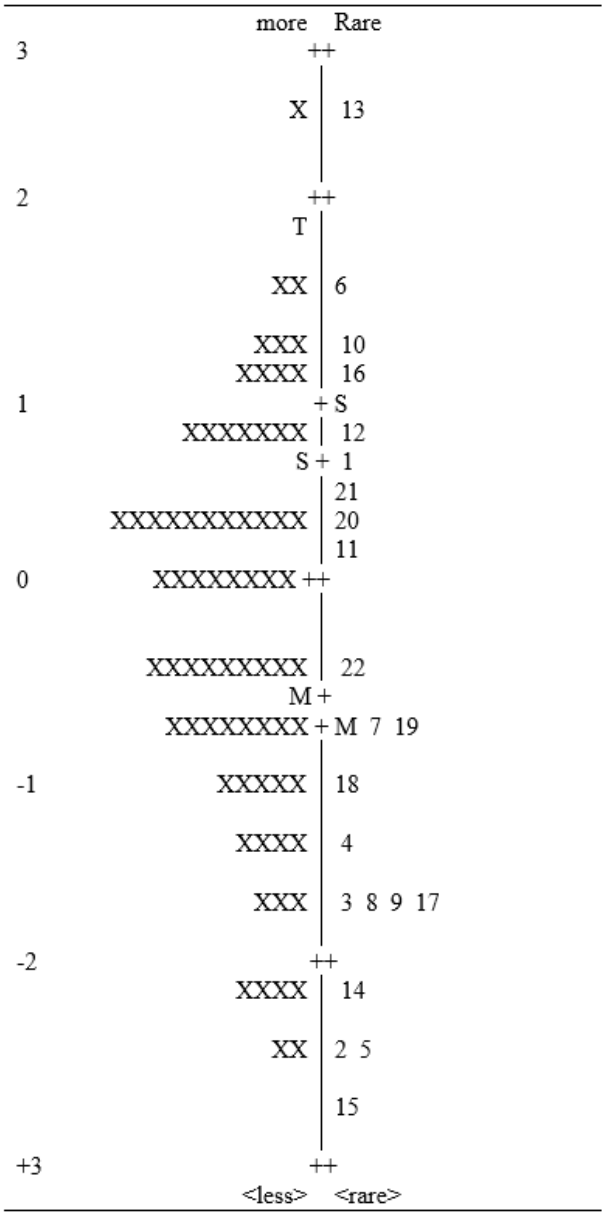

Figure 2. Wright map of items and person

Table 3. Summary of 346 measured person

	Total score	Model		Infit		Outfit	
		count	SE	MNSQ	ZSTD	MNSQ	ZSTD
Mean	11.3	22.0	5.03	.99	-.1	1.05	.0
P.SD	3.3	.0	.27	.29	1.3	.54	1.3
S.SD	3.4	.0	.28	.30	1.3	.55	1.3
Max.	17.0	22.0	6.00	1.81	3.2	3.43	3.7
Min.	4.0	22.0	4.81	.54	-2.6	.46	-2.1
Real RMSE = 5.33		True SD = 6.34 = .86		Separation = 2.19		Item Reliability	
Model RMSE= 5.04		True SD = 6.57 = .87		Separation = 2.30		Item Reliability	
SE of item mean = .96							

MNSQ: mean square residual; P.SD: population standard deviation; RMSE: root mean square standard error; SE: standard error; S.SD: sample standard deviation; ZSTD: standardized mean square residual.

Item separation index reported in Table 4 was "3.73" which is excellent level of separation. This index score indicates that items in test are trustful and good representative[30]. The separation-reliability estimate score was ".93" showing a high confidence in item reliability.

Table 4. Summary of 22 measured Items

	Total score	Model		Infit		Outfit	
		count	SE	MNSQ	ZSTD	MNSQ	ZSTD
Mean	167.5	346.0	2.76	.99	-.1	1.05	.0
P.SD	72.5	.0	.31	.16	1.3	.36	1.7
S.SD	72.6	.0	.31	.16	1.4	.37	1.7
Max.	294.0	346.0	3.56	1.39	2.9	2.08	4.1
Min.	61.0	346.0	2.48	.72	-3.2	.49	-3.1
Real RMSE = 2.85		True SD = 10.65		Separation = 3.73		Item Reliability = .93	
Model RMSE= 2.77		True SD = 10.67		Separation = 3.85		Item Reliability = .94	
SE of item mean = 2.40							

MNSQ: mean square residual; P.SD: population standard deviation; RMSE: root mean square standard error.

DISCUSSION

Having an unconscious and unbalanced diet is considered the main cause of common health problems and some fatal diseases[31]. When this situation is combined with a sedentary lifestyle, adolescence, during which weight change is experienced the most and fastest, is considered a vital process for life[32]. The determination of high school students' nutritional knowledge levels and the evaluation of the nutritional education provided come to the forefront as encouraging factors for developing a valid and reliable nutritional knowledge test. For this reason; the development of a NKT specific to high school students and individuals at the developmental age is a requirement in terms of gaining a healthy and balanced dietary understanding that should be taken into consideration throughout life. The aim of this study is to develop a valid and reliable nutritional knowledge test for high school students using the Rasch analysis.

There are many knowledge tests developed in different areas using Rasch modelling in the literature[20,22,33]. In their review study in which the issues to be considered for developing a valid scale on nutrition were examined, Trakman et al. reported that factor and Rasch analyses would be more valid methods to determine the nutritional knowledge level[34]. Guttersrud et al. and Mötteli et al. used the Rasch modelling in the scales they developed to determine nutritional literacy and understanding of balanced nutrition, respectively[35,36]. Our study, on the other hand, has a unique value since it used Rasch modelling to determine the nutritional knowledge levels of high school students.

According to the analyses performed in the study, it has been revealed that the results met the required item difficulty and item separation standards; thus, the developed NKT is a valid and reliable tool for determining the nutritional knowledge levels of high school students. Furthermore, factors such as benefiting from the opinion of a nutritionist during the preparation of the questions to be used in the test and determining the questions of appropriate quality and quantity according to topics increase the reliability of the test. In their Rasch analyses performed according to different numbers of samples (N=30, 50, 100, and 250), Chen et al. emphasized that it was important for the number of samples to be 100 or higher in terms of fit indices[37]. The fact that the number of samples in the study (N=346) was quite enough for the Rasch analysis is another factor that reveals the study's validity.

When the fit indices in the test, which was prepared in compliance with the high school curriculum and included a total of 22 questions at the end, were reviewed, it was observed that all questions, except for item 13 related to the concept of mineral and item 15 related to the concept of vitamin among basic nutrients, met the expected internal and external fit values (Table 2). Therefore, it is thought that it would be appropriate to exclude questions 13 and 15 from the test. In this context; it can be said that students have incomplete knowledge about vitamins and minerals, which are considered as essential nutrients. Moreover, it seems that there is no consistency between the learning outcomes of these subjects and the teaching process. The discrimination and confidence indices of all items (including items 13 and 15) and individuals are at an adequate level. The results obtained from a total of 346 high school students who responded to the NKT were found to have a correct response rate by 48.4%. In their study on the determination of European adolescents' nutritional knowledge levels, Sichert-Hellert et al. stated that approximately 60% of the participants gave correct responses to the questions[4]. In the same study, it was expressed that there were similar correct response results in studies that had been conducted in Europe and various countries of the world and put forward the nutritional knowledge levels[38,39]. Studies using Rasch modelling emphasize that the success rate to be achieved in all questions should be higher than 70% so that the level of knowledge can be considered adequate[40]. It is observed that the students participating in the presented study do not have adequate nutritional knowledge. The main reason for this situation is the failure of teachers in creating awareness on this issue since the nutrition lesson is not included in the curriculum adequately.

Independently of the studies using the Rasch analysis, the common finding in the studies conducted to determine nutritional knowledge levels in adolescents and adults is that nutritional knowledge levels are inadequate[4,26,41]. In this context, it is necessary to especially increase the basic nutritional knowledge levels of young people in the developmental age. The larger inclusion of the nutrition subject in the existing courses of health and physical education areas, if possible, giving the nutrition course as a separate course and informing teachers about the subject can be stated as possible solutions.

Although the questions in the developed NKT were created by adhering only to the nutrition topics in the high school curriculum of the Turkish Ministry of National Education, it is

anticipated that the information about a universal concept such as nutrition will be mostly similar for individuals of the same age and from different countries/cultures. The reason is that the questions in the test consist of basic topics such as the importance of nutrition and nutrients rather than being peculiar to a culturally specific field. In this scope, the problems that may be faced owing to a change in language in the possible translation of the test into different languages will be at a minimum level. Although it is tried to distribute the subjects of questions in the test evenly, factors such as the creation of the questions by researchers, the number of questions in the test and the determination of the response options indicate that personal choices are effective in the creation of the test, and these factors should be considered within the limitations of the study.

CONCLUSION

In conclusion, the 20-item instrument (NKT) is consistent, reliable, and valid to measure high school students' nutritional knowledge levels. The fact that social awareness will be created with the determination of the nutritional knowledge level at the development age is considered a factor that will popularize the practical use of the test. Furthermore, it is thought that the study findings obtained through the Rasch modelling and the knowledge test created will be a guiding tool in respect of multidimensionality, validity, and reliability for the concept, such as nutrition which is crucial in human life. Further research is needed to increase the number of valid and reliable measurement tools for nutrition knowledge in different school levels (i.e., middle school).

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AUTHORS' CONTRIBUTIONS

The authors are responsible for the research and have participated in the concept, design, analysis and interpretation of the data, writing and correction of the manuscript.

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COMPETING INTERESTS

The authors state that there are no conflicts of interest in preparing the manuscript. All authors have reviewed and approved the complete manuscript and the authors declared that this study has received no financial support.

REFERENCIAS

(1) Barzegari A, Ebrahimi M, Azizi M, Ranjbar K A. Study of Nutrition Knowledge, Attitudes and Food Habits of College Students. World Applied Sciences Journal. 2011;15(7):1012-7.

(2) Samoggia A, Riedel B. Assessment of nutrition-focused mobile apps' influence on consumers' healthy food behaviour and nutrition knowledge. Food Res Int. 2020;128:108766, doi: 10.1016/j.foodres.2019.108766.

(3) Kimokoti RW, Millen BE. Nutrition for the Prevention of Chronic Diseases. Med Clin North Am. 2016;100(6):1185-98, doi: 10.1016/j.mcna.2016.06.003.

(4) Sichert-Hellert W, Beghin L, De Henauw S, Grammatikaki E, Hallström L, Manios Y, et al. Nutritional knowledge in European adolescents: results from the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) study. Public Health Nutr. 2011;14(12):2083-91, doi: 10.1017/S1368980011001352.

(5) Häggman-Laitila A, Salokekkilä P, Karki S. Young People's Preparedness for Adult Life and Coping After Foster Care: A Systematic Review of Perceptions and Experiences in the Transition Period. Child Youth Care Forum. 2019;48(5):633-61, doi: 10.1007/s10566-019-09499-4.

(6) Golden NH, Schneider M, Wood C. Preventing Obesity and Eating Disorders in Adolescents. Pediatrics. 2016;138(3):e20161649, doi: 10.1542/peds.2016-1649.

(7) Moreno LA, Sarría A, Fleta J, Rodríguez G, González JM, Bueno M. Sociodemographic factors and trends on overweight prevalence in children and adolescents in Aragón (Spain) from 1985 to 1995. J Clin Epidemiol. 2001;54(9):921-7, doi: 10.1016/s0895-4356(01)00358-4.

(8) Harvey-Berino J, Hood V, Rourke J, Terrance T, Dorwaldt A, Secker-Walker R. Food preferences predict eating behavior of very young Mohawk children. J Am Diet Assoc. 1997;97(7):750-3, doi: 10.1016/S0002-8223(97)00186-7.

(9) Kostanjevec S, Jerman J, Koch V. Nutrition knowledge in relation to the eating behaviour and attitudes of Slovenian schoolchildren. Nutrition & Food Science. 2013;43(6):564-72, doi: 10.1108/NFS-10-2012-0108.

(10) Cavanagh SE, Riegle-Crumb C, Crosnoe R. Puberty and the Education of Girls. Soc Psychol Q. 2007;70(2):186-98.

(11) Jones AM, Zidenberg-Cherr S. Exploring nutrition education resources and barriers, and nutrition knowledge in teachers in California. J Nutr Educ Behav. 2015;47(2):162-9, doi: 10.1016/j.jneb.2014.06.011.

(12) D'Adamo CR, McArdle PF, Balick L, Peisach E, Ferguson T, Diehl A, et al. Spice MyPlate: Nutrition Education Focusing Upon Spices and Herbs Improved Diet Quality and Attitudes Among Urban High School Students. Am J Health Promot. 2016;30(5):346-56, doi: 10.1177/0890117116646333.

(13) de Vlieger N, Riley N, Miller A, Collins CE, Bucher T. Nutrition education in the Australian New South Wales primary school curriculum: An exploration of time allocation, translation and attitudes in a sample of teachers. Health Promot J Austr. 2019;30(1):94-101, doi: 10.1002/hpja.188.

(14) Schrama JW, Haidar MN, Geurden I, Heinsbroek LTN, Kaushik SJ. Energy efficiency of digestible protein, fat and carbohydrate utilisation for growth in rainbow trout and Nile tilapia. Br J Nutr. 2018;119(7):782-91, doi: 10.1017/S0007114518000259.

(15) Dickson-Spillmann M, Siegrist M, Keller C. Development and validation of a short, consumer-oriented nutrition knowledge questionnaire. Appetite. 2011;56(3):617-20, doi: 10.1016/j.appet.2011.01.034.

(16) Keller HH, McKenzie JD, Goy RE. Construct validation and test-retest reliability of the seniors in the community: risk evaluation for eating and nutrition questionnaire. J Gerontol A Biol Sci Med Sci. 2001;56(9):M552-558, doi: 10.1093/gerona/56.9.m552.

(17) Miller CK, Jensen GL, Achterberg CL. Evaluation of a food label nutrition intervention for women with type 2 diabetes mellitus. J Am Diet Assoc. 1999;99(3):323-8, doi: 10.1016/S0002-8223(99)00082-6.

(18) Parmenter K, Wardle J. Development of a general nutrition knowledge questionnaire for adults. Eur J Clin Nutr. 1999;53(4):298-308, doi: 10.1038/sj.ejcn.1600726.

(19) Sapp SG, Jensen HH. Reliability and Validity of Nutrition Knowledge and Diet-Health Awareness Tests Developed from the 1989–1991 Diet and Health Knowledge Surveys. Journal of Nutrition Education. 1997;29(2):63-72, doi: 10.1016/S0022-3182(97)70157-2.

(20) Trakman GL, Forsyth A, Hoye R, Belski R. Developing and validating a nutrition knowledge questionnaire: key methods and considerations. Public Health Nutr. 2017;20(15):2670-9, doi: 10.1017/S1368980017001471.

(21) Boone WJ. Rasch Analysis for Instrument Development: Why, When, and How? CBE Life Sci Educ. 2016;15(4):rm4, doi: 10.1187/cbe.16-04-0148.

(22) Devrilmez E, Dervent F, Ward P, Ince ML. A test of common content knowledge for gymnastics: A Rasch analysis. European Physical Education Review. 2019;25(2):512-23, doi: 10.1177/1356336X17751232.

(23) Rasch G. Probabilistic Models for Some Intelligence and Attainnment Tests. Chicago: Uni Chicago Press; 1980.

(24) T.C. Millî Eğitim Bakanlığı Talim Terbiye Kurulu Başkanlığı. Ortaöğretim Beden Eğitimi ve Spor Dersi Müfredatı. [accedido 19 enero 2022]. Disponible en: https://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=334.

(25) T.C. Millî Eğitim Bakanlığı Talim Terbiye Kurulu Başkanlığı. Ortaöğretim Sağlık Bilgisi Ders Müfredatı. [accedido 20 enero 2022]. Disponible en: https://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=348.

(26) Jones AM, Lamp C, Neelon M, Nicholson Y, Schneider C, Wooten Swanson P, et al. Reliability and validity of nutrition knowledge questionnaire for adults. J Nutr Educ Behav. 2015;47(1):69-74, doi: 10.1016/j.jneb.2014.08.003.

(27) Linacre J A. User's guide to winsteps rasch-model computer program. Version 3.65. 2008. [accedido 20 enero 2022]. Disponible en: https://www.winsteps.com.

(28) Bond T, Fox CM, Bond TG. Applying the Rasch Model: Fundamental Measurement in the Human Sciences, Second Edition. Mahwah, N.J; 2007.

(29) He Y, Ward P, Wang X. Validation of a Common Content Knowledge Test for Soccer. Journal of Teaching in Physical Education. 2018;37(4):407-12, doi: 10.1123/jtpe.2017-0204.

(30) Boone WJ, Staver JR, Yale MS. Rasch Analysis in the Human Sciences. New York, NY: Springer; 2014.

(31) Devries S, Agatston A, Aggarwal M, Aspry KE, Esselstyn CB, Kris-Etherton P, et al. A Deficiency of Nutrition Education and Practice in Cardiology. Am J Med. 2017;130(11):1298-305, doi: 10.1016/j.amjmed.2017.04.043.

(32) Kalantari N, Mohammadi NK, Rafieifar S, Eini-Zinab H, Aminifard A, Malmir H, et al. Indicator for Success of Obesity Reduction Programs in Adolescents: Body Composition or Body Mass Index? Evaluating a School-based Health Promotion Project after 12 Weeks of Intervention. Int J Prev Med. 2017;8:73, doi: 10.4103/ijpvm.IJPVM_306_16.

(33) Tavakol M, Dennick R. Psychometric evaluation of a knowledge based examination using Rasch analysis: An illustrative guide: AMEE Guide No. 72. Medical Teacher. 2013;35(1):e838-48, doi: 10.3109/0142159X.2012.737488.

(34) Trakman GL, Forsyth A, Hoye R, Belski R. The nutrition for sport knowledge questionnaire (NSKQ): development and validation using classical test theory and Rasch analysis. J Int Soc Sports Nutr. 2017;14:26, doi: 10.1186/s12970-017-0182-y.

(35) Guttersrud O, Dalane JØ, Pettersen S. Improving measurement in nutrition literacy research using Rasch modelling: examining construct validity of stage-specific «critical nutrition literacy» scales. Public Health Nutr. 2014;17(4):877-83, doi: 10.1017/S1368980013000530.

(36) Mötteli S, Barbey J, Keller C, Bucher T, Siegrist M. Measuring practical knowledge about balanced meals: development and validation of the brief PKB-7 scale. Eur J Clin Nutr. 2016;70(4):505-10, doi: 10.1038/ejcn.2015.173.

(37) Chen W-H, Lenderking W, Jin Y, Wyrwich KW, Gelhorn H, Revicki DA. Is Rasch model analysis applicable in small sample size pilot studies for assessing item characteristics? An example using PROMIS pain behavior item bank data. Qual Life Res. 2014;23(2):485-93, doi: 10.1007/s11136-013-0487-5.

(38) Osler M, Hansen ET. Dietary knowledge and behaviour among schoolchildren in Copenhagen, Denmark. Scand J Soc Med. 1993;21(2):135-40, doi: 10.1177/140349489302100214.

(39) Reinehr T, Kersting M, Chahda C, Andler W. Nutritional knowledge of obese and non-obese children. Nutr Res. 2003;23:645-9, doi: 10.1016/S0271-5317(03)00025-3.

(40) Castelli D, Williams L. Health-Related Fitness and Physical Education Teachers' Content Knowledge. Journal of Teaching in Physical Education. 2007;26:3-19, doi: 10.1123/jtpe.26.1.3.

(41) Fitzgerald JT, Funnell MM, Anderson RM, Nwankwo R, Stansfield RB, Piatt GA. Validation of the Revised Brief Diabetes Knowledge Test (DKT2). Diabetes Educ. 2016;42(2):178-87, doi: 10.1177/0145721715624968.