Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1359934
J Health Sci Med. 2023;6(6):1350-1355

Does nutrition knowledge level affect food group preferences and obesity in individuals aged 19 years and older?

Biriz Çakır[1], Fatma Nişancı Kılınç[1], Emine Merve Ekici[2], Çiler Özenir[1]

Department of Nutrition and Dietetics, Faculty of Health Sciences, Kırıkkale University, Kırıkkale, Türkiye
Department of Nutrition and Dietetics, Gülhane Faculty of Health Sciences, University of Health Sciences, Ankara, Türkiye

Cite this article as: Çakır B, Nişancı Kılınç F, Ekici EM, Özenir Ç. Does nutritional knowledge level affect food group preferences and obesity in adults?. *J Health Sci Med.* 2023;6(6):1350-1355.

Received: 13.09.2023 ◆ **Accepted**: 16.10.2023 ◆ **Published**: 29.10.2023

ABSTRACT

Aims: This study was conducted to determine the relationship between nutrition knowledge level, food group preferences, and obesity in individuals who applied to family health centers.

Methods: This study is a cross-sectional study and was conducted with individuals aged 19 years and over. The nutrition knowledge level of the individuals was determined with the nutrition knowledge test, anthropometric measurements were taken, and nutrition status was evaluated with a food frequency questionnaire and 24 hour-recall food consumption records. The data obtained from the study were analyzed with the SPSS 21.0

Results: Of the 1797 individuals who participated in the study, 70.5% were female, 22.0% were single, and 22.8% were university graduates. The mean nutrition knowledge score (NKS) was higher in singles (43.39±13.93) ($p=0.001$), university graduates (46.05±13.69) ($p<0.001$), and those who had previous knowledge about nutrition (42.95±13.83) ($p<0.001$). A significant difference was found between the mean NKS and body mass index (BMI) classification ($p<0.05$). Accordingly, it was observed that the nutrition knowledge scores of overweight and obese individuals were lower than those of normal-weight and underweight individuals. A negative correlation was found between NKS and body weight, BMI, waist circumference, and waist-to-height ratio ($p<0.001$). It was determined that the amount of meat-egg-legume group foods, butter, and olive oil consumed daily increased with the increase in NKS, while the amount of bread and cereal group foods (bread, rice, pasta, bagel, etc.) and margarine consumption decreased ($p<0.05$). In addition, food group preferences also differed according to the NKS level.

Conclusion: Since it has been determined that BMI is associated with a nutrition knowledge score, it is necessary to increase the level of knowledge about nutrition in order to prevent obesity and obesity-related diseases and consequently to increase well-being. Therefore, it is thought that it would be useful to organize awareness-raising education on adequate and balanced nutrition periodically in Family Health Centers.

Keywords: Eating habits, food consumption, nutrition, nutrition knowledge, overweight

INTRODUCTION

The estimates for global levels of overweight and obesity (BMI ≥25kg/m²), suggest that over 4 billion people may be affected by 2035, compared with over 2.6 billion in 2020.[1] With the rapid change in lifestyles such as nutrition in developed and developing societies, the prevalence of obesity is increasing rapidly and is seen as a public health problem.[2] The prevalence of obesity is increasing in Türkiye (Turkey), as it is around the world, with 36.6% of adults being overweight and 34.1% having obesity, according to the National Nutrition Survey 2019 report.[3]

According to reports, obesity is a multifactorial disorder that is brought on by both unchangeable factors such as gender, ethnic background, age, and familial characteristics as well as changeable ones like physical activity level, eating habits, and nutrition knowledge. It is important to have sufficient nutrition knowledge in order to develop healthy eating behaviors and make them a habit.[4]

Prevention of obesity and nutrition-related chronic diseases (such as obesity, Type 2 diabetes, heart diseases, and some kinds of cancers), which are frequently seen in the society and impair the quality of life, improvement and development of lifestyle and environmental conditions, and ensuring sustainable food security are possible by raising awareness and education of individuals on nutrition and health issues.[5] Individuals make choices about their dietary patterns in line with the nutrition knowledge they have.[6] Inadequate nutrition knowledge is one of the prominent problems in Türkiye (Turkey) and the low level of nutrition knowledge of the society throughout the country leads to incorrect food selection, incorrect preparation, cooking, storage methods, and causes an increase in the dimensions of nutrition problems.[7]

Countries carry out national programs and action plans to combat obesity, which is a global public health problem. One of the important activities of these programs is to increase the nutrition knowledge level of individuals and society by

Corresponding Author: Biriz Çakır, birizcakir1@gmail.com

organizing nutrition education.[8] However, governments need to take into account the factors affecting food choices when formulating healthy living policies. Factors affecting the modern diet, such as food composition, taste, availability, affordability, marketing, the modern environment, contemporary food culture, and gene-environment interaction have been reported to cause impulsive food selection behavior that governs instantaneous choices to consume low- or high-energy foods.[9]

No study was found in the literature to determine the nutrition status and nutrition knowledge levels of individuals applying to Family Health Centers (FHCs) in Kırıkkale. This study was conducted to determine the relationship between nutrition knowledge level, food group preferences, and obesity in individuals who applied to FHCs in Kırıkkale.

METHODS

The study was carried out with the permission of Kırıkkale University Social and Humanities Researches Ethics Committee (Date: 20.07.2016, Decision No: 3). An informed consent form from all patients was obtained for the procedure. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This study is a cross-sectional study and was conducted with individuals aged 19 years and over who applied to FHCs in Kırıkkale city center between July and August 2016, as determined according to the study scheduling. Family health centers are centers that provide primary health care services and are the first health institutions to which individuals of all ages from all segments of the society apply for their health problems (except in cases requiring emergency intervention). In order to reach individuals with different characteristics more easily, the study was conducted with volunteer individuals who applied to 13 FHCs in the provincial center.

Male and female individuals without any physical or mental disabilities were included in the study. Exclusion criteria included using drugs (antidepressants) for conditions affecting appetite, psychiatric diseases, and/or receiving eating behavior therapy; and pregnancy or lactation. Detailed information about the study was given to the participants who met the criteria of the study and agreed to participate in the study.

Individuals were informed about the study and included in the study after their consent was obtained. A questionnaire, including questions about demographic characteristics and dietary habits, food consumption frequency, a 24-hour food consumption record, and a nutrition knowledge level test was applied to the individuals by researchers within the scope of the study.

A food frequency questionnaire (FFQ) was used to determine how often and how much food groups or foods were consumed by individuals in the last one month. The frequency of consumption was questioned in terms of days, months, or weeks. In addition to FFQ, by 24-hours recall method foods and their quantities consumed by the individuals for 1 day (24 hours) were questioned in detail and recorded. Then, the foods consumed daily by individuals were grouped according to the food groups that specified in the Turkish Dietary Guidelines. Five groups as milk and milk products group; meat-egg-legumes group; bread and cereals group; vegetables group and fruits group, and the types of fat consumed by the individuals were evaluated also taken into consideration.[5]

The nutrition knowledge test (NKT), which includes 15 questions developed by Öktem Güngör,[10] was used to measure the level of nutrition knowledge of individuals. The scores obtained by the individuals from the test were named the nutrition knowledge score (NKS), and it was accepted that the individuals were successful as the score approached 100 points. The demographic characteristics (gender, marital status, educational status, presence of disease, knowledge of healthy eating) and anthropometric measurements of the individuals participating in the study were evaluated by comparing the mean of the NKS they received from this test.

Body weight (BW), height, waist circumference (WC), and hip circumference measurements were taken according to the technique to determine the obesity of the individuals.[11] TANITA BC 545 model scale was used to measure BW and body fat percentage (BF%), a stadiometer was used for height, and a non-flexible tape measure was used for body circumference measurements. The World Health Organization (WHO) BMI classification was used to assess body weight. According to this classification, BMI ≤18.5 kg/m² is underweight, 18.5-24.9 kg/m² is normal, 25.0-29.9 kg/m² is overweight, 30.0-34.9 kg/m² is class-1 obesity, 35.0-39.9 is class-2 obesity, and ≥40 kg/m² is class-3 obesity.[12]

There has been a consensus that health risks are associated with the distribution of adipose tissue rather than the total adipose tissue in the body.[13] There are various methods that directly measure the amount of fat in the body, which is related to abdominal fat and chronic diseases. These methods include total isotope dilution detection of body water, total body potassium detection, underwater weighing, neutron activation, radiological imaging methods (Ultrasound, MRI, CT scan), the fat-soluble gas method, and the dual energy x-ray absorption method (DEXA). These methods are difficult and costly to implement.[14] Therefore, in this study, anthropometric measurements, which are easy to apply, low-cost and reliable 14 were used for evaluating the risk of abdominal

obesity and chronic diseases according to different anthropometric parameters. One of these parameters is WC. A waist circumference of ≥80 cm for women and ≥94 cm for men is considered a "risk" for chronic diseases; a WC of ≥88 cm for women and ≥102 cm for men is considered a "high risk" for chronic diseases.[12,15] Another parameter is the waist-to-hip ratio (WHR) . A ratio of ≥0.85 for women and ≥0.90 for men indicates the risk of abdominal obesity and obesity-related chronic diseases.[12] Since WC and WHR measurements do not take into account the height of individuals, they may give the same risk ratio to individuals with different heights.16 Therefore, in this study, abdominal obesity was also evaluated according to the waist-to-height ratio.[17] A waist-to-height ratio >0.5 was accepted as abdominal obesity.[16,18]

Statistical Analysis

The data obtained from the study were analyzed with the SPSS 21.0 (Statistical Package for Social Science) statistical program. Statistical analyses were evaluated based on the questions answered in the questionnaire, available food consumption record data and anthropometric measurements. First of all, the distribution and skewness of the data were determined by normality tests, and the data were expressed as mean ( ) and standard error (Sx) values. In the comparison of the differences between two independent groups, parametric (t-test) or nonparametric (Mann-Whitney U test) hypothesis tests appropriate for quantitative data were used; The Pearson chi-square test was used for qualitative data. Bonferroni correction was applied as a Post-Hoc test to find out which group or groups caused the difference between the BMI groups. Non-parametric Spearman rank correlation analysis was used to determine the relationship between numerical variables. Statistical significance was determined by p<0.05.

RESULTS

Of the 1797 individuals who participated in the study, 70.5% were female, 29.5% were male, 70.9% were married, 29.5% were high school graduates, and 22.8% were university graduates. 45.1% of the individuals had a diagnosed disease. In the study, some general characteristics that are thought to affect the mean NKS were analyzed. The mean nutrition knowledge score (NKS) of the women participating in the study was 41.75±13.59, while that of the men was 40.32±12.89. In the study, it was observed that the mean NKS of single women was higher than that of non-single women (p<0.05). In addition, a significant difference was found between the mean NKS and educational status and the status of receiving information about adequate and balanced nutrition (p<0.05) (Table 1).

Table 1. Nutrition knowledge score (NKS) means according to general characteristics of individuals

General characteristics	n	%	NKS X±SD	p
Gender				0.056[a]
Woman	1267	70.5	41.75±13.59	
Man	530	29.5	40.32±12.89	
Marital status				0.001[b]
Married	1274	70.9	40.96±13.23	
Single	396	22.0	43.39±13.93	
Divorced/Widow	12	7.1	38.78±12.82	
Education status				<0.001[b]
Illiterate	93	5.2	38.26±13.18	
Literate	27	1.5	41.53±10.71	
Primary school	528	29.4	39.24±12.75	
Secondary school	209	11.6	38.04±12.71	
High-school	531	29.5	41.59±13.26	
University	409	22.8	46.05±13.69	
Presence of diagnosed disease				0.897[a]
Yes	811	45.1	40.73±13.37	
No	986	54.9	41.85± 13.42	
Having knowledge about healthy nutrition				<0.001[a]
Yes	1067	59.4	42.95± 13.83	
No	729	40.6	38.89±12.40	

a: Student t test (independent samples t test), b: One way ANOVA

In the study, the mean NKS of individuals was evaluated according to their anthropometric measurements in order to evaluate the effect of anthropometric measurements on the nutrition knowledge level. Accordingly, to this, a statistically significant difference was detected between the NKS average and BMI classification groups (p<0.05) (Table 2). A Bonferroni correction was made to determine which groups had a difference between the BMI classification and the mean NKS. Accordingly, a difference was observed between individuals of normal weight and those with class-1 obesity. Individuals with obesity-1 class have lower NKS than those with normal weight. At the same time, WC values, which are a risk factor for abdominal fat and chronic diseases, were higher in those with low nutrition knowledge (p<0.05).

Table 2. Mean nutrition knowledge score (NKS) according to anthropometric measurements of individuals

	n	%	NKS X±SD	p
BMI (kg/m²)				0.003b
Underweight	54	3.1	45.18±13.12	
Normal	469	27.3	42.71±13.64	
Overweight	573	33.4	41.55±13.43	
Obesity 1.class	402	23.4	39.81±13.67	
Obesity 2.class	152	8.8	40.26±12.59	
Obesity 3.class	68	4.0	38.82±12.07	
WC (cm)				0.03a
Risk +	1219	67.8	40.93 ±13.55	
Risk -	481	26.8	42.50±13.20	
WHR				0.621a
Risk +	916	54.6	41.14±13.71	
Risk -	762	45.4	41.69±13.18	
Waist-to-height ratio				0.69a
Risk +	1256	74.9	40.73±13.28	
Risk -	422	25.1	43.23±13.48	

a: Student t test (independent samples t test) b: One way ANOVA
BMI: Body Mass Index; WC: Waist circumference; WHR: waist-to-hip ratio; Risk: Chronic diseases risk

Since the mean NKS score a differed according to anthropometric measurement values in the study, an appropriate correlation test was performed to support the findings. A low but significant (p<0.001) negative correlation was found between NKS and BW, BMI, WC, and waist-to-height ratio (Table 3).

Table 3. The relationship between nutrition knowledge scores (NKS) and anthropometric measurements of individuals

Anthropometric measurements	NKS r (p)
BW (kg)	-0.08 (0.00)*
BMI (kg/m²)	-0.10 (0.00)*
WC (cm)	-0.09 (0.00)*
WHR	-0.04 (0.05)
Waist-to-height ratio	-0.10 (0.00)*
BF (%)	*0.00 (0.85)

*Spearman rank correlation, BW: Body weight; BMI: Body Mass Index; WC:Waist circumference; WHR: waist-to-hip ratio; BF: Body fat

It is thought that nutrition knowledge level also affects the daily food groups and amounts consumed. For this reason, in the study, the relationship between food groups and the amount of fat taken with NKS was examined, and an appropriate correlation test was applied. While the portion amount of meat-egg-legume group foods and the amount of olive oil consumed daily increased with the increase in NKS, the consumption of bread and cereal group foods (bread, rice, pasta, bagels, etc.) decreased (Table 4). This result shows that the level of nutrition knowledge has an effect on people's daily food preferences and quantities.

Table 4. The relationship between individuals' nutrition knowledge score and their consumption of 5 food groups and fats

Food groups and fat/oil types	NKS r(p)
Food groups	
Milk group	-0.02 (0.28)
Meat-egg-legumes group	0.11 (0.00)*
Bread and cereal group	-0.05 (0.04)*
Vegetable group	-0.02 (0.39)
Fruit group	0.01 (0.72)
Fat/Oil types	
Olive oil (g)	0.09 (0.00)*
Sunflower oil (g)	-0.02 (0.30)
Butter (g)	0.05 (0.03)*
Margarine (g)	-0.07 (0.00)*

*Spearman rank correlation

DISCUSSION

The study aims to investigate if there is a relationship between individuals' level of nutrition knowledge, their dietary preferences in terms of food groups and their obesity. Inadequate nutrition knowledge; it can be a significant barrier to maintaining healthy behaviors and a healthy body weight.[19] At the same time, nutrition knowledge can have effects beyond the individual level.[20] Therefore, it is important to determine the level of nutrition knowledge and to reveal the relationship between obesity and food group preferences. In this study conducted for this purpose, a negative relationship was found between individuals' NKS and body weight, BMI, WC, waist-to-height ratio (p<0.05). Individuals' food group preferences also differed depending on their NKS level.

In this study, the level of nutrition knowledge was found to be higher in single individuals, university graduates, and those who had previously received information on adequate and balanced nutrition. Although the study by Rose et al. stated that nutrition knowledge level was not related to gender.[21] there are studies reporting that women's nutrition knowledge level is higher than men.[22,23] In this study, although not statistically significant, it was observed that women's NKS was higher than men's. The fact that food shopping and cooking is usually done by women in the family also has an impact on women's knowledge about nutrition.[23]

In different studies, it has been emphasized that education level affects nutrition knowledge.[22,24,25] Individuals with higher levels of education tend to have better nutrition knowledge compared to those with lower levels of education. In a systematic review by Barbosa et al.[22] in which 25 articles were analyzed, it was shown that there was a positive correlation between education level and NKS, and it was stated that education is a basic tool for obtaining information about nutrition. In this study, the fact that the mean NKS was also higher in individuals with higher education levels and who had previously received education on adequate and balanced nutrition.

In a study, BW, BMI, BF%, WC, and hip circumference were found to be lower in women who received nutrition education, and it was emphasized that nutrition education may have an effect on healthy food selection and body composition components.[26] In another study, no significant correlation was found between the BMI, WC, BF%, and WHR values of female and male university students and their nutrition knowledge level and food preferences.[27] This situation suggested that nutrition knowledge could not be transformed into behavior. In this study, it was observed that the BMI of overweight and obese individuals was lower than that of normal and underweight individuals, and the difference between BMI and BMI groups was statistically significant. This finding led to the conclusion that individuals with nutrition knowledge eat more consciously and are more successful in body weight management. On the other hand, it was thought that the presence of underweight individuals among the individuals with nutrition knowledge may be related to aesthetic concerns and the perception of being thin as being healthy in the media. The difference between the NKS of those with and without chronic disease risk according to the parameters of WHR and waist-to-height was not found to be statistically

significant. This result suggested that individuals should increase their nutrition knowledge and raise awareness about transforming their knowledge into behavior in order to prevent not only obesity but also abdominal obesity, which is a risk factor for chronic diseases.

The relationship between nutrition knowledge level and obesity-related anthropometric measurements has been examined by various researchers.[28-30] In some studies examining the relationship between nutrition knowledge and BMI, no significant relationship was found.[21,30] On the other hand, a study by Valmórbida et al.[29] reported a negative relationship between nutrition knowledge level and BMI, WC, and waist-to-height ratio In this study, a low but significant negative correlation was found between NKS and BW, BMI, WC, and waist-to-height ratio. These contradictory results indicate that more comprehensive and specific studies investigating the relationship between nutrition knowledge and anthropometric measurements are needed.

Nutrition is an important factor in the treatment and prevention of many diseases as well as health protection. It is extremely important to determine the level of nutrition knowledge and to understand its relationship with food consumption.[31] In this study, the portion amount of meat-egg-legume group foods (red meat, white meat, etc.) and the amount of olive oil consumed per day increased with increasing NKS, while the consumption of bread and cereal group foods (bread, rice, pasta, bagels, etc.) and margarine consumption decreased. For adequate and balanced nutrition, foods in the five food groups should be consumed in the recommended amounts every day. Meat-egg-legume group foods are important as a source of protein. Olive oil is one of the most important components of the Mediterranean diet and is recommended for a healthy diet.[5] It is thought that these foods are consciously preferred as the NKS increases, and the consumption of bread and cereals, and margarine is also consciously limited. Butter is a type of fat that should be limited due to its saturated fat content.[5] However, in this study, it was observed that individuals with higher NKS than others preferred butter as a solid fat. The use of butter is common in Turkish cuisine and it is thought that butter is preferred to margarine in terms of traditional and cultural values. There are contradictions in the results of studies examining the relationship between NKS and food consumption. Similar to the present study, some studies have found a positive relationship between NKS and consumption of meat group foods and olive oil, while a negative relationship was found between NKS and carbohydrate intake.[32,33] However, studies have also reported that there is no relationship between NKS and food consumption or that various different results have been obtained.[31,34] In a study, it was also reported that nutrition knowledge does not translate into correct dietary behavior and that nutrition knowledge level alone is not effective on dietary behavior.[35] In addition to many individual factors such as taste, food preference, food costs, cultural and religious beliefs, it has been stated that the differences in study groups also affect this result.[31]

Study Limitations

In this study, the food group choices of individuals were examined, but the determinants of food choice, such as the characteristics of the foods they choose, familial, cultural, and social factors were not questioned. In addition, the disproportion between the numbers of male and female participants, the disproportion between BMI groups, the selection of participants from a single region, and the recording of food consumption for a single day can also be considered as limitations of the study.

CONCLUSION

In this study, it was observed that the nutrition knowledge scores of overweight and obese individuals were lower than those of normal weight and underweight individuals, and the difference between those with normal weight and those with 1st-degree obesity was found to be significant. In the study, it was determined that the mean nutrition knowledge score of individuals was low. Individuals' NKS also showed a negative relationship with anthropometric measurements associated with obesity. As NKS increased, consumption of meat-egg-legume group foods and olive oil increased, while consumption of bread and cereal group foods and margarine decreased. However, since this study's result based on an observation and correlation analysis, cause-effect relationships should not be conclusively inferred. Further research and analysis may be required. In future studies, the effects of factors related to food group choices should also be investigated.

Since BMI is associated with education level, consumption of daily food groups, and anthropometric measurements, the level of knowledge about adequate and balanced nutrition should be increased to prevent obesity and chronic diseases and to improve quality of life. For this purpose, it is thought that it will be useful to organize periodic and effective nutrition education by dietitians to be assigned to family health centers where the individuals can easily reach them.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kırıkkale University Social and Humanities Researches Ethics Committee (Date: 20.07.2016, Decision No: 3).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Acknowledgments: We would like to thank the Department of Nutrition and Dietetics' students for their help in data collection, and participants.

REFERENCES

1. World Obesity Federation, World Obesity Atlas 2023. https://data.worldobesity.org/publications/?cat=19 (Accessed date:10.10.2023)
2. Berghöfer A, Pischon T, Reinhold T, Apovian CM, Sharma AM, Willich SN. Obesity prevalence from a European perspective:a systematic review. *BMC Public Health.* 2008;8(1):1-10.
3. Sağlık Bakanlığı Halk Sağlığı Genel Müdürlüğü. Türkiye Beslenme ve Sağlık Araştırması (TBSA). Sağlık Bakanlığı Yayın No: 1132; Ankara, 2019.
4. López-Hernández L, Martínez-Arnau FM, Pérez-Ros P, Drehmer E, Pablos A. Improved nutrition knowledge in the obese adult population modifies eating habits and serum and anthropometric markers. *Nutrients.* 2020;12(11):3355.
5. Sağlık Bakanlığı Halk Sağlığı Genel Müdürlüğü. Türkiye Beslenme Rehberi (TÜBER) 2022. Sağlık Bakanlığı Yayın No:1031, Ankara, 2022.
6. Worsley A. Nutrition knowledge and food consumption:can nutrition knowledge change food behaviour? *Asia Pac J Clin Nutr.* 2002;11(3):579-585.
7. Devlet Planlama Teşkilatı, Ulusal Gıda ve Beslenme Stratejisi Çalışma Grubu Raporu (Rapor No: 2670), Ankara, 2003.
8. Sağlık Bakanlığı, Türkiye Halk Sağlığı Kurumu. Türkiye Sağlıklı Beslenme ve Hareketli Hayat Programı. Yayın No:773, Ankara, 2013.
9. Leng G, Adan RAH, Belot M, et al. Conference on 'new technology in nutrition research and practice' Symposium 3: novel strategies for behaviour changes. the determinants of food choice. *Proc Nutr Soc.* 2017;76(3):316-327.
10. Öktem Güngör E. Üniversite öğrencilerinde porsiyon algısı ve etkileyen faktörlerin belirlenmesi. Başkent Üniversitesi Sağlık Bilimleri Enstitüsü, Beslenme ve Diyetetik Yüksek Lisans Tezi, Ankara, 2014.
11. WHO WHO Consultation on Obesity (1999:Geneva, Switzerland) & World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO consultation. World Health Organization. Geneva, 2000. Available from: https://apps.who.int/iris/handle/10665/42330
12. World Health Organization. Waist circumference and waist-hip ratio:report of a WHO expert consultation, Geneva, 8-11 December 2008. World Health Organization, Geneva, 2011. Available from: https://www.who.int/publications/i/item/ 9789241501491
13. Ashwell M, Gibson S. Waist to height ratio is a simple and effective obesity screening tool for cardiovascular risk factors:Analysis of data from the British National Diet and Nutrition Survey of adults aged 19-64 years. *Obes Facts.* 2009;2(2):97-103.
14. İşler S, Koç F, Özkoçak V. Obezitenin antropolojik açıdan değerlendirilmesi. *SMART J.* 2020;6(31):639-646.
15. Mamtani MR, Kulkarni HR. Predictive performance of anthropometric indexes of central obesity for the risk of type 2 diabetes. *Arch Med Res.* 2005;36(5):581-589.
16. Browning LM, Hsieh SD, Ashwell M. A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. *Nutr Res Rev.* 2010;23(2):247-69.
17. Ashwell M, Hsieh SD. Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. *Int J Food Sci Nutr.* 2005;56(5):303-307.
18. Ashwell M, Gibson S. Waist-to-height ratio as an indicator of 'early health risk':simpler and more predictive than using a 'matrix' based on BMI and waist circumference. *BMJ open.* 2016;6(3):e010159.
19. Worsl, A. Nutrition knowledge and food consumption:can nutrition knowledge change food behaviour? *Asia Pac J Clin Nutr.* 2002;1(3):579-585.
20. Vereecken C, Maes L.Young children's dietary habits and associations with the mothers' nutrition knowledge and attitudes. *Appetite.* 2010;54(1):44-51.
21. Rose S, Pretto J, Paul C, Emmett B, Hensley M, Henskens F. Relationships between nutrition knowledge, obesity, and sleep disorder severity. *J Sleep Res.* 2016;25(3):350-355.
22. Barbosa LB, Vasconcelos SML, Correia LO, Ferreira RC. Nutrition knowledge assessment studies in adults:a systematic review. *Cien Saude Colet.* 2016;21(2):449-462.
23. Sharma SV, Gernand AD, Day RS. Nutrition knowledge predicts eating behavior of all food groups except fruits and vegetables among adults in the Paso del Norte region: Qué Sabrosa Vida. *J Nutr Educ Behav.* 2008;40(6):361-368.
24. Carrillo E, Varela P, Fiszman S. Influence of nutrition knowledge on the use and interpretation of Spanish nutrition food labels. *J Food Sci.* 2012;77(1):H1-8.
25. Lin W, Hang CM, Yang HC, Hung MH. 2005-2008 Nutrition and Health Survey in Taiwan:the nutrition knowledge, attitude and behavior of 19-64 years old adults. *Asia Pac J Clin Nutr.* 2011;20(2):309-318.
26. Uysal Yeler G, Göktaş Z. Beslenme eğitiminin besin seçimi, kolesterol alım düzeyi ve vücut kompozisyonuna etkisi. *SABİTED.* 2023;3(1):1-9.
27. Atasoy S, Güngör AE. Evaluation of nutrition knowledge level and obesity status of university students. *TJFM&PC.* 2022;16(2):340-349.
28. Akkartal Ş, Gezer C. Is nutrition knowledge related to diet quality and obesity? *Ecol Food Nutr.* 2020;59(2):119-129.
29. Valmórbida JL, Goulart MR, Busnello FM, Pellanda LC. Nutrition knowledge and body mass index:A cross-sectional study. *Rev Assoc Med Bras.* 2017;63(9):736-740.
30. Dattilo M, Furlanetto P, Kuroda AP, Nicastro H, Coimbra Cruz PCF, Simony RF. Nutrition knowledge and its association with the body mass index. *Nutrire: Rev Soc Bras Alim Nutr.* 2009;34(1):75-84.
31. Spronk I, Kullen C, Burdon C, O'Connor H. Relationship between nutrition knowledge and dietary intake. *Br J Nutr.* 2014;111(10):1713-1726.
32. Dallongeville J, Marécaux N, Cottel D, Bingham A, Amouyel P. Association between nutrition knowledge and nutrition intake in middle-aged men from Northern France. *Public Health Nutr.* 2001;4(1):27-33.
33. Frederick L, Hawkins ST. A comparison of nutrition knowledge and attitudes, dietary practices, and bone densities of postmenopausal women, female college athletes, and nonathletic college women. *J Am Diet Assoc.* 1992;92(3):299-303.
34. Rash CL, Malinauskas BM, Duffrin MW, Barber-Heidal K, Overton RF. Nutrition-related knowledge, attitude, and dietary intake of college track athletes. *Sport J.* 2008;11:48-55.
35. Akinmoladun OF, Oluyede OJ, Femi FA, Olatian OO, Nesamvuni CN. Association between nutrition knowledge, lifestyle, dietary practices and nutrition status among civil servants in western Nigeria. *Afr J Food Agric Nutr Dev.* 2021;21(10):18824-18838.