ΕΡΕΥΝΗΤΙΚΟ ΑΡΘΡΟ – RESEARCH ARTICLE

Nutrition knowledge among preadolescents in association with their dietary habits: A school-based survey

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ABSTRACT

Aim: To examine the association of nutrition knowledge and dietary behavior among preadolescents in the greater urban area of Athens. **Methods**: 615 school-aged children 10–12 years from the metropolitan area of Athens were enrolled in the study, in 2014–2015 and 2015-2016. Anthropometric data (height, weight, BMI z-score, waist circumference) and a short food frequency questionnaire were collected. A nutrition knowledge test (NKT) score was calculated based on the knowledge of 4 basic food groups. The statistical package SPSS (IBM SPSS Statistics 24.0) was used for all the analyses (chi-squared test, multinomial logistic regression). **Results**: A negative significant association was observed between the nutrition knowledge and the soft drinks (p<0.001), chocolates/croissants/biscuits (p=0.01) and cheese puffs/crisps consumption (p=0.034) in the total sample. Among boys a negative significant association was detected between the nutrition knowledge and the soft drinks (p<0.001), canned juices (p=0.003), chocolate/croissants/biscuits (p<0.001) and cheese puffs/crisps consumption (p=0.02). Among girls no significant associations were found between nutrition knowledge and dietary behavior. Overall, preadolescents showed a modest level of nutrition knowledge (58%). The odds ratio (O.R.) of achieving a higher nutrition knowledge score decreased with weight status (O.R.: 0.45; 95% C.I.: 0.27-0.74; p=0.002) with no sex differences. **Conclusion**: Healthy weight preadolescents tend to have better nutritional knowledge, which is associated with healthier nutritional behavior, compared to overweight and obese preadolescents. *Hellenic J Nutr Diet 2020, 12(1-2):3-13*

Key words: *Nutrition, Knowledge, Behavior, Childhood, Nutritional education*

ΠΕΡΙΛΗΨΗ

Διερεύνηση συσχέτισης γνώσεων διατροφής και διατροφικής συμπεριφοράς στην προεφηβική ηλικία: Μελέτη Παρατήρησης

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Σκοπός: Η διερεύνηση της συσχέτισης των γνώσεων διατροφής και της διατροφικής συμπεριφοράς των προ-εφήβων στην ευρύτερη περιοχή της Αθήνας. **Υλικό-Μέθοδοι:** 615 παιδιά ηλικίας 10-12 ετών από την ευρύτερη περιοχή της Αθήνας συμμετείχαν στη μελέτη τα σχολικά έτη 2014-2015 και 2015-2016. Συλλέχθηκαν ανθρωπομετρικά στοιχεία (ύψος, βάρος BMI z-score, περιφέρεια μέσης), η συχνότητα κατανάλωσης συγκεκριμένων τροφίμων, ενώ δημιουργήθηκε ένα σκορ που μετρούσε τις διατροφικές γνώσεις βασισμένο στις γνώσεις για τις 4 βασικές ομάδες τροφίμων. Για τη στατιστική ανάλυση χρησιμοποιήθηκε το στατιστικό πρόγραμμα IBM SPSS Statistics 24.0 (έλεγχος χι-τετράγωνο, πολλαπλή λογιστική παλινδρόμηση). **Αποτελέσματα**: Οι γνώσεις διατροφής συσχετίσθηκαν αρνητικά σε σημαντικό βαθμό με την κατανάλωση αναψυκτικών (p <0.001), σοκολατοειδών/κρουασάν/μπισκότων (p = 0.01) και πατατάκια/γαριδάκια (p = 0.034) στο συνολικό δείγμα. Συσχετίστηκαν ακόμη αρνητικά σε σημαντικό βαθμό με την κατανάλωση έτοιμων χυμών (p = 0.003), σοκολατοειδών/κρουασάν/μπισκότων (p <0.001) και σνακς όπως τα πατατάκια/γαριδάκια (p = 0.02) στα αγόρια. Αντιθέτως στα κορίτσια, δεν διαπιστώθηκε καμία συσχέτιση μεταξύ των γνώσεων διατροφής και της διατροφικής συμπεριφοράς. Συνολικά, οι προ-έφηβοι είχαν μέτριο επίπεδο διατροφικών γνώσεων (ποσοστό σωστών απαντήσεων 58%). Η σχετική πιθανότητα (O.R.) για την επίτευξη υψηλότερου σκορ γνώσεων διατροφής βρέθηκε μειωμένη σε σχέση με την κατάταξη του σωματικού βάρους (O.R.: 0.45, 95% C.I.: 0.27-0.74, p = 0.002) και στα δύο φύλα. **Συμπεράσματα**: Τα παιδιά με φυσιολογικό σωματικό βάρος τείνουν να έχουν καλύτερες διατροφικές γνώσεις λόγω υγιεινότερης διατροφικής συμπεριφοράς σε σχέση με τα υπέρβαρα και παχύσαρκα παιδιά. *Hellenic J Nutr Diet 2020, 12(1-2):3-13*

Introduction

The high prevalence and the adverse effects of childhood obesity in Greece, as well as the low adherence of Greek children to the Mediterranean diet during the last decades have been reported in many observational and intervention studies[1–3]. Nutrition habits of children and adolescents in Greece tend to change from the traditional Mediterranean diet to more Westernized dietary patterns[4]. Regular and high consumption of foods and snacks rich in saturated fats, sugar and salt such as pizzas, burgers, and sweets is associated with childhood obesity, which is documented as a risk factor for non-communicable diseases such as diabetes, cardiovascular diseases and metabolic syndrome in later life[5].

The association between nutrition knowledge and eating behavior in children and adolescents has been studied during the last decades. According to European data and specifically the Helena Study (Healthy Lifestyle in Europe by Nutrition in Adolescence), the nutrition knowledge in Europe was found to be modest, especially among groups of lower socioeconomic status. This finding implies that nutrition prevention programs

for younger ages are strongly needed[6]. Moreover, it has been reported that nutrition knowledge is an important goal for health education. Improving nutrition knowledge in young people may result in healthier dietary habits[7]. Asakura et al. observed, through the use of three questionnaires in a Japanese population, that a higher level of child and guardian nutrition knowledge was associated with healthier dietary habits among children, such as higher vegetable intake[8]. Additionally, in other similar studies, a positive association between a higher level of nutrition knowledge and healthier dietary behavior was demonstrated, although in some other studies a gap between knowledge and behavior has been observed[9–11]. However, little is known about the impact of nutrition knowledge on dietary behavior of preadolescents regarding the consumption of ready-to-eat foods. Preadolescence is a crucial stage of life, during which an individual is easily influenced by the school or the neighborhood environment, especially peers, can adhere to unhealthy food choices and this may lead to overweight and obesity status in adulthood.

The present study is the first one examining the association between the level of nutrition knowledge and

dietary behavior of Greek children in a representative sample of preadolescents living in the metropolitan area of Athens. More specifically, the present study aimed to examine whether nutrition knowledge influences nutrition patterns and free-choice consumption of foods and snacks, through a short questionnaire about food frequency consumption of the basic food groups (meat, fruit and vegetables, legumes and fish) and ready-to-eat foods and snacks. Furthermore, gender differences between nutrition knowledge and dietary behavior were also examined and finally, the association between the weight status and the nutrition knowledge was identified.

Methods

Study Design, Participants

The study was a cross-sectional survey carried out during 2014-2015 and 2015-2016 among preadolescents attending the 5th and 6th grades of 32 primary schools located in Athens, Greece; all classes of the selected schools were asked to participate. In particular, schools were selected using random sampling from a list of schools provided by the Greek Ministry of Education. The study sample is highly representative of the greater metropolitan area of Athens. The administration of the questionnaire was performed in the classrooms during school-time with the assistance of trained health professionals, following a short presentation of the aims of the study.

Measurements

Participants were subjected to anthropometric measurements such as weight, height (for Body Mass Index (BMI) calculation), waist circumference using scale and tape measure over skin-tight clothes. The weight status of the preadolescents was categorized using BMI z-scores cut-offs, with World Health Organization (WHO) growth charts based on age, gender, weight and height[12].

Questionnaires

Some specific questions regarding the food frequency were gathered through a short food frequency questionnaire. They have been previously validated in the Greek population in the certain age group by the Harokopio University of Athens that conducted the research. Preadolescents' demographic characteristics (age, gender, school area) were also recorded. Data were collected by a face-to-face interview. The ques-

tionnaire design was based on the objectives and the initial assumptions of the study and included 10 pre-coded questions related to the nutrition knowledge and the frequency of consumption of various group foods. For evaluating knowledge, preadolescents were asked, in closed questions, to report according to their knowledge and beliefs, the optimal consumption of certain food groups' intake per week (i.e. "How many times a week do you think that we should consume: meat, fish, fruits-vegetables and legumes?"). Moreover, they were asked about the food frequency consumption of some ready-to-eat meals and snacks.

Nutritional knowledge test (NKT) score

The questionnaire included a total of 4 multiple-choice questions concerning the knowledge on the weekly ideal frequency consumption of 4 basic food groups (meat, fruit and vegetables, legumes and fish). Each multiple-choice question offered three possible answers (only one was correct). For instance, regarding the fruits and vegetable weekly ideal consumption, the correct answer was more than 3 times/week; regarding the fish, meat and legumes weekly ideal consumption the correct answer was 2-3 times/week. A correct answer scored 1, while an incorrect answer scored 0. Finally, the individual scores were summed up and calculated as a total NKT-score based on the preadolescents' correct answers (0 if wrong answer; 1 if correct answer: total score range 0-4). Specifically, score 0 showed a lack of nutrition knowledge on recommended weekly dietary behavior; score 1 limited nutrition knowledge; score 2 moderate nutrition knowledge; score 3 very good nutrition knowledge and score 4 excellent nutrition knowledge.

To explore the association between the nutrition knowledge level and the bodyweight status, NKT-score was categorized as low (0-1), moderate (score 2) and high (score 3-4), with the low setting as the baseline. Scores 0 and 1, as well as 3-4, were grouped due to the small number of preadolescents, scoring either 0, or 4, increasing the power of analysis. Additionally, BMI z-score status was grouped into healthy weight (underweight and normal weight) and non-healthy weight (overweight and obese) preadolescents, for final comparisons.

Dietary Behavior

Information on common snacks and ready-to-eat meals, frequently consumed by preadolescents, was gathered through a short food frequency question-

naire. A total of six foods with usual ready-to-eat foods and snacks frequently consumed by preadolescents were included in the questionnaire, namely soft drinks, canned juices, chips, chocolates/croissants/biscuits, crisps/cheese puffs, as well as alcoholic drinks. Potential responses included: (i) never or less than one time per month, (ii) 1-2 times per month, (iii) 1 time per week, (iv) 2-6 times per week, (v) once a day and (vi) more than twice a day. The reason why these non-home-made foods were included in the dietary questionnaire is that they are mostly associated with children's dietary behavior and slightly with family's dietary behavior. Responses were tabulated with NKT-scores achieved, stratified by sex.

Bioethics

The study was approved by the Institute of Educational Policy of the Ministry of Education and Religious Affairs and was carried out under the Declaration of Helsinki (1989). The school principals, teachers, parents and students were informed about the aims and procedures of the study. Signed parental consent was obtained before the completion of the questionnaires.

Statistical analysis

Categorical variables are presented as absolute and relative frequencies. The answers the preadolescents gave in the survey have been recoded using nutrition score variables. A new variable has been calculated

based on the total NKT from score 0 to 4. Associations between categorical variables were tested by calculation of the chi-square test, in the total sample and by sex. The Fisher Exact test was used in place of the chi-squared test in 2 by 2 tables, in cases that >20% expected frequencies were less than 5. Also, a Monte-Carlo test was used because the sample was greater than 250 preadolescents (n=615). Multinomial logistic regression was used to examine the association between different levels of NKT-score and weight status, adjusted for known confounding variables, including school area (a proxy measure for socio-economic status), age, and sex. All reported p-values were based on two-sided hypotheses and p<0.05 was considered significant for all statistical tests conducted. The statistical package SPSS (IBM SPSS Statistics 24.0) was used for all the analyses.

Results

A total of 615 students from the 5th and 6th grades of primary schools (mean age of 11.4±0.9 years) was included in the present study (participation rate of 95%). Baseline and anthropometric characteristics, such as gender, age, weight, height, waist circumstance and BMI z-scores and weight status, are shown in Table 1. Girls were significantly older than the boys and BMI was significantly higher among boys (p-value <0.001). A wide range (i.e. 39-83%) of correct answers about

TABLE 1. Baseline characteristics and gender differences of preadolescents from the 5th and 6th grade of primary schools living in Athens, 2014-2016

Baseline characteristics	Total (Mean ±SD)	Boys	Girls	p-value
Number of preadolescents (N)	615	288	318	
Age (years)	11.4±0.9	11.29±1	11.34±0.8	0.005*
Height (cm)	151.7±9	151.2±11.6	151.8±14.4	0.51
Weight (kg)	44.2±9.6	45.1±10.1	43.32±8.7	0.11
Waist Circumstance (cm)	68.2±14.9	69.6±14	66.7±15.5	0.08
BMI z-score	0.57±1.58	0.83±1.55	0.33±1.56	**<0.001***
BMI z-score status	n (%)	n (%)	n (%)	
Underweight	64 (11.3%)	25 (9.3%)	39 (13%)	
Normal weight	282 (49.6%)	107 (39.9%)	175 (58.3%)	
Overweight	159 (28%)	91 (34%)	68 (22.7%)	
Obese	63 (11.1%)	45 (16.8%)	18 (6%)	

*p-value based on chi-squared test; Significant level at p<0.05
Statistically significant coefficients are indicated in bold font.

the recommended weekly consumption of the basic food groups was observed among the participants. More specifically, the average nutrition knowledge was modest, with 83% correct answers about the fruits and vegetables, 52% correct answers about the meat, 58% correct answers about the legumes and 39% correct answers about the weekly fish consumption. Overall, preadolescents achieved modest nutrition knowledge level (58%), but no association was observed between the gender and the total NKT-score (57.5 % v. 58.5 %; p=0.61) as it is shown in Table 2. A significant association was found only between the gender and the NKT-score regarding fish consumption (p=0.02), with boys showing higher nutrition knowledge than girls.

Nutrition Knowledge Test

The percentages of correct answers regarding the total NKT-score and each section are shown in Figure 1.

Nutrition knowledge and dietary behavior

The relationship between preadolescents' total nutrition knowledge and their dietary behavior is shown in Table 3. In the total sample, a significant association was observed between the NKT-score and the soft drinks (p<0.001), chocolates/croissants/biscuits (p=0.01) and cheese puffs/crisps consumption (p=0.034). However, no significant association was observed between the NKT-score and the canned juices (p=0.32), chips (p=0.06) and alcoholic drinks (wine or beer) consumption (p=0.08). Overall, a higher level of nutrition knowledge was associated with lower consumption of "unhealthy" snacks and foods. In particular, a higher knowledge level was significantly associated with lower soft drinks intake (never or once a month). A significant association between the lower NKT-score and a regular (2-6 times/week) consumption of chocolates/croissants/biscuits was

observed (p=0.01). Moreover, a higher level of children's nutrition knowledge was associated with lower cheese puffs and crisps consumption (never or once a month) (p=0.03).

To further explore gender differences between dietary behavior and nutrition knowledge, an adjusted gender analysis was performed. Among boys, the total NKT-score was significantly associated with the soft drinks (p<0.001), canned juices (p=0.003), chocolates/croissants/biscuits (p<0.001) and crisps/cheese puffs consumption (p=0.03). For instance, boys with higher nutrition knowledge scores were more likely to consume soft drinks and cheese puffs never or once/month and canned juices 1-2 times/month. Moreover, they were less likely to consume chocolates, croissants and biscuits 2-6 times/week.

On the other hand, no significant association between nutrition knowledge and dietary behavior was found among girls (Table 4).

Nutrition knowledge, weight status and socioeconomic status (SES)

According to the results of the multinomial logistic regression used to examine the association between different levels of the NKT-score and the weight status, adjusted for known confounding variables including school area (proxy measure for socioeconomic status), age, and sex, obese and overweight preadolescents were 55% and 64% less likely to achieve a high nutrition score (3-4 score) or a moderate nutrition score (2 score) compared to healthy weight status individuals in respect to the baseline level (0-1 score) (O.R.: 0.45; 95% C.I.: 0.27-0.74), and (0.36; 95% C.I.: 0.21-0.62, respectively). No associations were found between the socioeconomic status and nutrition knowledge; higher SES was not associated with higher nutrition knowledge (O.R.: 2.33; 95% C.I.: 0.75-7.29).

TABLE 2. Nutrition knowledge score and gender differences among Greek preadolescents

Nutrition knowledge score	Total (Mean ±SD)	Boys	Girls	p-value
Nutrition Score for meat consumption	0.52±0.5	0.52±0.5	0.55±0.5	0.62
Nutrition Score for fruits and vegetable consumption	0.83±0.38	0.78±0.41	0.84±0.37	0.27
Nutrition Score for legumes consumption	0.58±0.49	0.58±0.49	0.62±0.49	0.17
Nutrition Score for fish consumption	0.39±0.49	0.42±0.5	0.34±0.48	**0.02***
Total nutrition score	2.3±0.98	2.3±1	2.3±1	0.61

p-value based on chi-squared test; Significant level at p<0.05
Statistically significant coefficients are indicated in bold font.

(A) Score 0 lack of nutrition knowledge on recommended weekly consumption; Score 1 limited nutrition knowledge; Score 2 moderate nutrition knowledge; Score 3 very good nutrition knowledge; Score 4 excellent nutrition knowledge.
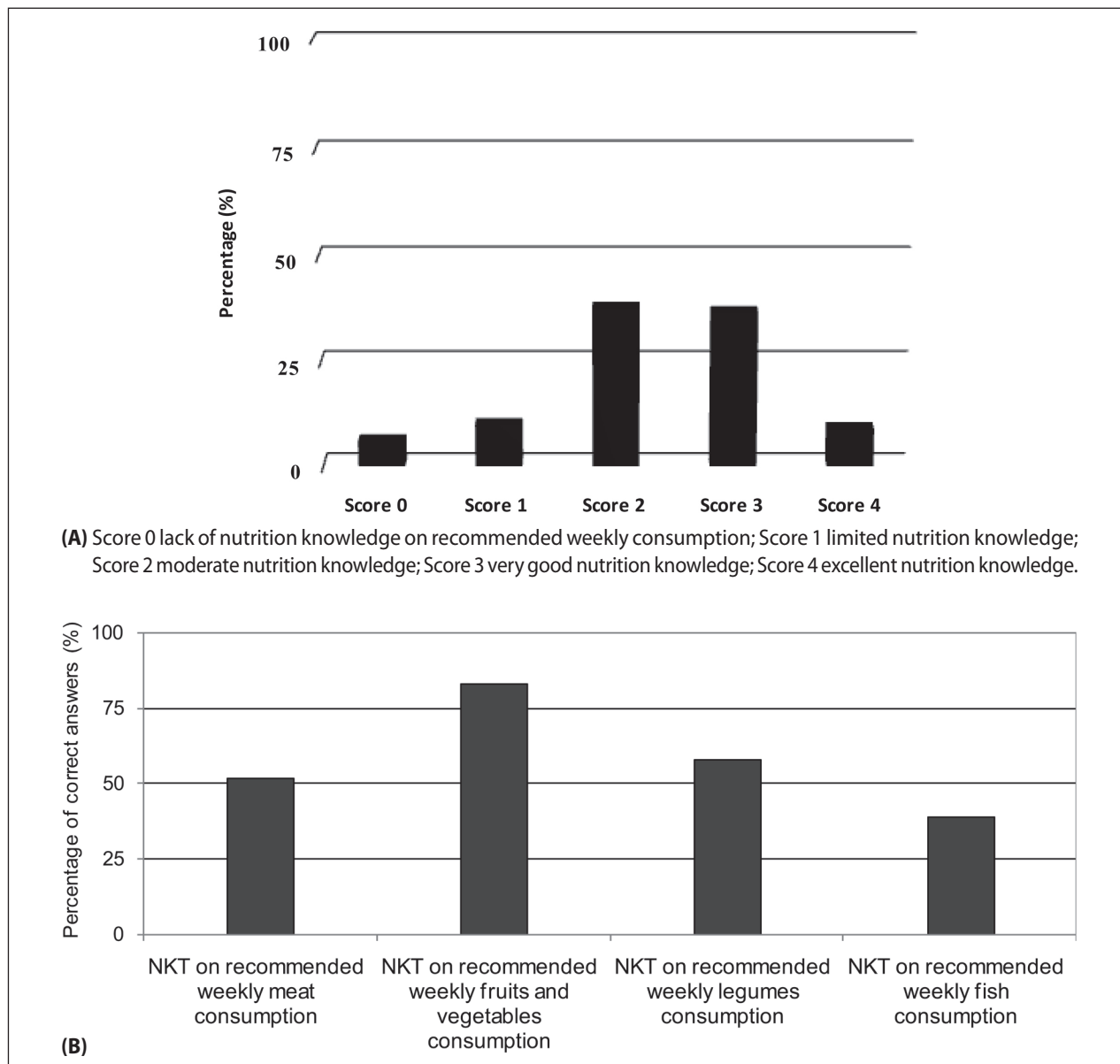

(B)

Figure 1. Total nutrition knowledge test (NKT) score (A) and nutrition knowledge for the recommended consumption of meat, fruits and vegetables, legumes and fish (B).

Discussion

According to the present study, the level of nutrition knowledge was modest for both genders with nutrition knowledge and healthier dietary behavior being correlated in preadolescents. Moreover, healthy weight preadolescents were more likely to achieve a higher nutrition knowledge score. A positive relationship between a higher level of nutrition knowledge and healthier dietary behavior was significantly observed in males, but not in females.

It was observed that the level of nutrition knowledge was modest as 58% of the questions were answered correctly. This percentage was similar to the level of knowledge reported in the context of the European HELENA study, in which approximately 60% of the questions were answered correctly. The HELENA study was conducted in 2006–2007 in ten countries: Austria, Belgium, France, Germany, Greece (one inland city and one island), Hungary, Italy, Spain and Sweden in 3546 adolescents[6]. The level of nutrition knowledge in the present study was higher than that of a similar study,

TABLE 3. Nutrition Knowledge Level and Dietary Behavior (whole sample)

	NKT (Score)	Never or <1 time/month (%)	1-2 times/months (%)	1 time/week (%)	2-6 times/week (%)	1 time/day (%)	>2 times/day (%)	p-value
Soft drinks	0	10	23.3	13.3	20.0	26.7	6.7	
	1	30.3	18.4	28.9	9.2	10.5	2.6	
	2	32.9	25.6	26.0	10	3.2	2.3	**<0.001***
	3	37.9	32.7	17.5	6.2	2.8	2.8	
	4	44.6	26.8	16.1	3.6	3.6	5.4	
Canned juices	0	24.1	13.8	13.8	24.1	24.1	0.0	
	1	31.6	19.7	17.1	17.1	13.2	1.3	
	2	28.8	27.4	23.3	12.1	7.4	0.9	0.319
	3	30.8	26.9	22.6	12.5	6.3	1.0	
	4	44.6	26.8	16.1	3.6	3.6	5.4	
Chips	0	3.4	17.2	24.1	44.8	10.3	0.0	
	1	6.8	29.7	31.1	28.4	2.7	1.4	
	2	17.7	30.0	29.1	15.9	5.0	2.3	0.065
	3	11.3	31.5	32.4	17.8	5.2	1.9	
	4	17.5	33.3	31.6	10.5	3.5	3.5	
Chocolates/ Croissants/ Biscuits	0	10.3	13.8	6.9	41.4	24.1	3.4	
	1	12.3	11.0	37.0	20.5	17.1	4.1	
	2	19.7	26.1	22.5	18.3	11.5	1.8	**0.01***
	3	17.5	25.0	22.2	23.1	7.5	4.7	
	4	11.5	10.9	8.1	7.9	10.6	0.0	
Cheese puffs/ Crisps	0	20.7	10.3	13.8	27.6	27.6	0.0	
	1	30.1	23.3	26.0	11.0	8.2	1.4	
	2	37.0	26.5	20.5	8.7	5.5	1.8	**0.034***
	3	32.7	27.0	22.3	10.0	6.2	1.9	
	4	44.6	21.4	25.0	5.4	3.6	0.0	
Alcoholic Drinks (wine/ beer)	0	92.9	3.6	3.6	0.0	0.0	0.0	
	1	95.9	1.4	1.4	0.0	0.0	0.0	
	2	81.3	6.7	6.2	3.8	1.9	0.0	0.078
	3	77.1	6.2	8.1	6.2	1.9	0.5	
	4	77.4	7.5	3.8	11.3	0.0	0.0	

P-value based on chi-squared test; Significant level at p<0.05
Statistically significant coefficients are indicated in bold font.

conducted in the USA and published in 2001, which included 532 children aged 11-13 years; approximately 40% of their answers were correct[11]. Nevertheless, the level of nutrition knowledge of Greek children, according to the present study was lower compared to the results of a recent study, conducted in 2014 in

TABLE 4. Nutrition Knowledge Level and Dietary Behavior by sex

	NKT (Score)	Never or <1 time/ month (%)		1-2 times/ month (%)		1 time/ week (%)		2-6 times/ week (%)		1 time/ day (%)		>2 times/ day (%)		p-value	
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Soft drinks	0	0.0	14.3	20.0	28.6	0.0	28.6	26.7	14.3	40	14.3	13.3	0.0		
	1	33.3	27.8	10.3	25	33.3	25	5.1	13.9	17.9	2.8	0.0	5.6		
	2	37.0	29.8	22.8	28.1	23.9	28.1	7.6	11.6	6.5	0.8	2.2	1.7	**>0.001***	0.105
	3	34.3	41.3	34.3	31.2	14.7	20.2	8.8	3.7	4.9	0.9	2.9	2.8		
	4	42.9	46.4	28.6	25	10.7	21.4	3.6	3.6	7.1	0.0	7.1	3.6		
Canned juices	0	21.4	21.4	7.1	21.4	7.1	21.4	28.6	21.4	35.7	14.3	0.0	0.0		
	1	35.0	28.6	15.0	25.7	15	17.1	12.5	22.9	20.0	5.7	2.5	0.0		
	2	30.8	27.1	26.4	29.7	25.3	20.3	14.3	10.2	3.3	11.0	0.0	1.7	**0.003***	0.801
	3	30.0	31.5	34.0	20.4	19.0	25.9	12.0	13.0	5.0	7.4	0.0	1.9		
	4	12.0	42.9	32.0	14.3	32.0	17.9	20.0	17.9	4.0	7.1	0.0	0.0		
Chips	0	6.7	0.0	20.0	15.4	26.7	23.1	33.3	53.8	13.3	7.7	0.0	0.0		
	1	7.9	5.7	18.4	42.9	34.2	25.7	34.2	22.9	5.3	0.0	0.0	2.9		
	2	13.0	21.3	35.9	25.4	26.1	31.3	14.1	18.0	5.4	4.1	5.4	0.0	0.288	0.06
	3	7.8	14.5	34	29.1	30.1	34.5	19.4	16.4	6.8	3.6	1.9	1.8		
	4	21.4	13.8	25.0	41.4	32.1	31.0	10.7	10.3	7.1	0.0	3.6	3.4		
Chocolates/ biscuits/ croissants	0	0.0	23.1	13.3	7.7	6.7	7.7	46.7	38.5	26.7	23.1	6.7	0.0		
	1	10.5	14.7	5.3	17.6	42.1	29.4	21.1	20.6	15.8	14.7	5.3	2.9		
	2	25.3	15.7	26.4	26.4	19.8	24.0	17.6	18.2	9.9	13.2	1.1	2.5	**>0.001***	0.809
	3	18.4	16.5	23.3	26.6	22.3	22.0	25.2	21.1	3.9	11.0	6.8	2.8		
	4	32.1	11.1	14.3	40.7	25.0	14.8	21.4	14.8	7.1	18.5	0.0	0.0		
Cheese puffs/ crisps	0	13.3	30.8	13.3	0.0	6.7	23.1	40	15.4	26.7	30.8	0.0	0.0		
	1	28.2	33.3	17.9	30.3	28.2	21.2	12.8	9.1	10.3	6.1	2.6	0.0		
	2	41.9	32.5	22.6	30.0	15.1	24.2	12.9	5.8	5.4	5.8	2.2	1.7	**0.016***	0.364
	3	26.2	38.9	33.0	21.3	22.3	22.2	11.7	8.3	6.8	5.6	0.0	3.7		
	4	44.4	44.8	14.8	27.6	29.6	20.7	7.4	3.4	3.7	3.4	0.0	0.0		
Alcoholic drinks (wine/ beer)	0	85.7	100	7.1	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	1	97.4	94.1	2.6	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0		
	2	76.1	86.1	8.0	4.3	8.0	5.2	4.5	3.5	3.4	0.9	0.0	0.0	0.11	0.741
	3	73.5	80.6	8.8	3.7	12.7	3.7	4.9	7.4	0.0	3.7	0.0	0.9		
	4	73.1	81.5	7.7	7.4	3.8	3.7	15.4	7.4	0.0	0..0	0.0	0.0		

*p-value based on chi-squared test; Significant level at p <0.05
Statistically significant coefficients are indicated in bold font.

a sample of 1210 primary school children in Japan; in that study, 72% of questions were answered correctly[8].

The present study found that most preadolescents (83%) answered the questions correctly about the recommended weekly fruits and vegetable consumption. A review regarding the determinants of fruits and vegetable consumption among children and adolescents has shown that Greek children demonstrated very high knowledge of the recommended weekly fruit consumption, which was associated with socioeconomic status, parental dietary habits and children's preferences[13]. Furthermore, a meta-analysis indicated that school-based intervention programs may improve fruit consumption, although they have minimal impact on vegetable consumption among children aged 5 to 12 years[14]. A study in Taiwanese children found that there is a gap between knowledge and behavior, especially regarding fruits and vegetable intake[10]. As regards the knowledge of the recommended weekly legume consumption, 58% of the preadolescents answered correctly, but an underestimation was observed, with many of them reporting less than once/week. This finding is in agreement with the study on Burgess-Champoux et al., in which children had limited knowledge of whole-grain foods consumption[15]. Regarding gender differences, it has been shown by Notara et al., that girls had higher nutrition knowledge than boys about the recommended weekly legume consumption[16]. In the present study, only 39% of the preadolescents were familiar with the recommended weekly fish consumption. In a Japanese study, it was observed that the higher children's nutrition knowledge might have been associated, with higher fish consumption for both genders[8]. It was also found in the present study that almost half of the preadolescents (52%) gave correct answers about the ideal weekly meat consumption. According to a large observational study about the recommended meat consumption knowledge and the meat consumption in 4.802 children and 9.640 adults, it was shown that a higher level of nutrition knowledge was associated with a lower likelihood of red meat consumption[17].

Moreover, the association between the level of nutrition knowledge and dietary behavior among preadolescents living in Athens was explored, and a positive relationship was found between a higher level of nutrition knowledge and healthier dietary behavior. More specifically, higher preadolescents' level of nutrition knowledge was associated with lower soft drinks, chocolates, croissants, biscuits, cheese puffs

and crisps consumption and the opposite. Similarly, this association between higher nutrition knowledge and less frequent consumption of "unhealthy" meals, foods and snacks was also demonstrated by Grosso et al.[7] Additionally, the relationship between the level of dietary knowledge and healthy behavior in children was demonstrated in a study in the early 1990s, which reported that teenagers with a higher level of nutrition knowledge had healthier nutritional habits, were more physically active, did not smoke and had balanced weight control[9]. Since then, a few observational and intervention studies have demonstrated the correlation between the level of nutrition knowledge and dietary behavior in children[6–8].

Regarding gender differences in the present study, a significant association between the level of nutritional knowledge and dietary behavior was found only among boys. This finding is opposed to other studies in adolescents, such as the HELENA study, which showed that girls had a higher level of nutrition knowledge scores than boys[6]. Indeed, most studies report that girls have a higher level of dietary knowledge than boys[11]. Lower soft drinks, canned juices, cheese puffs, crisps, chocolates, biscuits and croissant consumption were significantly associated with improved nutrition knowledge only among boys. No significant correlations were found between the dietary behavior and nutrition knowledge in girls.

To date, the relationship between nutrition knowledge and weight status remains controversial. More specifically, according to a study by Triches et al., researchers have reported that obese children tend to have lower nutrition knowledge and unhealthier eating behavior[18]. This is in agreement with the present study as preadolescents with healthy weight status tending to have higher nutritional knowledge. Nevertheless, this association was not observed by others[19]. The present study accounted for socioeconomic status (SES), using the school area as a proxy measure, however, this did not significantly affect the model, as stated in the HELENA study, that reported no significant differences between the nutrition knowledge and socioeconomic status[6]. The results of the present study are reasonable as nutrition knowledge is associated with general education which is related to school education.

Limitations

The present study, despite its strong findings with specific public health implications, has some limitations that should be acknowledged to better interpret

the results. The sample is exclusively from the wider region of Attica, which may make it difficult to generalize the findings in the total population of children in Greece. However, a strong effort was made for the wide distribution of the participating schools in the area of the research interest, and the results should not be underestimated.

Conclusions

The present study showed that even nowadays, Greek children have a modest nutrition knowledge level, while among girls there is a gap between nutrition knowledge and behavior indicating that the attitude towards healthy food consumption was not strong enough in this gender. The nutrition knowledge level of Greek preadolescents seems to be similar to children's nutrition knowledge levels in many European countries. Moreover, the findings of the present study suggest that a higher level of children's nutrition knowledge is associated with healthier dietary behavior, including moderate and lower consumption of "unhealthy" foods, especially among boys and healthy weight status children. Moreover, gender differences between nutrition knowledge and dietary behavior should be further investigated in the future. Finally, taking into account the likelihood of the childhood obesity epidemic[2], systematic nutritional intervention programs are recommended for the improvement of nutrition knowledge and dietary behavior, especially in high-risk groups, such as obese children.

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Conflict of Interests

None to declare.

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