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Does the healthy plate model workshop improve nutrition knowledge, behaviors, and habits in school-age children? The impact of workshop on dietary habits

Original article

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Abstract

Background This study was conducted to identify the impacts of the healthy plate model workshop on 4th-graders nutrition knowledge, behaviors, and habits.

Methods The study was conducted from March to June 2023 in the Uskudar district of Istanbul, involving 102 children (50% girls) with a mean age of 10.2 ± 0.45 years. A pretest-intervention-posttest design was used for the research. Before and after the training, a questionnaire was administered to measure students' demographic characteristics, physical activity status, adherence to the Mediterranean Diet, frequencies of food group consumption, and nutritional knowledge.

Results The number of students consuming eggs, legumes, vegetables, fruits, and oilseeds daily increased after the training ($p > 0.05$). Increases were observed in daily consumption of meat group and water ($p < 0.05$). While the proportion of students who consumed whole fruit with skin was 35.3% before the training, this rate increased to 47.1% after the training ($p < 0.05$). The mean nutritional knowledge score (before: 71.37 ± 11.8; after: 80.45 ± 1.6, $p < 0.05$) and the Mediterranean Diet Quality Index (KIDMED) score (before: 4.77 ± 2.41; after: 5.50 ± 2.45, $p < 0.05$) increased significantly after the training. A weak positive correlation was identified between pre-training nutritional knowledge scores and KIDMED index scores ($r = 0.19$; $p = 0.045$). Furthermore, a negative weak relationship was observed between post-training nutritional knowledge scores and meal-skipping status (r=-0.231; $p = 0.019$).

Conclusions Structured nutrition education for school-age children can positively impact their nutritional knowledge and dietary habits.

Keywords Dietary habits, Nutritional knowledge, Nutrition education, School-aged children, Healthy plate

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Introduction

Adequate and balanced nutrition is essential for maintaining health throughout all stages of life. The school age, covering ages 6–12, is the period when children experience the fastest physical, cognitive, and social development. This period is characterized by forming lifelong behaviors and is the most suitable time for acquiring information and establishing habits. It is also a high-risk period for the development of adult diseases [1–3]. Consequently, instilling healthy eating habits in children during school age can help them carry these habits into later life, prevent nutritional deficiencies, and ensure optimal growth and development [4–6].

School-age children can achieve a lot in their learning and are capable of changing their behaviors with the proper support and resources. Consequently, this period offers a great opportunity to enhance children's nutritional behaviors and dietary intake. Particularly schools provide a unique setting that integrates daily activity goals with learning and personal development [2, 4, 6]. This is why nutritional education given in schools is important for children to acquire the knowledge and skills necessary to make healthy choices [4–6]. School-based nutrition interventions positively contribute to children's nutritional behaviors, attitudes toward food, nutritional status, anthropometric status, and academic success. Additionally, these interventions may help address inadequate and unbalanced nutrition, which in turn reduces the risk of chronic diseases [1, 2, 4, 6]. Such education not only affects children's nutritional behaviors but also enables them to share their new knowledge with school staff, families, and peers, thereby fostering behaviors that can enhance public health [7, 8].

The educational method is also a crucial factor to consider when delivering nutrition education to school-age children. This education should address appropriate topics tailored to the age and needs of children. The duration and frequency of education should also be suitable for the specific group being taught [9, 10]. The most effective educational method for school-age children aligns with real-life scenarios, targets purposeful learning, and provides hands-on experience through practice [11]. Graphics and plate models included in nutritional guides make these guides easily understandable. Simple rules embedded in plate models help promote the consumption of a greater variety of foods and healthier choices; as well as enhance understanding [12]. The healthy plate model is a visual guide that illustrates the recommended portions and types of food groups necessary for a healthy, adequate, and balanced diet, which encourages consumers to adopt healthy eating habits [13]. When successfully implemented, the plate model reduces dietary energy intake, ensures a balanced intake of macronutrients, and therefore has the potential to promote healthy eating [14, 15].

Accordingly, this study aimed to evaluate primary students' nutritional habits and knowledge, as well as to assess whether school-based nutrition training led to changes in their behaviors.

Method

To conduct this study, Ethics Commission Approval (Number: E-10840098-772.02-17, dated 28.11.2022) was received from the Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee. Additionally, 'Survey and Research permission' (Number: E-59090411-44-73109696, dated 27.03.2023) was obtained from the Istanbul Provincial Directorate of National Education. The study was carried out between March and June 2023. A pretest-intervention-posttest design was used for the research. A pilot study evaluated the questionnaire's suitability, with revisions made to questions participants found difficult. The Uskudar district of Istanbul was selected as the study area. Elementary schools with fourth-grade students were invited to participate in the study. Three schools accepted the invitation. Following the determination of student and class enrollments at these participating schools, invitations were extended to parents to consider their child's participation. The sample size was determined using G*Power software, employing a power of 95%, an effect size of 0.5 (medium), and a significance level of $\alpha = 0.05$. The study involved 102 students selected by random sampling method from eight 4th grade classes, and eight teachers (School- n:30, School-2 n:40, School-3 n:32). Consent was received from principals of the schools agreed to participate. Students who were actively attending school, had no physical or mental disabilities, no medical conditions requiring clinical care, no food allergies, and no special dietary programs were included. After explaining the study's objectives, duration, and measurement procedures, written informed consent was obtained from parents/caregivers and teachers. In addition to parental consent, children's willingness was also assessed. Participation was restricted to children who agreed to take part in the study and whose parents signed an informed consent form. All methods used in this study were performed in strict accordance with the Declaration of Helsinki. Both students and parents were told that the information they provided would be guaranteed to remain private.

Study design

The study was carried out in three stages. The '1st Survey' was administered to participants as a pre-test to assess their demographic characteristics, dietary habits, nutritional knowledge, eating behavior, and consumption of food groups. Additionally, the researcher obtained the

students' anthropometric measurements. Furthermore, the Mediterranean Diet Quality Index (KIDMED) was utilized in this pre-test to assess participants' adherence to the Mediterranean diet. The nutritional knowledge of the participants was measured using a nutritional knowledge questionnaire developed (see Additional file 1, questionnaire form) based on the literature [8, 16, 17].

In the second stage, a nutrition training program was developed based on previous studies and expert opinions [6–8, 16, 17]. For the nutrition training program and workshop, participants were randomly assigned to groups of 10. With this training, food groups were taught to students using the 'Plate Model by Food Groups,' developed to increase awareness of healthy lifestyles and to make the concepts easily understandable, as introduced in Turkey Dietary Guidelines-2022 (TÜBER-2022) [3]. The author taught students about the nutrients and their functions in each food group, as well as the recommended daily amounts, through a 60-minute presentation using Microsoft PowerPoint. The presentation also included a description of the food groups recommended in TÜBER-2022 for this age group and their characteristics. Moreover, the plate model method was introduced. At the end of the presentation, students were given an activity sheet in the shape of an empty plate and were asked to draw and color their own healthy plate models. The plate models prepared by the students were evaluated together in class, and the students received feedback. To support the effectiveness of the workshop, five training brochures were prepared. During the 5 weeks following the workshop, students were given one brochure each week, and the content was read aloud to the teacher during the designated lesson time. To ensure that students comprehended the training topics, a group discussion was held in each session using structured questions. The brochure topics included adequate and balanced nutrition, water consumption, and the characteristics and roles of the food groups recommended in TÜBER-2022 (milk and dairy products, meat and meat products, fresh vegetables and fruits, bread, and grains).

In the third stage, a post-test (2nd questionnaire) was conducted in the sixth week of the study to evaluate whether the education and materials were effective (Fig. 1). Similar to the pre-test, the post-test measured students' eating habits and the frequency of food group consumption. The KIDMED Index and a nutrition knowledge test were also included.

Data collection and analysis

The researcher administered the surveys to the students through face-to-face interviews. The survey measured students' sociodemographic characteristics and frequency of food group consumption. The survey also included a nutritional knowledge questionnaire and the KIDMED index. Anthropometric measurements of the participants were taken by the researcher.

Evaluation of anthropometric measurements

The researcher took body weight and height measurements of the participants. Body weights (kg) were measured without shoes using a bioelectrical impedance analysis (Tanita BC 601) appliance with an accuracy of 100 g. Height measurements were conducted using a portable height meter (Mesilife-13539) with a sensitivity of 1 mm, positioned at Frankfort's horizontal plane, with participants standing straight and without shoes.

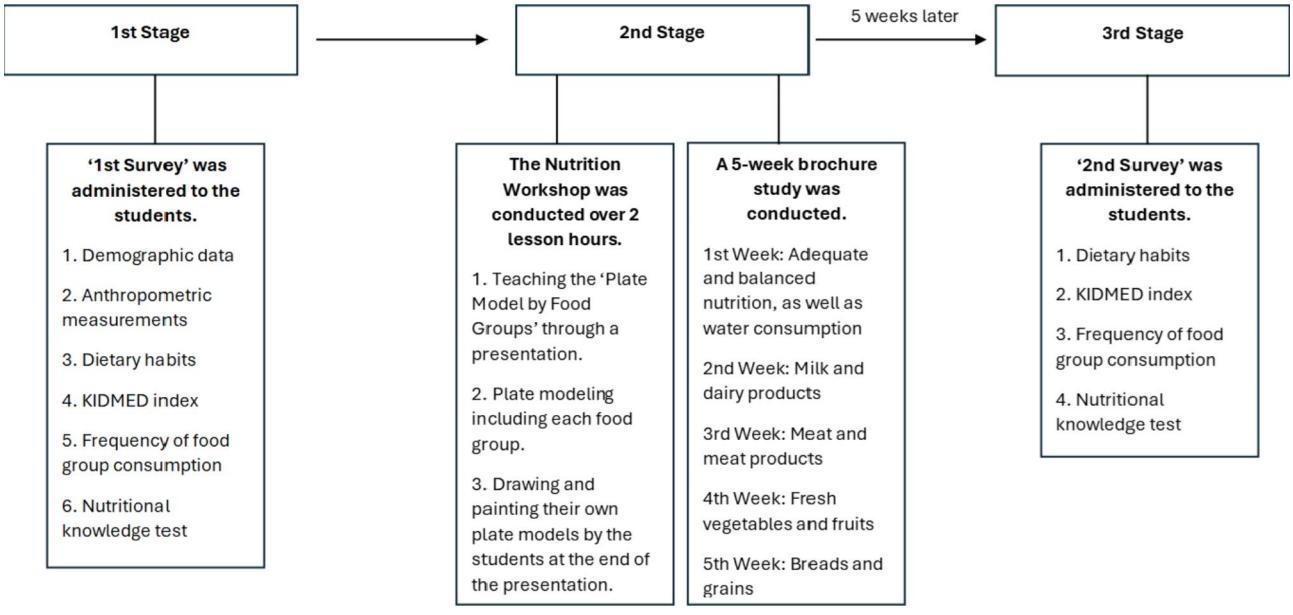

Fig. 1 Stages of the study

Age-and gender-specific Body Mass Index (BMI) and height percentiles of the students were calculated. The assessment of these values was done using the growth charts for Turkish children developed by Neyzi et al. [18].

Evaluation of nutritional characteristics

Before the training, the students were administered a questionnaire on the frequency of food group consumption, a nutritional knowledge questionnaire, and the KIDMED index. The dietary habits of the students across 10 different food groups (eggs, dairy, meat, legumes, grains, vegetables, fruits, oilseeds, sugar and sugary foods, fast food) were recorded in the questionnaire. The Turkish version of the Mediterranean Diet Quality Index (KIDMED), developed by Serra-Majem et al. [19] was used to determine participants' adherence to the Mediterranean Diet (MD). The reliability and validity of the Turkish version of KIDMED were assessed by Apaydın Kaya and Temiz [20]. The nutritional knowledge questionnaire was prepared by the researcher based on the literature. The questionnaire consisted of 10 multiple-choice questions (4 choices each) and 20 matching questions related to food-food groups. The nutrition knowledge test can be scored between 0 and 100. Each correct answer to the multiple-choice questions was scored 6 points, while each correct match in the matching questions was scored 2 points. No scores were given for incorrect answers.

Furthermore, the students' physical activity levels were assessed, taking into account the World Health Organization (WHO) recommendation of 60 min of moderate-intensity physical activity per day for children and adolescents [21].

Table 1 Demographic characteristics and anthropometric measures of the students

Demographic characteristics	Boys *n* (%)	Girls *n* (%)	Total *n* (%)	*p*
Gender	51(50.0)	51(50.0)	102(100.0)	
Age (years) (X̄±SD)	10.1 ± 0.43	10.3 ± 0.46	10.2 ± 0.45	
Mother's Education				
Primary School and below	-	3(5.9)	3(2.9)	
Secondary and High School	14(27.5)	11(21.6)	25(24.6)	0.186
Bachelor's and above	37(72.5)	37(72.5)	74(72.5)	
Father's Education				
Primary School and below	-	1(2.0)	1(1.0)	
Secondary and High School	5(9.8)	4(7.8)	9(8.8)	0.574
Bachelor's and above	46(90.2)	46(90.2)	92(90.2)	
Having a Disease (Yes)	8(15.7)	15(24.9)	23(22.5)	0.097
Number of People Living in the Household (X̄±SD)	4.5 ± 0.94	4.4 ± 1.0	4.5 ± 0.98	0.623
Anthropometric Measures				
Height (cm) (X̄±SD)	144.2 ± 5.7	143.5 ± 6.1	143.9 ± 5.9	0.551
Body Weight (kg) (X̄±SD)	35.8 ± 8.1	36.1 ± 7.7	36.0 ± 7.9	0.856
BMI (kg/m^2) (X̄±SD)	17.0 ± 3.0	17.4 ± 3.2	17.2 ± 3.1	0,542
BMI Classification				
Underweight	11(21.6)	10(19.6)	21(20.6)	
Normal Weight	33(64.7)	35(68.6)	68(66.7)	0.912
Overweight/Obese	7(13.7)	6(11.8)	13(12.7)	
Height Percentile Classification by Age				
Stunting	3(5.9)	10(19.6)	13(12.7)	
Normal	42(82.4)	38(74.5)	80(78.5)	0.074
Tall	6(11.7)	3(5.9)	9(8.8)	

X̄: mean, SD: standard deviation

Statistical analysis of the data

To control whether the data were normally distributed, Kolmogorov-Smirnov and Shapiro-Wilk normality tests were conducted. For categorical data analysis, the Chi-square test was conducted on independent groups. The Fisher's Exact test was performed when more than 20% of the cells had expected frequencies less than 5. For comparisons of two independent groups, normally distributed variables were analyzed using the independent samples t-test. Descriptive statistics were reported as mean (X̄), standard deviation (SD), sample size (n), and percentage (%) values. McNemar's test was used for dependent data with two groups, while the Marginal Homogeneity test was conducted for dependent data with more than two groups. Descriptive statistics were reported as frequencies and percentages. Linear relationships between two continuous variables that were normally distributed were tested using Pearson correlation, while variables that did not meet normal distribution criteria were tested using Spearman correlation. A correlation coefficient of 0.00-0.29 is interpreted as indicating a weak relationship between variables; 0.30–0.64 as a moderate relationship; 0.65–0.84 as a strong relationship; and 0.85-1.00 as a very strong relationship [22]. The statistical significance level was set at 0.05. Statistical analyses were conducted using SPSS version 18.

Results

The study involved a total of 102 students, 51 (%50) girls and 51 (%50) boys, with a mean age of 10.2 ± 0.45 years. The demographic characteristics and anthropometric measures of the students are given in Table 1. The mean height was 143.9 ± 5.9 cm, the mean body weight was 36.0 ± 7.9 kg, and the mean BMI was 17.2 ± 3.1 kg/m². No gender-related significant differences were observed in the anthropometric measurements of the students ($p > 0.05$).

Table 2 presents the students' nutritional habits, frequencies of food group consumption, and the observed changes before and after the training. Before the

Table 2 Pre- and Post-training Nutritional habits, Frequencies of Food Group Consumption, and physical activity status of the students

Nutritional Habits	Pre-Training *n* (%)	Post-Training *n* (%)	*p*
Number of Main Meal			
1–2	19(18.6)	20(19.6)	
3	60(58.9)	50(49.0)	0.473
≥ 4	23(22.5)	32(31.4)	
Number of Snacks			
None	5(4.9)	4(3.9)	
1–2	48(47.0)	51(50.0)	0.885
≥ 3	49(48.1)	47(46.1)	
Meal Skipping			
Yes	59(57.8)	54(52.9)	0.074
No	43(42.2)	48(47.1)	
Having a Regular Breakfast			
Yes	93(91.2)	96(94.1)	0.581
No	9(8.8)	6(5.9)	
Fruit Consumption			
Whole Fruit with Skin	13(12.7)	36(35.3)	
Whole Fruit without Skin	48(47.1)	52(51.0)	0.232
Fruit Juice	41(40.2)	14(13.7)	
Eating Speed			
Slow	16(15.7)	11(10.8)	
Moderate	71(69.6)	73(71.6)	0.157
Fast	15(14.7)	18(17.6)	
Food Group Consumptions			
Eggs	29 (28.4)	30(29.4)	0.234
Dairy Group	48(47.1)	46(45.1)	0.832
Meat Group	10(9.8)	17(16.7)	0.046*
Legumes	10(9.8)	12(11.8)	0.064
Grain Group	34(33.3)	33(32.4)	0.641
Vegetables	30(29.4)	39(38.2)	0.592
Fruits	60(58.8)	67(65.7)	0.212
Oil Seeds	25(24.5)	34(33.3)	0.532
Sugar and Sugary Foods	27(26.5)	27(26.5)	0.904
Fast Food	1(1.0)	3(2.9)	0.631
Water Consumption (glasses/24 h)	8.5 ± 4.3	9.2 ± 3.7	0.013*
Regular Physical Activity			
Yes	54(52.9)	59(57.8)	0.227
No	48(47.1)	43(42.2)	

*$p < 0.05$

training, 57.8% of the students skipped meals, but this rate decreased to 52.9% after the training. However, this decrease was not statistically significant ($p > 0.05$). After the training, the consumption of fruit juice and whole fruit without skin decreased, while the consumption of whole fruit with skin increased. An examination of students' food consumption speed revealed that after the training, the number of slow eaters decreased, while the number of moderate and fast eaters increased. However, the changes observed in food consumption speed and fruit consumption were not statistically significant ($p > 0.05$). The frequency of meat, eggs, legumes, and oilseeds consumption increased compared to before the training; however, only the increase in meat consumption was statistically significant ($p = 0.046$). Before the training, 29.4% of students consumed vegetables daily, and 58.8% consumed fruits daily. After the training, these rates increased to 38.2% and 65.7%, respectively. However, this increase was not statistically significant ($p > 0.05$). Regarding daily water consumption, the students' mean daily intake increased from 8.5 ± 4.3 glasses/24 h before the training to 9.2 ± 3.7 glasses/24 h after the training. The increase in the students' daily water consumption after the training was statistically significant ($p = 0.013$). Before the training, 52.9% of the students engaged in regular physical activity. This rate increased to 57.8% after the training, but the difference was not statistically significant ($p > 0.05$).

Students' nutritional knowledge and KIDMED scores are presented in Table 3. Students' pre- and post-training nutritional knowledge scores were 71.37 ± 11.8 and 80.45 ± 1.6, respectively. Furthermore, students' pre- and post-training KIDMED scores were 4.77 ± 2.41 and 5.50 ± 2.45, respectively. The differences in the pre- and post-training nutritional knowledge and KIDMED scores were found to be statistically significant ($p < 0.05$). Before the training, 11.8% ($n = 12$) of the students were in the high KIDMED score category. This percentage increased to 19.6% after the training. Moreover, the number of students in the low and moderate KIDMED score categories decreased after the training. The difference between pre- and post-training KIDMED categories was statistically significant ($p < 0.05$).

Table 4 presents the relationships between students' pre- and post-training nutritional knowledge scores, KIDMED scores, number of meals, and meal-skipping status. A positive weak correlation was observed between the pre-training nutritional knowledge scores and KIDMED scores ($r = 0.19$; $p = 0.045$). Furthermore, a negative weak linear relationship was identified between the post-training nutritional knowledge scores and meal-skipping status ($r = 0.231$; $p = 0.019$).

Discussion

This study explored the impact of the workshop about the healthy plate model on the nutritional habits, dietary behaviors, and nutritional knowledge of school-age children aged 9–11 years. The findings showed that school-based healthy nutrition training and workshops can positively impact meal intake, meal skipping status, nutritional knowledge, KIDMED scores, eating speed, regular physical activity, and the consumption of eggs, meat, vegetables, fruits, grains, legumes, and oilseeds.

Table 3 Students' pre- and Post-training Nutritional Knowledge and KIDMED scores

	Categories	*n*	x	SD	t	df	p^1
Nutritional Knowledge Score	Pre-Training	102	71.37	11.8	8.00	11.45	0.000*
	Post-Training	102	80.45	11.6			
KIDMED Score	Pre-Training	102	4.77	2.41	3.48	2.12	0.001*
	Post-Training	102	5.50	2.45			
	KIDMED Score Groups						
		Low		Moderate	High		p^2
Training Status	Pre-Training	25(24.5%)		65(63.7%)	12(11.8%)		0.035*
	Post-Training	19(18.6%)		63(71.8%)	20(19.6%)		

sd: standard deviation, df: degrees of freedom, p1: Dependent samples t-test, p_2: Marginal Homogeneity Test, *$p < 0.05$

Table 4 Relationships between students' pre- and post-training nutritional knowledge scores, mean kidmed scores, number of meals, and meal skipping status

Variables		*p*	Pearson
Pre-Training			
Nutritional Knowledge Score	KIDMED Score	0.045*	0.199
	Number of Meals	0.439	0.078
	Meal Skipping Status	0.962	0.005
Post-Training			
Nutritional Knowledge Score	KIDMED Score	0.464	0.073
	Number of Meals	0.743	-0.033
	Meal Skipping Status	0.019*	0.231

*$p < 0.05$

Many countries worldwide place importance on nutrition and health education for children. To this end, the World Health Organization developed and recommended the "Nutrition-Friendly Schools Initiative" program [23]. Recently, many countries have implemented various nutrition education interventions for children, and studies have explored the impact of such interventions on children's nutritional knowledge and habits [1, 5, 8, 24, 25]. For instance, Ying et al. conducted a 2-year nutrition and health education program for 8-10-year-old children in China. The authors reported that the intervention group showed increased nutritional knowledge scores and higher breakfast frequency, as well as significant changes in the intake of some food groups, including meat, eggs, milk, and vegetables, after two years [26]. In the Philippines, school children aged 7–9 years and their mothers/caregivers were provided with lunch and nutrition education. Following the training, children's sugar consumption decreased, while their consumption of vegetables and milk increased [1]. In a systematic review examining the effectiveness of school-based nutrition interventions in the League of Arab States, it was found that such programs had a significant positive impact on students' nutrition knowledge, self-efficacy, breakfast habits, fruit and vegetable consumption, and reduced dessert consumption [27]. In our study, we determined that the number of students consuming eggs, legumes, vegetables, fruits, and oilseeds every day increased after the training. However, in some studies examining school-based nutrition interventions, changes in students' food consumption frequencies and habits were not statistically significant [28–31]. School-based nutrition education programs vary widely in terms of their target populations and educational methodologies. However, each program offers unique advantages that can enhance participants' nutritional knowledge and influence dietary choices. Our research endeavored to integrate practical components (e.g., brochures, coloring activities) into the theoretical framework. Through this strategy, we sought to render nutrition education more pertinent, pleasurable, interactive, and participatory for students. This methodological choice has the potential to augment the probability of students transferring their acquired knowledge to real-world contexts and exerting a more substantial influence on their dietary habits and food choices. The differences between these reports may be explained by factors such as participants' dietary habits, culture, socio-economic status, parental or caregiver characteristics, and the methods used to assess food consumption frequencies.

It has been reported that school-based nutrition education can positively impact the amount and frequency of vegetable and fruit consumption among school-age children [32, 33]. For instance, Ilić et al. reported a significant increase in children's consumption of fruits and vegetables served at school compared to the control group (before: 4.19 ± 1.12; after: 4.29 ± 0.83, $p = 0.018$), after a three-year nutrition intervention for school children aged 7–10 years in Croatia [34]. Daas et al. implemented a 20-month multicomponent school-based nutrition education program in Norway and reported that after nutrition education, the intervention group consumed an average of 1.5 times (95% CI: 0.7 to 2.3) more fruits and 1.1 times (95% CI: 0.0 to 2.1) more vegetables per week compared to the control group [35]. Contrarily, some studies reported no significant changes in the consumption of fruits and vegetables following nutrition education provided to school-age children [30, 36]. In our study, 29.4% of the students consumed vegetables daily before the nutrition education, and this rate increased to 38.2% after the education. Similarly, while 58.8% of the

students consumed fruit daily before the training, our findings show that this rate increased to 65.7% after the intervention. The conflicting findings reported in these studies may be attributed to differences in the content and method of school-based education, the expertise of educators, the educational plan, the duration of the intervention, the age of participants, and the methods used to assess vegetable and fruit consumption.

The Mediterranean diet, a healthy eating model, is based on a high intake of low-glycemic index carbohydrates, unsaturated fats, fruits, and vegetables while recommending a lower intake of meat and dairy products [37, 38]. Kendel Jovanovi´c et al. conducted a study with school children aged 10–12 years in Croatia and found that the mean pre-training KIDMED index scores were 6.77 ± 2.15 in the intervention group and 7.90 ± 1.90 in the control group. Both groups were found to be moderately adherent to the Mediterranean diet. The authors reported that the proportion of children highly adherent to the Mediterranean diet was doubled after the training [38]. Similarly, in a study conducted in Italy, improvements were observed in students' adherence to the Mediterranean diet (high adherence: from 24.4 to 43.3%; low adherence: from 15.0 to 3.9%, $p < 0.05$) [39]. Consistent with this, we observed an increase in students' mean KIDMED scores from 4.77 ± 2.41 before the training to 5.50 ± 2.45 after the training (Table 3). Furthermore, while 11.8% of the students were in the high KIDMED index score group before training, this proportion increased to 19.6% after the training. Moreover, a weak positive linear correlation was identified between students' pre-training nutritional knowledge scores and their KIDMED scores. The high adherence to the Mediterranean diet (MD) among students with strong nutritional knowledge is consistent with studies reporting that nutrition education is effective in enhancing knowledge and promoting healthier eating [40, 41].

Another variable examined was the impact of nutrition education on students' nutritional knowledge. It is known that there is a strong correlation between nutritional knowledge and adherence to healthy dietary practices. Nutrition education significantly shapes children's knowledge, attitudes, and food choices in a positive way. There is evidence that school-based nutrition and health education can effectively improve nutrition knowledge and promote healthy eating behaviors in children [24, 42]. Yurni et al. examined the impact of nutrition education on 52 5th-graders and reported that the percentage of students with poor nutritional knowledge, which was 5.8% before the training, was reduced to zero, indicating that no students had poor nutritional knowledge after the training. Additionally, the percentage of students with high nutritional knowledge increased from 44.2 to 51.9% after the training [43]. Recent studies have reported that various nutrition education interventions provided to school-age children have increased their nutritional knowledge [1, 26, 33]. On the contrary, some studies reported that school-based nutrition education has a low impact on nutritional knowledge [7]. In our study, students' nutritional knowledge scores increased from 71.37 ± 11.8 to 80.45 ± 1.6 after the training (Table 3). Additionally, a negative weak correlation was observed between students' post-training nutritional knowledge scores and meal-skipping status. For nutrition training to have a strong impact on children's nutritional knowledge and meal skipping, continuity of education may be necessary. Furthermore, it should be noted that a child's dietary habits are shaped not only by their nutritional knowledge but also by the nutritional patterns of their family.

The study's strength lies in its comprehensive approach to nutrition education, combining theoretical knowledge with practical, engaging activities. A qualified dietitian's involvement guaranteed the delivery of accurate and up-to-date nutritional information. Limitations such as the small sample size, brief study period, and new questionnaire may restrict the applicability of the results and prevent a complete evaluation of long-term impacts.

In conclusion, it was determined that practical, sustainable nutrition training designed to meet the needs of school-age children positively affected their nutritional knowledge, adherence to the MD, and dietary habits. Previous research on nutrition interventions has confirmed that the school environment is an extremely important space for changing and improving children's eating habits. It is crucial to integrate nutrition education into the school curriculum and incorporate the concept of adequate and balanced nutrition into children's education to ensure optimal growth and development, as well as to instill lifelong healthy eating habits. While school-based nutrition education can enhance children's nutritional knowledge, this alone does not always lead to healthy dietary behaviors. This fact highlights the need to explore intervention models tailored to the developmental stage of school-age children and that can promote lasting behavioral changes. Repeating intervention studies with larger samples and conducting long-term follow-ups may provide a more comprehensive understanding of this topic.

Abbreviations

KIDMED	Mediterranean diet quality index
TUBER-2022	Turkey dietary guidelines-2022
MD	Mediterranean diet
WHO	World health organization
BMI	Body mass index
95%CI	95% confidence interval
SD	Standard deviations
Df	Degrees of freedom

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-21375-6.

Supplementary Material 1

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Author contributions
VÖ and HŞŞ contributed to the conception and design of the study. VÖ and HŞŞ collected article data, analyzed all survey data, and contributed to all statistical analyses and interpreted data. HŞŞ and VÖ wrote the manuscript. All authors contributed to the article and approved the submitted version.

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Data availability
The datasets presented in this article are not readily available due to restrictions (e.g., their containing information that could compromise the privacy of research participants). Requests to access the datasets should be directed to VÖ, volkan.ozkaya@ksbu.edu.tr.

Declarations

Ethics approval and consent to participate
The studies involving humans were approved by Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University approved the study protocol with decision number E-10840098-772.02-17, dated 28.11.2022. The studies were conducted in accordance with the local legislation and institutional requirements. Parents of all participants provided informed consent for this study that adhered the tenets of the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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