MEDICAL RESEARCH REPORTS

Med Res Rep 2026;9(1):45-61
https://doi.org/10.55517/mrr.1843137

ORIGINAL ARTICLE

Effect of a School Dietitian on Nutrition and Weight Control in High School Students: A School Case Study

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ABSTRACT

Aim: This study was planned and conducted to determine the effects of nutrition education and individualized counselling provided by a school dietitian on high school students' nutrition knowledge levels, dietary behaviors, anthropometric measurements, and body composition. **Methods:** This prospective educational intervention study was conducted during the 2024–2025 academic year among 255 students attending a public high school in Kayseri. Students received healthy nutrition education twice during the first and second semesters of the academic year, and the intervention was evaluated using a pretest–post-test design. Nutritional knowledge levels before and after the intervention were assessed using a 15-item multiple-choice nutrition knowledge test developed by Sarıdağ Devran; dietary habits were evaluated through a questionnaire; anthropometric measurements and body composition were assessed using the bioelectrical impedance analysis (BIA) method. Individualized nutrition counselling was provided to students when deemed necessary. Data were analysed using IBM SPSS Statistics version 22.0. Normality was assessed with the Kolmogorov–Smirnov test; the Wilcoxon signed-rank, Chi-square (χ^2), and McNemar tests were used for comparisons. Statistical significance was set at $p < 0.05$. **Results:** The study included a total of 255 students, comprising 136 boys (53.3%) and 119 girls (46.7%). The mean age of the participants was 15.76±1.12 years. The baseline mean nutrition knowledge score was 8.9±1.9. The mean body weight was 71.9±15.3 kg in boys and 59.4±12.5 kg in girls; the mean body mass index (BMI) was 23.0±4.4 kg/m² and 22.1±4.0 kg/m², respectively. The mean waist circumference was 81.2±11.2 cm in boys and 71.5±9.8 cm in girls. No changes were observed in meal patterns, and breakfast was identified as the most frequently skipped meal. Nutrition knowledge scores and levels increased significantly after the intervention ($p < 0.001$). Among female students, significant reductions in body weight and BMI were observed following the intervention ($p = 0.05$). According to BMI classification, the proportion of male students in the normal-weight category increased ($p = 0.486$), while decreases in the overweight and obese categories were observed among female students ($p = 0.031$). Waist circumference increased in both male and female students (Girl: $p = 0.004$, Boy: $p = 0.005$). Evaluation of the waist-to-height ratio revealed a significant increase in the proportion of female students in the normal category and a decrease in at-risk groups ($p < 0.001$). Body composition analyses showed increases in fat-free mass, fat-free mass percentage, total body water, and body water percentage, along with significant decreases in body fat percentage and fat mass in both male and female students ($p < 0.001$). **Conclusion:** Nutrition education and counselling interventions led by a school dietitian improved nutrition knowledge and positively affected anthropometric measurements and body composition indicators among high school students. These findings demonstrate that the school dietitian model is feasible at the high school level and may contribute to school health services.

Keywords: Adolescent, Body Composition, Nutrition Education, School Dietitian, Weight Control

ÖZET

Amaç: Lise öğrencilerine okul diyetisyeni tarafından verilen beslenme eğitimi ve bireysel danışmanlık hizmetlerinin öğrencilerin beslenme bilgi düzeyleri, beslenme davranışları, antropometrik ölçümleri ve vücut kompozisyonu üzerindeki etkisini saptamak amacıyla planlanmış ve yürütülmüştür.

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Yöntem: Bu prospektif eğitim müdahale çalışması, 2024–2025 eğitim-öğretim yılında Kayseri'de bir devlet lisesinde öğrenim gören 255 öğrenci üzerinde yürütülmüştür. Öğrencilere eğitim-öğretim yılının birinci ve ikinci dönemlerinde iki kez sağlıklı beslenme eğitimi verilmiş ve ön test–son test tasarımı ile değerlendirme yapılmıştır. Eğitim öncesi ve sonrası dönemde beslenme bilgi düzeyi Sarıdağ Devran tarafından geliştirilen 15 soruluk çoktan seçmeli beslenme bilgi testi kullanılarak değerlendirilmiş, beslenme alışkanlıkları anket ile sorgulanmış, antropometrik ölçümler ve biyoelektrik impedans analizi (BIA) yöntemiyle vücut kompozisyonu değerlendirilerek; gerekli görülen öğrencilere bireysel beslenme danışmanlığı sağlanmıştır. Veriler IBM SPSS Statistics 22.0 programı kullanılarak analiz edilmiştir. Verilerin dağılımı Kolmogorov–Smirnov testi ile değerlendirilmiş; karşılaştırmalarda Wilcoxon İşaretli Sıralar, Ki-Kare (χ^2) ve McNemar testleri kullanılmıştır. Anlamlılık düzeyi $p < 0,05$ olarak kabul edilmiştir. **Bulgular:** Çalışmaya, 136 erkek (%53,3) ve 119 kız (%46,7) toplam 255 öğrenci katılmıştır. Öğrencilerin yaş ortalaması 15,76±1,12 yıldır. Eğitim öncesi ortalama beslenme bilgi puanı 8,9±1,9 olarak belirlenmiştir. Erkek ve kız öğrencilerde sırasıyla ortalama vücut ağırlığı 71,9±15,3 kg ve 59,4±12,5 kg; beden kütle indeksi (BKİ) 23,0±4,4 kg/m² ve 22,1±4,0 kg/m²; bel çevresi ise 81,2±11,2 cm ve 71,5±9,8 cm olarak saptanmıştır. Öğün örüntülerinde değişiklik gözlenmemiş olup, kahvaltı en sık atlanan öğün olarak belirlenmiştir. Beslenme bilgi puanları ve düzeyleri artmıştır ($p < 0,001$). Kız öğrencilerde vücut ağırlığı ve BKİ değerlerinde eğitim sonrası anlamlı düşüş belirlenmiştir ($p = 0,05$). BKİ sınıflaması açısından erkek öğrencilerin normal grupta yer alma oranlarının arttığı ($p = 0,486$), kız öğrencilerde ise hafif şişman ve şişman gruplarında azalma olduğu saptanmıştır ($p = 0,031$). Hem kız hem erkek öğrencilerin bel çevrelerinde artış gözlenmiştir (Kız: $p = 0,004$, Erkek: $p = 0,005$). Bel/boy oranı değerlendirmesinde kız öğrencilerde normal grupta yer alma oranının belirgin biçimde arttığı ve riskli grupların azaldığı tespit edilmiştir ($p < 0,001$). Vücut kompozisyonu analizlerinde hem erkek hem de kız öğrencilerde yağsız vücut kütlesi, yağsız kütle yüzdesi, sıvı miktarı ve sıvı yüzdesinin arttığı; vücut yağ yüzdesi ve yağ miktarının anlamlı düzeyde azaldığı belirlenmiştir ($p < 0,001$). **Sonuç:** Okul diyetisyeni tarafından yürütülen beslenme eğitimi ve danışmanlık uygulamalarının lise öğrencilerinde hem bilgi düzeyini artırdığını hem de antropometrik ölçümler ve vücut kompozisyonu göstergelerini olumlu yönde etkilediğini göstermektedir. Bu sonuçlar, okul diyetisyeni modelinin lise düzeyinde uygulanabilir olduğunu ve okul sağlığı hizmetlerine katkı sağlayabileceğini ortaya koymaktadır.

Anahtar Kelimeler: Adolesan, Vücut Kompozisyonu, Beslenme Eğitimi, Okul Diyetisyeni, Kilo Kontrolü

Cite this article as: Kuruşcu Ş, Durmuş H. Effect of a School Dietitian on Nutrition and Weight Control in High School Students: A School Case Study. Medical Research Reports 2026;9(1):45-61.

INTRODUCTION

Nutrition refers to the intake and utilization of essential nutrients and bioactive components necessary for physical and cognitive growth and development, the maintenance of life, the protection of health, and the enhancement of productivity and overall quality of life. Establishing healthy eating as a lifestyle across the population is critical for preventing diseases and improving well-being. In an increasingly globalized world, enhancing nutritional awareness among individuals is essential for achieving the desired standard of living (1).

Adolescence is a critical period characterized by rapid growth and development, during which eating behaviors and lifelong health habits are formed. The World Health Organization (WHO) emphasizes that health behaviors established between ages 10 and 19 directly influence disease risk in adulthood (2).

In this period, eating behaviors are shaped by multiple factors, including family dynamics, socioeconomic status, media exposure, peer relationships, and the school environment (3). In particular, the school setting, where students spend much of their day, plays a pivotal role in shaping daily food choices and overall diet quality (4).

In Türkiye, the prevalence of obesity among children and adolescents has increased over the years, as demonstrated in national and regional studies. A meta-analysis of school-aged children (5–19 years) reported that obesity prevalence rose from 0.6% in 1990–1995 to 7.3% in 2011–2015, with a national prevalence of 8.2% among those aged 6–18 years (5). Despite rising obesity rates, school health services and nutrition-related practices remain insufficient. Although legal regulations exist for school health services in Türkiye, evidence indicates that these services are not delivered adequately and that clearer legal responsibilities are needed to establish a standardized structure (6). Similarly, Şahinöz et al. (7) emphasize that school health services encompass a wide range of components, including nutrition, growth and development, and environmental health, yet their multidisciplinary and multi-stakeholder nature makes it difficult to implement them in a comprehensive and sustainable way. A recent review published by Turkish Society of Public Health Specialists (HASUDER) highlights the absence of a national school nutrition program covering all students in Türkiye; existing initiatives (e.g., provision of milk or dried fruit) are limited in scope, and current research efforts in the field of school nutrition remain insufficient (8).

Strong evidence from the international literature demonstrates the effectiveness of school-based interventions in preventing obesity. A systematic review and meta-analysis by Nally et al (9) showed that school-based programs significantly increased physical activity levels in children, improved unhealthy eating behaviors, and produced small but statistically significant reductions in BMI z-scores. Similarly, Alhelal et al (10). reported that school-based interventions integrating both nutrition education and physical activity components improved students' nutrition knowledge, increased healthy food choices, and led to significant reductions in BMI and obesity risk.

International health organizations also identify school-based nutrition interventions as key strategies for preventing childhood obesity. WHO recommends improving access to nutritious foods in schools, restricting unhealthy food options, and implementing regular nutrition education programs (11). Schools provide an important opportunity to reach the majority of children for the prevention of diseases and the promotion of healthy lifestyle behaviors; in this context, dietitians take part in preventive public health services. A school dietitian is defined as a public health professional who provides nutrition education and counselling to students and school staff, supervises and regulates food services, and conducts screening, assessment,

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referral, and health promotion activities. The employment of dietitians in schools has been reported to improve healthy lifestyle behaviors among children, enhance the quality of food services, and contribute to economic savings (12). School dietitians undertake responsibilities such as providing nutrition education, identifying at-risk groups, conducting anthropometric monitoring, and delivering individualized nutrition counselling when necessary (13). While dietitians have been employed in schools for many years within the scope of national nutrition policies in many countries, in Türkiye, 125 dietitians were appointed for the first time under the Ministry of National Education in 2023; however, considering the 81 provinces and approximately 20 million students, this number has been stated to be insufficient. Furthermore, it has been reported that there are no specific regulations or legislative frameworks in Türkiye defining the roles and responsibilities of school dietitians (12).

This study was designed and conducted to determine the effects of nutrition education and individualized counselling delivered by a school dietitian on high school students' nutrition knowledge, eating behaviors, anthropometric measurements, and body composition.

MATERIAL AND METHODS

This section describes the design, setting, participants, intervention procedures, measurement tools, and analytical approach used to evaluate the impact of a school dietitian–led education and counselling program.

Study Design

This study was designed as a prospective educational intervention to evaluate the effects of a school dietitian on high school students' nutrition knowledge, eating behaviors, anthropometric measurements, and body composition. A pre–post design was used. The intervention consisted of structured nutrition education sessions for all participants, followed by individualized nutrition counselling for students identified as needing additional support. Changes in outcomes were assessed using questionnaires and bioelectrical-impedance–based body composition and anthropometric measurements collected before and after the intervention.

Study Setting

The study was carried out at Kayseri Osman Ulubaş Köşk Anatolian High School in the 2024–2025 academic year. The school was selected based on an existing institutional cooperation agreement between the involved organizations, which authorized the implementation of the intervention within this educational setting.

Participants and Recruitment

The target population consisted of all students aged 14–18 enrolled in the school. A total of 255 students (136 boys and 119 girls) agreed to participate and were included in the study. Participants were informed about the purpose and procedures of the study at the beginning of the research. Written informed consent was obtained from parents or legal guardians, and assent was obtained from the students prior to participation. No exclusion criteria were applied, and no students were removed after enrolment. For the study, ethical approval was obtained from the Erciyes University Social and Human Sciences Ethics Committee (Application No: 345, Date: August 27, 2024), and research implementation permission was granted through the Research Application Permission Application and Evaluation Module of the Ministry of National Education.

Intervention

The intervention consisted of two structured nutrition education sessions delivered during the 2024–2025 academic year, one in the first semester and one in the second. Each session included a 30-minute nutrition education lecture followed by a 10-minute question-and-answer period, totalling 40 minutes. Sessions were delivered interactively by a school dietitian and supported by PowerPoint presentations. Educational content was developed based on the Turkish Nutrition Guide (1) and covered topics such as the concept of nutrition, balanced eating, macronutrients and micronutrients, food groups, the healthy eating plate, adolescent nutrition, portion control, healthy snacks, the importance of breakfast, and foods that should be increased or limited. All education sessions followed a standardized protocol to ensure intervention fidelity.

Before the education sessions, students completed a baseline questionnaire and underwent anthropometric and body composition assessments. These data were jointly evaluated to identify students requiring individualized nutrition counselling. Counselling topics were tailored to students' specific needs, including underweight status, overweight/obesity, and nutrition management related to chronic conditions. Individualized dietary recommendations were provided for each student. Anthropometric and body composition indicators were reassessed as needed during counselling. After the second education session, the same questionnaire and all measurements were repeated to evaluate changes from baseline.

Instruments

Students completed structured questionnaires assessing sociodemographic characteristics, health status, nutrition habits, and nutrition knowledge. The questionnaire also included items on parental education level, perceived income status, and the presence of chronic diseases (e.g., cardiovascular diseases, diabetes, thyroid disorders, liver, lung, and kidney diseases), as well as whether students followed a special

diet due to any medical condition. Nutrition knowledge was measured using a 15-item multiple-choice test developed by Sarıdağ Devran, with each correct answer scored as 1 point (14). The original development study did not report validity and reliability coefficients (Cronbach's alpha) for the test. Height, waist circumference, and waist-to-height ratio were measured using a standard non-stretch measuring tape. Body weight, BMI, and body composition parameters (body fat percentage, fat mass, fat-free mass, fat-free mass percentage, total body water, and water percentage) were assessed using a bioelectrical impedance analysis (BIA) device (Tanita RD-545). All measurements were performed before and after the intervention using the same instruments.

Measures

Nutrition knowledge level was evaluated using the total score obtained from the test and classified as low, moderate, or high. Based on total scores, knowledge levels were classified as low (0–5 points), moderate (6–10 points), or high (11–15 points). Nutrition habits were assessed through items examining daily meal frequency, breakfast consumption, and meal-skipping behaviors.

Anthropometric measures included body weight, BMI, waist circumference, and waist-to-height ratio. BMI categories were defined according to the World Health Organization's 2007 growth reference percentiles (15). A waist-to-height ratio < 0.4 or > 0.5 was considered indicative of increased health risk (16), and WHtR values were classified as low (<0.40), normal (0.40–0.49), and high (≥0.50).

Body composition measures, including body fat percentage and mass, fat-free mass and percentage, and total body water and percentage, were derived from BIA analysis. All variables were assessed at baseline and post-intervention.

Procedures

All study procedures were carried out throughout the 2024–2025 academic year. At baseline, students completed questionnaires assessing sociodemographic characteristics, health information, nutrition habits, and nutrition knowledge, followed by anthropometric and body composition measurements. All anthropometric and body composition measurements were conducted by the same dietitian to ensure measurement consistency. Following baseline data collection, the first nutrition education session was delivered. Baseline findings were reviewed to identify students needing individualized nutrition counselling, and individualized counselling was provided to these students during the study period. Based on the initial evaluation and analyses, 121 students were identified as requiring individualized nutrition counselling, taking into account anthropometric measurements and nutritional risk status. The interval between the first and second education sessions was approximately three months. During this period, individualized nutrition counselling

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sessions were conducted every two weeks with the identified students. Meetings were scheduled during lunch breaks and recess periods to avoid disruption of academic activities.

Anthropometric measurements and individualized counselling sessions were conducted in a designated private room rather than in the classroom setting. Measurement results were shared individually with each student and were not disclosed in the classroom or to third parties. Personal health data were recorded using coded identifiers, and names were not used during the analysis process. These procedures were implemented to ensure confidentiality of personal data and to prevent potential stigmatization. Written informed consent was obtained from parents/guardians prior to the study, and the possibility of individualized nutrition counselling was clearly stated in the consent form. Therefore, no additional structured parental education or separate notification was provided during the intervention period. After the second education session, the same questionnaires and measurements were repeated using identical protocols, and baseline and post-intervention values were compared.

DataAnalysis

All data were analysed using IBM SPSS Statistics version 22.0. For continuous variables, means, standard deviations, medians, and minimum, maximum values were calculated; categorical variables were summarized using frequencies and percentages. The distributional characteristics of continuous variables were assessed with the Kolmogorov–Smirnov test, and nonparametric statistical methods were applied for variables that did not meet normality assumptions. Pre–post differences in continuous measures were evaluated using the Wilcoxon signed-rank test, while categorical variables were compared using the chi-square (χ^2) test. Changes in categorical classifications between baseline and post-intervention were assessed with the McNemar test. A significance level of $p < 0.05$ was used for all statistical analyses.

RESULTS

A total of 255 high school students participated in the study, including 136 boys (53.3%) and 119 girls (46.7%). The mean age of the participants was 15.76 ± 1.12 years.

Analysis of students' eating habits showed no significant changes in meal-skipping behaviour between pre- and post-intervention assessments ($p > 0.05$). In both periods, breakfast was the most frequently skipped meal, increasing from 48.6% before the intervention to 53.3% after the intervention. Skipping rates for lunch, dinner, and snacks also remained similar across periods. The most commonly reported reasons for skipping meals were "lack of appetite" and "lack of time," with no significant changes following the intervention ($p > 0.05$). The proportion of students who considered their diet healthy decreased significantly from 42.7% to 31.8% after the intervention ($p =$

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0.001). In contrast, the proportion of students reporting regular breakfast consumption increased slightly from 42.0% to 42.7%, though this change was not statistically significant ($p > 0.05$).

Table 1 presents the effects of the nutrition education and counselling on students' nutrition knowledge scores. The mean total knowledge score increased from 8.9 ± 1.9 before the intervention to 10.5 ± 1.9 after the intervention ($p < 0.001$). Examination of knowledge level categories showed that, prior to the intervention, 76.5% of students were classified as having a moderate level of knowledge, 20.4% as high, and 3.1% as low. Following the intervention, the proportion of students with high knowledge increased to 53.3%, while the proportion with moderate knowledge decreased to 44.7%, and the proportion with low knowledge declined to 2% ($p < 0.001$).

Table 1. Evaluation of the Effect of the Intervention on Students' Nutrition Knowledge Scores and Knowledge Levels (n=255)

	Before intervention		After intervention		
Knowledge score	**Mean ± SD**		**Mean ± SD**		**p**
	8.9 ± 1.9		10.5 ± 1.9		<0.001
Knowledge levels	**n**	**%**	**n**	**%**	**X^2/p**
Low	8	3.1	5	2	
Moderate	195	76.5	114	44.7	38.720/<0.001
High	52	20.4	136	53.3	

SD, standard deviation; X^2, Chi-square.
Note. Wilcoxon signed-rank test $p < 0.05$, Chi-square test $p < 0.05$.

As shown in Table 2, anthropometric measurements before and after the intervention were evaluated separately for boys and girls. Among boys, mean body weight decreased slightly from 71.9 ± 15.3 kg to 71.8 ± 14.4 kg, with no significant difference ($p > 0.05$). In girls, mean body weight decreased from 59.4 ± 12.5 kg to 59.0 ± 12.4 kg, and this change was statistically significant ($p = 0.005$). Among boys, mean BMI changed from 23.0 ± 4.4 kg/m² to 22.9 ± 4.2 kg/m² ($p > 0.05$), while in girls mean BMI decreased from 22.1 ± 4.0 kg/m² to 22.0 ± 4.0 kg/m², a significant reduction ($p = 0.005$). Waist circumference increased significantly in both genders after the intervention (boys $p = 0.005$; girls $p = 0.004$).

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Table 2. Comparison of Pre- and Post-Intervention Anthropometric Measurements by Gender (n = 255, Boys:136, Girls:119)

Anthropometric Measurements	Before Intervention			After Intervention			p
	Mean ± SD	Min–Max	Median (IQR)	Mean ± SD	Min–Max	Median (IQR)	
Weight (kg)							
Boys	71.9±15.3	42.2-136.8	71.4 (18.6)	71.8±14.4	42.2-125.6	71.1 (18.7)	0.648
Girls	59.4±12.5	40.5-102.6	57.6 (13.8)	59.0±12.4	41.1-102.5	57.4 (14)	0.005
BMI (kg/m²)							
Boys	23.0±4.4	13.7-36.7	22.5 (5.8)	22.9±4.2	13.9-36.8	22.7 (5.5)	0.716
Girls	22.1±4.0	15.5-38.2	21.2 (5.0)	22.0±4.0	15.6-38.3	21.3 (5.4)	0.005
Waist circumference (cm)							
Boys	81.2±11.2	60-120	79.5 (17.0)	82.1±9.9	63-113	81.0 (14.0)	0.005
Girls	71.5±9.8	56-102	69.0 (14.0)	72.4±8.2	60-100	70.0 (11.0)	0.004

SD, standard deviation; IQR, interquartile range; BMI, Body mass index.
Note. Wilcoxon signed-rank test $p < 0.05$.

As presented in Table 3, evaluation of BMI and waist-to-height ratio classifications showed differing patterns between girls and boys. Among girls, the number of students classified as overweight and obese decreased significantly following the intervention, while the number in the normal BMI category remained unchanged ($p = 0.031$). In boys, BMI classifications did not change significantly ($p > 0.05$). For waist-to-height ratio categories, the number of girls in the normal-risk group increased significantly after the intervention, whereas the number in the low-risk group decreased ($p = 0.001$). No significant changes were observed in waist-to-height ratio classifications among boys ($p > 0.05$).

Table 3. Comparison of Pre- and Post-Intervention BMI and Waist-to-Height Ratio Categories by Gender

	Boys (n:136)					Girls (n:119)				
	Before intervention		After intervention		X², p	Before intervention		After intervention		X², p
	n	%	n	%		n	%	n	%	
BMI (kg/m²)										
Underweight	7	5.1	8	5.9		1	0.8	1	0.8	
At risk of underweight	8	5.9	5	3.7	X^2=3.444, p=0.486	8	6.7	13	10.9	X^2=8.905, p=0.031
Normal	59	43.4	60	44.1		75	63.0	75	63.0	
Overweight	34	25.0	36	26.5		23	19.3	19	16.0	
Obese	28	20.6	27	19.9		12	10.1	11	9.2	
WHtR										
Low	22	16.2	16	11.8	X^2=2.571, p=0.276	36	30.3	20	16.8	X^2=13.467, p<0.001
Normal	86	63.2	92	67.6		71	59.7	89	74.8	
High	28	20.6	28	20.6		12	10	10	8.4	

WHtR, Waist-to-height ratio; BMI, Body mass index; χ², Chi-square.
Note. Mcnemar Bowker test p < 0.05.

Presented in Table 4, significant improvements were observed in body composition parameters in both genders following the intervention. For fat-free mass (kg), increases were observed in 88 boys and 74 girls, whereas decreases were seen in 47 boys and 44 girls (boys: $p < 0.001$; girls: $p < 0.001$). Similarly, fat-free mass percentage increased in 86 boys and 88 girls, with decreases recorded in 43 boys and 28 girls (boys: $p < 0.001$; girls: $p < 0.001$). Total body water (kg) increased in 89 boys and 78 girls, while decreases occurred in 45 boys and 40 girls (boys: $p < 0.001$; girls: $p < 0.001$). Body water percentage increased in 89 boys and 90 girls, and these changes were statistically significant for both genders (boys: $p < 0.001$; girls: $p < 0.001$). Body fat percentage decreased in 87 boys and 90 girls (boys: $p < 0.001$; girls: $p < 0.001$), and fat mass (kg) similarly decreased in 86 boys and 89 girls (boys: $p<0.001$; girls: $p < 0.001$). In Table 4, positive ranks indicate an increase, negative ranks indicate a decrease, and ties show that measurements did not change before and after the intervention.

Table 4. Comparison of Pre- and Post-Intervention Body Composition Measurements by Gender (n = 255; Boys: 136, Girls: 119)

Anthropometric Measurements	Gender	Negative (n)	Positive (n)	Ties (n)	Z	p
Fat-free mass (kg)	**Boys**	47	88	1	-3.822	<0.001
	Girls	44	74	1	-3.926	<0.001
Fat-free mass (%)	**Boys**	43	86	7	-4.141	<0.001
	Girls	28	88	3	-5.714	<0.001
Total body water (kg)	**Boys**	45	89	2	-4.119	<0.001
	Girls	40	78	1	-3.659	<0.001
Body water percentage (%)	**Boys**	41	89	6	-4.582	<0.001
	Girls	26	90	3	-6.016	<0.001
Body fat percentage (%)	**Boys**	87	42	7	-4.082	<0.001
	Girls	90	26	3	-6.170	<0.001
Fat mass (kg)	**Boys**	86	50	0	-3.482	<0.001
	Girls	89	30	0	-6.493	<0.001

Z, Wilcoxon test statistic.
Note. Wilcoxon signed-rank test $p < 0.05$.

DISCUSSION

This study demonstrated that the intervention led to a significant improvement in students' nutrition knowledge scores and knowledge levels. Favourable changes were also observed in anthropometric indicators, particularly among girls, including reductions in body weight, BMI, and waist-to-height ratio classifications. However, the intervention did not produce meaningful improvements in eating behaviors such as meal skipping or breakfast consumption. In contrast, considerable enhancements were detected in body composition for both genders, with increases in fat-free mass, fat-free mass percentage, and body water components, accompanied by significant reductions in body fat percentage and fat mass.

Regarding eating behaviors, breakfast was the most frequently skipped meal both before and after the intervention, and the most commonly reported reason for skipping meals was "lack of appetite," with no significant change post-intervention. Previous research similarly shows that approximately 45% of children and adolescents skip breakfast sometimes or often, with higher rates observed among older students, girls, and those living in socioeconomically disadvantaged areas (17). According to the 2017 Turkey Nutrition and Health Survey, 67.6% of adolescents aged

15–18 reported consuming breakfast regularly, and the most frequent reason for skipping breakfast was “lack of appetite” (48.7%) (18). Despite the significant improvements observed in nutrition knowledge and, particularly among girls, in anthropometric and body composition indicators, the absence of similar improvements in breakfast behaviour suggests that while school dietitian–led education and counselling increase knowledge and awareness, achieving sustained behavioural change may require more intensive, longer-term, and continuous interventions.

In this study, the proportion of students who perceived their diet as healthy decreased significantly following the intervention. Similarly, Calven et al. (19) reported that although adolescents generally hold positive attitudes toward healthy eating, only a small proportion identify themselves as “healthy eaters.” In the present study, the decline in students’ self-perception of eating healthfully may reflect increased awareness and critical self-evaluation resulting from improvements in nutrition knowledge, rather than an ineffective intervention. This suggests that as students gain knowledge, they may reassess their dietary behaviors more realistically. Therefore, longer-term, reinforcement-based, and behaviour-focused interventions may be needed to translate heightened awareness into positive and sustained self-perceptions of healthy eating.

No significant change was observed in daily breakfast consumption before and after the intervention. Similarly, the intervention study conducted by Sarıdağ Devran and Saka among high school students aged 14–17 reported an increase in regular breakfast consumption after nutrition education, although this change was not statistically significant (14). Conversely, Elseifi et al. (20) found that nutrition education significantly improved breakfast frequency among middle-school students (12–14 years) in Egypt, which may be attributed to the longer duration of the intervention and the inclusion of family involvement. In addition, Romero-Blanco et al. (21) emphasized that breakfast habits in adolescents are shaped not only by nutrition knowledge but also by environmental factors such as morning routines, family support, and time constraints. They noted that education alone is often insufficient to modify breakfast behaviour and that sustainable improvements require multicomponent strategies. Accordingly, implementing multicomponent school-based programs led by a school dietitian, including family participation, behaviour-focused content, and environmental support, may be necessary to promote lasting improvements in breakfast consumption.

Following the intervention, students’ nutrition knowledge scores increased, with a decrease in the proportion of those in the low and moderate categories and a notable rise in the proportion classified as having high knowledge. In a study involving 216

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adolescents, Aydın et al. (22) similarly reported significant improvements in knowledge scores across various educational approaches, including video-assisted instruction, visual materials, and peer education, and highlighted that visually supported education was particularly effective for long-term retention. The improvement observed in the present study may be attributed to students' active engagement and the age-appropriate design of the educational content and presentations. These findings suggest that even short-term, school-based interventions delivered by a school dietitian can contribute meaningfully to nutrition knowledge enhancement among adolescents.

Gender-specific differences emerged in body weight outcomes, with a decrease observed among girls but no significant change among boys. According to national data from the Turkey Nutrition and Health Survey 2017, the mean body weight for adolescents aged 15–18 is 66.3 ± 14.45 kg for boys and 58.6 ± 14.30 kg for girls (18). In the present study, the mean body weight of male adolescents was higher than these national reference values, while female students exhibited similar averages. Overall, the nutrition education and counselling did not lead to a significant short-term change in body weight among boys; however, it appeared to increase awareness among girls, contributing to more favourable weight-control behaviors.

Following the intervention, BMI values decreased among girls, whereas no significant change was observed among boys. A similar gender-specific pattern has been reported in the HEIA (Health in Adolescents) study conducted in Norway by Grydeland et al. (23), where a 20-month multicomponent school-based intervention involving 1,324 students aged 11–13 resulted in significant reductions in BMI and BMI z-scores among girls ($p = 0.024$ and $p = 0.003$, respectively), but not among boys. The authors attributed this difference to girls being more responsive to health-related interventions and more likely to adopt healthy lifestyle behaviors. Despite the older age range in the present study, a comparable gender difference was observed. These findings suggest that the nutrition education and individualized counselling provided in this study did not produce significant short-term changes in BMI among boys but may have enhanced awareness among girls, positively influencing their weight-control behaviors.

Following the intervention, waist circumference increased among both male and female students. Similarly, in a study conducted by Yabancı and Pekcan (24) involving 120 adolescents, the mean waist circumference was reported as 72.9 ± 8.4 cm in boys and 68.5 ± 7.7 cm in girls. The waist circumference averages observed in the present study were higher than those reported in Yabancı and Pekcan's findings. The significant post-intervention increase in waist circumference may be attributed to the natural growth and development that occur

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during adolescence, increases in muscle mass, or the lack of change in physical activity levels during the period following the education and counseling. Rather than indicating an adverse effect of the intervention, this pattern likely reflects the short-term nature of the behavioural changes, which may not immediately translate into measurable changes in anthropometric indicators.

When BMI classifications were evaluated, the number of girls in the normal category remained unchanged after the intervention, while the number of students classified as overweight or obese decreased significantly. Among boys, however, no significant post-intervention changes were observed in BMI categories. In the present study, the proportion of male students falling within the normal BMI range was lower than the national reference values reported in the Turkey Nutrition and Health Survey 2017, while the proportions classified as overweight or obese were higher. (18). Among girls, the prevalence of overweight was likewise higher than the national reference values. Similarly, Günalan et al. (25), in their study of 1,561 adolescents aged 14–17 years, reported that 3.6% were underweight, 68.4% were normal weight, 14.3% were overweight, and 13.8% were obese. Their findings also showed that boys were at higher risk for excess weight, whereas girls were more likely to fall within the normal BMI range. Overall, the findings of the current study suggest that the nutrition education and individualized counseling provided by the school dietitian contributed to a more favourable BMI distribution among girls, while no significant short-term change was observed among boys.

Waist-to-height ratio classifications indicated that most boys and girls fell within the normal range. No significant post-intervention changes were observed among boys; however, girls demonstrated meaningful improvements following the nutrition education and counseling. A waist-to-height ratio above 0.5 is widely recognized as a strong indicator of abdominal obesity and early cardiometabolic risk, and this cutoff has been validated across all age groups, including children and adolescents (26). In the present study, the nutrition education and individualized counseling provided by the school dietitian resulted in more pronounced improvements in waist-to-height ratio among girls, suggesting a favourable effect on indicators of abdominal obesity and cardiometabolic health.

Following the intervention, both boys and girls demonstrated improvements in multiple body composition parameters, including increases in fat-free mass (kg), fat-free mass percentage, total body water (kg), and water percentage, alongside decreases in fat mass (kg) and body fat percentage. Bogataj et al. (27) reported similar reductions in body fat percentage and fat mass in their 8-week school-based nutrition education and exercise program conducted among 48 overweight adolescent girls. The fact that

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comparable reductions in body fat were observed in the present study, despite the absence of a structured exercise component, highlights the potential effectiveness of the school dietitian–led model. In another study, Nascimento et al. (28) found that nutrition counseling among adolescent athletes led to changes in body composition characterized by increases in fat-free mass without marked reductions in fat mass. The simultaneous increase in fat-free mass and decrease in fat mass and body fat percentage observed in this study may be attributed to the implementation of the intervention in a general school population and the provision of individualized nutrition counseling throughout the process. Overall, the increases in fat-free mass, fat-free mass percentage, and body water components, together with significant reductions in fat mass and body fat percentage, indicate favourable metabolic effects of the intervention. These findings suggest that school-based education, monitoring, and individualized counseling provided by a school dietitian can yield positive short-term improvements in adolescents' body composition and represent a critical component of school nutrition services aimed at promoting adolescent health.

Limitations

This study has several limitations. First, the intervention was implemented in a single public high school, which may limit the generalizability of the findings to different school settings or regions. Second, physical activity levels and dietary intake were not quantitatively assessed, making it difficult to isolate the effects of the intervention from other lifestyle factors. Additionally, the short duration of the intervention may have limited the ability to observe long-term behavioural changes, particularly in eating habits such as breakfast consumption. The lack of parental involvement may have reduced the potential influence of the intervention on home-based eating behaviors. Despite these limitations, the study provides valuable evidence on the role of school dietitians in improving adolescents' nutrition knowledge, anthropometric indicators, and body composition.

CONCLUSION

Overall, the intervention improved students' nutrition knowledge, led to favourable changes in body composition, and resulted in improvements in anthropometric indicators, particularly among girls. However, the limited impact on eating behaviors, such as breakfast consumption, suggests that increased knowledge may not translate into immediate behavioural change. These findings highlight the value of school-based nutrition education and individualized counseling delivered by a school dietitian, while also indicating that longer-term and multi-component interventions may be necessary to achieve sustained behavioural changes in adolescents.

Based on the findings of this study, the

expansion and institutional support of dietitian employment within school health services should be considered an important priority. The presence of a school dietitian not only enables the delivery of nutrition education but also facilitates individualized counseling and regular monitoring of students' nutritional status, thereby contributing to the development and sustainability of healthy lifestyle behaviors among students.

Conflict of interest: The authors declare that they have no conflict of interest.

Financial Support: This study was supported by the Erciyes University Scientific Research Projects Coordination Unit (BAP) as a master's thesis project (Project No: 14195).

Ethics Approval: For the study, ethical approval was obtained from the Erciyes University Social and Human Sciences Ethics Committee (Application No: 345, Date: August 27, 2024), and research implementation permission was granted through the Research Application Permission Application and Evaluation Module of the Ministry of National Education.

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