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Evaluating the usefulness of the Mediterranean Diet Quality Index (KIDMED) in assessing eating habits and nutritional status among preschool children

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Abstract

Background. Establishing healthy eating habits during early childhood is essential for long-term health and prevention of non-communicable diseases. The Mediterranean Diet (MD) is recognized as one of the healthiest dietary patterns worldwide. This study aimed to evaluate dietary habits and adherence to the MD among preschool children using the Mediterranean Diet Quality Index (KIDMED) and to explore the influence of parental sociodemographic and anthropometric factors on children's dietary adherence.

Methods. This cross-sectional study included 114 preschool children (24-60 months) from Sarajevo and Orašje, Bosnia and Herzegovina. Data were collected using a modified KIDMED questionnaire, assessing dietary habits and general sociodemographic information. Children's anthropometric parameters were obtained from medical records, and Body Mass Index (BMI) z-scores were calculated using WHO AnthroPlus. Descriptive statistics, group comparisons, and multiple linear regression were performed in RStudio (version 2024.12.0+467), with statistical significance set at $p<0.05$.

Results. The mean KIDMED score was 5.17±2.98 (median 6, interquartile range IQR 3-8), indicating moderate adherence to the MD. Thirty-four percent of children had a poor-quality diet, 36.8% required improvement, and 28.9% showed optimal adherence. Fruit and vegetable consumption was high, but intake of fish, whole grains, nuts, and olive oil was low. Parental education, employment, economic status, and BMI were not significantly associated with children's KIDMED scores (Regression correlation coefficient=0.249, p=0.433).

Conclusions. Preschool children demonstrated moderate adherence to the MD, with clear signs of dietary westernization. Early, family-centered nutritional education is essential to promote and maintain healthy eating habits from early childhood.

Key words

- Mediterranean diet
- KIDMED Index
- preschool children
- dietary habits
- parental influence

INTRODUCTION

Providing optimized nutrition during the initial 1,000 days, spanning from conception through the second birthday, is essential for promoting healthy development [1, 2]. Establishing an appropriate dietary pattern during this early period forms the foundation for a diverse and balanced diet in the future. The overconsumption of high glycemic index foods, excessive intake of red meat and fast food, combined with insufficient consumption of fruits, vegetables, legumes, whole grains, and nuts, as well as low physical activity and prolonged sedentary behavior, plays a crucial role in the onset of obesity and related health conditions [3].

The features of the Mediterranean Diet (MD), widely recognized as one of the healthiest dietary patterns, are essential in preventing obesity, arterial hypertension, cardiovascular diseases, metabolic syndrome, diabetes, dyslipidemia, neurodegenerative diseases, malignan-

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cies, and other health conditions [4-7]. Adherence to the MD during pregnancy has been shown to positively influence the health of infants and children [4].

The MD is characterized by high consumption of diverse fruits, vegetables, whole grains, legumes, nuts, and seeds; moderate to high intake of fish and seafood; moderate consumption of poultry and dairy products; and low intake of red meat, processed foods, fast food, and sweets. Olive oil serves as the primary source of fat in this dietary pattern [4-6, 8, 9]. The MD has been demonstrated to improve blood lipid profiles, enhance insulin sensitivity, support endothelial and antithrombotic function, and exhibit anti-inflammatory and antioxidant properties. These effects contribute to the prevention of chronic non-communicable diseases, the extension of life expectancy, and the improvement of overall quality of life [5, 10-12].

Pereira-da-Silva and colleagues referenced several studies indicating a negative correlation between adherence to the MD and overweight in children, highlighting both short-term and long-term health implications [13].

The widespread issue of childhood obesity has been acknowledged as a global pandemic [14]. The prevalence of childhood obesity varies depending on the criteria used to define it, socioeconomic factors, dietary habits, levels of physical activity, and other contributing determinants.

According to the World Health Organization (WHO), the global prevalence of obesity in 2016 had tripled compared to 1975. WHO reported that 39 million children under the age of five were overweight or obese in 2020, and 340 million (18%) of children and adolescents aged 5-19 years were overweight or obese in 2016 [15]. Ukraine had the highest prevalence of overweight among European countries for children aged 0 to 6, with 27.8% of boys and 27.3% of girls affected, while Bosnia and Herzegovina also exhibited notable rates, with 17.1% of boys and 17.7% of girls being overweight [16]. This underscores a global trend of continuous growth in overweight and obesity across all age groups and countries. More than 60% of children who are overweight before puberty remain overweight in early adulthood [17].

Over the years, various indices have been developed to assess diet quality in accordance with dietary guidelines. This study focuses on the Mediterranean Diet Quality Index, designed to evaluate the adherence of children and young people to the MD. The index was originally developed by Serra-Majem *et al*. (2004 version) and later modified by Altavilla *et al*. (2019 version) [18, 19].

Several studies indicate that the Mediterranean Diet Quality Index (KIDMED) is a simple and practical tool for assessing the adequacy of children's dietary habits and their association with nutritional status. In routine medical practice, the assessment of children's eating habits, including the use of the KIDMED questionnaire, often receives insufficient attention. Buja *et al*. (2024) investigated adherence to the MD among Italian children aged 10-11 years using the KIDMED Index and found that higher screen-time and media use were significantly associated with lower diet quality. The study highlighted the early influence of lifestyle habits on nutritional behaviors in childhood. These findings emphasize the importance of early dietary screening and health education to support adherence to the MD [20].

Tambalis *et al*. (2024) analyzed dietary habits in a large national sample of over 177,000 Greek schoolchildren using the KIDMED Index, revealing a clear decline in MD adherence with increasing age. The results indicated that younger children tend to have healthier eating patterns than adolescents. This large-scale study reinforces the value of KIDMED as a tool for monitoring dietary patterns across childhood and adolescence [21].

Bober and Gaszyńska (2025) validated the Polish version of the updated KIDMED 2.0 questionnaire among children and adolescents aged 10-18 years. The study demonstrated satisfactory psychometric properties and confirmed the tool's reliability and applicability for assessing adherence to the MD in youth populations. This supports the broader use of KIDMED 2.0 as a standardized measure for evaluating diet quality in pediatric and adolescent groups [22].

The aim of this study was to assess the dietary habits and nutritional status of the participants and to explore the utility of the KIDMED Index in evaluating their dietary patterns and nutritional status.

METHODS

This cross-sectional study included a total of 152 preschool children and their parents. Of these, 38 parents did not complete the questionnaires and were excluded from further analysis, resulting in a response rate of 78%. All children were in good health and under regular medical supervision at the Sarajevo Health Center and the Orašje Health Center.

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Ethical Committee of the Health Center of Canton Sarajevo (approval n. 01-6-258/2), and written informed consent was obtained from parents prior to their children's participation.

Parents voluntarily, independently, and anonymously completed a questionnaire adapted for this study, a modified and updated KIDMED questionnaire by Altavilla and Caballero-Pérez (2019), consisting of 16 questions on children's dietary habits. According to the scoring system proposed by the original authors, a positive answer to each item was scored +1, and a negative answer -1.

The total score ranged from -4 to +12, categorized as follows:

- 0-3 points: poor adherence to the MD;
- 4-7 points: average adherence;
- ≥8 points: good adherence to the MD [19].

In addition to dietary questions, the questionnaire included general sociodemographic and anthropometric data: child's age and gender, parental age, parental educational level, family employment and economic status, child's birth weight, current body weight and height, parental Body Mass Index (BMI), duration of

breastfeeding, and age at the introduction of complementary feeding. Children's body weight (kg) and height/length (cm) were extracted from health records collected during routine pediatric checkups as part of vaccination visits, within one month prior to the study. BMI was calculated for each child, and BMI z-scores were derived using the WHO AnthroPlus software [23]. Based on the WHO child growth standards (2006, for ages 0-5 years) [24], nutritional status was categorized as follows: underweight, BMI z-score <-2 SD; normal body weight, BMI z-score from -2 SD to <+1 SD; at risk of overweight, BMI z-score >+1 SD to <+2 SD; overweight, BMI z-score ≥+2 SD to <+3 SD; obese, BMI z-score ≥+3 SD.

Parents self-reported their body weight and height, and BMI was calculated and categorized according to the standard adult classification: underweight (<18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (≥30 kg/m²). All data were analyzed using RStudio (version 2024.12.0+467). Descriptive statistics were applied to summarize the data: categorical variables were presented as absolute (N) and relative frequencies (%), while continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on data distribution.

Normality of continuous variables was assessed using the Shapiro-Wilk test. Differences between groups (boys *vs* girls) were evaluated using the independent samples t-test for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables. Associations between categorical variables were analyzed using the Chi-square test or Fisher's exact test when appropriate.

To explore the potential influence of parental sociodemographic and anthropometric factors on children's adherence to the MD (KIDMED score), a multiple linear regression analysis was performed. Predictor variables included parental BMI (mother and father), parental age, education level, employment status, family economic status, and parent completing the questionnaire. Statistical significance was set at $p<0.05$ for all analyses.

RESULTS

A total of 114 children were included in the study, of whom 54 (47.4%) were girls and 60 (52.6%) were boys. The mean age of the children was 41.57±12.1 months, ranging from 24 to 60 months. Girls were slightly older than boys (43.6±12.2 *vs* 39.7±11.8 months, p=0.044) (*Table 1*).

The majority of questionnaires were completed by mothers (76.3%), while fathers completed 23.7%. The mean age of mothers was 32.6±5.2 years, and of fathers 34.5±4.7 years, with no statistically significant difference between parents of boys and girls (p=0.372 and p=0.054, respectively). Regarding educational level,

Table 1
General information about participants

		Total	Girls	Boys	p
	Total N (R%)	**114 (100%)**	**54 (47.4%)**	**60 (52.6%)**	
Age of children (months)		41.57±12.1	43.6±12.2	39.7±11.8	0.044
Respondent	Mother	87 (76.3%)	41 (75.9%)	46 (76.7%)	0.926
	Father	27 (23.7%)	13 (24.1%)	14 (23.3%)	
Age of respondent (years)	Mother	32.6±5.2	32.4±5.3	32.8±5.0	0.372
	Father	34.5±4.7	36.0±4.3	33.1±4.8	0.054
Educational level	Elementary school	4 (3.5%)	1 (1.9%)	3 (5.0%)	0.164
	High school	42 (36.8%)	23 (42.6%)	19 (31.7%)	
	College	10 (8.8%)	5 (9.3%)	5 (8.3%)	
	University	52 (45.6%)	20 (37.0%)	32 (53.3%)	
	Master's or PhD	6 (5.3%)	5 (9.3%)	1 (1.7%)	
Employment status of parent which gave information	Unemployed	28 (24.6%)	13 (24.1%)	15 (25.0%)	0.909
	Employed	86 (75.4%)	41 (75.9%)	45 (75.0%)	
Household income	Below average	15 (13.2%)	6 (11.1%)	9 (15.0%)	0.814
	Average	36 (31.6%)	17 (31.5%)	19 (31.7%)	
	Above average	63 (55.3%)	31 (57.4%)	32 (53.3%)	
BMI mother	Normal body weight	78 (68.4%)	42 (77.8%)	36 (60.0%)	0.084
	Overweight	30 (26.3%)	9 (16.7%)	21 (35.0%)	
	Obese	6 (5.3%)	3 (5.6%)	3 (5.0%)	
BMI father	Normal body weight	44 (38.6%)	19 (35.2%)	25 (41.7%)	0.676
	Overweight	50 (43.9%)	24 (44.4%)	26 (43.3%)	
	Obese	20 (17.5%)	11 (20.4%)	9 (15.0%)	

N: frequency; R: row percentage; BMI: Body Mass Index, p: level of statistical significance.

45.6% of respondents had completed university, 36.8% high school, 8.8% college, 5.3% held a Master's or PhD degree, and 3.5% had only elementary education. There were no statistically significant gender differences in parental education (p=0.164). Most responding parents were employed (75.4%), while 24.6% were unemployed (p=0.909). More than half of families (55.3%) reported above-average household income, 31.6% average, and 13.2% below-average income, with no significant differences between parents of boys and girls (p=0.814).

Analysis of maternal BMI showed that 68.4% of mothers had normal body weight, 26.3% were overweight, and 5.3% were obese. Among fathers, 38.6% had normal weight, 43.9% were overweight, and 17.5% were obese. Differences in BMI categories between parents of boys and girls were not statistically significant (p=0.084 for mothers; p=0.676 for fathers).

The mean body weight of all participants was 16.9±3.5 kg, with girls showing slightly higher average weight than boys (17.2±3.6 kg *vs* 16.6±3.4 kg), though this difference was not statistically significant (p=0.088). The mean height was 101.4±10.4 cm, with no significant difference between girls (102.5±10.8 cm) and boys (100.5±10.1 cm, p=0.319) (*Table 2*).

The mean BMI for the entire group was 16.4±2.8 kg/m², and the mean BMI z-score was 0.91±1.50, without significant gender differences (p=0.308 and p=0.946, respectively). The average birth weight of the children was 3,345±587 g, similar between girls (3,377±502 g) and boys (3,316±658 g, p=0.485).

Analysis of breastfeeding showed that the median duration of breastfeeding was 6 months (IQR: 2-12 months). Introduction of complementary feeding after the fourth month of life was reported in 87 children (76.3%). The analysis of food intake based on the KIDMED Index is presented in *Figure 1*.

Analysis of individual KIDMED items revealed that 98.2% of children consumed at least one fruit daily, while 62.3% consumed two or more types of fruit each day. A very high proportion (97.4%) reported eating fresh or cooked vegetables once daily, and 51.8% ate vegetables more than once per day. Regular fish consumption (≥2-3 times per week) was reported by only 17.5% of children. More than one-third of participants (37.7%) visited fast-food restaurants more than once weekly. In contrast, 86.8% reported eating legumes (pulses) more than once per week. Daily consumption of whole-grain pasta or rice was reported by 34.2%, and 32.5% ate whole-grain cereals or bread for breakfast. Nuts were consumed regularly (≥2-3 times per week) by 37.7%, while olive oil was used at home by 38.6% of families. Breakfast skipping was reported by 32.5% of children. The majority (86.0%) consumed a dairy product (milk or yogurt) for breakfast, but 63.2% also reported eating commercially baked goods or pastries for breakfast. Slightly more than half (51.8%) consumed two yogurts and/or 40 g of cheese daily. Frequent consumption of sweets and candies (several times per day) was observed in 43.9% of children. Overall, the findings indicate moderate adherence to the Mediterranean dietary pattern among the surveyed preschool children.

The mean KIDMED Index score was 5.17±2.98, while the median value was 6 (IQR: 3-8) (*Figure 2*). Based on the KIDMED classification, 39 children (34.2%) had a very low-quality diet, 42 (36.8%) required improvement of their dietary pattern to align with the Mediterranean model, and 33 (28.9%) demonstrated an optimal MD. While fruit and vegetable consumption was high, suggesting awareness of healthy food choices, the low frequency of fish intake and limited consumption of whole-grain foods and olive oil point to deviations from traditional Mediterranean habits. The high proportion of children consuming fast food, pastries for breakfast, and sweets several times per day reflects the growing influence of Western dietary patterns. These results underline the need for early nutritional education and family-based interventions to reinforce healthy eating habits and improve adherence to the MD from early childhood.

A multiple linear regression model was constructed to examine the influence of parental sociodemographic and anthropometric characteristics on children's adherence to the MD, expressed through the KIDMED Index. The independent variables included parental BMI (mother and father), parental age, level of education, employment status, family material status, and which parent completed the questionnaire (mother or father).

The overall model did not reach statistical significance ($F(7,106)=1.004$, p=0.433), with a correlation coefficient of R=0.249 and an explained variance of 6.2% ($R^2=0.062$; adjusted $R^2=0.000$). This indicates a weak and statistically non-significant relationship between the examined parental factors and the children's KIDMED Index. None of the predictors demonstrated a significant individual effect on children's adherence to the MD, suggesting that within this cohort, parental

Table 2
Anthropometric characteristics of the children

	Total		Girls		Boys		p
	Mean	SD	Mean	SD	Mean	SD	
Weight (kg)	16.9	3.5	17.2	3.6	16.6	3.4	0.088
Height (cm)	101.4	10.4	102.5	10.8	100.5	10.1	0.319
BMI (kg/m²)	16.4	2.8	16.5	2.9	16.4	2.7	0.308
BMI z-score	0.91	1.50	1.01	1.58	0.82	1.43	0.946
Mass at birth (g)	3,345	587	3,377	502	3,316	658	0.485

SD: standard deviation; BMI: Body Mass Index. BMI z score – Body Mass Index z-scores were calculated based on World Health Organization growth standards.

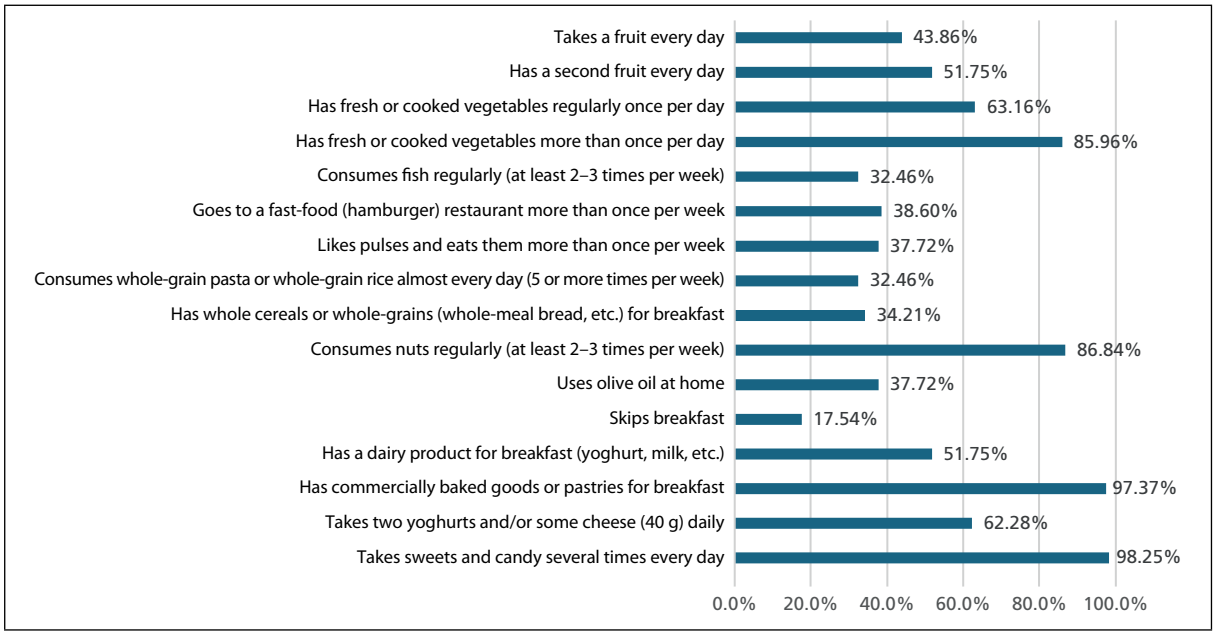

Figure 1
Food intake according to the KIDMED questionnaire.
KIDMED: Mediterranean Diet Quality Index.

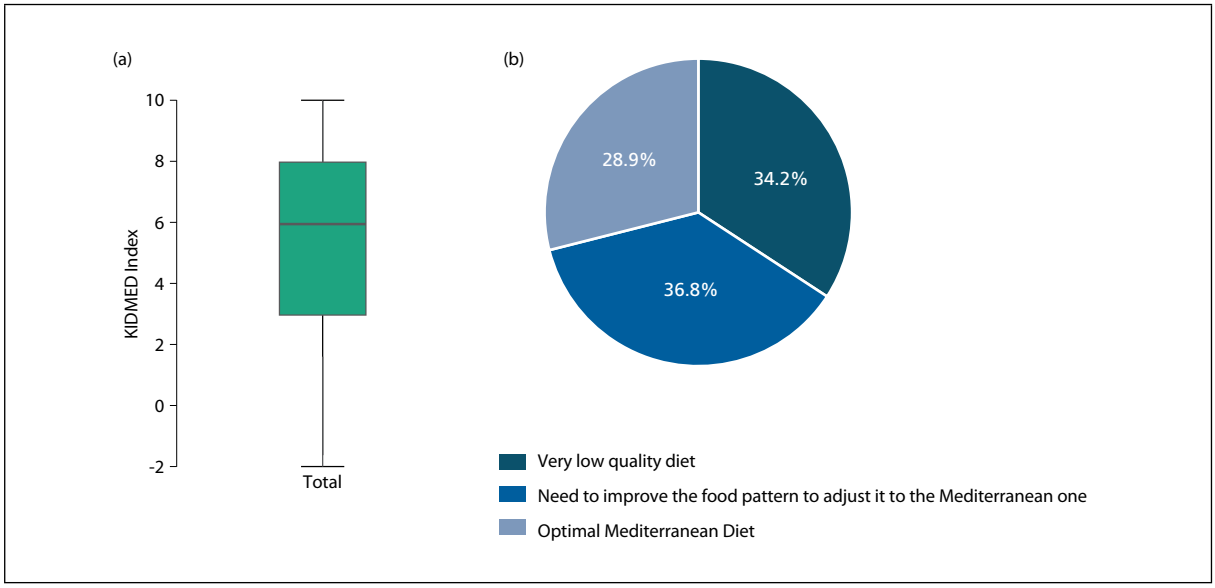

Figure 2
KIDMED Index value (a) and classification (b).

demographic, educational, economic, or BMI characteristics did not substantially influence dietary quality.

DISCUSSION

The mean KIDMED score observed in this study (5.17±2.98) indicates a moderate adherence to the MD among preschool children. These findings are comparable to those reported in Greek, Spanish, and Italian preschool populations, where mean scores typically range from 4.5 to 6.5 points [13, 22, 23, 25-27]. Similar to previous studies, the present research highlights a high intake of fruits and vegetables but insufficient consumption of fish, whole grains, nuts, and olive oil – core components of the traditional Mediterranean pattern [6, 12, 18, 19]. This imbalance suggests a gradual shift from traditional dietary habits toward more Westernized eating behaviors, characterized by greater consumption of fast food, sweets, and processed bakery products [3, 28].

Parental influence is considered a key determinant of children's dietary behavior, yet in this study, no significant association was found between parental education, employment, economic status, or BMI and the KIDMED Index. These findings align with those of

Bober and Gaszyńska [22] and Pereira-da-Silva *et al*. [13], who also observed limited predictive power of sociodemographic variables in explaining MD adherence in preschool children. However, other studies have reported mixed evidence – some suggesting that higher parental education and healthier parental BMI are associated with better KIDMED scores [8, 26, 28], while others attribute dietary differences primarily to environmental and cultural factors such as food availability and family mealtime practices [26, 30]. The weak correlation found in the current regression model ($R=0.249$, $R^2=0.062$) supports the notion that structural and environmental determinants may outweigh individual parental characteristics in shaping dietary habits during early childhood.

When compared with recent large-scale studies, the proportion of children demonstrating optimal adherence (28.9%) is relatively consistent. Tambalis *et al*. [21] reported similar results in over 170,000 Greek schoolchildren, while Buja *et al*. [20] found comparable rates of moderate to high adherence among Italian children. Conversely, lower adherence levels have been observed in non-Mediterranean European populations, suggesting that geographical and cultural proximity to the Mediterranean basin still offers a modest protective influence [23, 29].

The observed trends underscore the urgent need for early nutrition education that promotes the principles of the MD – particularly regular fish consumption, the use of olive oil, and the inclusion of whole grains and nuts in daily meals. Interventions targeting both parents and preschool institutions may be especially effective, as the early years represent a critical period for establishing long-term dietary preferences [1, 2, 31]. Consistent with global recommendations [15, 17], the findings reinforce that public-health strategies should focus not only on nutrient adequacy but also on dietary patterns that support lifelong metabolic and cardiovascular health.

Despite the valuable insights provided, this study has certain limitations, including its cross-sectional design and reliance on parent-reported dietary data, which may introduce recall bias. Nevertheless, the findings contribute to the limited body of evidence on MD adherence among preschool children in Southeast Europe. The observed patterns highlight both strengths – such as regular fruit and vegetable intake – and weaknesses, notably low fish and whole-grain consumption. Future research should explore longitudinal relationships between early dietary patterns, parental behaviors, and later health outcomes, as well as evaluate the effectiveness of preschool- and family-based nutrition interventions.

CONCLUSIONS

The study showed moderate adherence to the MD among preschool children, with high fruit and vegetable intake but low consumption of fish, whole grains, nuts, and olive oil. One-third of participants had poor dietary quality, while only about one-quarter achieved optimal adherence. Parental sociodemographic and anthropometric factors did not significantly influence children's KIDMED scores. The KIDMED Index proved to be a simple and effective screening tool for assessing dietary habits and identifying deviations from the Mediterranean pattern in preschool children of the Bosnian population. These findings emphasize the importance of early nutritional education to promote healthy eating habits from early childhood.

Conflict of interest statement

None.

Authors' contributions

Conceptualization: AJ; data collection: LS and ES; data analysis: AJ; writing-original draft preparation (Introduction): DŠ and ES; writing-discussion and interpretation: AJ and LS; review and final editing: SDM. All Authors have read and approved the final manuscript.

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