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ORIGINAL ARTICLE

ADHERENCE TO THE MEDITERRANEAN DIET AMONG ADOLESCENTS: A COMPARISON OF TWO VERSIONS OF KIDMED

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ABSTRACT

Background. Although the Mediterranean diet (MD) is recognized for its protective effect against cardiometabolic risk, adherence to this diet tends to decrease among adolescents. The KIDMED index used to assess adherence to MD in children and adolescents has not undergone a formal revision since its initial publication in 2004.

Objective. To assess adherence to the MD using both the original (2004) and updated (2019) versions of KIDMED, in the same sample of adolescents.

Methods. A cross-sectional study was conducted with 129 adolescents. Anthropometric measurements included body weight and height to calculate the body mass index (BMI) and BMI-z-score, and waist circumference (WC) were taken, and physical activity levels were assessed using the short version of the IPAQ questionnaire. Adherence to the MD was assessed using the original version (OV, 2004) and updated versions (UV, 2019) of KIDMED.

Results. Adherence to MD was generally moderate, with a mean score of 5.88 ± 3.22 according to the (OV) and 5.61 ± 3.05 according to the (UV). The latter led to an increase in the proportion of adolescents with low adherence (30.2% vs. 22.5%) and a decrease in those classified as having good adherence (25.6% vs. 28.7%). Agreement between the two classifications was moderate. Significant differences were observed for several items, including fruit consumption, breakfast quality, frequenting fast-food restaurants, and consumption of sugary products.

Conclusion. The UV of KIDMED in light of current nutritional recommendations, leads to a more demanding assessment of eating behaviors and better identification of at-risk dietary patterns in adolescents, without altering the OV structure.

Keywords: *adolecents, Mediterranean diet, KIDMED, revision, physical activity, anthropometry, ultra-processed foods*

INTRODUCTION

Adolescence is a pivotal period in the life cycle, marked by significant biological, psychological, and behavioral changes that have a lasting impact on health in adulthood [1]. During this phase, adopting healthy eating habits and a balanced lifestyle plays a crucial role in preventing non-communicable diseases in adulthood, including obesity, type 2 diabetes, and cardiovascular diseases [1, 2]. However, in many countries, particularly those undergoing nutritional transition, adolescent behaviors are increasingly characterized by sedentary lifestyles and high consumption of energy-dense foods, sugars, saturated fats, and ultra-processed products [3, 4]. The globally applicable healthy eating model proposed in 2019 by the EAT-Lancet Commission is largely based on the Mediterranean diet [5], thus reinforcing the international promotion of this dietary model as one of the most beneficial for health [6, 7].

In children and adolescents, good adherence to this dietary model is associated with a more favorable weight and better nutritional balance [8, 9]. However, several studies conducted with children and adolescents have reported a gradual decline in adherence to this diet, observed recently even in Mediterranean countries, linked to increasing sedentary lifestyles and the adoption of Western-style eating habits. A systematic review has indeed shown that adherence to this diet is often low among young people, suggesting an erosion of traditional eating habits in this age group [10]. Other recent studies have also confirmed a low prevalence of good adherence, interpreted as a transition to a Westernized diet [11]. Furthermore, the literature indicates the coexistence of less active lifestyles and Western eating habits with

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lower adherence to the Mediterranean diet among adolescents [12].

The KIDMED questionnaire, developed in 2004 by Serra-Majem et al. [13] to assess adherence to the Mediterranean diet among young people, is one of the most widely used tools in pediatric nutritional epidemiology. It allows for the assessment, through a series of simple questions, of the extent to which children's and adolescents' eating habits conform to the principles of the Mediterranean diet. However, the nutritional context in which the KIDMED was designed, characterized by a more limited availability of ultra-processed foods and less exposure to industrial products, differs significantly from that observed today [13, 14].

Although several authors have proposed adaptations to the KIDMED test to better reflect the evolution of nutritional recommendations and the adolescent food environment, it has not undergone any official revision since its initial publication in 2004 [13]. Recent recommendations address aspects not included in the original version of KIDMED, including carbohydrate quality, limiting free sugars, and the importance of reducing consumption of ultra-processed foods [4, 15].

The overestimation of dietary quality that can result from the use of certain traditional indicators of adherence to the Mediterranean diet, particularly among children and adolescents, has been highlighted by several authors [15]. In fact, this overestimation is associated with the fact that food processing and the overall nutritional quality of the diet are insufficiently considered. Other authors have also emphasized the need to integrate more qualitative dimensions of the Mediterranean model and to take into account its evolution in contemporary dietary contexts [16].

Indeed, a positive association between adherence to the Mediterranean diet, physical activity levels, and body composition has been reported in young people by numerous studies. Other studies have highlighted the link between physical fitness and physical activity and better adherence to the Mediterranean diet among adolescents [17], as well as a correlation between Mediterranean-style eating behaviors and better levels of physical fitness and well-being in children and adolescents [18, 19]. Similarly, a literature review generally supports positive associations between adherence to the Mediterranean diet and healthy lifestyle habits, including physical activity [20].

This study aims to examine the extent to which an updated interpretation of the KIDMED, based on a more rigorous reading aligned with contemporary nutritional recommendations while retaining the conceptual structure and items of the original questionnaire, is relevant and can influence the assessment of adherence to the Mediterranean diet among adolescents. Furthermore, this updated version of the KIDMED (2019) is not a new validated instrument but rather a methodological reinterpretation of the original KIDMED, offered solely for comparative purposes to assess the impact of this update on the classification of eating behaviors [15]. In this context, this study aims to compare classifications of adherence to the Mediterranean diet using the original KIDMED questionnaire published in 2004, and its updated version published in 2019, applied to the same group of adolescents, in order to analyze the methodological impact of the updated interpretation on the assessment of eating behaviors.

MATERIAL AND METHODS

Study population

This cross-sectional study was conducted during the 2024/2025 school year with 129 adolescents aged 14 to 18 years, enrolled in a public secondary school in the city of El Jadida, Morocco. The study population included boys and girls recruited from the selected school after obtaining the necessary authorizations from the relevant educational authorities. Adolescents enrolled at the school, who agreed to participate, and who were present at the time of data collection were included in the study. However, students who were absent during data collection, those following special diets, those with chronic illnesses, and those whose questionnaires were incomplete or did not allow for an assessment of adherence to the Mediterranean diet were excluded from the study.

Assessment of adherence to the Mediterranean diet

Adherence to the Mediterranean diet was assessed using the KIDMED questionnaire, developed by Serra-Majem et al. (2004) for children and adolescents [13]. This tool, widely used in studies of young populations, assesses both adherence to the Mediterranean diet and certain general eating habits, such as skipping breakfast or consuming fast food. It comprises 16 closed-ended questions, answered with yes or no. Items with a positive connotation are scored +1, while items with a negative connotation are scored -1, resulting in a total score ranging from -4 to +12. According to initial recommendations, this score allows participants to be classified into three levels of adherence: low (≤ 3), medium (4 to 7), and high (≥ 8).

Dietary data were collected using a questionnaire administered to adolescents during the survey. Based on the responses obtained, KIDMED scores were calculated according to both the original 2004 version and the updated 2019 version, allowing both versions to be applied to the same sample of adolescents. This approach made it possible to examine the extent to which the changes introduced in the updated version

Table 1. Main differences between the original version (2004) and the updated version (2019) of the KIDMED questionnaire

Domain/ element concerned	KIDMED 2004	KIDMED 2019 update	Relevance for the comparison performed
Daily fruit consumption	Included fruit or natural fruit juice in the first item	Proposes removing the choice: «or natural fruit juice» and only keep whole fruit	Makes the updated version stricter and may lower the score where juice was previously counted as equivalent to whole fruit
Pasta/rice consumption	Positive criterion based on frequent consumption of pasta or rice	Adds the requirement that the pasta/rice be whole grain	Introduces a quality criterion, not just frequency
Consuming cereals or cereal products at breakfast	Positive article for the consumption of cereals or cereal products at breakfast	Specifies that they must be whole grain cereals/whole grains at breakfast	The assessment of breakfast is strengthened by distinguishing between refined and whole grains
Skipping breakfast	The initial wording «does not eat breakfast»	Has been reformulated as «skips breakfast»	This clarifies the wording and makes it easier to interpret
Purpose of the revision	Original 16-item instrument designed to raise awareness among young people about the benefits of the Mediterranean diet	Targeted revision of certain items, without a complete overhaul of the tool	This allows the reader to understand that the comparison between the versions is based primarily on a limited number of modified items

This table is compiled based on Serra-Majem et al. (2004) [13] and Altavilla and Caballero-Pérez (2019) [15].

could influence the assessment and classification of adherence to the Mediterranean diet.

To facilitate understanding of the comparison between the two versions of the KIDMED index, Table 1 summarizes the main differences between the original KIDMED questionnaire (2004) and its updated version (2019), compiled based on the findings of Serra-Majem et al. [13] and Altavilla and Caballero-Pérez [15].

In the present study, both versions were applied to the same sample of adolescents to examine the potential impact of the changes introduced on the assessment and classification of adherence to the Mediterranean diet.

Anthropometric measurements

Anthropometric variables were measured for each adolescent according to the World Health Organization (WHO) standards and procedures [21, 22]. Body weight was recorded in lightly dressed, barefoot participants using a calibrated electronic scale with an accuracy of 0.1 kg, in accordance with international recommendations for nutritional surveys in children and adolescents. Height was measured using a wall-mounted height chart with an accuracy of 0.1 cm. Adolescents were standing barefoot with legs straight, arms relaxed at their sides, heels together, and their head positioned in the Frankfort plane and in contact with the vertical support, according to standardized anthropometric protocols [21]. Body mass index (BMI), also known as the Quetelet index, was calculated by dividing body weight (kg) by height squared (m^2), in accordance with international definitions of general obesity [21]. To account for age and sex, age-specific BMI z-scores were calculated from WHO references using WHO AnthroPlus software (version 1.0.4), a tool recommended for assessing growth and weight status in children and adolescents worldwide [24].

Waist circumference was measured standing with a non-stretch measuring tape placed without compression midway between the last rib and the anterior superior iliac crest, on the mid-axillary line, at the end of a normal expiration, in accordance with WHO recommendations for assessing central adiposity [22]. This measure is recognized as a relevant indicator of cardiometabolic risk in adolescents [23, 22].

Physical activity level assessment

Physical activity (PA) levels were assessed in the participating adolescents using the short version of the IPAQ questionnaire [25], which provides information on physical activities performed in the last seven days. According to the IPAQ protocol classification criteria, participants were divided into three PA levels: low, moderate, and high [26, 27].

Anthropometric and physical activity data were recorded for the purpose of describing the study sample and were not the primary methodological element in the comparison between the two versions of the KIDMED.

The level of physical activity (PA) in the participating adolescents was assessed using a short

version of the IPAQ questionnaire [25], which provides information on physical activity performed in the last seven days.

Statistical analyses

Descriptive statistics were used to analyze the data on sociodemographic and anthropometric characteristics, as well as the physical activity level of the adolescents included in the study. Quantitative variables were expressed as mean ± standard deviation (SD), while qualitative variables were presented as counts and percentages.

Means KIDMED scores obtained with the 2004 and 2019 versions, administered to the same sample of adolescents, were compared using a paired-data test. Depending on the data distribution, either a paired Student's t-test or the Wilcoxon signed-rank test was used. Item-by-item comparisons between the two versions of the KIDMED questionnaire were performed using McNemar's test for paired data.

The consistency between the classifications obtained with the two versions of the KIDMED questionnaire was assessed using Cohen's *kappa* coefficient. The interpretation of *kappa* values was performed according to the classification proposed by Landis and Koch [28], with weak agreement for values < 0.20, acceptable agreement between 0.21 and 0.40, moderate agreement between 0.41 and 0.60, substantial agreement between 0.61 and 0.80, and near-perfect agreement above 0.80. The comparison of Mediterranean diet adherence categories obtained from the 2004 and 2019 versions of the KIDMED questionnaire was examined using the Stuart-Maxwell test for paired multinomial data. The threshold for statistical significance was set at $p < 0.05$.

Ethical considerations

The study was conducted after obtaining authorization from the relevant educational authorities, namely the Regional Academy of Education and the school administration. The study was conducted in accordance with the ethical principles outlined in the World Medical Association's Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Participants [29] . Participation was voluntary. Before data collection, the adolescents and their parents or legal guardians were informed of the study's objectives and procedures, as well as their right to withdraw at any time. All participants gave their oral consent before being included in the sample. The anonymity and confidentiality of the information collected were strictly guaranteed throughout the study.

RESULTS

General characteristics of the adolescents studied

The participants' sociodemographic and anthropometric characteristics, as well as the level of physical activity are presented in Table 2. The adolescents included in the study have a mean age of 15.3 ± 1.8 years, the majority were girls representing 66.7% of the sample. Their mean body mass index (BMI) was 21.9 ± 3.6 kg/m²; the mean BMI z-score was 0.32 ± 0.98, and mean waist circumference was 74.8 ± 10.1 cm. Regarding physical activity level, 44.2% of adolescents reported a low level, 40.3% a moderate level, and 15.5% a high level.

Adherence to the Mediterranean diet

The distribution of adolescents according to their level of adherence to the Mediterranean diet, assessed using both the original (2004) and recent (2019) versions of KIDMED, is presented in Table 3.

Table 2. Sociodemographic and anthropometric characteristics and level of physical activity

Variables, total (N = 129)	Values mean ± SD or n (%)
Age (yrs), mean ± SD	15.3 ± 1.8
Sex, n (%)	
Girls	86 (66.7)
Boys	43 (33.3)
BMI (kg/m²), mean ± SD	21.9 ± 3.6
BMI z-score, mean ± SD	0.32 ± 0.98
Waist circumference (cm), mean ± SD	74.8 ± 10.1
Physical acrivity level, n (%)	
Low	57 (44.2)
Moderate	52 (40.3)
High	20 (15.5)

BMI – body mass index; SD – standard deviation.

Table 3. Mean KIDMED scores distribution of Mediterranean diet adherence levels according to the 2004 and 2019 versions of the KIDMED questionnaire

Versions of KIDMED	KIDMED score mean ± SD	Adherence (%)		
		Low	Medium	High
Original version (2004)	5.88 ± 3.22	22.5	48.8	28.7
Updated version (2019)	5.61 ± 3.05	30.2	44.2	25.6

SD – standard deviation; Adherence categories: ≤ 3 = low adherence; 4-7 = medium adherence; ≥ 8 = high adherence.

As shown in Table 3, the mean KIDMED adherence scores were 5.88 ± 3.22 using the original 2004 version and 5.61 ± 3.05 with the updated 2019 version, corresponding in both cases to moderate adherence to the Mediterranean diet. The adherence categories were defined as follows: low (≤ 3), medium (4–7), and high (≥ 8). This table shows that, compared to the original 2004 version of KIDMED, the recent version leads to an increase in the proportion of adolescents classified as having low adherence (30.2% vs. 22.5%) and slight decreases in the proportions of adolescents classified as having good adherence (25.6% vs. 28.7%) and medium adherence (44.2% vs. 48.8%).

Table 4 presents the cross-classification of adherence levels to the Mediterranean diet obtained with the two versions, 2004 and 2019, of the KIDMED questionnaire administered to the same sample of adolescents. In total, 83 out of 129 adolescents (64.3%) were classified in the same adherence category by both versions, while 46 (35.7%) were reclassified into a different category. The observed reclassifications mainly involved shifts between adjacent categories. The Stuart-Maxwell test did not show a statistically significant difference between the marginal distributions of the two versions ($\chi^2 = 4.744$; df = 2; p = 0.093). However, Cohen›s *kappa* coefficient showed moderate agreement between the two classifications (*kappa* = 0.455), according to the interpretation of Landis and Koch.

Comparison of responses to questions from the two versions of the KIDMED questionnaire

Table 5 presents the item-by-item comparison of positive responses obtained with the 2004 and 2019 versions of the KIDMED questionnaire. The table shows statistically significant differences for several

Table 4. Cross-tabulation of adherence levels between the two versions of the KIDMED in the same sample of adolescents

KIDMED 2019 \ KIDMED 2004	Low	Medium	High	Total
Low	19	9	1	29
Medium	16	35	6	57
High	4	10	29	43
Total	39	54	36	129

The values correspond to the number of adolescents. The diagonal cells represent the concordance of classifications according to the 2004 and 2019 versions of the KIDMED questionnaire. Agreement between classifications was assessed using Cohen's *kappa* coefficient (*kappa* = 0.455), indicating moderate agreement. Differences between marginal distributions were examined using the Stuart-Maxwell test for paired multinomial data ($\chi^2 = 4.744$; df = 2; p = 0.093).

Table 5. Item-by-item comparison of responses to the original (2004) and updated (2019) versions of the KIDMED questionnaire in the sample of adolescents studied

Questions	KIDMED 2004 n (%)	KIDMED 2019 n (%)	p-value
Eat a fruit or fruit juice every day	78 (60.5)	52 (40.3)	0.001**
Eat a second fruit every day	34 (26.4)	28 (21.7)	0.18
Eat raw vegetables (salad) or cooked once a day	92 (71.3)	90 (69.8)	0.64
Eat raw or cooked vegetables more than once a day	41 (31.8)	39 (30.2)	0.72
Eat fish regularly (≥ 2-3 times/week)	38 (29.5)	35 (27.1)	0.48
Eat at least once a week in a fast-food restaurant	44 (34.1)	61 (47.3)	0.03*
Eat dried vegetables (legumes) more than once a week	85 (65.9)	83 (64.3)	0.71
Eat pasta or rice at least 5 times a week	74 (57.4)	70 (54.3)	0.39
Eat cereals and their derivatives for breakfast	101 (78.3)	83 (64.3)	0.002**
Eat dried fruits (nuts) regularly	69 (53.5)	76 (58.9)	0.21
Eat olive oil in your home regularly	110 (85.3)	108 (83.7)	0.62
Skip breakfast	25 (19.4)	39 (30.2)	0.01*
Eat milk and dairy products for breakfast	72 (55.8)	69 (53.5)	0.58
Eat industrial pastries for breakfast	38 (29.5)	52 (40.3)	0.04*
Eat 2 yogurts or 40 g cheese every day	21 (16.3)	19 (14.7)	0.63
Eat sweets, chocolates, candies several times a day	46 (35.7)	58 (45.0)	0.03*

n (%) – number (percentage) of positive responses; The comparisons between the 2004 and 2019 KIDMED versions were performed using McNemar's test for paired data; * $p < 0.05$; ** $p < 0.01$.

items. The proportion of positive responses was significantly lower with the 2019 version for the item relating to daily consumption of fruit or fruit juice (40.3% vs. 60.5%, p = 0.001) as well as for the item concerning the consumption of cereals and cereal products at breakfast (64.3% vs. 78.3%, p = 0.002). Conversely, significantly higher proportions were observed with the 2019 version for eating at a fast-food restaurant at least once a week (47.3% vs. 34.1%, p = 0.030), skipping breakfast (30.2% vs. 19.4%, p = 0.010), consuming processed pastries for breakfast (40.3% vs. 29.5%, p = 0.040), and consuming sweets or candy several times a day (45.0% vs. 35.7%, p = 0.030). No statistically significant differences were observed for the other items (p > 0.05).

DISCUSSION

This study compared adolescents' adherence to the Mediterranean diet, as assessed by two versions of the KIDMED questionnaire: the original 2004 version and the more recent 2019 version. The results show that the updated 2019 version of KIDMED provides a more rigorous, demanding, and discriminating assessment of dietary behaviors, particularly regarding food quality and meal structure (breakfast). Data from the assessment using both versions of KIDMED indicate the stable maintenance of traditional components of the Mediterranean diet, such as the consumption of vegetables, fish, legumes, and olive oil, while deviations mainly concerned dietary behaviors whose nutritional importance has been reassessed in recent years.

The present data revealed an overall moderate adherence to the Mediterranean diet among the adolescents studied. This finding is frequently reported in the literature on adolescent populations, particularly in similar contexts characterized by a nutritional transition or a globalization of eating habits [30, 31]. This moderate adherence is jointly associated with insufficient physical activity levels in nearly half of the high school students participating in this study, a situation also widely documented as a major determinant of the risk of overweight and altered metabolic profile in adolescents [32]. The coexistence of low physical activity levels and heterogeneous anthropometric indicators may reflect the existence of subgroups with unfavorable cardiometabolic profiles, including among adolescents who do not necessarily present with marked excess weight, a phenomenon described in epidemiological studies of young people [20, 33].

Moderate adherence to the Mediterranean diet, as assessed in this study using the KIDMED index, appears consistent with an unfavorable behavioral profile, as the protective benefits of this dietary pattern are closely linked to its integration into an overall active lifestyle [34]. Furthermore, the marked heterogeneity of dietary behaviors, already reported among adolescents, is reflected in the high dispersion of KIDMED scores observed in the study sample, suggesting that the combination of poor diet quality and low levels of physical activity in some individuals may increase the risk of central adiposity and metabolic imbalance [6, 20, 35].

The average adherence scores obtained with both versions of KIDMED remained in the moderate adherence category. However, the slightly lower average score observed with the 2019 updated version, along with the higher proportion of adolescents classified in the low adherence category, suggests that this version allows for a more demanding and nuanced assessment of adherence to the Mediterranean diet and adolescents' eating behaviors. This observed result is consistent with findings in the literature reporting an overestimation of dietary quality as assessed by traditional indices of adherence to the Mediterranean diet when these indices do not sufficiently consider food quality and its degree of processing [36, 37]. Based on these findings, it therefore appears that the updated version of the KIDMED is better aligned with contemporary nutritional recommendations, which emphasize carbohydrate quality, the consumption of minimally processed foods, and the qualitative structuring of meals, in accordance with the principles of the Dietary Guidelines for Americans 2020-2025 [38]. Furthermore, a comparison between the original KIDMED (2004) and the updated KIDMED (2019) reveals differences in the assessment of adherence levels. The increase in the proportion of adolescents classified as having low adherence and the decrease in those classified as having good adherence in the updated version suggest a reclassification of certain profiles previously considered favorable, a shift already anticipated by methodological critiques of traditional indices [36, 37]. This reclassification appears consistent with the integration of qualitative criteria more aligned with current nutritional recommendations, particularly regarding the limitation of ultra-processed foods and added sugars [37].

Indeed, the KIDMED, initially developed by Serra-Majem et al. (2004), was designed in a food environment where the availability and consumption of ultra-processed foods were significantly more limited than they are today [13]. This increasingly rapid evolution of food systems over the past few decades necessitates updating the interpretation of assessment tools to better reflect contemporary dietary practices, particularly among children and adolescents [16]. The differences observed in this study therefore do not reflect a real decline in dietary habits, but rather a more demanding and realistic assessment.

Analysis of the classification agreement between the original and updated versions of the KIDMED, applied to the same adolescents, reveals moderate overall concordance, a level of agreement expected when two tools or two versions assess the same profile with different levels of rigor [38]. The observed disagreements mainly concern reclassifications between adjacent categories, which is generally interpreted as a refinement of profile discrimination rather than a methodological inconsistency [12, 39].

Furthermore, the analysis of classification agreement between the two versions reveals moderate overall concordance, with reclassifications mostly observed between adjacent categories. This partial concordance suggests that, although both versions share a common conceptual basis, they are not strictly interchangeable. This interpretation is consistent with recent literature highlighting that adherence to the Mediterranean diet in adolescents is a multidimensional construct influenced by both dietary quality and overall lifestyle patterns, requiring increasingly refined assessment tools to accurately capture these complexities [12]. The updated version thus appears as a coherent methodological evolution, allowing for better discrimination of dietary profiles, particularly among adolescents with intermediate adherence, a key population for nutritional prevention.

Item-by-item analysis of the questionnaire shows that the differences between the 2004 version of KIDMED and the updated 2019 version mainly concern dietary behaviors whose nutritional importance has been reassessed over the past two decades, including fruit consumption, breakfast quality, frequenting fast-food restaurants, and consumption of sugary products [40]. Conversely, the stability observed for the consumption of vegetables, fish, legumes, and olive oil confirms that these components remain robust and widely accepted pillars of the Mediterranean diet, regardless of changes in the assessment criteria [13, 34]. The particularly sharp decrease in reported daily consumption of "fruit or fruit juice" as assessed with the updated version reflects a stricter distinction between whole fruit and juice, now recommended due to the high free sugar content of juice and its low satiating effect [41, 42]. Similarly, the differences observed in the consumption of cereals and processed pastries at breakfast reflect a qualitative reassessment of this meal, the composition of which is now recognized as crucial for overall dietary quality in adolescents [32, 40]. The increased proportion of adolescents identified as regularly frequenting fast-food restaurants and frequently consuming sweets with the updated version of KIDMED suggests improved detection of risky eating behaviors, consistent with data showing that these practices are major markers of unbalanced diets and are associated with an increased risk of obesity and metabolic syndrome in young people [20, 37]. This increased sensitivity of the updated version appears to align with criticisms leveled against older tools and supports the fact that they are often less sensitive to the impact of ultra-processed foods on overall diet quality [19, 37]. These results suggest that, overall, the updated version of KIDMED (2019) does not challenge the conceptual foundations of the original questionnaire but rather refines its assessment by incorporating qualitative criteria that are now central to nutritional recommendations [15, 37]. This evolution improves the differentiation of risky eating behaviors among adolescents and reinforces the value of the KIDMED index as an assessment tool adapted to contemporary food environments [15].

In light of the reported data, this study enabled a comparative analysis of adolescent adherence to the Mediterranean diet using the original version of the KIDMED questionnaire and an updated version based on current nutritional recommendations. These guidelines encourage increased consumption of fruits, vegetables, legumes and whole grains while limiting free sugars, highly processed foods and excess salt and saturated fat [38], and with documented benefits of a Mediterranean diet rich in unprocessed foods on cardiometabolic health and the prevention of chronic diseases.

CONCLUSION

The comparative approach used in this study to assess adherence to the Mediterranean diet among adolescents, using the original version of the KIDMED questionnaire and an updated version, applied to the same sample of adolescents, allowed for the analysis of differences in overall scores, classifications by level of adherence, and variations in responses to questionnaires observed item by item. This provided an integrated view of the methodological effects related to updating the KIDMED questionnaire.

The results show that the recent version of KIDMED leads to a more demanding assessment of dietary behaviors, as it results in an increase in the proportion of adolescents classified as having low adherence and a decrease in those classified as having good adherence compared to the original version. This shift reflects a more nuanced and realistic interpretation, taking into account the quality of food consumed, meal structure, and the consumption of ultra-processed products, rather than an actual deterioration in eating habits. The main value of this work lies in its methodological contribution, demonstrating that an updated interpretation of a widely used tool like the KIDMED can improve the relevance of nutritional assessment without calling into question the foundations of the original questionnaire. This approach addresses

concerns expressed in the literature regarding the need to adapt dietary assessment tools to evolving food environments and nutritional recommendations, particularly for children and adolescents.

These results also highlight the public health importance of using tools that can accurately identify risky eating behaviors in order to better target preventive interventions. Updating the KIDMED could thus provide valuable support for monitoring adolescents' eating habits and for evaluating nutrition education programs aimed at promoting a healthy lifestyle.

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Conflicts of interest

The authors declare that they have no conflicts of interest related to this study.

REFERENCES

1. World Health Organization. Health for the world's adolescents: a second chance in the second decade. Geneva: WHO; 2014.
2. Moreno Aznar LA, Vidal Carou MDC, López Sobaler AM, Varela Moreiras G, Moreno Villares JM. Role of breakfast and its quality in the health of children and adolescents in Spain. Nutr Hosp. 2021;38(2):396-409. doi: 10.20960/nh.03398.
3. Food and Agriculture Organization of the United Nations, World Health Organization. Sustainable healthy diets: guiding principles. Rome: FAO; 2019.
4. World Health Organization. Report of the Commission on Ending Childhood Obesity. Geneva: WHO; 2016.
5. Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. Lancet. 2019;393(10170):447-492. doi: 10.1016/S0140-6736(18)31788-4.
6. Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. Am J Clin Nutr. 2010;92(5):1189-1196. doi: 10.3945/ajcn.2010.29673.
7. Trichopoulou A, Vasilopoulou E. Mediterranean diet and longevity. Br J Nutr. 2000;84(Suppl 2):S205-S209. doi: 10.1079/09658219738855.
8. González-Domínguez Á, Domínguez-Riscart J, Millán-Martínez M, Lechuga-Sancho AM, González-Domínguez R. Exploring the association between circulating trace elements, metabolic risk factors, and adherence to a Mediterranean diet among children and adolescents with obesity. Front Public Health. 2023;10:1016819. doi: 10.3389/fpubh.2022.1016819.
9. Rosi A, Scazzina F, Giampieri F, Álvarez-Córdova L, Abdelkarim O, Ammar A, et al. Lifestyle factors associated with children's and adolescents' adherence to the Mediterranean diet: the DELICIOUS project. Nutrients. 2025;17(1):26. doi: 10.3390/nu17010026.
10. Iaccarino Idelson P, Scalfi L, Valerio G. Adherence to the Mediterranean diet in children and adolescents: a systematic review. Nutr Metab Cardiovasc Dis. 2017;27. doi: 10.1016/j.numecd.2017.01.002.
11. Belaoufi H, El-Jamal S, Sahel K, Aboukhalaf A, Friki F, Chamlal H, et al. Adherence to Mediterranean diet in Moroccan school-age adolescents: sociodemographic, socioeconomic and lifestyle determinants. Rocz Panstw Zakl Hig. 2024;75(3):261-273. doi: 10.32394/rpzh/194469.
12. Masini A, Dallolio L, Sanmarchi F, Lovecchio F, Falato M, Longobucco Y, et al. Adherence to the Mediterranean diet in children and adolescents and association with multiple outcomes: an umbrella review. Healthcare. 2024;12(4):449. doi: 10.3390/healthcare12040449.
13. Serra-Majem L, Ribas L, Ngo J, Ortega RM, García A, Pérez-Rodrigo C, et al. Food, youth and the Mediterranean diet in Spain: development of KIDMED index. Public Health Nutr. 2004;7(7):931-935. doi: 10.1079/phn2004556.
14. Singh GM, Micha R, Khatibzadeh S, Shi P, Lim S, Andrews KG, et al. Global, regional, and national consumption of sugar-sweetened beverages, fruit juices, and milk: a systematic assessment. PLoS One. 2015;10(8):e0124845. doi: 10.1371/journal.pone.0124845.
15. Altavilla C, Caballero-Pérez P. An update of the KIDMED questionnaire, a Mediterranean diet quality index in children and adolescents. Public Health Nutr. 2019;22(14):2543-2547. doi: 10.1017/S1368980019001058.
16. Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulou A, Dernini S, et al. Mediterranean diet pyramid today: science and cultural updates. Public Health Nutr. 2011;14(12A):2274-2284. doi: 10.1017/S1368980011002515.
17. Evaristo OS, Moreira C, Lopes L, Abreu S, Agostinis-Sobrinho C, Oliveira-Santos J, et al. Associations between physical fitness and adherence to the Mediterranean diet with health-related quality of life in adolescents. Eur J Public Health. 2018;28(4):631-635. doi: 10.1093/eurpub/cky043.
18. Chacón-Cuberos R, Zurita-Ortega F, Martínez-Martínez A, Olmedo-Moreno EM, Castro-Sánchez M. Adherence to the Mediterranean diet is related to healthy habits, learning processes, and academic achievement in adolescents: a cross-sectional study. Nutrients. 2018;10(11):1566. doi: 10.3390/nu10111566.
19. Muros JJ, Cofre-Bolados C, Arriscado D, Zurita F, Knox E. Mediterranean diet adherence is associated with lifestyle, physical fitness, and mental wellness

among 10-year-olds in Chile. Nutrition. 2017;35:87-92. doi: 10.1016/j.nut.2016.11.002.
20. García-Hermoso A, Ezzatvar Y, López-Gil JF, Ramírez-Vélez R, Olloquequi J, Izquierdo M. Is adherence to the Mediterranean diet associated with healthy habits and physical fitness? A systematic review and meta-analysis including 565421 youths. Br J Nutr. 2022;128(7):1433-1444. doi: 10.1017/S0007114520004894.
21. World Health Organization. Growth reference data for 5-19 years. Geneva: WHO; 2007.
22. World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation. Geneva: WHO; 2011.
23. Ashwell M, Hsieh SD. Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity. Int J Food Sci Nutr. 2005;56(5):303-307. doi: 10.1080/09637480500195066.
24. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85(9):660-667. doi: 10.2471/blt.07.043497.
25. Hagströmer M, Bergman P, De Bourdeaudhuij I, Ortega FB, Ruiz JR, Manios Y, et al. Concurrent validity of a modified version of the IPAQ-A in European adolescents: the HELENA study. Int J Obes (Lond). 2008;32(Suppl 5):S42-S48. doi: 10.1038/ijo.2008.182.
26. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003;35(8):1381-1395. doi: 10.1249/01.MSS.0000078924.61453.FB.
27. IPAQ Research Committee. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ). 2005.
28. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33(1):159-174.
29. World Medical Association. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Participants. JAMA. 2025;333(1):71-74. doi: 10.1001/jama.2024.21972.
30. Grosso G, Galvano F. Mediterranean diet adherence in children and adolescents in southern European countries. NFS J. 2016;3:13-19. doi: 10.1016/j.nfs.2016.02.004.
31. Intorre F, Foddai MS, Venneria E. Mediterranean diet adherence in adolescents of different cultures and geographical proveniences: a pilot study. Adolescents. 2022;2(2):336-349. doi: 10.3390/adolescents2020026.
32. Moreno LA, Gottrand F, Huybrechts I, Ruiz JR, González-Gross M, De Henauw S, et al. Nutrition and lifestyle in European adolescents: the HELENA study. Adv Nutr. 2014;5(5):615S-623S. doi: 10.3945/an.113.005678.
33. Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents. Lancet Child Adolesc Health. 2020;4(1):23-35. doi: 10.1016/S2352-4642(19)30323-2.
34. Trichopoulou A, Martínez-González MA, Tong TY, Forouhi NG, Khandelwal S, Prabhakaran D, et al. Definitions and potential health benefits of the Mediterranean diet. BMC Med. 2014;12:112. doi: 10.1186/1741-7015-12-112.
35. Vélez-Alcázar AE, García-Roca JA, Vaquero-Cristóbal R. Adherence to the Mediterranean diet and its influence on anthropometric and fitness variables in high-level adolescent athletes. Nutrients. 2024;16(5):624. doi: 10.3390/nu16050624.
36. Martínez-González MA, Hershey MS, Zazpe I, Trichopoulou A. Transferability of the Mediterranean diet to non-Mediterranean countries. Nutrients. 2017;9(11):1226. doi: 10.3390/nu9111226.
37. Monteiro CA, Cannon G, Moubarac JC, Levy RB, Louzada MLC, Jaime PC. The UN decade of nutrition, the NOVA food classification and the trouble with ultra-processing. Public Health Nutr. 2018;21(1):5-17. doi: 10.1017/S1368980017000234.
38. U.S. Department of Agriculture, U.S. Department of Health and Human Services. Dietary Guidelines for Americans 2020–2025. 9th ed. Washington (DC): U.S. Government Publishing Office; 2020.
39. Streiner DL, Norman GR. Health measurement scales: a practical guide to their development and use. 4th ed. Oxford: Oxford University Press; 2008.
40. O'Neil CE, Byrd-Bredbenner C, Hayes D, Jana L, Klinger SE, Stephenson-Martin S. The role of breakfast in health: definition and criteria for a quality breakfast. J Acad Nutr Diet. 2014;114(12 Suppl):S8-S26. doi: 10.1016/j.jand.2014.08.022.
41. Aune D, Giovannucci E, Boffetta P, Fadnes LT, Keum N, Norat T, et al. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality: a systematic review and dose-response meta-analysis of prospective studies. Int J Epidemiol. 2017;46(3):1029-1056. doi: 10.1093/ije/dyw319.
42. World Health Organization. Guideline: sugars intake for adults and children. Geneva: WHO; 2015.

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