Research Article

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2024.56.008842

Comparison of Two Indexes of Adherence to Mediterranean Diet in Adolescents: A Cross Sectional Pilot Study

Federica Intorre*, Maria Stella Foddai and Eugenia Venneria

Council for Agricultural Research and Economics-Research Centre for Food and Nutrition (CREA-Food and Nutrition), Italy

***Corresponding author:** Federica Intorre, Council for Agricultural Research and Economics-Research Centre for Food and Nutrition (CREA-Food and Nutrition), Via Ardeatina 546, 00178 Rome, Italy

ARTICLE INFO

Received: April 22, 2024

Published: May 02, 2024

Citation: Federica Intorre, Maria Stella Foddai and Eugenia Venneria. Comparison of Two Indexes of Adherence to Mediterranean Diet in Adolescents: A Cross Sectional Pilot Study. Biomed J Sci & Tech Res 56(3)-2024. BJSTR. MS.ID.008842.

ABSTRACT

The objective of the present paper is to compare two different indexes of adherence to Mediterranean Diet (MD) from a pilot study on a sample of adolescents: the Mediterranean Diet Quality Index in children and adolescents (KIDMED) and the Mediterranean Diet Serving Score (MDSS). This work represents only one aspect of a broader and more articulated research that has as its purpose to evaluate lifestyle, eating habits, adherence to MD and nutritional status of adolescents of different cultures and geographical proveniences. The study was carried out by a structured packet of questionnaires, face-to-face administered, inquiring about demographic information and both dietary and lifestyle habits. A total of 223 adolescents (130 males and 93 females, mean age16.8±3.6 years) were included in this study. The mean KIDMED score (5.9±2.5 for males and 5.1±2.8 for females, P=ns) indicates a medium adherence to MD, while the mean MDSS (5.4±2.5 for males and 4.4±2.2 for females, P=ns), indicates a low adherence. Only 26.5% of the sample has the same level of MD adherence in both indexes, while the remaining 73.5% of volunteers is differently distributed among the three levels (low, medium, high) of MD adherence (P=0.000). Indeed, the KIDMED questionnaire examines different aspects respect to MDSS and, even for the same food group, the number of servings considered by the two indexes varies, leading to a different classification of subjects. It is therefore fundamental to look for an agreement between different methodologies about the inclusion of food groups, dietary behaviors, and lifestyle factors, as well as about the score assignment, to evenly evaluate MD adherence. Anyway, our investigation suggests that the adherence of younger age groups to this healthy dietary pattern is not optimal. This condition underlines the need to develop and apply nutritional education programs targeting adolescents to promote healthier lifestyle choices.

Keywords: Mediterranean Diet; Adolescents; KIDMED; Mediterranean Diet Serving Score (MDSS)

Abbreviations: MD: Mediterranean Diet; KIDMED: Mediterranean Diet Quality Index in Children and Adolescents; MDSS: Mediterranean Diet Serving Score; WHO: World Health Organization; FFQ: Food Frequency Questionnaire; SD: Standard Deviations

Introduction

The traditional Mediterranean Diet (MD) refers to the dietary pattern of the Mediterranean basin defined by prevalent consumption of foods of vegetable origin, regular but moderate intake of dairy products, low to moderate intake of fish and poultry, and very low intake of red meat. Other fundamental characteristics are seasonality, biodiversity, and the use of local and traditional food products; moreover, MD has also qualitative cultural and lifestyle elements, such as frugality, sobriety, conviviality, typical recipes, physical activity and adequate rest [1,2]. The MD has been identified a healthy dietary pattern for the prevention of non-communicable diseases, being associated with a better health status and a prolonged lifespan [3-6]. In evaluating the relationships between diet and health, a particular interest has developed to approximate the overall adherence to certain dietary patterns.

The assessment of MD adherence is made possible by using specific indexes (or scoring systems), suitable for adults [7], as well as for children and adolescents [8]. However, measuring the level of

adherence to MD is not immediate: a single method does not exist, as the definition of MD is influenced by socio-cultural, religious, and economic factors [7,9,10]. There are several methods assessing different elements, i.e. the intake of various nutrients/foods and/or specific food habits, to derive a score which may be used to categorize population groups. Differences between the various MD scores are mostly determined by the selection of the items and by the different cut-off points or scoring criteria adopted (mainly medians and tertiles) [7]. The first and most extensively used index is the Mediterranean Dietary Score (MDS), proposed by Trichopoulou et al. in 1995 and revised in 2003 [11,12], suitable for adults and elderly. Other indexes have been later proposed and adapted, each of them being appropriate for a specific population and underlying some specific aspects of the MD [9,13].

In recent years, a gradual withdrawal of MD fundamentals has been found especially in Mediterranean countries [14-18], and also in Italy [19,20]. This downward trend has been observed mainly for the younger age groups [21] and, as early eating habits influence adulthood health status [22], it is very important to focus the attention on these population groups. Adolescence is defined as the broad age range from 10–24 years [23]. To the best of our knowledge, the MD adherence indexes adopted for adolescents are: the Mediterranean Diet Quality Index in children and adolescents (KIDMED) [24], which is the most widely used scoring system; adapted versions of the original MDS [11,12], based on dietary records; and MD Scores, based on Food Frequency Questionnaires (FFQs), which represent a commonly used, reproducible and valid approach for dietary assessment [25]. The aim of this paper is to compare two different indexes to assess the adherence to MD in a sample of adolescents: the KIDMED index [24] and the Mediterranean Diet Serving Score (MDSS), based on a FFQ and suitable for adults as well as for adolescents [26]. This work represents only one aspect of a broader and more articulated research that has as its purpose to evaluate if and to what extentthe encounter between different cultures, in the context of globalization present in modern society,may have influenced lifestyle, eating habits, adherence to MD and nutritional status of adolescents of different cultures and geographical proveniences [27,28].

Materials and Methods

Participants and Study Design

The study sample was recruited in Youth Aggregation Centers, located in Rome, from October 2020 to March 2023 and included free-living adolescents. Before starting the data collection, the objective of the research and the intention to publish the results in scientific papers were described in detail. Participation in the study was fully voluntary and anonymous and volunteers could with-draw from the study at any time and for any reason. After obtaining informed consent, qualified interviewers administered questionnaires in a "face to face" assisted modality, on one occasion. They were designed to obtain information about lifestyle, eating habits, food consumption and adherence to MD; all the data were handled according to the European General Data Protection Regulation - GDPR 679/2016. In the case of minors, both releases were signed by parents or by whoever had parental responsibility. As the assessment did not involve invasive procedures or induce changes in dietary patterns, the approval by the Ethics Committee was not necessary.

Lifestyle and Eating Habits

Information about demographic factors and social aspects (age, sex, country of origin, education and/or occupation, living arrangement), leisure time activity (type and dedicated time) eating habits (frequency of meal consumption, away-from-home eating, water, soft-drinks, and alcohol consumption, eating differently from family members or roommates) were collected through a specifically designed questionnaire.

Food Consumption

Participants completed a qualitative FFQ related to the previous 12 months. The frequencies were expressed as "never", or as number of servings/day or servings/week or servings/month or servings/year.

Adherence to MD

Two validated score systems were selected: the KIDMED index [24,29], easy tool suitable for our sample, and the MDSS [26], based on the frequency of consumption of foods and food groups, in absence of information on nutrients and quantities in grams of foods. It was calculated based on the food items of the FFQ, which in a later time have been gathered into 13 items, according to the MD pyramid [1].

The KIDMED Questionnaire: The KIDMED questionnaire could be self-administered or conducted by trained interviewers and consists of 16 dichotomous (positive/negative) items, where the 4 questions denoting a negative connotation to the MD are scored with -1, and the 12 questions denoting a positive connotation are scored with +1 (Table 1). The score obtained summing the single answers let to classify the adherence to MD into three levels: low (≤ 3), medium (4–7), high (≥ 8) [24,29].

Table 1: KIDMED test to assess the Mediterranean diet quality [24].

Scoring	
Takes a fruit or fruit juice every day	+1
Has a second fruit every day	+1
Has fresh or cooked vegetables regularly once a day	+1
Has fresh or cooked vegetables more than once a day	+1
Consumes fish regularly (at least 2-3 times per week)	+1
Goes more than once a week to a fast-food (hamburger) restaurant	-1
Likes pulses and eats them more than once a week	+1
Consumes pasta or rice almost every day (5 or more times per week)	+1

Has cereals or grains (bread, etc.) for breakfast	+1
Consumes nuts regularly (at least 2-3 times per week)	+1
Uses olive oil at home	+1
Skips breakfast	-1
Uses dairy product for breakfast (yoghurt, milk, etc.)	+1
Has commercially baked goods or pastries for breakfast	-1
Takes two yoghurts and/or some cheese (40 g) daily	+1
Takes sweets and candy several times every day	-1

Note: KIDMED – Mediterranean Diet Quality Index in children and adolescents.

The Mediterranean Dietary Serving Score (MDSS): The MDSS is based on the latest update of the MD pyramid [1] and consists of 14 items for adults and 13 items for adolescents. Individuals whose intake is within the number of recommended servings are awarded a score of 3, 2, or 1 point for recommendations expressed in times/meal, times/day, or times/week, respectively. A score of 0 is given when the number of servings/meal, week or day is higher or lower than recommended (Table 2). The MDSS total score ranges between 0 and 24 points for adults and elderly, and between 0 and 23 for adolescents (because fermented beverages consumption is not considered for this age group). The sum of the scores of each item let to classify the adherence to MD into three levels: low (0-7), medium (8-15), high (16-23) [26]. The MDSS is comparable with the MDS created by Trichopoulou [11,12].

Table 2: According with the new MD pyramid [1].

	Recommendation*	Score
Fruit	1–2 servings/main meal**	3
Vegetables	≥ 2 servings/main meal**	3
Cereals[a]	1–2 servings/main meal**	3
Potatoes	≤ 3 servings/week	1
Olive Oil[b]	1 serving/main meal**	3
Nuts	1–2 servings/day	2
Dairy products[c]	2 servings/day	2
Legumes	≥ 2 servings/week	1
Eggs	2–4 servings/week	1
Fish	≥ 2 servings/week	1
White meat[d]	2 servings/week	1
Red meat[e]	< 2 servings/week	1
Sweets[f]	≤ 2 servings/week	1
Fermented beverages[g]	1-2 glass/day	1
Total score		24

Note: ** Main meals: breakfast, lunch and dinner.

a. Bread, breakfast cereals, rice and pasta.
b. Olive oil used on salads or bread or for frying.
c. Milk, yoghurt, cheese, ice-cream.
d. Poultry.
e. Pork, beef, or lamb.
f. Sugar, candies, pastries, sweetened fruit juices, and soft drinks.
g. Wine and beer.

Statistical Analysis

Statistical analysis was performed by the MedCalc software version 20.106 for Windows, setting the significance at $p < 0.05$. Continuous variables were presented as means and standard deviations (sd), while categorical variables as frequencies. Means were compared through the Student's t test, after checking the normal distribution by using the Shapiro–Wilk test, while differences between categorical variables through the Pearson chi-square test.

Results

Data were collected on 223 volunteers (130 males, mean age 17.2±3.8 years and 93 females, mean age 16.4±3.3 years, P=ns) (data not shown). Table 3 reports the frequency of meal consumption. There were no statistically significant differences between males and females. In our sample, 31.5% of males and 39.8% of females sometimes skipped breakfast, due to insufficient time or appetite and to the will to sleep longer; 13.1% of males and 5.4% of females never did breakfast. There was also a percentage of volunteers not having lunch or dinner every day (12.6% and 10.3% respectively). The tendency of eating between meals was once a day for 36.0% of volunteers (34.1% of males and 38.7% of females), twice a day for 35.6% of them (38.8% of males and 31.2% of females) and more than twice a day for 14.0% of them (10.0% of males and 19.3% of females). Table 4 reports the MD adherence by both the KIDMED index and the MDSS. A mean KIDMED score (5.9±2.5 for males and 5.1±2.8 for females) indicates a medium adherence, without significant differences between males and females. 50.8% of males and 49.5% of females had a medium adherence to MD; a great percentage of the sample (27.4%) had a high adherence, mainly represented by male volunteers (30.7%).

Table 3: Frequency of Meal Consumption by Sex.

	Total sample (%)	Males (%)	Females (%)	p Value
Frequency of breakfast				ns
Never	9.9	13.1	5.4	
Less than everyday	35.0	31.5	39.8	
Everyday	55.1	55.4	54.8	
Frequency of lunch				ns
Never	0.9	0.8	1.1	
Less than everyday	12.6	15.4	8.6	
Everyday	86.5	83.8	90.3	
Frequency of dinner				ns
Never	0.9	0.8	1.1	
Less than everyday	10.3	10.0	10.8	
Everyday	88.8	89.2	88.1	
Frequency of snacks				ns
Never	14.4	17.1	10.8	
1 a day	36.0	34.1	38.7	
2 a day	35.6	38.8	31.2	
>2 a day	14.0	10.0	19.3	

Note: Categorical variables are presented as percentages. Statistical analysis: Chi square test; ns=not significant.

Table 4: Adherence to Mediterranean Diet (MD) by KIDMED Index and MDSS by Sex.

	Total sample	Males	Females	p Value
KIDMED score (mean ± sd)	5.5±2.7	5.9±2.5	5.1±2.8	ns
Adherence to MD by KIDMED (%)				ns
Low (≤3)	22.4	18.5	27.9	
Medium (4-7)	50.2	50.8	49.5	
High (≥8)	27.4	30.7	22.6	
MDSS score (mean ± sd)	5.0±2.4	5.4±2.5	4.4±2.2	ns
Adherence to MD by MDSS (%)				0.026
Low (0-7)	83.9	79.2	90.3	
Medium (8-15)	16.1	20.8	9.7	
High (16-23)	0.0	0.0	0.0	

Note: Continuous variables are presented as mean ± sd and categorical variables as percentages. Statistical analysis: Student's T-Test and Chi square test; ns=not significant.

The mean MDSS score was 5.4±2.5 for males and 4.4±2.2 for females, without significant differences (P=ns), indicating a low MD adherence. Indeed, 83.9% of total sample had a low adherence according to the MDSS (79.2% of males and 90.3% of females) and no one had high adherence. There were statistically significant differences in MDSS categories between sexes (P=0.026). The adherence to MD was deepened by considering the responses to each single question of the KIDMED questionnaire, shown in Table 5, and the single items of the MDSS, reported in Table 6. Regarding the KIDMED index (Table 5), among the behaviors with a negative connotation with respect to the MD, those that prevailed were, for 43.9% of the sample, the consumption of baked goods or pastries for breakfast (by 44.6% of males and 43.0% of females) and skipping breakfast due to lack of time, a desire to sleep longer in the morning and a lack of appetite (by 43.8% of males and 44.1% of females), without significant differences between sexes. Among the behaviors with a positive connotation with respect to the MD, the use of olive oil was the most widespread among all the participants in the study (97.3% of the total sample, 96.2% of males and 98.9% of females, stated that they use it regularly at home), followed by the consumption of pasta or rice almost every day (80.7% of the total sample, 89.2% of males and 68.8% of females, P=0.000). The less followed behavior with a positive connotation with respect to the MD was the daily consumption of two yoghurts and/or some cheese (40 g) (by 21.5% of the total sample, 24.6% of males and 17.2% of females).

Table 5: Percentage of "yes" answers to each single question of the KIDMED questionnaire.

KIDMED questionnaire	Total sample (%)	Males (%)	Females (%)	p Value
Takes a fruit or fruit juice every day[1]	73.1	78.5	65.6	0.033
Has a second fruit every day[1]	40.8	47.7	31.2	0.013
Has fresh or cooked vegetables regularly once a day[1]	65.9	66.9	64.5	ns
Has fresh or cooked vegetables more than once a day[1]	40.4	37.7	44.1	ns
Consumes fish regularly (at least 2-3 times per week)[1]	50.2	52.3	47.3	ns
Goes more than once a week to a fast-food (hamburger) restaurant[2]	22.0	23.8	19.4	ns
Likes pulses and eats them more than once a week[1]	59.6	63.1	54.8	ns
Consumes pasta or rice almost every day (5 or more times per week)[1]	80.7	89.2	68.8	0.000
Has cereals or grains (bread, etc.) for breakfast[1]	60.5	62.3	58.1	ns
Consumes nuts regularly (at least 2-3 times per week)[1]	35.4	40.0	29.0	ns
Uses olive oil at home[1]	97.3	96.2	98.9	ns
Skips breakfast[2]	43.9	43.8	44.1	ns
Uses dairy product for breakfast (yoghurt, milk, etc.)[1]	67.3	66.2	68.8	ns
Has commercially baked goods or pastries for breakfast[2]	43.9	44.6	43.0	ns
Takes two yoghurts and/or some cheese (40 g) daily[1]	21.5	24.6	17.2	ns
Takes sweets and candy several times every day[2]	30.0	26.2	35.5	ns

Note: Data presented as percentages are referred to "yes" answers. Statistical analysis: Chi square test; ns=not significant; 1. "Yes" answers with a positive score (+1); 2. "Yes" answers with a negative score (−1).

Table 6: Percentage of volunteers Within and Outside Recommendations According to MDSS.

	% of volunteers within recommendations *			% of volunteers outside recommendations*					
				Low			Above		
	Total sample	Males	Females	Total sample	Males	Females	Total sample	Males	Females
Fruit	8.5	8.5	8.6	91.1	90.7	91.4	0.4	0.8	0.0
Vegetables	0.4	0.8	0.0	99.6	99.2	100.0	-	-	-
Cereals	36.3	41.5	29.0	62.4	56.9	69.9	1.3	1.5	1.1
Potatoes	75.3	76.2	74.2	-	-	-	24.7	23.8	25.8
Olive Oil	2.7	3.1	2.2	96.9	96.9	96.8	0.4	0.0	1.0
Nuts	15.2	17.7	11.8	83.0	81.5	84.9	1.8	0.8	3.3
Dairy products	16.6	20.0	11.8	60.1	55.4	66.7	23.3	24.6	21.5

Legumes	53.4	56.9	48.4	46.6	43.1	51.6	-	-	-
Eggs	39.9	42.3	36.6	46.2	42.3	51.6	13.9	15.4	11.8
Fish	43.9	50.0	35.5	56.1	50.0	64.5	-	-	-
White meat	25.1	20.8	31.2	30.0	30.8	29.0	44.9	48.4	39.8
Red meat	46.6	49.2	43.0	-	-	-	53.4	50.8	57.0
Sweets	4.9	3.1	7.5	-	-	-	95.1	96.9	92.5

Note: *According with the new MD pyramid [1]. Statistical analysis: Chi square test.

Regarding fruit and vegetables consumption, about the 40.0% of the total sample had a second fruit every day, or fresh or cooked vegetables more than once a day. The deepening of single items of the MDSS is described in Table 6, which shows the population distribution according to MDSS cut-off points. Regarding the total sample, the highest adherence to the recommendations was identified for potatoes (75.3%), legumes (53.4%) and red meat (46.6%), whereas the lowest was for vegetables (0.4%), olive oil (2.7%) and sweets (4.9%). Males complied better with all the recommendations except for fruit, white meat, and sweets. Most of sample was below the recommendation for vegetables (99.6%), olive oil (96.9%) and fruit (91.0%), and above the recommended values for sweets (95.1%), red meat (53.4%) and white meat (44.8%). There were not significant differences between sexes (P=ns). In Table 7 is summarized the adherence to MD according to the two different indexes. There are some aspects not included in MDSS, such as going to fast-food (hamburger) restaurant or skipping breakfast, whereas KIDMED questionnaire doesn't include consumption of potatoes, eggs, white meat, and red meat. Higher differences were observed for those foods which have to be consumed in every main meal, i.e. fruit, vegetables, cereals and olive oil.

Table 7: Comparison Between KIDMED index and MDSS.

Mediterranean diet components	KIDMED (% of volunteers)	MDSS* (% of volunteers within recommendation)
Fruit	73.1 1 serving/day (including fruit juice) 40.8 2 servings/day	8.5 1–2 servings/main meal
Vegetables	65.9 1 serving/day 40.4 > 1 serving/day	0.4 ≥ 2 servings/main meal
Cereals	80.7 ≥ 5 servings/week 60.5 Cereals or grains for breakfast	35.9 1–2 servings/main meal
Potatoes	Not included	75.3 ≤ 3 servings/week
Olive Oil	97.3 Olive oil at home	2.7 1 serving/main meal
Nuts	35.4 2-3 servings/week	15.2 1–2 servings/day

Dairy products	21.5 2 Yoghurts/day and/or Cheese 40 g/day 67.3 Dairy products for breakfast	16.6 2 servings/day
Legumes	59.6 ≥ 1 serving/week	53.4 ≥ 2 servings/week
Eggs	Not included	39.9 2–4 servings/week
Fish	50.2 ≥ 2 servings/week	43.9 ≥ 2 servings/week
White meat	Not included	25.1 2 servings/week
Red meat	Not included	46.6 < 2 servings/week
Sweets	43.9 Several times/day 30.0 Commercially baked goods or pastries for breakfast	4.9 ≤ 2 servings/week
Fast-food (hamburger) restaurant	22.0 > 1 /week	Not included
Skipping breakfast	43.9 Yes	Not included

Note: *According with the new MD pyramid [1]. Categorical variables are presented as percentages. Statistical analysis: Chi square test.

According to the KIDMED questionnaire, 73.1% of volunteers consumed 1 serving/day of fruit (including fruit juice) and 40.8% of them 2 servings/day (vs 8.5% of the sample being within recommendation according to MDSS); 65.9% consumed 1 serving/day of vegetables and 40.4% more than 1 serving/day (vs 0.4% of the sample being within recommendation according to MDSS); 80.7% consumed ≥ 5 servings/week of cereals and 60.5% consumed cereals or grains for breakfast (vs 35.9% of the sample being within recommendation according to MDSS); 97.3% used olive oil at home (vs 2.7% of the sample being within recommendation according to MDSS). Similar percentages were found for legumes (59.6% of volunteers within recommendation according to KIDMED vs 53.4% of volunteers within recommendation according to MDSS), even if the number of portions considered was different between the two tools. Only in case of fish, the methodologies can be compared both for servings/week and for the percentages of volunteers within recommendation (50.2% according to KIDMED vs 43.9% according to MDSS). In Table 8 is reported the distribution of volunteers according to both indexes. Only 26.5% of the sample had the same level of MD adherence in both indexes (47 volunteers having low adherence and 12 volunteers having a medium adherence), while the remaining 73.5% of volunteers was differently distributed among the three levels of MD adherence (P=0.000).

Table 8: Distribution of volunteers according to both indexes.

	MDSS score (N)				p Value
KIDMED score (N)	Low (0-7)	Medium (8-15)	High (16-23)	Total	
Low (≤3)	47	3	0	50	
Medium (4-7)	100	12	0	112	
High (≥8)	40	21	0	61	
Total	187	36	0	223	0.000

Note: Statistical analysis: Chi square test.

Discussion

The aim of this paper is to compare two different methodologies used to assess the adherence to MD in a sample of adolescents: the KIDMED index [24] and the MDSS [26]. Our results describe a sample of adolescents with a mean KIDMED score indicating a medium adherence to MD and a mean MDSS score indicating a low adherence. Most of volunteers are differently distributed among the three levels of MD adherence evaluated with the two indexes. According to KIDMED questionnaire, the 27.4% of our sample has a high MD adherence and 50.2% a medium adherence. A systematic review [30] conducted on participants 2–17 years old, shows that the KIDMED questionnaire is the method most often used, also for the Italian adolescents. In the study conducted by Bonaccorsi, et al. [31] on 314 volunteers aged 6-14 years old, high adherence is found in 24.8%, medium adherence in 56.4% and low adherence in 18.8% of the sample.

A cross-sectional study, conducted on adolescents of 11–16 years, reveals that 9.1% of the sample has high adherence, 61.0% medium adherence and 29.9% had low adherence to MD, measured by KIDMED [32]. The results of another cross-sectional study [16] carried out on students of 11-14 years, show that most subjects (60%) have a medium adherence to MD, and 12% has high adherence, according to KIDMED. Recently, in the DIMENU cross-sectional study carried out on participants aged 14-17, a medium adherence to MD assessed by the KIDMED score is reported in the 60.87% of the sample [33]. Archero, et al. [34] in a cross-sectional study on volunteers aged 6-16 years, highlight high adherence in 19.6%, medium adherence in 63.7% and low adherence in 16.7% of the sample, measured by KIDMED. The results obtained in our research according to MDSS show that most of the sample has low adherence (83.9%), while the remaining percentage has medium adherence. To the best of our knowledge, in Italy there are no studies on adolescents in which MDSS has been used. In the ARIANNA cross-sectional survey, this tool is used for participants aged ≥17 years, but results are not yet available [35].

Some literature studies compare different methodologies to assess the MD adherence; anyway, it is important to underline that the KIDMED score was not included in these studies. Milá Villaroel, et al. [36], basing on the analysis of 10 indexes of MD adherence reliability and founding a moderate correlation among them, conclude that a consensus on the components included in the MD indexes should be reached. Hernández Ruiz et al. [37] identifying 22 different indexes, confirm the findings of Milá Villaroel, et al. [36]: although all these indexes are related to the Mediterranean dietary pattern, they very differently evaluate the dietary characteristics of the MD. Differences encountered are based on the considered items, as they can be adapted to the population´s dietary habits, and whether their consumption is valued positively or negatively; the scoring scheme and finally, the cut-off points of each index and the contribution of each component to the overall score.

In a systematic review [9], 28 MD adherence scores are analyzed, many of them developed in Mediterranean countries and applied to the general population. Indeed, measuring food consumption and eating habits is far from being simple. Dietary pattern can be defined using a general description, dietary pyramids, a priori scoring systems (diet index), a posteriori dietary pattern formation, or by quantifying food and nutrient content [38,39]. The indexes are usually based on data acquired within a 24-hour quantitative intake recall, dietary records or FFQs. FFQ is one of the most used approaches for dietary assessment, also in adolescents [40], showing in addition good reproducibility and validity for MD assessment [25]. This method has been chosen in our study, in place of dietary records or 24-hour recall. Indeed, capturing detailed information about all foods and beverages would be difficult to carry out, due to the linguistic difficulties of some volunteers hailing from different countries. In our study, a qualitative FFQ was used to calculate MDSS, based on the latest MD recommendations. The MDSS classifies consumption frequency in servings per meal, day, or week and, considering the upper and lower recommended limits for each food group (when available), it penalizes individuals both when they do not reach the recommended intake and when they exceed it. Moreover, total score is more influenced by meeting, or not, the recommendations of the foods at the base of the pyramid than those at its apex [26].

Most indexes of MD adherence consider 9 items in comparison to the 14 included in the MDSS, which differentiates between the consumption of fresh fruit and dried fruit/nuts, cereals, and potatoes and red and white meats and introduces two new items to assess the intake of eggs and sweets. This permits a more accurate diagnosis of adherence to MD [41]. Even if FFQs are very useful to determine the dietary intake at the same time are time-consuming for volunteers

and require complex data management and processing. To overcome this issue, numerous short indexes have been developed, among which the KIDMED index [24]. It has been used for more than a decade but, based on the scientific evidence, some authors suggests some changes to the original version of the KIDMED questionnaire; these changes are represented by adding the term 'whole-grain' to the eighth and the ninth questions of the questionnaire, due to the recognized importance of the whole grain cereals and by deleting 'or fruit juice' from the first question of the questionnaire [42]. Other authors [43] update the 2019 KIDMED questionnaire producing a revised version, named KIDMED 2.0, adapting the instrument to the real MD. The original version of the questionnaire is however the one mainly used and, consequently, to compare literature data on adolescents, is the only questionnaire allowed.

However, the KIDMED questionnaire considers different aspects respect to MDSS: a lack of uniformity in the components of the diet between the two measures and, even within the same food group, the number of servings differs markedly among the indexes. Anyway, it is important to underline that, in our study, the answers relating to food consumption are congruent between the two methodologies, because they were immediately checked in the presence of the subject to avoid inconsistent reporting. The first obvious discrepancy between the two methodologies is that in the MDSS only fruit consumption is mentioned (1-2 servings/main meal, i.e. 3-6 servings/day), while in KIDMED fruit is associated with fruit juice consumption. According to the KIDMED questionnaire, 73.1% of volunteers consumed 1 serving/day of fruit (including fruit juice) and 40.8% consumed 2 servings/day, differently from the 8.5% of the sample within fruit recommendation according to MDSS: some volunteers answered positively to the first question of KIDMED as they consumed fruit juice and not fruit, data confirmed by the FFQ.

The WHO recommends eating at least 400 g (approximatively 5 servings) of fruit and vegetables per day [44], but their levels in adolescent diets are often low [45], as confirmed also by our results, keeping in mind that the first question of the KIDMED questionnaire considers, besides fruit, also fruit juice which, unlike whole fruit, is low in fiber and rich in sugar [46]. Moreover, the MDSS approach gives greater importance to foods (fruit, vegetables, olive oil, cereals) that should be consumed during the 3 main meals (breakfast, lunch, dinner). Nonetheless, 44.9% of the sample does not consume breakfast every day, hence, does not assume fruit for breakfast. There is also a percentage of volunteers not consuming lunch or dinner every day (respectively 13.5% and 11.2%), with effect on consumption of those food which are at the base of the MD pyramid. Moreover, those who regularly have breakfast do not eat fruit during this meal, as confirmed by the lifestyle questionnaire. The same trend is observed for vegetables, olive oil and cereals (bread, breakfast cereals, rice, and pasta) which, according to the MD pyramid [1] and consequently to the MDSS [26], should be consumed in the 3 main meals.

According to the MD pyramid [1] these food categories can also be found throughout the day; for this reason, we have considered the daily servings obtained by FFQ (fruit 3-6 servings/day; vegetables ≥ 6 servings/day; cereals 3-6 servings/day; olive oil servings/day). Moreover, volunteers that skip breakfast answered "No" to the 3 KIDMED questions related to breakfast (Has cereals or grains for breakfast; Uses dairy product for breakfast; Has commercially baked goods or pastries for breakfast) and consequently, the score of these questions was "zero". To better explain, in case of the consumption of commercially baked goods or pastries for breakfast, our volunteers are not virtuous, but they just skip breakfast, and consequently they are not assigned a negative score, even if skipping breakfast is an incorrect dietary behavior. The KIDMED questions should be rephrased, also because skipping breakfast is a very common dietary habit in children and adolescents, to which the KIDMED is addressed. It has been shown that children and adolescents who ate breakfast regularly were more likely to adhere to the MD than those who did not eat breakfast [47].

Rosi and coworkers [48] reported only 14% of participants were breakfast skippers, while in our sample this percentage is 44.9%. The percentage of breakfast skippers is like the results produced by Nardone and colleagues [45] showing 4 out of 10 adolescents skipped breakfast, while a recent systematic review on 286,804 children and adolescents living in 33 countries [49] reported extremely wide variability, ranging from 0.7% to 74.7% of prevalence of breakfast skippers, according to the definition of breakfast skipping used. reported above, another discrepancy between the two measures is related to olive oil, because the KIDMED questionnaire registers only the domestic consumption, without specifying the number of servings, while MDSS considers as recommended one serving per main meal (at the base of the pyramid with fruit, vegetables, and cereals). In our research, this difference is well highlighted by the percentages of adherent volunteers to olive oil consumption which are deeply dissimilar (97.3% according to KIDMED and 2.7% according to MDSS).

The two indexes consider a different number of servings for legumes and nuts. For legumes, the KIDMED index indicates an intake equal to or higher than 1 serving a week, while MDSS considers a double frequency of consumption per week. Anyway, the percentage of adherent volunteers is similar in our sample. In case of nuts, this difference is more evident: the KIDMED index indicates an intake of 2-3 servings a week, while MDSS considers a daily frequency of consumption (1-2 servings). For this reason, the percentage of adherent volunteers according to KIDMED questionnaire was more than double compared to the MDSS (35.4% vs 15.2%). Fish was the only item, which is perfectly comparable between the two methodologies, as the frequency of consumption is more than 2 servings/week, and moreover, the percentages of adherent volunteers are similar (50.2% according to KIDMED and 43.9% according to MDSS). Noteworthy differences occur for dairy products and sweets, which make the questionnaires not-comparable.

Finally, there are some components not included in one or the other questionnaire: potatoes, white and red meat consumption is not included in the KIDMED questionnaire, while the habit to go to fast-food restaurant and to skip breakfast are not included in MDSS, which considers only food consumption and not dietary habits. For these reasons, it is not possible to compare the two indexes, for these items. The strength of this study is that it is an in-person-administered survey: the administration of questionnaires occurred during face-to-face interviews conducted on one occasion, thus optimizing data quality, and allowing to verify immediately the consistency of answers related to food consumption. This kind of procedure inevitably imply the involvement of a small sample of volunteers, differently from online surveys which allow to reach a larger number of respondents; anyway, they don't give a chance to directly check the answers in the presence of the subjects to avoid bias and inconsistent reporting. The use of internationally validated questionnaires, suitable for adolescents, is another strength of the study. A limitation could be the current unequal number of males and females but, as we didn't investigate sex related parameters and didn't use sex specific questionnaires, in our opinion this item could be negligible for the purpose of the present research.

Conclusion

In understanding the relationship between MD and health, the evaluation of MD adherence is fundamental. Considering our sample of adolescents, we decided to apply the KIDMED questionnaire which is surely the most easy and suitable methods for younger population groups. Anyway, as also speculated in this paper, it does not give an exhaustive and real picture of adherence to MD, reason for which it has been reformulated, even if the original version is still the most used. Having available data on frequencies of consumption from FFQ, we established to calculate the MDSS and compare it to KIDMED to evaluate the correspondence of information obtained with the two different methods. As there are differences between methods, it is fundamental to recommend striving for agreement on the number food groups to consider, how they are measured and the dietary behaviors and lifestyle factors to include, as well as the methodology for assigning points in MD scoring systems. This approach will let comparisons across cultures and geographic regions since the topic is of great importance. Indeed, the lack of adherence of younger age groups to healthy dietary patterns, such as the MD, underlines the need to develop and apply nutritional education programs.

Author Contributions

All the authors conceptualized and designed the current research, performed the observational study and data analysis, wrote, and critically reviewed the manuscript; they have read and agreed to the published version of the manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not -for-profit sectors.

Acknowledgments

The authors gratefully thank the Youth Aggregation Centers for their availability and all the volunteers who provided time for interviews. Moreover, a special acknowledgment goes to Dr Sara Mestici; with her collaborative attitude, she effectively contributes to the provision of the results.

Declarations of Competing Interest

None.

References

1. Bach Faig A, Berry EM, Lairon D, Reguant J, Trichopoulou A, et al. (2011) Mediterranean Diet Foundation Expert Group. Mediterranean diet pyramid today. Science and cultural updates. Public Health Nutr 14(12A): 2274-2284.
2. Russo GL, Siani A, Fogliano V, Geleijnse JM, Giacco R, et al. (2021) The Mediterranean diet from past to future: Key concepts from the second "Ancel Keys" International Seminar. Nutr Metab Cardiovasc Dis 31(3): 717-732.
3. Karam G, Agarwal A, Sadeghirad B, Jalink M, Hitchcock CL, et al. (2023) Comparison of seven popular structured dietary programmes and risk of mortality and major cardiovascular events in patients at increased cardiovascular risk: systematic review and network meta-analysis. BMJ 380: e072003.
4. Dinu M, Pagliai G, Casini A, Sofi F (2018) Mediterranean diet and multiple health outcomes: an umbrella review of meta-analyses of observational studies and randomised trials. Eur J Clin Nutr 72: 30-43.
5. Becerra Tomás N, Blanco Mejía S, Viguiliouk E, Khan T, Kendall CWC, et al. (2020) Mediterranean diet, cardiovascular disease and mortality in diabetes: A systematic review and meta-analysis of prospective cohort studies and randomized clinical trials. Crit Rev Food Sci Nutr 60(7): 1207-1227.
6. Soltani S, Jayedi A, Shab Bidar S, Becerra Tomás N, Salas Salvadó J, et al. (2019) Adherence to the Mediterranean diet in relation to all–cause mortality: a systematic review and dose–response meta–analysis of prospective cohort studies. Adv Nutr 10: 1029-1039.
7. Bach A, Serra Majem L, Carrasco JL, Roman B, Ngo J, et al. (2006) The use of indexes evaluating the adherence to the Mediterranean diet in epidemiological studies: a review. Public Health Nutr 9(1A): 132-146.
8. Iaccarino Idelson P, Scalfi L, Valerio G (2017) Adherence to the Mediterranean Diet in children and adolescents: A systematic review. Nutr Met Cardiovascular Diseases 27(4): 283-299.
9. Zaragoza Martí A, Cabañero Martínez MJ, Hurtado Sánchez JA, Laguna Pérez A, et al. (2018) Evaluation of Mediterranean diet adherence scores: a systematic review. BMJ Open 8: e019033.
10. Bonaccio M, Iacoviello L, Donati MB, de Gaetano G (2022) The tenth anniversary as a UNESCO world cultural heritage: anunmissable opportunity to get back to the cultural roots of the Mediterranean diet. Eur J Clin Nutr 76(2): 179-183.

11. Trichopoulou A, Kouris Blazos A, Wahlqvist ML, Gnardellis C, Lagiou P, et al. (1995) Diet and overall survival in elderly people. BMJ 311: 1457-1460.
12. Trichopoulou A, Costacou T, Bamia C, Trichopoulou D (2003) Adherence to a Mediterranean and survival in a Greek population. N Engl J Med 348: 2599-2608.
13. Hutchins Wiese H, Bales C, Porter Starr K (2022) Mediterranean diet scoring systems: Understanding the evolution andapplications for Mediterranean and non-Mediterranean countries. British Journal of Nutrition 128(7): 1371-1392.
14. Vilarnau C, Stracker DM, Funtikov A, da Silva R, Estruch R, et al. (2019) Worldwide adherence to Mediterranean diet between 1960 and 2011. Eur J Clin Nutr 72: 83-91.
15. Biasini B, Rosi A, Menozzi D, Scazzina F (2021) Adherence to the Mediterranean diet in association with self-perception of diet sustainability, anthropometric and sociodemographic factors: a cross-sectional study in Italian adults. Nutrients 13(9): 3282.
16. Rosi A, Paolella G, Biasini B, Scazzina F, SINU Working Group on Nutritional Surveillance in Adolescents (2019) Dietary habits of adolescents living in North America, Europe or Oceania: A review on fruit, vegetable and legume consumption, sodium intake, and adherence to the Mediterranean Diet. Nutr Metab Cardiovasc Dis 29: 544-560.
17. Obeid CA, Gubbels JS, Jaalouk D, Kremers SPJ, Oenema A (2022) Adherence to the Mediterranean diet among adults in Mediterranean countries: a systematic literature review. Eur J Nutr 61: 3327-3344.
18. Buscemi S (2021) What are the determinants of adherence to the Mediterranean diet? Int J Food Sci Nutr 72(2): 143-144.
19. Veronese N, Notarnicola M, Cisternino AM, Inguaggiato R, Guerra V, et al. (2020) Trends in adherence to the Mediterra- 440 nean diet in South Italy: a cross sectional study. Nutr Metab Cardiovasc Dis 30: 410-417.
20. Aureli V, Rossi L (2022) Nutrition Knowledge as a Driver of Adherence to the Mediterranean Diet in Italy. Front Nutr 9: 804865.
21. Naja F, Hwalla N, Hachem, F, Abbas N, Al Zahraa Chokor F, et al. (2021) Erosion of the Mediterranean diet among adolescents: evidence from an Eastern Mediterranean Country. Br J Nutr 125(3): 346-356.
22. Noale M, Nardi M, Limongi F, Siviero P, Caregaro L, et al. (2014) For the Mediterranean Diet Foundation Study Group Adolescents in southern regions of Italy adhere to the Mediterranean diet more than those in the northern regions. Nutr Res 34(9): 771-779.
23. Sawyer SM, Azzopardi PS, Wickremarathne D, Patton GC (2018) The age of adolescence. Lancet Child Adolesc. Health 2(3): 223-228.
24. Serra Majem L, Ribas L, Ngo J, Ortega RM, Garcìa A, et al. (2004) Food, youth and the Mediterranean diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. Public Health Nutr 7(7): 931-935.
25. Aoun C, Bou Daher R, El Osta N, Papazian T, Khabbaz LR, et al. (2019) Reproducibility and relative validity of a food frequency questionnaire to assess dietary intake of adults living in a Mediterranean country. PLoS ONE 14(6): e0218541.
26. Monteagudo C, Mariscal Arcas M, Rivas A, Lorenzo Tovar ML, Tur JA, et al. (2015) Proposal of a Mediterranean diet serving score. PloS One 10(6): e0128594.
27. Intorre F, Foddai MS, Venneria E (2022) Mediterranean Diet Adherence in Adolescents of Different Cultures and Geographical Proveniences: A Pilot Study. Adolescents 2: 336-349.
28. Intorre F, Foddai MS, Venneria E (2023) Migration as Cultural Phenomenon in a Globalized World: A Pilot Study on Life style and Eating Behaviours of Adolescents Living in Rome. Adolescents 3(1): 92-109.
29. Serra Majem L, Ribas L, García A, Pérez Rodrigo C, Aranceta J, et al. (2003) Nutrient adequacy and Mediterranean Diet in Spanish school children and adolescents. Eur J Clin Nutr 57: 35-39.
30. Teixeira B, Afonso C, Rodrigues S, Oliveira A (2022) Healthy and Sustainable Dietary Patterns in Children and Adolescents: Systematic Review Adv Nutr 13(4): 1144-1185.
31. Bonaccorsi G, Furlan F, Scocuzza M, Lorini C (2020) Adherence to Mediterranean diet among students from primary and middle school in the Province of Taranto, 2016–2018. Int J Environ Res Public Health 17(15): 5437.
32. Mistretta A, Marventano S, Antoci M, Cagnetti A, Giogianni G, et al. (2017) Mediterranean diet adherence and body composition among Southern Italian adolescents. Obesity Research & Clinical Practice 11(2): 215-226.
33. Morelli C, Avolio E, Galluccio A, Caparello G, Manes E, et al. (2020) Impact of Vigorous-Intensity Physical Activity on Body Composition Parameters, Lipid Profile Markers, and Irisin Levels in Adolescents: A Cross-Sectional Study. Nutrients 12(3): 742.
34. Archero F, Ricotti R, Solito A, Carrera D, Civello F, et al (2018) Adherence to the Mediterranean diet among school children and adolescents living in Northern Italy and unhealthy food behaviors associated to overweight. Nutrients 10(9): 1322.
35. Cardamone E, Di Benedetto R, Lorenzoni G, Gallipoli S, Ghidina M, et al. (2023) Adherence to Mediterranean diet in Italy (ARIANNA) cross-sectional survey: study protocol. BMJ Open 13: e067534.
36. Milà Villarroel R, Bach Faig A, Puig J, Puchal A, Farran A, et al. (2011) Comparison and evaluation of the reliability of indexes of adherence to the Mediterranean diet. Public Health Nutr 14(12A): 2338-2345.
37. Hernández Ruiz A, García Villanova B, Guerra Hernández EJ, Amiano P, Azpiri M, et al. (2015) Description of indexes based on the adherence to the Mediterranean Dietary Pattern: a review. Nutr Hosp 32(5): 1872-1884.
38. Davis C, Bryan J, Hodgson J, Murphy K (2015) Definition of the Mediterranean Diet; A Literature Review. Nutrients 7: 9139-9915.
39. Real H, Queiroz J, Graça P (2020) Mediterranean food pattern vs. Mediterranean diet: a necessary approach? Int J Food Sci Nutr 71(1): 1-12.
40. Tabacchi G, Filippi AR, Amodio E, Jemni M, Bianco A, et al. (2015) A meta-analysis of the validity of FFQ targeted to adolescents. Public Health Nutr 19(7): 1168-1183.
41. Kourlaba G, Panagiotakos D (2009) The number of index components affects the diagnostic accuracy of a diet quality index: the role of intracorrelation and intercorrelation structure of the components. Ann Epidemiol 19: 692-700.
42. Altavilla C, Caballero Pérez P (2019) An update of the KIDMED questionnaire, a Mediterranean Diet Quality Index in children and adolescents. Public Health Nutr 22(14): 2543-2547.
43. López Gajardo MA, Leo FM, Sánchez Miguel PA, López Gajardo, D Soulas C, et al. (2022) KIDMED 2.0, An update of the KIDMED questionnaire: Evaluation of the psychometric properties in youth. Front Nutr 9: 945721.
44. (2020) World Health Organization. Healthy Diet.
45. Nardone P, Pierannunzio D, Ciardullo S, Lazzeri G, Cappello N, et al. (2020) Dietary habits among Italian adolescents and their relation to socio-demographic characteristics. Ann Ist Super Sanità 56(4): 504-513.

46. Giménez Legarre N, Santaliestra Pasías AM, Henauw S, Forsner M, González Gross M, et al. (2022) Breakfast consumptionand its relationship with diet quality and adherence to Mediterranean diet in European adolescents: the HELENA study. Eur J Clin Nutr 76(12): 1690-1696.

47. Wang DD, Li Y, Bhupathiraju SN, Rosner BA, Sun Q, et al. (2021) Fruit and Vegetable Intake and Mortality Results From 2 Prospective Cohort Studies of US Men and Women and a Meta-Analysis of 26 Cohort Studies. Circulation 143: 1642-1654.

48. Rosi A, Giopp F, Milioli G, Melegari G, Goldoni M, et al. (2020) Weight Status, Adherence to the Mediterranean Diet, Physical Activity Level, and Sleep Behavior of Italian Junior High School Adolescents. Nutrients 12(2): 478.

49. Monzani A, Ricotti R, Caputo M, Solito A, Archero F, et al. (2019) A systematic review of the association of skipping break-fast with weight and cardiometabolic risk factors in children and adolescents. What should we better investigate in the future? Nutrients 11(2): 387.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2024.56.008842

Federica Intorre. Biomed J Sci & Tech Res

Submission Link: https://biomedres.us/submit-manuscript.php