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Mediterranean diet adherence amongst adolescents in North Lebanon: the role of skipping meals, meals with the family, physical activity and physical well-being

Rosy N. Mitri[1]*, Christa Boulos[2] and Fouad Ziade[3]

[1]*Department of Nutrition & Dietetics, Faculty of Health Sciences, Beirut Arab University, Tripoli, Lebanon*
[2]*Department of Nutrition, Faculty of Pharmacy, Saint Joseph University, Beirut, Lebanon*
[3]*Faculty of Public Health III, Lebanese University, Tripoli, Lebanon*

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Abstract

The Mediterranean diet (MD) is a model of a healthy diet and healthy lifestyle. Adherence to the MD has been correlated with a reduction in many metabolic disorders including cancers. The factors associated with adolescents' adherence to the MD in North Lebanon using the KIDMED index have never been explored. Therefore, we thought to examine these factors amongst a sample of them. A cross-sectional survey was conducted in the city of Tripoli, North Lebanon. A total of 798 adolescents aged 11–18 years were randomly selected to participate in this study. All participants completed a questionnaire assessing adherence to the MD (KIDMED index), physical activity (physical activity questionnaires for older children and adolescents), health-related quality of life (KIDSCREEN-27 index) and sociodemographic characteristics (age, sex, grade level and parents' educational status). Anthropometric measurements, including weight, height and waist circumference, were also collected. Adherence to the MD was good amongst only 13·3 % of the adolescents. The prevalence rate of overweight and obesity was elevated, affecting 36·9 % of the students. Lower adherence to the MD was significantly correlated with skipping meals ($P = 0{\cdot}001$). Meanwhile, adolescents who were engaged in a high level of physical activity, those who consumed more meals with their families and those who benefited from better physical well-being had a better diet quality ($P < 0{\cdot}001$). Nutrition intervention programmes, as well as public health policies, would be of interest in order to improve diet quality amongst Lebanese adolescents.

Key words: **Mediterranean diet: Adolescents: Quality of life: Physical activity**

The Mediterranean dietary pattern has been used to describe the traditional dietary practices of countries bordering the Mediterranean Sea, such as Greece, southern Italy, Spain, Cyprus and Turkey, amongst others. This dietary pattern is rich in plant-derived products such as fruits, vegetables, breads and cereals (mainly wholegrains), beans, nuts and seeds, with olive oil as the main culinary fat used. It is also characterised by a low consumption of red meat and low-to-moderate intake of fish, poultry and wine, as well as high intakes of MUFA, fibres and antioxidants, such as vitamins E and C, resveratrol, polyphenols and Se[1]. There is a growing evidence of the numerous health benefits of this diet, including a reduction in the risk of CVD and a lengthened life expectancy[2]. Adherence to the Mediterranean diet (MD) was inversely associated with the metabolic syndrome[3], and with lower risks of cancer[4], and mental diseases such as depression[5]. These health benefits are mainly due to the synergistic effect of the diet's nutritional components, as well as other healthier habits like physical activity and social interaction such as sharing meals with others.

In recent decades, the majority of Mediterranean countries have more and more frequently abandoned this dietary pattern and substituted it with a high-energy, Westernised diet that is abundant in saturated fats while delivering a low amount of micronutrients. As a consequence of this nutrition transition, the obesity epidemic, along with other metabolic disorders, has risen dramatically in these countries[6]. The age group that has been most affected by this phenomenon is children and adolescents, where the traditional MD has been abandoned amongst youth in Turkey[7], Italy[8] and Greece[9], and was mainly related to poor consumption of fruits, vegetables and legumes and an overconsumption of commercially baked goods and sweets. Thus, in Lebanon, similar observations have been reported

Abbreviations: MD, Mediterranean diet; WHtR, waist:height ratio.

* **Corresponding author:** Rosy N. Mitri, email r.metri@bau.edu.lb

amongst a nationally representative sample, where 34·8 % of children and adolescents aged 6–19 years were overweight, and 13·2 % were obese[10].

The roots of most chronic diseases encountered during adulthood are largely linked to the nutritional choices adopted during adolescence[11]. Obese adolescents were at higher risk of becoming obese adults[12], and developing many chronic diseases in adulthood, including CVD, type 2 diabetes, certain types of cancers, in addition to psychological disorders[13,14]. Therefore, it is crucial to target this age group in order to decrease disease risks. The KIDMED index was developed by a group of Spanish researchers in order to evaluate youth (2–24 years old) compliance with the MD[15]. The results of a systematic review indicated that the KIDMED index was the most commonly used scoring index for assessing adherence to the MD amongst children and adolescents when compared with other tools such as the Mediterranean Diet Score and the food frequency-based Mediterranean Diet Score[16]. The KIDMED questionnaire has shown good validity and reliability for evaluating adherence to MD amongst young population from Mediterranean[17,18] and non-Mediterranean countries[19,20]. It has demonstrated adequate psychometric properties for assessing adherence to the MD in schoolchildren[20]. A review of the current available literature indicates that data are lacking in respect of factors associated with adolescents' adherence to the MD in North Lebanon. To our knowledge, the dietary pattern adopted by Lebanese teenagers has been assessed in the past using the FFQ and 24-h recall; however, none used the KIDMED index[21]. Hence, the objective of this study was to assess the level of MD adherence using the KIDMED test in a sample of Lebanese adolescents. The secondary objective was to explore the association between the adherence to the MD and the sociodemographic, eating habits and lifestyle factors of the participants, and to compare their dietary practices with similar studies conducted amongst adolescents in the Mediterranean region.

Methods

Study design and participants

This cross-sectional study was conducted between January and March 2019. The study included students aged 11–18 years enrolled in public and private schools in Tripoli for the academic years 2018–2019. Published studies regarding the adherence to the MD demonstrated that similar methodologies were used in the younger age group[22,23].

Sampling procedure

Based on a previously published paper conducted on Turkish adolescents[24], a total sample size of 780 students, distributed over the three categories of the score, was required to allow the detection of an 11 % decrease in KIDMED with a 5 % significance level and a 90 % study power. Turkey is a country with borders on the Mediterranean Sea, whose adolescents were also affected by this nutritional transition similar to the Lebanese youth[7].

Records provided from the Ministry of Education were used to compile a sampling frame of all schools in the City of Tripoli. Schools were randomly selected based on the stratified cluster sampling method. The strata were public and private schools, and complementary and secondary classes. Clusters were defined as the schools within each stratum, from which two schools were randomly selected. In total, our sample was composed of eight schools. The end units were all the students within the selected schools aged between 11 and 18 years and agreeing to participate. Students suffering from physical disabilities or who were absent on the days of the data collection were not invited to participate in the study.

Ethical approval

The study was approved by the Institutional Review Board of Beirut Arab University. Consent from students' parents was obtained regardless of whether the student was attending a private or public school.

Data collection

Each student completed a 25-min questionnaire, which was administered during school hours under the supervision of dietitians who received previous training to standardise the data collection procedures. A training session consisting of 2 h was performed prior to the data collection, where the objective of the study and sampling procedure were addressed, and special attention was provided to the standardisation of the anthropometric measurements procedure. The multicomponent questionnaire, which was completed through a face-to-face interview, evaluated the eating habits, sociodemographic characteristics, physical activity and quality of life of the participants. Each student was interviewed separately to ensure his privacy. The questionnaire was piloted in advance on a group of thirty students from different ages, in order to ensure the clarity of the questions. The data collection was carried out in the classroom in the presence of a teacher who helped in the questionnaire interpretation if needed. The results of piloting the questionnaire revealed that most of the questions were clear, except for two sentences that were paraphrased. Field monitoring was executed on the days of the school visits.

Measures

Eating habits. The KIDMED index was used to assess adherence to the MD and general meal habits (such as skipping breakfast). The index comprises sixteen yes-or-no questions with a total score ranging from −4 to +12[15]. Questions with a negative connotation (skipping breakfast, going to a fast-food restaurant more than once a week, eating pastries or baked goods for breakfast, eating sweets or candies several times a day) were given a score of −1, while the rest were given a score of +1. The total score was organised into three categories: ≤3, poor adherence; 4–7, average level of adherence and ≥8–12, good adherence[25]. The KIDMED index was followed by questions about the number of meals consumed daily and consumed with the family, as well as about the frequency of meals that were skipped.

Sociodemographic characteristics. Each adolescent provided information regarding his or her age, sex, grade level and parent's educational status (primary, complementary, secondary or university).

Quality of life. The KIDSCREEN-27, an internationally validated questionnaire, was used to assess the health-related quality of life of the participants. This tool consists of twenty-seven questions combining five dimensions of well-being: *physical wellbeing* (five items), *psychological well-being* (seven items), *parent relations and autonomy* (seven items), *social support and peers* (four items) and *school environment* (four items). The final score is the sum of all item responses. Better well-being was reflected through a high KIDSCREEN score[26].

The level of physical activity was evaluated using the physical activity questionnaires for children (below the age of 14 years) and adolescents (above the age of 14 years)[27].

Anthropometric measurements. Weight, height and waist circumference were measured for each student in duplicates using standardised techniques, and the average of two values was adopted[28]. Height was assessed in a standing position without shoes to the nearest 0·1 cm using a stadiometer. Feet were put together with buttocks, heels, scapulae and back of the head against the vertical board of the stadiometer during maximal expiration. Participants were weighed with light indoor clothing using an electronic digital calibrated scale to the nearest 0·1 kg. Waist circumference was measured in a standing position with non-stretchable flexible tape to the nearest 0·1 cm. BMI was calculated using the following formula: weight (kg)/height (m^2). The level of obesity was then estimated based on the Center for Disease Control and Prevention's age- and sex-specific growth charts. A value greater than the 85th percentile reflects overweight or obesity[29]. Central adiposity was defined according to the waist:height ratio (WHtR). A value of 0·5 or greater was used to detect children with elevated WHtR[30].

Statistical analysis

Means and standard deviations were calculated for continuous variables, while frequencies and percentages were generated for categorical variables. ANOVA test for the comparison of three means and χ^2 test were used to significantly identify the factors associated with adherence to MD amongst Lebanese adolescents. Multiple linear regression analysis using a stepwise technique was applied to identify the factors associated with adherence to the MD amongst Lebanese adolescents in a multivariate approach, where variables included in the equation were presented with their corresponding coefficients and *P*-values. To control for school's type, as children in the same school are likely to be correlated on a number of key variables, we performed a 'mixed model' analysis for the PAQ score and the KIDSCREEN-27 total score and the different subscales (physical well-being, psychological well-being, parent relations and autonomy, social support and peers and school environment), considering KIDMED categories as fixed effects and school as random effects. Data analysis was carried out using the Statistical Package for the Social Sciences (SPSS/PC version 22.0) software. All tests were two-tailed, and a *P*-value <0·05 was considered statistically significant.

Results

The baseline characteristics of the study sample (*n* 798) are presented in Table 1. The mean age of the participants was 15 years. Participants were distributed between complementary (56·4 %) and secondary classes (43·6 %). Those from private schools represented 52·5 % (*n* 419) of the whole sample. In addition, more than half of the parents attained a high educational level, especially the mothers (65·4 %). Prevalence rates of generalised overweight/obesity (according to BMI-for-age) and those of central obesity (evaluated by WHtR) were, respectively, 39·5 and 38·7 %. Moreover, skipping meals was highly prevalent, affecting almost 80 % of the sample.

Table 2 represents the factors associated with adherence to the MD amongst Lebanese adolescents in bivariate analysis. Adherence to the MD was high in 13·3 %, average in 57·5 % and poor in 29·2 % of the sample. Higher adherence to MD was reported amongst adolescents attending private schools when compared with those attending public schools ($P = 0·021$). Furthermore, students whose parents had a higher educational level benefited from a better adherence to the MD ($P = 0·048$). Skipping meals more often was significantly associated with a poor diet quality, while adolescents who consumed more meals per day with their families had a significantly higher KIDMED score ($P = 0·001$ and $P < 0·001$, respectively). A higher level of physical activity was also associated with a better adherence to the MD ($P < 0·001$). Finally, adolescents with a higher KIDMED score enjoyed a better general well-being (based on the KIDSCREEN total score) ($P < 0·001$), with significantly higher levels of physical and psychological well-being and better parental relationships, autonomy and school environment.

When all significant determinants following the bivariate analysis are taken into account in the multivariate analysis, the variables that remain positively associated with a higher KIDMED score are consuming more meals with the family ($P < 0·001$), engaging in a higher level of physical activity ($P < 0·001$) and a better physical well-being according to the KIDSCREEN score ($P < 0·01$), while skipping meals tends to be negatively correlated with a low KIDMED score ($P = 0·001$) (Table 3). The results of the mixed models revealed that three variables similar to the multivariate analysis came to be significant (skipping meals, meals with the family and physical activity), in addition to the school environment which emerged as a new variable instead of the physical well-being, which was significant in the multivariate analysis ($P < 0·001$) (Table 4).

Discussion

The current study reported data from 798 adolescents attending public and private schools in Tripoli, the capital of the North Lebanon Governorate, and evaluated the factors associated with adherence to the MD. The level of adherence to the MD was considered as poor amongst the participants; in fact, only 13·3 % of the adolescents had a good adherence to this traditional dietary

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Table 1. Characteristics of the adolescents by adherence to Mediterranean diet, health-related quality of life, physical activity, sociodemographic and anthropometric measurements*
(Mean values and standard deviations; numbers and percentages, $n = 798$)

	Total (n 798)	Mean	SD	%
Age		15	2·07	
Sex				
Male	422			52·9
Female	376			47·1
School				
Private	419			52·5
Public	379			47·5
Grade				
Complementary	450			56·4
Secondary	348			43·6
Father's education level				
Primary/Complementary	327			41·0
Secondary/University	471			59·0
Mother's education level				
Primary/Complementary	276			34·6
Secondary/University	522			65·4
PAQ total score		2·46	0·75	
KIDMED score				
Poor diet quality	233			29·2
Moderate diet quality	459			57·5
Optimal diet quality	106			13·3
BMI-for-age				
Underweight(<5th percentile)	40			5·1
Normal weight (5th–84th percentile)	438			55·4
Overweight (85th–94th percentile)	160			20·2
Obese (≥95th percentile)	153			19·3
Waist:height ratio (WHtR)				
Normal (<0·5)	489			61·3
High (≥0·5)	309			38·7
Skipping meals				
Never	157			19·7
Sometimes	544			68·2
Always	97			12·2
Number of meals (d)		3·04	0·94	
Number of meals with family (d)		2·03	0·87	

PAQ, Physical Activity Questionnaire.
* Means and standard deviations were calculated for continuous variables, while frequencies and percentages were generated for categorical variables.

pattern. A low adherence to the MD was also reported amongst Lebanese adolescents from private and public schools across Mount Lebanon and Beirut (15·8 %) in a recent study of 607 adolescents aged between 15 and 18 years[31].

Significant decreases in adherence to the MD were observed between 1997 and 2015 (using two different indexes: the composite MD and the Lebanese MD). Projections in 2030 reveal additional decreases, with less than a quarter of Lebanese adolescents continuing to follow this dietary pattern[32]. Compared with other Mediterranean countries where the KIDMED index was used, our results were above those reported amongst Turkish (7·7 %)[11], Italian (5 %)[8] and Greek adolescents (6·8 %)[9], but lower when compared with Spanish (30·9 %)[33] and Cretan adolescents (28·3 %)[34].

In the present study, skipping meals was associated with poor adherence to the MD. Similar findings were reported amongst Lebanese adolescents in Mount Lebanon and Beirut, where skipping breakfast in particular was correlated with poor adherence to the MD[31]. Skipping meals is associated with unnecessary snacking, particularly unhealthy food choices and energy-dense foods rather than the nutrient-dense items that are part of the MD[35,36]. Snacking is correlated with a reduction in the consumption of fruits and vegetables, which are essential food items of the MD[37]. The PANACEA study carried out in Greece revealed that the consumption of unhealthy salty snacks was associated with poor eating habits such as low adherence to the MD[38].

Another finding of this study relates to physical activity, which was strongly associated with adherence to MD. Having a healthy lifestyle involves making the right food choices and being physically active. Amongst Spanish adolescents, engagement in physical activities or, in contrast, spending more than 4 h daily watching television were main predictors of adherence to the MD[39]. Likewise, Greek and Italian adolescents who had low adherence to the MD were found to lead a more sedentary lifestyle[40,41]. The level of physical activity mediated the relationship between children's BMI and their adherence to the MD in the PANACEA study[42].

The current study demonstrated the beneficial influence of sharing meals with the family on improving adherence to the MD. Indeed, home-prepared meals are mostly based on traditional Lebanese cuisine, which focuses on various healthy and balanced dishes that are part of the MD. In addition, students living with their parents had a higher consumption of fruits and vegetables when compared with their peers who lived in a dorm[43]. Inversely, a transition to a more Westernised dietary pattern characterised the diet of young Greeks who had left their family home. Their new diet consisted of a higher intake of snack foods, fast foods, sugar and alcohol, with a reduced intake of vegetables, fruits, pulses and olive oil[44,45].

This study showed a strong association between adherence to an MD and self-perceived physical health, based on the KIDSCREEN questionnaire. The MD is abundant in vitamins, minerals and antioxidants, n-3 long-chain PUFA and MUFA (from olive oil), and the diet's positive effects on physical and mental health have been proven in many studies, lowering the incidence of diabetes, CVD and certain types of cancers[4,46]. In a cohort study amongst 11 015 Spanish adults, better adherence to the MD was found to be significantly correlated with improved mental and physical health[42]. Several other authors have associated the MD constituents with a better health-related quality of life[47–53].

Better adherence to the MD has been found to be associated with lower adiposity markers (such as BMI and WHtR) in some studies[53,54]. In some cases, this correlation was mediated by socio-economic status[55], as well as the educational level of the parents[56]. However, other investigators found no association at all[9,57]. The results of the current study could not find any association with BMI, nor with the WHtR, which could be explained by the fact that more than half of the adolescents (55·4 %) had a normal BMI-for-age and normal WHtR (61·3 %).

The findings of the present study should be seen in the light of their strengths and limitations. First, the authors used questionnaires that have been internationally validated amongst adolescents, such as the KIDMED, KIDSCREEN and the PAQ. Another main strength of this study is that data collection was carried

Table 2. Factors associated with adherence to Mediterranean diet amongst Lebanese adolescents (Numbers and percentages; mean values and standard deviations, bivariate analysis, $n = 798$)

				KIDMED score Low ≤ 3			KIDMED score Medium 4–7			KIDMED score High ≥ 8			
	n	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD	*P*
				29·2			57·5			13·3			
Age		15	2·07		15·09	2·02		14·46	2·08		14·01	2·0	<0·001*
Sex													
Male	422			27·3			58·1			14·7			0·280
Female	376			31·4			56·9			11·7			
School type													
Private	419			26·6			56·7			16·6			0·021*
Public	379			31·5			58·2			10·3			
Number of meals (d)		3·04	0·94		2·91	0·91		3·05	0·95		3·31	0·94	0·001*
Number of meals with family (d)		2·03	0·87		1·84	0·90		2·04	0·83		2·35	0·84	<0·001*
Grade													
Complementary	450			26·0			58·4			15·6			0·020*
Secondary	348			33·3			56·3			10·3			
Father's education level													
Primary/Complementary	327			31·2			59·0			9·8			0·048*
Secondary/University	471			27·8			56·5			5·7			
Mother's education level													
Primary/Complementary	276			31·9			58·0			10·1			0·123
Secondary/University	522			27·8			57·3			14·9			
PAQ total score		2·46	0·75		2·27	0·69		2·49	0·73		2·81	0·83	<0·001*
KIDSCREEN-27													
KIDSCREEN-27 total score		45·81	6·0		44·11	5·92		46·20	5·73		47·77	6·52	<0·001*
Physical well-being		44·85	8·44		43·00	8·73		45·07	8·05		48·0	8·50	<0·001*
Psychological well-being		37·38	4·41		36·75	4·82		37·59	4·20		37·88	4·23	0·029
Parents and autonomy		49·12	9·58		47·40	9·52		49·47	9·33		51·42	10·21	0·001*
Social support and peers		48·91	11·51		47·87	11·90		49·25	11·30		49·72	11·53	0·243
School environment		48·72	11·56		45·51	10·95		49·63	11·44		51·84	11·94	<0·001*
BMI-for-age													
Underweight (<5th percentile)	40			15·0			70·0			15·0			0·215
Normal weight (5th–84th percentile)	438			28·8			58·4			12·8			
Overweight (85th–94th percentile)	160			35·0			54·4			10·6			
Obese (≥95th percentile)	153			28·1			55·6			16·3			
Waist:height ratio (WHtR)													
Normal (<0·5)	489			27·8			58·9			13·3			0·536
High (≥0·5)	309			31·4			55·3			13·3			
Skipping meals													
Never	157			19·1			56·1			24·8			<0·001*
Sometimes	544			30·3			59·4			10·3			
Always	97			39·2			49·5			11·3			

PAQ, Physical Activity Questionnaire.
The difference between groups was examined using the χ^2 test for categorical variables and ANOVA test for continuous variables.
* $P < 0·05$ is considered as significant.

out through interviews, which could reduce the bias of self-reported data. In addition, the study was representative of adolescents attending schools in Tripoli. On the other hand, one of the limitations is the cross-sectional design, which prevents the investigation of causal relationships. Consequently, longitudinal studies should be undertaken to further investigate the association between those components in regard to adherence to the MD.

Conclusion and future implications

The results obtained from our study confirm previous findings reporting low adherence to the traditional MD amongst Lebanese adolescents. Consuming meals with the family, being physically active and physical well-being was positively associated with better adherence to the MD, whereas skipping meals tends to be negatively correlated.

Since adolescence is a critical phase in shaping health and nutritional choices, future interventions targeting Lebanese adolescents should be planned. These interventions should orient adolescents towards the benefits of the MD and should offer practical tips to improve their adherence. These types of interventions have shown a positive influence on shaping children's eating habits by increasing their fruits, vegetables, yogurt and/or cheese intake, while decreasing skipping breakfast, consumption of bakery products for breakfast and consumption of sweets[39]. Schools can act as a mediator in changing the adolescents' eating behaviours and, ultimately, in preventing obesity[58]. Intervention programmes that target nutrition and physical activity showed health benefits in preventing childhood obesity[59]. A school-based intervention programme delivered by a trained schoolteacher was successful in improving Lebanese children eating behaviours, such as increasing their

Table 3. Factors associated with KIDMED score – multiple regression analysis ($n = 798$)

	B	*t*	*P*	Variance inflation factor
(Constant)	2·465	1·537	0·125	
School type	–0·059	–0·270	0·788	1·633
Grade	0·155	0·505	0·614	3·133
Age	–0·074	–0·895	0·371	3·963
Skipping meals	–0·552	–3·377	0·001	1·129
Father's education level	0·007	0·032	0·974	1·365
Number of meals (d)	0·024	0·240	0·810	1·197
Number of meals with family (d)	0·448	4·159	0·000	1·173
PAQ total	0·523	3·899	0·000	1·370
KIDSCREEN-27 total score	–0·069	–1·684	0·093	8·255
Physical well-being	0·048	3·773	0·000	2·878
Psychological well-being	0·015	0·665	0·506	1·374
Parents and autonomy	0·022	1·475	0·141	2·795
School environment	0·028	1·848	0·065	2·145
Adjusted $R^2 = 0·133$	$F = 9·251$	$P < 0·0001$		

VIF: variance inflation factor.

breakfast consumption, while reducing crisp intake[60]. Another intervention delivered by nutritionist reduced the purchase of high-energy-dense snacks and beverages and raised the students' nutritional knowledge[61]. Furthermore, parents should participate in these programmes through educating them on how to make healthier choices when buying or preparing food at home.

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R. M. conceived and designed the study; she contributed to the questionnaire design, data collection supervision and co-ordination, data analysis and interpretation and writing and finalising the manuscript. F. Z. provided expertise in sampling methods, statistical analysis and revised and approved the final draft of the manuscript. C. B. assisted in the interpretation of data and revised and approved the final draft of the manuscript.

There are no conflicts of interest.

References

1. Davis C, Bryan J, Hodgson J, *et al.* (2015) Definition of the Mediterranean diet; a literature review. *Nutrients* **7**, 9139–9153.
2. Bonaccio M, Iacoviello L, De Gaetano G, *et al.* (2012) The Mediterranean diet: the reasons for a success. *Thromb Res* **129**, 401–404.
3. Godos J, Zappalà G, Bernardini S, *et al.* (2017) Adherence to the Mediterranean diet is inversely associated with metabolic syndrome occurrence: a meta-analysis of observational studies. *Int J Sci Nutr* **68**, 138–148.
4. Schwingshackl L & Hoffmann G (2015) Adherence to Mediterranean diet and risk of cancer: an updated systematic review and meta-analysis of observational studies. *Cancer Med* **4**, 1933–1947.
5. Aridi YS, Walker JL & Wright OR (2017) The association between the Mediterranean dietary pattern and cognitive health: a systematic review. *Nutrients* **9**, 674.

Table 4. Factors associated with KIDMED score – mixed model approach ($n = 798$)

Source		Type III sum of squares	df	Mean square	*F*	Sig.	Partial eta squared
Intercept	Hypothesis	14·961	1	14·961	2·548	0·111	0·003
	Error	4598·522	783·041	5·873			
Age	Hypothesis	4·040	1	4·040	0·684	0·408	0·001
	Error	4625·383	783	5·907			
Skipping meals	Hypothesis	67·865	1	67·865	11·488	0·001	0·014
	Error	4625·383	783	5·907			
Number of meals (d)	Hypothesis	0·440	1	0·440	0·074	0·785	0·000
	Error	4625·383	783	5·907			
Number of meals with family (d)	Hypothesis	102·118	1	102·118	17·287	0·000	0·022
	Error	4625·383	783	5·907			
PAQ total	Hypothesis	88·586	1	88·586	14·996	0·000	0·019
	Error	4625·383	783	5·907			
Physical well-being	Hypothesis	20·725	1	20·725	3·508	0·061	0·004
	Error	4625·383	783	5·907			
Psychological well-being	Hypothesis	2·656	1	2·656	0·450	0·503	0·001
	Error	4625·383	783	5·907			
Parents and autonomy	Hypothesis	12·647	1	12·647	2·141	0·144	0·003
	Error	4625·383	783	5·907			
School environment	Hypothesis	82·741	1	82·741	14·007	0·000	0·018
	Error	4625·383	783	5·907			
KIDSCREEN-27 total score	Hypothesis	16·764	1	16·764	2·838	0·092	0·004
	Error	4625·383	783	5·907			
School type	Hypothesis	0·035	1	0·035	0·012	0·923	0·007
	Error	4·896	1·734	2·823			
Father's education level	Hypothesis	0·026	1	0·026	0·011	0·934	0·011
	Error	2·428	1·002	2·424			
School Father's education level	Hypothesis	2·423	1	2·423	0·410	0·522	0·001
	Error	4625·383	783	5·907			

6. Musaiger AO, Al-Hazzaa HM, Takruri HR, *et al.* (2012) Change in nutrition and lifestyle in the Eastern Mediterranean Region: Health impact. *J Nutr Metab* **2012**, 436762.
7. Ċomert TK, Cerkez M, Tekin AG, *et al.* (2015) 'Compliance with mediterranean diet quality index (KIDMED) and eating patterns in school-age children with Gaziantep, Turkey'. *Am J Food Nutr* **3**, 28–33.
8. Roccaldo R, Censi L, D'Addezio L, *et al.* (2014) Adherence to the Mediterranean diet in Italian school children (The ZOOM8 Study). *Int J Sci Nutr* **65**, 621–628.
9. Mazaraki A, Tsioufis C, Dimitriadis K, *et al.* (2011) Adherence to the Mediterranean diet and albuminuria levels in Greek adolescents: data from the Leontio Lyceum ALbuminuria (3L study). *Eur J Clin Nutr* **65**, 219–225.
10. Nasreddine L, Naja F, Akl C, *et al.* (2014) Dietary, lifestyle and socio-economic correlates of overweight, obesity and central adiposity in Lebanese children and adolescents. *Nutrients* **6**, 1038–1062.
11. Cömert TK, Çerkez M, Tekin AG, *et al.* (2015) Compliance with Mediterranean Diet Quality Index (Kidmed) and eating patterns in school-age children with Gaziantep, Turkey. *Am J Food Nutr* **3**, 28–33.
12. The NS, Suchindran C, North KE, *et al.* (2010) Association of adolescent obesity with risk of severe obesity in adulthood. *JAMA* **304**, 2042–2047.
13. Black RE, Victora CG, Walker SP, *et al.* (2013) Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet* **382**, 427–451.
14. Park MH, Falconer C, Viner RM, *et al.* (2012) The impact of childhood obesity on morbidity and mortality in adulthood: a systematic review. *Obes Rev* **13**, 985–1000.
15. Serra-Majem L, Ribas L, Ngo J, *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**, 931–935.
16. Idelson PI, Scalfi L & Valerio G (2017) Adherence to the Mediterranean Diet in children and adolescents: a systematic review. *Nutr Metab Cardiovasc Dis* **27**, 283–299.
17. Rei M, Severo M & Rodrigues S (2021) Reproducibility and validity of the Mediterranean Diet Quality Index (KIDMED Index) in a sample of Portuguese adolescents. *Br J Nutr* 1–12. doi:10.1017/S000711452100053231
18. Štefan L, Prosoli R, Juranko D, *et al.* (2017) The reliability of the Mediterranean Diet Quality Index (KIDMED) questionnaire. *Nutrients* **9**, 419–427.
19. Atencio-Osorio MA, Carrillo-Arango HA, Correa-Rodríguez M, *et al.* (2020) Adherence to the Mediterranean Diet in college students: evaluation of psychometric properties of the KIDMED questionnaire. *Nutrients* **12**, 3897–3906.
20. Carrillo HA & Ramírez-Vélez R (2020) Adherence to the Mediterranean diet in a sample of Colombian schoolchildren: an evaluation of the psychometric properties of the KIDMED questionnaire. *Nutr Hosp* **37**, 73–79.
21. Naja F, Hwalla N, Itani L, *et al.* (2015) A Western dietary pattern is associated with overweight and obesity in a national sample of Lebanese adolescents (13–19 years): a cross-sectional study. *Br J Nutr* **114**, 1909–1919.
22. Archero F, Ricotti R, Solito A, *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**, 1322–1335.
23. Muros JJ, Cofre-Bolados C, Arriscado D, *et al.* (2017) Mediterranean diet adherence is associated with lifestyle, physical fitness, and mental wellness among 10-year-olds in Chile. *Nutrition* **35**, 87–92.
24. Sahingoz SA & Sanlier N (2011) Compliance with Mediterranean Diet Quality Index (KIDMED) and nutrition knowledge levels in adolescents. A case from Turkey. *Appetite* **57**, 272–277.
25. Kontogianni MD, Vidra N, Farmaki AE, *et al.* (2008) Adherence rates to the Mediterranean diet are low in a representative sample of Greek children and adolescents. *J Nutr* **138**, 1951–1956.
26. Ravens-Sieberer U, Auquier P, Erhart M, *et al.* (2007) The KIDSCREEN-27 quality of life measure for children and adolescents: psychometric results from a cross-cultural survey in 13 European countries. *Qual life Res* **16**, 1347–1356.
27. Kowalski KC, Crocker PR & Faulkner RA (1997) Validation of the physical activity questionnaire for older children. *Pediatr Exerc Sci* **9**, 174–186.
28. Lee R & Nieman D (2012) *Nutritional Assessment*, 6th ed. Boston: McGraw-Hill Companies.
29. Kuczmarski RJ (2002) 2000 CDC Growth Charts for the United States: Methods and development (No. 246). Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.
30. McCarthy HD & Ashwell M (2006) A study of central fatness using waist-to-height ratios in UK children and adolescents over two decades supports the simple message–'keep your waist circumference to less than half your height'. *Int J Obes* **30**, 988–992.
31. Mounayar R, Jreij R, Hachem J, *et al.* (2019) Breakfast intake and factors associated with adherence to the Mediterranean diet among Lebanese high school adolescents. *J Nutr Metab* **2019**, 2714286. https://doi.org/10.1155/2019/2714286.
32. Naja F, Hwalla N, Hachem F, *et al.* (2021) Erosion of the Mediterranean diet among adolescents: evidence from an Eastern Mediterranean Country. *Br J Nutr* **125**, 346–356.
33. Grao-Cruces A, Nuviala A, Fernández-Martínez A, *et al.* (2015) Relationship of physical activity and sedentarism with tobacco and alcohol consumption, and Mediterranean diet in Spanish teenagers. *Nutr Hosp* **31**, 1693–1700.
34. Chatzi L, Apostolaki G, Bibakis I, *et al.* (2007) Protective effect of fruits, vegetables and the Mediterranean diet on asthma and allergies among children in Crete. *Thorax* **62**, 677–683.
35. Grosso G, Marventano S, Buscemi S, *et al.* (2013) Factors associated with adherence to the Mediterranean diet among adolescents living in Sicily, Southern Italy. *Nutrients* **5**, 4908–4923.
36. Mithra P, Unnikrishnan B, Thapar R, *et al.* (2018) Snacking behaviour and its determinants among college-going students in Coastal South India. *J Nutr Metab* **2018**, 6785741.
37. Falbe J, Willett WC, Rosner B, *et al.* (2014) 'Longitudinal relations of television, electronic games, and digital versatile discs with changes in diet in adolescents'. *Am J Clin Nutr* **100**, 1173–1181.
38. Arvaniti F, Priftis KN, Papadimitriou A, *et al.* (2011) Adherence to the Mediterranean type of diet is associated with lower prevalence of asthma symptoms, among 10–12 years old children: the PANACEA study. *Pediatr Allergy Immunol* **22**, 283–289.
39. Bibiloni MD, Fernandez-Blanco J, Pujol-Plana N, *et al.* (2017) Improving diet quality in children through a new nutritional education programme: INFADIMED. *Gaceta Sanitaria* **31**, 472–477.
40. Papadaki S & Mavrikaki E (2015) Greek adolescents and the Mediterranean diet: factors affecting quality and adherence. *Nutrition* **31**, 345–349.
41. Santomauro F, Lorini C, Tanini T, *et al.* (2014) Adherence to Mediterranean diet in a sample of Tuscan adolescents. *Nutrition* **30**, 1379–1383.

British Journal of Nutrition

42. Priftis KN, Panagiotakos DB, Anthracopoulos MB, *et al.* (2007) Aims, methods and preliminary findings of the Physical Activity, Nutrition and Allergies in Children Examined in Athens (PANACEA) epidemiological study. *BMC Public Health* **7**, 1–7.
43. El Ansari W, Stock C & Mikolajczyk RT (2012) Relationships between food consumption and living arrangements among university students in four European countries-a cross-sectional study. *Nutr J* **11**, 28–35.
44. Kremmyda LS, Papadaki A, Hondros G, *et al.* (2008) Differentiating between the effect of rapid dietary acculturation and the effect of living away from home for the first time, on the diets of Greek students studying in Glasgow. *Appetite* **50**, 455–463.
45. Papadaki A, Hondros G, Scott JA, *et al.* (2007) Eating habits of university students living at, or away from home in Greece. *Appetite* **49**, 169–176.
46. Mattioli AV, Palmiero P, Manfrini O, *et al.* (2017) Mediterranean diet impact on cardiovascular diseases: a narrative review. *J Cardiovasc Med* **18**, 925–935.
47. Sánchez PH, Ruano C, De Irala J, *et al.* (2012) Adherence to the Mediterranean diet and quality of life in the SUN Project. *Eur J Clin Nutr* **66**, 360–368.
48. Crowe FL, Skeaff CM, Green TJ, *et al.* (2007) Serum phospholipid *n*-3 long-chain polyunsaturated fatty acids and physical and mental health in a population-based survey of New Zealand adolescents and adults. *Am J Clin Nutr* **86**, 1278–1285.
49. Liu C, Xie B, Chou CP, *et al.* (2007) Perceived stress, depression and food consumption frequency in the college students of China Seven Cities. *Physiol Behav* **92**, 748–754.
50. Mikolajczyk RT, El Ansari W & Maxwell AE (2009) Food consumption frequency and perceived stress and depressive symptoms among students in three European countries. *Nutr J* **8**, 31–37.
51. Myint PK, Welch AA, Bingham SA, *et al.* (2007) Fruit and vegetable consumption and self-reported functional health in men and women in the European Prospective Investigation into Cancer–Norfolk (EPIC–Norfolk): a population-based cross-sectional study. *Public Health Nutr* **10**, 34–41.
52. Schiepers OJ, De Groot RH, Jolles J, *et al.* (2010) Fish consumption, not fatty acid status, is related to quality of life in a healthy population. *Prostaglandins leukotrienes Essent Fat Acid* **83**, 31–35.
53. Panagiotakos DB, Chrysohoou C, Pitsavos C, *et al.* (2006) Association between the prevalence of obesity and adherence to the Mediterranean diet: the ATTICA study. *Nutrition* **22**, 449–456.
54. Schröder H, Marrugat J, Vila J, *et al.* (2004) Adherence to the traditional Mediterranean diet is inversely associated with body mass index and obesity in a Spanish population. *J Nutr* **134**, 3355–3361.
55. Lazarou C, Panagiotakos DB & Matalas AL (2009) Lifestyle factors are determinants of children's blood pressure levels: the CYKIDS study. *J Hum Hypertens* **23**, 456–463.
56. Antonogeorgos G, Panagiotakos DB, Grigoropoulou D, *et al.* (2013) The mediating effect of parents' educational status on the association between adherence to the Mediterranean diet and childhood obesity: the PANACEA study. *Int J Public Health* **58**, 401–408.
57. Trichopoulou A, Naska A, Orfanos P, *et al.* (2005) Mediterranean diet in relation to body mass index and waist-to-hip ratio: the Greek European Prospective Investigation into Cancer and Nutrition Study. *Am J Clin Nutr* **82**, 935–940.
58. Li YW, Yang Q, Lowry R, *et al.* (2003) Economic analysis of a school-based obesity prevention program. *Obes Res* **11**, 1313–1324.
59. Amini M, Djazayery A, Majdzadeh R, *et al.* (2015) Effect of school-based interventions to control childhood obesity: a review of reviews. *Int J Prev Med* **6**, 68–83.
60. Habib-Mourad C, Ghandour LA, Maliha C, *et al.* (2020) Impact of a one-year school-based teacher-implemented nutrition and physical activity intervention: main findings and future recommendations. *BMC Public Health* **20**, 1–7.
61. Habib-Mourad C, Ghandour LA, Moore HJ, *et al.* (2014) Promoting healthy eating and physical activity among school children: findings from Health-E-PALS, the first pilot intervention from Lebanon. *BMC Public Health* **14**, 1–11.

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