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Increased knowledge predicts greater adherence to the Mediterranean diet in Greek adolescents

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Abstract

Objectives: To examine knowledge of and adherence to the Mediterranean dietary pattern (MDP) among Greek adolescents, assess associations between MDP knowledge and adherence with BMI, and determine socio-cultural factors predicting MDP compliance.
Design: Cross-sectional.
Setting: Greek adolescents aged 15–17 years.
Subjects: Two hundred adolescents (103 females, ninety-seven males) from six schools on the Greek island of Chios. The sampling procedure was similar for all schools; schools were randomly selected from different geographic areas and all municipalities. BMI was calculated from measured height and weight; participants completed four questionnaires assessing parents' socio-economic status and education, adolescents' perceived and actual MDP knowledge, past-week dietary habits, and MDP adherence.
Results: Participants' BMI indicated 64·5% were normal weight and 35·5% were overweight/obese (mean BMI 23·7 (SD 3·8) kg/m^2). Over half had very poor MDP knowledge (58·5%) and adherence (59·5%); both perceived ($F = 3{\cdot}35$, $P = 0{\cdot}037$) and actual MDP knowledge ($F = 3{\cdot}45$, $P = 0{\cdot}034$) were significantly different across MDP adherence. Perceived MDP knowledge was positively correlated with vegetable consumption ($r = 0{\cdot}185$, $P = 0{\cdot}009$); actual knowledge was negatively correlated with meat consumption ($r = -0{\cdot}191$, $P = 0{\cdot}007$). BMI was negatively correlated with family income ($r = -0{\cdot}202$, $P = 0{\cdot}004$), indicating higher BMI in less affluent households. Actual MDP knowledge was the only significant predictor of MDP adherence (standardized $\beta = 0{\cdot}162$, $P = 0{\cdot}030$) in a model accounting for 7·3% of overall variance.
Conclusions: Greek adolescents reported consuming a more Westernized diet detached from the traditional MDP. Actual MDP knowledge and family income were important factors affecting MDP adherence and BMI, respectively. Promoting the traditional MDP among Greek adolescents and their families appears warranted.

Keywords
Mediterranean diet
Adolescents
Perceived knowledge
Adherence

During the past three decades, many epidemiological studies conducted worldwide have presented evidence for the essential role of diet and specific dietary components in the prevention and control of morbidity and premature mortality resulting from chronic diseases[1]. The Mediterranean dietary pattern (MDP) has been widely promoted as a healthy eating model[2]. This type of eating pattern gained attention following the Seven Countries study conducted by Keys and Grande[3], as they reported that Mediterranean countries following this eating pattern had lower rates of CHD and certain types of cancers, and a longer life expectancy.

The MDP is characterized by an abundance of plant foods such as fruits, vegetables, non-refined cereals and products, potatoes, beans, nuts and seeds[4]. Olive oil is the principal source of fat and moderate consumption of fish, poultry, dairy products (mainly cheese and yoghurt) and eggs is common, as is a relatively low consumption of red meat. Wine is consumed in low to moderate amounts, normally with meals[4].

Despite the growing scientific evidence that has followed the Seven Countries study about the MDP and its health benefits in both primary and secondary prevention of many chronic diseases such as obesity, CHD and type 2 diabetes mellitus[5–13], the national average of foods consumed in Greece has deviated from the MDP recommendations and Greece has adopted a more Westernized profile. With the exception of maintaining a high olive oil consumption and adequate fruit and vegetable intake, this deviation includes a greatly increased consumption of total energy, animal products, lipids other than olive oil and refined sugar[14,15].

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These changes in dietary patterns are also apparent among children and adolescents in many Mediterranean countries, including Greece. The abandonment of the traditional MDP and the Westernization of younger generations' dietary habits in these areas is thought to deteriorate their CVD risk profile[16–18], and predicts an unfavourable CVD morbidity and mortality for this population in the foreseeable future[19]. A school-based intervention study in Greek children and adolescents found an increased prevalence of CVD risk factors among approximately one-third of the participants[20].

The prevalence of obesity, which is considered one of the most important risk factors not only for CVD but also for other diseases such as diabetes and some cancers, has dramatically increased worldwide in children and adolescents[21,22]. According to Lobstein and Frelut[21], the results from the limited number of studies conducted in Greece have indicated that the prevalence of children's and adolescents' obesity in Greece is one of the highest in Europe. As obese children and adolescents are at high risk of becoming obese adults[23] and the development of CVD has its roots in childhood and adolescence[24], the implementation of therapeutic and preventive measures such as education to prevent and reduce obesity should be of high importance[19].

The unfavourable health profile of children and adolescents in Greece and the fact that dietary habits are established during childhood and adolescence make nutrition education a necessity in school programmes[25]. Consequently, the aims of the present study were to examine MDP knowledge and adherence among Greek adolescents, to assess the associations between MDP knowledge and adherence with BMI, and to determine whether various socio-cultural factors predict MDP compliance.

Subjects and methods

Recruitment and ethical approval

In the present cross-sectional study, 222 adolescent students from six schools located on the Greek island of Chios were initially asked to participate; 201 (90·54 %) agreed to participate. One student did not complete the survey during the data collection period; thus the final sample size was 200 (103 females and ninety-seven males). Ages ranged from 15 to 17 years and the sampling procedure was similar for all six schools that were included in the study for valid cross-regional comparison. The six schools were randomly selected from different geographic areas and from all municipalities of Chios. All participating students and their parents received an information sheet about the study and written consent was obtained from both students and their parents prior to participation in the study. Ethical approval was obtained from the School of Applied Community and Health Studies ethics committee at the University of Bristol.

Measurements

Anthropometric measurements were taken for each participant. Weight was measured to an accuracy of 0·01 kg with the use of a digital scale on participants without shoes and outer garments removed to leave only trousers or skirt and a T-shirt. Height was measured to the nearest 0·01 cm with the use of a measuring tape against a wall with the participants shoeless and in standing position with their shoulders relaxed and arms hanging freely. Participants' BMI was calculated by dividing weight (kg) by the square of height (m^2).

Questionnaires

Four questionnaires were given to the participants for completion in the classroom: (i) a questionnaire on personal characteristics, socio-economic status (SES) and parents' education level; (ii) a twenty-item questionnaire based on the principles of the Mediterranean diet pyramid[26] for the assessment of adolescents' perceived and actual knowledge about the MDP and its health outcomes; (iii) an FFQ for the assessment of their past-week dietary habits[27]; and (iv) a brief (sixteen-item) questionnaire (KIDMED) for assessment of their adherence to the MDP that has been successfully used among children and adolescents in Spain[28–30].

Statistical analysis

Means and percentages were calculated for demographic characteristics. Means and standard deviations for servings per week were calculated for all food group data. For this purpose adolescents' answers relative to their past-week food intake were grouped according to the Mediterranean diet pyramid as follows: meat, other meat-type foods (e.g. allantika, meat soup, mousaka), poultry, sweets, potatoes, fish, dairy products, fruits, vegetables, non-refined cereals and bread products, nuts, olives, eggs and pulses. BMI groups were calculated according to the cut-off points for adolescents' BMI defined by the International Obesity Taskforce (IOTF)[31].

Three categories were used to define adolescents' MDP adherence according to the KIDMED questionnaire[28–30]: (i) ≤3 points was defined as very poor adherence; (ii) 4–7 points was defined as medium adherence; and (iii) ≥8 points was defined as high adherence.

Four categories were used to define adolescents' knowledge about MDP recommendations: (i) ≤5 correct answers was defined as very poor knowledge; (ii) 6–10 correct answers was defined as poor knowledge; (iii) 11–15 correct answers was defined as medium knowledge; and (iv) 16–20 right answers was defined as high knowledge of the MDP and its health benefits. The first question of the MDP knowledge questionnaire assessed each adolescent's perceived knowledge (%) about the MDP.

Pearson correlations were calculated between participants' descriptive characteristics, perceived MDP knowledge, actual MDP knowledge and MDP compliance.

Pearson correlations were also calculated between perceived MDP knowledge, actual MDP knowledge, MDP compliance and the consumption of each food group. One-way ANOVA with associated *post hoc* Tukey tests were used to examine whether compliance with the MDP differed by participants' BMI, perceived MDP knowledge or actual MDP knowledge. All of these analyses were performed using the Statistical Package for the Social Sciences statistical software package version 14·0 (SPSS Inc., Chicago, IL, USA).

A linear regression model that controlled for the clustering of participants within schools was then performed using the XTREG procedure in the STATA statistical software package version 9·0 (Stata Corporation, College Station, TX, USA) to determine whether actual or perceived MDP knowledge predicted MDP compliance. The model included MDP compliance as continuous variable, with actual knowledge and perceived knowledge as independent variables while controlling for gender, age, BMI and family income. The associated within-group and between-group R^2 values for each model were obtained as was the overall R^2, which is comparable to the R^2 obtained from non-clustered models. Finally, a logistic regression model was run to determine whether actual MDP knowledge, perceived knowledge, gender, age, BMI or family income predicted whether participants had reasonable (4 or higher) or poor (3 or lower) MDP compliance. The model was run using the XTLOGIT command in STATA and controlled for the clustering of participants in schools. Alpha was set at $P < 0{\cdot}05$ for all analyses.

Results

Descriptive statistics for participant characteristics are shown in Table 1. The sample was 52% female and predominately from lower- to middle-income households. Participants were 15·8 (SD 0·6) years of age with a mean BMI of 23·7 (SD 3·8) kg/m^2. Classification by the IOTF criteria indicated that 129 (64·5%) were normal weight with fifty-one (25·5%) overweight and twenty obese (10·0%).

Descriptive statistics for the servings per week of key foods and adherence to the MDP are shown in Table 2. Participants were consuming 17·1 servings of fruits and 16·7 servings of vegetables weekly. This is approximately equivalent to 4·8 servings of fruits and vegetables daily. Analysis of the MDP questionnaire indicated that 119 (59·5%) of the participants had very poor MDP adherence, with 117 (58·5%) possessing poor or very poor actual knowledge. ANOVA indicated no difference in the BMI of participants with low, medium or high MDP adherence ($F = 0{\cdot}60$, df(2,1), $P = 0{\cdot}545$). There was a significant difference in perceived knowledge by MDP adherence ($F = 3{\cdot}35$, df(2,1), $P = 0{\cdot}037$) but there were no significant comparisons between the three adherence

Table 1 Descriptive statistics (frequencies and percentages, means and standard deviations) for participant characteristics: adolescents aged 15–17 years, Chios, Greece

	n	%
Gender		
Boys	97	48·5
Girls	103	51·5
Father's education		
Less than 6 years	26	13·0
6–12 years	58	29·0
More than 12 years	116	58·0
Mother's education		
Less than 6 years	37	18·5
6–12 years	89	44·5
More than 12 years	74	37·0
Father's working status		
Not working/retired	16	8·0
Working	184	92·0
Mother's working status		
House holding/retired	98	49·0
Working	102	51·0
Family income		
Low	92	46·0
Medium	96	48·0
High	12	6·0
	Mean	SD
Age (years)	15·8	0·6
BMI (kg/m^2)	23·7	3·8

Table 2 Descriptive statistics (means and standard deviations, frequencies and percentages) for consumption of individual food groups, adherence to and knowledge of the Mediterranean diet pattern (MDP): adolescents aged 15–17 years, Chios, Greece

	Mean	SD
Food groups (servings/week)		
Meat	7·79	4·62
Meat food	5·37	4·09
Poultry	2·34	2·17
Fish	3·77	3·05
Dairy products	18·92	10·24
Non-refined cereals and products	28·80	11·67
Pulses	2·94	2·39
Fruits	17·10	12·78
Vegetables	16·72	10·95
Potatoes	5·00	3·19
Sweets	16·10	11·87
Eggs	2·31	1·84
Olives	1·48	1·84
Nuts	1·70	1·67
	n	%
Adherence to MDP		
Very poor	119	59·5
Medium	56	28·0
High	25	12·5
Perceived knowledge of MDP		
Know nothing	19	9·5
Know a few recommendations	84	42·0
Know many recommendations	88	44·0
Know a lot of recommendations	9	4·5
Actual knowledge about MDP		
Very poor	6	3·0
Poor	111	55·5
Medium	82	41·0
High	1	0·5

Table 3 Regression model predicting compliance to the Mediterranean diet pattern: adolescents aged 15–17 years, Chios, Greece

Variable	Coefficient	SE	Standardized β	Z	P
Actual knowledge	0·329	0·15	0·162	2·17	0·030
Perceived knowledge	0·844	0·48	0·129	1·75	0·079
Gender	−1·194	0·67	−0·125	−1·78	0·075
Age	0·388	0·56	0·048	0·69	0·491
BMI	−0·061	0·09	−0·048	−0·67	0·506
Family income	−0·268	0·58	−0·034	−0·47	0·642
Within school $R^2 = 0·0725$			Between school $R^2 = 0·031$		Overall $R^2 = 0·073$

groups. There was a significant difference in actual knowledge of the three adherence groups ($F = 3·45$, df(2,1), $P = 0·034$), with Tukey *post hoc* tests indicating a difference between the low and medium adherence groups that approached significance ($P = 0·065$).

Correlations were calculated between participant characteristics, perceived MDP knowledge, actual knowledge and adherence with food group consumption. A number of significant correlations (all $P < 0·05$) were found. Gender was negatively associated with consumption of meat ($r = -0·245$), fish ($r = -0·141$), non-refined cereals ($r = -0·351$), sweets ($r = -0·150$) and nuts ($r = -0·252$), indicating lower consumption of these foods by boys. Mother's work status was negatively correlated with meat ($r = -0·158$), non-refined cereals ($r = -0·237$), pulses ($r = -0·150$), fruits ($r = -0·190$), vegetables ($r = -0·153$), sweets ($r = -0·217$) and nuts ($r = -0·162$), indicating that participants whose mother did not work consumed more of these foods. Perceived MDP knowledge was positively correlated with vegetable consumption ($r = 0·185$, $P = 0·009$) while actual knowledge was negatively correlated with meat consumption ($r = -0·191$, $P = 0·007$). BMI was negatively correlated with family income ($r = -0·202$, $P = 0·004$), indicating higher BMI in less affluent households.

The results of the regression model predicting MDP adherence are shown in Table 3. Actual knowledge was the only significant predictor of MDP adherence (standardized $\beta = 0·162$, $P = 0·030$) in a model that accounted for 7·3% of the variance within schools, 3·1% of the variance between schools and 7·3% of the overall variance.

Discussion

The results indicate that 35·5% of the 200 Chian adolescents participating in the present study were overweight or obese, and that more than half had very poor actual knowledge of, and adherence to, the MDP. There was no difference in BMI values between participants with low, medium or high MDP adherence, and actual knowledge was the only variable found to be a significant predictor of MDP adherence in this sample.

Many studies have presented strong evidence for the role of the Mediterranean diet in health promotion. The whole pattern apart from its individual nutrients is considered to be protective against several diseases[5,11,12,32]. Nevertheless, despite the existing evidence about its health benefits, the deterioration of the MDP is apparent in many studies conducted in Greece and other Mediterranean countries, not only among adult populations[11,17,33] but also among younger generations[27,29,34,35]. The results of the past-week FFQ in the present study indicted a lower consumption of food groups such as non-refined products, vegetables, olives and nuts, and a higher intake of meats and sweets. This eating pattern indicates a lower intake of foods considered protective against CVD and some cancers[7,9] and a higher intake of foods that could contribute to excessive energy intake and subsequent obesity. These results are consistent with data reported for fruit and vegetable intake in 11-year-old children in nine European countries (not including Greece); while fruit and vegetable intake varied widely across countries, total intake was less than currently recommended[36]. The results of the present study add to the growing body of literature indicating that Greek adolescents are no longer consuming a traditional MDP and the recommended servings of fruit and vegetables each day.

According to the theory of planned behaviour, knowledge is considered one of the most important predictors for food choices among adolescents[37]. In the present study perceived and actual knowledge were examined as was their potential association with MDP adherence. Although the direction of causality is not clear because of the cross-sectional design of the present study, regression findings have indicated that it is actual knowledge about the MDP that is key and appears to predict MDP adherence ($r = 0·2$, $P = 0·005$). Consequently, adolescents should be more aware about the MDP and its health benefits, as this may assist them in adopting a less Westernized way of eating that is lower in energy and saturated fat.

The findings of the present study suggest that prevention efforts need to focus on increasing actual MDP knowledge among Greek adolescents. According to Reynolds *et al.*[38], knowledge of the Five-A-Day guideline for fruit and vegetable consumption was the key to increasing fruit and vegetable intake among elementary-school children in the USA. These investigators also suggest that combining knowledge with goal setting is

likely to be more effective. Schools are considered suitable places for the implementation of interventions[39], and the results from studies conducted in Greece on school-based health promotion programmes show they are positively correlated with an increase in health knowledge[20,40,41]. Thus the implementation of a school-based nutrition education programme focusing on the MDP and its health benefits among Greek adolescents could be an essential step towards primary prevention of CVD and would be of substantial importance for future public health.

In the present study adolescents' BMI was negatively correlated with family income, indicating a higher BMI in adolescents living in less affluent households. These results are consistent with those found for adolescents living in countries such as the USA, UK and Australia, where children living in lower SES environments have higher BMI values[42–44]. There do not appear to be any published data on the relationship between SES and BMI among Greek adolescents. A study of Greek adults aged 18 to 87 years found that people living in lower and middle SES households had higher BMI[45]. This association between SES and BMI among Greek adults was mainly explained by lower physical activity levels and higher energy intakes in those of lower SES. As physical activity status and energy intake were not measured in the present study, it is not possible to determine the role they might play in the interaction between family income and BMI among Chian adolescents.

There are a number of limitations in the present study. The majority of data are self-reported and it is recognized that self-report measures of nutrient intake are subject to recall bias[46]. Additionally, the FFQ tool used in the present study for the assessment of adolescents' dietary habits provides information on habitual dietary patterns and can be used for assessment only of the frequency and not the actual quantity of the consumed foods. Another limitation is that the KIDMED index was developed for Spanish children and adolescents and has not been validated in Greek adolescents. However, there are no published tools to assess MDP adherence in Greek adolescents. For the purposes of the present study, it was felt that this tool was appropriate as it assesses adherence to general MDP principles that are widely applicable across various Mediterranean populations. Furthermore, the present study included a relatively small sample of adolescents from the Greek island of Chios. Although Chios is the fifth biggest island of Greece, its inhabitants (approximately 25 000) account for only a small percentage of the entire Greek population. Consequently, these results may not be generalizable to all Greek adolescents. However, the use of previously validated questionnaires in this sample of Chian adolescents (a group that has yet to be studied) can be considered an important strength which gives validity to the outcomes of the present study.

In conclusion, our findings suggest that the dietary habits of Chian adolescents present a more Westernized profile and a detachment from the traditional MDP. Actual MDP knowledge and family income seem to be the most important factors affecting adherence to the MDP and adolescents' BMI, respectively. A National Nutrition Policy for Greece that promotes the traditional MDP among adolescents and their families combined with an active lifestyle would likely result in a more favourable health profile in the future.

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