Mediterranean Journal of Nutrition and Metabolism 9 (2016) 137–147
DOI:10.3233/MNM-160066
IOS Press

Diet quality evaluated with the DQI-I and adherence to the Mediterranean diet in a Mediterranean sample of adolescents

R. Ferranti[a], M. Antoci[b], G. Giorgianni[b], F. Nolfo[b], S. Rametta[b], W. Currenti[c], M. Matalone[d] and A. Mistretta[b,*]

[a]*ATS Brescia. Equipe Territoriale Igiene, Brescia, Italy*
[b]*Department of Medical and Surgical Sciences and Advanced Technologies "G.F. Ingrassia", Section of Hygiene and Preventive Medicine, University of Catania, Catania, Italy*
[c]*University of Milan, Milan, Italy*
[d]*Department of School Policies, Municipality of Catania, CT, Italy*

Received 18 March 2016
Accepted 29 July 2016

Abstract.
BACKGROUND: The phenomenon of nutrition transition has been considered to greatly affect diet quality, especially of younger generations.
OBJECTIVE: The aim of this study was to evaluate, through the use of the Diet Quality Index-International (DQI-I), several aspects of the diet quality in a sample of Mediterranean adolescents.
METHODS: A cross-sectional investigation was conducted during two scholastic years (period October-May of 2012-13 and 2013-14) on 1643 adolescents attending 15 secondary schools of Sicily, southern Italy. Dietary information (through food frequency questionnaire), socio-demographic and lifestyle habits were collected.
RESULTS: The mean age of adolescents was 12.4 years and the mean total modified DQI-I score was 52.3% of the total possible score. Adolescents reported an intake of fruit between 50 and 100% of the recommended intake, while for vegetable and fibers more than 40% did not achieve the 50% of the recommendation. BMI, physical activity, breakfast habit and KIDMED were positively associated with DQI-I.
CONCLUSIONS: Diet quality of adolescent is low with a low adherence to traditional dietary patterns. Future intervention programs have to focus on increasing consumption of fresh fruits, vegetables and grains as well as in moderation of fat intake in order to achieve a better diet quality.

Keywords: Adolescent, DQI-I, KIDMED, fruits, vegetable

*Corresponding author: Antonio Mistretta, MD. Department of Medical and Surgical Sciences and Advanced Technologies "G.F. Ingrassia", Section of Hygiene and Preventive Medicine, University of Catania, Catania, Italy; Tel.: +39 095/3782182; Fax: +39 095/3782182; E-mail: anmist@unict.it.

ISSN 1973-798X/16/$35.00

1. Introduction

During last 50 years, a growing body of literature was made to explore the relation between health and overall diet quality from diverse perspectives and in a more comprehensive manner [1]. Indeed, most of recent studies focused on examining the contemporary consumption of many foods and multiple nutrients intake rather than studying the effects of single foods or nutrients as an indicator of diet quality [2]. This holistic approach of overall diet measure has been suggested to be more biologically plausible in assessing the role of dietary habits on modulating the risk of chronic diseases and results more strongly associated with disease risk than are single-index measures [3]. Many overall diet measures have been developed, including the Diet Quality Index (DQI) [4]. This diet quality measure represents one of the most complete tool to assess diet quality since take into account several nutritional concerns of both developed and developing countries considered necessary as a measure of a healthy diet (i.e., food variety, adequacy, moderation and overall balance). Moreover, a modified version of this instrument called Diet Quality Index-International (DQI-I) has been demonstrated to be effective to be used for international comparisons [5].

Assessment of diet quality is a major public health concern because it would provide information on dietary habits related to health status. The upcoming phenomenon of nutrition transition, intended as modification of food preferences from traditional to unhealthier dietary patterns, has been considered to greatly affect diet quality, especially of younger generations [6]. Among the most studied traditional dietary pattern, the Mediterranean diet has been the focus of attention over the last decades due to its association with decreased risk of metabolic, cardiovascular disease, and certain cancers [7–9].The Mediterranean diet has been considered a model of quality diet due to its main components: high consumption of fruit, vegetable, and legume as main source of fiber and plant antioxidant, such as vitamins and polyphenols [10–12]; frequent consumption of fish as main sources of proteins and poly-unsaturated fatty acids (PUFA), which demonstrated beneficial effects on cardiovascular and mental health [13, 14]; daily consumption of olive oil, as main source of mono-unsaturated fatty acids (MUFA) [15, 16]; moderate consumption of alcohol, which has been reported to be related with decreased risk of cardiovascular diseases [17, 18]; low consumption of meat and sweets, considered source of unhealthy fats, such as cholesterol and trans-fatty acids [19]. All together, the components of the Mediterranean diet resulted beneficial to a number of chronic diseases and supposed to be responsible for longer lifespan [20–22].

Adherence to Mediterranean diet has been lately reported to be decreased in Italy over the last decades, although higher adherence was yet associated with better metabolic outcomes [23–29]. Up to now, very few studies explored the association between adherence to the Mediterranean diet and diet quality evaluated with the DQI-I in young people living in Mediterranean countries [30, 31]. These studies suggested that higher adherence to a Mediterranean dietary pattern may be associated with better diet quality, although some concerns regarding the application of the DQI-I were found when applied to a Mediterranean population. The aim of this study was to evaluate, through the use of the Diet Quality Index-International (DQI-I), several aspects of the diet quality in a sample of Mediterranean adolescents.

2. Methods

2.1. Design, setting, participants

This study was a cross-sectional investigation conducted during two scholastic years (period October-May of 2012-13 and 2013-14) on 1643 adolescents of 13–16 years attending 15 secondary schools of Sicily, southern Italy. The schools were randomly selected in the urban area of the municipality of Catania. This was a stratified selection based on the socioeconomic level of the ten districts of the city to obtain a various range of socio-economic status (SES) among the participants. The classification of schools by SES was based on estimates of the district's socioeconomic level in which schools were located. For all enrolled school, adolescents attending

last year were invited to participate ($n = 1766$) and 1643 (93%) provided informed consent from parents and oral consent themselves prior to filling out the questionnaire. Participation was not compulsory and participants were assured of complete anonymity. The study was approved by the ethic committee of the Department of School Policies of Catania.

2.2. Data collection

Participants completed a self-administred questionnaire during school hours in the classroom in presence of a teacher and researchers, and attended a short clinical visit to perform anthropometric measurements (height and weight) in a separate room. BMI was then computed as weight in kilograms divided by the square of height in meters, and international age- and gender-specific cut-off points for children according to the International Obesity Task Force were used to define their weight status in terms of underweight, overweight and obesity [32].

Data collection was performed by three medical doctors and a member of the Department of the School Policies following a specific protocol to ensure that the same conditions were met for all participants.

The questionnaire consisted in a first part including demographic information, such as the adolescents' age, their parent's education level and job. Socio-cultural categories were given by other surveys taking into account education (primary, secondary/high school, and university) and occupation [unemployed and unskilled professions (i.e., manual workers); partially skilled professions (i.e., professors, nurses, etc.); skilled professions and white collars (i.e., medical doctors, lawyers, managers, etc.)] of participants' parents and was categorized in high, medium, and low according to the highest category achieved [33, 34]. Physical activity status was evaluated by Physical Activity Questionnaire for Adolescents (PAQ-A) [35].

2.3. Dietary intake measurements

The second part of the questionnaire focused on the dietary assessment based on a of food frequency questionnaires (FFQs) developed for Italian adolescents [36–38]. The food list included 62 items grouped in 11 principal food categories: i) breads and cereals; ii) meat and meat products; iii) fish; iv) milk and dairy products; v) legumes; vi) fresh fruits and nuts; vii) vegetables; viii) beverages; ix) sweets; x) olive oil; and xi) snacks and fast-foods. The response options for each food item were categorized in 9 categories: "seldom/never", "2–3 times/month", "once a week", "2–3 times/week", "4–6 times/week", "once a day", "2–3 times/day", "4–5 times/day", "6 or more times/day". The average portion sizes were identified through pictures of three different portions. Reproducibility and consistency of the questionnaire was measured throughout test–retest stability in 50 adolescents (64% girls, mean age of 12.7 years) and resulted acceptable in all groups except for oils and snacks.

For the analyses, the items of the FFQ containing more food components were separated according to their ingredients. The monthly or weekly food consumption was calculated in gr (or mL) and then converted in 24-h intake. Energy density and nutrient intakes were calculated according the Italian nutrition facts tables of the Research Centre for Food and Nutrition (CREA) [39].

2.4. Structure of the diet quality index

The DQI-I explores four major domains considered necessary to a healthy diet, i.e., variety, adequacy, moderation, and overall balance. The DQI-I incorporates an amount of both nutrients and foods in the assessment, providing a means with which to better describe the diversity of consumption from country to country. The basic rationale for the construction of the DQI-I has been described elsewhere [5]. In brief, current worldwide and individual national dietary guidelines encourage an adequate consumption of group of foods (variety) and key nutrients (adequacy) and suggest moderation in intake of certain compounds such as saturated fat, cholesterol, sodium and sugar. Finally, attention is pointed on overall balance, considered as a healthy proportion among

major components of the diet. However, the proposed cut-off points and corresponding scores by Tur et al [31] were used as more suitable to be applied to a Mediterranean population. The main four domains were evaluated as follow: (i) Variety was assessed by considering inclusion of serving per day of five main food groups (meat/poultry/fish/egg, dairy/beans, grains, fruits, and vegetables), with consumption of at least one of each food group indicating maximum overall variety score; (ii) Adequacy was assessed considering minimum intakes of key dietary elements, such as fruit, vegetables, grains and fiber, dependent on energy intake. Cut off values of 7118 kJ (1700 kcal), 9211 kJ (2200 kcal) and 11,304 kJ (2700 kcal) were used to define better diet quality with daily consumption of two, three, and four portions of fruit; three, four, and five portions of vegetable; >6, >9 and >11 portions of grains; and >20, >25 and >30 g of fiber, respectively. Proportion of total energy from protein >10% was considered adequate. Cut-off values for iron, calcium and vitamin C intake were derived from the recommended daily intakes for Italian adolescents [40]; (iii) Moderation was assessed considering maximum intakes of food and nutrients that may need restriction. Modification of the original DQI-I were used according results of the aforementioned study [31] suggesting an increase optimally to <30% of total energy/d (instead of 20%), due to presence of olive oil as main source of monounsaturated fatty acids (MUFA) in Mediterranean populations (other cut-off points are showed in Table 1); (iv) Overall balance indicated the proportion of energy sources and fatty acid composition. The scoring system consisted in an individual score for each of the main categories and an overall summary of all points ranging from 0 to 100 (0 being the poorest and 100 being the highest possible score). The analysis of the distinct domains of the index may help to identify aspects of the diet that most need improvement.

2.5. Structure of Mediterranean adherence score

The KIDMED index (Mediterranean Diet Quality Index for children and adolescent) developed by Serra-Majem et al. [41] was used to evaluate the different adherence to the Mediterranean diet. Increased consumption of foods characterizing the Mediterranean diet, such as fruit and vegetables, dairy products, grains and cereals, nuts, fish, and olive oil provided one point, while foods supposed to be away from this dietary patterns, such as sweets, meat and fast foods as well as lack of breakfast provided inverse points. For a maximum score of 12, a total score of 0–3 reflected poor adherence, a score of 4–7 described average adherence, and a score of 8–12 a good adherence to the Mediterranean diet.

2.6. Statistical analysis

The continuous measure of the DQI-I scores was presented as mean and standard deviations (SD) and summarized both as overall scores and individual scores in the four domains. Person's correlation coefficient was calculated to test correlation between the DQI-I scores (total and distinct domains) and the KIDMED scores. The total DQI-I scores were subsequently categorized into 2 categories identifying a good diet quality score >60 and multivariate regression analyses were used to study the association between the DQI-I scores and values of socio-economic status, habits, and body composition variables. A P-value < 0.05 was used to denote significant differences in all analyses. Tests were performed using SPSS 21.0 (SPSS Inc, Chicago, IL).

3. Results

The mean age of adolescents was 12.4 years (0.7 SD), the 53.9% were males and the 46.7% were overweight or obese. The mean total modified DQI-I score was 52.3% of the total possible score and 27% scored more than 60 (indicating an intermediate/good diet quality). The highest score was for variety, followed by adequacy and moderation. The lowest score was for overall balance (Table 1). Regarding the adequacy scores, most of

Table 1
Diet Quality Index-International (DQI-I) scores and the correlation coefficient with adherence to the Mediterranean Diet Quality Index for children and adolescent (KIDMED)

	Score ranges (points)	Mean and SD	r*
DQI-I, total	0–100	52.31 ± 8.89	0.38
Variety	0–20	13.09 ± 2.46	0.31
Overall food group variety	0–15	9.53 ± 2.19	0.27
Within-group variety for protein sources	0–5	3.56 ± 1.05	0.21
Adequacy	0–40	22.51 ± 3.81	0.33
Vegetable group	0–5	2.50 ± 1.29	0.32
Fruit group	0–5	3.15 ± 1.54	0.31
Grain group	0–5	2.11 ± 1.23	0.15
Fiber	0–5	2.51 ± 1.07	0.09
Iron	0–5	3.22 ± 1.32	0.11
Protein	0–5	3.73 ± 0.88	0.16
Calcium	0–5	2.84 ± 1.44	0.17
Vitamin C	0–5	2.45 ± 1.41	0.21
Moderation	0–30	13.48 ± 6.56	0.30
Total fat	0–6	2.41 ± 1.66	0.14
Saturated fat	0–6	2.41 ± 1.21	0.31
Cholesterol	0–6	2.93 ± 2.17	0.30
Sodium	0–6	3.82 ± 2.52	0.08
'Empty calorie foods'	0–6	1.91 ± 1.57	0.02
Overall balance	0–10	3.33 ± 2.07	0.10
Macronutrient ratio	0–6	1.12 ± 2.15	0.04
Fatty acid ratio	0–4	2.11 ± 1.64	0.12

*Person's correlation.

adolescents reported an intake of fruit between 50 and 100% of the recommended intake, while for vegetable and fibers more than 40% did not achieve the 50% of the recommendation (Table 2). Also regarding variety most of participants did not meet the recommended daily consumption of the aforementioned food groups (Table 2). Regarding moderation, the score in both total and saturated fat did not reach the half of the recommended intake. Intake of cholesterol was >300 mg/d in 47.8% of the participants and >400 mg/d in almost one third. Finally, poor overall balance was found for macronutrients ratio while MUFA+PUFA/SFA ratio was acceptable in more than half of adolescents. Correlation between the scores obtained for the overall DQI-I as well as the scores for each category and subcategory of the index and the KIDMED score showed a medium to low association between the two measures (Table 1). Among the four main domains, adequacy limited to fruit and vegetable intake and moderation to saturated fat and cholesterol were the highest correlated with the adherence to the Mediterranean diet (Table 1).

Potential determinants of and related factors to the DQI-I are shown in Table 3. BMI, physical activity, breakfast habit and KIDMED score were factors associated with DQI-I (Table 3). Overweight/Obese adolescents were less likely to have higher DQI-I scores than younger normal weight and underweight peers. Conversely, higher physical activity level and a daily breakfast consumption were positively associated with DQI-I score. Finally, adolescent with a good adherence to Mediterranean diet were 1.49 times more likely to have a higher DQI-I score.

Table 2
Components of Diet Quality Index-International (DQI-I) and the percentage of the study population in component subcategories

	Score ranges (points)	Points	Scoring criteria	%
Variety	0–20			
Overall food group variety	0–15	15	≥1 serving from each food group/d	17.4
		12	Any 1 food group missing/d	15.2
		9	Any 2 food groups missing/d	29.3
		6	Any 3 food groups missing/d	29.8
		3	≥4 food groups missing/d	8.3
		0	None from any food group	0.0
Within-group variety for protein sources	0–5	5	>100% recommendations	69.9
		3	50–100% recommendations	28.4
		1	<50% recommendations	1.7
		0	0% recommendations	0.0
Adequacy	0–40			
Vegetable group	0–5	5	>100% recommendations	27.1
		3	50–100% recommendations	32.4
		1	<50% recommendations	40.4
		0	0% recommendations	0.1
Fruit group	0–5	5	>100% recommendations	31.6
		3	50–100% recommendations	49.9
		1	<50% recommendations	18.5
		0	0% recommendations	0.0
Grain group	0–5	5	>100% recommendations	5.0
		3	50–100% recommendations	40.7
		1	<50% recommendations	48.7
		0	0% recommendations	5.6
Fiber	0–5	5	>100% recommendations	2.6
		3	50–100% recommendations	41.2
		1	<50% recommendations	53.1
		0	0% recommendations	3.1
Iron	0–5	5	>100% recommendations	29.6
		3	50–100% recommendations	56.4
		1	<50% recommendations	14.0
		0	0% recommendations	0.0
Protein	0–5	5	>100% recommendations	94.8
		3	50–100% recommendations	5.2
		1	<50% recommendations	0.0
		0	0% recommendations	0.0
Calcium	0–5	5	>100% recommendations	30.1
		3	50–100% recommendations	59.4
		1	<50% recommendations	10.5
		0	0% recommendations	0.0

(*Continued*)

Table 2
(*Continued*)

	Score ranges (points)	Points	Scoring criteria	%
Vitamin C	0–5	5	>100% recommendations	55.1
		3	50–100% recommendations	26.4
		1	<50% recommendations	18.3
		0	0% recommendations	0.2
Moderation	0–30			
Total fat	0–6	6	≤30% of total energy/d	10.2
		3	30–35% of total energy/d	18.6
		0	>35% of total energy/d	71.2
Saturated fat	0–6	6	≤7% of total energy/d	9.9
		3	7–10% of total energy/d	24.7
		0	>10% of total energy/d	65.4
Cholesterol	0–6	6	≤300 mg/d	52.2
		3	300–400 mg/d	20.4
		0	>400 mg/d	27.4
Sodium	0–6	6	≤2400 mg/d	60.1
		3	2400–3400 mg/d	28.8
		0	>3400 mg/d	11.1
'Empty calorie foods'	0–6	6	≤3% of total energy/d	7.7
		3	3–10% of total energy/d	14.3
		0	>10% of total energy/d	78.0
Overall balance	0–10			
Macronutrient ratio*	0–6	6	55–65 : 10–15 : 15–30	0.5
		4	65–68 : 9–16 : 13–32	1.9
		2	50–70 : 8–17 : 12–35	5.9
		0	Otherwise	89.7
Fatty acid ratio**	0–4	4	>2	24.2
		2	2–1.7	53.7
		0	<1.7	22.1

*carbohydrate:protein:fat; **(PUFA + MUFA)/SFA.

4. Discussion

In this study the diet quality of a sample of Mediterranean adolescents has been examined through the DQI-I, a composite measure of diet quality created to evaluate healthfulness of diet across countries for comparative work. Moreover, the effectiveness of the DQI-I has been tested according to its relation with background characteristics. Total DQI-I of the adolescents involved in our investigation reached around 50% of the total score, in line with previous studies conducted in Mediterranean and non-Mediterranean countries [5, 30, 31]. However, more than one third of the sample scored less than 50% of the total score, suggesting that a significant percentage of adolescents had low diet quality. Compared with previous similar investigations, we found a lower variety and adequacy score than those reported in other Mediterranean populations [30]. Similar values have been described in individuals living in Balearic Islands [30] whereas higher moderation scores have been encountered in southern Spain [31]. These results may reflect the economic development of rural areas that allow better financial resources

Table 3
Multivariate logistic regression between Diet Quality Index (DQI-I), socio-demographic variables and Mediterranean Diet Quality Index for children and adolescent (KIDMED) score

	DQI		Logistic regression	
	Mean	SD	OR	(95% CI)
Gender				
Male	52.5	8.9	1	–
Female	52.1	8.8	1.24	(0.79–3.66)
BMI				
Under/Normal	52.5	8.6	1	–
Overweight	50.7	9.6	0·84	(0.72–0.97)
Obese	48.7	8.2	0·77	(0.66–0.89)
Physical activity level				
Low	50.8	9.2	1	–
Medium	52.1	8.6	0.98	(0.65–1.51)
High	54.2	8.7	1.22	(1.07–1.40)
Parents' education, n (%)				
Secondary or lower	51.1	9.9	1	–
High school	52.2	8.4	1.01	(0.75–1.45)
University	52.1	8.5	1.05	(0.98–1.25)
Parents' occupation, n (%)				
Partially skilled professions or lower	50.5	9.7	1	–
Skilled professions	52.1	8.6	0.87	(0.62–1.23)
Specialized/managerial	54.2	8.7	0.97	(0.76–1.24)
Daily breakfast				
No	48.1	8.6	1	–
Yes	52.5	9.1	1.38	(1.05–1.81)
KIDMED score				
Low	50.1	8.8	1	–
Average	52.8	8.5	1.11	(0.92–1.34)
Good	52.9	9.2	1.49	(1.03–2.14)

and higher food availability observed in southern European countries [42]. The nutrition transition phenomenon and the "Westernization" of diet may have led to an increase in high-caloric high fat foods leading to the worldwide problem of overnutrition [42]. Notably, the total fat intake cut-off points were adjusted to <40%, thus results are not fully comparable with by Tur et al [31]. Nevertheless, the new cut-off points did not fully capture the optimal nutrients intakes in our sample. In contrast, although we reported that overnutrition represent a notable issue affecting the diet quality in our cohort, a high proportion of adolescents reported to have a weak consumption of the recommended intakes of many nutrients. The low intakes regarded fruit, vegetable, and fiber.

When comparing the scores of the DQI-I to the KIDMED score, a moderate correlation was found for total points and for some individual components of the index, including adequacy to vegetable and fruit, as well as moderation for saturated fats and cholesterol. In contrast, the lowest correlation was found for protein adequacy and total fat moderation. Regarding protein intake, the KIDMED score assign negative points to meat consumers while the DQI-I higher protein intake is indicating higher quality values. Regarding fat intake, olive oil is one of the main components of the Mediterranean diet but significantly contributes to total fat composition of the

diet due to its content in mono-unsaturated fatty acids. Olive oil is currently used in Mediterranean countries and similar proportion of PUFA, MUFA, and saturated fatty acids has been reported compared with previous investigations [30, 31]. However, in our sample we did not find a much higher intake of MUFA than PUFA, as previously reported. This may be explained because Sicilian inhabitants are also consuming high quantities of fish, which is the main source of PUFA in Mediterranean countries [23].

In this study we found that physical activity, having breakfast, and BMI status were independently associated with diet quality. Adolescents engaged in less physical activity and with higher BMI levels were more likely to have lower diet quality. A possible reason could be lack of control from parents that may lead to engagement in unhealthy behaviors. For instance, lack of breakfast may lead to more frequent out-of-home snaking during the day, which in turn increases the chances to eat junk and empty-calorie foods [43]. Higher BMI may be the results of such unhealthy behavior, which may occur as a result of lower diet quality and lower adherence to traditional dietary patterns [44, 45].

Results of this study should be considered in light of some limitations. First, a FFQ was used to test dietary intakes, but supplements or unknown foods items potentially not investigated in the questionnaire may affect accuracy of the study. The misreporting bias may lead to an underestimation of such food consumption and thus nutrients. Second, this method may be also affected by recall bias and participants may involuntarily under- or overestimate food intake. Regardless of these issues, this study allowed us to identify weaknesses of usual diet adopted by young populations living in Mediterranean countries. The main nutrition concern regarded the low intake of fruits and vegetables, and the lack of moderation in saturated fat, as reflected overall by low adherence to a Mediterranean dietary pattern. In the Sicilian setting, achieving overall balance through increased consumption of fresh fruits, vegetables and grains as well as moderation in fat intake is desired and technically possible due to the high availability of such foods. The results of this study provide insights that can be useful for public health experts to develop intervention programs focused on the weakness highlined. These finding may also be of interest to be compared with other countries experiencing similar nutrition transition level.

References

[1] Garcia-Alvarez A, Blanquer M, Ribas-Barba L, Wijnhoven TM, Tabacchi G, Gurinovic M, et al. How does the quality of surveys for nutrient intake adequacy assessment compare across Europe? A scoring system to rate the quality of data in such surveys. Br J Nutr. 2009;101(Suppl 2):S51-63.

[2] Blanquer M, Garcia-Alvarez A, Ribas-Barba L, Wijnhoven TM, Tabacchi G, Gurinovic M, et al. How to find information on national food and nutrient consumption surveys across Europe: Systematic literature review and questionnaires to selected country experts are both good strategies. Br J Nutr. 2009;101(Suppl 2):S37-50.

[3] Hernandez-Ruiz A, Garcia-Villanova B, Guerra Hernandez EJ, Amiano P, Azpiri M, Molina-Montes E. Description of indexes based on the adherence to the mediterranean dietary pattern: A review. Nutr Hosp. 2015; 32(5):1872-84.

[4] Patterson RE, Haines PS, Popkin BM. Diet quality index: Capturing a multidimensional behavior. J Am Diet Assoc. 1994;94(1):57-64.

[5] Kim S, Haines PS, Siega-Riz AM, Popkin BM. The Diet Quality Index-International (DQI-I) provides an effective tool for cross-national comparison of diet quality as illustrated by China and the United States. J Nutr. 2003;133(11):3476-84.

[6] De Craemer M, De Decker E, De Bourdeaudhuij I, Vereecken C, Deforche B, Manios Y, et al. Correlates of energy balance-related behaviours in preschool children: A systematic review. Obes Rev. 2012;13(Suppl 1):13-28.

[7] Grosso G, Buscemi S, Galvano F, Mistretta A, Marventano S, La Vela V, et al. Mediterranean diet and cancer: Epidemiological evidence and mechanism of selected aspects. BMC Surg. 2013;13(Suppl 2):S14.

[8] Grosso G, Marventano S, Yang J, Micek A, Pajak A, Scalfi L, et al. A Comprehensive Meta-analysis on Evidence of Mediterranean Diet and Cardiovascular Disease: Are Individual Components Equal? Crit Rev Food Sci Nutr. 2015:0.

[9] Buscemi S, Sprini D, Grosso G, Galvano F, Nicolucci A, Lucisano G, et al. Impact of lifestyle on metabolic syndrome in apparently healthy people. Eat Weight Disord. 2014;19(2):225-32.

[10] Zamora-Ros R, Knaze V, Lujan-Barroso L, Romieu I, Scalbert A, Slimani N, et al. Differences in dietary intakes, food sources and determinants of total flavonoids between Mediterranean and non-Mediterranean countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) study. Br J Nutr. 2013;109(8):1498-507.

[11] Zamora-Ros R, Knaze V, Lujan-Barroso L, Kuhnle GG, Mulligan AA, Touillaud M, et al. Dietary intakes and food sources of phytoestrogens in the European Prospective Investigation into Cancer and Nutrition (EPIC) 24-hour dietary recall cohort. Eur J Clin Nutr. 2012;66(8):932-41.

[12] Grosso G, Stepaniak U, Topor-Madry R, Szafraniec K, Pajak A. Estimated dietary intake and major food sources of polyphenols in the Polish arm of the HAPIEE study. Nutrition. 2014;30(11-12):1398-403.

[13] Marventano S, Kolacz P, Castellano S, Galvano F, Buscemi S, Mistretta A, et al. A review of recent evidence in human studies of n-3 and n-6 PUFA intake on cardiovascular disease, cancer, and depressive disorders: Does the ratio really matter? Int J Food Sci Nutr. 2015;66(6):611-22.

[14] Grosso G, Galvano F, Marventano S, Malaguarnera M, Bucolo C, Drago F, et al. Omega-3 fatty acids and depression: Scientific evidence and biological mechanisms. Oxid Med Cell Longev. 2014;2014:313570.

[15] Rondanelli M, Faliva MA, Peroni G, Moncaglieri F, Infantino V, Naso M, et al. Focus on pivotal role of dietary intake (diet and supplement) and blood levels of tocopherols and tocotrienols in obtaining successful aging. Int J Mol Sci. 2015;16(10): 23227-49.

[16] Grosso G, Yang J, Marventano S, Micek A, Galvano F, Kales SN. Nut consumption on all-cause, cardiovascular, and cancer mortality risk: A systematic review and meta-analysis of epidemiologic studies. Am J Clin Nutr. 2015;101(4):783-93.

[17] Giacosa A, Barale R, Bavaresco L, Faliva MA, Gerbi V, La Vecchia C, et al. Mediterranean way of drinking and longevity. Crit Rev Food Sci Nutr. 2014.

[18] Di Renzo L, Carraro A, Valente R, Iacopino L, Colica C, De Lorenzo A. Intake of red wine in different meals modulates oxidized LDL level, oxidative and inflammatory gene expression in healthy people: A randomized crossover trial. Oxid Med Cell Longev. 2014;2014:681318.

[19] Di Daniele N, Di Renzo L, Noce A, Iacopino L, Ferraro PM, Rizzo M, et al. Effects of Italian Mediterranean organic diet vs. low-protein diet in nephropathic patients according to MTHFR genotypes. J Nephrol. 2014;27(5):529-36.

[20] Sofi F, Macchi C, Abbate R, Gensini GF, Casini A. Mediterranean diet and health status: An updated meta-analysis and a proposal for a literature-based adherence score. Public Health Nutr. 2014;17(12):2769-82.

[21] Giacosa A, Barale R, Bavaresco L, Gatenby P, Gerbi V, Janssens J, et al. Cancer prevention in Europe: The Mediterranean diet as a protective choice. Eur J Cancer Prev. 2013;22(1):90-5.

[22] De Lorenzo A, Noce A, Bigioni M, Calabrese V, Della Rocca DG, Di Daniele N, et al. The effects of Italian Mediterranean organic diet (IMOD) on health status. Curr Pharm Des. 2010;16(7):814-24.

[23] Grosso G, Pajak A, Mistretta A, Marventano S, Raciti T, Buscemi S, et al. Protective role of the Mediterranean diet on several cardiovascular risk factors: Evidence from Sicily, southern Italy. Nutr Metab Cardiovasc Dis. 2014;24(4):370-7.

[24] Esposito K, Maiorino MI, Di Palo C, Giugliano D, Campanian Postprandial Hyperglycemia Study G. Adherence to a Mediterranean diet and glycaemic control in Type 2 diabetes mellitus. Diabet Med. 2009;26(9):900-7.

[25] Pierucci P, Misciagna G, Ventura MT, Inguaggiato R, Cisternino AM, Guerra VM, et al. Diet and myocardial infarction: A nested case-control study in a cohort of elderly subjects in a Mediterranean area of southern Italy. Nutr Metab Cardiovasc Dis. 2012;22(9): 727-33.

[26] Pounis G, Costanzo S, di Giuseppe R, de Lucia F, Santimone I, Sciarretta A, et al. Consumption of healthy foods at different content of antioxidant vitamins and phytochemicals and metabolic risk factors for cardiovascular disease in men and women of the Moli-sani study. Eur J Clin Nutr. 2013;67(2):207-13.

[27] Viscogliosi G, Cipriani E, Liguori ML, Marigliano B, Saliola M, Ettorre E, et al. Mediterranean dietary pattern adherence: Associations with prediabetes, metabolic syndrome, and related microinflammation. Metab Syndr Relat Disord. 2013;11(3):210-6.

[28] Grosso G, Marventano S, Galvano F, Pajak A, Mistretta A. Factors associated with metabolic syndrome in a mediterranean population: Role of caffeinated beverages. J Epidemiol. 2014;24(4):327-33.

[29] Buscemi S, Nicolucci A, Mattina A, Rosafio G, Massenti FM, Lucisano G, et al. Association of dietary patterns with insulin resistance and clinically silent carotid atherosclerosis in apparently healthy people. Eur J Clin Nutr. 2013;67(12):1284-90.

[30] Mariscal-Arcas M, Romaguera D, Rivas A, Feriche B, Pons A, Tur JA, et al. Diet quality of young people in southern Spain evaluated by a Mediterranean adaptation of the Diet Quality Index-International (DQI-I). Br J Nutr. 2007;98(6):1267-73.

[31] Tur JA, Romaguera D, Pons A. The Diet Quality Index-International (DQI-I): Is it a useful tool to evaluate the quality of the Mediterranean diet? Br J Nutr. 2005;93(3):369-76.

[32] Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: International survey. Bmj. 2000;320(7244):1240-3.

[33] Grosso G, Marventano S, Buscemi S, Scuderi A, Matalone M, Platania A, et al. Factors associated with adherence to the Mediterranean diet among adolescents living in Sicily, Southern Italy. Nutrients. 2013;5(12):4908-23.

[34] Lazarou C, Kalavana T. Urbanization influences dietary habits of Cypriot children: The CYKIDS study. Int J Public Health. 2009;54(2):69-77.

[35] Kowalski KC, Crocker RE, Donen RM. The Physical Activity Questionnaire for Older Children (PAC-C) and Adolescents (PAQ-A) Manual. Universtiy of Saskatchewan, Saskatoon, Canada. 2004.

[36] Turconi G, Bazzano R, Roggi C, Cena H. Reliability and relative validity of a quantitative food-frequency questionnaire for use among adults in Italian population. Int J Food Sci Nutr. 2010;61(8):846-62.

[37] Vereecken CA, Rossi S, Giacchi MV, Maes L. Comparison of a short food-frequency questionnaire and derived indices with a seven-day diet record in Belgian and Italian children. Int J Public Health. 2008;53(6):297-305.

[38] Grosso G, Mistretta A, Turconi G, Cena H, Roggi C, Galvano F. Nutrition knowledge and other determinants of food intake and lifestyle habits in children and young adolescents living in a rural area of Sicily, South Italy. Public Health Nutr. 2013;16(10):1827-36.

[39] Centro di ricerca per gli alimenti e la nutrizione. Tabelle di composizione degli alimenti. Available from: http://nut.entecra.it/646/tabelle_di_composizione_degli_alimenti.html. Accessed June 2015.

[40] Societá Italiana di Nutrizione Umana. IV Revisione dei Livelli di Assunzione di Riferimento di Nutrienti ed energia per la popolazione italiana (LARN) 2014. Available from: http://www.sinu.it/html/pag/tabelle_larn_2014_rev.asp. Accessed June 2015.

[41] Serra-Majem L, Ribas L, Ngo J, Ortega RM, Garcia A, Perez-Rodrigo C, et al. Food, youth and the Mediterranean diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. Public Health Nutr. 2004;7(7):931-5.

[42] Grosso G, Galvano F. Mediterranean diet adherence in children and adolescents in Southern European countries. NFS Journal. 2016;3:13-9.

[43] Giorgianni G, Nolfo F, Rametta S, Matalone M, Mistretta A. Eating and lifestyle habits in relation with weight status and place of living of adolescents in Sicily, Southern Italy. Mediterranean Journal of Nutrition and Metabolism. 2015;8(2):175-86.

[44] Di Renzo L, Tyndall E, Gualtieri P, Carboni C, Valente R, Ciani AS, et al. Association of body composition and eating behavior in the normal weight obese syndrome. Eat Weight Disord. 2015.

[45] Di Daniele N, Petramala L, Di Renzo L, Sarlo F, Della Rocca DG, Rizzo M, et al. Body composition changes and cardiometabolic benefits of a balanced Italian Mediterranean Diet in obese patients with metabolic syndrome. Acta Diabetol. 2013;50(3):409-16.