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The Diet Quality Index-International (DQI-I): is it a useful tool to evaluate the quality of the Mediterranean diet?

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The aim of this study was to assess whether the recently developed Diet Quality Index-International (DQI-I) could be used to evaluate diet quality of a Mediterranean population. A cross-sectional nutritional survey was carried out in the Balearic Islands (Spain) between 1999 and 2000. Dietary information (replicated 24 h recall and a food frequency questionnaire), and socio-demographic and lifestyle data were collected from a representative sample of the population (*n* 1200: 498 males and 702 females) aged 16–65 years (response rate 77·22 %). The DQI-I was developed according to the method defined by Kim *et al.* (2003), and focused on four major aspects of a high-quality diet (variety, adequacy, moderation and overall balance). The percentage of adherence to the Mediterranean dietary pattern (MDP) was also calculated and correlation analysis was carried out between the DQI-I score and the percentage of adherence to the MDP. The total score of the DQI-I reached 43 % of the possible score, indicating that the Balearic diet was a poor-quality diet. Correlation analysis between the DQI-I scores and adherence to the MDP showed that the DQI-I subcategories protein, iron and calcium adequacy were negatively correlated with the MDP. Furthermore, moderation in empty calorie food consumption and overall balance subcategories were not significantly correlated with the MDP. Due to some methodological factors and cultural biases, the proposed DQI-I scoring system is not useful to evaluate the quality of this Mediterranean-type diet. Further research is needed to develop a new diet quality index adapted to the MDP.

Diet quality: Diet Quality Index-International (DQI-I): Mediterranean diet: Balearic Islands

The traditional Balearic diet, found in the Balearic Islands at the beginning of the century, corresponds to the typical Mediterranean dietary pattern (MDP; Tur *et al.* 2004*a*,*b*,*c*,*d*). The MDP is characterized by a high intake of vegetables, legumes, fruits and nuts, cereals (that in the past were largely unrefined), a high intake of olive oil but a low intake of saturated lipids, a moderately high intake of fish (depending on the proximity to the sea), a low-to-moderate intake of dairy products (and then mostly in the form of cheese or yoghurt), a low intake of meat and poultry and a regular but moderate intake of alcohol, primarily in the form of wine and generally during meals (Trichopoulou & Vasilopoulou, 2000; Trichopoulou, 2001; Trichopoulou *et al.* 2003). The Mediterranean diet has been associated with better health and improvement in longevity (Trichopoulou & Vasilopoulou, 2000; Serra-Majem, 2001; Trichopoulou, 2001; Trichopoulou *et al.* 2003) and it has been promoted as a model for healthy eating (Serra-Majem, 2001; Hu, 2003; Trichopoulou *et al.* 2003). However, a major nutritional concern in Mediterranean countries is the loss of the Mediterranean diet. Epidemiological evidence suggests that dietary patterns in Mediterranean countries are changing rapidly, with increased consumption of animal products and saturated fat to the detriment of vegetable foodstuffs (Aranceta, 2001; Trichopoulou, 2001; Moreno *et al.* 2002). Reasons for this development can be found in the substantial socio-economic changes throughout all of Europe over the past 40 years. The observed departure from the Mediterranean diet in the Mediterranean countries might be accompanied by the loss of its protective effects on health and, consequently, a rise in diet-related diseases in the future, such as cardiovascular diseases and cancer (Serra-Majem *et al.* 1993).

The Nutritional Study of the Balearic Islands (ENIB) was carried out to describe the current pattern of food consumption in the Balearic Islands and to assess the nutritional status of the Balearic population (Tur *et al.* 2004*a*,*b*,*c*,*d*). The main interests in performing the Nutritional Study of the Balearic Islands were the analysis of secular changes in dietary patterns related to the nutrition transition and the loss of the traditional Mediterranean diet, as well as measuring diet quality and compliance with current nutritional recommendations. Compared to the dietary pattern prevalent in the Islands at the beginning of the last century, the fat and saturated fat content of the current Balearic diet has increased whereas the consumption of fruit, vegetables and fibre is lower than it used to be, indicating that the MDP is being lost in the Balearic Islands (Tur *et al.* 2004*a*). The degree of adherence to the MDP was further analysed (Tur *et al.* 2004*b*). The mean percentage of adherence to the MDP in this population was 43·14 % (SD 5·84) which was similar in all socio-demographic and lifestyle groups, with some differences according to age, sex and physical status. It was observed that being young and having sedentary lifestyles were significantly associated

Abbreviations: DQI-I, Diet Quality Index-International; MDP, Mediterranean dietary pattern; MDS, Mediterranean dietary score.

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with a lower adherence to the MDP. These findings are in agreement with previous studies which revealed the phenomenon of the nutrition transition in Mediterranean countries and the adoption of new dietary habits by the youngest generations (Aranceta, 2001; Trichopoulou, 2001; Moreno *et al.* 2002).

The aim of this study was to assess the quality of the Balearic diet using a comprehensive dietary index. The Healthy Eating Index and Diet Quality Index are good instruments to measure overall diet quality based on food group consumption, intake of nutrients associated with chronic disease or diet variety (Kant, 1996; Haines *et al.* 1999; Gerber *et al.* 2000; Marshall *et al.* 2001; Tangney *et al.* 2001; Weinstein *et al.* 2004). The recently developed Diet Quality Index-International (DQI-I; Kim *et al.* 2003) was chosen as the instrument to measure diet quality in the Balearic Islands since it was developed to make cross-national comparisons and it permits aspects of diet quality related to nutrition transition to be explored.

As stated above, nowadays the Mediterranean diet is considered one of the healthiest ways of eating and has been associated with lots of health outcomes including improvement in longevity (Trichopoulou & Vasilopoulou, 2000; Serra-Majem, 2001; Trichopoulou, 2001; Hu, 2003; Trichopoulou *et al.* 2003). As such, the usefulness of the DQI-I to assess diet quality in this Mediterranean population was examined in terms of how the scoring system successfully captured variation in the percentage of adherence to the MDP.

Subjects and methods

The present study is a population-based cross-sectional nutritional survey carried out in the Balearic Islands between 1999 and 2000.

Sample

The target population consisted of all inhabitants living in the Balearic Islands aged 16–65 years, and the sample population was derived from residents aged 16–65 years registered in the official population census of the Balearic Islands. The theoretical sample size was set at 1500 individuals in order to provide a specific relative precision of 5 % (type I error: 0·05; type II error: 0·10), taking into account an anticipated 70 % participation rate. The sampling technique included stratification according to geographical area and municipality size (six strata), age (three strata) and sex of inhabitants, and randomization into subgroups, with Balearic Islands municipalities being the primary sampling units, and individuals within these municipalities comprising the final sample units. Pregnant women were not considered in this study.

Questionnaires

Dietary questionnaires and a global questionnaire incorporating questions related to socio-economic status, education level, lifestyle factors and health status were utilized. The dietary questionnaires included two 24 h diet recalls and a validated quantitative food frequency questionnaire covering 145 food items (Serra-Majem & Ribas, 1996; Serra-Majem, 2000). The 24 h recalls were carried out twice during the study period, the first in the warm season (May to September) and the second in the cold season (November to March). This was done to avoid the influence of seasonal variations. The questionnaires were administered in the subject's home. A well-trained dietitian administered the survey measures, and verified and quantified the food questionnaires. To avoid bias brought on by day-to-day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. In order to estimate volumes and portion sizes, the household measures found in the subjects' own homes were used. Conversion of food into nutrients was made using a self-made computerized program based on Spanish (Moreiras *et al.* 2003; Mataix *et al.* 2004) and European Food (Feinberg *et al.* 1995) Composition Tables, and complemented with food composition data available for Balearic food items (Ripoll, 1992). Information about food consumption patterns was obtained from the food frequency questionnaire, whereas information on nutrient intake was derived from the average food daily consumption reported in the two 24 h recalls. More details of the surveys related to the methods of sampling and data collection appear elsewhere (Tur *et al.* 2004*a*,*b*,*c*,*d*).

Construction of the DQI-I

The DQI-I was calculated to assess the diet quality of the Balearic diet according to the method defined by Kim *et al.* (2003). The DQI-I focuses on four major aspects of a high-quality diet, i.e. variety, adequacy, moderation and overall balance. Under each of these categories there are specific components of diet to be assessed. These distinctive categories help users to readily identify aspects of the diet that most need improvement. Scores for each component are summarized in each of the four main categories, and the scores for all four categories are summed, resulting in the total DQI-I score, ranging from 0 to 100 (0 being the poorest and 100 being the highest possible score; see Table 1).

Variety. Variety in the diet is evaluated in two ways, i.e. overall variety and variety within protein sources, to assess whether intake comes from diverse sources both across and within food groups. Inclusion of at least one serving of food

Table 1. Diet Quality Index-International (DQI-I) scores and components (*n* 1200)

Component	Score ranges (points)	Mean	SD
DQI-I, total	0–100	42·87	10·09
Variety	0–20	9·70	5·91
Overall food group variety	0–15	7·58	4·64
Within-group variety for protein sources	0–5	2·12	1·62
Adequacy	0–40	22·67	4·66
Vegetable group	0–5	1·52	1·16
Fruit group	0–5	1·78	1·42
Grain group	0–5	1·44	1·04
Fibre	0–5	2·53	1·27
Protein	0–5	4·95	0·33
Iron	0–5	2·88	1·48
Calcium	0–5	3·53	1·37
Vitamin C	0–5	4·04	1·44
Moderation	0–30	10·35	4·65
Total fat	0–6	0·50	1·29
Saturated fat	0–6	0·74	1·63
Cholesterol	0–6	3·68	2·65
Sodium	0–6	5·14	1·66
Empty calorie foods	0–6	0·29	0·97
Overall balance	0–10	0·16	0·74
Macronutrient ratio	0–6	0·12	0·63
Fatty acid ratio	0–4	0·038	0·39

per day from each of the five food groups (meat/poultry/fish/egg, dairy/beans, grains, fruits, and vegetables) defines the maximum overall variety score. Variety among the protein sources (meat, poultry, fish, dairy, beans and eggs) is included to illustrate the benefits of including diverse sources of food in the diet even within the same food group. Intake of more than half the serving size per day is considered to be meaningful consumption. The variety category score was derived from the information obtained in the food frequency questionnaire. Information about the scoring system is illustrated in Table 2.

Adequacy. This category evaluates the intake of dietary elements that must be supplied sufficiently as a precaution against undernutrition and deficiency disorders. The recommended intake of fruit, vegetables, grains and fibre is dependent on energy intake. A diet that contains two to four servings of fruit and three to five serving of vegetables, depending on three levels of energy intake (7118 kJ (1700 kcal), 9211 kJ (2200 kcal) and 11 304 kJ (2700 kcal)), is given the highest score of five points. Daily intakes of six or more, nine or more, and eleven or more servings from the grain group and more than 20, 25 and 30 g of fibre for the three energy intake categories, respectively, meet the criteria for the highest score for the grain and fibre components. Intake of protein is adequate when the proportion of total energy from protein is more than 10 %. The level of intake that defines the highest score for adequacy of iron, calcium and vitamin C is derived from the recommended daily intakes for Spanish people (Moreiras *et al.* 2003), which vary according to age and gender.

Moderation. Moderation evaluates the intake of food and nutrients that are related to chronic diseases and that may need restriction. To emphasize the importance of moderation in fat intake, total fat intake in the DQI-I is evaluated using more stringent cut-off values than those found in other dietary indices. Caution for intake of saturated fats is also evaluated on the basis of percentage of energy from saturated fat. Intakes of cholesterol and sodium are examined on the basis of the level of the intakes (see Table 2). The 'empty calorie food' component assesses how much a person's energy supply is dependent on low-nutrient density foods, which provide energy but insufficient nutrients. The DQI-I stated that foods such as table sugar, alcohol and oil are empty calorie foods. In the DQI-I, if the sum of nutrient densities considered across nutrients in a food is <1, the food is considered to be an empty calorie food (see Table 2).

Overall balance. This category examines overall balance of diet in terms of proportion of energy sources and fatty acid composition. The detailed cut-off values and corresponding scores are described in Table 2.

Mediterranean dietary pattern

The MDP was defined according to a previously described score indicating the degree of adherence to the traditional Mediterranean diet (Trichopoulou *et al.* 2003). This Mediterranean dietary score (MDS) was converted to relative percentage of adherence using a previously described method (Sánchez-Villegas *et al.* 2002) that can be briefly summarized by the following steps.

An energy-adjusted value was obtained for each individual for the daily consumption of legumes, cereals, fruit (including nuts), vegetables, fish, meat (and meat products) and milk (and milk products). In order to score 'moderate alcohol consumption', a transformation centred at the level of consuming 30 g/d for men (30-|30-absolute alcohol intake|), and 20 g/d for women (20-|20-absolute alcohol intake|) was used to obtain the highest value for men consuming 30 g/d or women consuming 20 g/d, and progressively lower values as the consumption was lower or higher than these values. The ratio of monounsaturated to saturated fatty acids (MUFA/SFA) was calculated. All these values were standardized as a z value (observed intake – reference population mean intake/standard deviation of the reference population). The total MDS was computed adding up all the z scores obtained for the favourable or 'more Mediterranean' dietary components (legumes, cereals, fruit, vegetables, fish, moderate alcohol, MUFA/SFA ratio) and subtracting the z value obtained from the consumption of meat and milk:

$$\sum z_i = z_{\text{legumes}} + z_{\text{cereals}} + z_{\text{fruit}} + z_{\text{vegetables}} + z_{\text{MUFA/SFA}} + z_{\text{alcohol}} - z_{\text{meat}} - z_{\text{milk}}.$$

The MDS was converted to relative percentage of adherence using the range of values of the sample. This percentage ranged from 100 % (maximum adherence) to 0 % (minimum adherence).

$$\text{Adherence (percentage}_i) = \frac{(\Sigma z_i - \Sigma z_{\min}) \times 100}{(\Sigma z_{\max} - \Sigma z_{\min})}$$

More detailed information about the construction of this score has been described elsewhere (Tur *et al.* 2004*b*).

Statistical analysis

Analyses were performed with SPSS version 11.5 (SPSS Inc, Chicago, IL, USA). The scores of the DQI-I and its four main categories were descriptively summarized, both calculating the mean and standard deviation score obtained for each component of the DQI-I and the percentage of the sample in each component subcategory. Linear regression and Spearman correlation analysis were performed to assess the association between the observed overall DQI-I score as well as each category and subcategory scores, and the percentage of adherence to the MDP. A value of $P<0{\cdot}05$ was used to denote significant differences.

Results

Originally, 1554 subjects were included in the study, but the final sample size was 1200 individuals (77·22 % participation). Non-participation rates included potential subjects declining to be interviewed as well as involuntary non-participation due to census error caused by address changes, missing persons or unavoidable impediments to survey collaboration. The different sex distribution of the sample (58·5 % females and 41·5 % males) was partly caused by the greater female participation in the study (87·5 % of initially included women completed the study) compared to males (66·22 % participation). Nevertheless, the final sex distribution of the sample did not significantly differ from the current sex distribution in the Balearic population (Instituto Nacional de Estadística, 2003).

The total score of the DQI-I reached 43 % of the possible score (100 %). The best achieved score was the adequacy one, followed by the variety and moderation scores. Overall balance was the weakest area of the diet, according to the DQI-I standards (Table 1).

When the variety category is analysed, we can observe that 28·6 % of the sample consumed at least one serving from each

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

Component	Score ranges	Points	Scoring criteria	%
Variety	0–20			
Overall food group variety	0–15	15	≥1 serving from each food group/d	17·2
		12	Any 1 food group missing/d	11·4
		9	Any 2 food groups missing/d	15·5
		6	Any 3 food groups missing/d	25·9
		3	≥4 food groups missing/d	23·2
		0	None from any food group	6·9
Within-group variety from protein source	0–5	5	≥3 different sources/d	16·3
		3	2 different sources/d	28·6
		1	From 1 source/d	44·0
		0	None	11·0
Adequacy	0–40			
Vegetable group[a]	0–5	5	>100 % recommendations	7·2
		3	50–100 % recommendations	11·8
		1	<50 % recommendations	80·8
		0	0 % recommendations	0·2
Fruit group[a]	0–5	5	>100 % recommendations	1·5
		3	50–100 % recommendations	71·7
		1	<50 % recommendations	14·1
		0	0 % recommendations	12·7
Grain group[a]	0–5	5	>100 % recommendations	3·8
		3	50–100 % recommendations	16·3
		1	<50 % recommendations	76·7
		0	0 % recommendations	3·3
Fibre[a]	0–5	5	>100 % recommendations	11·1
		3	50–100 % recommendations	54·3
		1	<50 % recommendations	34·5
		0	0 % recommendations	0·1
Protein	0–5	5	>100 % recommendations	97·6
		3	50–100 % recommendations	2·2
		1	<50 % recommendations	0·1
		0	0 % recommendations	0·0
Iron[b]	0–5	5	>100 % recommendations	24·6
		3	50–100 % recommendations	44·8
		1	<50 % recommendations	30·6
		0	0 % recommendations	0·0
Calcium[b]	0–5	5	>100 % recommendations	40·3
		3	50–100 % recommendations	46·0
		1	<50 % recommendations	13·7
		0	0 % recommendations	0·0
Vitamin C[b]	0–5	5	>100 % recommendations	65·1
		3	50–100 % recommendations	21·7
		1	<50 % recommendations	13·2
		0	0 % recommendations	0·0
Moderation	0–30			
Total fat	0–6	6	≤20 % of total energy/d	2·2
		3	>20–30 % of total energy/d	12·3
		0	>30 % of total energy/d	85·5
Saturated fat	0–6	6	≤7 % of total energy/d	5·4
		3	>7–10 % of total energy/d	13·8
		0	>10 % of total energy/d	80·7
Cholesterol	0–6	6	≤300 mg/d	52·9
		3	>300–400 mg/d	16·9
		0	>400 mg/d	30·2
Sodium	0–6	6	≤2400 mg/d	76·5
		3	>2400–3400 mg/d	18·3
		0	>3400 mg/d	5·1
Empty calorie food	0–6	6	≤3 % total energy/d	0·9
		3	>3–10 % total energy/d	7·8
		0	>10 % total energy/d	91·3
Overall balance	0–10			
Macronutrient ratio (carbohydrate–protein–fat)	0–6	6	55–65:10–15:15–25	0·3
		4	52–68:9–16:13–27	1·7
		2	50–70:8–17:12–30	3·5
		0	Otherwise	94·5
Fatty acid ratio	0–4	4	P/S = 1–1·5; M/S = 1–1·5	0·9
		2	P/S = 0·8–1·7; M/S = 0·8–1·7	0·0
		0	Otherwise	99·1

M/S, ratio of MUFA to SFA intakes; P/S, ratio of PUFA to SFA intakes; SFA, saturated fatty acids.
[a] Based on 7118 kJ (1700 kcal)/9211 kJ (2200 kcal)/11 304 kJ (2700 kcal).
[b] Based on the recommended daily intakes for Spanish people (Moreiras *et al.* 2003).

food group or just one food group missing per day, and 16·3 % had three or more different sources of protein per day (Table 2). The adequacy score was the best achieved category of the DQI-I. Intakes above 50 % of the recommendations for proteins, vitamin C, calcium, fruit, iron and fibre were achieved by a high percentage of the population. However, the majority of the sample failed to meet the recommended levels of vegetable and grain group intake. In the moderation category, only 2·2 % and 5·4 % of the sample achieved the fat and saturated fat goals, respectively. Intakes of cholesterol $\leq$300 mg/d were observed in more than 50 % of the population and more than 75 % of the population met the goal for sodium intake. Only 1 % of the population had less than 3 % of energy from empty calorie foods. The goals for balance among energy-yielding nutrients as well as among fatty acids were very poorly met in this population.

In order to assess the usefulness of the DQI-I to assess the diet quality of the Balearic population, the scores obtained for the overall DQI-I as well as the scores for each category and subcategory of the index were correlated with the percentage of adherence to the MDP. It was hypothesized that if a high-quality diet, according to DQI-I, was correlated with a good maintenance of the MDP, the DQI-I could be considered a useful tool to assess the quality of a Mediterranean-type diet. As we can observe in Table 3, most of the components used to construct the DQI-I positively and significantly correlated with adherence to the MDP, although the correlation coefficients were not very high. The highest correlation coefficients were obtained for the overall DQI-I, vegetable adequacy and fruit adequacy categories. A greater diet adequacy in terms of its protein, iron and calcium content was associated with less adherence to the MDP. On the other hand, components of the DQI-I such as vitamin C, empty calorie foods, overall balance, macronutrient ratio and fatty acid ratio were not significantly related to the MDP.

Table 4 shows a different scoring criteria chosen to adapt certain subcategories of the DQI-I to the MDP. The cut-off value used to score moderation in fat intake was changed in order to better suit Mediterranean populations where the consumption of total fat is very high. Also olive oil and wine were excluded from the empty calorie food category and proportionality in fatty acids intake was assessed using a different system. Finally, linear regression and correlation analysis were carried out between the newly adapted DQI-I and the percentage of adherence to the MDP. The new DQI-I mean score and the mean categories and subcategories scores increased, resulting in a higher diet quality. Also, all the subcategories that were not correlated to the MDP using DQI-I cut-off values were significantly and positively correlated to the MDP after performing the modifications, with the exception of the moderation in empty calorie foods category.

Discussion

In this study, the DQI-I has been used to assess diet quality in a representative sample of the Balearic population with the aim of ascertaining possible nutritional problems related to the nutrition transition that may be occurring in this Mediterranean-type diet. Also the usefulness of this index to evaluate the diet quality of a Mediterranean population has been examined in terms of how it reflected variability in adherence to the MDP.

The total DQI-I obtained for the Balearic Islands diet reached only 43 % of full score, which is much lower than the mean scores observed in the USA and China (Kim *et al.* 2003). According to the criteria of Kim *et al.* (2003), scores of $<$60 % reflect poor-quality diets. Nevertheless, it is arguable whether or not the standards used to define high-quality diets according to the DQI-I criterion can be applied to assess the quality of Mediterranean-type diets.

Adequacy and variety were the areas of the Balearic diet that scored higher. Variety in the diet was evaluated in two ways, i.e. overall variety and variety within protein sources. Overall food group variety correlated better with adherence to the MDP than did protein source variety scores. It is worth arguing whether variety of animal food sources of dietary protein in cultures where

Table 3. Linear regression and correlation coefficient between overall Diet Quality Index-International (DQI-I), DQI-I categories and DQI-I subcategories scores, and the percentage of adherence to the Mediterranean dietary pattern

Component	Multiple *r*	Adjusted r^2	*b*	SE(*b*)	β	*P* value
DQI-I	0·36	0·13	0·23	0·02	0·36	0·000
Variety	0·25	0·06	0·28	0·03	0·25	0·000
Overall food group variety	0·25	0·06	0·36	0·04	0·25	0·000
Protein-sources variety	0·19	0·04	0·77	0·10	0·19	0·000
Adequacy	0·18	0·03	0·26	0·04	0·18	0·000
Vegetable group	0·39	0·15	2·19	0·13	0·39	0·000
Fruit group	0·37	0·14	1·73	0·11	0·37	0·000
Grain group	0·16	0·03	1·02	0·16	0·16	0·000
Fibre	0·08	0·01	0·44	0·13	0·08	0·001
Protein	0·12	0·01	−2·34	0·51	−0·12	0·000
Iron	0·10	0·01	−0·44	0·11	−0·10	0·000
Calcium	0·21	0·04	−1·01	0·12	−0·21	0·000
Vitamin C	0·05	0·00	0·24	0·12	0·05	0·046
Moderation	0·28	0·08	0·39	0·04	0·28	0·000
Total fat	0·10	0·01	0·49	0·13	0·10	0·000
Saturated fat	0·28	0·08	1·13	0·10	0·28	0·000
Cholesterol	0·14	0·02	0·36	0·06	0·15	0·000
Sodium	0·16	0·02	0·62	0·10	0·16	0·000
Empty calorie foods	0·04	0·00	0·33	0·18	0·05	0·059
Overall balance	0·01	0·00	0·09	0·23	0·01	0·697
Macronutrient ratio	0·02	0·00	0·24	0·27	0·02	0·381
Fatty acid ratio	0·02	0·00	−0·30	0·44	−0·02	0·493

Table 4. Components of the Diet Quality Index-International (DQI-I) adapted to the Mediterranean dietary pattern (MDP), proposed scoring criteria, and linear regression and correlation coefficient between the overall DQI-I, categories and subcategories adapted to the MDP and the percentage of adherence to the MDP

				Correlation with MDP					
Component	Score ranges	Mean	SD	*r*	*b*	*P* value	Scoring criteria	Points	% Population
DQI-I	0–100	48·40	11·32	0·377	0·218	0·000			
Moderation	0–30	13·47	5·79	0·226	0·256	0·000			
Total fat	0–6	1·37	2·20	0·087	0·260	0·001	≤30 % of total energy/d	6	14·5
							>30–35 % of total energy/d	3	16·7
							>35 % of total energy/d	0	68·8
Empty calorie food (without olive oil and wine)	0–6	2·53	2·50	0·003	0·008	0·911	≤3 % total energy/d	6	28·1
							>3–10 % total energy/d	3	28·4
							>10 % total energy/d	0	43·5
Overall balance	0–10	1·66	2·02	0·268	0·767	0·000			
Macronutrient ratio (carbohydrate–protein–fat)	0–6	1·52	1·54	0·052	0·227	0·043	55–65:10–15:15–30	6	2·5
							52–68:9–16:13–32	4	8·8
							50–70:8–17:12–35	2	32·5
							Otherwise	0	53·3
Fatty acid ratio (PUFA + MUFA/SFA)	0–4	1·41	1·73	0·308	1·167	0·000	>2	4	27·0
							1·7–2	2	16·7
							<1·7	0	56·3

SFA, saturated fatty acids.

animal foods are routinely consumed contributes to diet quality. Also, in dietary patterns undergoing the nutrition transition, as is the Balearic diet, protein variety scores may actually be higher due to changes in traditional protein sources. Therefore, in this context it would be more appropriate to use other criteria to assess variety within food groups such as variability in vegetables, fruit or grain sources.

Adequacy reflects compliance with prevailing recommendations to ensure a healthy diet. Despite the low average scores obtained for adequate intakes of fruit, vegetables, grain and fibre, these categories were positively and significantly associated with a greater adherence to the MDP. On the other hand, although adequacy in protein, iron and calcium intakes scored high in a large percentage of the population, they were negatively correlated to the MDP. This is obvious since the formula used to calculate the MDP score weighted unfavourably the consumption of meat (and meat products) and milk (and milk products). Vitamin C association with MDP can be considered non-significant. This might be caused by the fact that the population average intake of vitamin C almost doubles the recommended intake, and there might be a prevalent high consumption of vitamin C food sources independently of the degree of adherence to the MDP.

According to the DQI-I score, the Balearic diet is characterized by lack of moderation and it is highly unbalanced. Scores obtained for moderation in total fat and saturated fat consumption were very poor. Moderation in saturated fat intake scores were more strongly correlated to the MDP than moderation in total fat intake. DQI-I is based on a very strict set of standards, mainly for fat intake, in line with American recommendations. It is known that total fat intake in Mediterranean countries is in the range of 38–40 %, close to that of northern countries, whereas incidence of cardiovascular diseases and diet-related cancer is lower (Serra-Majem *et al.* 1997; Gerber *et al.* 2000). Olive oil is the central element of Mediterranean-type diets, a key contributor to the healthy aspects attributed to the Mediterranean diet, and it has been demonstrated that olive oil intake promotes higher vegetable intake in the Mediterranean area (Trichopoulos, 2002; Serra-Majem *et al.* 2003). It has traditionally been consumed in elevated quantities, which has led to high values of dietary lipids. As such, it is not the quantity but the quality of fat in the Mediterranean diet that should be addressed in any dietary guideline (e.g. reducing saturated fat without modifying olive oil consumption; Serra-Majem & Aranceta, 2001). The standard to define moderate fat consumption according to the DQI-I was set at <30 % of total energy. The current fat content of the Balearic diet is 39 % of total energy intake. Of the study sample, only 14·5 % show a fat intake at or below 30 % of energy intake. Therefore very low scores were obtained for the total fat moderation category. When the cut-off value to score fat moderation was increased to 35 %, the score rose from 0·50 to 1·37 and the correlation coefficient with the MDP also increased (Table 4). Nevertheless, the saturated fat cut-off value should not be modified, in line with prevailing nutritional recommendations in Mediterranean countries (Serra-Majem & Aranceta, 2001).

The scores obtained for moderation in the intake of empty calorie foods were very poor, and they were not significantly correlated with the MDP. Food items such as olive oil or wine were previously categorized in the DQI-I as empty calorie foods as they showed low nutrient densities. However, they should not be considered empty calorie foods in the Mediterranean context since these are very important components of the MDP. Olive oil contains a higher proportion of MUFA, vitamin E and a lot of antioxidant phenolic compounds (Owen *et al.* 2000; Visioli & Galli, 2001; Briante *et al.* 2003). Wine contains not only alcohol, but also vitamin E and antioxidant phenolic compounds (Bianchini & Vainio, 2003; Goldfinger, 2003; López-Velez *et al.* 2003; Pulido *et al.* 2003). When olive oil and wine were not included in the empty calorie food group category, the mean score went up from 0·29 to 2·53. However, the empty calorie food category without olive oil and wine was still not significantly correlated with the percentage of adherence to the MDP. Further research should be carried out to find a moderation indicator better suited to Mediterranean populations.

Overall balance category examines the proportionality in energy sources and fatty acid composition. The scores obtained for these components were not only very low but also did not correlate with the MDP. It should be noted that the proposed macronutrient ratios to define proportionality in energy sources always contained a percentage of energy from fat at or below

30 %. Once again, only a few individuals met this goal. When the cut-off value to assess energy from fat was modified to 35 %, the macronutrient ratio score increased from 0·12 to 1·52 and it was significantly correlated with the MDP (Table 4). As stated above, fat content of the MDP is high at the expense of the high unsaturated lipids consumption. Surprisingly, very low scores were obtained for the fatty acid composition component. The mean MUFA/SFA ratio in this sample is 1·6 but the mean PUFA/SFA ratio only reaches 0·4. In Mediterranean areas, olive oil is the most consumed source of unsaturated fat, hence involving a much higher intake of MUFA than PUFA. Actually, current Spanish Nutritional Objectives (based on prevailing Mediterranean dietary patterns), recommend 20 % of total energy from MUFA and 5 % from PUFA (Serra-Majem & Aranceta, 2001). The proposed PUFA/SFA ratios by the DQI-I are similar to the MUFA/SFA ratios (Table 2). Once again these standards are very difficult to extrapolate to this population. Other indicators of fatty acid balance such us the ratio MUFA + PUFA/SFA (normally used to study the cardiovascular risk of a diet) scored higher in this Mediterranean population and was positively correlated with the MDP, as shown in Table 4.

After modifying the scoring criteria of several components of the DQI-I in order to obtain a revised DQI-I suitable for use in Mediterranean regions, the overall DQI-I only increased by six points (from forty-two to forty-eight points). It is still a low score, reflecting a poor-quality diet. It should be analysed further whether the diet of the Balearic population is really a poor-quality diet or whether further modifications and adaptations of the scoring system are needed.

To conclude, it should be pointed out that the notion of a single diet quality score for cross-national comparisons is problematic. It is well known that any dietary recommendations should be based on prevailing food patterns in a population in order to be relevant and suitable to this specific population (Gerber *et al.* 2000; Aranceta & Serra-Majem, 2001; Serra-Majem & Aranceta, 2001). Several studies have reached the same conclusions (Drewnowski *et al.* 1996; Popkin *et al.* 2003). Therefore, diet quality indexes should be always carefully interpreted.

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