

Short communication

Adherence to the Mediterranean dietary pattern among the population of the Balearic Islands

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The aim of the present study was to assess the prevalence of the Mediterranean dietary pattern (MDP) in the population of the Balearic Islands and socio-demographic and lifestyle factors that might determine adherence to the MDP. A cross-sectional nutritional survey was carried out in the Balearic Islands between 1999 and 2000. A random sample (n 1200) of the adult population (16–65 years) was interviewed. Dietary questionnaires incorporating questions related to socio-economic status, education level, lifestyle factors and health status were utilised. Dietary habits were assessed by means of two 24 h recalls, and a quantitative food-frequency questionnaire. Adherence to the MDP was defined according to a score constructed considering the consumption of nine MDP characteristic components: high MUFA:saturated fatty acids ratio, moderate ethanol consumption, high legumes, cereals and roots, fruits, vegetables, and fish consumption, and low consumption of meat and milk. Then, socio-demographic, lifestyle and health status variables that could determine a higher or lower adherence were assessed. Adherence to the MDP among the population of the Balearic Islands was found to be 43.1 (SD 5.8) %, and was similar in all socio-demographic and lifestyle groups, with some differences according to age, sex and physical status. There was an increase in the percentage of adherence with age, which was greater in males than in females. A more physically active lifestyle was associated with a higher adherence to the MDP. The promotion of the Mediterranean lifestyle, including the MDP and greater physical activity, should be reinforced in the population of the Balearic Islands and especially in the younger generations.

Nutrition survey: Mediterranean diet: Balearic Islands

The Mediterranean diet can be described as the dietary pattern that was to be found in the olive-growing areas of the Mediterranean region in the late 1950s and early 1960s, when the consequences of World War II had been overcome, but before the fast-food culture had reached the area (Trichopoulou & Vasilopoulou, 2000; Trichopoulou, 2001). The traditional Mediterranean diet is characterised by a high intake of vegetables, legumes, fruits and nuts, and cereals (which 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 of 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 ethanol, primarily in the form of wine and generally during meals (Trichopoulou *et al.* 2003). The traditional Balearic diet corresponds to the typical Mediterranean dietary pattern (MDP; Tur, 2002).

The Mediterranean diet has been associated with better health and an improvement in longevity. Mortality statistics from the WHO database covering the period 1960–1990 have provided intriguing evidence that something unusual has been affecting in a beneficial way the health of the Mediterranean populations (Trichopoulou & Vasilopoulou, 2000; Trichopoulou, 2001). Ecological evidence suggesting beneficial health effects of the Mediterranean diet emerged from the classic studies of Keys (Trichopoulou, 2001; Hu, 2003; Trichopoulou *et al.* 2003). Direct evidence in support of the beneficial properties of the Mediterranean diet has also become available. The results of all these studies have linked a more Mediterranean diet with longer survival, protection against myocardial infarction, some cancers (breast cancer, colorectal cancer, prostate cancer, etc), diabetes, Alzheimer's and other diseases associated with oxidative processes (Trichopoulou & Vasilopoulou, 2000; Fernández-Jarne *et al.* 2002; Barzi *et al.* 2003; Hu, 2003; Trichopoulou *et al.* 2003).

Abbreviations: MDP, Mediterranean dietary pattern; MDS, Mediterranean dietary score; SFA, saturated fatty acids.

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Therefore the traditional Mediterranean diet meets several important criteria for a healthy diet and it has been promoted as a model for healthy eating (Hu, 2003; Trichopoulou *et al.* 2003).

Epidemiological evidence suggests that dietary patterns in the Mediterranean countries are changing rapidly, with an increased consumption of animal products and saturated fat and a decline of intake of basic foodstuffs based on vegetables (EPIC Group in Spain, 2002). Reasons for this development can be found in the substantial socio-economic changes throughout all of Europe over the past 40 years. All the recent nutritional surveys carried out in Spain in different groups of the population confirm a progressive departure from the traditional Mediterranean diet, mainly in younger generations (Aranceta, 2001; EPIC Group in Spain, 2002; Moreno *et al.* 2002; Sánchez-Villegas *et al.* 2002; Hu, 2003). All these changes observed in the Mediterranean diet involve deterioration not only of the macronutrient but also the micronutrient content of the Mediterranean diet and therefore its benefits on health (Serra-Majem, 2001).

The present study aimed to assess the prevalence of the MDP in the population of the Balearic Islands as well as socio-demographic and lifestyle factors that might determine the departure from or adherence to this dietary pattern.

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 randomisation into subgroups, with Balearic Islands municipalities being the primary sampling units, and individuals within these municipalities comprising the final sample units.

Questionnaires

Dietary questionnaires and a global questionnaire incorporating questions related to socio-economic status, education level, lifestyle factors and health status were utilised. Anthropometric measures were also obtained. Dietary questionnaires included two 24 h diet recalls and a quantitative food-frequency questionnaire covering 145 food items. The 24 h recall was carried out twice during the study period; the first in the warm season (May–September)

and the second in the cold season (November–March). This was to avoid the influence of seasonal variations. To avoid bias brought on by day-to-day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. Conversion of food into nutrients was made using a self-made computerised program based on Spanish (Mataix *et al.* 1998; Moreiras *et al.* 2003) and European (Favier *et al.* 1995) food composition tables and complemented with food composition data available for Majorcan food items (Ripoll, 1992). Identification of under-reported food intake was made using the energy intake:BMR ratio; <1.14 classified the individual as an under-reporter (Goldberg *et al.* 1991).

Mediterranean dietary pattern

The MDP was defined according to a previously defined score indicating the degree of adherence to the traditional Mediterranean diet (Trichopoulou *et al.* 1995, 2003). This Mediterranean dietary score (MDS) was converted to relative percentage of adherence using a previously described method (Sánchez-Villegas *et al.* 2002) that will now be briefly summarised.

An energy-adjusted value was obtained for each individual for the daily consumption of legumes, cereals and roots (including bread and potatoes), 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 progressive lower values as the consumption was lower or higher than these values. These values were associated with the lowest CHD risk in previous studies (Stampfer *et al.* 1988; Rimm *et al.* 1991). Information about the consumption of all these food items was obtained from the food-frequency questionnaire. The daily intake of fatty acids was calculated as the average intake recorded from the two 24 h recalls, and the MUFA:saturated fatty acids (SFA) ratio was calculated.

All these values were standardised as a Z value. A Z score expresses the difference between the individual's measurement and the mean value of the reference population (in this case, the study population), as a proportion of the SD of the reference population (observed intake–mean intake/SD). The total MDS was computed by adding up all the Z scores obtained for the favourable or 'more Mediterranean' dietary components (legumes, cereals and roots, fruit, vegetables, fish, moderate alcohol, MUFA:SFA ratio) and subtracting the Z value obtained from the consumption of meat and milk:

$$\sum Z_i = Z_{\text{legumes}} + Z_{\text{cereals and roots}} + Z_{\text{fruit}} + Z_{\text{vegetables}} + Z_{\text{fish}} \\ + Z_{\text{moderate alcohol}} + Z_{\text{MUFA:SFA}} - Z_{\text{meat}} - Z_{\text{milk}}$$

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

(minimum adherence):

$$\text{Adherence (Percentage)}_i = \frac{(\sum Z_i - \sum Z_{\min}) \times 100}{(\sum Z_{\max} - \sum Z_{\min})}$$

Once the percentage of adherence to the MDP was calculated, the variables that could determine a higher or lower adherence were assessed.

Statistics

Analyses were performed with SPSS version 10.0. Mean adherence values and SD were calculated. Quartile values of adherence to the Mediterranean diet were calculated in order to find the group of the population with the lowest adherence percentage (percentage below the lower quartile value) and those with the highest adherence (percentage above the upper quartile value). To further study the socio-demographic and lifestyle differences between those with the lowest and the highest adherence (in order to assess which variables better determined a high or low adherence), logistic regression models were used with the calculations of corresponding age- and sex-adjusted odds ratios and 95 % CI. The level of significance was established for P values < 0.05 .

Results

A total of 1200 individuals formed part of the present study (80 % participation). Under-reporters were excluded from the analysis of dietary patterns in order to avoid respondent bias usually present in recall dietary methods.

Fig. 1 shows that the distribution of percentage of adherence to the MDP roughly follows a normal distribution. The mean adherence is 43.14 (SD 5.84) % and the median adherence is 42.07 %.

Means and SD of the percentage of adherence are shown in Table 1, together with age- and sex-adjusted odds ratios for a low adherence. Females' percentage of adherence to the

MDP is greater than males', although this difference is not statistically significant after adjusting for age. A significant inverse association can be observed between age and the risk of low adherence. This trend of increasing adherence with age is more pronounced in males than in females, for which the percentage of adherence is fairly similar in all age groups (data not shown). Individuals engaged in sedentary leisure activities are four times more likely to form part of the low-adherence group. Frequent smokers show a reduction of 71 % in the risk of having a low adherence to the Mediterranean diet compared with non-smokers. All other socio-demographic and lifestyle variables are not significantly linked to a greater or lower adherence to the MDP.

Discussion

In nutritional epidemiology, analyses of individual nutrients and food can ignore important interactions between components of a diet. For this reason, there is an increasing interest in the study of dietary patterns because individuals do not eat isolated nutrients. The Mediterranean diet could offer an interesting alternative in health promotion because this pattern, and not only its individual nutrients, has been postulated as being protective against several diseases (Trichopoulou & Vasilopoulou, 2000; Sánchez-Villegas *et al.* 2002; Trichopoulou *et al.* 2003). Nevertheless, despite all the increasing evidence about the benefits of the Mediterranean diet, nowadays we are witnessing a reduction in the quality of this diet in many Mediterranean regions towards a more Western form (EPIC Group in Spain, 2002).

The present study aimed to assess the prevalence of the MDP in a representative sample of the Balearic Islands, a typically Mediterranean region. The MDP was measured according to a MDS, computed taking into account the most characteristic components of this dietary pattern and expressed as the percentage of adherence to this dietary pattern. The average adherence to the Mediterranean diet was 43.14 (SD 5.84) %. The observed SD indicates that the percentage of adherence to the Mediterranean diet is fairly uniform, with low variability across all study participants.

We found that age was directly associated with a higher adherence to the MDP. When we analysed the influence of age separately by sex, we could observe that this trend is more pronounced in males than in females (data not shown). Other studies carried out to assess dietary patterns in Spain have also found an association between age and a greater adherence to the MDP (Aranceta, 2001; EPIC Group in Spain, 2002; Moreno *et al.* 2002; Sánchez-Villegas *et al.* 2002, 2003). These findings have also been replicated in other Mediterranean regions such as Italy and Greece (De Lorenzo *et al.* 2001; Costacou *et al.* 2003).

Socio-economic and educational levels are important determinants of the health status in a community. There has been some speculation as to which dietary factors contribute to disease inequalities (De Irala-Estévez *et al.* 2000; Giskes *et al.* 2002). In the present study we did not find significant differences in the percentage of adherence to the MDP according to socio-economic and educational levels. Other studies carried out in Spain also did not find variations in the adherence to the Mediterranean diet according to educational level or social class (EPIC

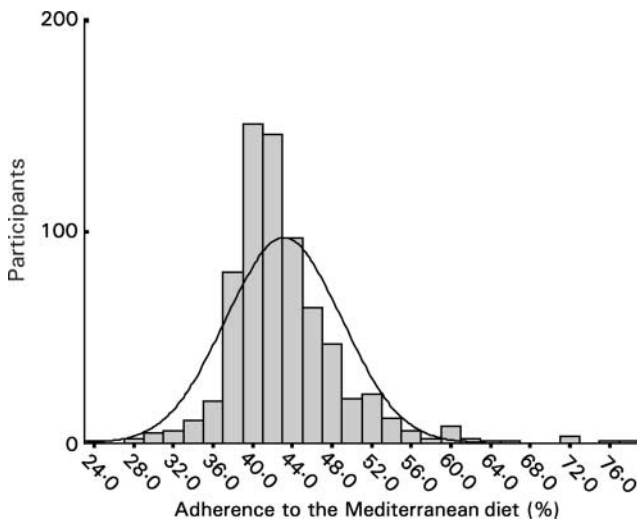


Fig. 1. Distribution of percentage of adherence to the Mediterranean dietary pattern among the population of the Balearic Islands.

Table 1. Percentage of adherence and risk of a low adherence (given by odds ratios (OR) and 95% confidence intervals) according to socio-demographic and lifestyle variables (Mean values and standard deviations)

Socio-demographic and lifestyle variables	Percentage adherence		Risk of low adherence*		
	Mean	SD	Age- and sex-adjusted OR	95% CI	P value
Sex					
Male	42.13	4.65	1.44	0.83, 2.49	0.190
Female	43.39	6.07	1.00 (reference)		
Age group					
16–25	42.70	5.40	2.06	1.19, 3.56	0.010
26–45	42.73	5.50	1.96	1.17, 3.29	0.011
46–65	43.99	6.48	1.00 (reference)		
Marital status					
Widowed	43.59	8.31	1.38	0.27, 7.06	0.702
Divorced	43.45	6.41	1.86	0.65, 5.30	0.248
Married	43.26	5.77	1.44	0.69, 3.00	0.330
Single	42.89	5.69	1.00 (reference)		
Place of birth					
Other country	42.72	7.41	2.50	0.90, 6.98	0.081
Other Spanish regions	43.96	6.62	0.67	0.37, 1.22	0.195
Spanish East coast	43.96	6.21	0.58	0.25, 1.37	0.218
Balearic Islands	42.87	5.47	1.00 (reference)		
Educational level†					
Low	44.04	7.32	1.02	0.44, 2.40	0.961
Medium	43.12	5.81	1.09	0.55, 2.15	0.813
High	43.11	5.40	1.00 (reference)		
Socio-economic status‡					
Low	42.63	4.51	0.91	0.45, 1.84	0.793
Medium	43.15	5.67	0.71	0.35, 1.43	0.332
High	42.83	5.82	1.00 (reference)		
Physical activity level§					
Sedentary	43.42	6.63	4.14	1.27, 13.42	0.018
Light	44.70	8.05	2.23	0.69, 7.30	0.182
Active	46.06	7.98	1.00 (reference)		
Smoking habit					
Yes	46.42	6.63	0.29	0.11, 0.77	0.013
Occasionally	44.70	8.05	0.22	0.02, 2.52	0.226
No	46.06	7.98	1.00 (reference)		
Presence of CVRF¶					
No CVRF	44.27	8.12	1.41	0.64, 3.10	0.393
One or more CVRF	46.45	8.03	1.00 (reference)		

CVRF, cardiovascular risk factors.

* Multiple logistic regression analysis adjusting for age and sex. Low adherence was defined as a percentage of adherence below the lower quartile (39.81%); high adherence was defined as a percentage of adherence above the upper quartile (45.27%).

† Educational level is grouped according to years and type of education: low (<6 years of education); medium (6–12 years of education); high (>12 years of education).

‡ Socio-economic level is based on the occupation of the head of household.

§ Physical activity level was determined according to the level of exercise reported by the interviewee during their free time.

|| Smoking habit was classified as: no (never); yes (more than one cigarette per d); occasionally (less than one cigarette per d).

¶ Excess weight (defined as BMI \geq 25 kg/m²) (SEEDO, 2000), reported hypertension, reported hypercholesterolaemia and reported diabetes.

Group in Spain, 2002; Sánchez-Villegas *et al.* 2002). Nevertheless, it has to be pointed out that it is possible that different educational and income groups consume different types of food items, although the overall MDS does not reflect these differences. In previous studies we have found that lower socio-economic and educational groups were at a higher risk of low intake of foods rich in antioxidant nutrients (Tur *et al.* 2004b). Also, studies conducted in Spain have demonstrated that lower socio-economic and educational levels had a lower consumption of fruits, vegetables and vitamins but a higher consumption of legumes and cereals (Aranceta, 2001; Ortega *et al.* 2001; EPIC Group in Spain, 2002; Moreno *et al.* 2002; Sánchez-Villegas *et al.* 2002).

A more physically active lifestyle is associated with a greater adherence to the Mediterranean diet. This association has been observed in many other studies (EPIC Group in Spain, 2002; Sánchez-Villegas *et al.* 2002, 2003; Costacou *et al.* 2003). Thus, it seems that healthy lifestyle variables tend to cluster and therefore we could speak about the Mediterranean lifestyle, including a higher level of physical activity as one aspect associated with the MDP that can be protective against different diseases.

Surprisingly we could also observe in the analysis that smoking is also associated with a greater adherence to the Mediterranean diet. It has been documented that smoking is linked to less-healthy dietary habits that might contribute to the higher risk for cancer and CVD in smokers (Lloveras

et al. 2001; Schröder *et al.* 2002). The present results should be interpreted with caution. This association has been carefully analysed and we have observed that this is not replicated when under-reporters are included in the analysis. The diet of smokers was also further analysed and it was observed that it was not significantly different to that of non-smokers, but it was slightly more fatty and sweeter than the non-smokers' diet. Therefore, it is possible that the association was caused by chance, taking into account the related power reduction and lower precision due to the decrease in the sample size of smokers after excluding under-reporters, and therefore does not represent the real association that may exist in the reference population.

The presence of one or more cardiovascular risk factors (obesity, hypertension, hypercholesterolaemia and diabetes) is not linked to a lower adherence to the MDP, although it has been reported that the Mediterranean diet protects against these diseases. However, it is probable that individuals with such problems had changed their diet in a healthier way as a result of medical advice or prescription, as it has been observed in the present study (data not shown) and in previous studies (Ballesteros-Pomar *et al.* 2000).

In conclusion, the present study demonstrates that the MDP is being lost in the Balearic Islands, mainly in the younger generations. It has been demonstrated that a high proportion of Spanish children and adolescents are at high nutritional risk, and it has also been demonstrated that the Mediterranean diet contributes to nutritional quality in Spanish schoolchildren and adolescents (Serra-Majem *et al.* 2002, 2003; Tur *et al.* 2004b). Therefore the promotion of not only the MDP but also the Mediterranean lifestyle, including greater physical activity, should be reinforced in the Balearic younger generations.

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