Association of fast food consumption with energy intake, diet quality, body mass index and the risk of obesity in a representative Mediterranean population

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The aim of the present study was to describe the association of fast food consumption with BMI, energy intake and diet quality in a Mediterranean population. The subjects were Spanish men (n 1491) and women (n 1563) aged 25–74 years who were examined in 1999–2000, in a population-based cross-sectional survey in northeast Spain (Girona). Dietary intake was assessed using a FFQ that included four typical fast food items. Two dietary-quality indices, the Mediterranean diet score and the healthy eating index, were created. Height and weight were measured. Within the population studied, 10·1 % reported eating fast food at least once per month. Dietary energy intake and energy density were directly associated with frequency of fast food consumption. Multivariate logistic regression analysis adjusted for lifestyle and educational level showed an inverse association of frequency of fast food consumption with meeting the dietary reference intake (DRI) for energy (P=0·001). The consumption of fast food more than once per week increased the risk of overall low diet quality (P<0·001), BMI was directly associated with fast food consumption expressed in g/d (P=0·025) and in kJ/d (P=0·017). The risk of being obese increased with the frequency of fast food consumption (P=0·046). Fast food consumption was associated with higher energy intakes, poor diet quality and higher BMI. The likelihood of not meeting the DRI for energy, and of being obese, increased with the frequency of fast food consumption.

Fast food: Diet quality: Body mass index: Mediterranean diet: Obesity: Energy density

Foods available in fast food outlets (henceforth termed fast food) are becoming an increasingly important part of the diet, particularly in the USA. The number of fast food outlets and sales increased dramatically during the past 30 years in North America and, to a lesser degree, also in Europe. There are several factors inherent to fast food that might promote energy imbalance. Fast food products are often characterised by their high content of fat and sugars, high palatability, large portion size and high energy density.

In the US population, about one-third of total energy intake is derived from fast food consumption. Furthermore, it often displaces healthier food options, reducing thereby the quality of the whole diet. For these reasons it is not surprising that fast food consumption has been associated with increased risk of excessive weight and low overall diet quality in children, adolescents and adults in the USA. A Spanish study reported a direct association of weight gain and fast food consumption (proxy variables including hamburgers, pizza and sausages) in a cohort of university graduates.

The increasing number of individuals with excessive weight is an important health concern in most European countries. The identification of lifestyle variables that are associated with this trend is crucial for health policy. Although there is information on the impact of fast food consumption on lifestyle and BMI in the USA, to the best of our knowledge no population-level scientific evidence on the association of fast food consumption with overall diet quality and anthropometric measures is available for Europe. If the impact of fast food consumption on diet quality and BMI, as seen in the USA, is confirmed in European populations, this evidence is essential for health policy makers in their efforts to combat the growing obesity epidemic.

The aim of the present study was to analyse the association of frequency of fast food consumption with energy intake, meeting dietary reference intakes (DRI) for energy, diet quality as characterised by the Mediterranean diet score (MDS) and healthy eating index (HEI), BMI and obesity in a representative Mediterranean population.

Abbreviations: DRI, dietary reference intake; EER, estimated energy requirement; HEI, healthy eating index; MDS, Mediterranean diet score; PA, physical activity.

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Fast food consumption and body mass index

Subjects and methods

Study population

The methods used in the population-based cross-sectional survey of cardiovascular risk conducted in Girona (Spain) in 2000 are identical to those of the cross-sectional survey of 1995, described in detail elsewhere. Using the 1996 census, 6000 subjects aged 25–74 years were randomly selected from the general population of Girona. After excluding census errors, 4359 eligible subjects remained, of whom 3058 agreed to participate in the present study from 1999 to 2000. Data were available from 2930 participants. All participants signed an informed consent form to allow the acquisition of biological samples for analyses and the storage of their personal data in a computer database. The protocol was approved by an ethics committee and the results of the examination were sent to all participants.

Measurement of diet and fast food consumption

The FFQ comprised 165 items, including foods, alcohol, and non-alcoholic beverages. For each food item, participants were asked to indicate their usual consumption from the nine frequency categories, ranging from never or less than once per month to six or more times per day. The FFQ did not include standard questions on portion size but rather indicated specific medium servings, defined by natural (for example, one orange, one slice of bread) or household units (for example, one spoon, one cup, one glass). The FFQ included frequency of consumption of the following fast food products: hamburger (McDonalds or similar); cheeseburger (McDonalds or similar); BigMac (McDonalds or similar); French fries (McDonalds or similar). Energy consumption and nutrient intake were calculated using the Medisystem 2000 software (Conaycite, Madrid, Spain).

Measurement of diet quality and energy requirement

We computed two indices, namely MDS and HEI, to calculate the overall diet quality. With the exception of red wine, the MDS was calculated according to the tertile distribution of energy-adjusted food consumption. The lowest tertile was coded as 1, medium as 2, and highest as 3, for cereals, fruits, vegetables, legumes, fish, olive oil, and nuts. The highest tertile was coded as 1, medium as 2, and lowest as 3 for meat and dairy products. Red wine consumption was computed as alcohol intake proceeding from red wine (0 g and more than 20 g alcohol = 1, and up to 20 g alcohol = 3). The values of distribution of all dietary components were calculated. The resulting MDS ranged from 10 to 30.

The percentages of energy provided through typical and non-typical foods of a healthy Mediterranean reference diet were calculated. The HEI consists of ten equally weighted components constituting an index of 0 to 100 points. Each of the components represents different dietary recommendations of the food guide pyramid and the 1990 Dietary Guidelines for Americans. Components 1–5 (grains, vegetables, fruits, meats, and milk) were calculated by comparing the number of servings reported for these five food groups with the recommended number of servings according to age and sex. Each component was scored proportionally from 0 to 10. An energy-adjusted food intake was not used because such an adjustment is not included in the HEI scoring system. Components 6–9 quantify the adherence to recommended dietary intakes of total fat (percentage of energy intake), saturated fat (percentage of energy intake), cholesterol, and Na. We also quantified the variety component differently, using McCullough et al. Subjects were grouped into eleven equal quantiles according to the number of unique foods consumed per month, and the groups were assigned scores of 0–10.

The estimated energy requirement (EER) was calculated to estimate the prevalence of inadequate energy intake in the study population. The equation to predict EER includes age, weight, height and physical activity (PA):

\[
\text{EER for men} = 662 - 9.53 \times \text{age (years)} + \text{PA} \times (15.91 \times \text{weight (kg)} + 539.6 \times \text{height (m)})
\]

\[
\text{EER for women} = 354 - 6.91 \times \text{age (years)} + \text{PA} \times (9.36 \times \text{weight (kg)} + 726 \times \text{height (m)})
\]

The equation included four different PA levels: sedentary (PA level $\leq 1$ to $<1.4$); low active (PA level $\geq 1.4$ to $<1.6$); active (PA level $\geq 1.6$ to $<1.9$); very active (PA level $\geq 1.9$ to $\leq 2.5$). The corresponding PA value for sedentary, low active, active and very active PA level is 1.0, 1.12, 1.27, and 1.45, respectively.

The PA level in the present population was calculated through the corresponding walking equivalence. DRI for energy was defined as the EER that corresponds to a normal BMI (18.5–24.9 kg/m²).

Measurement of non-diary variables

Information on demographic and socio-economic variables, medical history, diet, and lifestyle factors including tobacco smoking and alcohol consumption was obtained through structured standard questionnaires administered by trained personnel.

Leisure-time PA was measured by the Minnesota leisure-time physical activity questionnaire, also administered by a trained interviewer. This questionnaire has been previously validated for Spanish men and women.

Anthropometric measurements

A precision scale of easy calibration was used for weight measurement. Readings were rounded to 200 g. Individuals wore underwear. Height was measured in the standing position and measurements rounded to 5 mm. BMI was determined as weight divided by height squared (kg/m²).

Statistical analysis

The prevalence of fast food consumption was similar in both sexes for average age and also stratified for age groups (25–34 years, 35–44 years, 45–54 years, 55–64 years and 65–74 years). Data are presented with means or proportions. Student’s t test and the Mann–Whitney U test were used in...
the univariate analysis for continuous normally and not normally distributed variables, respectively. Logistic regression analysis (PROC LOGISTIC procedure of SAS, version 9.1: SAS Institute Inc., Cary, NC, USA) was performed to determine significance of proportions. General linear modelling procedures (PROC GLM procedure of SAS, version 9.1: SAS Institute Inc.) were used to estimate energy consumption, energy density and food intake (dependent variables) according to the frequency of fast food consumption (fixed factor).

Multiple linear regression models were fitted (PROC REG procedure of SAS, version 9.1: SAS Institute Inc.) to determine the association of BMI with the amount (g/d) and energy content (kJ/d) of fast food consumption.

Multiple logistic regression analysis (PROC LOGISTIC procedure of SAS, version 9.1: SAS Institute Inc.) was used to analyse the relationship of recommended energy intake and energy density and food intake (dependent variables) according to the frequency of fast food consumption. Differences were considered significant if \( P < 0.05 \).

**Results**

Of the study population, 10·1 % reported eating fast food at least once per month (6·3 % once per month; 2·7 % once per week, and 1·1 % more than once per week). Fast food consumption decreased significantly \( (P < 0.001) \) with increasing age.

Fast food consumers were more likely to be younger, smokers, and more highly educated than non-fast food consumers. They also reported higher energy intake and were more likely to exceed the recommended energy intake (Table 1).

Table 2 presents energy intake and the consumption of foods other than fast food according to the frequency of fast food consumption. Total energy intake and energy density increased across the frequency distribution of fast food consumption. In contrast, the water content of ingested foods and the consumption of fruits and olive oil were inversely associated with increasing frequency of fast food consumption.

Multiple logistical regression analysis revealed an inverse association between diet quality, characterised by the score for adherence to a traditional Mediterranean diet (MDS) and HEI score, and frequency of fast food consumption (Table 3). As shown in Table 3, participants with the highest frequency (more than once per week) of eating a product from a fast food outlet showed the lowest adherence to the MDS (OR 4·30 (95 % CI 1·82, 10·05)) and HEI (OR 3·91 (95 % CI 1·69, 9·02)).

Additionally, participants reporting the highest frequency of fast food consumption (more than once per week) showed a significantly higher risk (OR 3·30 (95 % CI 1·52, 7·14)) of failing to meet the DRI for energy consumption as compared with those who consumed no fast foods (Fig. 1).

A multiple linear regression model was fitted to analyse the association of BMI with the amount (g) and energy content (kJ) of fast food consumption (Table 4). BMI increased with the amount (g/d) of fast food consumption. Because the energy content differed among the fast food items of the FFQ (kJ/d), we also present data on the relationship between energy intake provided through fast food consumption and BMI. The magnitude of this association was slightly stronger \( (P=0.017) \) than that observed for fast food consumption expressed in g/d \( (P=0.025) \) (Table 4).

Furthermore, there was a significant direct relationship \( (P=0.046) \) between obesity and frequency of fast food consumption (Fig. 2). The consumption of a product from a fast food outlet more than once per week increased the risk of being obese by 129 % \( (P=0.057) \) in comparison with no consumption.

**Table 1.** General characteristics of the study population according to the classification of fast food consumption

(Percentage of subjects and 95 % confidence intervals)

<table>
<thead>
<tr>
<th></th>
<th>Non- fast food consumers (n 2977)</th>
<th>Fast food consumers (n 290)</th>
<th>( P ) *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td>% 95 % CI</td>
<td>% 95 % CI</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>Men 89·0 87·4, 90·6</td>
<td>11·0 9-4, 10-8</td>
<td>0·128</td>
</tr>
<tr>
<td></td>
<td>Women 90·7 89·2, 92·2</td>
<td>9-3 7-8, 10-8</td>
<td></td>
</tr>
<tr>
<td>Education (years)</td>
<td>Mean 51·1 42·6</td>
<td>13·0</td>
<td>&lt;0·001</td>
</tr>
<tr>
<td></td>
<td>SD 13·3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTPA (MET)·(min/d)</td>
<td>Mean 345·5 352·4</td>
<td>344·2</td>
<td>0·681</td>
</tr>
<tr>
<td></td>
<td>SD 356·8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smokers</td>
<td>Mean 22·6 21:0, 24·2</td>
<td>30·6 25·3, 36·0</td>
<td>0·005</td>
</tr>
<tr>
<td>Alcohol consumption (g/d)</td>
<td>Mean 11·5 12·1</td>
<td>19·8</td>
<td>0·369</td>
</tr>
<tr>
<td></td>
<td>SD 17·2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total energy intake (MJ/d)</td>
<td>Mean 10·9 12·5</td>
<td>4·2</td>
<td>&lt;0·001</td>
</tr>
<tr>
<td></td>
<td>SD 3·6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meeting recommended energy intake</td>
<td>63·5 61·6, 65·4</td>
<td>51·9 46·1, 57·8</td>
<td>&lt;0·001</td>
</tr>
</tbody>
</table>

LTPA, leisure-time physical activity; MET, metabolic equivalent.

* Significance for \( P \) between fast food consumers and non-fast food consumers by Student’s \( t \) test (continuous variables) and logistical regression analysis (categorical variables).
Table 2. Energy and food intake according to frequency of fast food consumption*
(Mean values and 95% confidence intervals)

<table>
<thead>
<tr>
<th>Frequency of fast food consumption</th>
<th>Less than once per month (n 2576)</th>
<th>One to three times per month (n 181)</th>
<th>Once per week (n 78)</th>
<th>More than once per week (n 31)</th>
<th>P for linear trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean 95% CI</td>
<td>Mean 95% CI</td>
<td>Mean 95% CI</td>
<td>Mean 95% CI</td>
<td></td>
</tr>
<tr>
<td>Energy (MJ)†</td>
<td>10·9 10·7, 11·0</td>
<td>11·6 10·7, 11·0</td>
<td>11·9 11·0, 12·7</td>
<td>12·7 11·3, 14·0</td>
<td>&lt; 0·001</td>
</tr>
<tr>
<td>Energy (MJ)‡</td>
<td>0 0·11</td>
<td>0·11 0·09, 0·13</td>
<td>0·31 0·28, 0·34</td>
<td>0·76 0·71, 0·81</td>
<td>&lt; 0·001</td>
</tr>
<tr>
<td>Energy density§</td>
<td>4·87 4·84, 4·94</td>
<td>5·27 5·08, 5·46</td>
<td>5·57 5·28, 5·86</td>
<td>5·66 5·20, 6·13</td>
<td>&lt; 0·001</td>
</tr>
<tr>
<td>Water (ml/4·184 MJ)</td>
<td>737 727, 746</td>
<td>694 662, 726</td>
<td>657 610, 706</td>
<td>651 576, 725</td>
<td>0·012</td>
</tr>
<tr>
<td>Cereals (g/4·184 MJ)</td>
<td>71·5 70·1, 72·8</td>
<td>70·8 65·7, 75·9</td>
<td>67·1 59·4, 74·8</td>
<td>66·6 54·4, 76·7</td>
<td>0·339</td>
</tr>
<tr>
<td>Vegetables (g/4·184 MJ)</td>
<td>207 203, 213</td>
<td>178 159, 197</td>
<td>174 146, 203</td>
<td>164 119, 209</td>
<td>0·063</td>
</tr>
<tr>
<td>Fruits (g/4·184 MJ)</td>
<td>216 210, 223</td>
<td>193 169, 218</td>
<td>169 132, 206</td>
<td>161 102, 219</td>
<td>0·040</td>
</tr>
<tr>
<td>Meat (g/4·184 MJ)</td>
<td>66·0 64·9, 67·1</td>
<td>66·9 62·7, 71·2</td>
<td>70·6 64·2, 77·0</td>
<td>75·3 65·1, 88·5</td>
<td>0·051</td>
</tr>
<tr>
<td>Fish (g/4·184 MJ)</td>
<td>33·0 32·2, 33·9</td>
<td>31·4 28·2, 34·6</td>
<td>32·6 27·9, 37·4</td>
<td>28·9 19·4, 34·5</td>
<td>0·155</td>
</tr>
<tr>
<td>Pulses (g/4·184 MJ)</td>
<td>22·4 21·6, 23·1</td>
<td>20·8 17·9, 23·8</td>
<td>18·0 13·5, 22·5</td>
<td>19·6 12·5, 26·8</td>
<td>0·329</td>
</tr>
<tr>
<td>Olive oil (g/4·184 MJ)</td>
<td>10·3 10·0, 10·6</td>
<td>9·4 8·3, 10·4</td>
<td>8·5 6·9, 10·2</td>
<td>7·8 5·2, 10·4</td>
<td>0·044</td>
</tr>
</tbody>
</table>

* Adjusted for sex and age.
† Energy from fast food not included.
‡ Energy content of fast food.
§ Energy density = total energy consumption (kJ)/total weight of diet (g).

Discussion

Scientific evidence indicates that fast food consumption is associated with higher total energy intakes. Our findings support this conclusion. When fast food was excluded from the analysis, total energy intake in the present population was significantly increased compared with those in the present study who do consume fast food more than once per week. Participants who reported eating fast food more than once per week had a 2·5 MJ/d higher total energy intake. Furthermore, energy intake from non-fast food sources and fast food more than once per week had a 1·4 MJ/d higher in fast food consumers than in non-consumers.

The main finding of the present study was that the frequency of fast food consumption was directly related to BMI and the risk of obesity. These findings suggest a wake-up call for a holistic approach to BM and the risk of obesity.

Changes in food supplies have been observed in Mediterranean countries during the last few decades. These changes have been associated with higher total diet quality and DRI for energy. Furthermore, frequent fast food consumption is associated with lower BMI and the risk of obesity. These findings suggest a wake-up call for a holistic approach to BM and the risk of obesity.

In the present population, it is a serious concern that diet quality was lower for those with lower fast food frequency. In the present study, the main finding was that the frequency of fast food consumption was directly related to BMI and the risk of obesity. These findings suggest a wake-up call for a holistic approach to BM and the risk of obesity.
through low adherence to the MDS and HEI, was 330 and 291 % higher, respectively, in the 1·1 % of participants who reported eating fast food more than once per week. Since we are not aware of other studies that compare diet quality measured by diet indices with the frequency of fast food consumption, we cannot directly compare our findings. However, other studies have reported lower intakes of healthy foods, such as vegetables, fruits, and legumes, and a less favourable overall nutrient intake profile among fast food consumers in comparison with non-fast food consumers1,6,21,22.

A prolonged positive energy imbalance is the driving force of the obesity epidemic that is currently drawing media attention. Increasing energy intake with a concurrent decrease of PA increases the risk of weight gain. In the present study, fast food consumers reported higher energy intakes, excluding energy provided by fast food, than non-consumers. The inability to compensate for the energy in fast food had previously been shown in overweight adolescents28. Therefore, it is not surprising that failing to meet the DRI for energy was more frequent among adult consumers of fast food as compared with non-fast food consumers in the present study. One might speculate that the extra energy provided by fast food (310 and 761 kJ/d corresponding to the consumption of fast food once and more than once per week, respectively) in the present population is too low to make a significant contribution to energy imbalance and consequently to an increase in BMI. In a theoretical model, however, it has been estimated that a daily surplus of 66 kJ leads to 1 kg per year weight gain29.

Table 3. Adherence to the Mediterranean diet score (MDS) and healthy eating index (HEI) according to the frequency of fast food consumption*
(Odds ratios and 95 % confidence intervals)

<table>
<thead>
<tr>
<th>Fast food consumption</th>
<th>n</th>
<th>MDS† OR (95 % CI)</th>
<th>HEI† OR (95 % CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None or less than once per month</td>
<td>2547</td>
<td>1 Reference</td>
<td>1 Reference</td>
</tr>
<tr>
<td>One to three times per month</td>
<td>181</td>
<td>1·26 0·90, 1·64</td>
<td>1·31 0·93, 1·85</td>
</tr>
<tr>
<td>Once per week</td>
<td>77</td>
<td>1·89 1·18, 3·03</td>
<td>2·95 1·77, 4·90</td>
</tr>
<tr>
<td>More than once per week</td>
<td>30</td>
<td>4·30 1·82, 10·05</td>
<td>3·91 1·69, 9·02</td>
</tr>
<tr>
<td>Linear P for trend</td>
<td>&lt; 0·001</td>
<td>&lt; 0·001</td>
<td></td>
</tr>
</tbody>
</table>

* Lowest tertile of the Mediterranean diet score and the healthy eating index.
† Adjusted for sex, age, energy consumption from non-fast food sources, smoking status and leisure-time physical activity.

Table 4. Association between body mass index and fast food consumption†
(Regression coefficients and 95 % confidence intervals)

<table>
<thead>
<tr>
<th>Fast food consumption (g/d)†</th>
<th>Regression coefficient</th>
<th>95 % CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>None or less than once per month</td>
<td>1·760</td>
<td>0·223, 3·298</td>
<td>0·025</td>
</tr>
<tr>
<td>One to three times per month</td>
<td>1·643</td>
<td>0·297, 2·99</td>
<td>0·017</td>
</tr>
<tr>
<td>Once per week</td>
<td>1·760</td>
<td>0·223, 3·298</td>
<td>0·025</td>
</tr>
<tr>
<td>More than once per week</td>
<td>1·643</td>
<td>0·297, 2·99</td>
<td>0·017</td>
</tr>
</tbody>
</table>

* Adjusted for sex, age, educational status, leisure-time physical activity, energy consumption of non-fast food sources, smoking status and alcohol drinking.
† Variable was log transformed.

Fig. 1. Risk of failing to meet dietary reference intake for energy consumption in relation to frequency of fast food consumption. Values are OR, with 95 % CI represented by vertical bars. The reference category is no consumption or less than once per month. The OR are adjusted for educational status, smoking, alcohol consumption and leisure-time physical activity. There is a significant linear trend (P< 0·001).

Fig. 2. Risk of obesity according to frequency of fast food consumption. Values are OR, with 95 % CI represented by vertical bars. The reference category is no fast food consumption. The OR are adjusted for age, sex, leisure-time physical activity, educational status, smoking, alcohol consumption and energy intake from non-fast food sources. There is a significant linear trend (P< 0·046).
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In the present population, higher BMI was associated with increasing consumption of fast food. This association was not attenuated after controlling for other lifestyle and socioeconomic confounders. Furthermore, obesity risk increased with the frequency of fast food consumption. These findings agree with previous results concerning fast food consumption and the obesity epidemic in the USA. It is of interest to note that the energy density of the diet increased with fast food consumption. Energy-dense diets have been associated with an increasing risk of obesity due to the effects on appetite and food intake regulation of these diets.

A limitation of the present study’s cross-sectional design is that causality among the variables studied cannot be drawn. Furthermore, fast food outlets offer many more products than the four items listed in the FFQ. Although French fries and hamburgers, the products most sold by fast food industry leaders, were included in the questionnaire, a possible underestimation of fast food consumption in the present population cannot be excluded (i.e., participants were not asked whether they ate fast food, but whether they ate four specific fast food items).

In conclusion, energy intake and the prevalence of subjects not meeting the DRI for energy consumption increased with the frequency of fast food consumption; overall diet quality decreased. Higher BMI and increased risk of obesity were related to the reported frequency of fast food consumption. Our findings underline the need for continued monitoring, research and analysis, and the attention of public health agencies to fast food consumption among the European Mediterranean population.

Acknowledgements

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