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# ORIGINAL COMMUNICATION

# Spanish children's diet: compliance with nutrient and food intake guidelines

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**Objective**: To compare the diet of Spanish children against the nutrient and food intake guidelines. To calculate an index of overall diet quality and check its validity against nutrient intake.
**Design and setting**: Cross-sectional study in four cities in Spain, where information on food and nutrient intake was obtained from schoolchildren through a food frequency questionnaire.
**Participants**: The sample included 1112 children (overall response rate of 85%) attending public and private schools and aged 6–7 y. Children were selected through random cluster sampling in schools, and stratified by sex and socioeconomic level.
**Main Outcome Measures**: Mean nutrient intake, number of food servings, and the percentage of children who meet recommended nutrient and food-serving intake levels. The overall dietary quality was assessed using the Healthy Eating Index (HEI).
**Results**: Mean micronutrient intake exceeded 100% of the recommended dietary allowances, except for vitamin B6, which registered a mean intake of 77.1%. For almost all children, intake of saturated fat was above, and that of carbohydrate below, the recommended level, in contrast to the relatively high compliance with the recommendations for poly- and monounsaturated fatty acid, salt and fiber intake (69.7, 43.7, 40.7, and 30.1%, respectively). Consumption of food servings for each of the five American pyramid food groups came close to or exceeded USDA guidelines, with the exception of cereals, with 5.4 servings per day. The mean score obtained in the HEI was 64.6. Children who complied with all the food guide pyramid recommendations registered a higher dietary variety and a healthier nutritional profile.
**Conclusions**: Children aged 6–7 y show scant compliance with the macronutrient goals for healthy eating. Micronutrient intake is adequate in general, yet there are small groups of children with risk of deficient intake of vitamins B6 and D. While Spanish children's eating habits are reasonably in line with American food guide pyramid guidelines, consumptions of cereals and fruit should be improved.
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**Keywords:** food guide pyramid; children; dietary patterns; RDA; diet quality

## Introduction

The role of certain nutrients and food groups in the prevention of cardiovascular disease and some malignant tumors has been highlighted by a considerable number of studies (Ascherio & Willet, 1995; Cummings & Bingham, 1998). Specifically, diets with a relatively high fruit and vegetable intake component are associated with a lower risk of mortality (Huijbregts *et al*, 1997) and of suffering cancer (Cummings & Bingham, 1998) or cardiovascular disease (Kant *et al*, 2000). Moreover, there is recent evidence to show that consumption patterns in childhood tend to be associated with subsequent risk of developing some types of cancer (Hansson *et al*, 1994), obesity (Lichtenstein *et al*, 1998), arterial hypertension and cardiovascular disease in adult life (Nicklas *et al*, 1988).

To promote a healthy diet, a series of recommended dietary allowances (RDAs) (National Research Council, 1989;

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Moreiras-Varela *et al*, 1999b) and nutritional goals (Aranceta, 1995) have been set at both a national and international level. To meet such recommendations, food guidelines have been drawn up and, in the case of the USA, have been further developed in recent years (USDA and USDHHS, 2000a, b). In Spain, where official nutritional goals and food guidelines have not been formally introduced at a national level (Serra *et al*, 1999), the Spanish Society for Community Nutrition (*Sociedad Española de Nutrición Comunitaria*—SENC) has nevertheless drawn up guidelines similar to those of the USA (Aranceta, 1995). Although these recommendations are not specific for any age group, they are also intended for children. Further, as long as dietary habits start being formed at ages 3–4 y and tend to become very resistant to change from age 11 y onwards (Hernández, 1999), it is important to ascertain the degree to which dietary habits in the child population conform to the pertinent recommendations. To date, research conducted on Spanish children's eating habits has been characterized by a certain degree of dispersion, with most studies being local or regional in scope. The results yielded by these studies reflect an excess in the contribution of lipids and proteins, and a relative deficit in the contribution of carbohydrates to total energy intake (Gorgojo *et al*, 1999). Although few studies have focused on analyzing compliance with RDAs, nutrition goals and dietary recommendations, at an individual level, knowing the percentage of individuals with intakes significantly below recommended levels can be extremely relevant (Truswell, 1990).

A complementary approach to assessing compliance with nutrition and food guidelines consists of obtaining an overall dietary index, which has the added value of taking account of the complexity of food consumption patterns and their multidimensional nature. In this respect, indices based on nutrients, foods and a combination of both have been proposed. Some of these indices have shown an association with risk of mortality and of suffering cardiovascular disease and some types of cancer, an association of a greater magnitude than that observed for any nutrient or food at an individual level (Kant, 1996; Osler *et al*, 2001). Specifically, the Healthy Eating Index (Kennedy *et al*, 1995), based on the USA dietary guidelines(USDA and USDHHS, 2000a), has been used successfully in both adults and children to study their overall dietary quality (Bowman *et al*, 1998).

This study compares the diet of children in four Spanish cities against the following: the RDAs of the Nutrition and Bromatology Institute, a body of the Spanish Scientific Research Council (*Consejo Superior de Investigaciones Científicas*—CSIC) (Moreiras-Varela *et al*, 1999b), the nutritional goals set by the SENC (Aranceta, 1995), and the US Department of Agriculture (USDA) Food Guide Pyramid serving recommendations (USDA and USDHHS, 2000b). The four cities were selected from regions having different demographic and sociocultural characteristics. Moreover, this is one of the first studies in the Mediterranean area that has formally tackled these questions simultaneously, including the task of calculating an index of overall diet quality and checking its validity against nutrient intake.

## Materials and methods

### Study subjects

Using a cross-sectional epidemiologic design, representative samples of schoolgoing children aged 6–7 y were selected in Cadiz, Madrid, Orense and Murcia (Figure 1) over the period 1998–1999. These cities were chosen both because they registered an approximately two-fold variation in coronary mortality, and for logistic reasons. More detailed information on the study design is available in previous publications (Rodríguez-Artalejo *et al*, 1999, 2002). The study protocol complied with Helsinki Declaration Guidelines and Spanish legal provisions governing clinical research on humans and was approved by the Clinical Ethics Committee of the Fundación Jiménez Díaz in Madrid.

Children were selected by means of random cluster sampling in schools, and stratified by sex and type of school (ie, public *vs* private), the latter factor being used as an approximate indicator of socioeconomic level. Sampling was carried out in two stages: first, schools were selected from lists made available by the Regional Educational Authorities; and second, class rooms and pupils were selected. To rule out the possibility of the values of any of the variables of interest being altered, all children reported by parents to be suffering from metabolic, endocrine, liver or kidney disorders were excluded.

### Data collection and study variables

The study was orally presented to the Board of Governors (*Consejo Escolar*) of each of the schools. Following this, a


**Figure 1** Map of Spain showing the situation of the four cities under review

letter was circulated to the parents of all the children invited to participate in the study, outlining the study goals and procedures, and securing their written authorization.

At each school, data were collected over a 6 week period by a field team, comprising a physician, a nurse and a group of persons trained in undertaking food frequency surveys, who conducted the survey and obtained the information from the children's mothers or other adults in charge of supervising their menus. Data collection was carried out at the schools. A total of six schools were selected in each city, and in each school all 6 to 7-y-old children were invited to take part (approximately 50 per school).

**Food and nutritional data**

Information on food and nutrition was obtained through a food frequency questionnaire (FFQ), initially developed for use on adults and previously validated in Spain by Martín-Moreno and colleagues (Martín-Moreno *et al*, 1993). For the purpose of this study, the questionnaire was adapted to a primary school population by amending and downscaling the list of foods and portions consumed on the basis of a recent systematic review of child-population food surveys in Spain (Gorgojo *et al*, 1999). The final version of the questionnaire included a total of 77 food codes grouped under 11 heads by affinity in nutrient content. For each food, the usual size of the serving eaten was defined (eg, 1 cup of milk equivalent to 170 $cm^3$; a dish of lentils, equivalent to 60 g dry weight) and the mean frequency of consumption of such servings over the previous year ascertained. The questionnaire provided the option of, in an open-ended way, answering in terms of the frequency per day, week, month or year. In cases where it was difficult to translate immediately the interviewee's answer in terms of mean frequency of consumption, the interviewer registered the answer literally and, once the interview was finished, he/she calculated the corresponding figure. Using Spanish food-composition tables (Mataix *et al*, 1998; Moreiras-Varela *et al*, 1999a), a food frequency conversion program was designed, which furnished a database with the annual food consumption and daily nutrient intake frequencies for each individual surveyed. This enabled nutrient and total caloric intake to be estimated (Willet & Stampfer, 1986; Martín-Moreno, 1993). The FFQ is available from the corresponding author upon request.

**Nutritional and food guidelines**

Adequacy of micronutrient and energy intake was evaluated as against CSIC Nutrition and Bromatology Institute RDAs (Moreiras-Varela *et al*, 1999b). We calculated the percentage of children who consumed an amount equal or superior to that recommended for each nutrient. Since the RDA is more than most people need, it is more useful to report how many individuals had intakes far below the recommended level (Truswell, 1990). As this number increases, the risk of nutritional deficiency becomes greater (Beaton, 1985), so we also calculated the percentage of children receiving less than 66% of the recommended intake. Adequacy of macronutrient intake was evaluated by calculating the percentage of children who complied with the nutritional goals proposed for the Spanish population by the SENC (Aranceta, 1995). In the light of current knowledge (Williams, 1995), the target fiber figure for the Spanish population (mean intake $>25$ g/day) was regarded as relatively inadequate for children aged 6–7 y. Accordingly, we used a range of fiber intake between age plus 5 and age plus 10 in g/day, as recommended by Williams *et al* (1995) and also endorsed by a number of Spanish experts (Hernández, 1999).

The SENC food pyramid does not provide sufficient information to classify individuals as compliers or non-compliers with the respective recommendations for any given food or food group. Hence, and also to enable comparison with other international studies, we assessed the degree to which the diet conformed to the American food pyramid (USDA and USDHHS 2000a, b). This indicates the number of servings recommended for each of the five main food groups (cereals, vegetables, fruit, dairy products and meat). Such indications vary according to the individual caloric intake prescribed for one of three pre-established guideline levels (1600, 2200 and 2800 kcal). However, the CSIC Nutrition and Bromatology Institute's recommended caloric intake for children aged 6–7 y (2000 kcal) (Moreiras-Varela *et al*, 1999b) coincides with none of these above levels. Consequently, to evaluate food intake, we took as reference the USDA recommended number of daily servings for children with an intake of 2000 kcal, a figure that was obtained by interpolation of the servings corresponding to 1600 and 2200 kcal (Bowman *et al*, 1998).

In order to identify the number of servings in each food group, we followed the American food pyramid criterion for assigning foods to the respective groups, eg, nuts, such as hazel- and walnuts, were assigned to the meat group. Mixed foods were divided into their constituent components, so that a single item might contribute to different food pyramid groups according to its composition. The weight of any serving varies in accordance with the food in question, the way of cooking it, and the group to which it belongs. Finally, each individual's complier or non-complier status was established by defining compliers as those having an intake equal or superior to the recommended level.

Overall dietary quality was assessed using the Healthy Eating Index (Kennedy *et al*, 1995) (HEI). This index consists of: one head with five components to measure food groups; a second with four components to measure nutrients; and another with one component to analyze dietary variety. For each HEI component, a value is established on the basis of which the minimum score (0 points) is obtained, and another on the basis of which the maximum score (10 points) is obtained. Between these two values, the score is obtained on a proportional basis, eg, in the case of cholesterol intake, 0 points are scored with values

≥450 mg, and 10 points with values below 300 mg; thus, an individual with 330 mg of cholesterol intake would obtain a score of 8 ([450−330] × 10/150). The total score, which can range anywhere from 0 to 100, is obtained by adding up the individual scores for the 10 components.

We have followed exactly HEI guidelines (USDA, 1995), except for two components. First, since olive oil was a staple in the diet of the sample population, 35% was designated as the upper limit for total fat consumption as a percentage of total food energy intake, in line with the nutritional goals set by the SENC (Aranceta, 1995). Secondly, the HEI was originally designed on the basis of data drawn from food registries and 24-h dietary recall, with the dietary variety component being scored according to the number of different foods consumed over a period of 3 days. However, our dietary assessment method, ie, a SQFFQ, is designed to measure usual intake and contains a fixed number of items. Consequently, in line with the method proposed by McCullough *et al* (2000), using an SQFFQ similar to ours', dietary variety was calculated according to the number of different foods (questionnaire items) consumed with a frequency exceeding one serving per month. Following HEI guidelines (USDA, 1995), similar foods were grouped together in a single item to assess the dietary variety component. A final number of 72 items was arrived at in this manner. To assign dietary variety scores, the sample was divided into 11 quantiles. Children in the bottom quantile were scored 0, those in the next quantile 1, and so on upwards, until reaching those in the top quantile who received a score of 10. Since the HEI dietary variety score was based upon the distribution of the number of different foods consumed by the children in the study, the mean value was pre-established at 5 points. Nevertheless, the high correlations observed between the original index (HEI) and that obtained from an SQFFQ (HEI-f) by the authors previously mentioned (McCullough *et al*, 2000) confirm that the HEI can be reasonably well estimated on the basis of an SQFFQ.

### Statistical data analysis

Differences between groups of children in degree of compliance with recommendations were compared using the $\chi^2$ test. Subsequently, logistic regression was used to adjust for total energy intake and to obtain odds ratios and 95% CI. Inter-group comparisons of means (number of servings and HEI-f) were performed using the Student's *t*-test and variance analysis. Means were adjusted for energy using covariance analysis. All comparisons were two-sided at a 0.05 significance level. Statistical analyses were performed using the Statistical Analysis System computer software package (Cody & Smith, 1991).

## Results

There was an overall response rate of 85%. The valid sample totaled 1112 individuals, comprising 557 (50.1%) boys and 555 (49.9%) girls, and had a mean energy intake of 2129 kcal/day. The mean age was 6.7 y, with no substantial differences as between the four cities studied.

### Nutrient intake compared with RDA

Examination of mean micronutrient intake showed that this exceeded 100% of the RDA, save in the case of vitamin B6, which registered a mean intake of 77.1%. When analyzed at an individual level, however, less than 80% of the children had vitamins B6, D and E intakes above the recommended levels; moreover, there were 36.7, 12 and 3%, respectively, of children with less than 66% of the recommended intakes (Table 1).

The percentage of boys with vitamin A (97.3%) and calcium (96.2%) intakes above the recommended levels exceeded that of girls (94.2 and 92.8%, respectively). While recognizing that IR are quoted in absolute values, we decided to adjust for total caloric intake when comparing boys with girls (mean energy intake of 2194 and 2063 kcal, respec-

**Table 1** Percentage of children complying with the recommended dietary allowances for the Spanish population*

| | | | *Total* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Guideline* | *% RDA* | *> 100% RDA* | *< 66% RDA* | *Boys*† | *Girls*† | *p*‡ | *OR*§ | *95% CI* |
| Calcium | 800 mg | 196.9 | 94.5 | 0.5 | 96.2 | 92.8 | 0.01 | 1.39 | 0.8–2.5 |
| *Vitamins* | | | | | | | | | |
| A[11] | 400 μg | 166.0 | 95.8 | 0.1 | 97.3 | 94.2 | 0.01 | 1.61 | 0.8–3.1 |
| B6 | 1.4 mg | 77.1 | 17.1 | 36.7 | 19.0 | 15.1 | 0.08 | 0.96 | 0.7–1.4 |
| C | 55 mg | 359.8 | 99.2 | 0 | 99.5 | 98.9 | 0.34 | 1.39 | 0.3–5.7 |
| D | 5 μg | 103.8 | 45.1 | 12.0 | 44.2 | 46.1 | 0.51 | 0.82 | 0.6–1.0 |
| E | 8 mg | 136.6 | 77.0 | 3.0 | 76.7 | 77.3 | 0.80 | 0.62 | 0.4–0.9 |
| Folic acid | 100 μg | 207.5 | 99.3 | 0 | 99.5 | 99.1 | 0.51 | 0.99 | 0.2–4.5 |

* Daily micronutrient intakes recommended by the CSIC Nutrition and Bromatology Institute (Huijbregts *et al*, 1997).
†Percentage of children having an intake above 100% of the recommended level.
‡These differences decrease or disappear when >66% compliers are compared.
§OR of being a complier (intake above 100% of the recommended level) for boys *vs* girls, adjusted for caloric intake.
[11]Retinol equivalents.

**Table 2** Percentage of children complying with nutritional goals set for the Spanish population

| | | | Percentage | | | |
|---|---|---|---|---|---|---|
| | *Guideline* | *Mean* | *Total* | *Boys* | *Girls* | P |
| Proteins* | 10–13% | 17.2 | 4.7 | 4.7 | 4.7 | 0.99 |
| Fats* | ≤ 35% | 45.9 | 0.6 | 0.4 | 0.9 | 0.3 |
| Monounsaturated fatty acids* | 15–20% | 18.3 | 69.7 | 69.7 | 69.7 | 0.98 |
| Polyunsaturated fatty acids* | ≤ 8% | 8.3 | 43.7 | 44.9 | 42.5 | 0.43 |
| Saturated fatty acids* | ≤ 10% | 16.7 | 0.2 | 0 | 0.4 | 0.25 |
| Ratio of unsaturated–saturated | ≥ 2 | 1.6 | 11.6 | 10.2 | 13.0 | 0.15 |
| Cholesterol density | < 100 | 169.5 | 4.9 | 5.2 | 4.5 | 0.59 |
| Linoleic acid* | 2–6% | 7.3 | 23.0 | 24.1 | 22.0 | 0.41 |
| Carbohydrates* | 55–60% | 38.3 | 0.3 | 0.2 | 0.4 | 0.62 |
| Simple carbohydrates* | < 10% | 21.2 | 1.1 | 1.3 | 0.9 | 0.6 |
| Complex carbohydrates* | > 50% | 17.8 | 0 | 0 | 0 | — |
| Salt | < 6 g | 6.8 | 40.7 | 35.9 | 45.6 | < 0.01 |
| Fiber† | 11–17 g | 19.7 | 30.1 | 26.9 | 33.3 | 0.02 |

*Percentage of total caloric intake supplied by the nutrient in question.
†Mean daily intake guideline established by Williams *et al* (1995).

tively). In this instance, boys were observed to register a worse dietary pattern than girls for vitamins D and E, with ORs of having an intake above 100% of the recommended levels of 0.82 (CI: 0.6–1.0) and 0.62 (CI: 0.4–0.9), respectively. Although no differences were observed in the crude analysis, on adjusting for energy we found that the OR of having a vitamin B6 intake above 66% of the recommended level was 0.76 (CI: 0.5–1.0) for boys *vs* girls.

### Nutrient intake compared with nutritional goals

The degree of compliance with nutritional goals proved very variable (Table 2). In terms of population means, only the target for monounsaturated fatty acid intake (18.3%) was complied with. In percentage terms, the level of compliance with the recommendations for food energy supplied by fats, saturated fatty acids and carbohydrates was practically nil, in contrast to the high percentage of compliance with the recommendations for poly- and monounsaturated fatty acid (69.7 and 43.7%, respectively) and salt intake (40.7%). Between these two extremes, the percentages of the sample that complied with the recommendations for linoleic acid, fiber and the saturated-to-unsaturated fatty acid ratio were 23, 30.1 and 11.6%, respectively.

While non-complier status was attributable to an excess in the case of total fat and linoleic acid intake and a deficit in the case of carbohydrate intake (data not shown), in the case of monounsaturated fatty acids and fiber, deviations in both directions were observed, albeit with a clear predominance of non-compliance due to excess (23.1 and 61.7%, respectively). From a gender standpoint, the only statistically significant difference in the degree of compliance was evident in the case of fiber intake (Table 2), with girls registering a better behavior pattern than boys (33.3% *vs* 26.9%).

### Food consumption compared with food guidelines

With the exception of cereals, mean consumption of food servings for each of the main American pyramid food groups came close to or exceeded USDA guidelines (Table 3). The percentage of children with an adequate food intake varied from 13% for the cereal group to 82.5% for the dairy products group (data not shown). Comparison by sex revealed the only statistically significant difference to be in the dairy products group, with a higher mean intake and percentage of compliers among boys. Insofar as vegetables were concerned, the crude analysis showed a greater mean consumption among boys, but a similar percentage of compliers in both groups. On adjusting for energy, however, the relationship was inverted, with girls displaying a better behavior pattern for both variables.

Table 4 shows nutrient intake according to the pattern of compliance with food guide pyramid recommendations for the five main food groups. Subjects who failed to comply with any of the recommendations registered the lowest values of energy and micronutrient intake and, in some cases (vitamins B6 and D) fell below the intake levels recommended by the SENC. At the opposite extreme, the children who complied with all the recommendations registered a lower percentage of energy derived from proteins and fats, a lower cholesterol density and a higher unsaturated–saturated fatty acid ratio. Likewise, both dietary variety and carbohydrate and fiber intake were higher in this group than in the remaining patterns studied.

### Overall quality of the diet

The mean score obtained in the HEI-f was 64.6. A total of 94.7% of the sample obtained an HEI-f score of 51–80 (must improve) and only 3.7 and 1.6% obtained scores below 51

**Table 3** Mean daily intake of servings for the five main food groups in the American food pyramid

| | *Number of servings* | | | | |
|---|---|---|---|---|---|
| | *Cereals (s.d.*)* | *Vegetables (s.d.*)* | *Fruit (s.d.*)* | *Dairy products (s.d.*)* | *Meat products (s.d.*)* |
| Guideline | 7.8 | 3.7 | 2.7 | 2 | 2.3 |
| Mean intake | | | | | |
| Overall | 5.4 (2.3) | 4.8 (3.1) | 2.5 (1.5) | 2.9 (1.1) | 2.6 (0.9) |
| Boys | 5.6 (2.4) | 4.8 (3.1) | 2.6 (1.6) | 3.1 (1.2) | 2.7 (1.0) |
| Adjusted† | 5.5 (2.6) | 4.7 (3.9) | 2.5 (2.0) | 3.0 (1.3) | 2.6 (1.1) |
| Girls | 5.2 (2.1) | 4.7 (3.0) | 2.4 (1.4) | 2.7 (1.1) | 2.6 (0.8) |
| Adjusted† | 5.4 (2.6) | 4.9 (3.9) | 2.5 (2.0) | 2.8 (1.3) | 2.7 (1.1) |
| *P*‡ | 0.63 | 0.17 | 0.76 | <0.01 | 0.62 |

*Standard deviation.
†Adjusted for total caloric intake.
‡Probability of the adjusted differences.

**Table 4** Nutrient intake and dietary variety in terms of compliance with USDA guidelines for the main groups in the American food pyramid

| | | *Degree of compliance* | | | |
|---|---|---|---|---|---|
| | *Guideline* | *All* (n=*35*) | *>1 and ≤4* (n=*1037*) | *None* (n=*40*) | P |
| Energy* | 2000 kcal | 3003.6 | 2124.8 | 1480.3 | |
| Proteins† | 10–13% | 16.4 | 17.3 | 16.2 | <0.01 |
| Fats† | ≤ 35% | 43.8 | 45.0 | 46.5 | <0.01 |
| Monounsaturated fatty acids† | 15–20% | 18.0 | 18.3 | 19.0 | 0.12 |
| Polyunsaturated fatty acids† | ≤ 8% | 7.6 | 8.3 | 8.9 | <0.01 |
| Saturated fatty acids† | ≤ 10% | 14.4 | 16.7 | 16.8 | <0.01 |
| Ratio of unsaturated–saturated | ≥ 2 | 1.8 | 1.6 | 1.7 | <0.01 |
| Cholesterol density | <100 | 160.2 | 169.4 | 180.4 | 0.26 |
| Linoleic acid† | 2–6% | 6.8 | 7.3 | 7.9 | 0.02 |
| Carbohydrates† | 55–60% | 41.6 | 38.1 | 38.6 | <0.01 |
| Simple carbohydrates† | <10% | 22.0 | 21.2 | 20.3 | 0.45 |
| Complex carbohydrates† | > 50% | 20.5 | 17.7 | 18.8 | <0.01 |
| Fiber* | 11–17 g | 29.8 | 19.7 | 12.4 | <0.01 |
| Vitamin A* ‡ | 400 μg | 827.2 | 667.2 | 435.7 | <0.01 |
| Vitamin B6* | 1.4 mg | 1.6 | 1.1 | 0.6 | <0.01 |
| Vitamin C* | 55 mg | 329.6 | 195.2 | 154.4 | <0.01 |
| Vitamin D* | 5 μg | 6.7 | 5.2 | 3.9 | <0.01 |
| Vitamin E* | 8 mg | 16.7 | 10.9 | 8.0 | <0.01 |
| Folic acid* | 100 μg | 326.8 | 206.0 | 142.4 | <0.01 |
| Calcium* | 800 mg | 2004.3 | 1026.3 | 1582.0 | <0.01 |
| Variety | — | 48.8 | 42.0 | 37.2 | <0.01 |

*Recommended daily intake.
†Percentage of total energy supplied by the nutrient in question.
‡Retinol equivalents.

(poor diet) and above 80 (good diet), respectively. The HEI-f score was slightly higher in girls (65) than in boys (64.3), though this difference failed to reach statistical significance ($P=0.15$), even after adjustment for energy ($P=0.09$). Mention should be made here of the low scores registered by the index components that analyze the proportion of energy derived from fats and saturated fatty acids, which, on a scale of 0–10, scored 2.97 and 0.74, respectively (Table 5).

The relationship between nutrient intakes and HEI-f tertiles is set out in Table 6 (shown without adjustment for energy in order to be consistent with the HEI-f). Fiber and carbohydrate intake and the unsaturated–saturated fatty acid ratio were positively associated with the HEI-f, while protein intake decreased as the HEI-f increased. Vitamin A was the only vitamin intake to be negatively associated with the HEI-f, a phenomenon also observed for calcium intake. Further-

**Table 5** Healthy Eating Index (HEI-f) scores for children in the study

| *Component* | *Criterion for 10 points* | *Criterion for 0 points* | *Mean score (s.d.*)* |
|---|---|---|---|
| *Food group* | | | |
| 1.Cereals | 7.8 servings | 0 servings | 6.62 (2.1) |
| 2.Vegetables | 3.7 servings | 0 servings | 8.46 (2.4) |
| 3.Fruit | 2.7 servings | 0 servings | 7.52 (2.7) |
| 4.Dairy products | 2 servings | 0 servings | 9.61 (1.2) |
| 5.Meat products | 2.3 servings | 0 servings | 9.48 (1.1) |
| *Dietary guidelines* | | | |
| 6.Total fats | $\leq$ 35% of energy | $\geq$ 50% of energy | 2.97 (2.5) |
| 7.Saturated fats | $\leq$ 10% of energy | $\geq$ 15% of energy | 0.74 (1.6) |
| 8.Cholesterol | $<$ 300 mg | $\geq$ 450 mg | 6.35 (3.9) |
| 9.Sodium | $<$ 2400 mg | $\geq$ 4800 mg | 7.87 (2.9) |
| 10.Variety | — | — | 5 |
| Total | | | 64.63 (7.5) |

*Standard deviation.

**Table 6** Nutrient intake and dietary variety by HEI-f tertiles

| | | *HEI-f tertiles* | | | |
|---|---|---|---|---|---|
| | *Guideline* | *Lower ($<$ 60.8)* | *Middle (60.8 – 68.6)* | *Upper ($>$ 68.6)* | P |
| Energy* | 2000 | 2047.1 | 2131.4 | 2209.1 | |
| Proteins† | 10–13% | 18.1 | 17.3 | 16.2 | $<$0.01 |
| Monounsaturated fatty acids† | 15–20% | 18.7 | 18.7 | 17.4 | $<$0.01 |
| Polyunsaturated fatty acids† | $\leq$ 8% | 8.3 | 8.5 | 8.2 | $<$0.09 |
| Ratio of unsaturated–saturated | $\geq$ 2 | 1.5 | 1.6 | 1.7 | $<$0.01 |
| Linoleic acid† | 2–6% | 7.2 | 7.4 | 7.2 | 0.13 |
| Carbohydrates† | 55–60% | 35.5 | 37.5 | 41.8 | $<$0.01 |
| Simple carbohydrates† | $<$ 10% | 20.3 | 20.6 | 22.8 | $<$0.01 |
| Complex carbohydrates† | $>$ 50% | 16.2 | 17.7 | 19.4 | $<$0.01 |
| Fiber* | 11–17 g | 17.0 | 19.5 | 22.7 | $<$0.01 |
| Vitamin A*‡ | 400 μg | 714.2 | 653.1 | 624.6 | $<$0.01 |
| Vitamin B6* | 1.4 mg | 1.0 | 1.1 | 1.1 | 0.02 |
| Vitamin C* | 55 mg | 181.5 | 201.3 | 210.9 | $<$0.01 |
| Vitamin D* | 5 μg | 5.2 | 5.2 | 5.1 | 0.76 |
| Vitamin E* | 8 mg | 10.7 | 11.1 | 11.0 | 0.48 |
| Folic acid* | 100 μg | 195.8 | 208.9 | 218.0 | $<$0.01 |
| Calcium* | 800 mg | 1690.8 | 1578.9 | 1456.3 | $<$0.01 |
| Variety | — | 37.9 | 42.8 | 45.1 | $<$0.01 |

*Recommended daily intake.
†Percentage of total energy supplied by the nutrient in question.
‡Retinol equivalents.

more, dietary variety and energy intake increased with a rise in the HEI-f score.

## Discussion

Our findings suggest that children aged 6–7 y show scant compliance with the nutritional goals set by the SENC for the Spanish population, with the sole exception of recommendations relating to unsaturated fatty acid, salt and fiber intake. Micronutrient intake is adequate in general terms, yet there are still small groups of children with a potential risk of deficient intakes of vitamins B6 and D. While Spanish children's eating habits are reasonably in line with American food guide pyramid guidelines, there is room for improvement in the case of cereals and fruit. Overall, the mean score obtained by Spanish children in the HEI-f indicates a need for improvement in the dietary habits of this age group.

As shown by a review of earlier studies, ours has the greatest geographic coverage of all surveys to target food and nutrition among schoolgoers in Spain over the last 20 years (Gorgojo *et al*, 1999). Nonetheless, the results should be interpreted with caution, not only because the main source of information relies upon mothers' power of recall, but also

because of the limitations inherent in the measuring instrument. On the one hand, while some studies show that FFQ lead to an overestimation of the caloric intake among children (Stein *et al*, 1992), others indicate that it is possible for usual intake of energy and nutrients to be properly measured using this type of questionnaire (Treiber *et al*, 1990). In most cases, SQFFQs have not used portion sizes adjusted for children's level of intake, so the overestimation of energy and nutrients may be due to the use of adult portion sizes (McPherson *et al*, 2000). Moreover, a study undertaken in the early 1990s on children aged 6–7 y in the Madrid region (Vázquez *et al*, 1996), the only Spanish study allowing for direct comparison with this one, yielded results similar to ours, particularly for the contribution of macronutrients to total energy intake. On the other hand, recall and information bias may be a serious concern, particularly for socially desirable foods. To enhance validity, the interviewers were given precise instructions about how to carry out the interview, how to express the questions, and how to take positive breaks in order to avoid deficiencies in the information gathered that could be due to the interviewee's tiredness. The blood test collection included in the study design (Rodríguez-Artalejo *et al*, 1999) could also have had a positive effect on validity (Willet, 1998). Moreover, there is evidence to show that mothers furnish reliable information on meals made for children at home (Treiber *et al*, 1990). Finally, although the observation of a high degree of correlation between the HEI and HEI-f may be partly due to the effect of correlated errors, a considerable degree of overlap between the distributions of both indices has also been observed (McCullough *et al*, 2000).

In most cases, intake of vitamins and minerals exceeded the RDA, as was to be expected from the consumption of fruit and vegetables. Nevertheless, these findings coexist with the presence of small groups of children requiring special attention, owing to the potential risk of their registering deficiencies in the intake of certain micronutrients, vitamins B6 and D in particular. Earlier studies (Albertson *et al*, 1992; Serra *et al*, 1996) have already highlighted the risk of deficiencies in the intake of both vitamins in certain child population subgroups. Contrary to the findings reported for children in the USA (Johnson, 2000), however, no risk of inadequate calcium intake was in evidence.

Adherence to recommended intakes of unsaturated fatty acids, fruit and vegetables**,** confirms that the diet of Spanish children retains some of the characteristics peculiar to the Mediterranean diet (Rodríguez-Artalejo *et al*, 1996). It is nevertheless remarkable that practically all the children studied failed to comply with nutritional goals for fat, saturated fatty acid and carbohydrate intakes. This finding is consistent with the reduced intake of cereals and high consumption of dairy and meat products, which has likewise been observed in other child population studies in Spain (Vázquez *et al*, 1995). These data show that Spanish children's dietary habits lie midway between a typically Mediterranean pattern and one more typical of Anglo-Saxon countries (Rodríguez-Artalejo *et al*, 1996), with the ensuing risk of a potential increase in incidence of chronic disease in adult life if the above trend in such habits is maintained.

Mean intake for the five main groups defined in the American food pyramid proved satisfactory. Compared with the results of two similar studies on US children in the same age group, the children in our study registered a higher degree of compliance with the recommended intakes for the five food groups in the American pyramid, except for cereals (Muñoz *et al*, 1997; Brady *et al*, 2000). A total of 3.1% of Spanish children complied with all the food guide pyramid recommendations, a figure higher than that observed in one of the above-mentioned studies (Muñoz *et al*, 1997). Moreover, only 3.6% of Spanish children complied with none of the food guide pyramid recommendations, *vs* figures ranging from 17 to 29% for US children (Muñoz *et al*, 1997; Brady *et al*, 2000).

In contrast to the results reported above, when the HEI-f value is applied, the overall quality of Spanish children's diet appears to be slightly lower than that of US children of the same age (Bowman *et al*, 1998). To interpret this seemingly incongruent information, two aspects must be borne in mind. In the first place, reasons of design dictate that the mean for the dietary variety component of the HEI-f must inevitably have a value of 5. However, using the same methodology, but with an appreciably smaller number of items, the range of variety in our study (21–60) proved comparable to that reported in two American population-based studies (McCullough *et al*, 2000). Furthermore, the mean score for this component in an American population (including children) varied from 6.6 in 1989 to 7.6 in 1996 (Bowman *et al*, 1998). It can therefore be safely assumed that a significantly higher score could have been expected for this component in Spanish children, had the original HEI method of dietary assessment been used. Secondly, whereas the index assesses total fat and saturated fatty acid intakes under two separate heads, it takes no account of unsaturated fatty acid intake (Hu *et al*, 1999; Kris-Etherton, 1999). The Mediterranean diet—rich in fats with a predominance of monounsaturated fatty acids—has been associated with a marked and significant reduction in total mortality (Trichopoulou & Vasilopoulou, 2000). Despite the fact that Spanish children's fat consumption pattern is very similar to that of the Mediterranean profile, this circumstance is not positively recognized in the HEI-f. In addition, although the percentage of US children complying with the guidelines in respect of fat consumption has risen in relative terms (% of total caloric intake) in the last 8 y, fat consumption in absolute terms (g/day) has increased over the same period of time (Johnson, 2000).

Total caloric intake showed hardly any change with HEI-f score, yet rose sharply according to the degree of compliance with food guide pyramid recommendations. Caution is thus needed when interpreting the associations between pyramid

compliance patterns and macro- and micronutrient intake, given the importance of maintaining a total caloric intake at acceptable levels (Napoli & Horton, 1997). Children with a dietary pattern of compliance with all the recommendations for the pyramid's five food groups as well as those with highest HEI-f scores registered a more varied diet and a more adequate nutrient intake than the remaining subjects. Nonetheless, fat consumption and the percentage of energy derived from saturated fatty acids were inappropriately high across all groups; unlike the position reported for US children (Muñoz *et al*, 1997), however, this intake was lower in those children whose dietary pattern complied with all five food group recommendations. These observations highlight the fact that, provided due caution is exercised and its inherent limitations are taken into account (Chung *et al*, 1996; McCullough *et al*, 2000), the HEI-f can be used to assess the overall diet quality of Spanish children. The fact that calcium intake decreases with a rise in the HEI-f score may be attributable to the predominance of whole milk (79.7% of the total) in the food profile of our child population, with consequent increase in the intake of saturated fats, which exert so much weight upon the HEI-f score. Given that mean calcium intake far exceeded recommended levels (197% RDA) and that cases of intake so low as to represent a risk of deficiency were practically non-existent, this leaves a certain leeway for reducing the consumption of dairy products, by limiting saturated fatty acid intake without in any way compromising the benefits to be derived from an adequate intake of calcium. Lastly, it is worth pointing out that children in the upper HEI-f tertile also registered a more varied diet, in line with the results of other studies(McCullough *et al*, 2000).

In conclusion, the results yielded by this study are of public health relevance. They may help to set nutritional goals and food guidelines based on the actual children food and nutritional status. They also suggest the potential usefulness of implementing measures which, while preserving the still prevailing characteristics typical of a Mediterranean diet, contribute to the promotion of a healthier diet, such as reducing milk consumption or increasing cereal intake.

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