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# Nutrient adequacy in Spanish children and adolescents

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The nutritional intakes of the Spanish child and adolescent population are presented, as well as the population at risk of inadequate nutrient status. A random sample of 3534 people aged 2–24 years were interviewed between 1998 and 2000. Interviews included two 24 h recalls and a general questionnaire and anthropometric evaluations for the entire sample. After excluding under-reporters (18·7 %), the final sample was 2855 individuals (1348 males and 1507 females). The average intake of energy was 9543 kJ in males and 7804 kJ in females, with important variations seen by age group. Energy intake increased with age in both sexes until 14–17 years, which also applied to almost all of the nutrients studied, with the exception of vitamin C. A decreasing trend in the percentage of energy from carbohydrates was seen in both sexes. At the low socioeconomic level, it was observed that all nutrient intakes were less favourable when compared with higher socioeconomic levels. Nutrients with associated intakes below one-third of the Spanish recommended nutrient intake (RNI) included vitamin D (42 % of the sample) and folate (10 % of females), and the percentages falling below two-thirds of the RNI corresponded to: vitamin D (97 %), vitamin A (60 %), vitamin E (54 %), folate (58 % of females), Fe (23 % of females), vitamin C (8 %), Mg (4·5 %), Ca (5 % of females) and vitamin $B_6$ (5 % of females). Adolescents aged between 14 and 17 years was the group with the highest nutritional risk, especially among girls. Nutritional adequacy in Spanish children was, in general, adequate, although it is necessary to analyse the implications of high inadequate intakes of vitamins D, E and A, which means that the current recommended intakes should be reconsidered. It should be noted that folate levels should be doubled in the near future.

**Nutrient adequacy: Recommended nutrient intake: Children: Adolescents: Nutrition survey: Spain**

The assessment of nutritional status in childhood and adolescence is critical to understanding the scientific basis of this priority public health issue, and thus in the development of coherent and appropriate policies. However, the majority of dietary information utilized in Spain comes from household or national availability surveys, which means that information for children and adolescents cannot be categorized. Moreover, the majority of nutrition surveys carried out at the regional level in Spain exclude this population group. With the exception of certain studies conducted in communities or cities, detailed information on dietary habits and nutritional status of children and adolescents does not exist in Spain. The enKid Study in Spain was designed and carried out with the aim of filling the gap for this target population. Its rigorous methodology has yielded results (Aranceta *et al.* 2001; Serra Majem & Aranceta Bartrina, 2001, 2002; Serra-Majem *et al.* 2001, 2002, 2003*a–d*, 2004; Aranceta *et al.* 2003; Pérez Rodrigo *et al.* 2003) that serve as an indispensable tool for community nutrition in Spain, setting the base for campaigns geared towards improving dietary habits related to eating breakfast, childhood obesity prevention and the promotion of physical activity (Agencia Española de Seguridad Alimentaria, 2005), among others.

Evaluating the nutritional adequacy of the diet is based on the comparison of the intake of proteins, vitamins and minerals to daily recommended intakes, for which various techniques are employed (Gibson, 1990). In the last few decades, such evaluations have become more sophisticated via the utilization of new techniques and statistical models that allow for attenuating intra-individual variability (Liu *et al.* 1978), as well as simultaneous analysis of various nutrients (Gibson, 1990) and excluding dietary under-reporters (Goldberg *et al.* 1991). Additionally, new reference values and cut-off points have emerged so as to facilitate comparisons. Such assessments have also taken into account the change in dietary habits in children and adolescents with the appearance of a great number of enriched and functional foods.

A recent review of childhood nutrition adequacy conducted by the International Life Sciences Institute Europe failed to include information from Spain and other European countries, due to methodological constraints and to the lack of available information (Lambert *et al.* 2004).

Infancy and adolescence constitute a period of undoubtable nutritional risk given the increased nutritional requirements for growth and development. Continuing with the analysis of the enKid Study, the objective of the present paper is to evaluate the nutritional status of the Spanish population aged 2–24 years, as well as to identify the population at risk of developing inadequate nutrient intakes.

**Abbreviation:** RNI, recommended nutrient intake.

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## Methodology

The present analysis is part of the enKid Study, a population-based, cross-sectional survey conducted in Spain between 1998 and 2000 (Serra Majem & Aranceta, 2000; Serra-Majem *et al.* 2001, 2002).

### *Sample*

The target population consisted of all inhabitants of Spain aged 2–24 years, and the sample population was derived from residents aged 2–24 years registered in the Spanish official population census. The theoretical sample size was set at 5200 individuals, taking into account an anticipated 70 % participation rate. The sampling technique included stratification according to geographical area (six strata) and municipality size (four strata) and randomization into subgroups, with Spanish 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 socioeconomic status, education level and life-style factors were utilized.

The dietary questionnaires conducted were: one 24 h diet recall and a quantitative food frequency questionnaire by subject; and a second 24 h diet recall in 25 % of the sample. In order to avoid the influence of seasonal variations, 24 h recalls were administered throughout the year. The questionnaires were conducted in the participant's home. 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.

Social class was estimated by the occupation of the head of the family according to the methodology described by Sociedad Española de Epidemiología (Álvarez Dardet *et al.* 1995). Three categories were specified: low (48 %), medium (32 %) and high (20 %).

### *Fieldwork*

Fieldwork was initiated on 1 May 1998 and ended on 30 April 2000. Home interviews were conducted by forty-three dietitians, who had undergone a rigorous selection, training and standardization process. Survey data were entered by the same field staff into laptop computers, which incorporated software specifically designed for the study.

In the case of children aged 2–5 years, mothers or primary caretakers responsible for feeding the child responded to the interview questions. For children aged 6–13 years, the interviews were answered by the children themselves, with support from the caretaker responsible for his/her feeding. When it was necessary, additional information was obtained from school lunch menus, conducting telephone interviews with the food service director of the school.

### *Nutrient intake and statistical analysis*

The food and nutrient information used in this analysis came from the 24 h recalls. The nutrient database software used for the study consisted of the Spanish database from Mataix Verdú & Mañas Almendros (1998), completed with information from French (Favier *et al.* 1995) and British (Holland *et al.* 1991) food composition tables.

The administration of two questionnaires in a subsample allowed for the adjustment of intakes for random intra-individual variation using the method described by Liu *et al.* (1978) and Beaton *et al*. (1983). The aim was to use the usual intakes of energy and nutrients of individuals from the sample as a starting point (Institute of Medicine, 2000) so as to accurately estimate distribution of intakes and percentage of population groups above or below defined cut-off points (i.e. recommended nutrient intakes, RNI).

For the identification of under-reported food intake we used the ratio of energy intake to basal metabolic rate: if less than 1·14 the individual was classified as an under-reporter (Goldberg *et al.* 1991).

The estimation of inadequate intakes of energy and nutrients was carried out using different methodologies (Gibson, 1990): (1) comparison with the Spanish nutrient values (RNI); (2) applying a probability approach; and (3) calculating nutrient adequacy ratios and mean adequacy ratios. In all the previously mentioned cases, Spanish nutrient reference values were applied (Consejo Superior de Investigaciones Científicas, 1994), of which only the reference value for folate in women between 13 and 24 years of age was modified (doubled to 400 μg).

Data were analysed using the statistical package SPSS for Windows version 10·0 (SPSS Inc., Chicago, IL, USA). Descriptive analyses are expressed by sex and age groups.

## Results

A total of 3534 individuals participated in the study, which represented 68·2 % of the theoretical sample. The distributions by age and sex of the sample and the study population were not significantly different from the Spanish population for the age groups under study. Additionally, the distribution by regions reflected the original geographical pattern of inhabitants. The percentage of under-reporters was 18·7 %, and upon their exclusion the sample used in this analysis consisted of 2855 individuals (1348 men and 1507 women).

Table 1 presents the mean daily intakes of energy and nutrients, macronutrients as percentage of total energy and nutrients per 1000 kJ by age group and gender. The average intake of energy was 9543 kJ in males and 7804 kJ in females, with important variations seen by age group. Energy intake increased with age in both sexes up to the age of 14–17 years, which also applied to almost all of the nutrients studied, with the exception of vitamin C. However, the percentage of energy from protein and lipids increased in an exponential form only in males, with no significant trends seen for females. A decreasing trend in the percentage of energy coming from carbohydrates was seen in both sexes.

Nutritional density (in 1000 kJ) showed increases in the contribution of fibre (more pronounced in girls), cholesterol, Fe, vitamin $B_{12}$, vitamin E and niacin and decreases in Ca, P, vitamin A, riboflavin and vitamin C (the latter only in boys). The greatest nutritional density for folate was observed in males aged 2–5 years and in females aged 18–24 years.

The analysis of intake as a function of socioeconomic status showed similar values for energy, although certain differences

**Table 1.** Mean daily intakes of energy and nutrients by sex and age in Spanish population aged 2–24 years; enKid Study (1998–2000)

| | Males | | | | | | Females | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2–5 years (*n* 192) | 6–9 years (*n* 203) | 10–13 years (*n* 261) | 14–17 years (*n* 256) | 18–24 years (*n* 436) | Total (*n* 1348) | 2–5 years (*n* 175) | 6–9 years (*n* 195) | 10–13 years (*n* 253) | 14–17 years (*n* 241) | 18–24 years (*n* 643) | Total (*n* 1507) |
| Energy (kJ) | 6674·6 | 8245·5 | 9631·7 | 10 729·7 | 10 385·7 | 9542·7 | 6257·5 | 7589·8 | 8154·9 | 8281·1 | 8036·1 | 7803·9 |
| Energy (kcal) | 1595·3 | 1970·7 | 2302·0 | 2564·5 | 2482·3 | 2280·8 | 1495·6 | 1814·0 | 1949·1 | 1979·2 | 1920·7 | 1865·2 |
| Protein (g) | 66·0 | 80·7 | 98·4 | 108·2 | 107·2 | 96·9 | 63·9 | 74·6 | 80·1 | 83·4 | 82·0 | 78·6 |
| Carbohydrate (g) | 187·4 | 228·5 | 274·3 | 286·0 | 264·1 | 254·6 | 179·7 | 203·1 | 224·0 | 225·0 | 208·2 | 209·3 |
| Lipids (g) | 68·0 | 86·5 | 99·6 | 115·3 | 106·6 | 99·2 | 63·6 | 81·2 | 84·9 | 84·7 | 84·5 | 81·4 |
| SAT (g) | 24·7 | 31·6 | 34·8 | 38·8 | 33·8 | 33·4 | 23·5 | 28·9 | 29·0 | 28·6 | 27·2 | 27·5 |
| MUFA (g) | 27·3 | 34·3 | 39·6 | 47·0 | 44·1 | 40·4 | 24·9 | 32·8 | 33·8 | 34·8 | 34·8 | 33·0 |
| PUFA (g) | 7·8 | 10·4 | 12·9 | 14·5 | 13·8 | 12·5 | 7·1 | 9·9 | 11·0 | 10·7 | 11·2 | 10·4 |
| Fibre (g) | 11·2 | 14·7 | 17·2 | 18·8 | 18·5 | 16·9 | 10·1 | 12·6 | 14·6 | 14·8 | 15·5 | 14·1 |
| Cholesterol (mg) | 290·2 | 332·1 | 391·6 | 457·0 | 489·0 | 419·8 | 253·7 | 320·1 | 337·9 | 365·8 | 372·5 | 343·0 |
| Na (mg) | 1636·1 | 2157·9 | 2746·1 | 3223·3 | 2851·0 | 2646·6 | 1568·0 | 1965·7 | 2306·3 | 2222·1 | 2137·9 | 2080·6 |
| K (mg) | 2353·8 | 2707·8 | 2945·8 | 3143·8 | 3151·2 | 2950·4 | 2196·4 | 2495·2 | 2531·6 | 2474·4 | 2693·0 | 2534·4 |
| Mg (mg) | 226·8 | 259·5 | 304·3 | 319·0 | 314·1 | 294·3 | 213·3 | 242·7 | 259·2 | 256·6 | 268·1 | 253·8 |
| P (mg) | 1199·8 | 1362·8 | 1536·8 | 1656·8 | 1655·5 | 1536·1 | 1169·5 | 1260·8 | 1312·4 | 1334·2 | 1343·7 | 1302·7 |
| Ca (mg) | 896·4 | 953·6 | 1010·0 | 1030·6 | 993·6 | 984·5 | 875·6 | 870·6 | 862·4 | 823·0 | 845·3 | 851·2 |
| Fe (mg) | 10·3 | 12·8 | 15·1 | 16·6 | 16·2 | 14·8 | 9·0 | 11·3 | 12·7 | 12·5 | 12·9 | 12·1 |
| Vitamin A (μg) | 490·8 | 517·7 | 521·1 | 551·1 | 543·5 | 530·8 | 415·0 | 472·1 | 453·2 | 414·5 | 488·1 | 457·0 |
| Thiamin (mg) | 1·2 | 1·3 | 1·5 | 1·6 | 1·5 | 1·5 | 1·0 | 1·2 | 1·3 | 1·3 | 1·3 | 1·2 |
| Riboflavin (mg) | 1·8 | 1·8 | 1·9 | 1·9 | 1·8 | 1·9 | 1·7 | 1·7 | 1·6 | 1·5 | 1·6 | 1·6 |
| Vitamin $B_6$ (mg) | 1·4 | 1·6 | 1·9 | 2·0 | 1·9 | 1·8 | 1·3 | 1·5 | 1·5 | 1·5 | 1·6 | 1·5 |
| Vitamin $B_{12}$ (μg) | 5·1 | 7·4 | 8·3 | 8·9 | 9·2 | 8·2 | 5·5 | 6·0 | 6·7 | 7·2 | 7·4 | 6·8 |
| Vitamin C (mg) | 80·3 | 75·8 | 70·0 | 76·3 | 80·8 | 77·6 | 72·2 | 69·1 | 69·7 | 73·7 | 84·5 | 76·5 |
| Vitamin D (μg) | 1·4 | 2·1 | 2·1 | 2·6 | 2·2 | 2·1 | 1·2 | 1·8 | 1·7 | 1·5 | 1·8 | 1·6 |
| Vitamin E (mg) | 4·7 | 6·1 | 7·2 | 8·0 | 8·2 | 7·3 | 4·6 | 6·0 | 6·7 | 6·4 | 7·0 | 6·4 |
| Niacin (mg) | 15·7 | 20·6 | 24·8 | 26·2 | 27·0 | 24·1 | 14·7 | 18·8 | 20·1 | 21·1 | 22·5 | 20·3 |
| Folate (μg) | 131·5 | 142·2 | 161·7 | 177·5 | 180·4 | 165·2 | 108·8 | 135·0 | 139·5 | 149·1 | 167·1 | 147·3 |
| Protein (% energy) | 16·6 | 16·4 | 17·1 | 17·0 | 18·0 | 17·3 | 17·1 | 16·6 | 16·5 | 17·1 | 17·5 | 17·1 |
| Carbohydrate (% energy) | 44·2 | 43·5 | 44·4 | 42·2 | 41·5 | 42·7 | 45·1 | 42·2 | 43·2 | 43·0 | 41·4 | 42·6 |
| Lipids (% energy) | 38·3 | 39·4 | 39·1 | 40·3 | 40·1 | 39·6 | 38·2 | 40·4 | 39·2 | 39·0 | 40·2 | 39·6 |
| SAT (% energy) | 13·9 | 14·4 | 13·7 | 13·6 | 12·7 | 13·4 | 14·0 | 14·3 | 13·4 | 13·1 | 13·0 | 13·4 |
| MUFA (% energy) | 15·3 | 15·6 | 15·5 | 16·4 | 16·6 | 16·1 | 14·9 | 16·3 | 15·6 | 16·0 | 16·6 | 16·1 |
| PUFA (% energy) | 4·4 | 4·8 | 5·0 | 5·1 | 5·2 | 5·0 | 4·2 | 5·0 | 5·1 | 4·9 | 5·3 | 5·0 |
| Fibre (g/1000 kJ) | 1·7 | 1·8 | 1·8 | 1·8 | 1·9 | 1·8 | 1·6 | 1·7 | 1·8 | 1·8 | 2·0 | 1·8 |
| Cholesterol (mg/1000 kJ) | 43·3 | 40·0 | 40·6 | 42·6 | 48·8 | 44·4 | 40·1 | 42·5 | 41·3 | 44·4 | 47·1 | 44·2 |
| Mg (mg/1000 kJ) | 34·0 | 31·6 | 31·6 | 30·1 | 31·4 | 31·6 | 34·0 | 32·2 | 32·0 | 31·5 | 34·2 | 33·1 |
| P (mg/1000 kJ) | 179·9 | 165·7 | 159·9 | 155·9 | 165·8 | 164·9 | 186·5 | 167·6 | 161·7 | 163·3 | 171·5 | 169·9 |
| Ca (mg/1000 kJ) | 135·0 | 116·1 | 105·0 | 96·9 | 99·0 | 106·7 | 139·5 | 115·8 | 106·1 | 100·9 | 108·0 | 111·6 |
| Fe (mg/1000 kJ) | 1·5 | 1·6 | 1·6 | 1·6 | 1·6 | 1·6 | 1·4 | 1·5 | 1·6 | 1·5 | 1·6 | 1·6 |
| Vitamin A (μg/1000 kJ) | 73·9 | 62·9 | 54·5 | 52·1 | 54·6 | 57·8 | 66·2 | 63·2 | 55·9 | 50·9 | 62·6 | 59·9 |
| Thiamin (mg/1000 kJ) | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 |
| Riboflavin (mg/1000 kJ) | 0·3 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·3 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 |
| Vitamin $B_6$ (mg/1000 kJ) | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 |
| Vitamin $B_{12}$ (μg/1000 kJ) | 0·8 | 0·9 | 0·9 | 0·8 | 0·9 | 0·9 | 0·9 | 0·8 | 0·8 | 0·9 | 0·9 | 0·9 |

**Table 1.** *Continued*

| | Males | | | | | | Females | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2–5 years (*n* 192) | 6–9 years (*n* 203) | 10–13 years (*n* 261) | 14–17 years (*n* 256) | 18–24 years (*n* 436) | Total (*n* 1348) | 2–5 years (*n* 175) | 6–9 years (*n* 195) | 10–13 years (*n* 253) | 14–17 years (*n* 241) | 18–24 years (*n* 643) | Total (*n* 1507) |
| Vitamin C (mg/1000 kJ) | 12·0 | 9·3 | 7·3 | 7·2 | 8·1 | 8·5 | 11·6 | 9·2 | 8·6 | 9·0 | 10·8 | 10·0 |
| Vitamin D (μg/1000 kJ) | 0·2 | 0·3 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 | 0·2 |
| Vitamin E (mg/1000 kJ) | 0·7 | 0·7 | 0·8 | 0·8 | 0·8 | 0·8 | 0·7 | 0·8 | 0·8 | 0·8 | 0·9 | 0·8 |
| Niacin (mg/1000 kJ) | 2·4 | 2·5 | 2·6 | 2·5 | 2·7 | 2·6 | 2·4 | 2·5 | 2·5 | 2·6 | 2·9 | 2·6 |
| Folate (μg/1000 kJ) | 19·7 | 17·3 | 16·9 | 16·7 | 18·1 | 17·7 | 17·4 | 17·9 | 17·2 | 18·3 | 21·4 | 19·2 |

SAT, saturated fatty acids.
Data adjusted for intra-individual variability. Under-reporters excluded.

were noted, of which the following stand out (high *v.* low socioeconomic status): folate (163 *v.* 153 μg/d), vitamins A (507 *v.* 489 μg/d) and C (80 *v.* 75 mg/d), Ca (933 *v.* 911 mg/d) and P (1443 *v.* 1416 mg/d). At the low socioeconomic level, it was observed that all nutrient intakes were less favourable when compared with higher socioeconomic levels. As for the association with the educational level of the mother, those subjects whose mothers had higher educational levels showed lower intakes of energy (−550 kJ/d), lipids (−6 g/d), cholesterol (−25 mg/d), fibre (−1·3 g/d), Fe (−0·7 mg/d) and higher intakes of Ca (+26 mg/d). The greatest differences were seen in nutrient density where the contribution per 1000 kJ showed greater values associated with higher levels of education for Ca (+9·7 mg/1000 kJ), vitamin A (+4 μg/1000 kJ) and vitamin C (+1 mg/1000 kJ).

Table 2 presents estimated inadequate intakes based on comparative analyses with the Spanish RNI. Data include gender and age group, the values of RNI used in the analysis, the percentage of the sample with intakes below one- and two-thirds of the RNI, as well as those with intakes below the RNI and the mean percentage RNI for energy and nutrients. Nutrients with associated intakes below one-third of the RNI included vitamin D in 42 % of the population (25 % males and 60 % females), folate in 10 % of the females, and to a lesser degree vitamins A (1 %), E (0·7 %) and C (0·3 %). The highest percentages of inadequate intake, falling below two-thirds of the RNI, corresponded to: vitamin D 97 % (96 % males and 99 % females), vitamin A 60 % (62 % males and 57 % females), vitamin E 54 % (42 % males and 67 % females), folate 32 % (9 % males and 58 % females), Fe 11 % (0 % males and 23 % females), vitamin C 8 % (9 % males and 8 % females), Mg 4·5 % (5 % males and 4 % females), Ca 3 % (1 % males and 5 % females), vitamin $B_6$ 2·6 % (1 % males and 5 % females), energy 2 %, riboflavin 0·6 % and niacin 0·1 %.

Table 3 shows, by age and gender, the distribution of the sample in relation to the number of nutrient intakes below two-thirds of the RNI. In this analysis, energy and fourteen nutrients (protein, Mg, Ca, Fe, vitamins $B_1$, $B_2$, $B_6$, $B_{12}$, C, A, D and E, niacin and folate) were included. Differences were seen for age and sex, with adolescent girls between 14 and 17 years showing the highest nutritional risk, with 45 % of this subset having intakes below two-thirds of the RNI for five or more nutrients, followed by females aged 18–24 years showing a 29 % prevalence for the same criterion.

Table 4 depicts the estimated inadequate intakes applying the probability approach. In general, the risk for deficiencies was greater in females than in males, with the exception of riboflavin and vitamin C. Inadequate intakes were again seen for vitamins D, E and A in both sexes and for folate in girls 14 years and older.

The distribution of the nutrient adequacy ratio for various nutrients and the mean of the nutrient adequacy ratios, the mean adequacy ratio, for seven, nine, twelve and fourteen nutrients are shown in Table 5. The nutrients with the worst outcomes for this index were always vitamins D, E and A, folate and Mg.

## Discussion

The intakes of energy and nutrients reflect the change in diet quantity and quality of Spanish children as a function of age.

**Table 2.** Risk of inadequate intake in Spanish population aged 2–24 years by gender and age; enKid study (1998–2000)

| Gender/age | | Energy | Protein | Mg | Ca | Fe | Vitamin A | Vitamin $B_1$ | Vitamin $B_2$ | Vitamin $B_6$ | Vitamin $B_{12}$ | Vitamin C | Vitamin D | Vitamin E | Niacin | Folate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Males | | | | | | | | | | | | | | | | |
| 2–5 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 99·3 | 0·0 | 0·0 | 0·0 |
| | % < 2/3 RNI | 0·4 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 2·4 | 100·0 | 25·4 | 0·0 | 0·7 |
| | % < RNI | 31·9 | 0·0 | 6·1 | 5·0 | 13·8 | 0·0 | 0·7 | 0·0 | 6·9 | 0·4 | 21·6 | 100·0 | 99·6 | 1·3 | 12·7 |
| | *X* %RNI | 112·5 | 256·9 | 151·3 | 112·1 | 132·3 | 163·3 | 208·1 | 206·2 | 171·1 | 471·4 | 146·0 | 14·0 | 72·8 | 171·8 | 131·5 |
| | RNI 2–3y/4–5y | 5230/7113 | 23/30 | 125/200 | 800 | 7/9 | 300 | 0·5/0·7 | 0·8/1·0 | 0·7/1·1 | 0·9/1·5 | 55 | 10 | 6/7 | 8/11 | 100 |
| 6–9 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 1·7 | 19·8 | 0·0 | 0·0 | 0·0 |
| | % < 2/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·8 | 0·0 | 0·0 | 0·0 | 0·0 | 15·3 | 94·9 | 36·3 | 0·0 | 0·0 |
| | % < RNI | 58·4 | 0·0 | 36·9 | 7·1 | 0·7 | 13·0 | 0·0 | 2·1 | 20·2 | 0·0 | 37·4 | 100·0 | 87·5 | 0·0 | 11·0 |
| | *X* %RNI | 98·4 | 223·9 | 103·7 | 119·1 | 141·6 | 129·1 | 166·5 | 151·5 | 116·9 | 490·8 | 137·9 | 41·3 | 75·9 | 158·4 | 142·2 |
| | RNI 6–9y | 8368 | 36 | 250 | 800 | 9 | 400 | 0·8 | 1·2 | 1·4 | 1·5 | 55 | 5 | 8 | 13 | 100 |
| 10–13 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·4 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 13·1 | 0·0 | 0·0 | 0·0 |
| | % < 2/3 RNI | 0·4 | 0·0 | 8·7 | 1·7 | 0·0 | 96·3 | 0·0 | 0·3 | 3·6 | 0·0 | 9·3 | 98·3 | 38·0 | 0·0 | 6·0 |
| | % < RNI | 86·3 | 0·0 | 89·9 | 52·7 | 15·6 | 99·6 | 1·1 | 16·5 | 47·6 | 0·0 | 40·1 | 100·0 | 99·0 | 1·2 | 28·8 |
| | *X* %RNI | 90·5 | 212·8 | 83·3 | 101·0 | 117·6 | 52·1 | 147·7 | 122·2 | 106·6 | 414·8 | 116·8 | 41·4 | 69·7 | 149·0 | 135·4 |
| | RNI 10–12y/13y | 10 251/11 506 | 43/54 | 350/400 | 1000 | 12/15 | 1000 | 1·0/1·1 | 1·5/1·7 | 1·6/2·1 | 2·0 | 60 | 5 | 10/11 | 16/18 | 100/200 |
| 14–17 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 5·6 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 3·5 | 0·0 | 0·0 | 0·0 |
| | % < 2/3 RNI | 0·8 | 0·0 | 7·9 | 1·3 | 0·0 | 84·0 | 0·0 | 1·1 | 0·0 | 0·0 | 11·7 | 88·3 | 47·6 | 0·0 | 23·1 |
| | % < RNI | 80·7 | 0·0 | 96·6 | 45·8 | 26·4 | 99·5 | 0·3 | 37·4 | 75·1 | 0·0 | 39·2 | 99·7 | 97·1 | 0·6 | 67·2 |
| | *X* %RNI | 89·4 | 196·7 | 79·7 | 103·1 | 111·0 | 55·1 | 142·5 | 110·4 | 94·2 | 443·3 | 127·2 | 51·1 | 70·0 | 138·4 | 88·8 |
| | RNI 14–15y/16–17y | 11 506/12 552 | 54/56 | 400 | 1000 | 15 | 1000 | 1·1/1·2 | 1·7/1·8 | 2·1 | 2·0 | 60 | 5 | 11/12 | 18/20 | 200 |
| 18–24 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 1·5 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 10·2 | 0·2 | 0·0 | 0·2 |
| | % < 2/3 RNI | 3·5 | 0·0 | 5·7 | 2·1 | 0·0 | 90·8 | 0·0 | 2·0 | 0·3 | 0·0 | 6·4 | 96·7 | 51·8 | 0·0 | 10·8 |
| | % < RNI | 93·4 | 0·0 | 83·7 | 30·7 | 10·5 | 99·2 | 3·5 | 51·9 | 41·4 | 0·0 | 27·9 | 100·0 | 97·1 | 0·3 | 69·4 |
| | *X* %RNI | 82·7 | 196·5 | 86·4 | 116·7 | 145·5 | 54·4 | 127·4 | 101·3 | 102·3 | 458·9 | 134·7 | 44·4 | 68·5 | 134·7 | 90·2 |
| | RNI 18–19y/20–24y | 12 552 | 56/54 | 400/350 | 1000/800 | 15/10 | 1000 | 1·2 | 1·8 | 2·1/1·8 | 2·0 | 60 | 5 | 12 | 20 | 200 |
| Total | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 1·5 | 0·0 | 0·0 | 0·0 | 0·0 | 0·3 | 25·4 | 0·1 | 0·0 | 0·1 |
| | % < 2/3 RNI | 1·4 | 0·0 | 4·8 | 1·2 | 0·0 | 61·9 | 0·0 | 0·9 | 0·7 | 0·0 | 8·6 | 95·9 | 42·0 | 0·0 | 8·8 |
| | % < RNI | 74·6 | 0·0 | 67·1 | 29·4 | 13·2 | 69·9 | 1·5 | 27·3 | 39·6 | 0·1 | 32·4 | 100·0 | 96·3 | 0·6 | 44·0 |
| | *X* %RNI | 92·5 | 213·3 | 97·9 | 111·3 | 132·0 | 83·3 | 152·6 | 131·2 | 114·9 | 455·7 | 132·6 | 39·6 | 70·8 | 147·5 | 112·4 |
| Females | | | | | | | | | | | | | | | | |
| 2–5 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 98·9 | 1·9 | 0·0 | 0·0 |
| | % < 2/3 RNI | 0·8 | 0·0 | 0·8 | 3·2 | 0·4 | 0·4 | 0·0 | 0·0 | 0·4 | 0·0 | 11·0 | 100·0 | 52·0 | 1·0 | 5·1 |
| | % < RNI | 45·3 | 0·0 | 12·3 | 35·5 | 26·1 | 16·9 | 0·8 | 2·9 | 9·4 | 0·0 | 36·1 | 100·0 | 89·8 | 6·9 | 33·6 |
| | *X* %RNI | 104·0 | 245·9 | 138·5 | 109·4 | 113·8 | 138·0 | 180·6 | 193·2 | 150·1 | 498·0 | 131·2 | 12·2 | 71·5 | 159·1 | 108·4 |
| | RNI 6–9y | 8368 | 36 | 250 | 800 | 9 | 400 | 0·8 | 1·2 | 1·4 | 1·5 | 55 | 5 | 8 | 13 | 100 |
| 6–9 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 52·6 | 1·4 | 0·0 | 0·0 |
| | % < 2/3 RNI | 2·3 | 0·0 | 1·5 | 1·1 | 0·0 | 0·7 | 0·0 | 0·0 | 3·4 | 0·0 | 8·8 | 96·4 | 43·4 | 0·0 | 0·0 |
| | % < RNI | 76·4 | 0·0 | 56·8 | 35·9 | 4·0 | 14·2 | 5·5 | 1·4 | 44·6 | 0·0 | 30·1 | 100·0 | 87·2 | 6·5 | 10·4 |
| | *X* %RNI | 90·6 | 207·2 | 97·0 | 108·7 | 125·4 | 117·6 | 149·5 | 137·4 | 104·9 | 396·9 | 125·7 | 35·5 | 75·4 | 144·4 | 135·0 |
| | RNI 2–3y/4–5y | 5230/7113 | 23/30 | 125/200 | 800 | 7/9 | 300 | 0·5/0·7 | 0·8/1·0 | 0·7/1·1 | 0·9/1·5 | 55 | 10 | 6/7 | 8/11 | 100 |
| 10–13 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·3 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 50·7 | 0·8 | 0·0 | 9·2 |
| | % < 2/3 RNI | 0·9 | 0·0 | 0·0 | 4·3 | 26·1 | 89·3 | 0·0 | 0·0 | 5·9 | 0·0 | 6·4 | 100·0 | 63·3 | 0·0 | 29·6 |
| | % < RNI | 97·2 | 0·0 | 98·2 | 87·3 | 100·0 | 99·7 | 0·7 | 15·3 | 87·5 | 0·0 | 38·8 | 100·0 | 95·0 | 0·0 | 30·2 |
| | *X* %RNI | 82·7 | 190·2 | 84·1 | 86·2 | 70·8 | 56·7 | 138·5 | 112·3 | 86·5 | 336·3 | 116·2 | 33·8 | 65·1 | 129·5 | 108·0 |
| | RNI 10–12y/13y | 9623/10 460 | 41/45 | 300/330 | 1000 | 18 | 800 | 0·9/1·0 | 1·4/1·5 | 1·6/2·1 | 2·0 | 60 | 5 | 10/11 | 15/17 | 100/400 |
| 14–17 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 3·3 | 0·0 | 0·0 | 0·0 | 0·0 | 2·4 | 79·2 | 0·0 | 0·0 | 30·3 |
| | % < 2/3 RNI | 5·3 | 0·0 | 4·6 | 13·9 | 34·8 | 91·8 | 0·0 | 1·0 | 13·4 | 0·0 | 18·8 | 100·0 | 88·8 | 0·0 | 100·0 |
| | % < RNI | 92·2 | 0·0 | 100·0 | 88·4 | 100·0 | 100·0 | 3·1 | 33·1 | 90·9 | 0·0 | 41·1 | 100·0 | 100·0 | 7·1 | 100·0 |
| | *X* %RNI | 82·7 | 189·8 | 77·7 | 82·3 | 69·6 | 51·8 | 134·5 | 106·1 | 80·5 | 359·8 | 122·8 | 29·1 | 55·5 | 132·3 | 37·3 |
| | RNI 14–15y/16–17y | 10 460/9623 | 45/43 | 330 | 1000 | 18 | 800 | 1·0/0·9 | 1·5/1·4 | 2·1/1·7 | 2·0 | 60 | 5 | 11/12 | 17/15 | 400 |

**Table 2.** *Continued*

| Gender/age | | Energy | Protein | Mg | Ca | Fe | Vitamin A | Vitamin $B_1$ | Vitamin $B_2$ | Vitamin $B_6$ | Vitamin $B_{12}$ | Vitamin C | Vitamin D | Vitamin E | Niacin | Folate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18–24 years | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·5 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 43·7 | 1·8 | 0·0 | 10·0 |
| | % < 2/3 RNI | 3·6 | 0·0 | 8·3 | 2·9 | 34·5 | 73·8 | 0·0 | 0·0 | 2·4 | 0·0 | 2·7 | 99·0 | 75·1 | 0·0 | 99·6 |
| | % < RNI | 90·5 | 0·0 | 94·0 | 52·7 | 98·4 | 99·5 | 1·7 | 22·4 | 49·5 | 0·0 | 24·1 | 100·0 | 99·3 | 0·5 | 99·9 |
| | $\bar{X}$ %RNI | 83·5 | 197·7 | 81·3 | 100·4 | 71·5 | 61·0 | 139·4 | 112·4 | 100·5 | 368·8 | 140·9 | 36·0 | 58·4 | 150·1 | 41·9 |
| | RNI 18–19y/20–24y | 9623 | 43/41 | 330 | 1000/800 | 18 | 800 | 0·9 | 1·4 | 1·7/1·6 | 2·0 | 60 | 5 | 12 | 15 | 400 |
| Total | % < 1/3 RNI | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·8 | 0·0 | 0·0 | 0·0 | 0·0 | 0·4 | 60·4 | 1·3 | 0·0 | 10·0 |
| | % < 2/3 RNI | 2·8 | 0·0 | 4·1 | 4·7 | 22·5 | 56·9 | 0·0 | 0·2 | 4·6 | 0·0 | 8·1 | 99·1 | 66·9 | 0·1 | 57·9 |
| | % < RNI | 83·0 | 0·0 | 77·6 | 59·3 | 73·2 | 73·8 | 2·2 | 16·8 | 56·0 | 0·0 | 32·1 | 100·0 | 95·4 | 3·4 | 63·9 |
| | $\bar{X}$ %RNI | 87·4 | 203·9 | 92·2 | 97·6 | 85·9 | 79·2 | 146·2 | 127·4 | 103·0 | 385·6 | 129·9 | 30·8 | 63·7 | 142·2 | 77·1 |

RNI, recommended nutrient intake for the Spanish population (Centro Superior de Investigaciones Científicas, 1994). From 13 to 24 years the RNI for folate doubles.
Units for RNI: energy in kJ; protein in g; Mg, Ca, Fe, vitamins $B_1$, $B_2$, $B_6$, C, E and niacin in mg; vitamins B12, D, A and folate in µg.
Data adjusted by intra-individual variability. Sample without under-reporters.

Moreover, it demonstrates a worsening evolution of nutrient density in children and adolescents, especially for the male gender.

Socioeconomic level in the enKid Study was associated with important differences in food consumption (Serra Majem *et al.* 2003). It was observed that at higher socioeconomic status, consumption was greater for dairy products, baked goods, fish, red meat, fruits and vegetables and lower in consumption of sausages, chicken and alcoholic beverages. When considering fruits and vegetables the difference was almost 60 g/d, which has repercussions for nutritional intake. It should also be noted that the higher intakes of energy and fats were found in the subjects whose mothers had the lowest educational levels.

The fact that food consumption is adequate from a nutritional point of view implies that individual nutritional needs are met within a wide margin and, as such, the metabolic functions involving vitamins and minerals are carried out normally. However, a diet adequate from a nutritional point of view does not necessarily imply that it is adequate in other aspects. For example, one can meet nutritional requirements but have undesirable quantities of saturated fats, *trans* fatty acids, alcohol or sugars, among others, which are related to childhood diseases of high prevalence such as obesity, hypercholesterolaemia or dental caries.

For this reason, even if a diet is nutritionally adequate and is usually also balanced in terms of food consumption, it is important to remember that they are two distinct concepts, and to a certain degree even independent.

As such, the adequacy of nutritional intake is only one part of the assessment of nutritional status of the Spanish population. Therefore, interventions in children and adolescents should not only focus on identifying nutritional risk and promoting foods rich in nutrients that are lacking, which has been the past approach (Bengoa, 2000), but rather define what comprises a balanced, nutritionally adequate diet, in a harmonious and coordinated manner.

Recommended intakes are quantitative estimations of nutritional requirements for essential nutrients, expressed as the quantity of nutrient per day which is considered adequate to meet the nutritional needs of almost the entire healthy population. The baseline is zero intake, and they are formulated as the quantity of nutrient per day, interpreted as representing the actual daily needs, are based on scientific studies in healthy individuals (upper limit) and are expressed by age groups, sex and physiological condition (Serra Majem, 2004).

Intake estimates below recommendations do not indicate nutrient deficiencies, as recommended intakes far exceed the mean requirement. However, they are useful to indicate a potential deficiency, which will be greater the larger are the differences between the calculated and the recommended. True deficiency states should be diagnosed via other means, especially through biochemical analysis (Gibson, 1990; Henríquez Sánchez *et al*. 2000).

In order to calculate the proportion of the population at risk for deficits (intakes below the recommended, or below two-thirds of the recommended intakes), several 24 h recalls or food registers are necessary, or data should be adjusted for intra-individual variance applying the calculation of the components of the variance on repeated recalls, as was carried out

**Table 3.** Distribution (%) of the sample according to number of nutrients* below two-thirds of the recommended nutrient intake (RNI)†

| | Number of nutrients* with intakes below 2/3 of RNI | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gender/age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | >8 |
| Males | | | | | | | | | | |
| 2–5 years | 0·0 | 72·9 | 25·4 | 1·7 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 |
| 6–9 years | 4·5 | 51·5 | 36·3 | 7·7 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 |
| 10–13 years | 0·0 | 3·4 | 52·1 | 29·8 | 10·6 | 1·6 | 2·6 | 0·0 | 0·0 | 0·0 |
| 14–17 years | 2·6 | 15·5 | 29·3 | 29·5 | 15·0 | 6·5 | 1·1 | 0·0 | 0·5 | 0·0 |
| 18–24 years | 0·5 | 6·2 | 40·0 | 38·9 | 9·4 | 2·4 | 1·0 | 0·9 | 0·6 | 0·0 |
| Total | 1·3 | 22·7 | 37·4 | 26·5 | 8·1 | 2·4 | 1·0 | 0·4 | 0·3 | 0·0 |
| Females | | | | | | | | | | |
| 2–5 years | 0·0 | 42·1 | 45·9 | 8·4 | 2·4 | 0·8 | 0·4 | 0·0 | 0·0 | 0·0 |
| 6–9 years | 3·2 | 50·1 | 37·4 | 5·9 | 2·7 | 0·0 | 0·8 | 0·0 | 0·0 | 0·0 |
| 10–13 years | 0·0 | 4·4 | 22·3 | 35·8 | 23·6 | 10·2 | 2·1 | 1·6 | 0·0 | 0·0 |
| 14–17 years | 0·0 | | 2·3 | 8·2 | 44·0 | 22·1 | 13·8 | 4·7 | 3·5 | 1·3 |
| 18–24 years | 0·0 | 0·1 | 7·8 | 25·0 | 38·2 | 19·8 | 5·8 | 2·4 | 0·7 | 0·3 |
| Total | 0·4 | 13·1 | 18·1 | 18·7 | 27·4 | 13·5 | 5·3 | 2·1 | 0·9 | 0·4 |

Data adjusted by intra-individual variability. Sample without under-reporters.
*Energy, protein, Mg, Ca, Fe, vitamins A, $B_1$, $B_2$, $B_6$, $B_{12}$, C, D and E, niacin, folate.
†RNI for the Spanish population (Consejo Superior de Investigaciones Científicas, 1994); see also Table 2.

in the present study (Carriquiry, 1999; Institute of Medicine, 2000).

A previous pooled analysis of the nutritional status of the Spanish population (particularly in the adult population), the EVE Study, revealed considerable inadequate intakes for certain vitamins and minerals in specific population groups (women of childbearing age, pregnant and lactating women, children and adolescents, institutionalized elderly, marginalized social groups; Aranceta *et al.* 2000). In general, vitamins and minerals that were usually found to be inadequate were Fe, Ca and Mg, and vitamins $B_1$, $B_2$, D, folic acid and retinol. The biochemical evaluations developed in the Basque country, Catalonia and the Canary Islands revealed percentages of sub-optimal levels for Fe (Basque country and the Canary Islands), folic acid (Basque country and the Canary Islands), retinol (Basque country and Catalonia), tocopherol (the Canary Islands), $B_6$ (Catalonia), Mg (Catalonia and the Basque country), among others (Aranceta *et al.* 2000; Henríquez Sánchez *et al.* 2000).

With respect to nutritional adequacy in Spanish children and youth, the results of the enKid Study show us that:

1. No risk of inadequate or deficient intakes exist for proteins or vitamin $B_{12}$.
2. In females, Fe, Ca and to a lesser degree Mg, are the minerals most likely to be associated with inadequate intakes.
3. Vitamins for which intakes fall below two-thirds of the RNI include (in decreasing order of importance): vitamins D, A, E, folate, vitamin C and vitamin $B_6$; for intakes below one-third of the RNI, vitamin D and folate.
4. Nutritional adequacy in Spanish children is, in general, adequate, although it is necessary to analyse the implications of elevated inadequate intakes of vitamins D, E and A, which compel us to reconsider the current recommended intakes. Folate is worthy of mentioning, whose levels of intake should be doubled in the near future.
5. Adolescents between the ages of 14 and 17 years are the group that presents with the most nutritional risk, especially so for girls.

**Table 4.** Percentage of Spanish population aged 2–24 years predicted to have inadequate intakes of nutrients using a probability approach

| Gender and age | Protein | Mg | Ca | Fe | Vit. A | Vit. $B_1$ | Vit. $B_2$ | Vit. $B_6$ | Vit. $B_{12}$ | Vit. C | Vit. D | Vit. E | Niacin | Folate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Males | | | | | | | | | | | | | | |
| 2–5 years | 0·0 | 0·5 | 0·7 | 2·1 | 0·0 | 0·1 | 0·0 | 1·7 | 0·4 | 8·0 | 100·0 | 61·2 | 0·2 | 2·5 |
| 6–9 years | 0·0 | 3·9 | 0·9 | 0·0 | 3·3 | 0·0 | 0·2 | 4·5 | 0·0 | 21·2 | 97·7 | 52·9 | 0·0 | 1·7 |
| 10–13 years | 0·0 | 38·1 | 13·6 | 1·2 | 96·1 | 0·1 | 2·9 | 13·2 | 0·0 | 18·8 | 98·8 | 68·8 | 0·2 | 13·1 |
| 14–17 years | 0·0 | 43·6 | 14·0 | 4·7 | 88·2 | 0·0 | 6·9 | 13·3 | 0·0 | 20·0 | 93·5 | 66·2 | 0·0 | 36·4 |
| 18–24 years | 0·0 | 31·4 | 7·4 | 1·6 | 92·9 | 0·5 | 10·6 | 7·2 | 0·0 | 12·5 | 98·2 | 70·0 | 0·1 | 28·1 |
| Total | 0·0 | 26·5 | 7·9 | 2·0 | 65·9 | 0·2 | 5·3 | 8·3 | 0·1 | 15·8 | 97·6 | 65·2 | 0·1 | 19·1 |
| Females | | | | | | | | | | | | | | |
| 2–5 years | 0·0 | 2·3 | 11·8 | 5·4 | 4·6 | 0·0 | 0·7 | 2·1 | 0·0 | 17·3 | 100·0 | 62·1 | 2·4 | 10·1 |
| 6–9 years | 0·0 | 12·4 | 6·3 | 0·7 | 2·5 | 0·7 | 0·2 | 13·6 | 0·0 | 12·4 | 97·8 | 55·0 | 1·2 | 2·1 |
| 10–13 years | 0·0 | 30·0 | 29·8 | 68·1 | 91·8 | 0·1 | 1·6 | 28·5 | 0·0 | 15·9 | 99·9 | 72·6 | 0·0 | 29·2 |
| 14–17 years | 0·0 | 48·3 | 40·9 | 71·0 | 94·3 | 0·4 | 7·8 | 43·3 | 0·0 | 26·6 | 100·0 | 91·6 | 0·9 | 100·0 |
| 18–24 years | 0·0 | 40·7 | 15·5 | 63·8 | 85·0 | 0·2 | 3·2 | 13·1 | 0·0 | 8·6 | 99·2 | 85·3 | 0·0 | 99·6 |
| Total | 0·0 | 32·0 | 20·3 | 50·7 | 67·6 | 0·3 | 3·0 | 19·3 | 0·0 | 14·2 | 99·4 | 77·5 | 0·6 | 64·8 |
| Total | 0·0 | 29·4 | 14·5 | 27·7 | 66·8 | 0·2 | 4·1 | 14·1 | 0·0 | 15·0 | 98·5 | 71·7 | 0·4 | 43·2 |

Data adjusted by intra-individual variability. Sample without under-reporters.

**Table 5.** Distribution of the nutrient adequacy ratio (NAR) of energy and several nutrients and the mean adequacy ratio (MAR) of seven, nine, twelve and fourteen nutrients in the Spanish population aged 2–24 years; enKid study (1998–2000)

| | Mean | SD | P5 | P10 | P15 | P25 | P50 | P75 | P85 | P90 | P95 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NAR | | | | | | | | | | | |
| Energy | 0·86 | 0·10 | 0·69 | 0·72 | 0·74 | 0·78 | 0·87 | 0·97 | 1 | 1 | 1 |
| Protein | 1·00 | 0·00 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Mg | 0·86 | 0·11 | 0·67 | 0·71 | 0·73 | 0·77 | 0·86 | 1 | 1 | 1 | 1 |
| Ca | 0·93 | 0·11 | 0·71 | 0·76 | 0·80 | 0·87 | 1 | 1 | 1 | 1 | 1 |
| Fe | 0·88 | 0·15 | 0·62 | 0·65 | 0·68 | 0·73 | 1 | 1 | 1 | 1 | 1 |
| Vitamin A | 0·67 | 0·21 | 0·41 | 0·45 | 0·48 | 0·52 | 0·60 | 0·96 | 1 | 1 | 1 |
| Thiamin | 1·00 | 0·01 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Riboflavin | 0·98 | 0·06 | 0·86 | 0·91 | 0·95 | 1 | 1 | 1 | 1 | 1 | 1 |
| Vitamin $B_6$ | 0·93 | 0·10 | 0·70 | 0·77 | 0·81 | 0·88 | 1 | 1 | 1 | 1 | 1 |
| Vitamin $B_{12}$ | 1·00 | 0·00 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Vitamin C | 0·93 | 0·14 | 0·60 | 0·71 | 0·78 | 0·92 | 1 | 1 | 1 | 1 | 1 |
| Vitamin D | 0·36 | 0·14 | 0·12 | 0·15 | 0·21 | 0·28 | 0·36 | 0·44 | 0·49 | 0·53 | 0·59 |
| Vitamin E | 0·66 | 0·15 | 0·43 | 0·48 | 0·50 | 0·55 | 0·65 | 0·76 | 0·83 | 0·89 | 0·99 |
| Niacin | 1·00 | 0·02 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Folate | 0·75 | 0·27 | 0·33 | 0·36 | 0·39 | 0·45 | 0·89 | 1 | 1 | 1 | 1 |
| MAR 7 | 0·91 | 0·06 | 0·81 | 0·84 | 0·85 | 0·87 | 0·91 | 0·96 | 1 | 1 | 1 |
| MAR 9 | 0·92 | 0·06 | 0·82 | 0·84 | 0·86 | 0·88 | 0·92 | 0·96 | 0·99 | 1 | 1 |
| MAR 12 | 0·86 | 0·06 | 0·76 | 0·78 | 0·80 | 0·82 | 0·87 | 0·91 | 0·93 | 0·93 | 0·95 |
| MAR 14 | 0·85 | 0·06 | 0·74 | 0·77 | 0·79 | 0·81 | 0·86 | 0·90 | 0·92 | 0·93 | 0·94 |

P, percentile.
Data adjusted by intra-individual variability. Sample without under-reporters.
NAR values are truncated at 1·0.
MAR 7: protein, Ca, Fe, thiamin, riboflavin, vitamins C and A.
MAR 9: protein, Ca, Fe, thiamin, riboflavin, vitamins C, A, Mg, vitamin $B_{12}$.
MAR 12: protein, Ca, Fe, thiamin, riboflavin, vitamins C, A, Mg, vitamin $B_{12}$, folate, vitamin D, niacin.
MAR 14: protein, Ca, Fe, thiamin, riboflavin, vitamins C, A, Mg, vitamin $B_{12}$, folate, vitamin D, niacin, vitamins $B_6$ and E.

It is preferable for the nutritional adequacy of the diet to be met through natural foods rather than with enriched foods. In some countries, fortified foods have become the main source of certain vitamins such as vitamin C or minerals such as Fe. This creates a dependency on the enriched product, which may be problematic. Moreover, the proliferation of fortified foods and their role of providing nutrition within the context of a nutritionally adequate diet may undermine the promotion of adequate dietary habits via nutrition education. The latter should be the foundation of nutrition interventions in childhood and adolescence. This would facilitate not only the meeting of nutritional needs, but would also foster dietary habits that are appropriate for health promotion and disease prevention in illnesses such as obesity or hyperlipidaemias, which are not necessarily linked to nutritional adequacy of the diet.

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