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Determinants of Nutrient Intake among Children and Adolescents: Results from the enKid Study

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Key Words
Nutrient adequacy · Risk factors · Children · Adolescent · Nutrition survey · Breakfast · Physical activity · Spain

Abstract
Background: Although adequacy of nutrient intake has been studied considerably in children and adolescents across Europe, the factors associated with nutritional risk have rarely been addressed. This study was developed in order to explore the nutritional intakes of Spanish children and the factors influencing the risk of nutritional inadequacy. ***Objectives:*** To evaluate socio-economic and lifestyle variables associated with nutritional adequacy in Spanish children and adolescents. ***Methods:*** A cross-sectional study utilising face-to-face interviews. A random sample of 3,534 individuals aged 2–24 years were interviewed by a team of 43 dieticians in the subjects' homes. Interviews included two 24-hour recalls (a second 24-hour recall in 25% of the sample) and other questions, including lifestyle. Weight and height were measured in all subjects. Under-reporters (18%) were excluded from the present analysis. An unconditional logistic regression analysis was used to identify variables associated with greater nutritional risk. ***Results:*** The participation rate was 68%. Twenty percent of males and 50% of females were classified as being at high nutritional risk. Variables associated with increased nutritional risk were: age between 14 and 24 years, being female, low social class, low educational level of the mother, having more than one sibling, smoking, watching TV during meals, sedentary habits at leisure time, infrequent meals and a poor quality breakfast. One dietary factor closely associated with nutritional risk was a failure to consume ready-to-eat cereals. ***Conclusions:*** Nutritional risk during infancy and adolescence is associated with socio-economic and educational variables of the family, and some lifestyle factors including physical activity and the quality of the breakfast meal.

Introduction

In the majority of European countries, children and adolescents constitute a group at risk for nutritional deficiencies. This is due to increased micronutrient needs for growth, as well as changes in eating and lifestyle habits arising from increasing independence from the family. During this time, nutritional requirements are high, yet

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vitamin and mineral intakes tend to be reduced as there is a greater consumption of 'empty calories', frequent meal skipping, adoption of inappropriate weight control behaviours and decreased vegetable and fruit intake [1–3]. This contributes on the one hand to a greater percentage of nutritional risk in this population and, on the other, to an increased prevalence of obesity [4]. Together these constitute the double-edged sword of nutritional issues in children and adolescents that challenge industrialised countries.

In spite of the fact that in many countries much is known about the nutritional situation of children and adolescents [1–8], less information is available for this age group than for adults, and no data exist on risk factors associated with inadequate intakes in the younger cohort. The quantity and quality of available information is scarce, and in general is limited to the evaluation of dietary intakes, including the contribution of fortified foods to nutritional adequacy.

For this reason, and taking into account the multifactorial nature of the nutritional issues at hand, the present study was designed with the objective of identifying the factors associated with nutritional risk in the Spanish population aged between 2 and 24 years.

Methods

The present study forms part of the enKid Study, a population-based cross-sectional survey carried out in Spain between 1998 and 2000, for which the methodology has been described in detail elsewhere [8, 9].

Sample. The target population consisted of all inhabitants living in Spain aged 2–24 years, and the sample population was derived from residents aged 2–24 years registered in the official Spanish population census. The theoretical sample size was set at 5,500 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 randomisation 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 socio-economic status, education level and lifestyle factors were utilised. The dietary questionnaires included one 24-hour diet recall and a quantitative food frequency questionnaire in all subjects. A second 24-hour diet recall was carried out in 25% of the sample. The 24-hour recalls were administered throughout the year, in order to avoid the influence of seasonal variations. The questionnaires were administered in the subject'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. 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. [10]. Breakfast quality was classified using a three-level score according to the inclusion of dairy products, cereals and/or fruit: poor (none consumed), medium (one), or adequate (consumption of two or three of the specified food items) [11].

Information on smoking habits, physical activity and alcohol intake was collected using specific questionnaires [12]. Social class was estimated by the occupation of the head of the family according to the methodology described by the Spanish Society of Epidemiology (SEE) [13]. Three categories were specified: low (48%), medium (32%) and high (20%).

Anthropometric Measures. The anthropometric measures used in this analysis were: weight, height and body mass index (BMI; weight/height^2). Measurements were taken during the interview. Participants were weighed without shoes and only wearing underclothes. BMI was classified as low (< P15), normal (between P15 and P85), overweight (between P85 and P95) or obese (> P95).

Fieldwork. Fieldwork was initiated on May 1, 1998, and ended on April 30, 2000. Interviewers were provided with a list of subjects to interview, and interview times were arranged by telephone. Home interviews were conducted by 43 dieticians or nutritionists, who had undergone a rigorous selection, training and standardisation process. Survey data was entered by the same field staff into laptop computers which had software specifically designed for this study.

In the case of children aged 2–5 years, mothers or the primary caregiver responsible for feeding the child responded to the interview questions. For children aged 6–13, 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. The remaining subjects (14–24 years) were interviewed alone.

Nutrient Intake and Statistical Analysis. The food and nutrient information used in this analysis came from the 24-hour recalls. The nutrient database software used for the study consisted of the Spanish database from Mataix et al. [14], completed with information from French [15] and British [16] food composition tables.

Data from the 24-hour recalls were adjusted for intra-individual variability in order to accurately estimate distribution of intakes and percentage of population groups above or below defined cut-off points (RNI) [10]. Identification of under-reported food intake was made using the EI/BMR (energy intake/basal metabolic rate) ratio: <1.14 classified the individual as an under-reporter [17]. The reference nutrient values utilised were those elaborated by Centro Superior de Investigaciones Cientificas (CSIC, 1994) for energy and 14 nutrients (protein, calcium, iron, magnesium, thiamine, riboflavin, niacin, folic acid, and vitamins B_6, B_{12}, C, A, D and E) [18]. Nutritional risk was classified into three categories: low (none or one nutrient below 2/3 of the RNI), medium (two or three nutrients below 2/3 of the RNI) and high (up to three nutrients below 2/3 of the RNI).

Data were analysed using the statistical package SPSS for Windows version 10.0. Odds ratio and 95% confidence interval were calculated for cases (high nutritional risk) and controls (low nutritional risk) based on socio-economic and lifestyle variables. An unconditional logistic regression was used to adjust odds ratio by age, gender and socio-economic variables [19].

Table 1. Distribution of different variables according to nutritional risk in the Spanish population aged 2–24 years (EnKid Study 1998–2000)

		Males, nutritional risk			Females, nutritional risk		
		low %	medium %	high %	low %	medium %	high %
Age groups, years	2–5	72.9	27.1	0.0	42.1	54.3	3.6
	6–9	56.0	44.0	0.0	53.3	43.2	3.5
	10–13	3.4	81.9	14.7	4.4	58.1	37.5
	14–17	18.1	58.8	23.1	0.0	10.5	89.5
	18–24	6.7	79.0	14.3	0.1	32.8	67.1
	Total	24.0	63.9	12.1	13.6	36.8	49.6
Social class	Low	22.1	62.3	15.6	10.7	35.9	53.4
	Medium	25.9	63.8	10.3	16.1	34.8	49.1
	High	25.7	66.9	7.4	16.0	42.1	41.9
Father's educational level	Low	15.8	68.9	15.3	8.3	33.5	58.2
	Medium	28.3	59.4	12.3	14.4	38.3	47.3
	High	25.7	66.1	8.2	18.3	38.7	43.0
Mother's educational level	Low	13.1	70.9	16.0	5.6	34.7	59.7
	Medium	28.9	59.6	11.5	14.4	37.4	48.2
	High	29.6	62.9	7.5	22.3	39.6	38.1
Population size (inhabitants)	<10,000	18.4	66.5	15.1	12.7	39.4	47.9
	10–50,000	28.4	57.8	13.8	14.5	35.7	49.8
	50–350,000	21.2	65.9	12.9	13.2	35.1	51.7
	>350,000	27.2	66.6	6.2	13.5	37.8	48.7
Regions	Central	21.3	67.2	11.5	12.7	31.9	55.4
	Northeast	25.2	62.0	12.8	15.5	40.6	43.9
	North	17.6	72.3	10.1	13.4	36.3	50.3
	South	29.5	58.2	12.3	12.7	42.4	44.9
	Levant	26.0	57.9	16.1	13.2	34.4	52.4
	Canary Islands	25.6	66.4	8.0	15.6	30.8	53.6
Number of siblings	0	45.7	50.3	4.0	23.3	46.3	30.4
	1	25.4	64.3	10.3	16.4	38.0	45.6
	2 or more	14.8	68.0	17.2	6.9	32.5	60.6
Single parent family	Yes	30.9	56.4	12.7	17.8	29.8	52.4
	No	23.4	64.7	11.9	13.2	37.7	49.1
Smoking status (>12 years)	Non-smoker	10.4	69.9	19.7	0.3	32.3	67.4
	Ex-smoker	14.7	78.5	6.8	0.0	26.2	73.8
	Smoker	6.2	77.2	16.6	0.5	25.8	73.7
Alcohol intake (>12 years)	Non-drinker	12.5	68.8	18.7	0.4	26.8	72.8
	Moderate drinker	7.7	74.8	17.5	0.2	31.3	68.5
	Excessive drinker	6.5	82.4	11.1	2.0	24.3	73.7
Sports during leisure time	No	33.5	55.3	11.2	14.2	35.6	50.2
	30 min/day	24.6	65.2	10.2	14.6	42.8	42.6
	>30 min/day	13.6	71.6	14.8	7.8	28.4	63.8
Hours of sleep	<7.5 h	11.2	75.0	13.8	0.7	26.7	72.6
	7.5–9.5 h	16.3	68.0	15.7	9.2	34.5	56.3
	>9.5 h	49.5	46.6	3.9	34.0	50.8	15.2
TV, hours viewed	<1 h	31.2	59.9	8.9	23.9	39.8	36.3
	1–2 h	24.5	65.4	10.1	11.4	35.5	53.1
	>2 h	15.9	63.5	20.6	6.5	37.2	56.3
Number of meals/day	2 or 3	8.8	71.1	20.1	1.7	27.0	71.3
	4	22.9	65.5	11.6	13.0	38.3	48.7
	>4	31.0	59.4	9.6	20.8	40.8	38.4
Breakfast	Yes	24.8	64.2	11.0	14.2	37.2	48.6
	No	20.5	58.6	20.9	5.4	33.1	61.5

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Table 1 (continued)

		Males, nutritional risk			Females, nutritional risk		
		low %	medium %	high %	low %	medium %	high %
Breakfast score	0	19.5	57.5	23.0	4.4	30.7	64.9
	1	22.0	65.0	13.0	13.1	36.0	50.9
	2–3	26.7	63.9	9.4	16.2	39.0	44.8
RTEC consumption	No	19.2	66.1	14.7	10.7	33.4	55.9
	Yes	29.2	61.4	9.4	16.2	40.0	43.8
Distraction during meals	No	34.1	57.3	8.6	28.1	41.7	30.2
	TV	19.9	63.4	16.7	11.2	36.5	52.3
	Conversation	22.3	71.2	6.5	10.1	34.6	55.3
	Others	45.3	51.5	3.2	25.9	44.3	29.8
BMI	P15	17.0	67.6	15.4	11.9	33.1	55.0
	P15–P85	23.8	64.1	12.1	13.4	36.4	50.2
	P85–P95	35.5	56.1	8.4	15.8	43.8	40.4
	>P95	38.9	58.9	2.2	20.7	48.0	31.3
Weight reduction diet	Yes	0.0	100.0	0.0	2.0	28.1	69.9
	No	24.4	63.5	12.1	13.9	37.2	48.9

Sample without under-reporters (n = 2,855)

Results

A total of 3,534 individuals participated in the study, which represented 64.4% of the theoretical sample and 68.2% of the final sample. The distributions by age and sex of the sample and the study population were not significantly different from the Spanish population for these age groups. 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 2,855 individuals.

Twenty percent of males and 50% of females were classified as being at high nutritional risk, and the percentage was highest for the group aged 14–17 and lowest in the 2- to 9-year-olds. The distribution of the different variables according to nutritional risk is shown in table 1. The percentage of females at high nutritional risk was greater for those with lower incomes, less educated parents, overweight status, those skipping breakfast or having a low score (quality) for this meal, dieters and residents in certain regions, among others.

Table 2 shows the variables associated with high nutritional risk expressed as crude and adjusted odds ratios. After adjustment the variables which remained associated with the highest nutritional risk were: socio-economic and educational levels, having more than one sibling, watching TV during meals and smoking. Protective factors were: residence in a large city, residence in the south or the Canary Islands, ex-smokers, sports activity during leisure time, more frequent meal consumption, good breakfast habits, and ready-to-eat cereal (RTEC) intake.

After adjusting for age and gender, social class and parental educational level remained significantly associated to nutritional risk. After adjusting for age, gender and social class, only the mother's educational level (and not that of the father) remained significant. The adjustment for social class attenuated the influence of population size on nutritional risk and smoking. Breakfast quality and use of RTEC influenced nutritional risk independently of social class.

Discussion

Most nutritional studies performed during childhood and adolescence in developed countries report intakes falling below recommendations in a significant percentage of the population [1–8]. Lack of physical activity and inadequate food choices have been proposed as the principal determinants of this phenomenon. However, little attention has been paid to factors associated with the inability to meet recommended intakes in this age group.

Table 2. Variables associated with high nutritional risk in the Spanish population aged 2–24 years (enKid Study 1998–2000)

Variables		Nutritional risk		Crude			Adjusted[1]			Adjusted[2]		
		high	low	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Gender	Males	156	334	1.00								
	Females	746	199	2.83	2.51–3.20	0.00						
Age group, years	2–5	5	217	1.00								
	6–9	5	220	0.03	0.01–0.06	0.00						
	10–13	126	20	7.90	4.97–12.56	0.00						
	14–17	273	46	7.44	5.12–10.82	0.00						
	18–24	493	30	20.61	13.77–30.85	0.00						
p for trend						0.00						
Social class	Low	443	206	1.00			1.00					
	Medium	269	181	0.95	0.81–1.11	0.50	1.10	0.77–1.58	0.60			
	High	143	118	0.77	0.64–0.93	0.01	0.63	0.42–0.95	0.03			
p for trend						0.00			0.05			
Father's educational level	Low	253	71	1.00			1.00			1.00		
	Medium	312	217	0.79	0.67–0.93	0.00	1.10	0.77–1.55	0.61	1.04	0.71–1.52	0.84
	High	217	184	0.65	0.55–0.77	0.00	0.62	0.43–0.91	0.01	0.69	0.43–1.11	0.12
p for trend						0.00			0.04			0.26
Mother's educational level	Low	284	61	1.00			1.00			1.00		
	Medium	358	242	0.82	0.70–0.96	0.01	1.20	0.86–1.68	0.29	1.17	0.81–1.67	0.40
	High	154	180	0.47	0.40–0.57	0.00	0.54	0.37–0.78	0.00	0.55	0.36–0.86	0.01
p for trend						0.00			0.01			0.03
Population size (inhabitants)	<10,000	186	97	1.00			1.00			1.00		
	10–50,000	256	158	0.95	0.80–1.14	0.60	1.37	0.93–2.01	0.11	1.34	0.89–2.03	0.16
	50–350,000	264	137	1.14	0.95–1.36	0.17	1.06	0.72–1.55	0.77	1.05	0.70–1.57	0.81
	>350,000	902	141	0.82	0.68–0.99	0.04	0.63	0.41–0.97	0.04	0.69	0.44–1.10	0.12
p for trend						0.12			0.15			0.36
Regions	Central	260	86	1.00			1.00			1.00		
	Northeast	207	157	0.81	0.65–0.99	0.04	0.97	0.63–1.49	0.88	0.97	0.61–1.53	0.88
	North	171	106	0.99	0.78–1.24	0.90	1.21	0.74–1.99	0.45	1.34	0.78–2.30	0.28
	South	105	82	0.78	0.60–1.02	0.07	0.97	0.56–1.70	0.92	1.11	0.61–2.03	0.73
	Levant	103	63	1.00	0.75–1.32	0.99	0.98	0.57–1.68	0.95	0.91	0.51–1.61	0.74
	Canary Islands	56	39	0.88	0.62–1.25	0.47	0.48	0.24–0.96)	0.04	0.43	0.20–0.90	0.03
p for trend						0.00			0.15			0.14
Number of siblings	0	75	133	1.00			1.00			1.00		
	1	358	258	0.95	0.81–1.12	0.54	1.08	0.76–1.53	0.67	1.09	0.75–1.58	0.65
	2 or more	401	101	2.72	2.27–3.26	0.00	1.57	1.09–2.27	0.02	1.57	1.06–2.32	0.02
p for trend						0.00			0.05			0.07
Single parent family	Yes	72	48	1.00			1.00			1.00		
	No	761	442	1.07	0.88–1.30	0.48	1.13	0.77–1.68	0.53	1.25	0.80–1.96	0.33
Smoking status	Non smoker	444	56	1.00			1.00			1.00		
	Ex-smoker	72	8	0.81	0.48–1.36	0.42	0.44	0.21–0.90	0.02	0.44	0.19–1.02	0.05
	Smoker	311	16	1.74	1.14–2.66	0.01	1.68	1.00–2.83	0.05	1.58	0.89–2.80	0.12
p for trend						0.01			0.07			0.16
Alcohol intake	Non-drinker	406	48	1.00			1.00			1.00		
	Moderate drinker	421	32	1.32	0.85–2.02	0.21	1.39	0.83–2.35	0.21	1.24	0.70–2.20	0.45
	Excessive drinker	36	4	0.90	0.44–1.82	0.77	0.82	0.34–1.96	0.66	1.08	0.42–2.79	0.88
p for trend						0.18			0.29			0.31
Sports during leisure time	No	440	250	1.00			1.00			1.00		
	30 min/day	239	180	0.75	0.63–0.89	0.00	0.75	0.54–1.06	0.10	0.74	0.51–1.06	0.10
	>30 min/day	159	67	1.34	1.09–1.65	0.01	0.79	0.56–1.14	0.21	0.71	0.49–1.05	0.09
p for trend						0.00			0.03			0.01
Hours of sleep	<7.5	270	31	1.00			1.00			1.00		
	7.5–9.5	500	164	1.68	1.39–2.04	0.00	1.14	0.81–1.59	0.45	1.14	0.80–1.63	0.47
	>9.5	68	302	0.12	0.10–0.16	0.00	0.84	0.50–1.41	0.51	0.86	0.50–1.49	0.59
p for trend						0.00			0.72			0.75

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Table 2 (continued)

Variables		Nutritional risk		Crude			Adjusted[1]			Adjusted[2]		
		high	low	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
TV, hours viewed	<1	151	181	1.00			1.00			1.00		
	1–2	500	267	1.03	0.88–1.21	0.70	0.99	0.72–1.37	0.97	0.93	0.66–1.31	0.67
	>2	187	49	2.11	1.68–2.64	0.00	1.35	0.91–1.99	0.13	1.31	0.86–1.99	0.21
p for trend						0.00			0.28			0.46
Number of meals/day	2 or 3	267	21	1.00			1.00			1.00		
	4	325	204	0.60	0.50–0.73	0.00	0.86	0.61–1.22	0.40	0.89	0.61–1.29	0.53
	>4	241	264	0.35	0.28–0.42	0.00	0.57	0.40–0.82	0.00	0.59	0.40–0.86	0.01
p for trend						0.00			0.00			0.01
Breakfast	Yes	719	457	1.00			1.00			1.00		
	No	81	22	1.53	1.20–1.95	0.00	1.08	0.71–1.64	0.72	1.09	0.70–1.70	0.71
Breakfast score	0	137	30	1.00			1.00			1.00		
	1	401	196	0.92	0.77–1.10	0.35	1.09	0.78–1.53	0.62	1.10	0.76–1.58	0.62
	2–3	364	307	0.53	0.45–0.63	0.00	0.65	0.47–0.90	0.01	0.58	0.41–0.82	0.00
p for trend						0.00			0.03			0.01
RTEC consumption	No	493	199	1.00			1.00			1.00		
	Yes	409	333	0.70	0.63–0.79	0.00	0.61	0.48–0.78	0.00	0.66	0.51–0.84	0.00
Distraction during meals	No	63	107	1.00			1.00			1.00		
	TV	456	194	2.16	1.78–2.61	0.00	1.35	0.88–2.05	0.17	1.52	0.97–2.38	0.07
	Conversation	278	119	2.15	1.73–2.65	0.00	1.06	0.65–1.73	0.81	1.19	0.71–1.99	0.51
	Others	30	69	0.40	0.29–0.56	0.00	1.05	0.45–2.47	0.91	0.80	0.32–2.00	0.64
p for trend						0.00			0.29			0.20
BMI	P15	188	74	1.00			1.00			1.00		
	P15–P85	633	378	1.22	0.96–1.54	0.10	0.89	0.46–1.72	0.72	0.92	0.45–1.86	0.81
	P85–P95	55	47	0.85	0.60–1.21	0.36	0.85	0.34–2.09	0.72	0.82	0.32–2.12	0.68
	> P95	13	18	0.52	0.30–0.91	0.02	1.20	0.22–6.64	0.84	1.23	0.19–7.89	0.83
p for trend						0.00			0.89			0.94
Weight reduction diet	Yes	26	1	1.00			1.00			1.00		
	No	812	496	0.25	0.09–0.68	0.01	0.55	0.08–3.93	0.56	0.53	0.06–5.14	0.59

Sample without under-reporters (n = 2,855).
[1] Adjusted by a logistic regression for age and gender.
[2] Adjusted by a logistic regression for age, gender and social class.

The present paper emphasises the role of socio-economic variables on nutritional intake and status in populations, as well as the interactions of food habits with other lifestyles. It also highlights the contribution of breakfast as an important component of the nutritional balance in the diet.

The enKid Study is the most complete and comprehensive nutrition survey ever conducted in a random sample of the Spanish infant, child and adolescent populations. Both the methodological rigour and the population sample contribute to the validity and representation of the observations. To assess nutrient adequacy, we classified the population into three groups according to the number of nutrients falling below 2/3 of the RNI; those having none or one nutrient below this level were considered at low risk, and those with more than three nutrients were classified as being at high risk. Other methods to assess nutrient adequacy include intakes below the LRNI [20]. In order to properly estimate the percentage of intakes below 2/3 of the RNI, data were adjusted for intra-individual variability and under-reporters were excluded. Thus, it is unlikely that the percentage of population at high nutritional risk was overestimated.

High nutritional risk varied considerably according to age group and gender, with females from 14 to 24 years constituting the group showing the highest risk percentage (around 80%). In some other groups, such as males from 2 to 9 years, the percentage at risk was 0%. Thus, the most important variables determining nutritional risk during childhood and adolescence were age and gender.

Socio-economic conditions were also analysed. After adjusting for age and gender, belonging to the upper social class (20% of the population) reduced the risk of poor nutritional intake by almost 40%. The effect of social class appeared to be independent of the mother's educational level, but not that of the father. Several authors have affirmed the relationship between socio-economic status and poor nutrition [20–23] but others have not [24]. In Spain, as is likely in other Mediterranean countries, poor socio-economic conditions represent a nutritional risk factor [25]. Although population size and geographical region, together with race, have constituted nutritional risk factors in other studies [20, 21], this was not observed in our analysis. Residence in the Canary Islands was the only geographical factor associated with lower nutritional risk in Spain, however living in rural areas was not a significant variable, as seen in other studies [22].

Family size, specifically two or more siblings at home was associated with higher risk, independent of socio-economic status. This finding may be related to the responsibility of having to prepare meals or to less attention being given to food or individuals in families with a larger number of children [3]. Also, household budget surveys in Spain show that the amount of money per capita spent on food decreased as the number of children increased [26]. On the other hand, belonging to a single parent family was not associated with higher risk in Spain, although contradicting results have been shown in the United States [27, 28]. This may be explained by the fact that most single parent families in Spain have only one child, and as such, risk appears to be reduced compared to families with more children.

Alcohol and tobacco consumption were not strongly correlated to nutritional risk in this study, but sports activities during leisure time were clearly associated with nutritional status. Children and adolescents participating in sports for 30 min or more per day had a 30% reduction in nutritional risk. This constitutes an important finding of the study and reflects the issue that active children and adolescents consume greater amounts of food and energy, and consequently can more readily meet recommended nutrient intakes.

Other key findings of this study were related to the number of meals per day (having more than four meals per day reduced the probability of high nutritional risk by 40%), and to a high breakfast score (having a score of 2 or 3, which signifies at least one dairy product and a cereal or a fruit, also reduced the risk by 40%). Skipping breakfast was not related to risk, but a poor breakfast was strongly correlated with the lowest nutritional intake. Moreover, the use of RTEC was associated with a better profile in Spain, as has been observed in other countries [20, 27], with improved macronutrient and micronutrient intakes.

The results of this study once again demonstrate the potential of food fortification in contributing to micronutrient intakes of children and adolescents [1]. Further analysis will be required to ascertain the interaction of RTEC with other variables. In this study, the effect of RTEC consumption on nutritional intake is independent of socio-economic class. Dieting was not related to nutritional risk in this study, but associations have been clearly demonstrated in others [29]. This may be explained by the fact that most of the dieting children and adolescents were defined as under-reporters and thus excluded from this analysis.

The present study contributes to the understanding of the variables determining nutrient intake in populations and demonstrates the importance of socio-economic conditions, physical activity, number of meals, breakfast and fortified foods on nutritional status among children and adolescents in developed countries. It also points towards the need of establishing social support and assistance to families of more than two children from low socio-economic conditions.

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References

1 Serra-Majem L: Vitamin and mineral intakes in European children. Is food fortification needed? Public Health Nutr 2001;4:101–107.
2 Hercberg S, Preziosi P, Galan P, Deheeger M, Papoz L, Dupin H: Dietary intake of a representative sample of the population of Val-de-Marne (in French). Rev Epidemiol Sante Publ 1991;39:245–261.
3 Gregory J, Lowe S: National Diet and Nutrition Survey: Young people aged 4–18 years. London, The Stationary Office, 2000.
4 Tomkins A: Vitamin and mineral nutrition for the health and development of the children of Europe. Public Health Nutr 2001;4:91–99.
5 Zive MM, Nicklas TA, Busch EC, Myers I, Berenson GS: Marginal vitamin and mineral intakes of young adults: The Bogalusa Heart Study. J Adolesc Health 1996;19:39–47.
6 Decarli B, Cavadini C, Grin J, Blondel-Lubrano A, Narring F, Michaud PA: Food and nutrient intakes in a group of 11- to 16-year-old Swiss teenagers. Int J Vitam Nutr Res 2000;70: 139–147.
7 Serra-Majem L, Ribas L, Ngo J, Aranceta J, Garaulet M, Carazo E, Mataix J, Pérez-Rodrigo C, Quemada M, Tojo R, Vázquez C: Risk of inadequate intakes of vitamins A, B_1, B_6, C, E, folate, iron and calcium in the Spanish population aged 4–18. Int J Vitam Nutr Res 2001; 71:27–31.
8 Serra Majem L, Aranceta Bartrina J, Ribas Barba L, Pérez Rodrigo C, García-Closas R: Estudio enKid: Objetivos y metodología; in Serra-Majem L, Aranceta Bartrina J (eds): Desayuno y equilibrio alimentario: Estudio enKid. Barcelona, Masson, 2000, pp 1–8.
9 Serra Majem L, García-Closas R, Ribas L, Pérez Rodrigo C, Aranceta J: Food patterns of Spanish schoolchildren and adolescents: The enKid Study. Public Health Nutr 2001;4: 1433–1438.
10 Liu K, Stamler J, Dyer A, McKeever J, McKeever P: Statistical methods to assess and minimize the role of intra-individual variability in obscuring the relationship between dietary lipids and serum cholesterol. J Chronic Dis 1978;31:399–418.
11 Aranceta Bartrina J, Serra Majem L, Ribas Barba L, Pérez Rodrigo C: El desayuno en la población infantil y juvenil española; in Serra-Majem L, Aranceta Bartrina J (eds): Desayuno y equilibrio alimentario: Estudio enKid. Masson, Barcelona, 2000, pp 45–73.
12 Serra Majem L, Ribas L, García Closas R, Ramon JM, Salvador G, Farran A, et al: Libre Blanc: Avaluació de l'estat nutricional de la població catalana (1992–93). Barcelona, Departament de Sanitat i Seguretat Social, Generalitat de Catalunya, 1996, pp 1–252.
13 Alvarez Dardet C, Alonso J, Domingo A, Regidor E: La medición de la clase social en ciencias de la salud. Barcelona, SG-Sociedad Española de Epidemiología, 1995.
14 Mataix J, Mañas M, Llopis J, Martínez de Victoria E: Tabla de composición de alimentos españoles, ed 3. Granada, Universidad de Granada, 1998.
15 Favier JC, Ireland-Ripert J, Toque C, Feinberg M: Repertoire général des aliments. Table de composition. París, Lavoisier Tec+Doc, 1995.
16 Holland B, Welch AA, Unwin ID, Buss DH, Paul AA, Southgate DAT: McCance and Widdowson's: The Composition of foods, ed 5 rev. Cambridge, Royal Society of Chemistry, 1991.
17 Goldberg GR, Black AE, Jebb SA, Cole TJ, Murgatroyd PR, Coward WA, Prentice AM: Critical evaluation of energy intake data using fundamental principles of energy physiology. 1. Derivation of cut-off limits to identify under-recording. Eur J Clin Nutr 1991;45:569–581.
18 Centro Superior de Investigaciones Científicas: Tablas de ingestas recomendadas en energía y nutrientes para la población española. Madrid, CSIC-Universidad Complutense de Madrid, 1994.
19 Pagano M, Gauvreau K: Principles of Biostatistics. Belmont/Calif, Duxbury Press, 1993.
20 McNulty H, Eaton-Evans J, Cran G, Woulahan G, Boreham C, Savage JM, Fletcher R, Strain JJ: Nutrient intakes and impact of fortified breakfast cereals in schoolchildren. Arch Dis Child 1996;75:474–481.
21 Johnson RK, Guthrie H, Smiciklas-Wright H, Wang MQ: Characterizing nutrient intakes of children by sociodemographic factors. Public Health Rep 1994;109:414–420.
22 Rogers MA, Simon DG, Zucker LB, Mackessy JS, Newman-Palmer NB: Indicators of poor dietary habits in a high-risk population. J Am Coll Nutr 1995;14:159–164.
23 Inano M, Pringle DJ: Dietary survey of low-income, rural families in Iowa and North Carolina. II. Family distribution of dietary adequacy. J Am Diet Assoc 1975;66:361–365.
24 Ghadirian P, Shatenstein B: Nutrient patterns and nutritional adequacy among French-Canadian children in Montreal. J Am Coll Nutr 1996;15:264–272.
25 Serra-Majem L, Ferro-Luzzi A, Bellizzi MC, Salleras L: Nutrition policies in Mediterranean Europe. Nutr Rev 1997;55(suppl II):S42–S57.
26 MAPA (Ministerio de Agricultura, Pesca y Alimentación): La alimentación en España 1998. Datos 1996–1997. Madrid, MAPA, 1998.
27 Siega-Riz AM, Popkin BM, Carson T: Trends in breakfast consumption for children in the United States from 1965 to 1991. Am J Clin Nutr 1998;67:S748S–S756.
28 Drahe MA: The nutritional status and dietary adequacy of single homeless women and their children in shelters. Public Health Rep 1992; 107:312–319.
29 Birch LL, Fisher JO: Development of eating behaviours among children and adolescents. Pediatrics 1998;101:539–549.