International Journal of Food Sciences and Nutrition (2002) **53**, 79–87

Breakfast quality differences among children and adolescents in Croatia

Irena Colić Barić and Zvonimir Šatalić

Faculty of Food Technology and Biotechnology, Laboratory of Food Chemistry and Nutrition, University of Zagreb, Pierottijeva 6, 10 000 Zagreb, Croatia

The aim of this study was to establish nutrient intake from breakfast in children and adolescents in Croatia (n = 1190). A quantified FFQ method was used. The results showed that 1.7% of subjects skip breakfast. Energy intake from breakfast was 26% RDA. Adolescents obtained significantly more energy from carbohydrates and less from fat than children. Children had significantly higher cholesterol and significantly lower dietary fiber intake than adolescents. Intakes of almost all examined micronutrients differed significantly according to age. Milk and dairy products were major energy contributors in children's breakfast whereas most of the adolescents' energy came from cereal products. Breakfasts containing at least one dairy food, one cereal food and fruit/fruit juice were consumed by 13.7% and 21.9% of children and adolescents respectively. A total of 33.3% and 47.6% of subjects respectively consumed milk every day while 15.9% and 10.4% did not consume milk for breakfast at all. Subjects with BMI > 85th percentile had significantly higher energy intake while those with BMI < 25th percentile had significantly lower energy intake than those of normal weight.

Education about adequate nutrition and human health and providing breakfast at schools would improve dietary habits of this population.

Introduction

Eating breakfast is considered to be an important factor in nutritional wellbeing. Omission of breakfast or consumption of an inadequate breakfast is a factor contributing to poor school performance and to dietary inadequacies that are rarely compensated for in other meals of the day (Nicklas *et al.*, 1998a). Skipping breakfast causes impaired cognition, particularly regarding the speed of information retrieval in working memory and the ability to learn, but it seems that it does not have an adverse effect on intelligence tests (Pollit, 1995; Benton & Parker, 1998; Mongeau & Larivee, 2000). Individuals who consume a cereal breakfast report higher morning subjective mood states than those who do not (Smith *et al.*, 1999; Lluch *et al.*, 2000). It is possible that an inadequate breakfast contributes to the making of poor food choices over the rest of the day and in the long term to an increased risk of obesity (Ortega *et al.*, 1998). Omitting breakfast has an effect that is more pronounced in nutritionally at-risk than in well-nourished children (Pollit & Mathews, 1998). Breakfast food patterns differ markedly

Correspondence to: Irena Colić Barić.

ISSN 0963-7486 printed/ISSN 1465-3478 online
02/010079-09 © 2002 Taylor & Francis Ltd
DOI: 10.1080/09637480120057000

Table 1. Subjects defined by age and gender

Parameters	Subjects		
	7–18 years	*7–10 years*	*11–18 years*
Age (years) ($\bar{x}$ ± SD)	11.5 ± 3.01	8.8 ± 1.00	13.8 ± 2.07
Number (*n*)	1170	534	636
Boys (*n*)	583	270	313
Girls (*n*)	587	264	323

by various sociodemographic factors such as gender, ethnicity and educational level (Siega-Riz *et al.*, 2000).

In Croatia, population data especially for breakfast quality has been missing for at least the last 10 years. Because of this the aim of this study was to establish current breakfast food habits and nutrient intake from breakfast in children and adolescents in Croatia. Nutritional status was also observed with regard to anthropometric measures.

Materials and methods

Subjects

An investigation was carried out among 1190 healthy children (543 at age 7–10 years) and adolescents (647 at age 11–18 years) from four different regions in Croatia. Both genders participated (591 boys and 599 girls). Children and adolescents were recruited from public primary and secondary schools that do not provide 'all day care' or meals during school-

Table 2. Average food, energy, macronutrients, cholesterol and dietary fibre intake at breakfast ($\bar{x}$ ± SD)

Parameters	Subjects			F-test
	7–18 years	*7–10 years*	*11–18 years*	
Food intake (g)	454.0 ± 213.63	414.1 ± 164.89	487.6 ± 242.35	***
Energy intake (kJ)	2488.3 ± 1273.73	2180.2 ± 1021.98	2673.3 ± 1413.83	***
Energy intake (% RDA)	26.1 ± 12.75	26.0 ± 12.20	26.1 ± 13.20	*
Energy intake (kJ/100 g food)	552.6 ± 194.97	531.4 ± 176.94	570.3 ± 207.39	***
Proteins (g)	21.4 ± 10.37	19.4 ± 8.58	23.0 ± 11.41	***
Proteins (% RDA)	57.7 ± 28.67	69.3 ± 30.65	48.1 ± 22.81	***
Proteins (% kJ)	15.0 ± 2.49	15.2 ± 2.68	14.8 ± 2.30	***
Fats (g)	21.5 ± 12.35	20.2 ± 11.03	22.5 ± 13.27	***
Fats (% kJ)	32.6 ± 6.55	34.1 ± 7.14	31.4 ± 5.72	***
SFA (% kJ)	16.9 ± 4.34	17.8 ± 4.52	16.1 ± 4.03	*
MUFA (% kJ)	10.9 ± 2.53	11.4 ± 2.97	10.4 ± 1.98	***
PUFA (% kJ)	2.7 ± 0.87	2.8 ± 0.98	2.7 ± 0.76	***
SFA : MUFA : PUFA (% kJ)	1:(0.7 ± 0.20):(0.2 ± 0.12)	1:(0.7 ± 0.19):(0.2 ± 0.14)	1:(0.7 ± 0.21):(0.2 ± 0.09)	—
Cholesterol (mg)	53.4 ± 41.75	54.0 ± 43.14	52.9 ± 40.57	—
Cholesterol (mg/4187 kJ)	21.7 ± 10.98	24.3 ± 13.37	19.6 ± 7.84	***
Carbohydrates (g)	76.5 ± 41.07	65.3 ± 30.63	85.9 ± 46.08	***
Carbohydrates (% kJ)	52.4 ± 7.83	50.7 ± 8.54	53.8 ± 6.88	***
Dietary fibre (g)	3.9 ± 2.28	3.1 ± 1.57	4.6 ± 2.56	***
Dietary fibre (% of the 'age +5' rule)	23.7 ± 12.42	22.8 ± 11.63	24.4 ± 13.01	*

*$P < 0.05$; **$P < 0.001$; ***$P < 0.0001$ (according to age).

Table 3. Average intake of micronutrients at breakfast (% RDA, % DRI) ($\bar{x}$ ± SD)

Parameters	*Subjects*			*F-test*
	7–18 years	*7–10 years*	*11–18 years*	
Vitamin A (% RDA)	20.8 ± 10.97	22.4 ± 11.36	19.4 ± 10.44	*
Vitamin D (% RDA)	1.7 ± 1.27	1.7 ± 1.34	1.7 ± 1.21	*
Vitamin D (% DRI)	3.3 ± 2.54	3.4 ± 2.69	3.3 ± 2.42	*
Vitamin E (% RDA)	19.1 ± 10.64	19.2 ± 10.52	19.0 ± 10.75	—
Vitamin C (% RDA)	14.1 ± 18.55	14.1 ± 19.75	14.1 ± 17.50	*
Thiamin (% RDA)	53.8 ± 28.62	51.1 ± 26.17	56.1 ± 30.35	**
Thiamin (% DRI)	68.1 ± 36.78	66.9 ± 36.16	69.1 ± 37.30	—
Riboflavin (% RDA)	62.8 ± 31.06	63.8 ± 28.79	62.0 ± 32.85	**
Riboflavin (% DRI)	93.7 ± 47.90	100.2 ± 47.94	88.3 ± 47.22	—
Niacin (% RDA)	59.7 ± 30.71	59.5 ± 29.46	59.9 ± 31.75	*
Niacin (% DRI)	74.4 ± 39.09	75.9 ± 39.38	73.1 ± 38.83	—
Vitamin B_6 (% RDA)	24.6 ± 12.19	23.7 ± 11.15	25.4 ± 12.96	**
Vitamin B_6 (% DRI)	38.7 ± 20.65	41.2 ± 22.28	36.6 ± 18.93	***
Folate (% RDA)	21.8 ± 12.50	27.0 ± 12.91	17.3 ± 10.26	***
Folate (% DRI)	9.4 ± 5.51	10.7 ± 5.72	8.3 ± 5.08	*
Vitamin B_{12} (% RDA)	111.9 ± 76.54	131.5 ± 85.80	95.5 ± 63.36	***
Vitamin B_{12} (% DRI)	103.5 ± 68.93	119.7 ± 78.76	90.0 ± 56.01	***
Calcium (% RDA)	40.4 ± 20.13	47.0 ± 20.39	34.8 ± 18.16	*
Calcium (% DRI)	33.6 ± 17.01	35.3 ± 17.16	32.1 ± 16.76	—
Phosphorus (% RDA)	46.5 ± 21.83	52.6 ± 21.98	41.4 ± 20.35	*
Phosphorus (% DRI)	45.1 ± 26.55	51.6 ± 31.86	39.7 ± 19.54	***
Magnesium (% RDA)	35.5 ± 16.42	42.1 ± 16.92	29.9 ± 13.73	***
Magnesium (% DRI)	33.9 ± 17.44	38.9 ± 19.43	29.7 ± 14.28	***
Iron (% RDA)	48.9 ± 31.51	45.8 ± 25.07	51.6 ± 35.84	***
Zinc (% RDA)	30.5 ± 15.74	30.5 ± 14.37	30.5 ± 16.81	***
Iodine (% RDA)	16.3 ± 8.69	17.0 ± 8.53	15.8 ± 8.79	—
Selenium (% RDA)	13.5 ± 8.17	15.7 ± 9.34	11.6 ± 6.48	***

*$P < 0.05$; **$P < 0.001$; ***$P < 0.0001$ (according to age).

time. Parents were informed about the investigation from the school principles and their consent was obtained.

Methods

The assessment of energy and nutrient intake used a completely quantified food frequency questionnaire (FFQ) (McDonald, 1991).

The questionnaire contained a list of 23 different foods and enough space for adding foods that were consumed but were not listed. Available frequencies of food consumption were from 'once a month' to 'every day'. Quantities were described as units of serving (piece, plate, cup, glass, spoon, etc.) and marked as small, medium or large. Records were converted to quantities by using food composition tables and product declarations (Kulier, 1990).

Food, energy, macronutrient, cholesterol, dietary fibre and micronutrient intakes were examined. Consumption frequencies and intakes of different foods at breakfast in children and adolescents were also detected.

The survey for children was obtained from parents or caregivers who were informed how to fill in the FFQ and who also received written instructions and pictures explaining portion sizes. Information from adolescents was obtained by a personal interview with trained interviewers. Portion sizes were demonstrated with food and dish models.

Anthropometric assessment included measures of weight and height. Height was measured without shoes on a portable stadiometer. Body weight was measured on an electronic scale (Tanita Corp., Tokyo, Japan). Body mass index (BMI) was calculated using the formula: body weight (kg) divided by square of body height (m^2). Marginal percentiles for BMI (25th and 85th) were determined within examined population with regard to age and gender.

Table 4. Frequency and an average intake of different foods by breakfast in children and adolescents ($\bar{x}$ ± SD)

Parameters	*Subjects*			*F-test*
	7–18 years	*7–10 years*	*11–18 years*	
Milk and dairy products (*n* times/week)	6.6 ± 1.24	6.7 ± 1.07	6.5 ± 1.37	***
Milk (*n* times/week)	4.6 ± 2.56	4.2 ± 2.60	4.9 ± 2.49	—
Yoghurt (*n* times/week)	1.8 ± 2.10	1.8 ± 2.05	1.7 ± 2.14	—
Corn flakes with milk (*n* times/week)	0.9 ± 1.58	0.7 ± 1.41	1.0 ± 1.69	***
Cereal products (*n* times/week)	6.4 ± 1.62	6.4 ± 1.68	6.4 ± 1.57	—
Meat products (*n* times/week)	4.0 ± 2.74	4.0 ± 2.81	4.0 ± 2.68	—
Eggs (*n* times/week)	0.3 ± 0.81	0.4 ± 0.93	0.2 ± 0.72	***
Fruits (*n* times/week)	1.5 ± 2.25	1.5 ± 2.23	1.5 ± 2.27	—
Confectionery (*n* times/week)	1.6 ± 1.63	2.0 ± 1.52	1.2 ± 1.66	*
Milk and dairy products (g)	294.8 ± 159.21	271.4 ± 122.36	314.5 ± 182.35	***
Milk (ml)	174.2 ± 116.99	153.9 ± 102.67	191.1 ± 125.36	***
Cereal products (g)	72.1 ± 53.51	60.1 ± 46.73	82.1 ± 56.73	***
Meat products (g)	11.1 ± 11.50	11.8 ± 12.50	10.5 ± 10.56	***
Eggs (g)	1.6 ± 5.43	1.9 ± 5.72	1.4 ± 5.17	*
Fruits (g)	29.6 ± 39.30	27.5 ± 37.93	31.4 ± 40.36	—
Confectionery (g)	12.3 ± 23.39	16.6 ± 26.91	8.7 ± 19.24	***
Milk and dairy products (% wt)	63.3 ± 19.10	64.5 ± 18.44	62.3 ± 19.60	—
Cereal products (% wt)	16.3 ± 11.31	14.5 ± 10.12	17.8 ± 12.02	***
Meat products (% wt)	2.7 ± 3.42	2.9 ± 3.50	2.6 ± 3.34	—
Eggs (% wt)	0.3 ± 1.02	0.4 ± 1.29	0.2 ± 0.70	***
Fruits (% wt)	9.0 ± 14.48	8.8 ± 15.43	9.1 ± 13.64	*
Confectionery (% wt)	2.6 ± 4.93	3.6 ± 5.53	1.8 ± 4.19	***
Milk and dairy products (% kJ)	37.5 ± 16.70	39.5 ± 17.64	35.7 ± 15.67	*
Cereal products (% kJ)	43.6 ± 18.62	37.7 ± 18.10	48.5 ± 17.60	—
Meat products (% kJ)	2.9 ± 3.46	3.4 ± 4.07	2.5 ± 2.80	***
Eggs (% kJ)	0.3 ± 1.09	0.5 ± 1.38	0.2 ± 0.77	***
Fruits (% kJ)	5.8 ± 10.60	6.3 ± 12.90	5.5 ± 8.17	***
Confectionery (% kJ)	7.5 ± 13.35	10.5 ± 14.88	5.1 ± 11.34	***

*$P < 0.05$; **$P < 0.001$; ***$P < 0.0001$ (according to age).

Statistical analyses were performed by StatSoft, Inc. (1995) Version 5.1 and included *F*-test and calculation of Pearson's correlation coefficient (Pavić, 1970).

Results

From 1190 subjects, 20 (1.7%) did not have breakfast at all and they were excluded from further investigation.

The number of subjects with regard to age and gender are presented in Table 1. The subjects divided according to BMI are shown in Table 7.

Adolescents had a significantly larger breakfast (487.6 vs 414.1 g) ($P < 0.0001$), higher energy intake at breakfast (2673.3 vs 2180.2 kJ) ($P < 0.0001$) and also breakfast with higher energy density than children (570.3 vs 531.4 kJ/100 g food) ($P < 0.0001$) (Table 2).

Protein intake was very high: 69.3 and 48.1% RDA for children and adolescents respectively (Table 2) (National Academy of Science, 1989; Regulation of the Health Accuracy of Food, 1994).

Intakes of vitamins (A, D, E, C, B_6, B_{12}, thiamine, riboflavin, niacin and folate) and minerals (calcium, phosphorus, magnesium, iron, zinc, iodine and selenium) were examined (Table 3). Intakes of all micronutrients differed significantly according to age except intakes of vitamin E and iodine expressed as % RDA and intakes of thiamine, riboflavin, niacin and calcium expressed as % DRI (Table 3). Differences in micronutrient intakes expressed as a percentage of RDA and DRI are due to different age categories defined by RDA and DRI (Food

Table 5. Consumption frequency of some foods at breakfast by children and adolescents (% subjects)

	Subjects							
	7–10 years				*11–18 years*			
Parameters	*Never*	*1–3 times/wk*	*4–6 times/wk*	*Every day*	*Never*	*1–3 times/wk*	*4–6 times/wk*	*Every day*
Milk	15.9	22.5	28.3	33.3	10.4	19.3	22.6	47.6
Yoghurt	34.6	48.3	9.2	7.9	42.5	39.6	10.1	7.9
Corn flakes with milk	67.8	24.7	6.0	1.5	60.8	29.6	6.6	3.0
Fruit	58.4	24.7	8.1	8.8	54.2	28.8	7.2	9.7

and Nutrition Board, 1997). The highest micronutrient intakes were of vitamin B_{12} and riboflavin (111.9 and 93.7% RDA respectively) (Table 3).

Children had significantly higher cholesterol intake than adolescents (54.0 vs 52.9 mg; 24.3 vs 19.6 mg/4187 kJ) ($P < 0.0001$) (Table 2). Dietary fibre intake was significantly higher in adolescents than in children (4.6 vs 3.1 g) (Table 2).

Proteins, fat and carbohydrates as energy nutrients contributed 15.0, 32.6 and 52.4% respectively ($P < 0.0001$ according to age) (Table 2). Adolescents obtained more energy from carbohydrates and less from fat than did children (Table 2). The ratio of saturated, monounsaturated and polyunsaturated fatty acids intake presented as a percentage of energy was especially unfavourable when polyunsaturated fatty acid intake was observed, which is a consequence of high saturated fatty acid intake (17.8 and 16.1% kJ in children and adolescents respectively) (Table 2).

Milk and dairy products presented the largest part of breakfast (63.3% wt) which probably led to high intake of saturated fatty acids (16.9% kJ) (Tables 2 and 4). Adolescents consumed more milk than children did (191.1 vs 153.9 ml) ($P < 0.0001$), but there was no significant difference between frequencies of milk consumption (4.2 vs 4.9 times/week) (Table 5). Frequency of milk consumption correlated with energy intake (% RDA) in both children ($r = 0.23$; $P < 0.05$) and adolescents ($r = 0.42$; $P < 0.001$). Corn flakes with milk were consumed more frequent by adolescents than by children (1.0 vs 0.7 times/week) ($P < 0.0001$) (Table 5).

Yoghurt was consumed 1.8 times/week (Table 5). Coffee with milk was present in breakfast of 20.8 and 42.6% of children and adolescents respectively (Table 6).

Milk and dairy products were major energy contributors in children's breakfasts (39.5% kJ) (Table 6). The main source of energy in breakfasts of adolescents were cereal products (48.5% kJ) (Table 4). Meat products, eggs and confectionery (cakes, doughnuts, etc.) provided a higher percent of energy intake in breakfasts of children than in adolescents ($P < 0.0001$) (Table 4). Consumption of confectionery (g) in adolescents correlated with age ($r = 0.49$; $P < 0.001$) and BMI ($r = 0.21$; $P < 0.05$).

Table 6. Consumption of some foods in breakfast by children and adolescents

	% Subjects (consumers)		
Parameters	*7–18 years*	*7–10 years*	*11–18 years*
Milk and dairy products	98.7	98.3	99.1
Coffee with milk	32.6	20.8	42.6
Cereal products	93.3	90.4	95.8
Meat products	81.3	77.7	84.3
Eggs	11.3	13.1	9.7
Fruit/fruit juice	43.9	41.6	45.8
Confectionery	36.5	41.8	32.1
Dairy and creal products and fruit/fruit juice	18.2	13.7	21.9

Table 7. Distribution of subjects with regard to marginal percentiles for BMI (% subjects)

Parameters	*Subjects*		
	7–18 years	*7–10 years*	*11–18 years*
<25th percentile of BMI	25.0	24.7	25.3
25–85th percentile of BMI	59.4	59.2	59.6
>85th percentile of BMI	15.6	16.1	15.1
BMI > 25 kg/m^2	3.2	0.7	5.3
BMI > 30 kg/m^2	0.3	0.0	0.6

A total of 41.6 and 45.8% of children and adolescents respectively had fruit/fruit juice for breakfast, and fruit/fruit juice was more often present in breakfasts of adolescents (% wt) ($P < 0.0001$) (Tables 4–6). Fruit/fruit juice consumption (g) correlated negatively with age in both children ($r = -0.21$; $P < 0.05$) and adolescents ($r = -0.34$; $P < 0.001$).

Since no Croatian standards exist, a marginal value for obesity was taken as the 85th percentile of the BMI (kg/m^2) of investigated population with regard to age and gender. A total of 16.1 and 15.1% of children and adolescents respectively were found to be obese (Table 7). In all, 24.7 and 25.3% of children and adolescents respectively were undernourished (Table 7).

Discussion

In this study 1.7% of the investigated population did not have breakfast at all, which is lower than in similar studies (from 3 to 12%) (Mathematical Policy Research, Inc., 1993; Bellisle & Rolland-Cachera, 2000). Examination of breakfast consumption patterns between 1965 and 1991 for children and adolescents in the United States indicate a decline in breakfast consumption, particularly for older adolescents aged 15–18 years (Siega-Riz *et al.*, 1998). Nicklas *et al.* (1998b) reported that 37% of young adults skip breakfast and Siega-Riz *et al.* (2000) found that 17.3% of adults also skip breakfast. That is worrying because dietary habits run within families (Oliveira *et al.*, 1992). Regular breakfast as a healthy dietary habit should be established in early childhood since eating patterns seem to track from childhood until late adolescence (Kelder *et al.*, 1994). Health promotion interventions should begin before the 6th grade because there is some evidence to indicate that children's food choices after that age become resistant to change (Kelder *et al.*, 1994).

In this study the observed energy intake from breakfast in both age groups was 26% RDA (Table 2) (National Academy of Science, 1989; Regulation of the Health Accuracy of Food, 1994). Colić Barić *et al.* (2000a) reported similar energy intake (% RDA) in Croatian adolescents. Adolescents in this study had breakfasts that were higher in energy than their Swiss peers (Decarli *et al.*, 2000).

A total of 33.0 and 37.7% of children and adolescents respectively had an energy intake of less than 20% RDA. Wyon *et al.* (1997) found that voluntary physical endurance and the performance of a creativity test were significantly better after a breakfast from which children derived over 20% of their recommended daily energy intake than after a breakfast from which they obtained less than 10% of recommended values.

Protein intake was very high: 69.3 and 48.1% RDA for children and adolescents respectively, which can also indicate a very high daily intake (Table 2). Daily protein intake more than double RDA is worrying because some studies established that high amounts of dietary protein increase the renal excretion of calcium (Allen *et al.*, 1979).

Nicklas *et al.* (1998b) reported that the higher population of young adults who skip breakfast did not meet two-thirds of RDA for most micronutrients, compared with those who consumed breakfast. The average daily intake of most micronutrients in 2 to 11-year-old Americans exceeds 100% RDA, but after age 11 there

is an increase in the percentage of youths and adolescents who do not meet the RDAs, particularly for iron (in girls) and zinc, or the DRIs for calcium (Yates *et al.*, 1998). In this study, children had higher intakes of most of micronutrients (% RDA, % DRI) than adolescents (Table 3).

Cholesterol intake was approximately one-sixth of maximal daily tolerable intake, which is 300 mg or 100 mg/4187 kJ, depending upon the source (Table 2) (AAPCN, 1998; Whitney & Rofles, 1999).

Fat intake was higher than recommended. Spanish 11-years-olds had similar fat (34.4% kJ) and saturated fatty acid intake (19.4% kJ) (Rocandio *et al.*, 2000). Nicklas *et al.* (1998b) found that the breakfasts of the young adult population provided 13% of energy from proteins, 34% from fat, 55% from carbohydrates and 12% from saturated fatty acids. These results are in agreement with our research, except for our findings on saturated fatty acids; our subjects had a higher intake of saturated fatty acids (Table 2).

The recommendation for children older than 2 years is to achieve an amount of dietary fibre intake equal or greater than their age plus 5 g per day (Williams, 1995). Dietary fibre intake presented as a percentage of the 'age +5' rule was significantly higher in adolescents (24.4%) than in children (22.8%) ($P < 0.05$) (Table 2). The role of dietary fibre in human health is well known (Anderson, 1986; Council on Scientific Affairs, 1989; Block *et al.* 1992, Steinberg, 1992).

A total of 33.3 and 47.6% of children and adolescent respectively consumed milk every day, while 15.9 and 10.4% did not consume milk for breakfast at all (Tables 5 and 6). Milk intake at a younger age may contribute to similar habits of milk intake later in life (Teegarden *et al.*, 1999). High intake of milk and dairy products probably led to a high intake of saturated fatty acids (16.9% kJ) (Tables 2 and 4), but dairy fat could be considered better than other fat of animal origin (Parodi, 1997).

Some clinical studies demonstrated that calcium intake at level higher than RDA can increase bone mineral density in children, but some did not (Johnston *et al.*, 1992; Welten *et al.*, 1994). It is very difficult to meet children's calcium needs without a source of milk in the diet and 60% of RDA for calcium should be derived from milk and diary products (Infante & Tormo, 2000). Colić Barić *et al.* (2000b) reported adequate daily calcium intake derived from milk and dairy products in a population of Croatian children and adolescents. In this study intake of calcium from breakfast was 33.6 and 35.3% DRI for children and adolescents respectively (Table 4).

Corn flakes with milk were consumed by 32.2 and 39.2% of children and adolescents respectively and more frequent by adolescents ($P < 0.0001$) (Tables 5 and 6). Baublis *et al.* (2000) found that wheat-based cereals could be important dietary antioxidants.

Coffee with milk was present in the breakfast of 20.8 and 42.6% of children and adolescents respectively (Table 6). Even Smith *et al.* (1999) found that coffee consumed at breakfast increases blood pressure and pulse rate, has no effect on working memory and improves encoding of new information. Consumption of coffee in that age should be under control.

Rocandio *et al.* (2000) found correlation between fruit intake and BMI in 11-year-olds. In this study, frequency of fruit/fruit juice consumption in adolescents correlated negatively with BMI ($r = -0.28$; $P < 0.01$). Bellisle and Rolland-Cachera (2000) observed from consecutive surveys that an increasing percentage of children (11–17%) had breakfast containing at least one dairy food, one cereal food and one fruit or fruit juice. Such breakfast composition we found for 13.7 and 21.9% of children and adolescents respectively (Table 6). Berg *et al.* (2000) observed healthier breakfast choices for the oldest children in a population of 11–15 years old, and this was also observed in this study.

Confectionery was consumed by a higher percentage of children than adolescents (41.8 vs 32.1%) (Table 6). Meat products were consumed by a large number of children and adolescents, but apparently in small quantities (Tables 5 and 6). Eggs do not seem to be a very common breakfast food: 13.1 and 9.7% of children and adolescents consumed eggs for breakfast (Table 6).

Children and adolescents whose BMI was between the 25th and 85th percentile had energy intake from breakfast of 21.6 and 19.9% RDA respectively.

When obese and undernourished subjects were compared, obese ones had higher energy

intake (% RDA) ($P < 0.0001$). Obese children ($P < 0.05$) and adolescents ($P < 0.0001$) had a higher energy intake (% RDA) than those of normal weight, contrary to Ortega *et al.*'s (1998) results, which showed that energy supplied by breakfast (measured as a percentage of energy expenditure) was significantly lower in obese (BMI above 85th percentile) than in schoolchildren of normal weight. These different results may reflect the different approaches. Undernourished subjects had a lower energy intake (% RDA) than those of normal weight ($P < 0.0001$).

In order to improve breakfast quality for children and adolescents we suggest education about adequate nutrition and human health and providing breakfast at schools. Breakfast consumption in school- and pre-school-children has been shown to improve some cognitive functions, particularly in undernourished children, and bolt decrease intake of simple sugar and increase consumption of starch-rich foods and fibre (Granthammcgregor *et al.*, 1998; Worobey & Worobey, 1999).

Summary

The aim of this study was to establish nutrient intake from breakfast in children and adolescents in Croatia ($n = 1190$). A quantified FFQ method was used. The results showed that 1.7% of subjects skip breakfast. Energy intake from breakfast in both age groups was 26% RDA. Adolescents obtained significantly more energy from carbohydrates and less from fat than children. Children had significantly higher cholesterol and significantly less dietary fibre intake than adolescents. Intakes of almost all examined micronutrients (% RDA, % DRI) differed significantly according to age. Milk and dairy products were major energy contributors in children's breakfast whereas most of the adolescents' energy came from cereal products. Breakfasts containing at least one dairy food, one cereal food and fruit/fruit juice were consumed by 13.7 and 21.9% of children and adolescents respectively. Consumption of confectionery (g) by adolescents was correlated with age ($r = 0.49$) and BMI ($r = 0.21$). Fruit/fruit juice consumption (g) correlated negatively with age in both children ($r = -0.21$) and adolescents ($r = -0.34$). Frequency of fruit/fruit juice consumption by adolescents correlated negatively with BMI ($r = -0.28$). A total of 33.3 and 47.6% of children and adolescent respectively consumed milk every day while 15.9 and 10.4% did not consume milk for breakfast at all. Obese children and adolescents (BMI > 85th percentile) had a significantly higher energy intake while undernourished (BMI < 25th percentile) had a significantly lower energy intake (% RDA) than those of normal weight.

In order to improve dietary habits and breakfast quality of this population we suggest education about adequate nutrition and human health and the provision of breakfast at schools.

References

AAPCN (American Academy of Pediatrics Committee on Nutrition) (1998): Cholesterol in children. *Pedia* **101**, 141–147.

Allen LH, Oddoye EA & Margen S (1979): Protein-induced hypercalciuria: a long term study. *Am. J. Clin. Nutr.* **32**, 741–749.

Anderson JW (1986): Fiber and health: an overview. *Am. J. Gastroenterol.* **81**, 892–897.

Baublis A, Decker EA & Clydesdale FM (2000): Antioxidant effects of aqueous extracts from wheat based ready-to-eat breakfast cereals. *Food Chem.* **68**, 1–6.

Bellisle F & Rolland-Cachera MF (2000): Three consecutive (1993, 1995, 1997) surveys of food intake, nutritional attitudes and knowledge, and lifestyle in 1000 French children, aged 9–11 years. *J. Hum. Nutr. Diet.* **13**, 101–111.

Benton D & Parker PY (1998): Breakfast, blood glucose, and cognition. *Am. J. Clin. Nutr.* **67**, 772–778.

Berg C, Jonsson I & Conner M (2000): Understanding choice of milk and bread for breakfast among Swedish children aged 11–15 years: an application of the Theory of Planned Behaviour. *Appetite* **34**, 5–19.

Block G, Patterson B & Subar A (1992): Fruit, vegetables, and cancer prevention: a review of the epidemiologic evidence. *Nutr. Cancer* **18**, 1–29.

Colić Barić I, Kajfež R & Cvijetić S (2000a): Dietary habits and nutritional status of adolescents. *Food Technol. Biotechnol.* **38**, 217–224.

Colić Barić I, Kenđel G, Španjur L & Šatalić Z (2000b): Milk and diary products in daily diet of children and adolescents according to age and sex. *Mljekarstvo (Dairy)* **50**, 99–112.

Council on Scientific Affairs (1989): Dietary fiber and health. *J. Am. Med. Assoc.* **262**, 542–546.

Decarli B, Cavadini C, Grin J, Blondel-Lubrano A, Narring F & Michaud PA (2000): Food and nutrient intakes in a

group of 11 to 16 years old Swiss teenagers. *Int. J. Vit. Nutr. Res.* **70**, 139–147.

Food and Nutrition Board (1997): *Dietary Reference Intake for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride*. Washington, DC: National Academy Press.

Granthammcgregor SM, Chang S & Walker SP (1998): Evaluation of school feeding programs: some Jamaican examples. *Am. J. Clin. Nutr.* **64**, 785–789.

Infante D & Tormo R (2000): Risk of inadequate bone mineralization in diseases involving long-term suppression of diary products. *J. Pediatr. Gastroenterol. Nutr.* **30**, 310–313.

Johnston CC, Miller JZ, Slemenda CW, Reister TK, Hui S, Christian JC & Peacock M (1992): Calcium supplementation increases in bone mineral density in children. *N. Engl. J. Med.* **327**, 82–87.

Kelder SH, Perry CL, Knut-Inge K & Lytle LL (1994): Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. *Am. J. Public Health* **84**, 1121–1126.

Kulier I (1990): *Prehrambene tablice (Food Composition Data)*. Zagreb: Diana.

Lluch A, Hubert P, King NA & Blundell JE (2000): Selective effects of acute exercise and breakfast interventions on mood and motivation to eat. *Physiol. Behav.* **68**, 515–520.

Mathematical Policy Research, Inc. (1993): *The School Nutrition Dietary Assessment Study*. Princeton, NJ: Food and Nutritional Service, US Department of Agriculture.

McDonald (1991): *Monitoring Dietary Intakes*, pp. 4–34. Berlin: Springer-Verlag.

Mongeau E & Larivee S (2000): Nutrition and intelligence. *Int. J. Psyco.* **35**, 10–23.

National Academy of Science (1989): *Recommended Dietary Allowances*. Washington, DC: National Academy of Science.

Nicklas TA, Oneil CE & Berenson GS (1998a): Nutrient contribution of breakfast, secular trends, and the role of ready-to-eat cereals: a review of data from the Bogalusa Heart Study. *Am. J. Clin. Nutr.* **67**, 757–763.

Nicklas TA, Myers L, Reger C, Beech B & Berenson GS (1998b): Impact of breakfast consumption on nutritional adequacy of the diets of young adults in Bogalusa, Louisiana: ethnic and gender contrasts. *J. Am. Diet. Assoc.* **98**, 1432–1438.

Oliveira S, Ellison R, Moore L & Gillman M (1992): Parent–child relationship in nutrient intake: the Framingham Children's Study. *Am. J. Clin. Nutr.* **56**, 594–598.

Ortega RM, Requejo AM, Lopezsobaler AM, Quintas ME, Andrea P, Redondo MR, Navia B, Lopezbonilla MD & Rivas T (1998): Differences in the breakfast habits of overweight/obese and normal weight schoolchildren. *Int. J. Vit. Nutr. Res.* **68**, 125–132.

Parodi PW (1997): Cow's milk fat components as potential anticarcenogenic agents. *J. Nutr.* **127**, 1055–1060.

Pavić I (1970): *Statistička teorija i primjena* (*Statistic theory and application*), 1st ed. Zagreb: Tehnička knjiga.

Pollit E (1995): Does breakfast make a difference in school? *J. Am. Diet. Assoc.* **95**, 1134–1139.

Pollit E & Mathews R (1998): Breakfast and cognition: An integrative summary. *Am. J. Clin. Nutr.* **67**, 804–813.

Regulation of the Health Accuracy of Food (Pravilnik o zdravstvenoj ispravnosti dijetetskih namirnica) (1994): Narodne novine No. 46.

Rocandio AM, Ansotegui L & Arroyo M (2000): Relationship between breakfast and obesity among school-aged children. *Revista Clinica Espanola* **200**, 420–423.

Siega-Riz AM, Poplin BM & Carson T (1998): Trends in breakfast consumption for children in the United States from 1965 to 1991. *Am. J. Clin. Nutr.* **67**, 748–756.

Siega-Riz AM, Poplin BM & Carson T (2000): Differences in food patterns at breakfast by sociodemographic characteristics among a nationally representative sample of adults in the United States. *Prev. Med.* **30**, 415–424.

Smith AP, Clark R & Gallagher J (1999): Breakfast cereal and caffeinated coffee: effects on working memory, attention, mood, and cardiovascular function. *Physiol. Behav.* **67**, 9–17.

Steinberg D (1992): Antioxidants and the prevention of human atherosclerosis. *Circulation* **85**, 2338–2344.

Teegarden D, Lyle RM, Proulx WR, Johnston CC & Weaver CM (1999): Previous milk consumption is associated with greater bone density in young women. *Am. J. Clin. Nutr.* **69**, 1014–1017.

Welten DC, Kemper HC, Post GB, Van Mechelen W, Twist J, Lips P & Teule GJ (1994): Weight-bearing activity during youth is a more important factor for peak bone mass than calcium intake. *J. Bone Miner. Res.* **9**, 1089–1096.

Whitney EN & Rofles SR (1999): *Understanding Nutrition*, 2nd edn. Belmont CA: Wadsworth Publishing Company.

Williams CL (1995): Importance of dietary fiber in childhood. *J Am Diet Assoc* **95**, 1140–1146.

Worobey HS & Worobey J (1999): Efficacy of a preschool breakfast program in reducing refined sugar intake. *Int. J. Food Sci. Nutr.* **50**, 391–397.

Wyon DP, Abrahamsson L, Jartelius M & Fletcher RJ (1997): An experimental study of the effects of energy intake at breakfast on the test performance of 10–year-old children in school. *Int. J. Food Sci. Nutr.* **48**, 5–12.

Yates AA, Schlicker SA & Suitor CW (1998): Dietary Reference Intakes: the new basis for recommendations for calcium and related nutrients, B vitamins, and cholin. *Am. J. Diet. Assoc.* **98**, 699–706.