

# Eating patterns and fat intake in school children in Croatia

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## Abstract

The aim of this study was to assess the quality of children's daily diet and some nutritional habits with regard to fat, cholesterol and saturated fatty acid (SFA) intake. Food Frequency Questionnaire (FFQ) with weight, height, Body Mass Index (BMI) and body fat as anthropometric parameter was used in children aged 7–10 years. The average energy intake in almost all subgroups was below the Recommended Dietary Allowance (RDA) level while protein intake was double the RDA. The intake of vitamins and minerals correlated with fat intake. Iodine, selenium and vitamin D intake was not sufficient in all the children. In subgroups of children with low fat, cholesterol and SFA intake, the intake of calcium was below RDA. According to BMI, the population was considered as non-obese. The total energy, fat, cholesterol and SFA intake showed no or weakly significant correlation with antropometric factors in all the subgroups. The results showed that high fat intake in children's diet was not accompanied with dietary patterns that were all considered as unhealthy. © 2002 Elsevier Science Inc. All rights reserved.

*Keywords:* Children; Eating patterns; Anthropometry; Dietary fat; Cholesterol; Fatty acids

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## 1. Introduction

Factors, other than health concerns, such as taste preferences, cultural norms, and food availability influence food choices [1]. The interventions for health promotion should begin before the 6<sup>th</sup> grade of school because some evidence indicates that food choices become resistant to change in children after that age [2,3]. The precise percentage of dietary fat intake

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to support normal growth and development, and to reducing the risk of atherosclerosis is not known. However, The American Academy of Paediatrics Committee on Nutrition's recommendations are as follows: saturated fatty acids (SFA) should be less than 10% of total energy, total fat over several days should be not more than 30% of total energy and not less than 20% of total energy, and dietary cholesterol should be less than 300 mg per day [4].

The aim of this study was to assess the quality of daily diet intake and some nutritional habits with regard to fat, cholesterol and SFA among school children in Croatia. Such information is important for paediatricians, nutritionists and other health care professionals, especially when there is lack of dietetic data in Croatia.

## 2. Subjects and methods

### 2.1. Subjects

The subjects of this study were a cohort of 233 healthy fourth grade ( $8.9 \pm 0.74$  years) elementary school children, 51% boys, 49% girls, from Zagreb. All children were selected randomly. The children with chronic disease or on regular medical treatment were excluded. The study was done for two years from November 1998 to December 2000 after the approval of the school principals and parents. Parents were informed about the project by the professionals at a school meeting. They participated voluntarily in the project with full name, surname and the date of birth. Starting with 245 children at the beginning, 4.9% were excluded because the FFQ were not completed correctly or were not returned at all.

### 2.2. Study protocol

The weight and height of the subjects were measured in the morning wearing only underwear and no shoes, as per the standards of World Health Organization (WHO) [5]. The height was measured on a portable stadiometer, to the nearest 0.5 cm and the body weight was taken using an electronic scale (Tanita Corp., Tokyo, Japan). The percentage of fat tissue was automatically calculated and displayed on the scale. Body mass index (BMI) was calculated using the formula: body weight (kg) divided by square of height ( $m^2$ ).

### 2.3. Assessment of diet

For the assessment of daily energy and nutrient intake completely quantified Food Frequency Questionnaire (FFQ) was used not less than once a month. McDonald [6] considered FFQ as a suitable tool to estimate average daily intake of nutrients as well as the intake of fat, fatty acids and cholesterol [6]. The FFQ is also suitable for classifying individuals into groups based on their energy percentage obtained from fat [7,8]. The specially designed food questionnaire contained 83 different foods and had open-ended questions to allow the introduction of food items not included in the list. Consumption frequency was categorised into seven different categories for each food item such as: never, at least once a month, 2–3 times a month, 1–2 times a week, 3–4 times a week, 5–6 times

a week, once or more a day. The quantities in FFQ were also described as units of serving (piece, plate, cup, glass, spoon, etc.) and marked as small, medium or large. Daily food intake was designed to assess intakes at breakfast, lunch, dinner and snacks (both morning and afternoon snacks).

The consent for the survey was obtained from parents or caregivers who were informed at school meetings by professionals as to how to fill FFQ. Along with FFQ they received a booklet with written instructions and pictures as visual aids explaining the portion size of the food intake. Parent's recall was useful to classify children by their intake of calories, macronutrients and micronutrients [6,9]. The completed FFQ were collected in closed envelopes and converted into quantities using food composition tables and products by professionals [10].

Descriptive analyses (e.g., mean, SD) of demographic characteristics (age, height, weight, body mass index, gender), and the number of servings were made from food groups, percentage of calories obtained from fat (saturated, monounsaturated, polyunsaturated fatty acids) and carbohydrates. The analysis of energy intake and percentage of Recommended Dietary Allowances (RDA) and Dietary Referent Intake (DRI) were made for all children by gender from the recorded intake of food groups, meals, calorie and nutrients. The analyses were also made to find out correlation of other dietary characteristics using fat, cholesterol and saturated fatty acids intake in subgroups of children who were not found to be overweight or obese.

StatSoft Inc. Version 5,1 (1995) was used for statistical analyses [11].

### 3. Results

To correlate the relationship between fat intake with anthropometric and dietetic characteristics, the children were divided into subgroups by using the following criteria: fat intake (less vs. more than 35% kJ/day) (Tables 1 and 1a), cholesterol intake (less vs. more than 100 mg/4187 kJ) (Tables 2 and 2a), cholesterol and fat intake (less vs. more than 300 mg/day and 35% kJ/day) (Tables 3 and 3a).

All children, except one girl, had SFA intake above the recommended (11.2–20.4% kJ/day). The subjects were divided by quartiles regarding SFA intake (4<sup>th</sup> vs. 1<sup>st</sup> quartile) (Tables 4 and 4a).

Energy intake expressed as a percentage of RDA in almost all subgroups was less than the recommended (84–99% RDA). Only the subgroup with daily cholesterol intake over 300 mg and fat intake over 35% of energy exceeded recommendation (121% RDA). Protein intake in children was very high and in almost all subgroups exceeded 200% RDA. Proteins were mostly of animal origin.

Proteins, fat and carbohydrates in subgroups with higher fat, cholesterol or SFA intake contributed to daily energy intake of 14, 36–38 and 47–49%, respectively. In subgroups whose fat, cholesterol and SFA intake was lower than recommended, protein contributed to daily energy intake as in previous subgroups, while fat and carbohydrates contributed in daily energy intake with 32–33 and 52–54%, respectively. The average consumption of macronutrients was unbalanced in all eight subgroups of children. More than 90% of children

Table 1

Dietetic and anthropometric characteristics of children divided by daily fat intake ( $\bar{x} \pm \text{sd}$ )

Parameters	>35 % kJ	<35 % kJ	F <sub>experimental</sub>
Percentage of all subjects (%)	61.8	38.2	/
Weight (kg)	34.4 ± 7.52	33.5 ± 6.56	1.31
Height (cm)	139.2 ± 7.40	138.0 ± 7.01	1.12
BMI (kg/m <sup>2</sup> )	17.6 ± 2.82	17.4 ± 2.50	1.28
Body fat (%)	22.2 ± 7.56	21.9 ± 6.69	1.28
Daily food intake (g)	1609.0 ± 456.62	1606.4 ± 403.76	1.28
kJ**	8340.4 ± 2405.03	7447.7 ± 1722.85	1.95
kJ/100g of food	521.7 ± 66.69	469.6 ± 57.96	1.32
kJ/kg of body weight*	253.3 ± 89.63	230.7 ± 67.66	1.75
Proteins (g)*	68.8 ± 19.22	61.6 ± 14.69	1.71
Proteins (g/cm of body height)*	0.5 ± 0.14	0.4 ± 0.11	1.75
Proteins (g/kg of body weight)*	2.1 ± 0.72	1.9 ± 0.56	1.64
Proteins (% kJ)	13.9 ± 1.50	13.9 ± 1.49	1.01
Animal proteins (g)*	45.1 ± 12.82	38.9 ± 10.48	1.50
Vegetative proteins (g)**	23.8 ± 8.09	22.6 ± 5.61	2.08
Fat (g)***	83.3 ± 24.18	65.2 ± 15.96	2.30
Fat (% kJ)	37.6 ± 1.86	32.9 ± 1.78	1.09
Saturated fatty acids (SFA) (g)***	33.0 ± 1.86	25.4 ± 6.24	2.33
Monounsaturated fatty acids (MUFA) (g)***	33.0 ± 9.52	22.5 ± 6.24	2.49
Polyunsaturated fatty acids (PUFA) (g)**	28.8 ± 8.86	22.5 ± 5.61	1.90
Saturated fatty acids (SFA) (% kJ)*	12.7 ± 4.23	12.9 ± 1.22	1.70
Monounsaturated fatty acids (MUFA) (% kJ)	15.0 ± 1.59	11.4 ± 0.91	1.02
Polyunsaturated fatty acids (PUFA) (% kJ)	13.0 ± 0.92	4.9 ± 0.91	1.00
SFA (% kJ) : MUFA (% kJ) : PUFA (% kJ)	1 : (0.9 ± 0.10) : (0.4 ± 0.09)	1 : (0.9 ± 0.09) : (0.4 ± 0.09)	/
Cholesterol (mg)*	285.6 ± 117.59	228.3 ± 88.69	1.76
Cholesterol (mg/4187kJ)	143.5 ± 42.06	127.7 ± 39.83	1.12
Carbohydrates (g)*	241.8 ± 73.07	236.5 ± 55.57	1.73
Carbohydrates (% kJ)	48.4 ± 2.39	53.2 ± 2.17	1.22
Dietary fiber (g)*	11.9 ± 3.95	11.3 ± 2.98	1.76

\* p &lt; 0.05; \*\* p &lt; 0.001, \*\*\* p &lt; 0.0001.

had above 30% kJ/day fat intake and the saturated fatty acids constituted more than 10% of daily energy. The average cholesterol intake expressed as weight per day was in correlation with dietary standards in all subgroups with exception of children divided by the cholesterol criteria (Table 1–4). The cholesterol intake was higher than recommended by 100 mg/4187 kJ in all subgroups with exception of children divided by that cholesterol criteria (Table 1–4).

Following the rule “age + 5” it was found out that the intake of dietary fiber in children was not sufficient in all subgroups except children divided by both cholesterol and fat intake (Table 1–4).

The average daily intake of vitamin D, iodine and selenium in all children was insufficient

Table 1a

Dietetic and anthropometric characteristics of children divided by daily fat intake ( $\bar{x} \pm \text{sd}$ )

Parameters	>35 % kJ	<35 % kJ	F <sub>experimental</sub>
Vitamin A ( $\mu\text{g RE}$ )*	800.8 $\pm$ 317.59	749.0 $\pm$ 259.07	1.50
Vitamin D ( $\mu\text{g}$ )*	2.2 $\pm$ 0.92	1.9 $\pm$ 0.76	1.45
Vitamin E (mg $\alpha$ -TE)*	7.9 $\pm$ 2.60	6.8 $\pm$ 1.95	1.76
Vitamin C (mg)	117.8 $\pm$ 56.09	142.7 $\pm$ 57.27	1.04
Thiamin (mg)	1.7 $\pm$ 0.54	1.7 $\pm$ 0.47	1.29
Riboflavin (mg)*	1.8 $\pm$ 0.51	1.6 $\pm$ 0.41	1.56
Niacin (mg NE)*	26.7 $\pm$ 7.73	24.3 $\pm$ 5.82	1.77
Vitamin B <sub>6</sub> (mg)	3.0 $\pm$ 1.38	3.5 $\pm$ 1.41	1.03
Folate ( $\mu\text{g}$ )	156.4 $\pm$ 62.43	142.3 $\pm$ 54.25	1.32
Vitamin B <sub>12</sub> ( $\mu\text{g}$ )*	4.8 $\pm$ 1.76	3.9 $\pm$ 1.35	1.71
Calcium (mg)*	887.4 $\pm$ 266.72	737.9 $\pm$ 200.85	1.76
Phosphorus (mg)*	1204.2 $\pm$ 328.26	1053.0 $\pm$ 247.21	1.76
Magnesium (mg)*	256.7 $\pm$ 73.21	244.4 $\pm$ 57.93	1.60
Iron (mg)*	14.6 $\pm$ 4.20	14.4 $\pm$ 3.31	1.61
Zinc (mg)*	10.3 $\pm$ 2.94	9.4 $\pm$ 2.40	1.50
Iodine ( $\mu\text{g}$ )*	46.2 $\pm$ 16.06	38.3 $\pm$ 11.97	1.80
Selenium ( $\mu\text{g}$ )**	23.0 $\pm$ 8.24	19.2 $\pm$ 5.97	1.91
Breakfast (% kJ)*	33.9 $\pm$ 8.14	32.1 $\pm$ 9.74	1.43
Lunch and dinner (% kJ)	40.8 $\pm$ 10.63	44.6 $\pm$ 10.37	1.05
Snacks (%kJ)	25.3 $\pm$ 9.62	23.4 $\pm$ 8.30	1.34
Cereal products (% kJ)	23.6 $\pm$ 6.48	24.4 $\pm$ 6.59	1.03
Milk and dairy products (% kJ)*	14.2 $\pm$ 4.97	12.7 $\pm$ 3.94	1.59
Meat (% kJ)	10.8 $\pm$ 3.02	10.6 $\pm$ 3.01	1.01
Fish (% kJ)*	1.7 $\pm$ 1.49	1.4 $\pm$ 1.13	1.74
Eggs (% kJ)	1.9 $\pm$ 1.30	1.7 $\pm$ 1.19	1.18
Fats and products (% kJ)	3.2 $\pm$ 1.58	2.4 $\pm$ 1.51	1.11
Vegetables (% kJ)	9.0 $\pm$ 4.38	11.5 $\pm$ 5.56	1.61
Fruits (% kJ)*	5.0 $\pm$ 2.29	5.5 $\pm$ 2.71	1.39
Confectionery (% kJ)	26.1 $\pm$ 7.79	22.7 $\pm$ 7.49	1.08
Sugar (% kJ)*	4.6 $\pm$ 2.64	7.1 $\pm$ 3.23	1.49
Milk (mL)	223.1 $\pm$ 150.19	218.3 $\pm$ 129.55	1.34
Fruit juice (mL)	153.2 $\pm$ 125.95	225.7 $\pm$ 142.36	1.28
Soft drinks (mL)**	42.0 $\pm$ 56.28	56.7 $\pm$ 79.12	1.98
Fast food (kJ)***	151.2 $\pm$ 167.59	84.5 $\pm$ 105.92	2.50

\*  $p < 0.05$ ; \*\*  $p < 0.001$ , \*\*\*  $p < 0.0001$ .

according to RDA and local regulations for health accuracy of food [12,13]. The calcium intake was insufficient in all subgroups with lower fat, cholesterol or SFA intake according to RDA and DRI, but in other subgroups of children it exceeded 100% RDA, but not 100% DRI, (Tables 1a-4a). The intake of other micronutrients mostly exceeded 100% RDA (Tables 1a-4a).

The food groups were defined as cereal products (bread, rice, noodles, cereals), milk and dairy products; meat (red meat and poultry), fish, eggs, fats and fat products (butter, margarine, mayonnaise, salad dressings, oil), vegetables, fruits, confectionery (chocolate, doughnuts, ice cream, pancakes, pudding, cakes) and added sugar. Cereal products and confectionery were major contributors to daily energy intake (average of 24 and 27%, respectively). Meat, fish, eggs, milk and dairy products, contributed about 13–15% of daily energy, vegetable 10%, sugar 5%, fruits 5% and fats and fat products 3% of daily energy.

Table 2

Dietetic and anthropometric characteristics of children divided by daily cholesterol intake ( $\bar{x} \pm sd$ )

Parameters	>100 mg/4187 kJ	<100 mg/4187 kJ	F <sub>experimental</sub>
Percentage of all subjects (%)	81.1	18.9	/
Weight (kg)*	34.5 ± 7.37	32.1 ± 5.91	1.56
Height (cm)	139.2 ± 7.32	136.6 ± 6.70	1.19
BMI (kg/m <sup>2</sup> )	17.6 ± 2.74	17.1 ± 2.49	1.22
Body fat (%)	22.2 ± 7.43	21.6 ± 6.36	1.36
Daily food intake (g)	1626.1 ± 436.06	1530.4 ± 438.03	1.01
kJ	8052.2 ± 2210.10	7772.5 ± 2215.64	1.01
kJ/100g of food*	498.7 ± 64.97	515.4 ± 80.30	1.53
kJ/kg of body weight	244.1 ± 85.28	247.5 ± 70.26	1.47
Proteins (g)	67.7 ± 17.9	59.0 ± 17.03	1.09
Proteins (g/cm of body height)	0.5 ± 0.13	0.4 ± 0.12	1.19
Proteins (g/kg of body weight)*	2.0 ± 0.69	1.9 ± 0.54	1.65
Proteins (% kJ)	14.2 ± 1.39	12.8 ± 1.39	1.00
Animal proteins (g)	44.3 ± 12.00	35.8 ± 11.37	1.11
Vegetative proteins (g)	23.4 ± 7.23	23.1 ± 7.43	1.06
Fat (g)	77.3 ± 23.07	72.2 ± 23.21	1.01
Fat (% kJ)	36.1 ± 2.80	34.8 ± 3.33	1.41
Saturated fatty acids (SFA) (g)	30.6 ± 9.21	28.2 ± 8.90	1.07
Monounsaturated fatty acids (MUFA) (g)	26.6 ± 8.30	25.3 ± 8.58	1.07
Polyunsaturated fatty acids (PUFA) (g)	11.7 ± 4.04	11.0 ± 4.21	1.09
Saturated fatty acids (SFA) (% kJ)	14.3 ± 1.78	13.7 ± 1.72	1.07
Monounsaturated fatty acids (MUFA) (% kJ)*	12.4 ± 1.78	12.2 ± 1.47	1.70
Polyunsaturated fatty acids (PUFA) (% kJ)	5.5 ± 0.96	5.3 ± 1.11	1.33
SFA (% kJ) : MUFA (% kJ) : PUFA (% kJ)	1 : (0.9 ± 0.09) : (0.4 ± 0.09)	1 : (0.9 ± 0.10) : (0.4 ± 0.10)	/
Cholesterol (mg)***	287.6 ± 107.30	161.0 ± 51.35	4.37
Cholesterol (mg/4187 kJ)***	149.3 ± 37.17	86.6 ± 12.04	9.53
Carbohydrates (g)	239.1 ± 66.71	242.7 ± 68.13	1.04
Carbohydrates (% kJ)	49.8 ± 3.06	52.4 ± 3.33	1.19
Dietary fiber (g)	11.7 ± 3.55	11.6 ± 3.93	1.23

\* p &lt; 0.05; \*\* p &lt; 0.001, \*\*\* p &lt; 0.0001.

The energy intake from fast food per day was very low. Breakfast and snacks contributed more to daily energy intake than expected. The average energy fraction of lunch and dinner together was less than 60% of recommended daily energy for 95.3% of children.

61.8% of subjects obtained 35% of energy from fat (Table 1). As was expected, they all had significantly higher intake of energy, protein, fat, all fatty acids, cholesterol, vitamins soluble in fat and minerals (Tables 1 and 1a). Unexpectedly higher intake of carbohydrates, dietary fiber and some vitamins soluble in water was also detected among children with higher fat intake. On the contrary, the intake of soft drinks and fast food was lower in this subgroup.

In 81.1% of subjects daily cholesterol intake was more than 100 mg/4187kJ (Table 2).

Table 2a

Dietetic characteristics of children divided by daily cholesterol intake ( $\bar{x} \pm sd$ )

Parameters	>100 mg/4187 kJ	<100 mg/4187 kJ	F <sub>experimental</sub>
Vitamin A ( $\mu\text{g RE}$ )*	809.0 $\pm$ 306.68	660.7 $\pm$ 216.28	2.01
Vitamin D ( $\mu\text{g}$ )*	2.2 $\pm$ 0.89	1.6 $\pm$ 0.57	2.39
Vitamin E (mg $\alpha$ -TE)	7.7 $\pm$ 2.46	6.5 $\pm$ 2.07	1.42
Vitamin C (mg)*	127.9 $\pm$ 55.35	124.6 $\pm$ 67.55	1.49
Thiamin (mg)	1.7 $\pm$ 0.52	1.7 $\pm$ 0.48	1.14
Riboflavin (mg)	1.8 $\pm$ 0.48	1.5 $\pm$ 0.43	1.26
Niacin (mg NE)	26.2 $\pm$ 7.13	24.1 $\pm$ 7.05	1.02
Vitamin B <sub>6</sub> (mg)	3.2 $\pm$ 1.37	3.1 $\pm$ 1.58	1.34
Folate ( $\mu\text{g}$ )*	157.1 $\pm$ 60.80	125.1 $\pm$ 47.26	1.65
Vitamin B <sub>12</sub> ( $\mu\text{g}$ )*	4.7 $\pm$ 1.68	3.6 $\pm$ 1.37	1.50
Calcium (mg)	851.0 $\pm$ 255.19	741.3 $\pm$ 230.24	1.23
Phosphorus (mg)	1170.9 $\pm$ 305.38	1041.5 $\pm$ 301.70	1.02
Magnesium (mg)	254.7 $\pm$ 66.83	240.6 $\pm$ 72.07	1.16
Iron (mg)	14.7 $\pm$ 3.88	13.7 $\pm$ 3.81	1.04
Zinc (mg)	10.2 $\pm$ 2.73	9.1 $\pm$ 2.82	1.07
Iodine ( $\mu\text{g}$ )*	45.1 $\pm$ 15.18	34.8 $\pm$ 11.66	1.69
Selenium ( $\mu\text{g}$ ***)	22.9 $\pm$ 7.56	15.4 $\pm$ 4.44	2.89
Breakfast (% kJ)	33.6 $\pm$ 8.55	31.6 $\pm$ 9.78	1.31
Lunch and dinner (% kJ)*	42.6 $\pm$ 9.98	40.9 $\pm$ 13.26	1.76
Snacks (% kJ)	23.9 $\pm$ 8.89	27.5 $\pm$ 9.86	1.23
Cereal products (% kJ)*	23.8 $\pm$ 6.00	24.6 $\pm$ 8.43	1.97
Milk and dairy products (% kJ)	14.0 $\pm$ 4.68	12.2 $\pm$ 4.25	1.21
Meat (% kJ)	11.0 $\pm$ 2.94	9.6 $\pm$ 3.04	1.06
Fish (% kJ)*	1.7 $\pm$ 1.42	1.1 $\pm$ 0.98	2.11
Eggs (% kJ)***	2.1 $\pm$ 1.22	0.6 $\pm$ 0.44	7.54
Fats and products (% kJ)	2.9 $\pm$ 1.54	2.6 $\pm$ 1.84	1.43
Vegetables (% kJ)*	9.8 $\pm$ 4.67	10.4 $\pm$ 6.28	1.81
Fruits (% kJ)	5.2 $\pm$ 2.50	5.1 $\pm$ 2.37	1.11
Confectionery (% kJ)*	24.1 $\pm$ 7.25	27.9 $\pm$ 9.47	1.71
Sugar (% kJ)	5.5 $\pm$ 3.04	5.9 $\pm$ 3.52	1.34
Milk (mL)	223.0 $\pm$ 145.11	213.7 $\pm$ 131.40	1.22
Fruit juice (mL)	177.8 $\pm$ 132.18	194.1 $\pm$ 155.98	1.39
Soft drinks (mL)	47.3 $\pm$ 64.46	49.0 $\pm$ 73.82	1.31
Fast food (kJ)	131.5 $\pm$ 151.87	100.9 $\pm$ 142.98	1.13

\*  $p < 0.05$ ; \*\*  $p < 0.001$ , \*\*\*  $p < 0.0001$ .

This subgroup had significantly higher body weight, energy, protein, MUFA and some vitamins and minerals intake (Tables 2 and 2a). Lunch and supper together were also significantly higher energy sources.

Only 30.5% of all subjects had both cholesterol and fat intake in correlation with dietary standard (Table 3). Children with fat and cholesterol intake over the recommendation, had a significantly higher intake of food, energy, macronutrients and almost all vitamins and minerals (Tables 3 and 3a). Dietary habits and anthropometric parameters in children divided by SFA criteria are presented in Tables 4 and 4a. Subjects in the 4<sup>th</sup> quartile had significantly lower intake of PUFA, carbohydrates, dietary fiber, fish, vegetable, sugar and fruit juice and statistically higher intake of milk and dairy products.

The anthropometric parameters and body mass index (BMI) ( $\text{kg/m}^2$ ), showed that the population was considered as non-obese. Only 1.3% of children had BMI higher than 25 and

Table 3

Dietetic and characteristics of children divided by daily cholesterol intake ( $\bar{x} \pm sd$ )

Parameters	-Cholesterol (>300 mg/day)	-Cholesterol (<300 mg/day)	F <sub>experimental</sub>
	-Fat (>35% kJ/day)	-Fat (<35% kJ/day)	
Percentage of all subjects (%)	21.9	30.5	/
Weight (kg)	34.4 ± 8.00	33.2 ± 6.62	1.46
Height (cm)	139.0 ± 7.21	137.6 ± 7.25	1.01
BMI (kg/m <sup>2</sup> )	17.6 ± 2.96	17.4 ± 2.48	1.43
Body fat (%)	21.0 ± 7.09	21.7 ± 6.40	1.23
Daily food intake (g)*	1940.4 ± 453.99	1523.5 ± 366.33	1.54
kJ*	10151.8 ± 2272.88	7064.4 ± 1549.50	2.15
kJ/100g of food	527.6 ± 59.78	470.2 ± 61.84	1.07
kJ/kg of body weight**	310.5 ± 98.06	221.0 ± 62.77	2.44
Proteins (g)*	84.5 ± 18.02	58.1 ± 13.75	1.72
Proteins (g/cm of body height)*	0.6 ± 0.14	0.4 ± 0.10	1.81
Proteins (g/kg of body weight)*	2.6 ± 0.78	1.8 ± 0.54	2.09
Proteins (% kJ)	14.0 ± 1.40	13.8 ± 1.51	1.17
Animal proteins (g)	55.7 ± 11.91	36.6 ± 10.20	1.36
Vegetables proteins (g)***	28.8 ± 8.26	21.4 ± 4.81	2.94
Fat (g)**	101.9 ± 22.53	61.5 ± 14.44	2.43
Fat (% kJ)	37.8 ± 1.80	32.8 ± 1.81	1.00
Saturated fatty acids (SFA) (g)***	39.8 ± 9.29	24.1 ± 5.64	2.72
Monounsaturated fatty acids (MUFA) (g)***	35.3 ± 8.46	21.2 ± 5.64	2.83
Polyunsaturated fatty acids (PUFA) (g)*	15.8 ± 4.09	9.3 ± 2.99	1.87
Saturated fatty acids (SFA) (% kJ)*	14.8 ± 1.58	12.9 ± 1.26	1.57
Monounsaturated fatty acids (MUFA) (% kJ)	13.1 ± 0.84	11.3 ± 0.89	1.12
Polyunsaturated fatty acids (PUFA) (% kJ)	5.9 ± 0.94	4.9 ± 0.93	1.02
SFA (% kJ) : MUFA (% kJ) : PUFA (% kJ)	1 : (0.9 ± 0.09) : (0.4 ± 0.09)	1 : (0.9 ± 0.09) : (0.4 ± 0.10)	/
Cholesterol (mg)**	414.4 ± 91.43	194.7 ± 57.98	2.49
Cholesterol (mg/4187 kJ)*	175.8 ± 41.47	116.2 ± 30.35	1.87
Carbohydrates (g)*	292.5 ± 71.15	225.4 ± 49.64	2.05
Carbohydrates (% kJ)	48.1 ± 2.13	53.5 ± 2.14	1.01
Dietary fiber (g)*	14.4 ± 3.90	10.8 ± 2.70	2.09

\* p &lt; 0.05; \*\* p &lt; 0.001, \*\*\* p &lt; 0.0001.

no one showed BMI higher than 30. No statistically significant correlation was found between anthropometry and observed dietetic parameters.

After dividing the children according to their dietary criteria it was found that body weight, body height, BMI and percentage of body fat, were higher in children with higher fat intake (Tables 1–4), but a significant difference ( $p < 0.05$ ) was observed only for weight in children grouped by cholesterol intake (Table 2). Dietary fat correlated with weight ( $r = 0.44$ ,  $p < 0.001$ ), body mass index ( $r = 0.57$ ,  $p < 0.001$ ) and body fat (%) ( $r = 0.31$ ,  $p < 0.05$ ) in subgroups of children grouped by cholesterol and fat intake. In some subgroups dietary



Table 3a

Dietetic characteristics of children divided by daily cholesterol and fat intake ( $\bar{x} \pm \text{sd}$ )

Parameters	-Cholesterol (>300 mg/day) -Fat (>35 % kJ/day)	-Cholesterol (<300 mg/day) -Fat (<35 % kJ/day)	F <sub>experimental</sub>
Vitamin A ( $\mu\text{g RE}$ )	1001.6 $\pm$ 301.11	705.3 $\pm$ 246.74	1.49
Vitamin D ( $\mu\text{g}$ )*	2.9 $\pm$ 0.93	1.7 $\pm$ 0.63	2.20
Vitamin E (mg $\alpha$ -TE)*	10.0 $\pm$ 2.38	6.4 $\pm$ 1.88	1.60
Vitamin C (mg)	141.9 $\pm$ 58.69	137.6 $\pm$ 58.33	1.01
Thiamin (mg)	2.1 $\pm$ 0.53	1.7 $\pm$ 0.45	1.40
Riboflavin (mg)*	2.2 $\pm$ 0.50	1.5 $\pm$ 0.36	1.92
Niacin (mg NE)*	32.3 $\pm$ 7.90	23.1 $\pm$ 5.49	2.07
Vitamin B <sub>6</sub> (mg)	3.7 $\pm$ 1.49	3.3 $\pm$ 1.39	1.15
Folate ( $\mu\text{g}$ )*	191.2 $\pm$ 62.88	135.1 $\pm$ 49.21	1.63
Vitamin B <sub>12</sub> ( $\mu\text{g}$ )*	5.9 $\pm$ 1.75	3.6 $\pm$ 1.22	2.07
Calcium (mg)**	1010.5 $\pm$ 278.06	702.5 $\pm$ 179.42	2.40
Phosphorus (mg)*	1451.8 $\pm$ 318.17	996.0 $\pm$ 228.74	1.93
Magnesium (mg)*	305.6 $\pm$ 73.81	234.1 $\pm$ 54.07	1.86
Iron (mg)*	17.6 $\pm$ 4.02	13.6 $\pm$ 3.09	1.69
Zinc (mg)*	12.5 $\pm$ 2.94	9.0 $\pm$ 2.33	1.59
Iodine ( $\mu\text{g}$ ***)	58.0 $\pm$ 15.81	35.1 $\pm$ 9.63	2.69
Selenium ( $\mu\text{g}$ ***)	31.0 $\pm$ 7.53	17.0 $\pm$ 4.27	3.10
Breakfast (% kJ)*	32.2 $\pm$ 8.28	32.1 $\pm$ 10.61	1.64
Lunch and dinner (% kJ)	43.1 $\pm$ 10.65	44.3 $\pm$ 10.80	1.03
Snacks (% kJ)	24.7 $\pm$ 8.54	23.6 $\pm$ 8.37	1.04
Cereal products (% kJ)	22.1 $\pm$ 5.88	24.1 $\pm$ 6.86	1.36
Milk and dairy products (% kJ)	13.0 $\pm$ 4.87	12.9 $\pm$ 3.97	1.50
Meat (% kJ)	10.9 $\pm$ 2.58	10.5 $\pm$ 2.88	1.24
Fish (% kJ)	1.7 $\pm$ 1.27	1.3 $\pm$ 1.04	1.49
Eggs (% kJ)**	2.9 $\pm$ 1.40	1.3 $\pm$ 0.86	2.67
Fats and products (% kJ)	3.3 $\pm$ 1.42	2.4 $\pm$ 1.49	1.09
Vegetables (% kJ)*	9.5 $\pm$ 4.21	11.5 $\pm$ 5.70	1.84
Fruits (% kJ)	5.0 $\pm$ 2.57	5.7 $\pm$ 2.70	1.10
Confectionery (% kJ)	27.1 $\pm$ 7.54	23.1 $\pm$ 7.65	1.03
Sugar (% kJ)*	4.4 $\pm$ 2.49	7.1 $\pm$ 3.37	1.83
Milk (mL)*	258.6 $\pm$ 183.06	211.7 $\pm$ 127.95	2.05
Fruit juice (mL)	181.2 $\pm$ 140.71	217.0 $\pm$ 143.39	1.04
Soft drinks (mL)	57.8 $\pm$ 70.39	49.7 $\pm$ 71.84	1.04
Fast food (kJ)***	196.5 $\pm$ 220.55	80.2 $\pm$ 102.77	4.61

\*  $p < 0.05$ ; \*\*  $p < 0.001$ , \*\*\*  $p < 0.0001$ .

cholesterol was correlated to daily energy intake when expressed as kJ/day ( $r=0.58$ ,  $p < 0.001$ ) but not when expressed as density (kJ/g food).

#### 4. Discussion

Butte [14] concluded that the current recommendation of 30% energy from dietary fat for children aged  $>2$  y was significant for adequate growth [14]. Some European researchers observed that a higher fat intake indicated inappropriate nutritional habits. Clavien et al [2] have reported that the type of diet which has been linked with several chronic diseases in adults living in developed countries already prevailed before puberty [2,15].

Table 4

Dietetic and anthropometric characteristics of children divided by daily intake of SFA (% kJ) ( $\bar{x} \pm sd$ )

Parameters	4 <sup>th</sup> quartile	1 <sup>st</sup> quartile	F <sub>experimental</sub>
Percentage of all subjects (%)	25.3	24.5	/
Weight (kg)	34.7 ± 6.93	32.7 ± 6.02	1.32
Height (cm)	139.7 ± 6.77	136.7 ± 6.62	1.04
BMI (kg/m <sup>2</sup> )	17.7 ± 2.88	17.4 ± 2.39	1.45
Body fat (%)	22.8 ± 7.29	21.8 ± 6.26	1.35
Daily food intake (g)	1503.9 ± 395.87	1675.8 ± 481.53	1.48
kJ	7909.2 ± 2039.02	7760.9 ± 2405.27	1.39
kJ/100g of food	530.4 ± 61.55	466.1 ± 61.29	1.01
kJ/kg of body weight	237.7 ± 81.30	244.0 ± 80.98	1.01
Proteins (g)	65.9 ± 18.13	64.4 ± 18.74	1.07
Proteins (g/cm of body height)	0.5 ± 0.14	0.5 ± 0.14	1.02
Proteins (g/kg of body weight)	2.0 ± 0.73	2.0 ± 0.63	1.32
Proteins (% kJ)	14.0 ± 1.68	14.0 ± 1.53	1.21
Animal proteins (g)	44.4 ± 13.11	40.3 ± 12.69	1.07
Vegetables proteins (g)	21.5 ± 6.67	24.1 ± 7.72	1.34
Fat (g)	81.4 ± 21.61	68.2 ± 23.74	1.21
Fat (% kJ)	38.7 ± 2.04	33.0 ± 2.40	1.38
Saturated fatty acids (SFA) (g)	34.6 ± 9.03	24.9 ± 8.19	1.22
Monounsaturated fatty acids (MUFA) (g)	27.6 ± 7.65	23.8 ± 8.78	1.32
Polyunsaturated fatty acids (PUFA) (g)*	11.1 ± 3.54	11.6 ± 4.65	1.73
Saturated fatty acids (SPA) (% kJ)*	16.5 ± 1.16	12.1 ± 0.79	2.17
Monounsaturated fatty acids (MUFA) (% kJ)	13.1 ± 0.97	11.5 ± 1.20	1.54
Polyunsaturated fatty acids (PUFA) (% kJ)	5.2 ± 0.85	5.6 ± 1.11	1.72
SFA (% kJ) : MUFA (% kJ) : pUFA (% kJ)	1 : (0.8 ± 0.07) : (0.3 ± 0.06)	1 : (1.0 ± 0.09) : (0.5 ± 0.09)	/
Cholesterol (mg)	264.5 ± 98.33	238.5 ± 93.28	1.11
Cholesterol (mg/4187 kJ)	140.3 ± 35.21	130.1 ± 40.76	1.33
Carbohydrates (g)*	223.3 ± 59.03	245.5 ± 75.03	1.62
Carbohydrates (% kJ)	47.3 ± 2.87	53.0 ± 2.70	1.14
Dietary fiber (g)*	11.0 ± 3.17	12.3 ± 4.19	1.74

\* p &lt; 0.05; \*\* p &lt; 0.001, \*\*\* p &lt; 0.0001.

In this study the mean daily energy intake in all groups were below 100% RDA similar to studies on adolescents in Switzerland and children in USA, but in contrast to the research done in adolescents of Croatia [16–18]. Total energy intake showed no or weak significant correlation with anthropometric factors in all subgroups. This was supported by a study in which no difference in the energy intake between obese and normal adolescents was detected [19].

The protein intake (% kJ/day) in all groups was within the recommended level, but the energy fraction of carbohydrates and fat was more appropriate in lower fat intake groups. Several studies in Europe, and USA, as well as our study, showed that total fat and SFA intake in children often exceeds RDA [16,20–23]. A study done in France showed that high

Table 4a

Dietetic characteristics of children divided by daily intake of SFA (% kJ) ( $\bar{x} \pm \text{sd}$ )

Parameters	4 <sup>th</sup> quartile	1 <sup>st</sup> quartile	F <sub>experimental</sub>
Vitamin A ( $\mu\text{g RE}$ )	756.5 $\pm$ 343.98	809.8 $\pm$ 278.81	1.52
Vitamin D ( $\mu\text{g}$ )	1.9 $\pm$ 0.79	2.2 $\pm$ 0.88	1.23
Vitamin E (mg $\alpha$ -TE)	7.0 $\pm$ 2.25	7.8 $\pm$ 2.59	1.32
Vitamin C (mg)*	99.6 $\pm$ 46.66	157.1 $\pm$ 63.28	1.84
Thiamin (mg)	1.6 $\pm$ 0.49	1.8 $\pm$ 0.58	1.39
Riboflavin (mg)	1.8 $\pm$ 0.45	1.6 $\pm$ 0.50	1.23
Niacin (mg NE)	25.1 $\pm$ 6.77	25.8 $\pm$ 8.11	1.43
Vitamin B <sub>6</sub> (mg)*	2.5 $\pm$ 1.01	3.8 $\pm$ 1.53	2.29
Folate ( $\mu\text{g}$ )	149.3 $\pm$ 65.30	156.0 $\pm$ 59.13	1.22
Vitamin B <sub>12</sub> ( $\mu\text{g}$ )	4.8 $\pm$ 1.46	3.9 $\pm$ 1.45	1.01
Calcium (mg)	944.0 $\pm$ 263.06	706.4 $\pm$ 235.73	1.25
Phosphorus (mg)	1187.6 $\pm$ 307.79	1068.3 $\pm$ 317.41	1.06
Magnesium (mg)	244.4 $\pm$ 62.54	253.6 $\pm$ 76.38	1.49
Iron (mg)	13.5 $\pm$ 3.43	15.1 $\pm$ 4.25	1.53
Zinc (mg)	10.0 $\pm$ 2.76	9.9 $\pm$ 2.92	1.12
Iodine ( $\mu\text{g}$ )*	47.1 $\pm$ 2.76	37.2 $\pm$ 13.10	1.68
Selenium ( $\mu\text{g}$ )	20.9 $\pm$ 6.93	20.8 $\pm$ 7.61	1.21
Breakfast (% kJ)*	37.1 $\pm$ 6.80	29.6 $\pm$ 9.61	2.00
Lunch and dinner (% kJ)*	35.2 $\pm$ 7.67	48.8 $\pm$ 10.22	1.78
Snacks (% kJ)*	27.7 $\pm$ 10.00	21.6 $\pm$ 7.80	1.64
Cereal products (% kJ)	24.3 $\pm$ 5.36	23.7 $\pm$ 6.17	1.33
Milk and dairy products (% kJ)*	16.8 $\pm$ 5.48	11.0 $\pm$ 3.97	1.90
Meat (% kJ)	10.7 $\pm$ 3.12	11.4 $\pm$ 2.67	1.37
Fish (% kJ)*	1.4 $\pm$ 1.67	1.9 $\pm$ 1.16	2.06
Eggs (% kJ)	1.7 $\pm$ 1.01	1.7 $\pm$ 1.18	1.35
Fats and products (% kJ)	3.0 $\pm$ 1.46	3.0 $\pm$ 1.80	1.51
Vegetables (% kJ)**	7.2 $\pm$ 3.05	12.2 $\pm$ 5.10	2.78
Fruits (% kJ)	5.3 $\pm$ 2.21	5.4 $\pm$ 2.54	1.31
Confectionery (% kJ)	25.9 $\pm$ 7.65	22.4 $\pm$ 7.72	1.02
Sugar (% kJ)*	3.9 $\pm$ 2.46	7.3 $\pm$ 3.13	1.62
Milk (mL)*	217.9 $\pm$ 166.60	198.3 $\pm$ 132.46	1.58
Fruit juice (mL)*	112.4 $\pm$ 102.71	248.7 $\pm$ 143.49	1.95
Soft drinks (mL)	40.1 $\pm$ 55.50	47.3 $\pm$ 63.28	1.30
Fast food (kJ)	138.8 $\pm$ 136.87	78.9 $\pm$ 116.59	1.38

\*  $p < 0.05$ ; \*\*  $p < 0.001$ , \*\*\*  $p < 0.0001$ .

energy intake of fat over the upper limit (>35%) is associated with greater adiposity. Another study in Spain showed a connection between high fat and low carbohydrate diet independent of total energy intake, with obesity in adolescents [19]. The study done by Guillaume et al. showed that fat and cholesterol intake showed consistent positive correlation with weight, body mass index and body fat [24].

Butte et al. [14] pointed out that a lower fat intake may be associated with inadequate vitamin and mineral intake which increased the risk of poor growth [14]. Differences in vitamins and minerals intake was observed in almost all subgroups, which is opposite to the study by Ylonen et al. [23]. The intake of most of minerals was higher in all groups with higher fat intake. In all subjects the intake of iodine, selenium and vitamin D was below 100% RDA as well as the intake of calcium in subgroups with low fat, cholesterol and SFA

intake. Similar data were presented in an Nordic study [25]. In a recent pilot study done in Croatian youth, adequate intake of iodine and calcium was observed [26,27].

The insufficient intake of dietary fiber in all subgroups was similar to the intake of dietary fiber in other countries [28].

The energy intake of breakfast of all groups of children, as in Nordic adolescents, exceeded recommended 15–20% of daily energy which was opposite to the intake observed in Swiss teenagers [16,25]. In subgroups of higher fat, cholesterol and SFA intake, energy intake in breakfast was high.

A decreased fat intake was associated with an increase sugar, fruit and vegetable intake as in the study by Tonstad et al. [29].

Children with high fat intake consumed more milk and fast food, but less soft drinks, which is opposite to the study done by Troiano et al. [22]. The average daily intake of soft drinks, as well as fast food, was very low and opposite to similar studies [30,31,15] There is no strong link of fat intake with anthropometric and dietary characteristics [16,23,29,32]. These results show that high fat intake in children was not accompanied with dietary patterns that are generally considered as unhealthy and vice versa. Nevertheless, using fat intake in children is a successful tool in achieving the goals of science-based dietary guidelines through food-based dietary guidance.

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