

THE FOOD COMPOSITION AND DIETARY INTAKE OF 1–2 YEARS OLD CHILDREN FROM TWO REGIONS OF THE CZECH REPUBLIC

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Nutrition plays an important role in the health and development of children. Therefore, it is necessary to make the correct recommendations as well as knowing the real state of nutrition of the children involved. In the scope of prospective longitudinal monitoring of 200 children, randomly selected at birth from 2 regions of the Czech Republic, an examination of their dietary intake and food composition in the year 2000/2001 during their 14–25 months of age (mean 19.2±2.7 months) was performed. A standardised food frequency questionnaire was administered to the whole sample (response rate through mothers was 98%). Moreover, every second mother who has not yet breastfed the child was asked for a 24-h dietary weight record of her child (response rate 79%). Twelve percent of the children were long term breastfed. The “Food pyramid” of sample was created by the following daily portions: milk and dairy (3.5), other protein-rich food (1.0), fruits and vegetables (4.2) and cereals (2.5). The energy intake of non-breastfed children, comprising of 15% protein (41.7±17.4 g), 35% fat and 50% carbohydrates, was 4.9±1.6 MJ. The results of micronutrient dietary intake in comparison to the European “Population Reference Intake” were satisfying with the exception of iodine. The analysis of the nutrition of Czech children aged 14–25 months did not show any serious problem without a low representation of long-term breastfed children and probably lower intake of iodine, when compared with European recommendations.

Keywords: toddlers, dietary intake, food composition, breast-feeding

Children aged 12–24 months are characterised by a deceleration of growth in comparison with the first year of life. According to WHO allowances, breast-feeding should remain the indivisible part of child nutrition until 2 years of life have been completed (WHA, 2001; WHO, 2001). Although not able to cover energy and nutrient needs, human milk is an important source of energy, containing essential fatty acids, vitamin A, calcium and riboflavin. It is supposed that a breastfed child between 12 and 23 months obtains on average 35–40% of its total energy intake from human milk.

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From another point of view, this age is characterised by a gradual adaptation to mixed food. It is a transitional period from the period of exclusive breast-feeding at the end of 6 months of life, where fat forms up to 50% of total energy intake, to the adult nutrition style. Thus it is recommended that fat should form 30–45% of total energy at 1–2 years of age (BIER et al., 1999).

Despite the rather low international recommendation for reference protein (EU 1.26–1.17 g/kg body weight; SCIENTIFIC COMMITTEE FOR FOOD, 1993); US 1.14 g/kg (NATIONAL RESEARCH COUNCIL U.S., 1989), some agencies, like the Czech Society for Nutrition, emphasise a relatively high need for total protein in relation to 1 kg of body weight (SPOLECNOST PRO VYZIVU, 1992). This corresponds to the recommendation of protein that should form a minimum of 10% of the energy in a mixed diet on condition that all other energy and nutrient intakes are adequate (MILLA, 2001). The difference may be caused by a lower net protein utilisation of infant formulas (BARIĆ et al., 2002) in comparison to human milk utilisation, which is why the international recommendations were conceived. The question of potential negative output of high protein intake is a topic for contemporary running discussions. Apart from energy and macronutrients, the adequate intake of minerals, vitamins and trace elements are necessary for an optimal nutritional state.

1. Methods

The examination was performed in the year 2000/2001 on the sample, which had been randomly selected at the time of birth in the West and South Bohemian regions of the Czech Republic since 1998–99 for the needs of the multi-centre study to monitor infant nutrition during the first six months of life, financed by the Ministry of Health of the Czech Republic (grant-NPZ 203/98) (SCHNEIDEROVÁ et al., 2004). In this study, the sample consisted of 200 children between the age of 14–25 months, with the mean±standard deviation of 19.2±2.7 months. Their mothers were asked to collaborate in the examination of the dietary habits of their children using a food frequency questionnaire (FFQ) method. Every second mother who have not yet breastfed their children were asked for a 24-h dietary record of their children with weighed portions of food (24 DR). Respondancy of FFQ was 98% (196 children from 200) and respondancy of 24 DR was 79% (68 children from 86).

With the aim of examining nutritionally specific age group of children (1–2 years old), we developed our own “Bat FFQ” questionnaire. This detects the frequency of food portion intake in the following main groups of food (in the parentheses the numbers of examined food groups in the range of main food commodity are given): cereals (5), vegetables (4), fruit (4), milk and dairy products (6), meat, poultry, fish, eggs, pulse (5), sweet (1). The frequency scale covers 7 categories, which extend from the category “nearly never” to the category “4 and more times daily”. Mothers were asked to evaluate the last month of their children’s nutrition. The study was performed evenly throughout the whole year. The average daily frequencies of food intake from

the main food commodities in the sample were calculated using a mathematical model by conversion of frequency categories to the mathematical expression for everybody, and after that by using statistical analysis the average dietary habit of the sample was obtained. The second method, which was used, consisted of inventory analyses of 24 DR with the weighing of portions. Mothers were asked to continuously record the weighed portions of food and drink, which were consumed by their children during one day. The analysis of 24 DRs was carried out using a food composition database, a compilation consisting of Czech and international data of food composition, which was enriched by the kinds of food for specific child nutrition like commercial infant formulas, purees for children (MULLER et al., 2000). Implementation of the study started with the invitation letters to participate in the study together with the FFQ, which were sent to the randomly selected mothers. After receiving the mothers' answer, the chosen mothers were given explanatively standardised descriptions, which concerned the accuracy, weighing and form of 24 DR recording. Ambiguities from records were elucidated or specified during a subsequent interview of the mother with a nutritionist. Basal statistics in the form of population distribution, means and standard deviation for nutrient intake were computed using statistical package Epi-info 6. Some nutrient estimates are by their nature very skewed (vitamin A, E, D, B12, iron, zinc) and thus some variables (e.g. means and standard deviation), which assume normality, should be interpreted with caution.

2. Results and discussion

2.1. Results of FFQ method

The daily average of frequencies of eaten portions in the main and particular food commodities are summarised in Table 1. The analysis of milk and dairy consumption shows that children most frequently consumed milk, with a mean of 1.5 portions daily. Twelve percent (12.3%) of children in the whole sample was still breastfed together with complementary food. Most of the toddlers (80.2%) were on a milk formula diet, mostly in combination with cow's milk and up to 7.5% were on cow's milk only.

2.2. Results of 24 DR method

The mean of the values and standard deviation of energy, macronutrients and fibre intake of non-breastfed children are summarised in Table 2. Energy intake was provided by protein, fat and carbohydrates in the following percentages 15:35:50, respectively. The intake of micronutrients is compared to the European Population Reference Intakes (PRI) (SCIENTIFIC COMMITTEE FOR FOOD, 1993) and US recommendation (Table 3).

Table 1. Composition of food in main food categories according to daily portion eaten and their frequency

Main food commodities	Average frequency of portion eaten per day	Food commodities	Average frequency of portion eaten per day
Milk and dairy	3.5	Milk formula diet	0.7
		Cow milk	0.5
		Human milk	0.3
		Yoghurt	0.9
		Cheese	0.6
		Cottage cheese	0.5
Other protein rich food	1.0	Meat, poultry	0.4
		Smoked sausage	0.2
		Eggs	0.2
		Fish	0.1
		Pulses	0.1
Cereals	2.5	White bread	0.8
		Wholegrain bread	0.6
		Sweet bread	0.4
		Mush, puree	0.4
		Rice, pasta	0.3
Vegetables	2.0	Vegetable soup	0.7
		Fresh vegetable	0.7
		Potatoes	0.4
		Other boiled vegetables	0.2
Fruit	2.2	Fresh fruit	1.2
		Juice	0.6
		Fruit elelenses	0.3
		Fruit salad	0.1

Table 2. The results of statistical evaluation of the daily intake of nutrients (macronutrients and fibre) in the sample of 68 children, aged 1–2 years (mean $\pm$ standard deviation)

Energy and nutrients (units)	Mean $\pm$ standard deviation
Energy (MJ)	4.9 $\pm$ 1.6
Protein (g)	41.7 $\pm$ 17.4
Fat (g)	45.7 $\pm$ 22.6
Carbohydrates (g)	138.7 $\pm$ 49.0
Mono- and disaccharides (g)	68.9 $\pm$ 37.8
Lactose (g)	20.5 $\pm$ 12.6
Polysaccharides (g)	46.8 $\pm$ 19.8
Fibre (g)	10.5 $\pm$ 4.1
SFA (g)	16.6 $\pm$ 10.9
MUFA (g)	12 $\pm$ 6.9
PUFA (g)	8.3 $\pm$ 6.4
Cholesterol (mg)	176.5 $\pm$ 132.3

SFA: saturated fatty acids, MUFA: monounsaturated fatty acids, PUFA: polyunsaturated fatty acids

Table 3. The results of the statistical evaluation of the daily intake of micronutrients in the sample of 68 children, aged 1–2 years (mean $\pm$ standard deviation) in comparison to international recommendations

	n=68	Czech RDA (1992)	EU PRI	US RDI
Vitamin A μ g RE	541.0 $\pm$ 394.0	400	400	400
Vitamin D μ g	3.6 $\pm$ 6.9		0–10 ^c	5 ^b
Vitamin E mg	8.1 $\pm$ 4.5	6		6
Thiamin mg	1.0 $\pm$ 0.7	0.5	100 μ g/MJ	0.5 ^a
Riboflavin mg	1.4 $\pm$ 0.6	0.8	0.8	0.5 ^a
Niacin mg NE	16.2 $\pm$ 7.1		1.6 mg/MJ	6 mg ^a
Vitamin B6 mg	1.4 $\pm$ 0.6		15 μ g/g protein	0.6 ^a
Vitamin B12 μ g	3.9 $\pm$ 2.8		0.7	0.9 ^a
Folic acid μ g	138.2 $\pm$ 71.0		100	150 ^a
Vitamin C mg	123.3 $\pm$ 92.7	50	25	40
Calcium mg	837.1 $\pm$ 308.7	900	400	500 ^b
Phosphorus mg	1069.0 $\pm$ 434.0		300	450 ^a
Potassium mg	2480.0 $\pm$ 1178.0		800	
Sodium mg	1832.0 $\pm$ 1181.0		575–3500	
Magnesium mg	216.0 $\pm$ 68.6			80 ^a
Iron mg	9.2 $\pm$ 4.6	10	4	10
Zinc mg	5.9 $\pm$ 2.6		4	10
Iodine μ g	67.9 $\pm$ 37.1		70	70
Selenium μ g	46.7 $\pm$ 34.1		10	20
Fluoride μ g	562.3 $\pm$ 385.5			700 ^b

Czech RDA (SPOLECNOST PRO VYZIVU, 1992), EU PRI (Population Reference Intake) (SCIENTIFIC COMMITTEE FOR FOOD, 1993). ^cAcceptable range (SCIENTIFIC COMMITTEE FOR FOOD, 1993). US: ^aRDI (Recommended Dietary Intake) and ^bAI (Acceptable Intake) from DRI (Dietary Reference Intake) from 1997–1998 y. (INSTITUTE OF MEDICINE, FOOD AND NUTRITION BOARD, 1998). ^{not signed values} RDA Recommended Dietary Allowances from 1989. (NATIONAL RESEARCH COUNCIL U.S., 1989) RE=retinol equivalent. NE=niacin equivalent.

Intake of vitamin A, E, D, B12, iron, zinc showed a non-normal distribution in the population and thus variables which assume normality should be interpreted with caution.

Table 4. Percentage of individuals with diet that does not meet 100 or 66% of EU or US recommended values for nutrient intake

	Less than	Vit. A	Vit. B1	Vit. B2	Vit. E	Vit. D	Iron	Zinc	Iodine	Fluoride	Folic acid
EU	100% PRI	39.7	11.8	13.2	–	0 ^c	4.4	20.6	57.4	–	36.8
	66% PRI	16.2	1.5	2.9		0 ^c	2.9	1.5	27.9		8.8
US	100% RDA	39.7	11.8 ^a	1.5 ^a	33.8	82.4 ^b	91.2	91.2	57.4	73.5 ^b	61.8 ^a
	66% RDA	16.2	1.5 ^a	1.5 ^a	20.6	76.5^b	35.3	66.7	27.9	49.2^b	36.8^a

EU: ^{not signed values} PRI (Population Reference Intake). ^cAR (Acceptable range) (SCIENTIFIC COMMITTEE FOR FOOD, 1993). US: ^aRDI (Recommended Dietary Intake) and ^bAI (Acceptable Intake) from DRI (Dietary Reference Intake) from 1997–1998 y. (INSTITUTE OF MEDICINE, FOOD AND NUTRITION BOARD, 1998). ^{not signed values} RDA Recommended Dietary Allowances from 1989. (NATIONAL RESEARCH COUNCIL U.S., 1989).

Low micronutrient intake and risk of deficiency are defined as an intake of less than 66% of the Recommended Dietary Allowances (RDA) (NATIONAL RESEARCH COUNCIL U.S., 1989) or Recommended Dietary Intake (DRI) (INSTITUTE OF MEDICINE, FOOD AND NUTRITION BOARD, 1998) or Population Reference Intakes (PRI) (SCIENTIFIC COMMITTEE FOR FOOD, 1993). In this way, a defined low intake was found in the case of vitamin D, zinc, fluoride, folic acid and iron in a substantial part of the sample (more than 33% of individuals) only in comparison to RDA or RDI. From the European point of view, only one-third of the sample (28%) in the case of iodine intake (Table 4) was less than 66% of PRI. Other nutrients were consumed in sufficient quantities.

The results of the inventory analysis of dietary records show a lower intake of energy in comparison with Czech and international recommendations (4.9 ± 1.6 vs. 5.5 or 5.7 MJ) (NATIONAL RESEARCH COUNCIL U.S., 1989; SPOLECNOST PRO VYZIVU, 1992). However, it could be questionable due to the error of the method used, because it is generally known that an inventory analysis of dietary records underestimates the energy intake. It is usually caused by the omission of some food during the recording of data. On the opposite side, it is not possible to exclude systematic errors. The average intake of protein from our sample corresponds to the Czech recommended value, which is 45 g. However, in comparison to the international recommendation US (NATIONAL RESEARCH COUNCIL U.S., 1989), or EU (SCIENTIFIC COMMITTEE FOR FOOD, 1993) it seems that the intake is much higher. The results of micronutrient intake compared to PRI do not show any serious problems. In the Czech Republic, where salt iodisation program is implemented, it is very difficult to monitor iodine intake using the dietary record method because of the inaccurate assessment of salt intake. However, NOVACEK (2000) confirmed prevalence of decreased value of ioduria for 15% Czech children aged 1–3 years. In comparison to US recommendation, the study showed an insufficient intake of vitamin D, zinc, iron, folic acid and fluoride in the nutrition of children. On this basis, it is dubious whether the low intake of vitamin D found is sufficient or not. Its need by an organism is dependent on the dose of the sun's UV radiation. This is respected in an acceptable range of 0–10 µg of vitamin D recommended by EU. However, it is considered quite a low intake by the monitored sample of our children, which suggests the possibility of vitamin D deficiency of children due to an adequate sun exposure. The quite high value of 10 mg iron daily of the US RDA from 1989 (NATIONAL RESEARCH COUNCIL U.S., 1989) does not fit 91% of our children. With regard to the intake of 4 mg of iron according to the EU recommendation, we observed that one-third of the children are exposed to lower iron intake than 4 mg. Meat is the richest and easiest absorbable food source of iron and zinc. Moreover, due to the relatively low meat intake (0.4 portion per day), it is necessary to reconsider the impact of high protein provided by cottage cheese that is deficient in iron and zinc and in addition, may contribute to iron insufficiency observed in about one-third of children. Twelve percent of toddlers were yet breastfed. However, in this study we did not analyse social status of mothers, for example, influence of lower family income (SWIECICKA et al., 2003) or influence of education, and therefore we were not able to confirm it.

3. Conclusion

In summary, the analysis of the nutrition of Czech children aged 14–25 months showed that twelve percent of toddlers were long-term breastfed, eighty percent were on a milk formula diet, mostly in combination with cow's milk and eight percent were on cow's milk only together with complementary food. The average "Food pyramid" of the sample was created by the following daily portions: milk and dairy (3.5), other protein rich food (1.0), fruits and vegetables (4.2), and cereals (2.5). At expense of meat as a source of protein, cottage cheese was consumed more frequently. In comparison to the international recommendation for reference protein, the Czech toddlers' real intake of total protein was nearly three times higher. The results of micronutrient dietary intake in comparison to European PRI were satisfying with the exception to iodine, however, comparison to RDAs (NATIONAL RESEARCH COUNCIL U.S., 1989) and DRI (INSTITUTE OF MEDICINE, FOOD AND NUTRITION BOARD, 1998) suggests the risk of deficiency and low dietary intake of vitamin D, iron, zinc, folic acid and fluoride.

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