

ENERGY AND NUTRIENT INTAKE AMONG PRE-SCHOOL CHILDREN IN CENTRAL SLOVENIA

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The purpose of this study was to evaluate the energy and dietary intake of pre-school children (PSC) in Central Slovenia.

A total of 129 PSC, average age 4.2 years, were included. The intake was assessed with the use of three-day weighed food records.

The average daily energy intake of PSC was 5881.0±1394.2 kJ (1405.2 kcal). The average estimated daily intakes of macronutrients were: protein 13.9%E, fats 28.8%E and carbohydrates 57.1%E. The average daily intake of vitamins were: A 0.2±0.2 mg, E 11.5±3.8 mg, B₁ 0.9±1.0 mg, B₂ 1.0±0.2 mg, B₆ 1.2±0.4 mg, D 1.1±0.7 µg, C 104.5±46.2 mg, folates 176.4±63.1 µg and minerals: potassium 2276.4±762.4 mg, sodium 1951.4±583.0 mg, phosphorous 910.8±260.0 mg, zinc 7.3±2.1 mg, iodine 104.0±32.9 µg, calcium 580.1±170.6 mg, magnesium 249.6±91.2 mg in iron 9.1±3.4 mg.

The average daily energy intake and average estimated daily intake of macronutrients of PSC were comparable to recommendations. We found low average estimated daily intake of vitamin D, folates and relative high intake of sodium in PSC diet.

Keywords: nutrition, dietary intake, macronutrients, micronutrients, pre-school children

Provision of balanced diet in the early stages of childhood is of vital importance for a child's normal growth and development. Children acquire basic nutritional habits from their parents and the community at a very early stage of their lives, and these have an important effect on their health during later stages. There has been a substantial increase over recent years in the use of dietary patterns to assess diet-disease associations. These are used as an alternative to studying the intake of individual food items, food groups or a nutrient specific approach. Establishing of a healthy diet during the years of childhood is important for both short- and long-term health. Dietary habits adopted during the second year of life when the children gain independence and seek a degree of dietary autonomy are important because that will be taken forward into later childhood and adult life (LANIGAN et al., 2007). In most studies of diet and disease, the primary exposure of interest is relative (adjusted for energy) rather than absolute dietary intake. Unhealthy dietary habits very often result in inadequate choice of foods, inappropriate regime and not least unhealthy nutritional culture. These are very often the reasons for overweight and obesity, which are important risk factors for the development of numerous chronic diseases. Overweight children often become overweight adolescents and adults (GUO et al., 2002), and overweight in adulthood is a serious health risk (SPEISER et

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al., 2005; NADER et al., 2006). Promotion activities of healthy nutrition should be one of the main goals of each country to achieve better health among its citizens (POKORN, 2001). The objective of the study was to evaluate the energy and dietary intake of pre-school children in Central Slovenia and to compare to recommendations.

1. Materials and methods

1.1. Study population

The study was carried out between January 2006 and January 2007 in public kindergartens in Central Slovenia. Kindergartens were selected from a database obtained from the Ministry of Education and Sports of the Republic of Slovenia. Pre-school children were selected from 20 kindergartens located in Ljubljana and its surroundings. The age range of kindergarten children recruited in this study was between 4 and 7. Out of 250 kindergarten children, 202 accepted to participate (81%). Another 18 children did not participate in the measurements due to their absence. Finally, the three-day weighed food records were returned from 129 (70%) children (68 boys, 61 girls), of average age 4.2 ± 1.1 years and were included in the analysis of the present study. The study was approved by the National Medical Ethic Committee.

1.2. Respondent recruitments

An introductory letter about the study was posted to the principal of each kindergartens selected. If the principal agreed with the study in kindergarten, we posted an introductory letter with the information brochure to the children's parents. Parents gave written consent for the children's participation after having been fully informed both orally and in writing. Parents were asked to record detailed information regarding the amount and types of all foods, beverages consumed over the 3-day period and where applicable the cooking method used, the brand name of the food consumed, packaging size and type, who weighed the food/beverage, and details of recipes. After 3-days parents were asked to return the detailed information on the dietary intake to the nutritional researcher.

1.3. Dietary intake assessment

A 3-day weighed food records were used to collect food and beverage intake. The assessment during the three days comprised of monitoring the intake of all offered meals (breakfast, morning snack, lunch and afternoon snack). Brands of products as well as methods of preparation were also recorded. Three-day weighed food records were completed by the nutritionist researchers and the children's parents at home after they were given detailed oral and written instructions. Energy and nutrient intakes were assessed as the mean of the 3-day weighed food records. The dietary software *Prodi 5.2 Expert* used to calculate energy and dietary intakes. The obtained information was compared to a European research, which can be seen in Table 1.

1.4. Statistical analysis

The SPSS, version 15.0, statistical programme was used for all analyses. To assess for potential selection bias, we compared the basic characteristics between the children who

returned the three-day weighed food records and those who did not (129 vs. 55). There was no significant difference in the distribution of gender (χ^2 test, $P=0.235$) and age (Student t -test, $P=0.400$) between responders and non-responders.

Table 1. The outline of research on the intake of nutrients and energy from various European countries

Country	Age group	Method	References	Year of survey
Austria	3–6 years	3-day-weighed record	ELMADFA & FREISLING, (2003); ELMADFA et al., (2005)	2001
	7–14 years	7-day-weighed record		2000–2001
Denmark	1–14 years	7-day-weighed record, personal interview	HARALDSDOTTIR, (1999)	1995
Greece	1–5 years	3-day overall, combination of weighed food records and 24-hour recall or food diaries (3-day)	MANIOS et al., (2008)	2008
Ireland	5–6 years	7-day weighed record	NATIONAL CHILDREN'S FOOD SURVEY (2005)	2003–2004
Central Slovenia	2–6 years	3-day- weighed record	This study	2006–2007

Sources: ELMADFA et al., 2005; ELMADFA et al., 2009

2. Results and discussion

In this study meals which children consume during their stay in kindergarten (breakfast, morning snack, lunch and afternoon snack), plus meals received at home (breakfast, snacks and dinner) were included. The information on energy and specific nutrients intake among pre-school children can be seen in Table 2.

2.1. Energy intake

Children in Central Slovenia consumed on average 5881.0 ± 1394.2 kJ (1405.2 ± 332.9 kcal), boys: 6070.2 ± 1481.3 kJ (1450.5 ± 353.6 kcal); girls: 5670.2 ± 1269.1 kJ (1354.7 ± 303.1 kcal) of daily energy intake, which is in line with the recommendations D-A-CH and Slovenian dietary recommendations for pre-school children (GABRIJELČIČ BLENKUŠ et al., 2005). The data on energy intake was compared to the other European countries, which can be seen in Fig. 1.

2.2. Macronutrients intake

Dietary proteins provide the body with amino acids and other nitrogenous compounds needed to synthesize endogenous proteins and other metabolically active substances (INSEL et al., 2004; ROLFES et al., 2006; D-A-CH, 2008). The recommended value from proteins for children from 4 to 6 years old amounted from 10 to 15% daily energy intake (FLEISCHER MICHAELSEN et al., 2000). On average, the examinees consumed $13.9 \pm 2.5\%$ E from proteins (boys $14.0 \pm 2.6\%$ E; girls: $13.7 \pm 2.3\%$ E), which is in line with the recommendations (D-A-CH, 2008). One hundred and twenty-six children (97.7% of examinees) reach the recommendations for the protein intake. In comparison to other European countries, Slovenia

Table 2. Average daily energy and nutrients intake of children from Central Slovenia with recommendations

	Units	Energy/nutrients intake	Recommendations (D-A-CH, 2008)	The proportion of children who reached at least 60% of recommendations D-A-CH (%)
Energy intake				
Boys	kJ	6070.2±1481.3	6700	/
	(kcal)	(1450.5±353.6)	1600	
Girls	kJ	5670.2±269.1	6150	/
	(kcal)	(1354.7±303.1)	1450	
Macronutrients				
Proteins	%E	13.9±2.5	10–15	97.7
Fats	%E	28.8±5.5	30–35	41.1
SFA*		10.9	< 10	100
MUFA**		9.0	> 10	100
PUFA***		6.4	7	100
Cholesterol	mg	186.2±154.0	300	45
Carbohydrates	%E	57.1±6.5	> 50	84.5
Dietary fibre	g/1000 kcal	13.0 ± 3.3	> 10	99.2
Vitamins				
Vitamin A	mg	0.2±0.2	0.7	11.6
Vitamin B ₁	mg	0.9±1.0	0.8	96.1
Vitamin B ₂	mg	1.0±0.2	0.9	97.7
Vitamin B ₆	mg	1.2±0.4	0.5	100
Vitamin C	mg	104.5±46.2	70	95.3
Vitamin D	µg	1.1±0.7	5	2.3
Vitamin E	mg	11.5±3.8	8	100
Folates	µg	176.4±63.1	300	39.5
Minerals				
Sodium	mg	1951.4±583.0	410	99.2
Potassium	mg	2276.4±762.4	1400	99.2
Magnesium	mg	249.6±91.2	120	100
Calcium	mg	580.1±170.6	700	82.9
Iron	mg	9.1±3.4	8	97.7
Phosphorus	mg	910.8±260.0	600	100
Zinc	mg	7.3±2.1	5	100
Iodine	µg	104.0±32.9	120	85.3

* Saturated fatty acid; ** monounsaturated fatty acid; *** polyunsaturated fatty acid

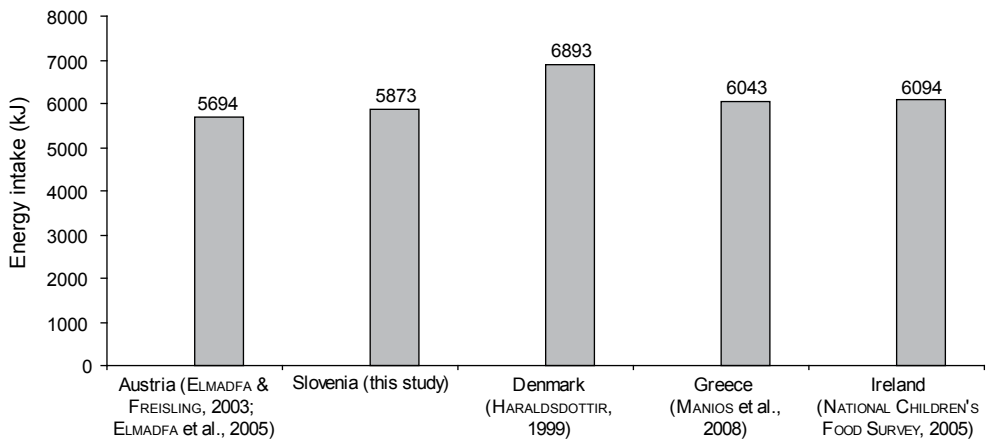


Fig. 1. Average daily energy intake of children in Central Slovenia and from other countries (in kJ)

is positioned in the middle as regards the intake of proteins. A higher energy intake from proteins has been observed in case of children from Denmark (14%E with both gender) (HARALDSDOTTIR, 1999) and from Greece (boys 16.4±2.5%E; girls: 16.3±2.3%E) (MANIOS et al., 2008). The recommended value for dietary carbohydrates intake amounts >50% of the daily energy intake (D-A-CH, 2008). Children consumed on average 57.1±6.5% of daily energy intake from carbohydrates (boys: 57.5±6.2%E; girls: 56.6±6.8%E), which is in line with the recommendations (D-A-CH, 2008), which indicate that children should consume more than 50% of daily energy intake from foods of carbohydrate origin. One hundred and nine examinees (84.5%) met the recommendations for carbohydrates intake. In comparison with the children from Denmark (52%E) (HARALDSDOTTIR, 1999), Austria (55%E) (ELMADFA & FREISLING, 2003; ELMADFA et al., 2005), Greece (45%E) (MANIOS et al., 2008), and Ireland (51.5%E) (NATIONAL CHILDREN'S FOOD SURVEY, 2005), we found that Slovenian children consume the highest proportion of energy from carbohydrates. Dietary fats are important sources of energy (D-A-CH, 2008), but at the same time a risk factor for increasing the risk for chronic non-communicable diseases (ROLFES et al., 2006). The average estimated energy intake from total fats among examinees amounted to 28.8±5.5% of daily energy intake (boys: 28.2±4.7%E, girls: 29.5±6.2%E), which is still in line with recommendations (D-A-CH, 2008), which recommend the intake to be between 30 and 35%E for these aged group. Fifty-three examinees (41.1%) reached the recommendations for the intake of total fats. We observed that the children from Central Slovenia consumed less total fats than children from other European countries (Fig. 2).

For children, the guiding value for intake of dietary fibre is at least 10 g/4.18 MJ (D-A-CH, 2008). We found the average dietary fibre intake of children was 13.0±3.3 g/1000 kcal (boys: 13.03±3.3; girls: 12.9±3.3). The higher dietary fibre intake was found in case of children from Denmark (girls: 15 g; boys: 17 g) (HARALDSDOTTIR, 1999).

2.3. Micronutrients intake

2.3.1. Vitamins intake. The results of the three-day weighed food records method among pre-school children for micronutrient intake showed that average estimated daily intake of vitamins (vitamin A, vitamin B₁, vitamin B₂, vitamin B₆, vitamin C and vitamin E)

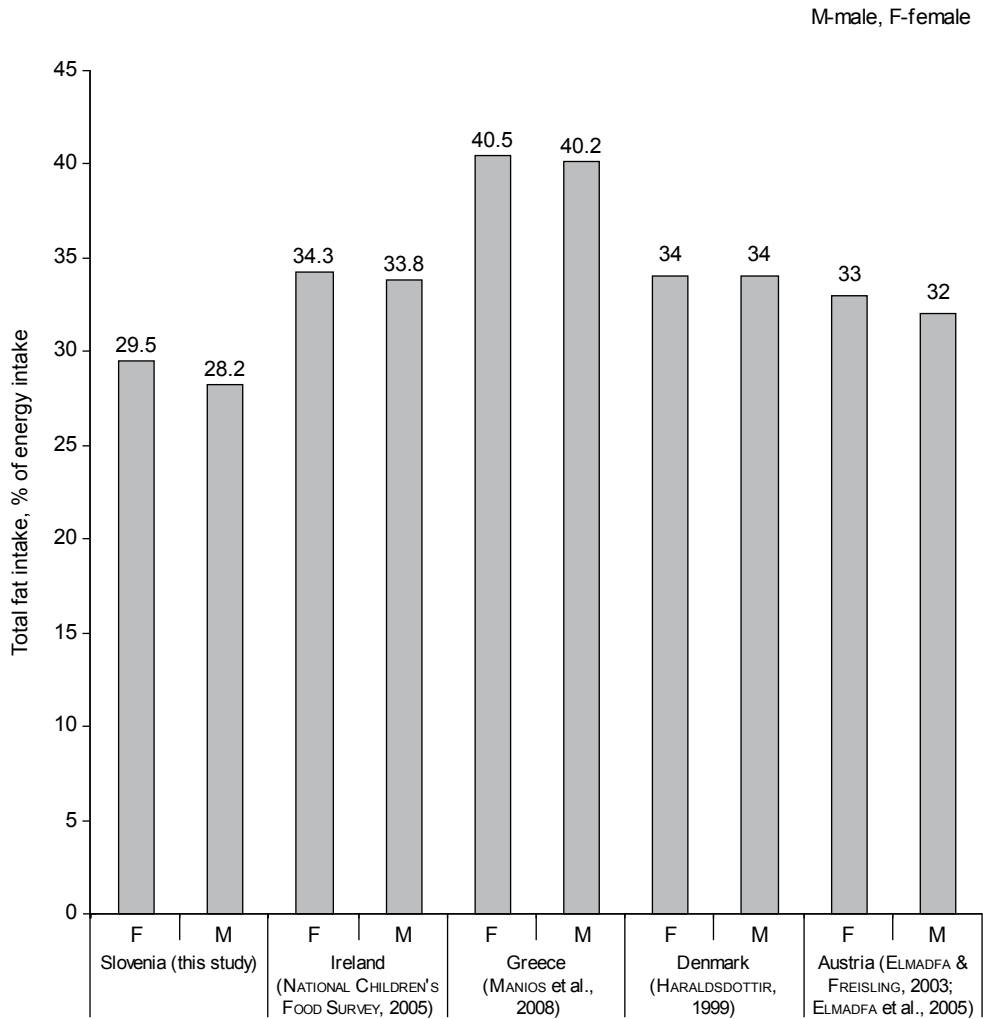


Fig. 2. The average estimated daily intake of total fats of children from Central Slovenia and from other European countries (proportion in % of daily energy intake)

were comparable to the Slovenian dietary recommendations for pre-school children (GABRIJELČIČ-BLENKUŠ et al., 2005) and D-A-CH recommendations. The results showed low intakes of folates and vitamin D below recommended levels. We found that the average children consume 0.2 ± 0.2 mg of vitamin A (boys: 0.2 ± 0.1 ; girls: 0.3 ± 0.2). The intake was low and it captured only 40% of the D-A-CH recommendation. The intake of vitamin B₁ amounts to 0.9 ± 1.0 mg (boys: 1.0 ± 1.3 ; girls: 0.8 ± 0.3) and was in line with the recommendations 0.8 mg (D-A-CH, 2008). The same data were found in Austria (ELMADFA & FREISLING, 2003; ELMADFA et al., 2005). The research showed that the intake of vitamin D was extremely low

and below recommended levels (D-A-CH, 2008; 5 µg/day). On average, children consume only 1.1 ± 0.75 µg of vitamin D (boys: 1.0 ± 0.7 µg; girls: 1.1 ± 0.7 µg) per day. The intake of vitamin D reaches only 22.6% of D-A-CH recommendation. Too low intake of vitamin D also represents a problem in other European countries, which can be seen in Fig. 3.

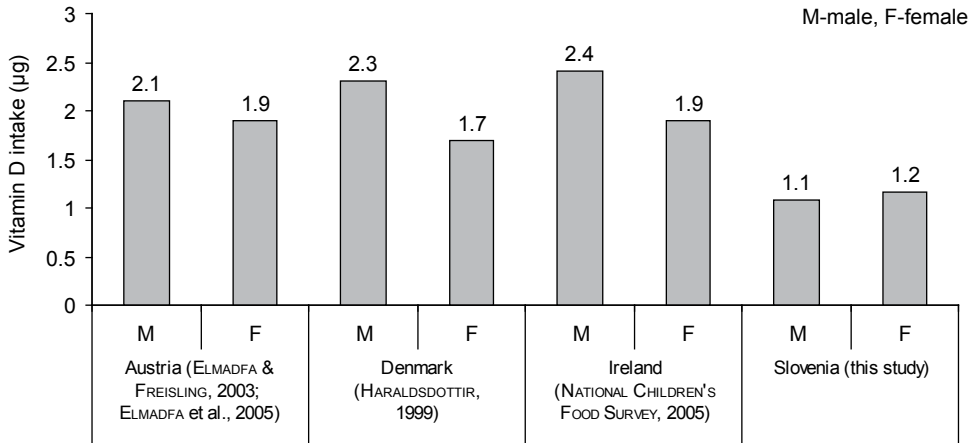


Fig. 3. The intake of vitamin D of children in Central Slovenia and children from other European countries (in µg)

On the other hand, children from Central Slovenia consumed more vitamin E as recommended by D-A-CH recommendations (8 mg/day), namely 11.5 ± 3.8 mg (boys: 12.1 ± 4.0 mg; girls: 10.9 ± 3.5 mg). All children included in the research met the borderline values of recommendations.

In Austria (ELMADFA & FREISLING, 2003; ELMADFA et al., 2005) children consume on average 5.8 mg of vitamin E and in Ireland on average 5.6 mg of vitamin E (NATIONAL CHILDREN'S FOOD SURVEY, 2005). The daily average intake of folates is, in comparison to other countries, relatively high, as it amounts to 176.4 ± 63.1 µg per day (boys: 184.0 ± 73.0 µg; girls: 167.9 ± 48.9 µg). Recommendations (D-A-CH, 2008) indicate that children between 4 and less than 7 year of age consume 300 µg of folates per day. A higher intake of folates has been discovered with boys (209 µg) and girls (189 µg) from Denmark (HARALDSDOTTIR, 1999), and with boys (225 µg) and girls (196 µg) from Ireland (NATIONAL CHILDREN'S FOOD SURVEY, 2005). Lower amounts of folates intake was found in Austria (ELMADFA & FREISLING, 2003; ELMADFA et al., 2005), 155.5 µg. Diets of Slovenian children is inadequate in folates.

2.3.2. Minerals intake. The results of the three-day weighed food records method among pre-school children for micronutrient intake showed that average estimated daily intakes of minerals (iron, phosphorus, zinc, magnesium and iodine) were comparable to the Slovenian dietary recommendations for pre-school children (GABRIJELČIČ-BLENKUŠ et al., 2005) and D-A-CH recommendations (Table 2). The results showed high intakes of sodium and potassium and low intake of calcium. The intake of sodium in the nutrition of children on average amounted to 1951.4 ± 583.0 mg (boys: 2003.4 ± 621.1 mg; girls: 1893.4 ± 536.6 mg) per day. A higher intake was observed in case of children from Denmark (HARALDSDOTTIR,

1999). Lower intake of sodium was observed in children from Austria (ELMADFA & FREISLING, 2003; ELMADFA et al., 2005) and Ireland (boys: 1900 mg; girls: 1800 mg) (NATIONAL CHILDREN'S FOOD SURVEY, 2005). Recommendations (D-A-CH, 2008) indicate that children between 4 and less than 7 years of age consume 410 mg of sodium per day. Children from Central Slovenia exceed this value by more than 4.7 times. Higher intake can be connected to the fact that children consume too much salt in their diet. Children's daily intake of potassium on average amounted to 2276.3 ± 762.4 mg (boys: 2361.3 ± 811.4 mg; girls: 2181.5 ± 698.2 mg), which implies that the recommendations (D-A-CH, 2008), which recommend the intake in the amount of 1400 mg/day, are exceeded by 1.6 times. Lower intake of potassium was discovered in case of children from Austria (1600 mg) (ELMADFA & FREISLING, 2003; ELMADFA et al., 2005) and Ireland (boys: 2000 mg; girls: 1900 mg) (NATIONAL CHILDREN'S FOOD SURVEY, 2005), while higher intake was discovered in case of children from Denmark (HARALDSDOTTIR, 1999), where 2300 mg of potassium is consumed through food per day. The intake of calcium in case of children from Central Slovenia on average amounted to 580.1 ± 170.6 mg per day (boys: 603.7 ± 177.8 mg; girls: 553.8 ± 159.4 mg), but the recommendations were not met entirely. One hundred and seven (82.9%) examinees reached 60% of D-A-CH recommendation (420 mg) for the intake of calcium (Fig. 4).

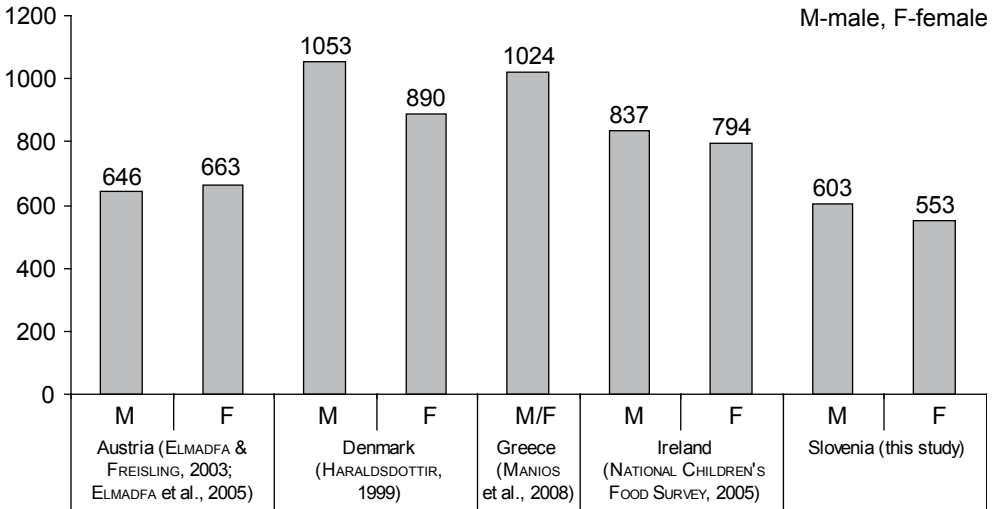


Fig. 4. The intake of calcium of children in Central Slovenia and children from other European countries (in mg)

On average children consumed 104.0 ± 32.9 μ g of iodine per day (boys: 104.4 ± 29.4 μ g; girls: 103.6 ± 36.7 μ g), which was slightly lower than the recommended values (D-A-CH, 2008; 120 μ g/day). With regard to the proportion of the intake, we observed that 85.3% (110) of examinees reached 60% of D-A-CH recommendations. The average estimated intake of iodine in Austria amounts to 68 μ g (ELMADFA & FREISLING, 2003; ELMADFA et al., 2005) and in Denmark 64 μ g (HARALDSDOTTIR, 1999). The highest intake of iodine was found in case of children from Ireland (boys: 142 μ g; girls: 137 μ g) (NATIONAL CHILDREN'S FOOD SURVEY, 2005).

3. Conclusions

The energy intake and the intake of proteins, fats, carbohydrates, and dietary fibre of children from Central Slovenia were in line with recommendations. The estimated intake of vitamin A was lower from the recommended values. Average estimated intake of vitamin D was under the value of recommendations, and we therefore believe that the nutrition of Slovenian pre-school children should contain more food rich in vitamin D or food enriched with vitamin D (eggs, butter, margarine, milk, etc.), or children should be able to spend more time outside. With regard to the low intake of folates, children's diets should contain more vegetables. With regard to the conclusion that the intake of sodium exceeds the recommended minimum intake levels by 5 times, less salt should be used in food preparation, or less food products and end food rich in salt (ready made and half ready made foods, crisps, instant soups and sauces, and fast food, etc.) should be used. We found low intake of vegetable led to low intake of folates, vitamins A and E. Such an effect could have adverse health effects in the long-term, since vegetable consumption is inversely associated with some types of cancer, diabetes, and heart diseases (BLOCK et al., 1992). More importantly 'healthy' dietary habits established in early childhood contribute to similar habits later in life and influence adult health (MIKKILA et al., 2004; NESS et al., 2005).

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