Progress in Nutrition 2019; Vol. 21, N. 3: 521-531 DOI: 10.23751/pn.v21i3.7335

ORIGINAL ARTICLE

Micronutrient intake by preschool aged children attending kindergartens in Kosovo

Agim Rysha[1], Tahire M Gjergji[2], Angelika Ploeger[3]

[1]Department of Food Technology, Faculty of Agribusiness, University of Pejë, Kosovo - E-mail: agim.rysha@unhz.eu; [2]Medical Faculty, University of Prishtina, Mather Theresa, Prishtinë, Kosovo; [3]Department of Organic Food Quality and Food Culture, Faculty of Organic Agricultural Sciences, University of Kassel, Witzenhausen, Germany

Summary. *Aim:* Assessment of the micronutrient intake of children attending kindergartens in Kosovo. The micronutrient intake assessment included breakfast meal, lunch meal and afternoon snack, while data of food consumption after kindergartens hours were not collected. *Methods:* Preschool aged children (n=469) from randomly selected kindergartens of Kosovo have participated in a dietary intake assessment through *weighted dietary record* method. The micronutrient assessed in this study included minerals such as calcium, iodine, iron magnesium, phosphorus, potassium, sodium and zinc, while vitamins assessed included: biotin, folic acid, niacin, thiamine, riboflavin vitamin C and other vitamins such as: B6, B12, vitamin D, vitamin E and vitamin K. The one - way analyses of variance (ANOVA) was used for determination of differences between the mean values according to age and gender as well as between public and private kindergartens. *Results:* The intake of several micronutrients in selected kindergartens was below recommendations (iodine, iron), folic acid intake was quite low and the average intake of thiamine, riboflavin and vitamin C by children attending public kindergartens was below 50 % of daily recommended allowances, while sodium intake percentage was much higher (for 1<4 old children was 291% and for 4<7 years old children was about 306%) than the recommended daily intake. *Conclusions:* Diets of the kindergartens children in Kosovo are deficient in several micronutrients.

Keywords: Kosovo, Pre-school children, Micronutrients, Kindergartens

Introduction

Appropriate food intake by preschool aged children is important for their normal growth. Poor nutritional status in developing countries and consumption of energy dense foods and lifestyle changes in developed countries are considered to be the major factors associated with a risk of different adult diseases (1-3). Many studies show that children's diet, although high in energy, are very often characterized by low micronutrient content. Deficiencies or excessive intake of certain micronutrients influence human function and health and may be associated with adverse long-term health effects.

This is due to increased consumption of fast foods, soft drinks, salty snacks and decreased consumption of fruits, vegetables, grains and milk (4-7). According to World Health Organization (WHO), at least half of children worldwide aged 6 months to 5 years suffer from one or more micronutrient deficiencies and it is considered that globally more than 2 billion people are affected (8). Prevention of diseases related to micronutrient deficiencies should start in childhood when adequate intake of micronutrients is crucial for the child's physical, mental and emotional development (9).

Because of the importance of adequate nutrition for children, many nutrition assessment studies are taking place in the preschool institutions and kindergartens are examples of such institutional settings (10, 11).

The accurate assessment of nutrient intakes in children and adolescents is an essential prerequisite for

monitoring the nutritional status of these age groups, as well as for conducting epidemiological and clinical research on the links between diet and health (12, 13).

Countries usually recommend about how much food a child in a full - day program should receive in order to meet certain percentage of daily nutrition needs. In USA for instance, children in full-day program should receive foods that meet at least half to two thirds of child's daily nutrition needs (14). Another example could be Estonia, where kindergartens provide three meals a day and food served should cover 80-85% of a child's daily energy requirements (15).

Recent study in Kosovo showed that the dietary pattern was low in wholegrain products and fruits and vegetables, and high in soft drinks and sweet and salty food (16).

Actually, Kosovo does not have the Dietary Guidelines for preschool aged children, thus meal planning does not refer to any recommendations on dietary allowances or dietary reference intakes and recommendations on proportional share of nutrient requirements according to servings is missing, too.

This work aimed to observe menu designs and to evaluate for the first times the micronutrient intake by children attending public and private kindergartens of Kosovo (full day programme-8 hours). The micronutrient assessed in this study included minerals such as calcium, iodine, iron magnesium, phosphorus, potassium, sodium and zinc, while vitamins assessed included: biotin, folic acid, niacin, thiamine, riboflavin vitamin C and other vitamins such as: B6, B12, vitamin D, vitamin E and vitamin K.

Methods

The sample size for this cross-sectional research covered five randomly selected kindergartens (four public and one private) from different regions of Kosovo (Prishtinë; Ferizaj; Kamenicë and Obiliq). According to the Kosovo education statistics for 2010/2011 (17), the number of kindergartens was 52 with about 6,000 children enrolled. The percentage of pre-school age children attending kindergartens in Kosovo is very low (less than 10%). There is a high demand by families to send their children to kindergartens, but a lack of kindergartens and budget limitations prevent many children from attending such pre-school institutions. In general the socio economic and educational status of families whose children attend kindergarten does not differ from those whose children stay at home.

All registered children from the selected kindergartens were eligible to participate in the assessment. The inclusion criteria for the recruited subjects were: a) children registered and attending the selected kindergarten, and b) children between 12 and 84 months of age.

The goal was to have 100% sampling, however 469 children or more than 90% of registered children in selected kindergartens (87 children from a private kindergarten and 382 children from public kindergartens) participated in 3 days dietary intake assessment through food measuring in kindergartens. In terms of gender, 257 were boys and 212 were girls.

Child care in kindergartens of Kosovo covers a full day program (8 hours) and meals served include breakfast, lunch and afternoon snack. In four out of five of the kindergartens, the food was cooked in the kindergarten's kitchen; while in one the food was prepared elsewhere and distributed to the children as ready-to-eat food.

Although, several methods are used to assess the dietary intake of preschool children such as *dietary recalls, dietary records, food frequency questionnaires (FFQs), direct observation, physiologic measures* etc., the *weighted dietary record method* was chosen for this study considering that multiple days of records provide valid measure of intake for most nutrients and is more useful method for the assessment of intake of variety of nutrients. The preparation of all meals as well as recipe content was also accurately followed, measured and recorded.

Due to logistics, all food and drink consumed in kindergartens for a period of three consecutive days (out of five working week days) were measured and recorded, and wasted food and leftovers had been measured and subtracted from the record correctly. *Seca 856* Digital Scale with the fine 1 g graduation was used for weighting foods and leftovers. The data were recorded by a principal investigator who was supported by trained nurses in conducting the measurement for the duration of survey. The total time over which the measurements occurred was about four months.

The coding was checked before the food record was linked to the nutrient database for conversion of food items to their constituent nutrients. The completed records were analysed with the program PRODI - version 5.9, NutriScience, Freiburg, Germany and transferred into SPSS (version 17.0) for calculation and comparison of nutrient values with reference values. Since Kosovo does not have the Dietary Guidelines for preschool aged children, the obtained results from this study were compared with the recommendations published by the German, Austrian and Swiss Societies for Nutrition, which consider two age groups: 1<4 years old and 4<7 years old children (18).

Statistical analyses were carried out using statistical package SPSS version 17.0. The one - way analyses of variance (ANOVA) was used for determination of differences between the mean values according to age and gender as well as according to public and private kindergartens. The level of significance adopted for statistical tests was 5%.

Since there is no Ethic Review Committee in Kosovo, this study was approved by the Ministry of Education, Science and Technology of Kosovo which has issued a consent letter, inviting Municipal Education Directors as well as the Kindergarten Directors to support this study as the first nutritional assessment research in preschool settings of Kosovo. The concept and the objective of the study were explained to each parent personally and they have signed a consent form.

The compliance with STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) has been addressed in this study.

Results

The results of micronutrient intake assessment include data of breakfast meal, lunch meal and afternoon snack, while data of food consumption after kindergartens hours were not collected.

Although, our main focus was to understand the micronutrient intake, investigating the intake of individual nutrients, we observed carefully the types of food which are served in kindergartens.

Menu designs: There are very little guidelines on menu design and meals which are served in public and private kindergartens do not follow recommendations for promotion of balanced healthy diets. It was observed that black tea with added sugar was mostly served during breakfast in all kindergartens, while milk was served in rare cases only for little babies. White salty cheese, processed chicken sausage, white bread, marmalade, white biscuits and chocolate cream were mostly served during breakfast meals in all kindergartens. In almost all kindergartens, lunch was comprised mostly of fatty minced meat prepared with ready potatoes pure, white rice, mashed potatoes, and processed white beans, processed sausages. White bread was served during lunch meals in all selected kindergartens. Vegetable salad (mostly composed of cabbage and cucumbers) was served during three consecutive days only in private kindergarten while in public kindergartens was served only sometimes. Afternoon snack consisted mostly of processed cakes and low quality fruit juices.

Lean meat and fish (expensive products) was not served in any of assessed kindergartens. Foods which belong to the breads, cereals and potato group which are recommended to be as the bases of all age groups are taken in very limited amounts. Almost all products from this group are made from white flour. It was observed that consumption of whole grains which are rich in fiber, iron and many B vitamins was not promoted at all. Potatoes were peeled, so lot of fiber is removed. White rice is consumed while brown rice despite its advantages (minerals, fiber, vitamins) is not consumed by children in Kosovo. Fruit and vegetable intake by preschool aged children is much lower than the recommended amounts of more servings a day.

Micronutrient intake: The program PRODI was used to convert food items to the constituent nutrients

Table 1 presents the mean values of minerals consumed by children from all kindergarten according to gender and age.

The One Way ANOVA test does not show significant differences between consumption of minerals according to gender and age in all kindergartens. Obtained results from this study were compared with the recommendations published by the German, Austrian and Swiss Societies for Nutrition, which consider two age groups: 1<4 years old and 4<7 years old children.

The mean intake of *calcium* for 1<4 year old chil-

Table 1. Mean intake of minerals, according to age and gender (breakfast, lunch and afternoon snack provided in kindergartens)

		Minerals							
Gender and age (months)	**n**	**Calcium mg**	**Iodine µg**	**Iron mg**	**Magnesium mg**	**Phosphorus mg**	**Potassium mg**	**Sodium mg**	**Zinc mg**
		Mean	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Boys all	257								
12 to < 24	25	217.8	9.6	3.3	84.0	361.0	952.1	828.7	2.6
24 to < 36	36	202.7	8.9	3.0	79.3	352.4	878.9	780.0	2.7
36 to < 48	64	222.8	10.6	3.6	91.3	392.2	1002.1	999.8	3.2
48 to < 60	65	263.7	11.9	3.8	101.3	437.1	997.9	1159.8	3.6
60 to < 72	48	267.3	12.0	3.7	99.9	440.7	1010.9	1164.8	3.7
72 to < 84	19	324.5	15.4	4.9	128.5	541.7	1276.5	1359.9	4.2
Girls all	212								
12 to < 24	19	201.6	8.9	3.0	73.5	333.4	874.2	773.4	2.4
24 to < 36	34	198.1	8.8	3.1	79.0	367.7	926.6	831.2	3.0
36 to < 48	59	215.8	11.1	3.8	94.7	386.5	1023.1	1022.0	3.2
48 to < 60	46	261.4	12.1	4.2	106.3	460.4	1077.9	1265.5	4.0
60 to < 72	45	288.3	12.5	3.8	101.8	458.5	998.2	1200.2	3.8
72 to < 84	9	304.3	15.1	4.7	117.4	506.0	1128.2	1409.0	4.2
Combined all	469								
12 to < 24	44	210.8	9.3	3.2	79.5	349.1	918.5	804.8	2.5
24 to < 36	70	200.4	8.8	3.1	79.1	359.8	902.1	804.9	2.8
36 to < 48	123	219.4	10.8	3.7	92.9	389.5	1012.1	1010.5	3.2
48 to < 60	111	262.8	12.0	3.9	103.4	446.8	1031.1	1203.6	3.8
60 to < 72	93	277.5	12.2	3.7	100.8	449.3	1004.8	1182.0	3.7
72 to < 84	28	318.0	15.3	4.9	125.0	530.3	1228.8	1375.7	4.2
One Way ANOVA		P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05

dren was 210.2 mg covering for about 35% the recommended intake (600 mg per day) and 4<7 years old children consumed in average 286.1 mg of *calcium* that covers only about 40% of recommended daily intake (700 mg) for this age. The *sodium* intake was much higher than the recommended daily intake. The mean *sodium* intake percentage for 1<4 old children was 291% and for 4<7 years old children was about 306% of recommended daily intake. The exceeded intake of *sodium* was observed in all children regardless of gender, age and place of attendance.

The *iodine* intake was very low in all children regardless of gender, age and kindergarten. The average intake of *iodine* for 1<4 years old children covered only 9.6 % and for 4<7 years old children covered only 11% of recommended daily intake, while *iron* intake covered 41.3% of daily recommended intake for 1<4 years old children and 52.5% of daily recommended intake for 4<7 years old children. Daily intake of *magnesium* in all kindergartens covered for about 104.8% of recommended intake for 1<4 years old children (80 mg) and for about 91.4% of recommended intake for 4<7 year old children (120 mg). Significant differences were observed when consumption of most minerals was compared in public and private kindergartens (Table 2) as well as when calculated separately for each kindergarten.

Children in each age in private kindergartens consumed more minerals when compared to children in comparable age groups in public kindergartens. It was observed that *calcium* intake by children attending private kindergarten was slightly higher compared to those attending public kindergartens. Statistical tests show also that children attending public kindergartens consumed far less *iodine, iron*, *magnesium* and *potassium* than those attending private kindergartens. Children attending private kindergartens consume on average significantly more *magnesium* than those attending public kindergartens, covering for 147% the recommended daily intake for 1 < 4 year old children (80 mg) and 118% for 1<7 years old children (120 mg). *Potassium* intake was higher in private than in public

Table 2. Difference between mean intake of minerals in public and private kindergartens according to age (breakfast, lunch and afternoon snack provided in kindergarten)

			Minerals						
Age (months)	**n**	**Kinder garten**	**Calcium mg**	**Iron mg**	**Magnesium mg**	**Phosphorus mg**	**Potassium mg**	**Sodium mg**	**Zinc mg**
			Mean	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Combined all	87	Private							
12 to < 24	15		308.2	4.5	116.6	456.4	1253.8	944.7	2.9
24 to < 36	12		265.3	4.6	106.0	418.5	1118.3	1048.4	2.9
36 to < 48	29		260.1	5.9	131.5	473.6	1408.3	1358.1	3.7
48 to < 60	14		267.5	6.0	134.7	490.8	1438.8	1337.1	3.7
60 to < 72	8		272.5	5.9	133.9	492.1	1418.3	1343.5	3.7
72 to < 83	9		287.9	7.0	157.1	575.9	1674.0	1494.3	4.1
Combined all	382	Public							
12 to < 24	29		160.4	2.5	60.3	293.6	745.0	732.5	2.2
24 to < 36	58		187.0	2.8	73.5	347.7	857.3	754.5	2.8
36 to < 48	94		206.9	3.0	81.0	363.5	889.9	903.2	3.0
48 to < 60	97		262.1	3.6	98.9	440.4	972.2	1184.3	3.8
60 to < 72	85		277.9	3.5	97.7	445.3	965.9	1166.8	3.7
72 to < 83	19		332.3	3.9	109.8	508.6	1018.0	1319.5	4.2
One Way ANOVA			P<0.01	P<0.01	P<0.01	P<0.05	P<0.01	P<0.01	P>0.05

kindergartens. The intake of *potassium* in private kindergartens (full day-8 hours) covered 126% and 108% of recommended daily intake for 1<4 respectively 4<7 years old children. As far as *zinc* intake is concerned it was observed that 1<4 year old children attending private kindergarten exceeded the recommended daily intake (3 mg) during their stay in kindergarten. On the other side 4<7 years old children consumed about 77% of recommended daily intake (5 mg).

The mean values of vitamin intake are presented in Table 3. The statistical test shows significant differences (P<0.05) in consumption of vitamins according to gender and age. Mean intake of vitamins from this study were also compared with the recommendations published by the German, Austrian and Swiss Societies for Nutrition.

The One Way ANOVA test also showed significant differences between consumption of certain vitamins in public and private kindergarten (Table 4). Children in each age in private kindergartens consumed more vitamins when compared to children in comparable age groups in public kindergartens.

Biotin intake exceeded lower and upper recommended intake levels (10-15 μg) in both children age groups 1<4 years and 4<7 years old, who attend private kindergartens.

The children attending public kindergartens exceeded as well the recommended lower level for *biotin* intake, while the upper level was covered for about 74% of recommended intake for 1<4 years old children and about 97% for 4<7 years old children. Significant differences were observed between consumption of *biotin* in public and private kindergartens.

Folic acid intake by children was in general quite low, particularly in public kindergartens covering only about 23% of recommended daily intake. Significant differences were observed in consumption according to gender and age as well as between children attending public and private kindergartens. Children attending private kindergarten took more *folic acid* than children attending public kindergartens but still the intake was lower than the recommendations.

The statistical tests showed significant differences in consumption of *pantothenic acid* according to gender and age but also between public and private kindergartens. The intake ranged between 1.4 mg for 1<4 years old children and about 8.1 mg for 4<7 years old children covering 35% of recommended daily intake for 1<4 years old age group and 45% of recommended daily intake for 4<7 years old children. Average intake in public kindergartens was 1.2 mg for 1<4 years old age children, covering 29.3% of recommended daily intake

Table 3. Mean intake of vitamins according to age and gender (breakfast, lunch and afternoon snack provided in kindergartens)

Gender and age (months)	n	Biotin µg	folic acid µg	niacin equivalent µg	pantothenic acid acid mg	*Retinol equivalent µg	retinol µg	thiamine mg	vitamin B12 µg	riboflavin mg	vitamin B6 mg	vitamin C mg	vitamin D µg	vitamin E activ.mg	vitamin K µg
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Boys ali	257														
12 to < 24	25	13.9	66.2	5617.2	1.4	230.9	100.0	0.3	0.8	0.3	0.5	21.2	0.3	7.6	26.3
24 to < 36	36	12.6	56.5	6116.6	1.3	174.0	100.0	0.3	0.8	0.3	0.5	18.7	0.3	6.0	19.7
36 to < 48	64	14.4	69.9	7052.6	1.5	184.1	100.0	0.3	0.9	0.3	0.6	26.8	0.3	7.1	25.4
48 to < 60	65	15.3	75.0	7407.9	1.7	170.6	100.0	0.4	1.0	0.4	0.6	27.1	0.4	6.9	21.0
60 to < 72	48	14.9	70.4	7822.3	1.7	152.8	100.0	0.4	1.0	0.4	0.6	26.6	0.4	6.5	17.5
72 to < 84	19	20.0	105.0	8330.4	2.1	258.0	100.0	0.5	1.1	0.5	0.7	32.7	0.5	11.3	36.2
Girls ali	212						100.0								
12 to < 24	19	12.8	55.2	5317.3	1.2	193.4	100.0	0.3	0.8	0.3	0.5	19.2	0.3	6.1	19.6
24 to < 36	34	11.9	54.7	6859.8	1.3	145.0	100.0	0.3	0.9	0.3	0.5	18.0	0.3	5.7	16.2
36 to < 48	59	15.5	77.0	7026.9	1.6	213.1	100.0	0.4	0.9	0.3	0.6	28.4	0.3	8.6	32.5
48 to < 60	46	15.6	77.5	8741.9	1.8	184.2	100.0	0.4	1.1	0.4	0.7	26.2	0.4	7.8	22.6
60 to < 72	45	15.0	71.0	7792.1	1.7	160.9	100.0	0.4	1.1	0.4	0.6	22.9	0.4	6.8	18.8
72 to < 84	9	18.5	92.4	8745.4	2.1	244.5	100.0	0.4	1.2	0.4	0.7	30.1	0.5	10.7	36.9
Combined ali	469						100.0								
12 to < 24	44	13.4	61.5	5487.7	1.3	214.7	100.0	0.3	0.8	0.3	0.5	20.3	0.3	7.0	23.4
24 to < 36	70	12.2	55.6	6477.6	1.3	159.9	100.0	0.3	0.9	0.3	0.5	18.4	0.3	5.8	18.0
36 to < 48	123	14.9	73.3	7040.3	1.6	198.0	100.0	0.3	0.9	0.3	0.6	27.6	0.3	7.8	28.8
48 to < 60	111	15.4	76.0	7960.7	1.7	176.2	100.0	0.4	1.0	0.4	0.6	26.8	0.4	7.3	21.7
60 to < 72	93	14.9	70.7	7807.7	1.7	156.7	100.0	0.4	1.0	0.4	0.6	24.8	0.4	6.7	18.2
72 to < 84	28	19.5	100.9	8463.8	2.1	253.7	100.0	0.4	1.1	0.4	0.7	31.9	0.5	11.1	36.4
One Way ANO'		P<0.01	P<0.01	P>0.05	P<0.05	P<0.01	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P<0.01	P<0.01	P<0.01	P<0.01

Table 4: Difference between mean intake of vitamins in public an d private kindergartens according to age (breakfast, lunch and afternoon snack provided in kindergartens)

Gender and age (months)	n	Kinder-garten	Biotin µg	folic acid µg	niacin equivalent µg	pantothenic acid mg	*Retinol equivalent µg	retinol µg	thiamine mg	vitamin B12 µg	riboflavin mg	vitamin B6 mg	vitamin C mg	vitamin D µg	vitamin E activ.mg	vitamin K µg
			Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Combined all	87	Private														
12 to < 24	15		19.3	103.3	5783.3	1.9	348.7	100.0	0.4	0.8	0.4	0.6	32.5	0.4	14.0	47.7
24 to < 36	12		18.3	103.0	5709.5	1.8	340.8	100.0	0.4	0.7	0.4	0.5	32.0	0.4	14.6	55.8
36 to < 48	29		24.2	134.2	7862.9	2.3	440.7	100.0	0.5	0.9	0.4	0.6	47.6	0.6	19.7	83.1
48 to < 60	14		25.4	136.3	7702.3	2.3	415.3	100.0	0.5	1.0	0.4	0.6	45.7	0.7	18.6	72.9
60 to < 72	8		24.3	134.4	7604.7	2.4	407.2	100.0	0.5	1.0	0.4	0.6	43.2	0.7	18.1	68.0
72 to < 83	9		28.1	156.7	8475.9	2.5	462.1	100.0	0.6	1.0	0.4	0.7	50.7	0.8	20.8	79.7
Combined all	382	Public						100.0								
12 to < 24	29		10.4	39.8	5334.7	1.0	145.4	100.0	0.2	0.8	0.3	0.4	14.0	0.3	3.3	10.8
24 to < 36	58		11.0	45.8	6636.5	1.2	122.5	100.0	0.3	0.9	0.3	0.5	15.5	0.3	4.0	10.2
36 to < 48	94		12.0	54.6	6786.5	1.3	123.1	100.0	0.3	0.9	0.3	0.6	21.4	0.3	4.2	12.1
48 to < 60	97		14.0	67.3	7998.0	1.7	141.7	100.0	0.3	1.0	0.4	0.6	24.0	0.3	5.7	14.3
60 to < 72	85		14.0	64.7	7826.8	1.7	133.1	100.0	0.3	1.0	0.4	0.6	23.1	0.3	5.6	13.5
72 to < 83	19		15.5	74.5	8458.1	1.9	155.0	100.0	0.4	1.2	0.4	0.6	23.0	0.4	6.4	15.9
One Way ANOVA			P<0.01	P<0.01	P>0.05	P<0.05	P<0.01	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P<0.01	P<0.01	P<0.01	P<0.01

(4 mg) and 1.7 mg for 4<7 years age group covering 43.2% of recommended daily intake (4 mg). In private kindergartens the average consumption was 2 mg for 1<4 years old children covering 49.4% of recommended daily intake and 2.4 mg for 4<7 years old children covering 60.1% of recommended daily intake.

Retinol equivalent as a unit of measurements used to determine the value of *retinol* in sources of *retinol* as well as *retinol* were also calculated. The average intake of *retinol equivalent* in all kindergartens was around 0.19 mg for both, 1<4 years age old children and 4<7 years age group, and covered 31.8% of daily recommended intake for 1<4 years age old children and 27.9% for 1<7 years age old children. Significant differences were observed in terms of consumption of *retinol equivalent* in public and private kindergartens, as well as according to gender and age.

The intake of v*itamin C* ranged from 18.4 mg for the age group 24<36 months to 31.9 mg for the age group 72<84 months showing significant differences according to gender and age. The daily intake of *vitamin C* by children attending public and private kindergartens was significantly different. Children attending public kindergartens took in average around 17 mg for 1<4 years old children, covering only 28.3% of daily recommended intake (60 mg) and around 23.4 mg for 4<7 years old children, covering 33.4% of daily recommended intake (70 mg). On the other side, the intake of *thiamine, riboflavine* and especially *vitamin C* by children attending private kindergartens was higher than in public kindergartens. Average consumption of *vitamin B6* was above daily recommended intakes in both, private and private kindergartens. So, the mean intake ranged between 0.5 and 0.6 mg covering for about 128% up to the 144.5% of recommended daily intake for 1<4 years old children and 4<7 years old children.

Vitamin E and *vitamin K* intake have exceeded the recommendations. The *vitamin E* active intake ranged from 5.8 mg for the age group 24<36 months to 11.1 mg for the age group 72<84 months, while the intake of *vitamin K* ranged from 18.0 mg for the age group 24<36 months to 36.4

mg for the age group 72<84 months.

The average intake of *vitamin E* by 1<4 years old children was 6.9 mg covering about 115% of the recommended daily intake, while 4<7 years old children consumed on average 8.3 mg during their stay in kindergarten (full day-8 hours), covering about 103.8% of the recommended daily intake. Significant differences were observed in terms of intake of *vitamin E* and *vitamin K* according to gender and age as well as between children attending public and private kindergartens.

Children attending private kindergartens consumed far more of the mentioned vitamins than those in public kindergartens. Consumption of *vitamin K* by children attending private kindergartens exceeded very much the recommended daily intake. So , the 1<4 years old children on average consumed around 62 μg of *vitamin K*, covering about 414.5% of the daily recommended intake (15 μg) and 4<7 years old children consumed on average 73.4 μg, covering about 367.5% of the recommended daily intake (20 μg). The *vitamin D* intake ranged from 0.3 μg up to maximum 0.7 μg. Even though the *vitamin D* intake was much below the recommended daily intake (20 μg for 1 to 15 years old children), the body can produce *vitamin D,* when it is exposed to sunlight.

Discussion

The objective of this study was to investigate for the first time the micronutrient intake of preschool children attending public and private kindergartens of Kosovo. Although, the main focus was to understand the micronutrient intake, types of foods that are served in kindergartens were carefully observed. The present study indicates deficiencies in intake of several micronutrients that are essential for the adequate growth of children, but excessive intake of certain micronutrients occurred, too. Diets of kindergartens indicate deficits in micronutrient intake, particularly of *calcium, iron, iodine, folic acid*, *vitamin A*, *vitamin C*. This is due to inadequate intake and also due to limited food diversity. It was observed that foods served in kindergartens of Kosovo are not nutrient balanced and the access to the appropriate dietary habits is missing too. Since there are no previous data or reports of micronutrient intake by preschool aged children in Kosovo, the dietary intake results from this study were compared mostly with reference values for nutrition intake recommended by German, Austrian and Swiss societies for nutrition.

Insufficient calcium intake was caused by limited consumption of milk and milk products. It was observed that many children did not want to consume milk. Low intake of *calcium* in childhood may be critical having in mind the essential role of *calcium* in bone and tooth formation, prevention of different disorders but also regulation of body weight (19-21).

These results indicate that consumption of high *sodium* by preschool children in kindergartens is very critical and should be reduced because even though childhood is not the target group for hypertension disease, the adult consumption behaviour is established at that stage. *Sodium* sources were from cooking, and also from processed foods, bread, sausages and other sources. High levels of *sodium* intake by all ages remain prevalent around the world and despite this, only a few countries are making efforts to reduce the consumption (22). High *sodium* intake can lead to hypertension which causes cardiovascular diseases and WHO predicts that by 2025 the number of people suffering from hypertension will increase to 60 percent (23, 24). Findings of this study are in line with many other research studies that have reported the increase in *sodium* intake. A survey of sodium intake of preschool children in USA and Canada reveals high consumption level of *sodium*. The same conclusions have also derived from other studies (25-27). Despite high intake of *sodium* (which mostly come from salt consumption) by children attending kindergartens in Kosovo, the low level of *iodine* may be due to consumption of not iodized salt and low intake of food with a higher content of *iodine.* The deficiency of iodine, iron and *vitamin A* in women and school children of Kosovo was shown also in the micronutrient status survey in 2001 (28), where half of the women and half of the observed school children had low values of urinary iodine concentration, as well as deficiency of iron and *vitamin A*. *Iron* and *iodine* deficiencies are reported all over the world, especially in developing countries (29). Low *iodine* intake should be of concern having in mind its role for the synthesis

of the thyroid hormones which regulate a number of physiologic processes such as growth, metabolism and reproductive function (30, 31).

On the other side, *iron* deficiency, as the most common nutritional deficiency in the world, may lead to anaemia, poor cognitive development, inefficient transmission of nerve impulses and nucleic acid synthesis (32-34).

Deficiency and low level of *folic acid*, particularly in public kindergartens is most likely due to consumption of micronutrient-poor foods, lack of adjusted dietary folate intake, insufficient consumption of fruit and vegetables, as well as consumption of refined and not diverse foods. *Folic acid* is an essential vitamin and is important for production and maintenance of new cells and amino acid metabolism, thus it is critical during periods of child growth and development (35, 36).

These results are in line with many other studies worldwide which report micronutrient deficiencies or micronutrient malnutrition, mostly in developing countries (37, 38), and with findings which show the inadequate intake of some micronutrients also in developed countries due to consumption of energy-dense but nutrient-poor foods (39-41).

Kosovo is not implementing any program on food fortification like other countries do. WHO and FAO issued Guidelines on food fortification with micronutrients which is used by different countries for development and implementation of fortification programs (42).

Diets of kindergartens indicate deficits in micronutrient intake, particularly of *calcium, iron, iodine, folic acid, vitamin A, vitamin C* in public kindergartens and *vitamin D*, as well as exceeded intake of *sodium*. Observed deficiencies in intake of several micronutrients should be addressed and there is a need for multi-dimensional studies of preschool aged children in various parts of Kosovo to confirm the data obtained in the present study.

The limitation of this study is that kindergartens in Kosovo have capacities to receive only a part of the preschool aged children (less than 10%), so the results, may not be indicative of the all preschool aged children living in the country. Next limitation of this study is that micronutrient intake assessment included breakfast meal, lunch meal and afternoon snack, while data of food consumption after kindergartens hours were not collected.

Further researches are needed to identify health status and diet quality, as well as studies which would assess the health effects of children's dietary pattern in childhood.

Acknowledgements

The authors would like to acknowledge the contribution of Dr. Sanije Hoxha for her advice and support during data processing. The authors acknowledge also the children of five kindergartens, parents, teachers, cooking ladies and directors.

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Correspondence:
Agim Rysha
Department of Food Technology, Faculty of Agribusiness,
University of Pejë,
Rr."UÇK-së" 30000 Pejë, Kosovo
Phone: + 383 (0) 44 121 271
E-mail: agim.rysha@unhz.eu