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Assessment of vitamins and minerals content in the diets of preschool children

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Abstract

Introduction

A proper, varied diet is indispensable to ensure the correct growth and development of children. Nutrition of this period of life also affects health status in adulthood. Evaluation of nutritional status in this vulnerable group can provide significant information, some of which will be applicable to the entire community. Findings can provide suggestions for measures that can be instituted to alleviate the problems observed and to improve nutritional status.

Aim

To assess the intake of selected vitamins and minerals by preschool-age children.

Material & methods.

The study population comprised 102 children aged 4 years (46 girls and 56 boys). The intake of vitamins and minerals was assessed by using the 24-h dietary recall for 3 days. The results were compared with the Polish EAR and AI levels.

Results

Total calcium and vitamin D, as well as vitamin E intakes did not meet the Estimated Average Requirements (EAR) among both groups of children. The mean intake of calcium values 10%, vitamin D 72% and vitamin E 75% of EAR respectively. Also the water intake was insufficient according to EAR

Conclusion

Study confirmed that diets of preschool children, in context of vitamin and mineral contents, need urgent modification to prevent many chronic diseases related to diet in the future.

Key words: preschool-age children, vitamins, minerals, dietary reference intake

Introduction

A healthful diet containing appropriate amounts of macronutrients and micronutrients can help ensure the normal growth and development of children. Furthermore, it helps prevent the development of obesity and related chronic diseases in adulthood [1, 2]. As both deficiencies and excesses in energy and nutrients disturb metabolic homeostasis, inadequate supply of vitamins and minerals resulting in malnutrition and deterioration of health condition, among others, disorders of the nervous system, immune system, circulation or development of bone tissue [3]. Although there are many vitamins and minerals required for good health status, particular attention should be given to the children consume proper amounts of calcium, vitamin D and iron [4]. Most vitamins and minerals diet deficiency are caused by a lack of varied diet and unhealthy eating habits, as well as abnormalities of diet qualitative and quantitative composition [5]. Evaluation of nutritional status in this vulnerable group can provide significant information, some of which will be applicable to the entire community. Findings can provide suggestions for measures that can be instituted to alleviate the problems observed and to improve nutritional status. The purpose of the present study was to assess the vitamin and mineral content in the daily food intake of preschool children.

Material and methods

The study was conducted at the turn of 2015 and 2016 in public kindergartens in Kielce. Total dietary interviews were obtained for 120 children, but the analysis covered 102 of them (56 boys and 46 girls), 18 children were excluded due to lack of complete data. Nutritional status of children rated based on features (weight and body height) and anthropometric indicators (BMI) for centile charts (WHO normal weight - 5 to 85 percentile, overweight - from 85 to 95 percentile, obesity - over 95 percentile). The intake of vitamins and minerals was assessed by using the 24-h dietary recall for 3 days. The serving sizes were specified in common polish household units and weight in grams. The results were compared with the Polish EAR and AI levels. The content of vitamins and minerals was calculated by using the Diet 5 software. Nutrient intakes were compared with dietary reference values [6]. In order to evaluate whether the participants had sufficient intake levels to meet the daily nutrient requirements, the values were calculated for the following nutrients: vitamin A, vitamin D, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate/folic acid, vitamin B12, sodium, potassium, calcium, phosphorus, magnesium, iron, zinc, copper, iodine, and manganese. Dietary intakes of the participants were expressed as the means (X) and standard deviations (SD), medians (Me), and the range of quartiles 1 and 3 (Q1-Q3), due to skewed distribution of some of the analyzed nutritional variables. Mann–Whitney test was used to compare two groups of children with normal BMI and children with excess body weight. Significance level of 0.05 was used, and statistical analyses were performed using STATISTICA software.

Results

Table 1 presents vitamin and mineral intakes in all of the studied children. Nutritional assessment with regard to energy and macronutrient intake of the studied children were presented in the previous article [8]. In current study there was no statistically significant difference between the groups of children with normal BMI and children with excess body weight with respect to vitamins and minerals intake.

Total calcium and vitamin D, as well as vitamin E intakes did not meet the Estimated Average Requirements (EAR) among both groups of children. The mean intake of calcium values 10%, vitamin D 72% and vitamin E 75% of EAR respectively. Also the water intake was insufficient according to EAR, as it values only 75 % of this Dietary Reference Intake.

Intakes of sodium, potassium and phosphorus were too high in both groups of children and values 214 %, 187 % and 203 % of EAR.

Table 2 shows the average intake of vitamin and mineral among children with normal BMI and children with excess body weight separately. It should be mentioned that nutrient densities for all vitamins and minerals were higher in children with excess body weight, however, these results did not reach statistical significance.

Table 1. Average vitamin and mineral intake in examined group in reference to standard

	Children (total)			Standard
	X (SD)	ME	(Q1-Q3)	EAR/ AI*
Na [mg]	2209,20 (497,436)	2147,20	1859,24-2460,48	1000*
K [mg]	2060,20 (480,342)	2062,25	1806,12-2349,05	1100*
Ca [mg]	577,59 (187,221)	577,93	422,31-687,96	800
P [mg]	836,52 (182,438)	834,34	698,24-963,49	410
Mg [mg]	188,14 (42,413)	181,63	160,35-212,21	110
Fe [mg]	7,60 (2,541)	7,37	6,20-8,40	4
Zn [mg]	6,03 (1,934)	5,79	4,89-6,79	4
Cu [mg]	0,78 (0,278)	0,75	0,61-0,89	0,3
Mn [mg]	1,98 (0,589)	1,90	1,53-2,36	1,5*
J [□g]	109,31 (37,349)	105,32	82,87-128,31	65
Vitamin A [□g]	1029,99 (533,358)	959,64	712,29-1251,45	300
Retinol [□g]	270,08 (234,514)	237,43	188,28-292,65	
Beta-carotene [□g]	4371,76 (2776,624)	3931,55	2395,50-5816,99	
Vitamin E [mg]	5,56 (3,798)	4,52	3,59-6,56	6*
Vitamin B1 [mg]	0,89 (0,539)	0,80	0,64-0,95	0,5
Vitamin B2 [mg]	1,36 (0,415)	1,30	1,05-1,63	0,5
Vitamin B3 [mg]	10,84 (3,791)	10,22	8,24-13,19	6
Vitamin B6 [mg]	1,34 (0,404)	1,31	1,04-1,50	0,5
Vitamin C [mg]	75,83 (41,785)	68,43	40,74-97,78	40
Folate (Vitamin B9) [□g]	172,42 (81,354)	163,11	134,68-189,25	160
Vitamin B12 [□g]	2,53 (1,217)	2,26	1,79-2,93	1
Vitamin D [□g]	2,47 (2,955)	1,59	1,13-2,52	15*
Water [g]	1205,15 (321,262)	1181,15	984,37-1379,17	1600*

Table 2. Average vitamin and mineral intake in reference to children with normal BMI and children with excess body weight.

	Children with normal BMI			Children with excess body weight			Z*	p*
	X (SD)	ME	(Q1-Q3)	X (SD)	ME	(Q1-Q3)		
Na [mg]	2195,75 (514,11)	1827,24	1827,24-2444,22	2276,47 (410,62)	2223,81	1980,45-2669,16	-0,86200	0,388686
K [mg]	2096,11 (469,50)	1815,59	1815,59-2357,03	1880,68 (508,05)	2007,49	1357,74-2200,51	1,31994	0,186855
Ca [mg]	583,89 (181,11)	433,37	433,37-686,04	546,10 (218,63)	557,83	329,03-687,96	0,68242	0,494974
P [mg]	841,27 (180,13)	712,77	712,77-963,49	812,78 (197,56)	844,61	648,70-949,50	0,44896	0,653460
Mg [mg]	190,53 (42,15)	161,98	161,98-212,21	176,18 (42,94)	188,17	139,28-207,21	0,96078	0,336666
Fe [mg]	7,55 (2,51)	6,33	6,33-8,40	7,85 (2,74)	7,51	5,93-8,20	-0,10775	0,914194
Zn [mg]	5,98 (1,93)	4,84	4,84-6,67	6,26 (2,00)	5,73	5,35-6,97	-0,58365	0,559457
Cu [mg]	0,80 (0,29)	0,62	0,62-0,93	0,68 (0,17)	0,69	0,55-0,80	1,68809	0,091395
Mn [mg]	2,00 (0,61)	1,54	1,54-2,36	1,86 (0,46)	1,79	1,47-2,20	0,59263	0,553431
J [□g]	108,65 (36,00)	85,08	85,08-124,16	112,57 (44,57)	106,38	74,12-139,90	-0,14367	0,885763
Vitamin A [□g]	1041,02 (556,13)	730,46	730,46-1249,23	974,86 (410,00)	879,28	712,29-1279,58	0,14367	0,885763
Retinol [□g]	274,20 (253,94)	188,28	188,28-291,05	249,47 (89,80)	264,92	193,50-293,77	-0,56569	0,571605
Beta-carotene [□g]	4448,37 (2902,65)	2662,24	2662,24-5712,78	3988,66 (2060,78)	4092,16	2395,50-5927,90	0,32325	0,746505
Vitamin E [mg]	5,54 (3,89)	3,65	3,65-6,56	5,66 (3,39)	4,85	3,38-6,56	0,00000	1,000000
Vitamin B1 [mg]	0,86 (0,48)	0,64	0,64-0,94	1,03 (0,76)	0,78	0,63-1,07	-0,54773	0,583876
Vitamin B2 [mg]	1,37 (0,40)	1,06	1,06-1,63	1,33 (0,49)	1,27	1,02-1,45	0,54773	0,583876
Vitamin B3 [mg]	10,85 (3,96)	8,24	8,24-12,95	10,74 (2,87)	10,20	8,99-13,19	-0,28733	0,773856
Vitamin B6 [mg]	1,35 (0,41)	1,05	1,05-1,52	1,28 (0,37)	1,22	1,00-1,44	0,63752	0,523784
Vitamin C [mg]	76,77 (41,04)	45,87	45,87-98,87	71,15 (46,38)	60,42	32,39-90,36	0,76323	0,445325
Folate (Vitamin B9) [□g]	174,40 (85,27)	135,60	135,60-189,19	162,54 (58,98)	151,92	127,25-194,79	0,74527	0,456106
Vitamin B12 [□g]	2,57 (1,24)	1,87	1,87-2,91	2,36 (1,14)	2,16	1,50-2,93	0,78119	0,434691
Vitamin D [□g]	2,42 (3,02)	1,13	1,13-2,52	2,72 (2,66)	2,02	1,12-2,39	-0,50284	0,615080
Water [g]	1197,01 (264,06)	1171,22	1010,37-1357,33)	1245,84 (532,28)	1200,82	892,54-1379,17	0,26938	0,787640

**Z – normal distribution*

**p - statistical significance*

Discussion

The obtained data shows very low intake of vitamin D, vitamin E and calcium. Vitamin D deficiency is a worldwide health problem and has been associated with rickets and osteoporosis [9], greater risk of heart disease, diabetes (both type 1 and type 2), cancer, dementia and autoimmune diseases like multiple sclerosis [10].

Inadequate intake of vitamin D in preschool children was observed also by other authors [11-16]. In a Polish nationwide study conducted by Charzewska and Weker [17], it has been shown that over 90% of children suffer from chronic deficiency of vitamin D in the diet, which is mainly due to the low level of nutritional education of adults responsible for children' nutrition [17, 18].

The mean vitamin E intake was lower than the EARs in all children, similar to what was presented in other preschoolers [13, 19, 20]. Vitamin E is a powerful antioxidant that may help reduce free radical damage and slow the aging process of cells [21]

Total calcium intake was the lowest among the mineral nutrients analyzed in this study and it is confirmed with some other studies [12, 20, 22]. As calcium is essential to overall health, especially bone mineralization, heart health, muscle function and nerve signaling [23], it insufficient intake can lead to serious chronic diseases.

Water is a macronutrient that has an important role in proper bodily system functioning as it provides a majority of body weight and is involved in many important functions, including regulating body temperature, brain function and metabolism [24]. In current study the preschoolers' diets were inadequate due to total water intake, that correspond to other authors data [12, 16, 20, 22].

The iron intake was adequate for studied children and values 190 % of EAR, and what is more, it reached 74% of Recommended Dietary Allowance (RDA) for 4-6-yearolds [6]. These data are similar to other study findings [12, 27]. Conversely, some authors [4, 19, 28, 29, 30] showed insufficient intake of this micronutrient. Iron deficiency is the most common nutritional disorder in the world that lead to serious health complications, thus it is very important, especially for young children, to provide appropriate iron intake from diet. The high intake of iron from studied children's diets was due to their consumption of large quantities of iron-rich foods such as red meat, eggs, green leafy vegetables, whole grains and cocoa. Some participants also ate iron-fortified products like cereal, cocoa, formula milk or baby porridge.

Sodium intake exceeded the AI for studied children age group. Therefore, the negative health effects of high sodium intakes should be taken into consideration, as eating habits developed in childhood translate to eating patterns in adulthood. The problem of inadequate sodium intake is a widespread problem, which is confirmed also by many other researches [12, 13, 20, 31, 32].

Conclusion

In conclusion, this paper provides recent data on the dietary, daily vitamin and mineral intake of preschool children form Kielce, Poland. The results of the study indicate that diets of preschool children in context of vitamin and mineral contents, need urgent modification to prevent many chronic diseases related to diet in the future. Parents' nutrition education and more intervention programs are needed to avert micronutrient deficiency and development of inappropriate eating habits early in life.

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Authors' contributions

ES designed the study, participated in the statistical analysis and reviewed the manuscript. EC participated in the statistical analysis, reviewed the manuscript and collected data from studied group. MJP analyzed and interpreted the nutrition data and wrote the manuscript. All authors read and approved the final manuscript.

References

1.World Health Organization. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation. Geneva, World Health Organization, 2003.

2.Melanson K.J.: Lifestyle Approaches to Promoting Healthy Eating for children. AJLM 2008; 2: 26-29.

3.Wolnicka K., Jaczewska-Schuetz J.: Stan odżywienia a nawyki żywieniowe wśród dzieci w wieku szkolnym z Warszawy. Post. N. Med. 2011, 9, 724-31

4.Kehoe L., Walton J., McNulty B.A., Nugent A.P. & Flynn A. (2017) Dietary strategies for achieving adequate vitamin D and iron intakes in young children in Ireland. J Hum Nutr Diet. 30, 405–416 doi: 10.1111/jhn.12449

5.Stoś K., Przygoda B., Jarosz M.: Znaczenie żywności wzbogacanej i suplementów diety w zwalczaniu niedożywienia. Żyw. Człow. Metab., 2012, 4, 265-275.

6.Normy żywienia dla populacji Polski – nowelizacja. Red.: Jarosz M. Wyd. IŻŻ, Warszawa 2017.

7.Zasady prawidłowego żywienia dzieci i młodzieży oraz wskazówki dotyczące zdrowego stylu życia Red: prof. dr hab. n. med. Mirosław Jarosz Warszawa 2008

8.Suliga E, Cieśla E, Zemlik J, Pietraszkiewicz MJ. Evaluation of nutrition in children of preschool age. Journal of Education, Health and Sport 2017; 7 (10), 52-58

9.Love C. The role of diet in the prevention of osteoporosis. J Orthop Nursing. 2002;6:101–10

10.Holick MF, Chen TC. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr. 2008 Apr;87(4):1080S-6S.

11.Cribb VL, Northstone K, Hopkins D, Emmett PM. Sources of vitamin D and calcium in the diets of preschool children in the UK and the theoretical effect of food fortification. J Hum Nutr Diet. 2015 Dec;28(6):583-92. doi: 10.1111/jhn.12277. Epub 2014 Oct 3.

12.López-Sobaler AM, Aparicio A, González-Rodríguez LG, et al. Adequacy of Usual Vitamin and Mineral Intake in Spanish Children and Adolescents: ENALIA Study. Nutrients. 2017;9(2):131. doi:10.3390/nu9020131.

13.Huybrechts I, De Henauw S: Energy and nutrient intakes by pre-school children in Flanders-Belgium. Br J Nutr. 2007, 98: 600-610. 10.1017/S000711450773458X.

14.Merkiel, S. & Chalcarz, W. Dietary intake in 6-year-old children from southern Poland: part 2 – vitamin and mineral intakes. BMC Pediatr (2014) 14: 310. https://doi.org/10.1186/s12887-014-0310-7

15.Walton J, Kehoe L, McNulty BA, Nugent AP, Flynn A. Nutrient intakes and compliance with nutrient recommendations in children aged 1-4 years in Ireland. J Hum Nutr Diet. 2017 Oct;30(5):665-676. doi: 10.1111/jhn.12452. Epub 2017 Feb 2.

16.Goldbohm, R. Alexandra; Rubingh, Carina M.; Lanting, Caren I.; et al. Food Consumption and Nutrient Intake by Children Aged 10 to 48 Months Attending Day Care in The Netherlands. Nutrients 2016, 8, 428; doi:10.3390/nu8070428.

17.Charzewska J, Weker H. Ogólnopolskie badanie nad zawartością wapnia i witaminy D w dietach dzieci w wieku4lat. Pediatr Współcz Gastroenterol Hepatol Żywienie Dziecka. 2006; 8, 2, 107-109;

18.Chwojnowska Z., Charzewska J., Błędy w żywieniu dzieci w wieku przedszkolnym, [w:] Rekomendacje dla realizatorów żywienia z zakresu zasad prawidłowego żywienia dzieci w przedszkolach, red. J. Charzewska, IŻŻ, 2011

19.Kyttala P, Erkkola M, Kronberg-Kippila C, Tapanainen H, Veijola R, Simell O, Knip M, Virtanen SM. Food consumption and nutrient intake in Finnish 1-6-year-old children. Public Health Nutr. 2010, 13, 947–956.

20.Sylwia Merkiel, Wojciech Chalcarz. Preschool diets in children from Piła, Poland, require urgent intervention as implied by high risk of nutrient inadequacies. Journal of Health, Population and Nutrition (2016) 35:11 DOI 10.1186/s41043-016-0050-4

21.Traber MG. Vitamin E. In: Shils ME, Shike M, Ross AC, Caballero B, Cousins R, eds. Modern Nutrition in Health and Disease. 10th ed. Baltimore, MD: Lippincott Williams & Wilkins, 2006;396-411.

22.Merkiel-Pawłowska S, Chalcarz W. Gender differences and typical nutrition concerns of the diets of preschool children – the results of the first stage of an intervention study. BMC Pediatrics. 2017;17:207. doi:10.1186/s12887-017-0962-1.

23.Peterlik M, Kállay E, Cross HS. Calcium Nutrition and Extracellular Calcium Sensing:Relevance for the Pathogenesis of Osteoporosis, Cancer and Cardiovascular Diseases. Nutrients. 2013;5(1):302-327. doi:10.3390/nu5010302.

24.Riebl SK, Davy BM. The Hydration Equation: Update on Water Balance and Cognitive Performance. ACSM's health & fitness journal. 2013;17(6):21-28. doi:10.1249/FIT.0b013e3182a9570f.

25.Michael Boschmann, Jochen Steiniger, Gabriele Franke, Andreas L. Birkenfeld, Friedrich C. Luft, Jens Jordan; Water Drinking Induces Thermogenesis through Osmosensitive Mechanisms, The Journal of Clinical Endocrinology & Metabolism, Volume 92, Issue 8, 1 August 2007, Pages 3334–3337, https://doi.org/10.1210/jc.2006-1438

26.Weisstaub G, Hertrampf E, López de Romaña D, Salazar G, Bugueño C, Castillo-Duran C. Plasma zinc concentration, body composition and physical activity in obese preschool children. Biol Trace Elem Res 2007;118:167–74.

27.Ahluwalia, N.; Herrick, K.A.; Rossen, L.M.; Rhodes, D.; Kit, B.; Moshfegh, A.; Dodd, K.W. Usual nutrient intakes of us infants and toddlers generally meet or exceed dietary reference intakes: Findings from NHANES 2009–2012. Am. J. Clin. Nutr. 2016, 104, 1167–1174.

28.Cotta RMM, Oliveira FCC, Magalhães KA, Ribeiro AQ, Sant'Ana LFR, Priore SE, et al. Social and biological determinants of iron deficiency anemia. Cad Saúde Pública. 2011;27(2):s309-20. https://doi.org/10.1590/S0102-311X2011001400017

29.Tympa-Psirropoulou E, Vagenas C, Dafni O, Matala A, Skopouli F. Environmental risk factors for iron deficiency old in the area of Thessalia in Greece. Hippokratia. 2008;12(4):240-50.

30.Ayoya MA, Ngnie-Teta I, Séraphin MN, Mamadoultaibou A, Boldon E, Saint-Fleur JE, et al. Prevalence and risk factors of anemia among children 6-59 months old in Haiti. Anemia. 2013;2013:502968. https://doi.org/10.1155/2013/502968

31.Wang H, Wang D, Ouyang Y, Huang F, Ding G, Zhang B. Do Chinese Children Get Enough Micronutrients? Nutrients 2017, 9, 397; doi:10.3390/nu9040397

32.Wang DT, van der Horst K, Jacquier EF, Afeiche MC, Eldridge AL. Snacking Patterns in Children: A Comparison between Australia, China, Mexico, and the US. Nutrients 2018, 10, 198; doi:10.3390/nu10020198.