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Intake of Selected Minerals in Daily Food Rations of the Elderly

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Abstract: The aim of this paper was to analyze the levels of selected minerals consumption by the elderly. The investigation was carried out in May and June of 1999 with people between 75 and 80 years of age permanently living in urban and rural areas and small towns of the province of Warmia and Mazury. In total, 160 males and 194 females were examined. The average consumption of nutrients was estimated by the 24-hour interview method. After including the standard loss, it was compared with a consumption norm on a safe level. The average consumption of the selected minerals i.e. Mg, Zn and Cu was compared between the sex and environment groups including the selected classes of norm completion (2/3, 90 and 110%). The average consumption of magnesium, zinc and copper was obtained for 54-59, 61 and 81-96% of the examined people respectively. This indicates the high risk of minerals insufficiency (below 2/3 of the norm). The largest percentage of people (65-91% of the examined) endangered with the insufficiency of the analyzed micro-and macro elements was obtained among the males and the females living in a small town.

Key words: Daily intake, magnesium, zinc, copper, elderly

Introduction

Dietary research of different groups of people, carried out systematically, enabled rather accurately to learn and value their dieting (Chwojnowska *et al.*, 1992; Przyslawski *et al.*, 1998; Sygnowska *et al.*, 1997; Ziemiański *et al.*, 1997; Seidel *et al.*, 1991; Alvarez-Pineiro *et al.*, 1998). Against this background the information about dieting of the elderly still remains fragmentary. This state is particularly worrisome in the matter of fact about ageing of the population (Raport, 1994), which is a serious demographic and social-health problem both in the world and in the country. The essential element influencing on good health condition and setting back the involution is rational dieting (Garry *et al.*, 1992; Schlettwein-Gsell *et al.*, 1991; Widdowson *et al.*, 1992). Both too low intake of nutrients, including macro and micro nutrients, and exceeding the maximum level, disturbs organism functions causing numerous illnesses (Zajac, 2000; Chabros *et al.*, 1998; Ziemiański *et al.*, 1998; Vellas *et al.*, 1997). The aim of the work was the analysis of selected minerals intake by the elderly.

Materials and Methods

For the research carried out in May and June 1999 six hundred people, aged 75-80, living permanently in urban, rural and parochial habitat of province of Warmia and Mazury, were drawn in Census Department. 160 men with the body mass of 75.5±14.4 kg, BMI of 27.5±4.4 kg/m² and 194 women with the body mass of 70.7±15.5 kg, BMI of 30.0±6.8 kg/m² agreed to participate in the research. The average nutrients consumption was determined with 24-hour recall method (Gibson, 1990; Charzewska

et al., 1997). The interviews were carried out once with each of the examined people in all days of the week, saving the proportions between weekdays and weekends. During the research specially prepared questionnaires and "Album produktów o zróżnicowanej wielkości porcji" (Szczygłowa *et al.*, 1982) were used. The results were analyzed using the computer program "Żywnienie", which was elaborated on the basis of "Tabele składu i wartości odżywczej produktów spożywczych" (Kunachowicz *et al.*, 1998). The obtained so nutrients intake, after including the standard losses (10%), was compared with the RDI for the safe level (Ziemiański *et al.*, 1994), accepting for each of the examined people actual body mass and small physical activity. Both in sex and environmental groups the average intake of selected minerals i.e. Mg, Zn and Cu was compared, including selected groups of the RDI realization. 2/3, 90 and 110% of the RDI were determined as borderlines. The statistical analysis of the results was executed with the program "Statistical v.5.5 PL", with the level of significance $p \leq 0.05$. The comparison of the average values and the differentiation of collocation of women and men hailing from different environments in selected minerals consumption classes were verified on the basis of variance analysis and χ^2 test.

Results

In the group of examined men, in comparison to women, a significantly higher ($p \leq 0.05$) realization of RDI for energy (correspondingly 91 and 79% of the RDI), protein (115 and 95% of the RDI) and fat (125 and 101% of the RDI) was stated (Table 1). In both sex groups too low extend of RDI realization for carbohydrates (81% of the

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Table 1: The analyzed nutrients intake and per cent of the RDI realization in group of examined people

	Males								Females								Sex	Difference statistically significant	
	Total N=160								Total N=194										
	Environment								Environment										
	City (1) N=51		Town (2) N=46		Country (3) N=63		City (1) N=67		Town (2) N=51		Country (3) N=76		Environment						
x	SD	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD	Males	Females		
Intake:																			
Energy (kcal)	1875	783	1861	580	1491	486	2168	965	1405	558	1414	555	1234	429	1512	614	sign	1-2, 2-3	2-3,
Total protein (g)	67.0	32.0	74.7	26.7	52.4	19.9	71.4	39.3	48.7	23.2	52.7	21.7	45.8	20.7	47.2	25.7	sign	1-2, 2-3	
FAT (g)	71.4	40.3	64.2	26.2	64.9	28.2	82.0	53.4	49.6	26.7	46.0	25.8	48.4	24.5	53.4	28.8	sign	sign	
Carbohydrates (g)	258.0	116.2	265.2	91.8	187.8	62.9	303.3	138.4	202.8	82.5	210.4	83.0	165.1	52.3	221.3	91.0	sign	1-2, 2-3	1-2, 2-3
%energy from protein	14.3	3.5	16.0	3.1	14.1	3.1	13.0	3.6	13.6	3.9	14.9	3.2	14.2	4.5	12.1	3.5	sign	1-2, 1-3	1-3, 2-3
%energy from fat	33.9	9.8	30.9	8.0	38.2	8.6	33.2	10.9	30.6	9.6	28.2	8.4	33.3	9.3	30.9	10.4	sign	1-2, 2-3	1-2,
%energy from carbohydrates	51.4	10.4	52.6	9.1	47.5	9.6	53.4	11.2	54.4	11.5	56.4	9.4	50.3	12.2	55.4	12.2	sign	1-2, 2-3	1-2,
Mg (mg)	246.1	117.8	290.6	147.8	194.7	80.4	247.7	98.5	178.2	74.9	193.2	79.6	167.9	63.9	171.8	76.4	sign	1-2,	
Zn (mg)	9.1	4.2	10.1	3.8	7.4	2.8	9.7	4.9	6.4	2.9	6.7	2.6	6.2	3.0	6.2	3.0	sign	1-2, 2-3	
Cu (mg)	0.98	0.48	1.10	0.48	0.77	0.36	1.04	0.51	0.74	0.33	0.76	0.28	0.77	0.41	0.70	0.31	sign	1-2, 2-3	
Zn:Cu	9.8	2.6	9.6	2.5	10.0	2.5	9.7	2.8	8.8	2.3	8.9	1.9	8.4	2.2	9.0	2.7	sign		
Degree of realization of RDI:ENERGY	91.0	39.3	89.4	28.4	70.7	23.1	107.2	48.5	79.0	32.0	78.4	30.3	70.4	24.8	85.1	36.3	sign	1-2-3,	
PROTEIN	114.6	56.8	127.0	49.8	86.7	32.8	125.0	68.3	94.6	46.6	99.9	40.5	91.7	42.9	91.8	53.6	sign	1-2, 2-3	
FAT	124.6	70.6	111.4	47.0	110.9	48.4	145.3	92.6	100.6	54.7	92.1	51.2	99.9	50.4	108.6	59.6	sign	1-2, 2-3	
Carbohydrates	81.2	38.5	82.2	27.9	57.4	19.7	97.9	46.8	76.0	32.1	77.8	30.4	63.3	21.5	82.9	36.9	sign	1-2, 2-3	1-2, 2-3
Mg	70.3	33.7	83.0	42.2	55.6	23.0	70.8	28.2	63.4	26.8	68.8	28.5	59.6	22.6	61.3	27.4	sign	1-2,	
Zn	65.2	29.7	71.8	27.2	52.7	20.3	68.9	34.7	63.4	28.7	66.7	26.2	61.5	29.5	61.8	30.4	sign	1-2, 2-3	
Cu	48.2	21.4	53.8	20.7	38.3	17.2	51.0	22.4	37.0	16.3	38.2	14.0	38.3	20.2	35.1	15.3	sign	1-2, 2-3	

N – sample size, x – mean value, SD – standard deviation, sign, 1-2, 2-3... – differences statistically significant for $p \leq 0.05$

RDI among men and 76% of the RDI among women), magnesium (correspondingly 70 and 63% of the RDI), zinc (correspondingly 65 and 63% of the RDI) and copper (correspondingly 48 and 37% of the RDI) was stated, however in male group, in comparison to female group, the magnesium and copper consumption was vitally higher (Table 1). Proportional participation of energy from protein was similar for men and women and amounted correspondingly 15 and 14% (Table 1). The percentage of energy from fat was significantly higher among men than among women (correspondingly 34 and 31%), and from carbohydrates significantly lower (correspondingly 51 and 54%). The executed statistical analysis revealed the highest consumption of energy (2168kcal among men and 1512kcal among women), fat (correspondingly 82g and 53g) and carbohydrates (correspondingly 303g and 221g) among people living in the country, whereas protein (correspondingly

75g and 53g) and minerals among people living in the city (Table 1).

In food rations of people inhabiting towns the lowest level of energy was stated: 1234 kcal among women-1491 among men, protein: 46g among women - 52g among men, carbohydrates: 165g among women-188g among men, magnesium: 168mg among women - 195mg among men and zinc: 6.2 mg among women - 7.4mg among men and the highest percent of energy from fat: 33% among women - 38% among men, along with the lowest from carbohydrates: 50% among women-48% among men (Table 1). For all nutrients a differentiation in their intake between men inhabiting city, town and village was confirmed with the statistical methods.

The high values of standard deviation, which measures individual differentiation of the results from the average value, points on the high differentiation in analyzed food products intake. The intake leading to high

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Table 2: Per cent of the population in the selected minerals intake classes

	Total N=160				Males				Total N=194				Females				Difference statistically significant		
	Environment								Environment										
	City (1) N=51		Town (2) N=46		Country (3) N=63		City (1) N=67		Town (2) N=51		Country (3) N=76		City (1) N=67		Town (2) N=51			Country (3) N=76	
	N	%N	N	%N	N	%N	N	%N	N	%N	N	%N	N	%N	N	%N		N	%N
Magnesium																			
less than 66.7% RDI	87	54.4	20	39.2	36	78.3	31	49.2	115	59.3	33	49.3	37	72.6	45	59.2	sex, M-E		
66.7 - 90% RDI	40	25.0	15	29.4	7	15.2	18	28.6	49	25.3	21	31.3	8	15.7	20	26.3			
90 - 110% RDI	14	8.8	7	13.7	0	0.0	7	11.1	24	12.4	11	16.4	5	9.8	8	10.5			
more than 110% RDI	19	11.9	9	17.7	3	6.5	7	11.1	6	3.1	2	3.0	1	2.0	3	4.0			
Zinc																			
less than 66.7% RDI	99	61.9	25	49.0	38	82.6	36	57.1	119	61.3	36	53.7	33	64.7	50	65.8	M-E		
66.7 - 90% RDI	34	21.3	14	27.5	6	13.0	14	22.2	43	22.2	19	28.4	10	19.6	14	18.4			
90 - 110% RDI	14	8.8	7	13.7	1	2.2	6	9.5	20	10.3	9	13.4	4	7.8	7	9.2			
more than 110% RDI	13	8.1	5	9.8	1	2.2	7	11.1	12	6.2	3	4.5	4	7.8	5	6.6			
Copper																			
less than 66.7% RDI	129	80.6	38	74.5	42	91.3	49	77.8	186	95.9	67	100.0	45	88.2	74	97.4	sex, F-E		
66.7 - 90% RDI	22	13.8	10	19.6	3	6.5	9	14.3	6	3.1	0	0.0	4	7.8	2	2.6			
90 - 110% RDI	7	4.4	2	3.9	1	2.2	4	6.4	2	1.0	0	0.0	2	3.9	0	0.0			
more than 110% RDI	2	1.3	1	2.0	0	0.0	1	1.6	0	0.0									

N – sample size,; %N – per cent of population. sex – differences statistically significant for $p \leq 0.05$, in sex group. M-E – differences statistically significant for $p \leq 0.05$, in male group, according to the environment. F-E – differences statistically significant for $p \leq 0.05$, in female group, according to the environment

deficiency risk (below 2/3 of the RDI) was stated in relation to magnesium among 54-55% of the population, to zinc - 61% of the population and to copper - 81-96% of analyzed people (Table 2). Among these people the average magnesium intake equaled 170-173 mg/day, zinc intake 6.5-6.6 mg/day and copper intake 0.80-0.84 mg/day (Table 3), what realized the recommendations of analyzed group of people correspondingly in 46-49, 45-47 and 35-40% of the RDI (Table 4). The intake of discussed minerals, showing unprofitable dietary habits (on the level of 2/3-90% of the RDI), was stated correspondingly among 25, 21-22 and 3-14% of the people. The average intake in the range of proper values (90-110% of the RDI) was stated among as few as 9-12% of the people for magnesium, among 9-10% of the people for zinc and 1-4% of the people of copper. The high magnesium, zinc and copper intake (over 110% of the RDI) was stated correspondingly among 3-12, 6-8 and 0-1% of analyzed people (Table 2). The analyzed minerals intake in this group of people did not exceed advises in more than 40% in the case of magnesium, 30% in the case of zinc and 20% in the case of copper (Table 4). The analysis of these minerals intake depending on the place of living revealed the highest percent of people (65-91% of analyzed people) endangered with their deficiency among townspeople, and higher percentage of deficiency endangered was stated among men

(Table 2).

Discussion

Modern food rations in developed countries differ much from physiological dietary system. There are plenty of protein (especially animal), fat (mainly unsaturated) and carbohydrates highly refined in them, they contain too little amounts of fibre, some vitamins and minerals (Keys, 1984; Ziemiński, 1994; Sygnowska *et al.*, 1997; Alvarez-Pineiro *et al.*, 1998). This state causes specified health consequences, which may cause, especially among the elderly, a syndrome named metabolic civilization diseases (Szostak and cybulska, 1990; WHO, 1990).

The analyzed elderly people food rations differed from dietary recommendations for this population group. The RDI realization lower by 21% for the energy and by 24% for carbohydrates stated among women, despite rather correct structure of energetic components intake (14% of energy from protein, 31% of energy from fat, 54% of energy from carbohydrates), was also connected with low (on the level of 60% of the RDI for Mg and Zn and 40% of the RDI for Cu) analyzed minerals intake in daily food rations. The analysis in environmental groups showed the least correct energy intake structure along

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Table 3. The average minerals intake in selected classes

	Total N=160				Males				Total N=194				Females							
					Environment								Environment							
					City N=51		Town N=46		Country N=63						City N = 67		Town N = 51		Country N = 76	
	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD		
Magnesium																				
less than 66.7% RDI	(1)	170.7	43.9	180.2	36.2	163.3	44.6	173.0	47.4	129.6	40.2	131.3	43.5	138.3	40.0	121.2	36.9			
66.7 - 90% RDI	(2)	268.1	22.6	273.0	22.3	259.1	21.9	267.6	23.1	217.9	19.1	224.0	13.9	216.5	24.7	212.0	20.5			
90 - 110% RDI	(3)	337.4	16.6	345.9	18.2	0.0	0.0	328.8	9.8	275.1	12.9	274.6	11.0	271.6	17.6	278.0	13.2			
more than 110% RDI	(4)	478.2	142.2	522.4	195.5	420.7	14.6	446.1	61.8	397.3	56.6	444.7	83.8	357.1	0.0	379.1	30.7			
Difference statistically significant		sign.				sign.		sign.		sign.		sign.		sign.		sign.				
		1-2-3-4				1-2-3-4		1-2-3-4		1-2-3-4		1-2-3-4		1-2, 1-3, 1-4, 2-4		1-2-3-4				
Zinc less than 66.7% RDI	(1)	6.57	1.70	6.94	1.52	6.40	1.79	6.50	1.72	4.56	1.44	4.73	1.62	4.48	1.34	4.50	1.39			
66.7 - 90% RDI	(2)	10.92	1.09	11.02	1.03	10.97	1.30	10.80	1.14	7.84	0.75	8.13	0.67	7.57	0.79	7.64	0.74			
90 - 110% RDI	(3)	14.06	0.74	13.92	0.80	14.01	0.00	14.24	0.75	9.97	0.59	9.82	0.55	9.95	0.74	10.18	0.58			
more than 110% RDI	(4)	18.55	3.79	17.53	1.85	16.22	0.00	19.62	4.84	13.08	1.97	12.02	0.58	13.28	1.59	13.55	2.73			
Difference statistically significant		sign		sign		sign		sign		sign		sign	1-2, 1-3,	sign		sign				
		1-2-3-4		1-2-3-4		1-2, 1-3, 1-4		1-2-3-4		1-2-3-4		1-4, 2-3, 2-4		1-2-3-4		1-2-3-4				
Copper less than 66.7% RDI	(1)	0.80	0.25	0.88	0.23	0.68	0.20	0.84	0.27	0.70	0.27	0.76	0.28	0.64	0.22	0.68	0.27			
66.7 - 90% RDI	(2)	1.50	0.10	1.51	0.12	1.55	0.07	1.47	0.08	1.54	0.07			1.53	0.08	1.56	0.06			
90 - 110% RDI	(3)	2.13	0.31	2.19	0.43	2.23	0.00	2.08	0.35	2.03	0.11			2.03	0.11					
more than 110% RDI	(4)	3.01	0.15	2.91	0.00			3.12	0.00											
Difference statistically significant		sign		sign	1-2, 1-3,	sign		sign		sign				sign		sign				
		1-2-3-4		1-4, 2-3, 2-4		1-2-3		1-2-3-4		1-2, 1-3				1-2, 1-3						

N – sample size, x – mean value, SD – standard deviation, sign, 1-2, 2-3... – differences statistically significant for p≤0.05

with the lowest content of both energetic nutrients and Mg (56% of the RDI), Zn (53% of the RDI) and Cu (38% of the RDI) in analyzed men living in town daily food rations.

Summarizing, the food rations of selected sub-populations, among which the amount and structure of consumed energetic components were closer to the advised, characterized higher analyzed minerals intake level, what is also confirmed by the research carried out by Nicklas, 2000; Gordon and Mickinney 1995; Przyslawski and Gertig, 1997.

Low minerals intake is typical for the average food ration in the Polish population, what is confirmed by other authors research results. The deficiency of minerals intake was stated among children in school age (Przyslawski *et al.*, 1998), adults (Rutkowska *et al.*, 1994, 2000) and the elderly (Kaluza and Brzozowska, 2000; Wierzbicka and Roszkowski, 2000). Similar deficiencies of daily food rations in other countries were stated by Chung-Ja-Sung and Young-Hwa-Yoon (2000); Gariballa and Sinclair (1998). However, the research carried out by Cals *et al.* (1997) revealed satisfying levels of

analyzed minerals among active and health caring elderly people.

The unprofitable character of analyzed elderly people daily food rations intensifies the fact that the RDI was accomplished below 2/3 of the safe level among 54-61% of population in case of Mg and Zn and 81-96% for Cu. From epidemiological point of view these data show the possibility of potential menace of these minerals deficiency. Among the elderly it may come to higher deficiency of minerals owing to the occurrence of dysfunction of digestion, intussusception and metabolism disorders (Ziemiański *et al.*, 1998). The longer remaining deficiency of analyzed essential nutrients in diet may result in serious consequences in the form of specific-for given nutrient-illnesses and disorders conducive to progress of civilization illnesses, such as sclerosis, osteoporosis, some forms of neoplasm diseases or diabetes (Gawecki and Hryniewiecki, 1998; Lukasiak *et al.*, 1998; Bialkowska *et al.*, 1985).

Conclusion: The daily food ration of analyzed elderly people characterized

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Table 4: The RDI realization percentage in selected minerals intake classes

		Total N = 160		Males						Total N = 194		Females					
		Environment															
				City N=51		Town N=46		Country N=63				City N=67		Town N=51		Country N=76	
		x	SD	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD
Magnesium																	
less than 66.7% RDI	(1)	48.8	12.6	51.5	10.3	46.7	12.8	49.4	13.6	46.0	14.0	46.5	15.0	48.9	13.5	43.1	13.3
66.7 - 90% RDI	(2)	76.6	6.4	78.0	6.4	74.0	6.3	76.5	6.6	77.8	6.8	80.0	5.0	77.3	8.8	75.7	7.3
90 - 110% RDI	(3)	96.4	4.7	98.8	5.2	0.0	0.0	94.0	2.8	98.3	4.6	98.1	3.9	97.0	6.3	99.3	4.7
more than 110% RDI	(4)	136.6	40.6	149.2	55.9	120.2	4.2	127.5	17.6	141.9	20.2	158.8	29.9	127.5	0.0	135.4	11.0
Difference statistically significant		sign		sign	1-2, 1-3	sign	1-2-3-4	sign	1-2-3-4	sign	1-2-3-4	sign	1-2-3-4	sign	1-2, 1-3, 1-4, 2-4	Sign.	1-2-3-4
Zinc																	
less than 66.7% RDI	(1)	46.95	12.12	49.60	10.89	45.70	12.77	46.43	12.27	45.33	14.16	46.72	15.34	44.80	13.39	44.69	13.99
66.7 - 90% RDI	(2)	78.02	7.81	78.74	7.35	78.39	9.31	77.14	8.12	77.75	7.30	81.27	6.67	73.00	5.20	76.38	7.36
90 - 110% RDI	(3)	100.44	5.25	99.41	5.74	100.08	0.00	101.69	5.36	99.69	5.92	98.18	5.54	99.46	7.40	101.76	5.83
more than 110% RDI	(4)	132.53	27.10	125.20	13.23	115.88	0.00	140.14	34.55	130.80	19.73	120.17	5.78	132.84	15.94	135.54	27.32
Difference statistically significant		sign		sign		sign	1-2,	sign	1-2-3-4	sign	1-2-3-4	sign	1-2, 1-3,	sign	1-2-3-4	sign	1-2-3-4
		1-2-3-4		1-2-3-4		1-3,	1-4					1-4,	2-3,				
Copper																	
less than 66.7% RDI	(1)	39.92	12.57	44.09	11.64	34.00	10.01	41.75	13.54	35.08	13.43	38.20	14.04	32.23	11.20	34.00	13.71
66.7 - 90% RDI	(2)	74.95	5.10	75.68	6.22	77.30	3.72	73.36	3.96	76.86	3.32			76.37	3.85	77.85	2.74
90 - 110% RDI	(3)	96.86	4.72	97.10	4.11	100.00	0.00	95.95	5.87	98.83	1.66			98.83	1.66		
more than 110% RDI	(4)	120.48	5.88	116.32	0.00			124.63	0.00								
Difference statistically significant		sign	1-2, 1-3,	sign	1-2, 1-3,	sign	1-2, 1-3	sign	1-2, 1-3,	sign	1-2, 1-3			Sign.		Sign	
		1-4,	2-3,	2-4	1-4,	2-4		1-4,	2-4	1-2,	1-3			1-2,	1-3		

N – sample size, x – mean value, SD – standard deviation, sign, 1-2, 2-3... – differences statistically significant for $p \leq 0.05$

incompatible with recommendations structure and amount of consumed energetic components and low average magnesium, zinc and copper intake. The stated low intake of analyzed nutrients, revealed among over ¾ of analyzed population, may highly risk in deficiency and evidence unprofitable dietary habits.

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