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Chosen metals concentration in hair of sickes people (Arterial hypertension, Hypofunction of kidney, Arteriosclerosis)

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Abstract. In the present paper studied cumulation Ca, Na, K, Mg, Pb, Cd, Zn, Cu, Al and Fe in hair of sick persons (arterial hypertension, hypofunction of kidneys, arteriosclerosis) and healthy persons. Contents of selected metals were found to be significant higher in the hair of ill persons compared with those of healthy persons, with the exception of Ca, Mg, Fe and Zn. The concentrations of Fe, Zn, Ca and Mg in hair were observed to decrease with age of healthy and sick persons and concentrations Pb and Cd increased with age those. The ratios of individuals metals concentrations in hair changed depending on age too.

Keywords: Heavy metals, hair, arterial hypertension, hypofunction of kidneys, arteriosclerosis

Introduction

Recently a great deal of interest has been developed in research aimed at exploring occupational, clinical, toxicological and environmental exposure of trace metals along with their impact on human health [7, 9, 13]. Hair analysis can be regarded at as a non-invasive of investigation and a powerful approach to assess health-affecting variations in the content of both essential and potentially toxic elements in human body. Given its ability to accumulate elements in the keratinous structure, human hair can be considered as a reliable biological indicator of unbalances in the content of minerals in the human body, thus reflecting the health status of an individual as integrated over a period of several months [5, 14]. It is recognized that metal distribution in human hair has marked dependence on age and gender [1, 2], and hair related environmental studies can, therefore, be used to differentiate between the health status of various segments of the population [1].

Materials and Methods

Within years of 2009 - 2010 hair coming 856 persons from the Wielkopolska (Poland) were analyzed (248 persons – ills with arterial hypertension, 214 – hypofunction of kidneys, 164 – arteriosclerosis, 230 healthy persons were control group). These persons represented vast spectrum of age (19 – 78 years). People were selected by random manner. The hair samples, cut from the nap of the neck close to scalp, as strands 3-5 cm long, with a pair of plastic scissors, were stored in zip-mouthed polythene bags. Prior to analysis, hair samples were cleaned of surface contamination by washing, according to International Atomic Energy Agency (IAEA) instructions [8]. The samples (20-50 mg) were then digested with 5 ml of concentrated nitric acid (Suprapure, 69%).

An inductively coupled argon plasma atomic emission spectrometr (model Optima 3100 XL, Perkin Elmer) was used for the determination of selected metals (Ca, Na, K, Mg, Pb, Cd, Zn, Cu, Al, Fe) inthe digested samples solutions by following the standard procedure prescribed in the working instructions for the instrument. Samples were analysed in triplicate, the mean metal concentration being within ±1%.

The data were statistically analyzed as repeated measures ANOVA by using the procedure for STATISTICA 8. One-way analysis of variance was used to test for significant differences in study parameters.

Results and Discussion

Average contents of studied metals in hair of research population are given in Table 1. Values for healthy persons were in the range reported by Bocca *et al*., [3], Khalliqu *et al*.[10], Chojnacka *et al.* [4], and Pasha *et al*.,

Tab.1 Average concentrations (μg g^{-1}dry weight) of selected metals in scalp hair of ill and healthy persons

Metal	X*± SD Healthy	Hypofunction of kidneys	Arterial hypertension	Arteriosclerosis
Ca	526.9±138.1	530.2±234.1	541.0±201.2	416.6±149.8
Na	256±38.1	472.9±142.6	473.1±83.8	378.4±118.7
K	159.0±39.7	259.5±75.2	262.3±52.1	277.4±88.8
Mg	39.65±8.43	24.74±15.54	25.70±7.62	18.06±8.23
Fe	24.92±11.71	21.62±4.95	18.41±13.18	16.88±.27
Cu	9.05±2.12	12.58±3.74	11.46±2.22	7.78±2.93
Zn	179.5±51.9	138.9±50.5	126.8±44.2	105.3±47.4
Al	3.234±0.719	5.280±1.458	5.751±1.265	5.231±2.047
Pb	1.690±0.727	2.957±1.173	2.613±1.327	3.162±1.336
Cd	0.153 ± 0.095	0.266 ± 0.112	0.287 ± 0.160	0.292 ± 0.150

[12]. The order of decrease in average concentration for the metals in scalp hair of healthy persons followed the pattern: Ca > Na > Zn > K > Mg > Fe > Cu > Al > Pb > Cd, and for sick persons: Ca > Na > K > Zn > Mg > Fe > Cu > Al > Pb > Cd. The average contents of selected metals were found to be significant higher in the hair of ill persons compared with those of healthy persons, with the exception of Ca, Mg, Fe and Zn. The levels of Mg, Fe and Zn were smaller in the hair of ill persons and the level of Ca was significant smaller in the hair of ill with arteriosclerosis. As it results from collected data, there is a relationship between arterial hypertension, hypofunction of kidneys and arteriosclerosis of examined individuals and the level of Na, K, Mg, Pb, Cd, Zn, Cu, Al in their hair. There is also a relationship between arteriosclerosis and the concentrations Ca and Fe, and between arterial hypertension and concentration Fe.

Concentrations of some metals in hair changed depending on age in individual groups. The concentrations of Fe, Zn, Ca and Mg in hair were observed to decrease with age of healthy and sick persons and concentrations Pb and Cd increased with age those. In turn, the contents of Na in hair all study persons no change with age. Potassium content in hair of healthy persons and patients suffering from arteriosclerosis was increasing with age and patients suffering from arterial hypertension but only after 60 years. A trend was observed for copper content in hair of healthy persons and ill with arterial hypertension or hypofunction of kidneys to increase with age, and ill with arteriosclerosis to decrease with age. In turn, the level of Al in hair of healthy persons were observed to decrease with age and in hair of ills to increase. Based on elemental analysis conclusions may be drawn on the possible relationship between a specific disease and detected deficiency or surplus of bioelements. Inferences may also be presented on an increased risk of incidence of specific diseases, suggesting a potentially harmful effect of toxic elements on the metabolism of the patient [6, 15].

Presence some metals in organism influence to concentration other metals. Therefore proportion of concentrations between individuals metals were important too [11]. Table 2 present average values of ratios of individuals metals concentrations in hair of examin persons. On the basis of the results of this research it may be stated that ratios of Ca/K, Ca/Mg, Ca/Pb, Ca/Cd, Ca/Al, Zn/Pb, Zn/Cd, Fe/Pb and Mg/Pb show a significant dependence with arteriosclerosis, ratios of Ca/Na, Ca/Zn, Ca/Al, Zn/Pb, Zn/Cu and Fe/Cu with arterial hypertension, and ratios of Ca/Mg, Ca/Cd, Zn/Pb, Zn/Cd, Zn/Fe, Na/K, Na/Mg and Fe/Pb with hypofunction of kidneys. The ratios of individuals metals concentrations in hair changed depending on age.

Conclusions

The present study evidences that the body metabolism in the arteriosclerosis, arterial hypertension and hypofunction of kidneys patients is being affected by most of the selected metal levels. Imbalances in metals content as a function of these diseases can be observed. The hair levels of Na, K, Al, Pb and Cd are significantly higher in the hair of ill persons as compared with healthy persons, and levels of Mg and Zn are significantly smaller. The concentrations of Ca and Fe are also significantly smaller in the hair of arteriosclerosis patients and Fe content in arterial hypertension patients too. In turn, content of Cu are significantly higher in the hair of arterial hypertension and hypofunction of kidneys patients.

Tab.2 Average values of ratios of individuals metals concentrations in scalp hair of ill and healthy persons

Ratio	X*± SD Healthy	Hypofunction of kidneys	Arterial hypertension	Arteriosclerosis
Ca/K	3.51 ± 1.24	2.03 ± 0.59	2.17 ± 0.93	1.71 ± 0.96
Ca/Na	2.05 ±0.45	1.26 ± 0.76	1.17 ± 0.46	1.25 ± 0.73
Ca/Mg	13.25 ± 2.18	25.22 ± 7.28	21.06 ±13.99	24.83 ± 6.23
Ca/ Pb	377.9 ± 196.5	235.5 ± 179.3	296.8 ± 246.9	173.8 ± 123.2
Ca/Cd	5112 ± 3942	2707 ± 2159	3142 ± 3314	1846 ± 1118
Ca/Zn	3.00 ± 0.46	3.76 ± 0.68	4.29 ± 0.87	4.17 ± 1.08
Ca/Al	163.8 ± 33.1	115.3 ± 80.5	105.5 ± 65.1	96.5 ± 59.9
Ca/Fe	23.49 ± 6.93	23.97 ± 7.41	35.3 ± 13.1	28.66 ± 11.30
Zn/Pb	129.4 ±70.4	235.8 ± 106.3	69.5 ± 58.1	44.2 ± 35.8
Zn/Cd	1758 ± 1323	691 ± 512	742 ± 800	466 ± 319
Zn/Fe	7.85 ± 1.93	6.39 ± 1.54	8.11 2.22	7.08 ± 2.77
Zn/Cu	22.35 ± 11.66	13.12 ± 8.67	12.45 ± 7.81	14.14 ± 5.09
Na/K	1.69 ± 0.41	1.98 ± 0.85	1.86 ± 0.45	1.45 ± 0.54
Na/Mg	6.69 ± 1.44	29.32 ± 21.14	20.82 ± 10.70	26.51 ± 16.26
Fe/Pb	18.30 ± 12.56	9.36 ± 6.23	10.85 ± 13.26	6.74 ± 4.85
Fe/Cu	3.18 ± 2.31	1.97 ± 0.99	1.89 ± 1.91	2.24 ±0,98
Mg/Pb	27.95 ± 13.49	11.36 ± 10.25	13.75 ± 9.91	7.73 ± 6.21

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