THE CONTENT OF CADMIUM AND LEAD IN THE TEETH OF PEOPLE FROM DIFFERENT AGE GROUPS

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ABSTRACT

Cadmium and lead are the elements which are characterized by high toxicity. These elements do not bring any benefit to the organism and their presence is harmful in almost any dose. These elements can accumulate in body tissues for years and it takes a lot of time until the body can expel them. They can lead to the malfunction of internal organs, cellular metabolism or DNA damage. The main sources of cadmium emissions are industry, batteries, fertilizers, and municipal waste. The biggest source of lead emissions into the environment in the twentieth century were fuels. Areas that belong to the most polluted are those where the lead is still used as an additive for fuels. The research material was human teeth, which were collected from residents of the Kazimierza County. 170 teeth of all types have been examined - 67 belonged to men, and 103 to women. The entire study material has been divided into eight age groups. The teeth were subjected to washing, drying, weighing and mineralization. The heavy metal content was measured by an atomic absorption spectrophotometer (FAAS). Statistical analysis was performed in the program StatSoft Statistica 8.0. The results confirmed the presence of heavy metals in the teeth. The highest concentrations of cadmium and lead have been found in the oldest age group.

Key words: heavy metals, lead, cadmium, teeth

INTRODUCTION

Cadmium and lead are elements that interfere with metabolic processes of living cells, even though their amount in a cell is small (Stawarz, 2009).Cadmium is an extremely toxic element for both humans and animals. It may cause among people a disease called Itai – Itai (Mochizuki et al., 2002). The mass poisoning with cadmium has been reported for the first time in Japan in the 1960's, among which deadly cases were found too. The main sources of cadmium pollution are municipal waste, batteries, and fertilizers, which lead to pollution of soil and water environment. The presence of this element causes a number of biochemical and

physiological disorders among living organisms, such as oxidative stress, ion imbalance or DNA damage (Rajotte, Couture, 2002). The characteristic features of cadmium are a long biological half-life, low rate of expelling from the body and the ability to accumulate in organs and tissues which may cause disturbances in their action (Stawarz, 2002). In addition, cadmium compounds are classified as human carcinogens.

Lead is one of the most common neurotoxic metal in the environment which is not degraded. Long exposure to this metal can damage the central nervous system (She et al., 2009). The presence of lead may also inhibit the activity of certain enzymes. It can lead to significant changes in morphological structures of the organisms, and ultimately to death. Children are more susceptible to neurological, metabolic and behavioral changes caused by lead than adults (Landrigan et al., 2002; Stawarz, 2002). Lead is ubiquitous in the environment and it is used in many building materials. It was used in the early twentieth century as an additive to fuel in order to increase their productivity. Lead as a fuel component was the largest source of emission into the environment. Countries in which fuels with lead are still used are among the most polluted. Another source of lead emissions into the environment is the industry (Kadir et al., 2008).

The aim of this study was to measure the cadmium and lead contents in the teeth collected from people living in Kazimierza County (South of Poland).

MATERIALS AND METHODS

The experimental material comprised teeth from men and women in the age range 6 - 85 years of age. All types of teeth were examined, of which most were upper premolars and molars. The material was obtained from private dental offices located in the Kazimierza County of _Świętokrzyskie Voivodeship. 170 teeth (n = 170) were collected and described, among which 67 belonged to men, and 103 to women. Eight age groups have been isolated in the study.

Table 1 Age ranges and number of teeth in different age groups regardless of sex.

	Age brackets
1	6 – 10
2	11 – 20
3	21 – 30
4	31 – 40
5	41 – 50
6	51 – 60
7	61 – 70
8	71 and more

A survey concerning smoking shows that 31 teeth belonged to smokers (19 to women, 12 to men), and 112 teeth belonged to non-smokers (68 to women, 44 to men). Such an information has not been obtained from other people. The collected teeth have been rinsed, first in hydrogen peroxide, and then in distilled water. After washing, the material has been dried at 105 ˚ C for about 7 days. Then all teeth have been crushed, weighed and covered with 2cm^3 of 65% nitric acid and mineralized. The content of Cd and Pb has been measured with flame atomic absorption spectrophotometry (FAAS).

A parametric analysis of variance ANOVA has been performed in order to compare the cadmium and lead content in the teeth of people from different age groups. Homogeneity of variance was determined by Levene's test. An analysis of correlation in the age groups has been performed in the study too in order to determine the relationship between cadmium and lead contents in the teeth. All statistical calculations have been performed in StatSoft Statistica 8.0.

Table 2 The average content of cadmium and lead ± SD (mg·kg^{-1} d.m.) in different age groups.

Age brackets	Cd	Pb
6 – 10	2.857 ± 1.695	30.247 ± 10.605
11- 20	2.126 ± 0.816	19.391 ± 8.226
21 – 30	2.263 ± 0.884	25.663 ± 16.640
31 - 40	2.109 ± 0.588	23.741 ± 8.682
41 - 50	2.067 ± 0.698	29.266 ± 11.104
51 - 60	2.148 ± 0.728	26.236 ± 14.829
61 - 70	2.026 ± 0.563	26.479 ± 12.541
70 i więcej	3.983 ± 6.305	30.156 ± 6.579

Table 3 The results of analysis of variance content of cadmium and lead in the teeth of people from different age groups (* p <0.05, ** p <0.01, *** P <0.001).

	Cd	Pb
ANOVA – analysis of variance	0.118	0.091
Levene's test	0.15	0.174

Table 4 The results of the analysis of the correlation between the contents of cadmium and lead in different age groups (* p <0.05, ** p <0.01, *** P <0.001).

Age brackets	Results of correlation analysis between Cd and Pb
6 – 10	0.9651 p=0.000***
11 - 20	0.9022 p=0.000***
21 - 30	0.6393 p=0.000***
31 - 40	0.9535 p=0.000***
41 - 50	0.5407 p=0.004**
51 – 60	0.5568 p=0.003**
61 - 70	0.9456 p=0.000***
70 and more	0.8272 p=0.000***

RESULTS

The highest cadmium content has been noted in eighth age group and amounted to 3.983 mg.kg^{-1}dm. Other high amounts of cadmium have been demonstrated in the first age group (2.857 mg·kg^{-1} d. m. The lowest cadmium content was noted in the seventh age group (2.026 mg/kg d. m.) and in the fifth age group (2.067 mg·kg^{-1} d. m.). The average content of cadmium in all age groups was 2.414 mg·kg^{-1} d. m.

In the case of lead, much of this element has been noted in the eighth age group (30.156 mg/kg d. m.) and in the first age group (30.247 mg·kg^{-1} d. m.). The lowest concentration of lead has been found in the teeth of the second age group (19.391 mg·kg^{-1} d. m.). The average content of lead in all teeth was 26.086 mg·kg^{-1} d. m.

We have indicated positive correlations between the content of cadmium and lead in all age groups. Very strong correlations occurred in the age groups 41 to 50 and 51 to 60.

DISCUSSION

In studies on the evaluation of environmental pollution, teeth may serve as an indicator of contamination with heavy metals such as cadmium or lead. Heavy metals can accumulate in teeth due to the fact that teeth contain proteins (Smith, 1999).

Material was collected from people living in Kazimierza County which is situated in Świętokrzyskie Voivodeship. There is relatively low air pollution in the Kazimierza County, and this area is counted among the least polluted in the region. The main source of air pollution in the Kazimierza County are industrial plants, public transport and utilities. In addition, there are three municipal landfills in this area. There were no exceeding of heavy metals in soils of Kazimierza County (Kaczmarczyk et al., 2008).

As a result of the study, it can be concluded that the accumulation of metals such as cadmium or lead is affected by age, gender, and type of tooth. Results of research, conducted by Nowak among the inhabitants of the Beskid, support this conclusion (Smith, 1995 and 1996). The results of other publications have also confirmed that the concentration of lead in teeth increases with age (Khandekar et al., 1978, Gil et al., 1994, Khanderkar et al., 1986). The results concerning cadmium and lead content in people living in the Kazimierza County show that the highest content of these metals occurs people over 71 years old (30,156 $mg \cdot kg^{-1}$ d. m. for lead and 3.983 $mg \cdot kg^{-1}$ d. m. for cadmium).

The relationship between lead content and dental hygiene in the past has already been tested among Spaniards (Gil et al., 1996). The results of these studies show that teeth affected by tooth decay include much higher amount of lead than other teeth. In addition, caries was more common among adults than children. A large amount of heavy metals can affect the spread of caries (Bowen, 2001, Moss et al., 1999, Davies, Anderson, 1987). This may be due to the fact that the metal is incorporated into hydroxyapatite as a result, the enamel is more prone to collapse during the initiation of caries development (Davies, Anderson, 1987; Curzon, Croker, 1987). High lead content was found in teeth stained and subjected to erosion, which may be associated with age and poorer health of teeth. It can be assumed that more frequent teeth brushing may contribute to the reduction of heavy metals adjacent to the dental plaque and to a smaller spread of caries (Gil et al., 1996).

CONCLUSIONS

- cadmium and lead have been found in all the teeth
- the concentration of cadmium and lead was the highest in the oldest age groups
- the concentration of heavy metals increased with age.

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