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Chronic Lead Exposure in Children Living in Miskolc, Hungary, on the Basis of Teeth Lead Levels

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The lead pollution of the environment is a global problem (Erkkila et al. 1992; Aguilar et al. 1993; Rosen et al. 1993; Takács 1991). The major part of lead pollution can derive from the traffic, from exhausted gases of vehicles (Jarallah et al. 1993). Adverse health effects of lead exposure in childhood are well documented (Needleman et al. 1990). Blood lead (Pb) levels are indices of absorption during the previous 21-30 days, whereas measurements of Pb in bone and in teeth reflect cumulative lead exposure (Rosen et al. 1993).
On the basis of that knowledge, we wanted to determine the tooth lead levels of children living in Miskolc, Hungary. The city of Miskolc is situated on the North-East part of Hungary, and can be characterized by urban-industrial air pollution. The population of the city is about 200,000.

MATERIALS AND METHODS

The lead levels were determined in four hundred teeth derived from 312 children aged 4 to 16 years. 168 (53.8%) of these children were boys, and 144 (46.2%) were girls. The teeth were collected in the Children's Dental Polyclinic of Miskolc. Majority of the teeth investigated were deciduous teeth no. IV and no. V. From permanent teeth, no. 6 tooth was examined the most often. The teeth were prepared for investigations according to the method of Keating et al. (1987).

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Briefly, the whole tooth was soaked overnight in a 10% V/V solution of hydrogen peroxide and then rinsed with distilled water. The tooth was kept at 80°C in a 2% solution of Decon-75 detergent for 30 min and then rinsed with distilled water and dried. The tooth was ground in a mortar, and weighed into digestion tubes. The digestion was made with nitric acid at 120°C in an aluminum block heater. The residues were dissolved in 10 mL of 5% nitric acid.

Measurements were made with an atomic absorption spectrometry system consisting of a Varian Spectra 300 P spectrometer, a GTA 96 furnace, an automatic sampler and a quality control protocol software. Instrumental conditions for the measurement of lead were as follows:

wavelength:	283.3 nm
slit width:	0.5 nm
dry:	120°C
ash:	350°C
atomise:	2300°C
clean:	2500°C

All measurements were subjected to a strict quality control procedure; the quality control material was: animal bone powder H-5 (International Atomic Energy Agency, Vienna, Austria), which contained 3.1 μg Pb/g. The measured mean lead level in the reference material was 2.96 ± 0.08 μg Pb/g.

Differences between values were evaluated by Student's t test.

The lead levels in the dust samples were determined by AAS3 spectrometer (Zeiss, Jena, Germany).

RESULTS AND DISCUSSION

Fig. 1 shows the lead levels in deciduous and permanent teeth of children investigated. The lead content in the teeth changed between < 1 μg/g and 42 μg/g tooth tissue. The most frequent lead concentration was 3 μg/g tooth tissue. In 25 teeth (6.25%), lead levels were higher than 10 μg/g, which value was suggested as an upper limit of low lead exposure (Needleman et al. 1990). The highest lead value (42 μg/g) was found in the deciduous tooth no. IV derived from the left inferior set of teeth of a four-year-old girl. The mean lead concentration of teeth investigated was 3.98 ± 4.3 μg/g tooth tissue, while the geometric mean lead level was 2.52 ± 3.1 μg/g.

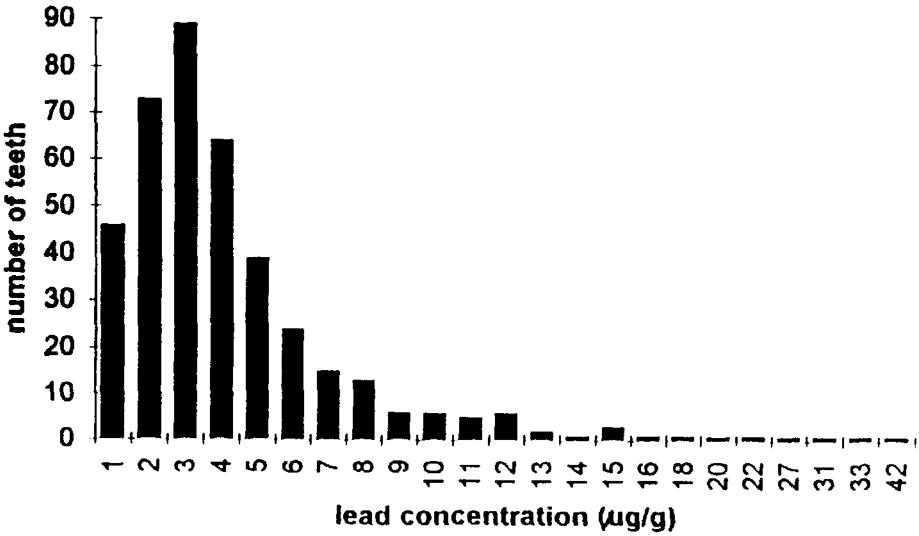

Figure 1. Distribution of teeth examined according to the lead content

Table 1./ Distribution of teeth containing more lead than 10 µg/g according to their localizations

Localization (set of teeth)	Number of teeth examined	Number of teeth containing > 10 µg Pb/g tooth tissue	Percent
right superior	118	8	6.8
right inferior	116	6	5.2
left superior	86	1	1.2
left inferior	80	10	12.5

Table 2. Lead levels in various types of teeth

Type of tooth	Number of teeth	Lead level μg/g tooth tissue ± S.D.
I + I I (deciduous)	64	5.l±5.7
III (deciduous)	17	4.5±3.8
IV (deciduous)	130	3.8±4.4
V (deciduous)	124	3.8±4.1
Permanents	65	3.7±3.2

The geometric mean lead level of teeth, which derived from boys was 2.2 ± 3.5 μg/g; this value was found 2.2 ± 3.6 μg in deciduous teeth, and 2.7 ± 1.9 μg/g in permanent teeth. The geometric mean lead level of teeth, which derived from girls was 2.8 ± 2.7 μg/g; that value was 2.7 ± 2.8 μg/g in deciduous teeth, and 3.3 ± 2.1 μg/g in permanent teeth. 12.5% of teeth derived from the left inferior set of teeth contained more than 10 μg Pb/g tooth tissue (Table 1).

The incisors contained the highest lead level in average; thereafter the canines, and the lowest Pb level was found in the permanent teeth (Table 2). The mean lead level of deciduous teeth derived from older children was higher than that of deciduous teeth derived from younger children (Table 3), but the difference was not significant.

Lead level in the dust samples has been measured in Miskolc from 1988; the value of that has never been higher than 6,000 μg/m^2/30 days, the 50% of the Hungarian national standard limit.

Table 3. Changes in the mean lead levels of deciduous teeth according to the age and sex of children investigated

Age (years)	Number of samples examined	Sex of children examined boys	girls	Geometric mean Pb levels µg/g ± S.D.	Mean Pb levels (µg/g ± S.D.) according sex of children boys	girls
4	21	15	6	2.3 ± 3.3	2.4±2.2	2.0±4.5
5	42	25	17	2.4 ± 3.4	3.0±3.0	1.8±3.8
6	54	21	33	2.5 ± 3.2	2.4±3.5	2.5±2.8
7	65	34	31	1.9 ± 3.6	1.5±4.6	2.5±2.5
8	52	28	24	2.5 ± 5.0	1.7±5.2	3.0±3.1
9	41	13	28	2.6 ± 3.5	1.7±5.9	3.1±2.6
10	36	24	12	3.7 ± 1.7	3.7±1.7	3.7±1.7
11	26	17	9	2.3 ± 2.3	1.8±2.2	3.4
12	3	2	1	6.7	9.4	1.5
13	2	0	2	7.3	-	7.3
14	2	1	1	7.2	6.6	7.6

It can be stated that the children living in Miskolc have been exposed with medium lead concentrations in the last 16 years. This exposure is the same as the exposure of children living in Boston (Rabinowitz et al. 1991), in London (Pocock et al. 1987), or in Ankara (Karakaya et al. 1996).

For children whose teeth lead levels were found to be higher than 10 μg/g, the measurement of blood lead levels and the clearing up of the sources of the possible extra lead exposure are suggested.

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