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Lead Levels in Deciduous Teeth of Children from Urban and Suburban Regions in Ankara (Turkey)

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Lead is one of the most common pollutants in the environment and especially dangerous for young children. Therefore, biomonitoring studies of the effects of lead on children's health are of primary importance. The level of lead in blood is the best indicator of current exposure. On the other hand, determination of lead concentration in shed deciduous teeth has become a useful measure of past lead exposure in children. Epidemiological studies have shown that the skeleton contains most of the lead body burden in humans (about 90% in adults and 70% in children) (Steenhout 1982). Whereas lead levels in blood and urine are indicators of relatively recent exposure, the analysis of mineralizing tissues, specifically deciduous teeth, provides an assessment of internal exposure integrated over a longer period of time.

It is generally recognized that the most important source of lead pollution is leaded gasoline, since most of this lead is emitted into the atmosphere. Leaded gasoline accounts for almost 90% of the total amount of lead released from all sources into the air (US EPA 1986). Wherever leaded gasoline is an air pollutant, children are exposed to levels of lead that reduce intellectual performance throughout their lives. Some investigators have shown that prolonged pre-school exposure to low doses of lead in childhood results in reduction of IQ scores (Needleman and Gatsonis 1990; Needleman et al 1990). It is known that lead levels in the atmosphere of urban centers, varying from 0.5 µg to 10 µg /m^3 are generally higher than those recorded in rural zones, varying from 0.1 µg to 1 µg /m^3 (Caplun et al 1984). Therefore, in this work we aimed to investigate whether variations in traffic intensity or maximum lead contents of motor gasoline influence the lead content of children dentin.

In the present study, a comparison of lead burden of children deciduous teeth collected in suburban and urban areas of Ankara, the capital of Turkey, having 3.5 million inhabitants, more than 531 000 motor vehicles and 4000 km of streets and avenues, was undertaken.

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MATERIALS AND METHODS

We collected shed teeth from 103 primary school children aged 7 to 12 years (53 boys; 50 girls) who have been living in Ankara from birth. 54 of these children were chosen from urban area which is characterized by heavy traffic and high air pollution and 49 children from suburban region.

For each tooth, the dentist filled in a small slip with the date of birth, name and address of the child, duration of residence at the last dwelling-place, the occupation of the father and mother, position of the tooth in the jaw and in particular whether he or she lives near a main road or not. Each tooth was stored at 5° C in a plastic vessel before use. For the measurement of whole-tooth lead levels, a segment representing approximately half of tooth (for double measurement) including the circumpumpal dentin, was washed with distilled water and dried for two hours at 110° C. The dried specimen was weighed and then digested in perchloric and nitric acid solution. Lead measurements were performed with flame atomic absorption spectrophotometer combining the techniques of chelating-extraction and atom trapping (Brown and Taylor 1985; Karakaya et al. 1992).
For the statistical comparisons of dentin lead content between two groups, the Mann-Whitney two sample test was utilized.

RESULTS AND DISCUSSION

The general characteristics of children with regard to the distribution of age, sex, and the mean dentin lead levels in urban and suburban region are summarized in Table 1.

Table 1. The general characteristics of children

	Urban region (n=54)	Suburban region (n=49)
Age (mean, range)	9.44 (7-12)	9.40 (7-12)
Sex	23 F	28 F
	31 M	21 M
Dentin lead (µg/g) (mean, range)	4.99 (0.50-14.54)*	1.69 (0.20-7.80)

* Significantly different ($p<0.0001$)

The results presented in Table 1 show that children from suburban area have mean tooth lead levels of about 1.69 µg/g, whereas children from urban area have much higher tooth lead levels (4.99 ± 0.46 µg/g vs 1.69 ± 0.25 µg/g). The differences in the group means are extremely significant at the $p<0.001$ level. The average dentin lead concentration of the two groups is 3.42 ± 0.31 µg/g (mean ± s.e.). The data show that in the area where the traffic is very heavy, tooth lead levels are elevated. This finding is an evidence that the deciduous tooth can be used as an indicator of lead intake in children.

Comparison of mean dentin lead levels in deciduous teeth from other countries is presented in Table 2. These investigations show that the children living in the lead smelter-area (Stolberg, Port Pirie) or near lead polluted area (Sassuolo, Ceramic factories) usually have a significantly higher lead body burden. Brockhaus et al (1988) found that there was a difference between mean lead levels in deciduous teeth of urban and suburban/rural children. In the other urban centers with heavy traffic loads, mean lead level in deciduous teeth is approximately 3-4 ppm. These findings may be due to the differences in atmospheric lead in the city and the suburbs.

Table 2. Comparison of studies of dentin lead levels in deciduous teeth

Place	Mean lead (ppm)	Part used	Number of children	Reference
Stolberg (Germany)	6.16	whole	115	Winneke et al 1983
London	F: 4.02 M: 3.98	whole	220 182	Pocock et al 1987
North-West Germany		whole	~3000	Brockhaus et al 1988
Suburban/rural area	1.8-2.3			
Urban area	2.3-2.8			
Sassuola (Italy)	6.05	whole	115	Bergomi et al 1989
Taiwan Boston	4.3 3.4	whole	390	Robinowitz et al 1991
Port Pirie (South Australia)	8.6	whole	262	McMichael et al 1994
Ankara (Turkey)	3.42	whole	103	This study

If lead at low dose causes a serious neurotoxic hazard as suggested by most of the earlier studies (Needleman and Gatsonis 1990; McMichael et al. 1994), it is clear that the control of lead's neurotoxic potential will be necessary. The developmental effects of chronic low-level lead exposure in early life include: reduced birthweight; impaired mental development in the fast two years of life; IQ deficits in school age children; and disturbances in sensory pathways within the central nervous system persisting for five or more years (Shy 1990). The US

Environmental Protection Agency (EPA) set the defined threshold for neuropsychological impairment in infants and children at blood lead levels at 0.5-0.7µmol/L (Needleman 1989). Needleman et al (1990) reported that the young people with dentin lead levels >20 ppm in childhood had a markedly higher risk of dropping out of high school. Increased use of unleaded gasoline and reduction in the lead content of gasoline have been estimated to result in a decrease in mean blood lead levels in the USA (Mushak and Crocetti 1989).

In Turkey, motor gasoline contains a maximum of 0.5 g Lead /L. The effect of this high level of lead emitted into the ambient environment may have increased due to a doubling in the number of vehicles on the road in the last 2-3 years and higher fuel consumption.

Children who live in Ankara have a relatively high degree of tooth lead contamination, particularly in the urban area. These data should encourage Turkish authorities to increase the control of lead emission sources.

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