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Tooth Lead Concentration as an Indicator for Environmental Lead Pollution in Agra City, India

M. M. Srivastava, Shalini Srivastava, and Anup Vaid

Department of Chemistry, Dayalbagh Educational Institute, Agra-282005, India

Agra (India), the city of Taj Mahal, is receiving keen attention of environmentalists on the problem of escalating environmental pollution. The increase in dis-semination of lead in to the environment from stationary as well as mobile sources has resulted in a widespread lead exposure. The continued use of leaded gasoline and lead based paint in India is the major source of high environmental lead concentration resulting in the gradual accumulation in the human system (Aggarwal et al, 1979, Khandekar et al 1984). Although the blood lead level is considered as an early indicator of the lead exposure, lead concentration in teeth and hair have been used as an indicator of long term exposure. Tissues that store lead have an advantage of reflecting the total burden of the organism over finite time and there by offer a practical way to determine the exposure. Ingested lead is deposited in bones and teeth (Shapiro et al 1975). Of these two tissues, teeth have an advantage over bones as biopsy tissues ; they are easy to collect and are physically stable. The amount of lead stored in the tooth provides an index of cumulative exposure.

The present study provides a preliminary report on the level of stable lead in teeth samples collected at Agra.

MATERIALS AND METHODS

Tooth samples (38 male and female adults and 42 male and female children) were collected at random from dental sections of private clinics and hospitals situated in different parts of Agra city. With each tooth sample, details such as name, address, age, type of tooth and sex of donor were recorded. Teeth in which more than 25% of crown was rotten were discarded.

Teeth were cleaned with double distilled water, dried and weighed accurately. Samples were digested with nitric acid and perchloric acid mixture (50 : 50) and 5 ml of ammonium citrate buffer was added. The lead was complexed with ammonium tetramethylene dithiocarbamate (APDC) and extracted with methyl iso-butyl ketone (MIBK) and read at 283.3 nm an using atomic absorption spectrophotometer (AAS) (Perkin-Elmer model 5000) (Yea-ger et al, 1971).The background levels of lead in the reagents were also monitored in blank samples.

Send all correspondence to Dr. M.M. Srivastava at above address.

RESULTS AND DISCUSSION

The mean lead concentration according to the sex of the donor are presented in Table 1. As the distribution was found to be log-normal the data was normalized by logarthamic transformation and the 't' test was applied. No statistical difference between the values of lead in the teeth of male, female adults and the children was observed.

Table 1. Comparision between the mean lead contents of male and female adults or children.

	Total Subjects	Lead* Contents	Range ug\g
Adults	38	9.91 ± 1.26	1.88 -26.50
Male	18	10.41 ± 1.28	2.40 -28.65
Female	20	9.47 ± 1.18	1.88 -23.22
Children	42	2.75 ± 1.30[a]	0.26 -16.20
Male	18	2.43 ± 1.23	1.07 -16.20
Female	24	2.64 ± 1.32	0.24 -15.87

* ug/g of tooth; Mean ± S.D.

a_p <0.001 compared to corresponding Adults as evaluated by the students t test.

Lead concentration in adult males ranged between 2.4 to 28.65 µg/g of tooth while for female adults the range was between 0.24 to 15.97 µg/g of tooth. The data obviously shows that the lead concentration in the teeth of both male and female children was significantly low compared to adults.

Variation in tooth lead levels of Agra residents with age were examined and data are presented in table 2.

Table 2. Age Distribution of Tooth Lead

AGE OF DONOR YEARS	SUBJECTS	LEAD CONTENT ug/g
3 - 15	37	2.71 ± 1.26
16 - 28	15	4.83 ± 1.28
29 - 41	14	8.85 ± 1.30
42 - 55 and above	14	10.93 ± 1.36

No marked increase in the tooth lead levels with age of donors was observed among young children (3--15 years). However a significant increase was noticed with the increase in age of the donors. Similar results were also observed by Strehlow and Kneip (1969) for American subjects. Lead, like calcium is deposited in the skeleton by mineral formation as well as by long term exchange. Unlike bones, dental hard tissues are not normally involved in long life remodeling process. Once fully developed, teeth do not undergo calcification. It has been indicated that teeth are permeable to ions in both directions, whether uptake is from internal or external exposure. (Strehlow and Kneip, 1969).

The mean lead concentration living in three different parts of Agra city are summerized in table 3.

Table 3. Area distribution of tooth lead in children

PLACE	SUBJECTS	LEAD CONTENT ug\g	RANGE ug\g
NEW AGRA	12	2.24 ± 1.34	0.28 -2.98
VIJAY NAGAR	14	2.96 ± 1.38	0.26 -12.33
LOHA MANDI	16	3.38 ± 1.43	1.52 -23.21

Lead level were low in New Agra area and relatively high in Vijay Nagar and Loha Mandi areas, (centre part of Agra city).

The higher lead levels in the Loha Mandi area could be attributed to several printing presses (conventional type) and lead melting operations, while in Vijay nagar, there are iron foundries emmissions and high traffic density. The New Agra area is a comparatively less polluted sub urban area of Agra city.

Only a few published reports from India are available on lead levels of male and female adults or children. One such study by Khandekar et al, (1978) reported a mean value of 15.5 μg/g of tooth in males and females in Bombay city, while in our case the mean value were 10.41 and 9.47 μg/g of tooth for adult male and female respectively, in Agra city. Our data seems considerably lower than reported by Khandeker et al, (1975), however, it is similar to those reported from other big cities in the world (Mackie et al, 1977, Needleman et al, 1972).

Our observations document elevated lead exposure in Agra city and it is imperative that further characterisation of the magnitude of this problem be conducted among residents of Agra city in order to mitigate the toxic effects of lead.

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