Lead Poisoning among Children of Santo Amaro, Bahia, Brazil in 1980, 1985, and 1992[1]

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A cross-sectional epidemiologic survey conducted at the beginning of 1992 evaluated the status of lead intoxication among children from 1 to 5 years of age living within 500 meters of a primary lead smelter in the Brazilian city of Santo Amaro, Bahia. A total of 103 children in this age group were initially enrolled in the study; however, 2 were later excluded because they could not be located, and 1 was excluded from the statistical analyses for reasons noted below. The results were compared with those from similar surveys made in 1980 and 1985 in the same area with children of the same age.

A blood sample was obtained from each child, the child's hematocrit and zinc protoporphyrin (ZPP) level were determined, and an interview questionnaire was used to collect information of clinical or epidemiologic interest from the child's mother or guardian. The geometric average ZPP was 65.5 µg/100 mL (geometric standard deviation = 1.7), a level far exceeding the upper limit of normality established by the U.S. Centers for Disease Control and Prevention of 30 µg/100 mL. One child was excluded from the statistical analyses because it exhibited an extremely high ZPP level (789 µg/100 mL). Higher average ZPP levels were found for girls, children with darker-skinned racial backgrounds, children from homes where smelter slag was commonly used around the house, children presenting pica, and children of smelter workers. Of the symptoms of lead poisoning investigated, only nervousness and easy irritability exhibited high frequencies among the children studied. However, the prevalence of above-normal ZPP levels suggestive of lead poisoning was 92.2% in 1980, 98.4% in 1985, and 97.0% in 1992. Hence, the apparent prevalence of lead poisoning continued very high in 1992, indicating that the control measures adopted were ineffective or that other unidentified and uncontrolled risk factors were playing an important role. Overall, however, the proportion of children with very high ZPP levels fell sharply, and that of children with moderately high levels also declined notably, indicating that the severity of the problem had been reduced even though new cases of intoxication continued to occur. The Santo Amaro smelter closed its doors in December 1993.

According to Brazil's 1991 census, the Municipality of Santo Amaro in the State of Bahia (Figure 1) then had a population of 54 144 inhabitants. The factories established there, including a lead smelter, had long been attracting immigrants in search of work and better living conditions. For this reason, many families occupied land in the vicinity of these plants, thus exposing themselves to pollution. Among other things, a relatively large population came to live around the lead smelter, one that included many of the smelter's workers and their family members.

The smelter, operating since 1960, employed about 260 workers and produced approximately 12 000 tons of lead bars per year (1). The smelter's reports estimated that about 500 000 tons of furnace slag, containing 1%-3% lead, had been dumped into surrounding areas since the plant began working (1). As of 1975, average lead and cadmium levels in the Su-baé River exceeded international potability standards (2).

The toxic effects of environmental lead and cadmium on the health of Santo Amaro's residents has previously been described (3–8). In 1980 a cross-sectional survey was conducted to investigate the prevalence of lead poisoning and potentially related variables (7). In it, 693 children 1 to 9 years old were studied; of these, 592 were living within 900 meters of the smelter and 101 were residing in other parts of Santo Amaro. Among other things, the study found that fabric of bags from the stack filters, discarded by the smelter, was being used in workers' homes for purposes such as carpeting. Statements by smelter workers also indicated that antipollution equipment at the plant was not being satisfactorily maintained.

Starting in 1980, various improvements aimed at reducing pollution were made in response to orders from the public body

Figure 1. A map of Brazil showing the State of Bahia and the location of Santo Amaro.
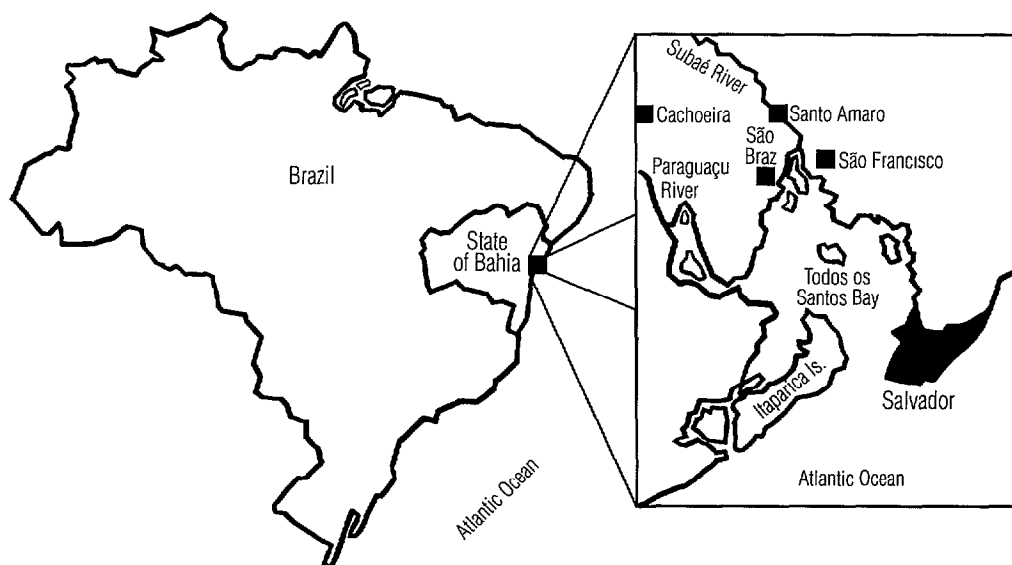
responsible for environmental policy in the State of Bahia. In January 1985 a second cross-sectional survey was conducted (8), this one including 250 children who resided in the same geographic area (within 900 meters of the smelter's stack). Comparison of the 1980 and 1985 results revealed a decline in the average levels of lead and of zinc protoporphyrin (ZPP) in blood samples, and also a decline in the prevalence of extremely high levels of these indicators. However, the prevalence of mild cases of intoxication appeared to have increased, and new cases continued to occur. For this reason, the prevalence of individuals exposed to poisoning—defined as all those children with ZPP concentrations above the normal limit set by the U.S. Centers for Disease Control and Prevention (CDC) (9)—was higher in 1985 than in 1980. Also, the soil in the survey area was still highly contaminated by lead and presented a long-term toxicity hazard for children residing there.

The aim of the work reported here was to provide a third evaluation of the epidemiologic status of lead intoxication among children living in this same area, and to trace the problem's evolution from 1980 to 1992.

MATERIALS AND METHODS

The research group conducted a cross-sectional epidemiologic survey in December 1991 that found 103 children 1–5 years old living within 500 meters of the smelter's main stack. The area of the survey was defined using the same procedures adopted in 1980 and 1985.[6] All children residing in the survey area were initially

included in the survey, three children later being excluded.

Medical students conducted home interviews with each child's mother or guardian in January 1992, administering a questionnaire that requested information about the child (name, age, sex, race, length of residence in Santo Amaro, and whether the child customarily ingested mud, earth, plaster, or other foreign materials) as well as certain family characteristics (whether the parents or other family members worked at the smelter, visible presence of smelter slag around the house, and use of smelter slag around the house by the family). The survey instrument also posed questions about lead poisoning symptoms (including difficulty speaking or walking, abdominal pain, convulsions, etc.). This questionnaire was not exactly the same as those used in the two earlier surveys, but data on each listed variable were defined, coded, and collected in the same manner. A translation of the questionnaire is presented in Annex 1.

A blood sample was taken from each child by finger-prick and collected in capillary tubes. ZPP concentrations were determined with a hematofluorometer following the manufacturer's instructions (10). The accuracy of the ZPP determinations was confirmed at each shift change or every 50 determinations, using certified ZPP samples in whole blood that were furnished by the hematofluorometer's manufacturer. These reference samples had certified ZPP concentrations of 33, 72, and 100 μg/100 mL.

The children were classified into four groups according to their ZPP levels, based on values suggested by the CDC, which had been derived using an apparatus with an absorptivity of 241 L cm^{-1} mmol^{-1} (9); levels of lead in the blood were not considered in making this classification. The hematofluorometer used in the 1980 and 1985 studies operated with an absorptivity of 241 L cm^{-1} mmol^{-1}, and the

[6]While the 1980 and 1985 studies included children living within 900 meters of the smelter's stack, all comparisons of the three studies were done using only the data for children living within 500 meters of the stack.

ZPP values were estimated assuming a constant hematocrit of 35%. However, the apparatus used in 1992 operated with an absorptivity of 297 L cm^{-1} mmol^{-1}; and the values obtained at this absorptivity are 19% lower than those obtained at an absorptivity of 241 L cm^{-1} mmol^{-1} (11). Thus, in order that comparisons could be made between the three studies, ZPP values 19% lower than those specified by the CDC in 1987 (9) were used as cutoffs for purposes of classifying degrees of poisoning.

Assuming a constant hematocrit of 35% for all the 1992 study children, the factor for converting the ZPP from µmolZPP/molHeme to µg/100 mL was equal to 0.44839. Because of a large degree of asymmetry found in the frequency distribution, the ZPP concentrations were expressed as geometric averages (GA) plus or minus one geometric standard deviation (GSD).

The procedures and techniques used to determine concentrations of lead in the study subjects' blood and the survey area's soil have been described previously by Tavares (12).

To determine the study subjects' actual hematocrits, an IEC Damon microcentrifuge was used. Anemia was defined by a hematocrit value ≤32%.

The children were classified into three racial groups based on skin color, type of hair, set of nose, and thickness of lips (13).

Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS) for personal computers, following the recommended procedures (14).

RESULTS

Zinc Protoporphyrin, Anemia, and Lead Poisoning

Of the 103 children initially included in the 1992 study, only two could not be subsequently located (one was traveling and the other had left the area). These two children were excluded from the study, together with one child whose ZPP value (789 µg/100 mL) appeared anomalous, it being far above the average for the group analyzed. This child was referred to the hospital of the Federal University of Bahia for further diagnostic evaluation. A month after the 1992 study ended, the laboratory results for this child showed a ZPP value of 715 µg/100 mL, a hematocrit of 21%, a blood lead concentration of 41 µg/100 mL, and a serum ferritin level of 4 ng/mL.

The geometric average ZPP level was 65.5 µg/100 mL (GSD = 1.7), this value being substantially above the limit of normality established by the CDC, which currently considers values below 30 µg/100 mL as normal (11). According to this criterion, ZPP levels indicating lead poisoning were found in 92.2% of the 1980 study children, 98.4% of the 1985 children, and 97.0% of the 1992 children.

The arithmetic mean and standard deviation of the 1992 study children's hematocrits were 33.5% ± 2.5%, the median hematocrit being 35%. Overall, 35% of the children had hematocrits ≤32%, indicating anemia.

Frequently, high ZPP levels are found in individuals with iron deficiency (6, 15–17). In our study, anemic children presented a geometric average ZPP of 74.2 µg/100 mL (GSD = 1.7), while the non-anemic children showed an average ZPP level of 61.2 µg/100 mL (GSD = 1.6). However, the Pearson correlation coefficient between logZPP and hematocrit was quite low (−0.2272), with R^2 equal to 0.05. These results do not permit one to ignore the influence of iron deficiency in elevating ZPP, but it can be affirmed that its impact was slight and that the variation in ZPP was more strongly associated with the toxic effects of lead.

A more detailed analysis was made of the relationships between iron defi-

ciency, malnutrition, and levels of hemo-globin and blood lead using data from the 1980 study (6). It was found that the hemoglobin level was significantly asso-ciated with malnutrition, and that the lat-ter was interacting with iron deficiency. No association was found between hemoglobin level, lead poisoning, iron deficiency, or hookworm infection. In ad-dition, it is known that the conditions generating anemia in the children of Santo Amaro did not undergo major changes over the course of the 1980–1992 study period.

Zinc Protoporphyrin Levels in 1992

Table 1 shows the geometric average ZPP values and standard deviations for different groups of study children. These data indicate that girls had a higher av-erage ZPP than boys and that race played a role, children classed as racially darker having higher average ZPPs.

As also noted in the table, 11% of the study children were reported to be living in places where smelter waste (slag) was visibly present around the house. Eight percent of the children's mothers or guardians who were interviewed said they had used smelter slag around the house within 6 years. They also reported that 17% of the children had pica—habitual ingestion of foreign matter (soil, wall plaster, etc.); 9% of the children were living with someone (father, mother, or other family member) actively employed by the smelter at the time of the inter-view; and 21% were living with a person who had previously worked at the smelter. At the time of the interview, the average study child's length of residence in the study area and length of residence in the home visited were 3.5 ± 1.5 years and 3.0 ± 1.6 years, respectively.

Children living in homes where smelter slag was visibly present did not show average ZPP levels much higher than those of children from homes without slag

Table 1. Geometric averages (GA) and standard deviations (GSD) of zinc protoporphyrin (ZPP) levels (μg/100 mL) found in blood samples obtained from the 1992 study children of Santo Amaro, grouped according to six epidemiologic variables.

Variables and categories	n	Zinc protoporphyrin (μg/100 mL)	
		GA	GSD
Sex:			
Male	50	60.8	1.6
Female	50	70.4	1.7
*Race:**			
Light	5	49.0	1.5
Medium	29	57.0	1.6
Dark	59	72.2	1.7
Slag visible around the home:			
Yes	11	67.9	1.6
No	89	65.1	1.7
Use of slag around the home in last six years:			
Never used	92	64.6	1.7
1–3 times	6	69.4	1.6
4–9 times	2	98.5	1.3
Foreign materials habitually eaten by child:			
Plaster	8	111.2	1.0
Mud, earth	1	79.8	—
Other	2	77.6	1.2
Combinations of the above	6	121.5	2.3
None	83	60.8	1.6
Child is living with smelter worker who:			
Works there currently	9	86.3	1 7
Worked there in the past	21	64.1	1.8
Never worked there	70	63.5	1.6

* The three racial categories listed were obtained by treating the six racial categories shown in the annex as follows. "white" and "light mulatto" were considered light; "me-dium mulatto" was considered medium; while "dark mu-latto" and "black" were considered dark. None of the study children were classified as "Indian." The racial as-sessment only considered 93 children because racial in-formation about 7 children was missing.

(67.9 vs. 65.1 μg/100 mL). However, a great difference was observed in the av-erage ZPP levels of children living in

Table 2. Geometric averages (GA) and standard deviations (GSD) of ZPP levels (µg/100 mL) found in blood specimens obtained from the 1980, 1985, and 1992 study children, grouped by the presence or absence of pica and a visible presence of slag around the home.

Pica	Slag present around home	Year								
		1980			1985			1992		
		n	GA	GSD	*n*	GA	GSD	*n*	GA	GSD
Yes		*15*	*208.6*	*1.9*	*13*	*91.0*	*2.2*	*17*	*94.1*	*1.8*
	Yes	11	205.2	2.1	11	84.8	2.0	4	97.2	1.2
	No	4	218.4	1.6	2	134.0	4.4	13	93.2	2.0
No		*101*	*124.2*	*2.2*	*51*	*71.8*	*1.4*	*83*	*60.8*	*1.6*
	Yes	49	106.3	2.0	22	69.7	1.4	7	55.3	1.6
	No	52	143.9	2.2	29	73.4	1.4	76	61.3	1.6
Total		*116*	*132.8*	*2.2*	*64*	*75.3*	*1.6*	*100*	*65.4*	*1.7*

homes where slag was reportedly used four or more times in the last 6 years (98.5 µg/100 mL), as compared to the ZPP levels of children from homes where slag was said to be less frequently or never used (69.4 and 64.6 µg/100 mL, respectively).

With respect to pica, it was observed that the children with this habit had much higher average ZPP levels than other children, those ingesting more than one type of foreign matter having the highest average ZPP levels.

Children living with people who were working in the smelter at the time of the interview had a higher average ZPP level than those living with people who had worked at the smelter in the past or never worked there.

The average age of the children was 3.7 ± 1.4 years. A linear correlation coefficient (*r*) of −0.2389 was obtained for the relationship between age and logZPP.

Table 2 shows the results of analyzing data stratified by the variables of pica and "slag visible in area around house" for each year studied. Analysis of the 1992 data showed no great differences between the ZPP averages of children living in homes with and without slag visibly present, irrespective of whether they had

pica (97.2 vs. 93.2 µg/100 mL) or not (55.3 vs. 61.3 µg/100 mL). The earlier surveys found considerable differences between these averages, but in each case the average ZPP level was higher for children living in homes *without* slag visibly present, this difference being especially marked for children in the 1980 survey who did not have pica.

It might be assumed that contaminated soil in the areas surrounding the smelter was a major source of exposure to lead. Soil contamination in this area was great in 1980 and 1985. The average level of lead in 1980 soil samples collected within 500 meters of the smelter was 9 683 ppm, values for individual samples ranging from 32 to 100 925 ppm; in 1985 the comparable average value was 6 372 ppm within a range of 615 to 22 087 ppm.

When the average ZPP level of 1980 study children living in homes with soil lead concentrations ≥10 000 ppm (143 µg/ 100 mL) was compared to the average ZPP level of the other 1980 children (118 µg/100 mL), the difference appeared substantial. However, the 1985 data showed no great difference (78 µg/100 mL vs. 75 µg/100 mL), suggesting that although the soil was once a major source of exposure to lead, as of 1985 it did not appear to

Table 3. Evolution of prevalences of lead poisoning, as indicated by ZPP levels (μg/100 mL) in the 1980, 1985, and 1992 study children. The values in parentheses were used as cutoff scores only in 1992.

ZPP (μg/100 mL)	1980		1985		1992	
	n	%	n	%	n	%
Normal, ≤38 (<30)	9	7.8	1	1.6	3	3.0
Slightly elevated, 39−81 (30−66)	19	16.4	31	50.8	53	53.0
Moderately elevated, 82−191 (67−155)	48	41.4	27	44.3	36	36.0
Extremely elevated, ≥192 (≥156)	40	34.4	2	3.3	8	8.0
Total	116	100.0	61	100.0	100	100.0

have as strong an impact on the ZPP levels of the children of Santo Amaro.[7]

Changes in ZPP Levels: 1980, 1985, and 1992

Table 3 shows the percentages of study children with excessive levels of ZPP indicating lead poisoning in 1980, 1985, and 1992. As may be seen, the percentage of children with very high ZPP levels fell from 34.4% in 1980 to 3.3% in 1985 before increasing again to 8.0% in 1992. Conversely, the percentage with moderately high ZPP levels rose slightly—from 41.4% in 1980 to 44.3% in 1985—before declining to 36.0% in 1992. Finally, the percentage with slightly elevated ZPP levels rose very sharply—from 16.4% in 1980 to 50.8% in 1985—and stayed high (at 53.0%) in 1992, while the percentage with normal ZPP levels declined from 7.8% in 1980 to 1.6% in 1985 before rising slightly to 3.0% in 1992.

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[7]Because of financial limitations, soil samples were not collected in 1992.

Symptoms Relating to Lead Poisoning, 1992

Table 4 shows that the lead poisoning symptoms investigated were reported by a relatively small number of mothers or guardians, the percentage of positive re-

Table 4. Prevalence of signs or symptoms indicative of lead poisoning among the 1992 study children. The total in each line of the table varies according to the number of children for whom the information specified was obtained.

Sign or symptom	Yes		No	
	n	%	n	%
Difficulty speaking	11	11.5	85	88.5
Difficulty walking	4	4.0	95	96.0
Thumb sucking	10	10.0	90	90.0
Nail biting	11	11.3	86	88.7
Nervousness	20	20.0	80	80.0
Irritability	30	30.0	70	70.0
Difficulty sleeping	5	5.0	95	95.0
Nightmares	7	7.0	93	93.0
Fainting spells	1	1.0	99	99.0
Convulsive crises	2	2.0	98	98.0
Forgetfulness	4	4.2	91	95.8
Constipation	8	8.0	92	92.0
Stomach ache	12	12.1	87	87.9
Vomiting	4	4.0	96	96.0

plies ranging from 1.0% (for fainting spells or blackouts) to 12.1% (for chronic stomach ache), with two exceptions. That is, 20% of the study children were said to be nervous and 30% were said to be irritable. In addition (see annex) 11% of the children were found to have psychomotor development differing from that usually encountered in normal children, but only 2.2% were said to have experienced a kidney ailment at some point in their lives. The average age at which the study children began to walk was 1 year, with a standard deviation of 0.37 years.

When the geometric average ZPP level of the children whose parents reported a specific symptom were compared with that of the children for whom no such symptom was reported, higher average ZPP levels were found only among those who reportedly had difficulty speaking, difficulty sleeping, woke up screaming or had nightmares, sucked their thumbs, or experienced frequent vomiting. The only child said to have frequent fainting spells and loss of consciousness had a ZPP level of 138 µg/100 mL, a level considerably exceeding the average for the study children (65.5 µg/100 mL).

DISCUSSION AND CONCLUSIONS

Twelve years after major pollution control measures began, elevated ZPP levels persisted in nearly all children 1–5 years old residing in the study area—indicating that the measures implemented had not been adequate and also that risk factors may have been present that were not initially identified or controlled. Overall, the sharp decline in the percentage of study children with very high ZPP levels in 1985 (despite a lesser increase in 1992), together with a sharp increase in the percentage with slightly elevated ZPP levels in 1985, suggests that the severity of the problem diminished even though new cases continued to emerge.

In Belgium, a study by Roels et al. (18) assessing the impact of measures for controlling environmental lead pollution found no change after 18 months in the average soil lead and ZPP levels among Belgian children living within one kilometer of a smelter. The authors of that study suggested two explanations for their findings: (a) ingestion of highly contaminated dust on the hands and (b) lead-bearing dust particles suspended in the air that were derived from highly contaminated soil around the smelter.

Lead-contaminated soils have been cited consistently in the world scientific literature as being capable of elevating lead levels in children's blood (19). For instance, a place known as Silver Valley in the United States experienced an episode of intense environmental contamination with lead of industrial origin. In this case soils with lead concentrations >1 000 ppm were associated with significant elevation of blood lead levels in children 1–9 years old living around a smelter (20). Subsequent analyses (21) indicated that lead in the soil could be a major source of lead ingestion among children 2–7 years old, it being estimated that for children 6 years old the blood lead level increased an average of 4% for each increase of 1 000 ppm in the soil lead concentration.

The U.S. Centers for Disease Control and Prevention assert that "even if ongoing deposition of lead into soil and dust is eventually halted, measures will have to be taken to reduce exposures from lead-contaminated soils and dusts. Until data demonstrating the efficacy and cost-effectiveness of permanent soil and dust abatement measures are available, interim risk reduction steps will be needed in some places" (11).

During the period of the study reported here, from 1980 to 1992, no cleaning or decontamination of the soil was required of the facility located in Santo Amaro. As of 1980, 61.5% of the children under 6 years old who were living within

500 meters of the smelter were exposed to soil containing >10 000 ppm of lead. As of 1985, this percentage had fallen to 25.0%. In 1992, no determinations were made of soil lead concentrations, but it was observed that many children were still living along the highly polluted road used by vehicles transporting ore to the smelter.

The studies done in Santo Amaro in 1980 and 1985 found positive associations between soil lead concentrations and ZPP levels, lead in the blood (8), and lead in the hair (22). A positive association was also found between cadmium concentrations in the soil and in the hair of the young child populations studied (23).

Another potential source of exposure was slag from the smelter, which contained 1%–3% lead insoluble in neutral water but quite soluble in an acid medium. It may be assumed that children with pica could absorb lead from this source, due to the action of gastric juices on the slag. In both 1980 and 1985, 52% of the study children were found to be living in homes around which slag was visible. As of 1992, however, this percentage was found to be 11%, a sharp drop having occurred. However, the absence of visible slag did not necessarily mean that children were not exposed to this source, because the slag could have been hidden by vegetation or spread out more over the location, depending on the time elapsed since its last placement.

Stratified analysis of the data relating to pica and visible presence of slag around the home indicated that the current presence of slag, detected by simple visual inspection, did not appear to be a major factor in lead poisoning in Santo Amaro. The influence of pica (found in all three studies) must therefore occur as a result of other mechanisms—such as contamination of the children's hands with soil or dust, polluted by smelter stack emissions, that is deposited in and around the children's homes and/or the action of

one or more unidentified factors not investigated in the present study.

In the case of Santo Amaro, something that helps to explain the persistently high levels of exposure and absorption of lead (18) was deficient maintenance of the smelter's pollution control equipment and the precarious nature of inspections performed by the competent authorities.

At the end of 1992, it was estimated that about 50% of the particulate matter generated by the smelter was not being captured (19). It was also noted that contaminated storm waters were being dumped into the river Subaé as a result of overflow from the smelter's containment basins. In other words, there is good evidence that pollution of the environment was continuing as the result of inadequate pollution control activity on the part of the enterprise. However, it was not possible to include an empirical investigation of that aspect in this study, for lack of data on emission of particulates sufficient to relate particulate emissions with ZPP levels.

The 1992 study showed that children whose parents or family members were working or had worked at the smelter continued to present more elevated average ZPP levels than other children, indicating that the measures adopted to prevent this (a ban on departure from the smelter in work clothing and a requirement that workers bathe at the time of departure) were not being properly complied with.

The Santo Amaro smelter closed its doors permanently in December 1993.

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Annex 1. Questionnaire used in the study, 1992.

FEDERAL UNIVERSITY OF BAHIA
School of Medicine
Department of Preventive Medicine - Institute of Chemistry
Lead intoxication among children of Santo Amaro, BA, 1992

PART I

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1. No. of child, in order

2. Name of child _____

3. Age (years, months)

4. Sex: 1 = male
                      2 = female

5. Race: 1 = white   4 = dark mulatto
            2 = light mulatto   5 = black
            3 = medium mulatto   6 = Indian
                9 = missing value

6. Time of residence (years, months)
                                   In Santo Amaro
    9999 = missing value   In the area
                                   In this house

7. Has the child had a blood test for lead poisoning
at the initiative of the factory?   1 = yes   2 = no   3 = don't know

8. Slag visible in area around house?
                     1 = yes   2 = no

9. *In the last 6 years*, how many times was factory slag used in the area
around this house?   1 = never used   2 = 1 to 3 times
3 = 4 to 9 times   4 = 10 or + times   5 = don't know

10. The child is accustomed to ingesting:
1 = mud, earth   2 = plaster   3 = other materials
4 = combination of 1, 2, and 3   5 = not ingested

11. Work of father, mother, or other family member at PLUMBUM:
1 = never worked   2 = works currently
            3 = worked in the past

PART II

Use the following codes for questions 12 to 27:

1 = no, never	2 = little, rarely	3 = more or less, at times
4 = a lot, always	8 = don't know	9 = not obtained/not applicable

The child:

12. Has (or had) difficulty in speaking? ⊔

13. Has (or had) difficulty in walking? ⊔

14. Sucks fingers? ⊔

15. Bites nails? ⊔

16. Is nervous? ⊔

17. Gets angry easily? ⊔

18. Gets along well with the others in the house? ⊔

19. Has difficulty in sleeping? ⊔

20. Wakes up screaming, has nightmares? ⊔

21. Has fainting spells, loses consciousness? ⊔

22. Has convulsive crises (has attacks, hits self)? ⊔

23. Is forgetful, does not pay attention to things? ⊔

24. Has constipation regularly? ⊔

25. Has stomach aches regularly? ⊔

26. Vomits frequently? ⊔

27. Has (or had) any kidney ailment? ⊔

28. Your child began to walk at how many months of age?
    02 = don't know   03 = not applicable ☐☐

29. Is the child's general development equal to that of other
    children of the same age?   1 = yes   2 = no   3 = don't know ☐

Remarks: _____

_____