

CHANGES IN BLOOD LEAD LEVELS IN URUGUAYAN POPULATIONS

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Lead exposure in Uruguay is nowadays of public concern. It was not until 2001 that lead pollution first received official attention because the affected community began a broad mobilization demanding solutions. As a response, social and political actions, as well as regulations, for its environmental health risk management and control, have been carried out. Leaded gasoline has recently phased out and thousands of lead in blood determinations were done.

Our Toxicology team has a 15-year-research-experience in lead monitoring of different Uruguayan populations with quality assurance and quality controls (QA/QC) analytical results. We studied exposed lead workers, children and many low-income families that settled down in lead polluted areas, not aware of the high health risks for their children.

The aim of this study is to evaluate the main changes observed in the blood lead levels (BLL) of Uruguayan populations within a 10 - year - period considering the current actions to prevent lead exposure risks.

INTRODUCTION

Lead is an environmental pollutant of high risk for human health. Its adverse effects are well known, being children the most affected population. There is a significant negative correlation between children's mental development and environmental lead exposure [1,2,3,4]

Uruguay is a small country with a population of 3 millions inhabitants, half of them living in its capital harbour city Montevideo. Most lead processing industries, such as metallurgies, foundries, manufacturers and batteries recyclers, have established around Montevideo, thus contributing to the contamination of the peripheral settlements.

The use of tetraethyl lead in gasoline (replaced in 2004 by tertbutyl-methyl-ether) and the existence of lead pipes for the drinking-water-supply in older buildings are the main sources of lead exposure for the general population. Living in or near manufacturing areas, as well as the incorrect handling of lead materials and solid wastes, are also relevant sources of non occupational exposure [5,6,7,8]

But, in Uruguay, it was not until 2001 that lead exposure became a matter of public concern, when cases of children with blood lead levels (BLL) higher than 20 micrograms/dL appeared in some areas of a low-income-neighbourhood of Montevideo, called La Teja [7]. There, the worst situation found was in soil samples from some slum settlements which showed more than 3,000 ppm of lead due to scrap land fillings[8,9]. .

After the arousal of those cases of high blood lead levels in some children of La Teja there was a broad mobilization and a movement in public opinion, demanding solutions. As a consequence, an official interinstitutional committee including health, environmental and regulatory authorities was established. Then, social and political actions, as well as regulations, for the environmental health risk management and control, have been carried out. In the meantime, thousands of lead in blood analysis were performed, mostly by the Laboratory of our Toxicology Department.

At the Faculty of Chemistry, our Department of Toxicology and Environmental Hygiene has been assessing heavy- metal- exposure in different Uruguayan populations, being lead its main research line since 1986. We work with QA/QC analytical results. Therefore, when the lead issue arose in 2001, the authorities could take advantage of our 15-year-scientific experience in the analytical determination of lead in blood. We had previously studied groups of workers, children and general population, producing scientific publications and several reports [6, 10, 11,12,13,14]

In 2004, after the leaded gasoline phasing out process in Uruguay was completed, we studied three populations: children, non occupationally exposed adults and lead workers to correlate BLL with variables such as age, sex, area of residence, available environmental lead data, among others. We compared these results with those from our similar screening studies 10 years ago, to assess the current risk factors with a statistical approach [10, 11,12,].

We present the observed main changes in the blood lead levels of Uruguayan populations within this 10 - year -period considering the current actions to prevent lead exposure risks.

MATERIALS AND METHODS

The children sampling campaign was made during an 8 - month - period and comprised those children visiting a Social Security Care Center for health control. These children population (n=180) were parent volunteers and randomly selected. Most of them, were living in Montevideo and surroundings, aging 0 to 15 years. Data were collected from each individual regarding age, house and school addresses, intensity of traffic near their houses and smoking habits of their parents.

Non occupationally lead exposed adults sampling included those individuals visiting a private Workers Health Care Centre to get their health certificate and different criteria of inclusion - exclusion were considered.

The studied population sample consisted of 714 non occupationally exposed adults, ages 20 to 64, living in Montevideo. For the purpose of this study, the city was divided in 5 areas, according to the following variables: concentration of population, vehicle traffic intensity, industrial areas for lead, etc.

The exposed lead workers population (n =81) consisted of codified samples sent as labour control by the State Risk Insurance Agency, therefore individual data are not available.

Sampling conditions and analytical techniques were the same for all the studies. 10 mL of blood were obtained from the cubital vein in heparin moistened evacuated disposable syringes [15]. Samples were kept in the same labelled syringes frozen at -20° until their analysis.

All blood analysis were done by atomic spectrometry (FAAS & GFAAS) with quality controls. Associations between BLL and single variables were assessed using statistical analysis.

BLL results were contrasted with intercalibration programs [16] and internal controls. Most samples were analysed by the National Institute for Occupational Safety and Health (NIOSH) method [17], original method P&CAM 208 [18] modified by substituting the APDC (ammonium pirrolidin dithiocarbamate) with DDDC (N, N dithio-carbamate diethylammonium) resulting a lead complex more stable over time. This allows processing several samples at the same time, without risk of decomposition at the moment of the measurement.

RESULTS AND DISCUSSION

Our obtained results and the reference guidelines for blood lead levels in the different studied population [2,19, 20,21] are described in the following table (Table I)

Populations (2004)	n	BLL ug/dL	Range BLL ug/dL	Reference BLL ug/dL	BBL >Reference %
Children	180	5,7	3,0- 16,0	< 10 [19,20]	6,7 %
Non occupationally exposed Adults	714	5,5	3,0- 24,0	< 25 [2]	0 %
Occupationally exposed Adults	81	41,9	9,0-69,0	< 30 [21]	76,5 %
				<10 women in fertile age [21]	

Table I: Blood Lead Levels (BLL) in ug/dL from different uruguayan populations sampled in 2004, reference limit values respectively and % of data over those limits

Up to the year 1994 little official attention was paid to environmental lead exposure although our research group had carried out several studies that were published during the 90s decade reviewed by Manay et al. [6].

By that time and still now, Montevideo had several lead emitting industries, most of them in residential areas. Old buildings and houses still had lead pipelines in their water systems.

In addition, primary gasoline used in Uruguay up to December 2003 contained lead tetraethyl as an antiknock agent (150 - 300 mg/L). It is well known that a clear decrease of blood lead level has been associated with the elimination of lead in gasoline in the USA and Sweden [22, 23].

Uruguayan children studied by Schutz et.al [10] and described in Manay et. al, [6] sampled 10 years before, in 1994, showed an average BLL 9.6 ug/dL (n=96, range 4,7-19,1) and 9,5 (n=34, range 4,7-15,4) respectively.

At the same time, screening studies on occupationally unexposed workers (civil servants and school teachers) had showed an average BLL of 9,1 µg/dL (n= 29, range 5,0-16,3) [11] and for randomly selected adults in Cousillas et al. [12] the average BLL was 8,6 µg (n=84, range 3,1-24,8)

Considering the BLL of lead exposed workers, also ten years before, a total of 31 individuals had been recruited among the employees at two storage battery plants (n=16 and n= 8 respectively), from a lead scrap smelter (n=6) in Montevideo surroundings and also a self employed storage battery reconditioner[11]. They showed three times higher BLL , 49,7 µg/dL (n= 31 range 24,4-87,0) than those from unexposed adult population and 84% were over the biological exposure index described by the American Conference of Governmental Industrial Hygienists [21] (BEI: 30 µg/dL).

Manay et al. 1999 [6] reviewed other studies on exposed workers from different manufacturing industries like battery factories, foundries and wire factories who have significant high BBL and almost 60% were above 40 µg/dL. In addition, a pilot study with workers from a battery storage plant who were sampled for control purposes, they also showed higher BLL, 48,2 ug/dL (n=60 range 29,0-80,0) and 94% were over 30 ug/dL [23]

In these recent 2004 studies, children showed significantly lower BLL (5,7 ug/dL) and occupationally unexposed adults (5,5 ug/dL) than those sampled in 1994 (9,6 ug/L and 9,1 ug/dL respectively) with a p<0.001. The study with children in 1994[10] showed a positive relationship of BLL with traffic intensity and 40% of the BLL were above the intervention value (10 ug/dL) while in 2004 we had only 6,7 % of the BLL from the sampled children.

In addition, spot samples of gasoline were taken from gas stations after leaded gasoline was officially phased out. Those samples were lead analyzed by GFAAS and the data showed lead concentrations of less than 10 mg/L as it was expected.

However, uruguayan lead workers showed no significant BLL differences within this 10 years period (49,7 and 41,9 ug/dL respectively) and their mean values exceeded the biological exposure index for lead in blood (< 30 µg/dL) in our sampled populations.

CONCLUSIONS

The observed changes suggest a decrease in the contribution of environmental lead to the overall exposure of children and non occupationally exposed adults. This could be the result of several facts, mainly: the gradual phasing out of leaded gasoline, the progressive substitution of lead pipes for the drinking water supply and the improvement of education and hygienic habits in children. On the whole, it is the consequence of a new attitude of the population, who is now more aware of the lead health risks.

In the case of lead workers, our data do not allow to draw definite conclusions about their still high BLL on average and their consequent lead exposure risk . We consider that during this period, as a consequence of the worsened economic situation, the field of lead activity has changed and little attention has been paid to the environmental working conditions in lead industries

We conclude that there is a significant change in preventing lead exposure due to the public sensitisation together with the integration of multidisciplinary actions promoted although our country still does not have a complete official surveillance-screening program, including human population and the environment (air,water and soil). In relation to lead workers new laws have been approved and now lead in blood must be controlled in the health certificate protocol once per year

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