Persistent Organic Pollutants in children in contaminated sites of Mexico

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Introduction

Environmental policies in Mexico have contributed to the reduction on production or use of some Persistent Organic Pollutants (POPs) and metals. However, there is no monitoring of concentrations in hot spots where health risks are presumed to be considerable. Exposure assessments are developed only when the contamination rises to emergency levels. Thus, in the absence of information, it has been difficult to establish a national strategy to prevent contamination and avoid health problems. For this reason, further research is required in order to obtain background levels and enough data to identify the critical hot spots for a National Monitoring Programme.

This study is an ongoing project developed in order to analyze the concentration of some POPs in six to nine year old school children of nine cities of Mexico where highly contaminant activities are developed. Exposure pathways and background levels were established and will be used as a basis for a Biomonitoring National Programme.

Materials and Methods

Selection of Sampling Sites

The sampling sites were selected according to previous knowledge of contamination in the site and distribution throughout the country, including sites recognized for their industrial activity, agricultural practices with past and current use of pesticides, brick manufacturing or waste disposal (Figure 1). Children were approached through a school located in the sites after parental consent.

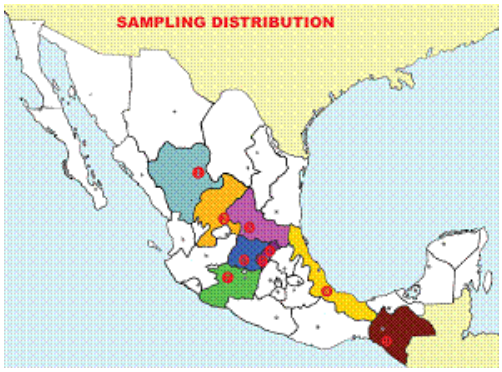


Figure 1. Distribution of sampling sites

Blood sampling and POPs analysis

Blood samples were obtained and maintained under adequate temperature conditions until analyzed. POPs were extracted from plasma by liquid - liquid extraction using ammonium sulfate : ethanol : hexane, concentrated and purified in FLORISIL columns, eluted in hexane with methylene chloride and analyzed by Gas Chromatography / Mass Spectrometry (electron ionization). A HP 6890 Gas Chromatographer coupled with an HP 5973 Mass Detector and a Capillary Column DB-XLB, 0.25 mm x 60 m x 0.25 µm were used. Standard calibration curves were generated for each substance prior to analysis. Detection and quantification limits for each analyte were determined. We used a-HCH and PCB-141^{13}C isotopes as internal standards. Percent recovery ranged from 85 to130 %.

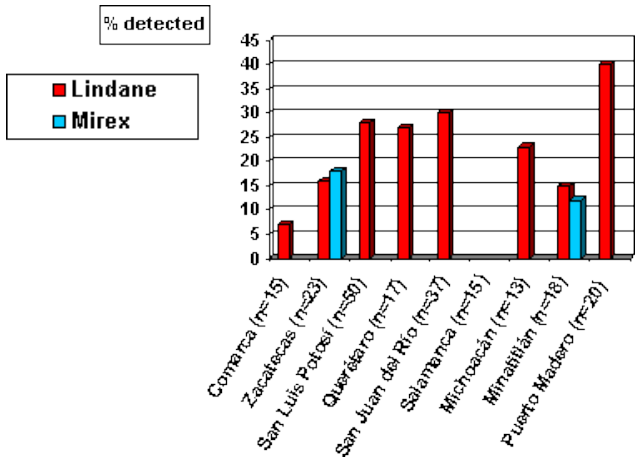
Results and Discussion

Lindane and Mirex

Results for lindane and mirex are shown in Figure 2.

LOD: Detection limit

LOQ: Quantification limit



Substance	LOD (ng/g lipid)	LOQ (ng/g lipid)
α-HCH	10.25	36.89
γ-HCH	26.64	88.11
β-HCH	22.54	73.77
Mirex	20.49	71.72

Figure 2. Lindane and mirex concentration

In four sites, 25 % of the children had detectable levels of lindane. The highest levels were observed in the San Luis Potosi community living near a dumping site. This might indicate that exposure to lindane is through lice and scabies treatment due to poor hygienic conditions. Zacatecas and Minatitlan were the only sites where Mirex, banned in Mexico since 1991, was detected in 18% and 12% of the children, respectively. The site is highly agricultural indicating a possible illegal use that needs further investigation. Other banned pesticides, like Aldrin, were not detected in the present study.

p,p'-DDE

Results for p,p' -DDE are shown in Figure 3.

Substance	LOD (ng/g lipid)	LOQ (ng/g lipid)
DDE	16.39	57.38

LOD: Detection limit

LOQ: Quantification limit

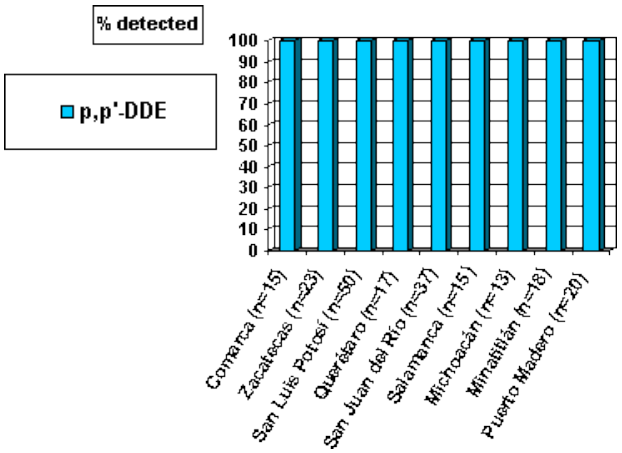


Figure 3. p,p' -DDE concentration

All the children included in this study had detectable levels of p,p'-DDE indicating a generalized past exposure to DDT. This pesticide was extensively used for malaria control in Mexico in the past, but since 2002, use of DDT has been restricted to emergency situations and under those circumstances, it can only be applied by the Ministry of Health. Mexico has been successfully applying an integrated approach to control malaria in the country.

PCBs (138, 153, 180) and Hexachlorobenzene

Results for PCBs (138, 153, 180) and Hexachlorobenzene are shown in Figure 4.

Substance	LOD (ng/g lipid)	LOQ (ng/g lipid)
PCB138	8.20	26.64
PCB153	10.25	34.84
PCB180	10.25	34.84
HCB	20.49	67.62

LOD: Detection limit

LOQ: Quantification limit

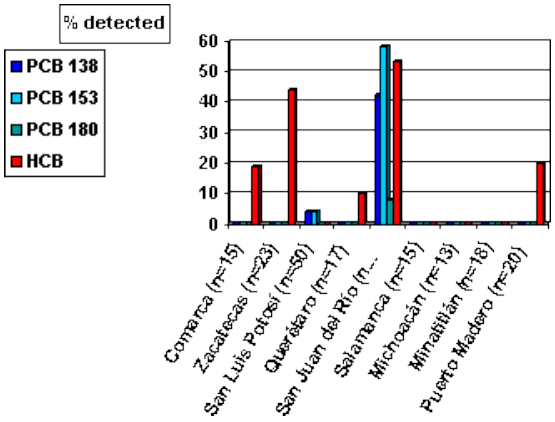


Figure 4. PCBs (138, 153, 180) and Hexachlorobenzene concentration

Three of the five sites where Hexachlorobenzene was found have brick kiln production activities. HCB was detected in 50% of the children studied from the San Nicolas site. This was also the only site where measurable levels of PCB's (138, 153 and 180) were observed. Exposure to these compounds is probably due to the use of polluted oil as fuel in brick kilns or to the use of wood previously treated with this substance. The University of San Luis Potosi has already started a study to assess the risk from exposure to PCBs in this site.

Conclusions

Results can not be generalized since the nine communities selected are not representative of the Mexican population. But results give an approximate idea of a Mexican children population.

For sites where more than 20% of the children had detectable levels of POPs, it is necessary to increase the number of samples in the site in order to have more representative values.

Environmental data and biomonitoring in children are essential to envision the health risk in each site. This might help the authorities to develop risk reduction strategies and establish activities for environmental remediation.

PCBs were found to be an important risk in at least one community (San Nicolas, Queretaro). Follow up activities are being developed in cooperation with the National Autonomous University of Mexico (UNAM), the Autonomous University of Queretaro (UAQ) and the National Institute of Ecology (INE).

Acknowledgements

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