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Paint as Another Possible Source of Lead Exposure in Saudi Arabia

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It has been long established at least in the UK and the USA, that lead in paint represents potentially an important source of lead intake, especially for young children living in old houses who exhibit the habit of pica. Pica for paint chips was identified as a major contributor to lead exposure early in this century (Strong 1920, Ruddock 1924).

The association between childhood lead poisoning and ingestion of peeling chips of lead containing house paint is well recognized (Barltrop and Killala 1969; Stark et al. 1982; Chislom et at. 1985; Clark et al. 1985; Rabinowitz et al. 1985). Lead- paints not only pose a danger because of peeling flakes but also act as a source of house dust and garden soil contamination to which children are also exposed (Vostal et al. 1974; Bogden and Louria 1975; Charney et al. 1980; Que-Hee et al. 1985).

Although the hazard from lead in new paint has been reduced substantially during the 1950s and thereafter, there is still a potential hazard from lead paint used for exterior surfaces in places accessible to children. In 1978, the Consumer Product Safety Commission in US banned the manufacture of paint containing more than 0.06% lead by weight on interior and exterior residential surfaces, toys, and furniture. Unfortunately, lead-based paint that is still available for industrial, military, and marine usage occasionally ends up being used in homes. Also, many buildings; especially those built before 1950 still contained lead-based paints on interior and exterior walls, window sills and other surfaces accessible to children. However, there is a general lack of knowledge of how widespread old-lead painted surfaces are. Preventing children from ingesting some of that paint remains a critical element in the control of exposure of urban children to lead.

In Saudi Arabia, childhood lead exposure has been associated with the use of traditional cosmetics and remedies (Abdulla 1983; Al-Saleh 1990; Al-Saleh et al. 1993). However, other sources, especially lead-based paint, can pose a hazard particularly to children. Because most modern houses and buildings in Saudi Arabia were built during the 1970s and 1980s, one could speculate the lead in paint does not represent a potential source of lead exposure as in the West particularly for children prone to pica. The Saudi Arabian Standards Organization (SASO) has established that lead in paint should not exceed 0.06% lead by weight (SASO 1986). This has led us to measure lead content in different brands of paint manufactured in Saudi Arabia to check whether it is within the SASO permissible level.

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MATERIALS AND METHODS

One hundred forty-nine paints samples were collected from seven paint factories (A,B,C,D,E,F, and G) located in Saudi Arabia. In general, paint is made from three major components: solvent, binder, and pigment. In addition, almost all paints contain small amounts of additional materials known as additives such as driers. In this study, two types of paints were selected in this study; those based on the solvent white spirit (n=85) and those on water (n=64).

In a white spirit based paint the binder is dissolved in the solvent. When the paint is applied, the white spirit evaporates leaving a sticky dispersion of pigment in binder which, over a period of several hours, react with oxygen in the atmosphere to form a dry film. It is this reaction with oxygen which is speeded up by the metal driers. The water-based paints differ in that the binder is not dissolved in the water but it dispersed in the form of an emulsion. When these "emulsion paints" are applied, the water evaporates and the small particles of binder coalesce to form a coherent dry film. There is no reaction with atmosphere oxygen and hence no need for the presence of driers (Paint Research Association 1981). The number of paint samples selected from each factory whether solvent-or water-based are shown in Table 1. The main used of these selected paints is for interior and exterior decoration and protection.

Table 1. Number of paint samples collected from each factory.

Factory	Solvent-based paints	Water-based paints	Total
A	10	12	22
B	22	8	30
C	6	3	9
D	16	9	25
E	5	6	11
F	11	12	23
G	15	14	29

A thin layer of well-mixed paint sample was spread on a glass microscope slide (50 x 75 mm) and oven-dried at 120 C for two hours. Each paint sample was done in duplicate. 100mg of the dried paint was scraped off into a Teflon digestion vessel and 3 mL of concentrated "selectipur" nitric acid (E. Merck, D-6100 Darmstaot, Frankfurter Strasse 250 Germany) was added and placed into the oven at 150 C for one hour. After digestion, the samples were allowed to cool to room temperature. The solvent-based paint samples were diluted to 50mL with deionized water, whereas the water-based paint samples were diluted to 10mL. Hence, the solvent-based paint samples contain 5% nitric acid and the water-based paint samples contain 25%. After diluting and mixing, the digestate was centrifuged at 300 rpm (Dupont Sovall RT 6000 B) for 10 minutes and the clear supernatant was transferred into a clean tube. This method was recommended by Holack (1975). All lead analyses were performed using a Varian AA-40 atomic absorption spectrophotometer (Varian Techtron Pty. Ltd. Australia). Table 2 describes the flame conditions for the determination of lead in paint samples. Where high absorbance readings were obtained, further dilutions were made with either 5% or 25% nitric acid.

Table 2. Instrument parameters for the determination of lead in paint samples.

Wave length	217.0 nm
Slit width	1.0 nm
Lamp current	5.0 mA
Air flow	15.0 L/min
Acetylene flow	2.1 L/min
Photomultiplier volts	382.7
Aspiration rate	6.0 L/min

Working standard solutions were made up in the range 1.25 to 10ug/mL using 5% or 25% nitric acid solution depending on the type of paint to be analyzed. A calibration curve of absorbance versus concentration of lead was drawn and the concentrations of the unknown samples were read from the calibration graph. To check the accuracy of the method, a Standard Reference Material (SRM) 1579a, 11.99% lead (National Institute of Standards and Technology, NIST, Gaithersburg, MD, USA) was used. Our results were in good agreement with the NIST certified level (11.70% q 0.24) Quadruplicate determinations were made on all samples. The concentration of lead in paint samples were expressed as a percentage of dry weight.

RESULTS AND DISCUSSION

The mean percent of lead content in different brands of solvent-based paint samples (n=85) manufactured in seven different factories located in Saudi Arabia was 1.65% w/w (0 to 28.64% w/w). In all samples, the mean percent of lead content was higher than the SASO permissible level (0.06% lead by weight) as shown in Table 3. Of the 85 solvent-based paint samples, 63 paint samples (74%) had lead percent greater than 0.06% lead by weight. This might be related to the presence of driers an additive to paint. On the other hand, no lead was found in all the water-based paint samples. In conclusion, this study has shown that lead concentrations in solvent-based paint samples manufactured in Saudi Arabia may pose a potential health hazard particularly for children prone to pica. Also, one could anticipate that painted toys, furniture and pencils are potential hazards of special importance because of the extent to which they are normally chewed by children. In UK, a limit of 0.25% is now imposed on lead in paint applied to children's toys, whereas for paints used on pencils, pens, brushes, the limit is 0.025% (DHSS 1980).

Table 3. The percentage of lead content of solvent-based paint samples manufactured in Saudi Arabia.

Factory	n	Lead (%) (w/w)	Range		
A	10	1.87	0.050	-	15.09
B	22	0.23	0	-	0.67
C	6	0.37	0.01	-	0.70
D	16	4.38	0	-	28.64
E	5	0.23	0.17	-	0.31
F	11	0.35	0	-	2.50
G	15	2.59	0	-	17.08
Total	85	1.65	0	-	28.64

Indeed, the amount of lead added to Saudi paint is higher than the maximum permissible levels in many industrial countries; i.e 0.06% lead by weight in USA. Since no published data are available on lead in Saudi paint and its relationship to lead exposure, more investigation is needed to measure and evaluate the risk of exposure of Saudi children to leaded paint.

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