Lead-based paint on playground equipment in public children's parks in Johannesburg, Tshwane and Ekurhuleni

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Objective. To determine the use of lead-based paint in public playgrounds in the municipalities of Johannesburg, Tshwane and Ekurhuleni.

Methods. Forty-nine public parks were selected from the municipalities of Johannesburg, Tshwane and Ekurhuleni. Lead levels in paint on playground equipment were measured *in situ* using a hand-held Thermo Scientific NITON XLP 700 Series X-ray fluorescence (XRF) analyser.

Results. Playground lead levels ranged from 'too low to detect' to 10.4 mg/cm^2. The mean and median lead concentrations were 1.9 mg/cm^2 and 0.9 mg/cm^2 respectively. Forty-eight per cent of lead paint measurements exceeded the internationally accepted reference level of 1 mg/cm^2.

Conclusion. The study shows that lead-based paint is widely used in public playgrounds in the three study municipalities, and most likely throughout South Africa. We suggest key actions to ensure that children's playgrounds in South Africa are lead-free zones, and that childhood lead exposure in these settings is prevented.

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Lead is a highly versatile and widely used – yet toxic – heavy metal. Especially over the past century, its use has resulted in it becoming a global environmental contaminant.[1] In South Africa, lead has had many uses such as in petrol, paint, batteries, solder, electrical appliances, fishing weights and road markings. A large and mounting body of evidence has associated lead exposure in children with health and social sequelae, including hyperactivity, shortened concentration spans and learning difficulties at school, even at very low concentrations of lead in the blood.[2] Local studies have shown that lead poisoning is a major public health concern for South African children and that comprehensive action is required to tackle the problem.[3] A 2002 survey of blood lead levels of Grade 1 children at Johannesburg schools showed that levels ranged from 1.1 µg/dl to 44.4 µg/dl (SD 3.59); mean and median concentrations were 9.1 µg/dl and 8.9 µg/dl respectively; and 35% of levels were ≥10 µg/dl – the internationally accepted level at which action should be taken.[4]

The use of leaded petrol was discontinued on 1 January 2006, but lead-based paint is still used in South Africa, sometimes at high concentrations.[5] Over time, because of exposure to sunlight, heat and moisture, and normal wear-and-tear, paint may peel or chip, with potential contamination of the environment[6] or direct ingestion, especially by children with pica (ingesting non-food items such as paint chips, soil, sticks, cigarette butts, matchsticks). Even at the conclusion of the present legislative process to regulate the use of lead in paint manufactured in South Africa, the past application of lead-based paint to homes, schools, playground equipment, toys and other items will pose a risk of lead poisoning in children for decades to come.

A survey was conducted in 2008 to determine the extent of use of lead-based paint in public children's playgrounds in the municipalities of Johannesburg, Tshwane and Ekurhuleni in Gauteng Province. The study was prompted by an article about a Canadian child who had suffered lead poisoning after the ingestion of lead-based paint chips from a playground.[7] Earlier studies had demonstrated the use of lead-based paint in South African dwellings and schools.[8] This article outlines the findings of the survey of lead-based paint in children's parks in the Gauteng region, and makes recommendations to reduce the risk of lead exposure and poisoning from this source.

Methods

A total of 49 children's playgrounds were selected, in partnership with Parks Department officials, from the municipalities of Johannesburg (19 parks), Tshwane (21 parks), and Ekurhuleni (9 parks). Because of a municipal strike during the fieldwork, data collection had to be terminated earlier than planned in Ekurhuleni. The parks were specifically selected

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to include locations across the wealth spectrum in each municipality. Lead levels in paint on playground equipment were measured *in situ* using a portable, hand-held Thermo Scientific NITON XLP 700 Series X-ray fluorescence (XRF) analyser. Measurements were done on a variety of paint colours on playground equipment (swings, slides, jungle gyms, seesaws, etc.). The state of the paint (whether it was chipped or not) was also recorded. Lead measurements were entered into the STATA version 9 statistical package for analysis.

The paints' measured lead levels were assessed against the reference level adopted by the USA Environmental Protection Agency of 1 mg/cm^2 or 5 000 µg/g by weight (0.5%)[9] (South Africa has not set a reference level). In the USA, paint with a lead concentration at or above 1 mg/cm^2 is deemed to be lead-based, and regulatory guidelines exist regarding the safe removal and disposal of such paint to hazardous waste disposal sites by professionally qualified and suitably protected individuals.[9]

Results

Table I gives the distribution of paint lead concentrations for the total sample and by municipality. In terms of the total sample, paint lead concentrations ranged from 'too low to detect' to 10.4 mg/cm^2 (i.e. up to 10 times higher than the international reference level of 1 mg/cm^2). The mean and median paint lead concentrations were 1.9 mg/cm^2 and 0.9 mg/cm^2, respectively. Of the 2 416 lead measurements taken, around half (48%) were elevated. High paint lead concentrations were found on all types of playground equipment and in all colours of paint tested; however, the highest lead concentrations were found in yellow and red paint.

In each of the three municipalities, at least one sample of lead-based paint was found in most public playgrounds studied, ranging from 95% of parks in Johannesburg to all parks in Tshwane. In only 2 (4%) of the 49 parks studied were all paint lead concentrations found to be below the reference level. This positive finding was a matter of chance rather than a consequence of municipal policy implementation. In some parks, the use of lead-based paint was limited, with only 8% of measurements indicating its presence. However, the use of lead-based paint in other parks was more widespread (94%). Of concern was the high prevalence of chipping or peeling of paint from playground equipment in all of the parks and municipalities, which increases the risk of lead contamination of the environment.

Discussion

Our study has shown that hazardous lead-based paint, sometimes at very high concentrations, is widely used in children's playgrounds in the Gauteng metropoles, and very probably throughout the country. Lead-based paint from playground equipment is most likely not the predominant or even significant contributor to the currently unacceptable levels of lead poisoning among South African children. To date, no case of lead poisoning in a child from the ingestion of lead-based playground equipment has been recorded. However, the possibility exists that in settings where lead-based paint is widely used and there is considerable peeling or flaking of paint (as in the playgrounds in this study), local environmental

Table I. Playground paint lead distribution (mg/cm^2) by municipality

	Johannesburg	Ekurhuleni	Tshwane	Total sample
Number of parks	19	9	21	49
Number of readings	843	325	980	2 416
Minimum	TLTD*	TLTD*	TLTD*	TLTD*
Maximum	6.8	8.9	10.4	10.4
Median	0.7	0.7	1.2	0.9
Mean	1.1	1.2	1.8	1.9
Standard deviation	1.2	1.6	1.9	1.6
Percentage of measurements >1 mg/cm^2	40%	37%	58%	49%
Percentage of parks with chipped paint	87%	86%	79%	83%
Percentage of parks with elevated paint lead concentrations	95%	89%	100%	96%
Range in proportion of elevated paint lead measurements in parks with lead-based paint	8 - 89%	8 - 67%	10 - 94%	8 - 94%

*Too low to detect.

lead levels could be elevated to some extent. For some children, especially those with pronounced mouthing behaviour or pica for paint or soil, there is an increased risk of exposure to environmental lead. For example, the blood lead level of a Canadian child was found to be 41.4 µg/dl after ingestion of paint chips from a local playground. Paint samples taken from the playground equipment and fencing around the park in which the child regularly played were found to have lead concentrations well in excess of international reference levels.[7]

Internationally, precautionary action is necessary concerning children's environmental health. Consequently, even though the risk of lead poisoning from ingesting chips of lead-based paint in children's playgrounds is most probably low, we nevertheless suggest that parks and recreation departments ensure that all children's playgrounds are lead-free zones. Local authorities throughout the country should immediately discontinue the use of hazardous lead-based paint on equipment and other items (e.g. benches, fencing) in public playgrounds. As far as possible, and especially where there is evidence of peeling paint, public playgrounds should be assessed to determine the prevalence of lead-based paint. Where lead-based paint is found, it must be removed in a manner ensuring no or minimal contamination of the playground; workers must be adequately protected during this process; and it must be disposed of in a hazardous or other suitable waste dump site. Parks departments could also encourage hand washing after use of playgrounds, and alert child caregivers to the risk of lead exposure and poisoning in park users with pronounced mouthing behaviour or pica.

While this study was undertaken in children's public playgrounds administered by three municipalities, it is probable that a similarly high prevalence of lead-based paint may be found in other settings with painted playground equipment, e.g. schools, pre-school institutions and private homes. Widespread education campaigns should be conducted to raise the awareness of potential lead hazards and their management.

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