Available online at www.sciencedirect.com
SCIENCE DIRECT
Science of the Total Environment 359 (2006) 111–119
Science of the Total Environment
An International Journal for Scientific Research into the Environment and its Relationship with Humankind
www.elsevier.com/locate/scitotenv

Dealing with lead in Broken Hill—Trends in blood lead levels in young children 1991–2003

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Received 11 January 2005; accepted 20 April 2005
Available online 31 May 2005

Abstract

The objective of the study was to investigate trends in blood lead concentrations in preschool children between 1991 and 2003, as part of the evaluation strategy of a public health lead management program in Broken Hill, Australia. Since 1991, all Broken Hill children aged 1–4 years have been offered at least annual blood lead screening as part of a community-wide lead management program. Recruitment of children was promoted throughout the period using local media and distribution of promotional material from health care centres and preschool, childcare, and educational facilities around the city. Venous blood samples were collected using standard procedures and analyses were subjected to internal and external quality control programs. Because the frequency distribution of blood lead levels are skewed, geometric rather than arithmetic means were used for comparative purposes. Trend analysis was based on age and sex standardised mean blood lead levels. The number of 1- to 4-year-old children screened ranged between 496 and 948 in any one year and response rates varied between 39% and 73%. The age–sex standardised mean blood lead level decreased from 16.3 μg/dL to 7.1 μg/dL between 1991 and 2003. Overall, blood lead levels declined by 56% over 13 years. These reductions were consistently observed irrespective of age or where a child lived in the town. The rate of decline has slowed since 1997. We conclude that substantial progress has been made in dealing with the lead problem in Broken Hill children, although the rate of decline of blood lead levels has slowed. Continued public health action is still needed to bring the proportion of young children with significantly elevated blood lead levels (>15 μg/dL) down from the 2003 figure of 12% to the NHMRC community-based target for lead in young Australians of 5%.

Keywords: Blood lead levels; Children; Community remediation programs; Broken Hill

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doi:10.1016/j.scitotenv.2005.04.022

1. Introduction

Broken Hill, a city of over 20,000 people, was founded in 1883 following the discovery of one of the world's richest deposits of silver–lead–zinc (Solomon, 1988). Mining activities, including smelting in the town for a short period at the end of the nineteenth century, have continued to the present day.

Lead poisoning was evident amongst the early miners and their families and was viewed as primarily an occupational hazard (Thompson, 1898). Around the centenary of Broken Hill, Australia, a growing appreciation emerged of the impact lead might be having on the community at large. As evidence accumulated elsewhere about its detrimental effects on intellectual development and behaviour in young children the significance of environmental exposure to lead gained prominence as a public health issue. A survey of school-aged Broken Hill children in 1982 found that all had blood lead levels below the then National Health and Medical Research Council (NHMRC) level of concern [40 μg/dL] (Woodward-Clyde, 1993; Phillips, 1998).

The recommissioning of open-pit mining and a drought in the late 1980s saw the rise in veterinary notifications of lead poisoning in dogs. A second survey conducted among preschool-aged children in 1991 showed that one fifth of children were above the revised NHMRC level of concern [25 μg/dL] (NHMRC, 1993). What followed was the development of short and long term strategies for amelioration of the effects of lead contamination in Broken Hill.

1.1. Program development

The re-evaluation of lead as a community health issue at the beginning of the 1990s occurred with the revitalisation of public health services in NSW (Morey, 1990) and was informed by the emerging evidence about the health effects of lead, particularly in preschool-aged children, the results of a blood lead survey in Broken Hill during 1991 and the downward revision of National Health and Medical Research Council's level of concern.

In early 1992, the NSW Environment Protection Authority made funding available to i) investigate potential hazard sources (storage points for lead in the environment) and exposure pathways (the ways in which lead moves from the sources to children) in Broken Hill, ii) support control measures such as public education and limited case management, and iii) develop an organised strategy. Evidence accumulating from Trail in Canada (Trail Lead Program, 1994) and elsewhere (Davies et al., 1987) suggested that exposure to lead in the home environment was a major determinant of blood lead levels in young children.

Several factors influenced the approach taken to deal with the lead problem.

The first related to the fact that lead in Broken Hill is ubiquitous. The distribution and concentration of lead in soil and dust around the city has been shaped by the natural weathering and dispersion of contaminated dust prior to settlement, past mining and mine waste management practices, and the impact of wind and water erosion on the mine leases and other lead contaminated sites. Control of lead hazards at their sources by removal of contaminated overburden and soil or by revegetation was not a feasible proposition due to the large areas and semi-arid conditions.

Second, young children were most likely to become exposed to lead through contact with contaminated soil around the home and dust in the living space of the home. The indoor dust is continuously replenished from entrapped dust in home linings as well as that entering the house directly from the outdoor environment (Phillips, 1998). A significant component of this lead arose from the ore body (Gulson et al., 1994).

Third, Broken Hill weather is dry and windy allowing for ongoing and irregular dispersion patterns from leases and other contaminated sites and the redistribution of lead dust outside those sites, around the town and into people's homes.

Thus the lack of a single source of lead, and its widespread distribution in and around the city, meant that cleaning up the whole town and preventing the further release of lead into the environment was not feasible as a primary strategy. The situation required a more targeted approach that dealt with specific sources that could be linked to children with a high blood lead level, both reducing the amount of hazard at the probable source and modifying the rate or spatial distribution of release of lead that remained.

This approach was underpinned by a range of educational, behavioural, and environmental interventions aimed at all children and specifically reinforced