

CASE REPORT

Lead poisoning in shooting-range workers in Gauteng Province, South Africa: Two case studies

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Background. Lead exposure constitutes a major public health concern globally. Relative to developed nations, lead exposure is understudied and poorly addressed in Africa, and there is a dearth of information available to inform lead poisoning prevention strategies, even in high-risk groups such as workers in shooting ranges who are potentially exposed to lead daily.

Methods. Two workers at a private shooting range in Gauteng, South Africa (SA), had blood lead levels and exposure histories taken.

Results. Workers had highly elevated blood lead levels and clinical symptoms associated with elevated blood lead levels.

Conclusion. Workers in private SA shooting ranges are vulnerable to lead exposure and poisoning, and scaled-up action is required to protect them and their families, as well as shooting-range users, from lead and the related health risks.

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Its many useful properties have resulted in lead being widely used in modern life. However, research has revealed lead to be highly toxic and associated with a wide range of detrimental health effects, including impaired cognitive function,^[1] hearing deficits, behavioural abnormalities, aggressive behaviour,^[2] anaemia and other clinical effects, as well as a range of nonspecific effects, such as joint pain, headaches, weight loss, abdominal pain and in severe cases, muscular paralysis, coma and death.^[3]

While lead exposure is a recognised public health concern in Africa,^[4] there is a paucity of research information available to describe the levels and pathways of exposure to lead in the general public, as well as in specific high-risk settings. Shooting ranges, for example, have been established to be a setting of high risk for lead exposure elsewhere in the world,^[5-7] but little information is available, to our knowledge, on the lead exposure situation in South African (SA) shooting ranges. Here, two case studies of elevated lead exposure in workers at a private shooting range in Gauteng Province are described.

Methods

In 2014, blood lead analyses were undertaken in two workers at a private indoor shooting range in greater Johannesburg. Blood lead levels were determined using a LeadCare II (Magellan Diagnostics, USA) portable testing system, with a 50 µL aliquot of whole blood obtained from a finger prick following the thorough washing of hands with soap and water. Ethical approval for this work, which was part of a broader cross-sectional survey of the blood lead levels of users of indoor shooting ranges, was obtained from the Human Research Ethics Committee of the SA Medical Research Council. Written, informed consent was obtained from all participants prior to enrolling them in the study.

Results

Case 1

A 63-year-old woman living in an informal settlement on the periphery of Johannesburg had a laboratory-confirmed blood lead level of 42.8 µg/dL. She had been employed at the indoor shooting range as a cleaner for the previous 22 years, before which she had been employed as a domestic worker. She was responsible for cleaning the entire range and collecting spent ammunition, which the shooting-range owner sold for lead recycling.

The range was poorly ventilated and not fitted with air filtration devices. The walls in the shooting range were padded with a rippled, spongy material in an effort to reduce noise, and some of the floors were carpeted. Both these materials serve as traps for dust present in the range, and the spongy material, originally yellowish in colour, had deeply blackened over time. She cleaned the range predominantly using a dry duster, dry broom and ordinary domestic vacuum cleaner, and was not provided with personal protective equipment. She neither hunted nor practised gun shooting, and had no other identifiable source of lead exposure.

She reported long-standing type 2 diabetes mellitus, essential hypertension and rheumatoid arthritis, for which she was receiving treatment. She described her general health as fair, but complained of paraesthesiae in her hands and feet, and experienced occasional abdominal cramps. She had been pregnant five times, and one had ended in a miscarriage in 2000.

Case 2

A 27-year-old man living in a suburban area south-east of Johannesburg had a laboratory-confirmed blood lead level of 60.0 µg/dL. He had been employed at the indoor shooting range for the previous 3 years, where he worked as an administrator and instructor. He

had been shooting for 9 years, and practised on a weekly basis for around 30 minutes. Most often he used a handgun, but on occasion would also use a shotgun or rifle. He mainly used non-jacketed (lead head) bullets. He was not a hunter. He always used hearing protection, sometimes eye protection but no other personal protective equipment. He sometimes placed bullets in his mouth and often ate at the range. He reported always washing his hands after shooting. He was a tobacco smoker and smoked at the range. He was unaware of any other sources of exposure to lead outside his work environment.

He reported no major health concerns, but during the previous 2 years he and his family had observed changes in his mood and difficulty controlling anger. He also reported abdominal cramps and paraesthesiae in his hands and feet.

Discussion

The case studies presented here raise concerns over the potential for high levels of exposure to lead among workers in privately owned SA shooting ranges. Both workers had highly elevated blood lead levels, and no evidence of alternative sources of exposure. The blood level lead of case 2 (60 µg/dL) was sufficiently elevated to require removal from his duties or workplace in terms of lead regulations promulgated under the umbrella of the SA Occupational Health and Safety Act No. 83 of 1993. Yet, for both of the cases, despite long periods of work in a high lead-exposure setting (case 1 had worked at the range for 22 years), this was the first occasion on which they had undergone a blood lead test, indicating the need for a higher level of occupational health monitoring and vigilance in this vulnerable group of workers. Both workers reported symptoms, for example paraesthesia in extremities, consistent with lead poisoning.

Observations at the range revealed concerns regarding the inadequate design of the infrastructure (such as the absence of effective ventilation systems), floor and wall surfaces that could trap dust and that were not easy to clean (such as carpeted floors and spongy wall finishes), poor hygiene facilities and practices (disposable towels and soap were not provided) and poor housekeeping (the range was being cleaned with ordinary domestic brooms and dry cloths, rather than wet cleaning and the use of a high-efficiency particulate air vacuum cleaner). In addition, the workers' knowledge of lead hazards was weak, as has been shown to be the case more broadly in SA.^[8]

Apart from the direct exposure to lead in shooting-range workers, there is also concern over the indirect exposure to lead among their family or household members. Lead particles may be transported from the range, via the skin, hair, clothing and footwear of the workers, into their homes, thus indirectly causing others

to be exposed to lead. Workers' clothing was also being washed together with that of their household members, constituting another potential indirect pathway of lead exposure for their families. In the interests of workers and their families, it is therefore imperative that the health, labour and industrial/commercial sectors join forces to ensure that measures are put in place to eliminate or significantly reduce lead exposure in shooting-range workers. These might include lead hazard awareness campaigns, the institution of shooting-range monitoring and surveillance programmes, and the development of guidelines or standards for the design and fitting of private shooting ranges in South Africa.

Conclusion

This study has shown highly elevated worker exposure to lead at an SA shooting range, with one of the two workers having a blood lead level that requires removal in terms of SA lead regulations. Numerous opportunities for lowered lead exposure were identified, including improved ventilation, personal hygiene, lead hazard awareness, improved housekeeping, worker monitoring and surveillance programmes at ranges and the drafting of guidelines or standards for the design and fitting of shooting ranges.

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1. Bellinger D, Dietrich KN. Low-level lead exposure and cognitive function in children. *Pediatr Ann* 1994;23(11):600-605. <https://dx.doi.org/10.3928/0090-4481-19941101-08>
2. Needleman HL, McFarland C, Ness RB, Fienberg SE, Tobin MJ. Bone lead levels in adjudicated delinquents. A case control study. *Neurotoxicol Teratol* 2002;24(6):711-717. [https://dx.doi.org/10.1016/s0892-0362\(02\)00269-6](https://dx.doi.org/10.1016/s0892-0362(02)00269-6)
3. Tong S, von Schirnding YE, Prapamontol T. Environmental lead exposure: A public health problem of global dimensions. *Bull World Health Organ* 2000;78(9):1068-1077.
4. Nriagu JO, Blankson ML, Ocran K. Childhood lead poisoning in Africa: A growing public health problem. *Sci Total Environ* 1996;181(2):93-100. [https://dx.doi.org/10.1016/0048-9697\(95\)04954-1](https://dx.doi.org/10.1016/0048-9697(95)04954-1)
5. Fayiga A, Saha U. Soil pollution at outdoor shooting ranges: Health effects, bioavailability and best management practices. *Environ Pollut* 2016;216:135-145. <https://dx.doi.org/10.1016/j.envpol.2016.05.062>
6. Abudhaise B, Alzoubi M, Rabi A, Alwash R. Lead exposure in indoor firing ranges: Environmental impact and health risk to the range users. *Int J Occup Med Environ Health* 1995;9(4):323-329.
7. Beaucham C, Page E, Alarcon WA, Calvert GM, Methner M, Schoonover TM. Indoor firing ranges and elevated blood lead levels – United States, 2002 - 2013. *Morb Mortal Wkly Rep* 2014;63(16):347-351.
8. Haman T, Mathee A, Swart A. Low levels of awareness of lead hazards among pregnant women in a high risk Johannesburg neighbourhood. *Int J Environ Res Public Health* 2015;12(12):15022-15027. <https://dx.doi.org/10.3390/ijerph121214968>

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