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Health Consultation: Midvale Slag (8071)
Midvale, Utah

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BACKGROUND AND STATEMENT OF ISSUES

As recommended in the Agency for Toxic Substances and Disease Registry's (ATSDR) "Site Review and Update" for the Midvale Slag site [1], ATSDR has prepared this consultation to address the public health implications of contaminants in drinking water, in indoor air, in soil off site, and in soil along the right-of-way of a proposed road through the site.

The Midvale Slag Site (MSS) is an inactive facility encompassing approximately 330 acres in Midvale, Utah, about twelve miles south of Salt Lake City [2]. Large amounts of slag were generated during copper and lead smelting activities which occurred on site from about 1906 to 1958. From 1964 until 1992, the site was used to produce material for railroad beds, road bases, and fill, and aggregate for shot and grit blasting [3]. Approximately two million tons of slag remain on site [1].

MSS is in a mixed commercial/residential area along the Jordan

River. The Winchester Estates Mobile Home Park, a retirement community, is at the site's northern boundary, but there are only a few other houses near the site [1]. Schools, hospitals, parks, and a golf course are within a half-mile [3]. The Sharon Steel National Priorities List (NPL) site is also nearby [1].

Lead, arsenic, and cadmium have been identified as contaminants of concern on site. In August 1990, the Environmental Protection Agency (EPA) erected a fence to prevent people from entering the property. EPA has also vegetated sections of MSS to reduce the amount of contaminated soil that can blow off site [1].

Samples from the Winchester Estates Mobile Home Park indicate that significant contamination exists in surface and subsurface soil. Lead has been found in one 0-2 inch sample at a concentration of 3110 parts per million (ppm), in four other 0-2 inch samples at concentrations over 1000 ppm, and in one 2-6 inch sample at a concentration of 4930 ppm. Arsenic has been found in two 0-2 inch samples at concentrations around 360 ppm and in one 2-6 inch sample at a concentration of 1860 ppm [3].

On-site soil along the right-of-way for a proposed road is also contaminated. One-foot composite soil samples were collected to a depth of six feet or more depending on the presence of fill material. Lead was found at a maximum concentration of 31,500 ppm and in 20 locations at concentrations in excess of 1000 ppm. Arsenic was identified in one subsurface soil sample at a

concentration of 3170 ppm, in one subsurface sample at a concentration of 1460 ppm, and in 22 locations at concentrations above 100 ppm. The cadmium contamination was not as significant, although a couple of locations had cadmium in excess of 50 ppm, and one sample had a cadmium concentration of 246 ppm [2].

Indoor air at the Winchester Estates Mobile Home Park has not been sampled, but five dust samples were collected from homes there. The reported lead concentrations were 1983 ppm, 1740 ppm, 744 ppm, 524 ppm, and 463 ppm [3]. A background sample had a lead concentration of 1167 ppm, a cadmium concentration of 4319 ppm, and an arsenic concentration of 272 ppm [3]. ATSDR does not have information on the source or extent of the background sample's contamination.

There is no information indicating that residences in the area use private well water for drinking [1]. Private well water is used for irrigation purposes only at Winchester Estates, so people there are not being exposed to site contaminants in their drinking water.

DISCUSSION

Lead

Certain segments of the population are very susceptible to lead's health effects. For example, lead in the environment may cause serious adverse health effects in young children and fetuses [4].

Factors accounting for this susceptibility include 1) the immaturity of the blood brain barrier which allows entry of lead into the immature nervous system; 2) hand-to-mouth behavior and pica behavior (eating material not fit for food) which leads to consumption of lead contaminated media; 3) enhanced gastrointestinal absorption of lead (affected by the nutritional status of the child); 4) low body weight; and 5) the ready transfer of lead across the placenta to the developing fetus. Pregnant women, the elderly, smokers, alcoholics, people with genetic diseases affecting heme synthesis (a blood disorder), the poorly nourished, and those with neurological or kidney dysfunction are also likely to be sensitive to lead's effects [5].

Studies [5] indicate that ingestion and inhalation of lead contaminated soil can lead to elevated blood lead levels. According to the Centers for Disease Control and Prevention (CDC), blood levels are raised, on average, about 5 micrograms of lead per deciliter of blood (ug/dl) for every 1000 ppm of lead in soil or dust [6]. Other research suggests that blood lead levels may increase much more than the mean response depending on exposure conditions such as play habits and mouthing behavior [7].

Adverse health effects may occur with relatively small increases in blood lead levels and after exposure to relatively small amounts of lead. Blood lead levels above 10 ug/dl have been

associated with developmental effects in fetuses and hearing impairment, growth impairment, and reductions in intelligence quotient (IQ) in children. Prenatal exposure to lead (8-14 ug/dl fetal cord blood lead level) is associated with premature delivery, decreased birth weight, impaired postnatal neuro-behavioral development, and decreased postnatal growth. Reductions in erythrocyte ALA-D (a blood enzyme) production in adults have been demonstrated at an ingested dose of 0.02 milligrams of lead per kilogram body weight per day (mg/kg/day) for three days and at air concentrations of as little as 3 micrograms of lead per cubic meter of air (ug/m³) for three to four months [5].

Arsenic and Cadmium

Specific subgroups of the population that are susceptible to the effects of arsenic and cadmium have not been unequivocally identified. However, certain people prove more sensitive to these metals than others. The genetic make-up, developmental stage, health and nutritional status, and chemical exposure history of these individuals apparently contribute to reduce the efficiency of the body's detoxification and excretory processes [8,9]. For these reasons, the elderly, with declining organ function, and the young, with immature and developing organs, are generally more vulnerable to both of these metals than healthy adults.

Chronic inhalation or ingestion of inorganic arsenic may result

in cancer. Epidemiological studies indicate that the risks of cancer increase as the exposed concentration increases. Airborne concentrations of arsenic that resulted in an increased incidence of respiratory cancer ranged from 10 to 300 ug/m³. Levels of ingested arsenic which resulted in an increased incidence of skin or internal cancer ranged from 0.009 to 0.04 mg/kg/day [8].

Chronic exposure to arsenic can also result in a variety of noncarcinogenic adverse health effects. Ingestion of low levels of arsenic has been shown to cause gastrointestinal disturbances (0.05 mg/kg/day for 2-3 weeks), pigmentation of the skin (0.05 mg/kg/day for 0.5-15 years), peripheral neuropathy (a disorder of the nervous system) (0.05 mg/kg/day for 0.5-15 years), and adverse cardiovascular effects (0.05 mg/kg/day for 2-3 weeks). Inhalation of arsenic has been shown to cause adverse immunological effects in laboratory animals at levels as low as 0.94 mg/m³ for exposures of less than one week and 0.5 mg/m³ for four week exposures [8].

Cadmium is a probable human carcinogen through inhalation. Epidemiological studies are not conclusive as to whether inhaling cadmium has caused cancer in people occupationally exposed. However, animal studies do indicate that chronic inhalation exposure can cause lung cancer in rats [9].

Regarding cadmium's noncarcinogenic effects, the kidney is the most sensitive organ when exposure occurs. Following ingestion

and absorption from the gastrointestinal tract or after inhalation, cadmium distributes throughout the body. However, it preferentially accumulates in the kidney and liver. It is excreted very slowly. Cadmium concentrations in the kidney are near zero at birth, but they increase roughly linearly with age and peak between ages 50 - 60. After the age of 60, they begin to decline. Human studies indicate that adverse renal effects may occur when the concentration of cadmium in the renal cortex exceeds 200 micrograms per gram wet weight [9].

Estimating Exposure

The primary routes of human exposure to the contaminants at the Midvale Slag site are ingestion and inhalation. Ingestion of contaminated soil via hand-to-mouth activities is probably the dominant route of exposure, particularly for children. However, inhalation of airborne particulates may also be significant. Metals in bare soil and interior dust are in areas where direct contact with the contaminated medium is most likely. Consequently, people active in dusty or dirty areas are at the greatest risk of being exposed. People may also ingest cadmium, arsenic, or lead that may be on or in home-grown vegetables.

Although significant contamination exists on and off site, it is difficult to determine whether people will come in contact with contaminated soil or dust in ways that may affect their health. This difficulty is evident in the four exposure scenarios considered below.

1. In the Winchester Estates Mobile Home Park, arsenic in surface soil is at levels where long-term exposure may represent an increased risk of cancer. However, Winchester Estates is a retirement community, and the residents may not frequently come in contact with contaminated soil (from gardening, digging, etc.) or be exposed for long enough periods to result in an increased risk of cancer.

2. Lead levels are elevated in Winchester Estates soil and dust. Adults are probably not at risk because of their decreased susceptibility to lead. If children visit or play in the area, the chances of health problems increase. Soil and dust lead levels are high enough to result in adverse health effects if a child ingests contaminated soil or dust (500 milligrams) even over a short time (3-5 days).

3. People involved in the road's construction and use may be exposed to metals at levels of concern, but good estimates of the concentrations of the metals in right-of-way soil are not available because the reported data are based on one-foot composite samples. Moreover, and more importantly, people may or may not come in contact with the contaminants during and after construction because much of the contamination is currently beneath the surface.

4. A background sample has significant lead, arsenic, and cadmium contamination. All three metals are at levels that are

potentially hazardous. However, there is no information in ATSDR files describing the location of this background sample and indicating if people are being exposed.

CONCLUSIONS

1. Lead in soil and dust at the Winchester Estates Mobile Home Park represents a threat to the health of children who may visit or play in the area.
2. Arsenic in soil at the Winchester Estates Mobile Home Park represents a threat to public health if long-term exposure occurs.
3. Metals in the background sample taken for the mobile home park represent a threat to public health if people are being exposed.
4. Home-grown vegetables from the mobile home park may also be contaminated.
5. The metals in right-of-way soil represent a potential threat to human health. Whether people are exposed depends in part on how subsurface contaminants are relocated when the road is built.
6. Ground water is probably not used as drinking water in the

area of the MSS.

RECOMMENDATIONS

1. Prevent exposure to contaminated soil and dust at the Winchester Estates Mobile Home Park. Advise residents of ways to reduce exposure, such as regular cleaning of the living areas where children and other sensitive people spend their time.
2. Take blood lead samples of children who play in or visit the mobile home park. Reevaluate the blood lead levels if exposure becomes more likely, as in spring and summer when children spend more time outdoors.
3. Ensure that people in the area of the Winchester Estates background sample are not being exposed to metals at levels of health concern.
4. Ensure that home-grown vegetables from the mobile home park are not contaminated.
5. Ensure that people building and using the proposed road are not being exposed to lead, arsenic, or cadmium at levels of health concern.

If further clarification is required or if additional information becomes available for review, please do not hesitate to contact me at (404) 639-0628.

Steven J. Hanes, Ph.D.

REFERENCES

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