MedicalXpress

Kids' risks from toxic metals in dirt downplayed using standard tools

June 25 2014

Current approaches may be underestimating the risks posed to children by toxic metals that they are exposed to while playing outdoors, according to Japanese researchers. The researchers used a new approach that they developed for their study of how much dirt and associated metals adheres to children's hands. They found that lead, chromium, zinc and other heavy metals adhere more to smaller soil particles than to the larger particles typically employed in soil exposure studies. That finding suggests using the researcher's new approach going forward to better assess children's soil-related risks.

Children's ingestion of contaminants through soil has long been a concern of the U.S. Environmental Protection Agency and its counterparts in other nations, so the study by researchers in Japan adds new insights into better protections for children and the risks posed by soil-related exposures.

As the study explains, soil ingestion is one of the most important pathways through which children are exposed to toxic substances. Children have higher exposure rates from soil than adults because of their hand-to-mouth behavior. As they play outside in dirt mounds and playgrounds, there is a risk that children will ingest soil particles and heavy metals which may have been underestimated by researchers to date.

For the study, researchers collected soil samples from 58 playgrounds located in Kyoto City in Japan and used a standard 2-millimeter (mm),

or 2,000 microns (μm), "sieving system" to measure the quantity of heavy metals in the soil. But, according to the paper by Maiko Ikegami of Kyoto University's Research Reactor Institute and colleagues, using "2-mm sieving in preparation for measuring heavy metal content caused underestimation of the risk of direct soil intake." The paper, "Effect of Particle Size on Risk Assessment of Direct Soil Ingestion and Metals Adhered to Children's Hands at Playgrounds," has been posted electronically in *Risk Analysis: An International Journal*, published by the Society for Risk Analysis. Dr. Ikegami's collaborators include Minoru Yoneda, Takashi Tsuji, Osamu Bannai, and Shinsuke Morisawa.

As part of their study, the researchers adopted a hydrochloric acid (HC1) extraction method, which is thought to be capable of measuring the approximate quantity of heavy metals that can be absorbed by the human body. It is used for extracting heavy metals to evaluate the risk of direct soil ingestion. A basic expectation of current soil risk analysis is that soil particles that adhere to the body or are ingested directly from the air will be smaller than 2 mm in size. Some studies have shown, however, that the concentration of metals in soil increases with smaller particle sizes, such as particles less than 45 μm.

For the study, 69 children in a Kyoto City nursery school were selected "to measure the amounts of metal adhered to their hands on a clear day." After playing outside for 30 minutes, the children had their hands—including fingers, thumb and palm—wiped with cotton pads wetted with purified water. The amount of soil adhered to the children's hands was estimated from the quantity of metals on their hands.

In conducting their evaluation of particle-size distribution of soil adhered to human hands, the researchers first removed large soil particles that were not obviously adhered to hands from the surface area. After some students' hands were washed and dried, they were rubbed on the surface soil for 30 seconds, moving in a 60-centimeter-wide

horizontal direction at 30 times per minute. Soil was removed from the students' hands by tapping the hands without washing until soil particles no longer fell off. Their hands were then washed in 300 milliliters of ultrapure water, creating a liquid sample whose particle-size distribution was then measured.

"To accurately evaluate the risk, it is important to understand what size of the soil particles children ingest directly," according to the paper. The study "found that smaller particles had a tendency to contain more heavy metals than bigger particles." According to the authors, the HC1 extraction method using samples of soil smaller than 2 mm "may underestimate the risk of direct soil ingestion if the soil size ingested is usually much smaller than 2 mm." Researchers measured the particle-size distribution of soil adhered to three students' hands, producing a particle-size distribution for all samples of 0.22–313.08 μm. Results indicated that approximately 90 percent of soil particles remaining on the hands were less than 100 μm, suggesting that laboratories and researchers should transition to the method used by the authors in order to avoid underestimating children's risks.

In general, the researchers conclude that more careful methods for assessing soil ingestion are necessary to protect children who ingest soil with metals while playing on dirt playgrounds, near hazardous waste sites, or in areas with heavy vehicle traffic. Also of concern are so-called "pica children," those with the unusual habit of deliberately ingesting large amounts of soil and the associated contaminants.

More information: The complete study is available online: onlinelibrary.wiley.com/doi/10 … 1111/risa.12215/full

Provided by Society for Risk Analysis