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Data Article

Environmental monitoring and exposure science dataset to calculate ingestion and inhalation of metal(loid)s through preschool gardening

Iliana Manjón [a, d], Mónica D. Ramírez-Andreotta [a, b, *], A. Eduardo Sáez [c], Robert A. Root [a], Joanne Hild [e], M. Katy Janes [f], Annika Alexander-Ozinskas [e]

[a] *Department of Environmental Science, University of Arizona, Tucson, AZ, USA*
[b] *Mel and Enid Zuckerman College of Public Health's Division of Community, Environment & Policy, University of Arizona, Tucson, AZ, USA*
[c] *Department of Chemical and Environmental Engineering, University of Arizona, Tucson, AZ, USA*
[d] *University of Arizona College of Medicine — Tucson, Tucson, AZ, USA*
[e] *Sierra Streams Institute, Nevada City, CA, USA*
[f] *California Department of Water Resources, Sacramento, CA, USA*

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ABSTRACT

Metal(loid) contamination may pose an increased risk of exposure to children residing near legacy and active resource extraction sites. Children may be exposed to arsenic, cadmium, and/or lead by ingestion and/or inhalation while engaging in school or home outdoor activities via environmental media including water, soil, dust, and locally grown produce. It is thus critical to collect site-specific data to best assess these risks. This data article provides gastric and lung *in-vitro* bioaccessibility assay (IVBA) data, as well as environmental monitoring data for water, soil, dust, and garden produce collected from preschools (N = 4) in mining communities throughout Nevada County, California in 2018. Arsenic, cadmium, and lead concentrations in the aforementioned media and synthetic gastric and lung fluids were measured by inductively coupled plasma-mass spectrometry (ICP-MS). This dataset provides useful metal(loid) concentrations for future risk assessments for similar settings.

* Corresponding author. Department of Environmental Science, University of Arizona, Tucson, AZ, USA.
E-mail address: mdramire@email.arizona.edu (M.D. Ramírez-Andreotta).

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Specifications Table

Subject	Environmental Science
Specific subject area	Environmental Health
Type of data	Tables
How data were acquired	Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) Model: Agilent 7700 (ICP-MS) and Agilent 8900 (ICP-QQQ)
Data format	Raw data are included within this data article. See Supplemental Material, Tables 1–10 These are the raw data related to figures in the publication: I. Manjón, M.D. Ramírez-Andreotta, A. Eduardo Sáez, R.A. Root, J. Hild, M. Katy Janes, A. Alexander-Ozinskas, Ingestion and Inhalation of Metal(loid)s Through Preschool Gardening: An Exposure and Risk Assessment in Legacy Mining Communities, Science of the Total Environment (2019), doi: https://doi.org/10.1016/j.scitotenv.2019.134639
Parameters for data collection	Soil, irrigation water, and plant samples were collected from May 2018 to October 2018. Soil samples were collected of the top 2 cm and 15 cm of garden and playground areas at 4 preschool sites in Nevada County, CA. Samples collected at 2 cm were used for dust generation. All samples were immediately refrigerated after collection. Soil and water samples were shipped to the University of Arizona (UA) within 2 days of collection, and plant samples were dried after collection and then shipped to the UA for preparation and analysis.
Description of data collection	Samples were collected by the research team and trained community members. Four sets of soil samples were collected: top 15 cm of (1) garden, and (2) native, playground soil for ICP-MS and IVBA analysis; and top 2 cm of (3) garden and (4) native, playground soil for dust generation (<10 μm diameter), ICP-MS, and IVBA analysis. Soil samples were dried, sieved, and acid microwave-digested before ICP-MS analysis (US EPA Methods 3051A (SW-846)). Irrigation water and plant samples were immediately analyzed by ICP-MS per U.S. EPA Method 6020B and 3051 (SW-846), respectively, upon arrival to UA.
Data source location	Soil (garden and playground), irrigation water, and plant samples were collected in Nevada City and Grass Valley, Nevada County, CA, USA. Latitude and longitude (and GPS coordinates) are not given to protect the privacy of the public and private preschools that participated in the study.
Data accessibility	Within the data article as a Supplemental Material
Related research article	I. Manjón, M.D. Ramírez-Andreotta, A. Eduardo Sáez, R.A. Root, J. Hild, M. Katy Janes, A. Alexander-Ozinskas, Ingestion and Inhalation of Metal(loid)s Through Preschool Gardening: An Exposure and Risk Assessment in Legacy Mining Communities, Science of the Total Environment (2019), doi: https://doi.org/10.1016/j.scitotenv.2019.134639

Value of the Data

- The data provide site-specific metal(loid) concentrations in soil, water, dust, and garden plants from preschool sites in a legacy mining community.
- The data are useful for environmental project managers and human health risk assessors at local, state, and federal governmental organizations as well as academia, non-government organizations, policy makers, and government officials to inform and guide environmental management efforts.
- The data can be used to estimate a child's potential exposure to arsenic, cadmium, and lead and calculated cancer and noncancer risks associated with the ingestion of locally grown produce, water, incidental soil ingestion, and dust inhalation.
- The data inform residents about the environmental quality of their community and help make informed decisions regarding home-gardening in similar communities.

1. Data description

Tables 1–10 (Supplemental Material) summarize total arsenic (As), cadmium (Cd), and lead (Pb) concentrations measured in irrigation water, soil, dust, and garden plants at each preschool site. Metal(loid) concentration in garden irrigation water is shown in Table 1. The concentrations in garden and native, unamended playground soil samples (top 15 cm) are discussed in Tables 2 and 3, respectively. Tables 4 and 5 show the metal(loid) concentration measured in the <10 μm diameter generated garden (Table 4) and playground (Table 5) dust from each site. Table 6 lists the fresh weight to dry weight ratio (FW/DW) and metal(loid) concentration for each garden plant sample collected per site. The mean moisture content ratio of 0.8771 for parsley as reported by the U.S. EPA Exposure Factor Handbook was used (cilantro was not provided; [12]). Measured metal(loid) concentrations below the limit of detections were reported as ½ limit of detection [4,8]. Tables 7–10 show the maximum bioaccessible fraction of metal(loid) from a simulated ingestion or inhalation event. Tables 7 and 8 show the concentration of metal(loid) extracted into the synthetic gastric fluid per garden (Table 7) and playground (Table 8) soil sample replicate. Tables 9 and 10 show the concentration of metal(loid) extracted into the synthetic lung fluid per garden (Table 9) and playground (Table 10) dust sample replicates.

2. Experimental design, materials, and methods

2.1. Site description

Samples were collected from four preschools throughout Grass Valley and Nevada City, CA as part of the *Gardenroots: The Nevada County, CA Garden Project* in 2018. These two cities have a rich Gold Rush mining history due to their location at the base of the Sierra Nevada foothills [1]. Mean soil pH at sites 1, 2, 3, and 4 gardens were 5.4, 5.8, 7.0, and 5.2, respectively. The dominant soil type for the area is Josephine-mariposa complex composed of a gravelly loam within the first 30.48 cm from the surface [6].

2.2. Sample collection

One water sample from the irrigation source for each garden and one field blank at each preschool were collected in May 2018. For field blank sampling, a trace metal-free 50 mL tube was filled with nanopure water, and then transferred into a clean one adjacent to the irrigation source being sampled.

Soil samples from garden (4–8 samples) and native, unamended playground areas (3–4 samples) at each preschool were collected for a total of 38 soil samples. Soil was collected from the top 15 cm of the garden from six sampling spots within a grid drawn at the surface of each garden. Soil from each sampling spot was homogenized within a five-gallon plastic bucket, up to four samples were collected from the bucket and separated into individual brown paper bags. The same method was used for collecting playground soil samples from areas where children were often seen playing. Ground cover elements were cleared before collecting the samples from playgrounds at each site.

A separate set of garden and playground soil samples was collected at each site to be used for dust generation. At each site, a five-gallon plastic bucket was filled with the top 2 cm of the garden, and another with the top 2 cm of each playground area for a total of 8 samples. Along with irrigation water and soil samples, these five-gallon plastic buckets were immediately refrigerated and shipped on ice to the University of Arizona (UA) within two days.

Plant samples of the following species were collected from July to October 2018: cilantro (also known as coriander) (*Apiaceae Coriandrum sativum*), kale (*Brassicaceae Brassica oleracea 'Lacinato'*), carrot (*Apiaceae Daucus carota*), cabbage (*Brassicaceae Brassica oleracea*), and lettuce (*Asteraceae Lactuca sativa*). Three samples of carrot, lettuce, and either cabbage or kale, and also mint or cilantro were collected at each site for a total of 45 samples. Plant samples were stored in sterile sample bags (Whirl-Pak® or VWR®) and immediately refrigerated upon collection.

2.3. Sample preparation

All soil samples (top 15 cm and top 2 cm) were air-dried for approximately 24–96 hours then sieved to $\leq$ 2 mm diameter before oven drying at 105 °C until they reached a constant mass. The soil samples collected from the top 15 cm were then additionally sieved to $\leq$63 μm diameter using a stainless-steel mesh sieve (W.S. Tyler™, ASTM E−11 standard No. 230).

A laboratory dust generator (described by Gonzales et al. [2] and Thomas et al. [5]) was used to generate each dust sample to less than 10 μm diameter using the bulk garden and playground soil samples collected for dust generation (top 2 cm). One dust sample for each garden and playground was generated for a total of 8 samples.

The inedible portions of each plant sample were removed, and the samples were then washed for 30 seconds with deionized water, and oven-dried at 60 °C in brown papers. After drying, the samples were finely ground using a mortar and pestle or laboratory coffee grinder and then shipped to UA in sealed manila envelopes.

All soil (<63 μm diameter), dust (<10 μm diameter), and plant samples were digested prior to ICP-MS analysis by microwave-assisted acid digestion (modified U.S. EPA Method 3051 [9]), (CEM Model MARS6 microwave, Matthews, North Carolina). For each sample, 0.1 g was reacted with 1 mL of concentrated nitric acid (Omni-trace HNO_3, EMD Chemicals) for 1 hr, one milliliter of ultrapure water was then added, and the sample solution was subjected to microwave digestion at controlled higher pressure and temperature (CEM Model MARS6 microwave, Matthews, North Carolina). A NIST standard was included to each batch of samples for quality control. NIST SRM 2711a Montana II soil, NIST SRM 2584 Trace Elements in Indoor Dust, and NIST SRM 1515 Apple Leaves were used for soil, dust, and plant samples, respectively.

An in-vitro bioaccessibility assay (IVBA) was preformed to simulate a child's incidental soil ingestion and dust inhalation exposure using a protocol modified from the US EPA Method 1340 [5,11]. A subset ($N = 20$) of the <63 μm diameter garden and playground soil samples were used for the gastric IVBA. The lung IVBA was preformed using replicates of the <10 μm diameter garden and playground dust samples ($N = 8$). IVBA samples were acid-preserved using HNO_3 and microwave-assisted acid digested [10]. The contents of the synthetic gastric and lung extraction fluids (SGF and SLF), protocol, and reaction conditions are detailed by Manjón et al. [3].

2.4. Sample analysis

Upon arrival at UA, irrigation water samples were analyzed for total As, Cd, and Pb concentration by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) (Agilent 7700 ICP-MS, Santa Clara, CA) following the U.S. EPA Method 6020B (SW-846) [7] at the Arizona Laboratory for Emerging Contaminants (ALEC). The ICP-MS instrument quantifiable limit of detection for water analysis were: 0.0018–0.033 $\mu g\ L^{-1}$, 0.00064 $\mu g\ L^{-1}$, and 0.00047 $\mu g\ L^{-1}$ for As, Cd, and Pb, respectively.

Soil, dust, plant, and acid-preserved IVBA extraction fluid samples were analyzed for As, Cd, and Pb concentrations via ICP-MS (Agilent 7700 ICP-MS and Agilent 8900 (ICP-QQQ), Santa Clara, CA) with quantifiable detection limits of 0.041–0.0032 $\mu g\ g^{-1}$, 0.0018 $\mu g\ g^{-1}$, and 0.0016 $\mu g\ g^{-1}$, respectively. Quality assurance/quality control (QA/QC) protocols based on the aforementioned EPA methods were performed during ICP-MS analysis of water, soil, dust, and plant samples. A standard calibration curve using at least 7 samples of stock solutions (SPEX Certiprep, Metuchen, NJ) was created before sample analysis (correlation coefficients > 0.995). At minimum, one quality control sample, a continuing calibration blank, and a calibration verification solution was included in the QC protocol after every 12 samples and at the end of each set of samples. An acceptable QC result needed to within a 90–110% of the certified value for each standard solution used.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.105050.

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