

Cadmium and Other Metals in Children's Jewelry



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Overview

Highlighted Findings

- The highest levels of toxic metals were found in jewelry sold as an accessory with an article of clothing.
- Four necklace pendants/charms contained high - 98.4%, 93.1%, 53.4%, and 39.7% - levels of cadmium.
- An additional necklace pendant/charm contained over 5% lead.
- All 38 samples submitted for laboratory analysis contained one or more of the 7 tested metals above the reporting limit.

In 2015, the Washington State Department of Ecology (Ecology) evaluated the presence of cadmium, lead, and five other toxic metals (antimony, arsenic, cobalt, mercury, and molybdenum) in children's jewelry. The study was carried out to provide data for assessing compliance with the Washington State Children's Safe Products Act (CSPA; RCW 70.240).

Current Washington law restricts levels of cadmium and lead in children's products to levels of 40 ppm and 90 ppm, respectively. State law also requires manufacturers to report to Ecology if a product contains any [Chemicals of High Concern to Children](#) (CHCC), including antimony, arsenic, cadmium, cobalt, mercury, and molybdenum. Studies have shown exposure to toxic metals can be linked to carcinogenicity, as well as demonstrated adverse reproductive, developmental, or neurological disorders (Ecology, 2011).

Cadmium and lead in some children's products are also regulated by the federal Consumer Product Safety Commission. Where appropriate, product information and results from samples containing high concentrations of cadmium or lead will be forwarded to the Commission.

In this study, Ecology purchased 159 items of inexpensive all-metal children's jewelry and metal-based jewelry with plastic components. The articles of jewelry were broken down into 893 individual components and screened with the X-ray fluorescence (XRF) instrument for the target metals. Based on detection with the XRF screenings, 38 samples of individual product components were selected for laboratory analysis of the metals.



Necklace with high cadmium levels sold with a child's dress.

Methods

Product Collection, Processing, and Laboratory Sample Selection

During September and October of 2015, Ecology purchased 159 articles of children's jewelry from 15 large south Puget Sound retail stores and 3 online retailers. The practice of purchasing from large retail stores, with statewide distribution, ensures that the purchased items are representative of products sold across the state. Additional products purchased from large online retailers fit within the standard purchasing approach, because online retailers are considered accessible by most state residents.

In this study, *children's jewelry* was defined as products designed and intended as an ornament primarily worn by children 12 years or younger. The jewelry considered for selection was labeled for children, marketed for children (e.g., lower product placement on display shelves, consisting of bright colors, and/or incorporated designs attractive to children), or was sold with children's apparel.

A broad range of jewelry product types were targeted for collection, including anklets, arm cuffs, bracelets, brooches, chains, crowns, cuff links, decorated hair accessories, earrings, necklaces, pins, rings, and body piercing jewelry, or any bead, chain, link, pendant, or other component of such an ornament. Figure 2 displays the types and distribution of products purchased for this study.

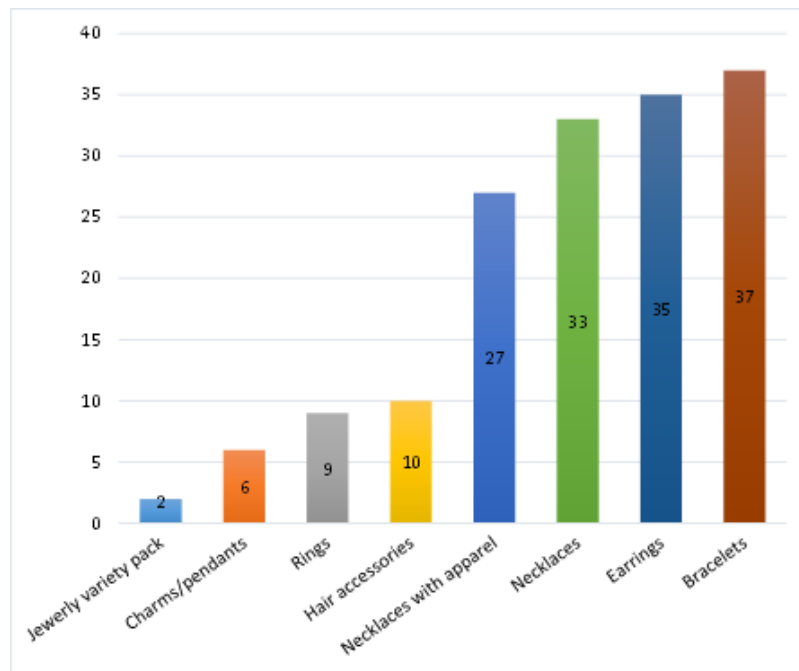


Figure 2. Types and Distribution of Purchased Jewelry Products.

The children's jewelry products purchased were cataloged and separated into 893 individual product components. To aid in sample selection for laboratory analyses, each component was screened for the target metals with an X-ray fluorescence (XRF) analyzer. All component samples that contained XRF-measurable cadmium or XRF-detected lead above 90 ppm were analyzed for the metal suite: antimony, arsenic, cadmium, cobalt, lead, mercury, and molybdenum. Based on the XRF screenings, 37 individual metal-based components were sized-reduced and analyzed for the seven target metals. An additional portion of one component sample was analyzed as a field duplicate.

Complete laboratory results for this study can be downloaded from Ecology's Product Testing Database, <https://fortress.wa.gov/ecy/ptdbpublicreporting/>, by selecting Download Data/Study: *Cadmium and Metals in Children's Jewelry*.

Laboratory Procedures

Ecology's Manchester Environmental Laboratory (MEL) prepared samples in three batches, using the microwave digestion technique, U.S. Environmental Protection Agency (EPA) Method 3052. Analyses were performed on the inductively coupled plasma mass spectrometer (ICP-MS) following EPA Method 6020A. Instruments were calibrated with National Institute of Standards and Technology (NIST) traceable standards and were verified with a second source NIST traceable standard. All standard residuals and instrument calibration (initial and continuing) verification checks were within acceptance limits.

MEL prepared written case narratives assessing the quality of the data. With few exceptions, the results met acceptance criteria for these analyses, and the data were deemed usable as qualified. The written case narratives are available upon request.

Data Quality

Quality control (QC) tests and measurement quality objectives (MQOs) are outlined in the project plan (Sekerak, 2015). Data sets and case narratives from MEL were reviewed, and all the data were accepted, as qualified, by the project manager.

Method blanks, laboratory control samples (LCSs), laboratory duplicates, matrix spikes (MSs), MS duplicates (MSDs) and a certified reference material (CRM) were analyzed with each batch of samples. No metal analytes were detected above the reporting limits in the method blanks associated with each sample batch.

All LCS and CRM recoveries were within acceptance limits. The CRM included in this study, ERM-EC680k, served as an additional consumer matrix performance indicator.

Duplicate QC data were within the MQOs with one exception: one duplicate sample relative percent difference (RPD) for cobalt. The source sample for cobalt was qualified J as an estimate.

Matrix spike recoveries were within acceptance limits with one exception: one sample that contained high levels of lead and antimony. The source sample for lead and antimony was qualified J as an estimate, due to insufficient concentration of the spike added to the source sample.

During sample preparation (size reduction), a random component sample was selected to be replicated and sent to MEL as a field duplicate. Field sample duplication was used as a measurement to assess precision during the sample preparation process. RPD for the sample analytes demonstrated an acceptable precision between sample duplicates (Table 1).

Table 1. Precision on Selected Field Duplicate Sample.

Metals results reported in parts per million (ppm).

Analyte	Antimony	Arsenic	Cadmium	Cobalt	Lead	Mercury	Molybdenum
Dup. #1	1960	26.3	9.6	3.75	107	0.244	1 U
Dup. #2	1890	26.7	9.46	3.71	107	0.275	1 U
RPD	4%	2%	1%	1%	0%	12%	0%

RPD: relative percent difference

U: Not detected at or above the reported sample quantitation limit

Precision MQO for duplicate RPD: $\leq 20\%$

Results

Samples sent to the laboratory for metals were pre-screened by the XRF analyzer and selected based upon (1) any detected concentration of cadmium, and (2) levels of lead > 90 ppm. All laboratory-tested samples contained one or more of the metals above the laboratory method reporting limit, and 13 samples contained levels greater than 100-ppm CSPA threshold for reporting contaminants. Table 2 displays the summary statistics for laboratory-detected metals in children's jewelry.

Table 2. Summary Statistics of Detected Metals in Children's Jewelry.

Analyte	Antimony	Arsenic	Cadmium	Cobalt	Lead	Mercury	Molybdenum
Number (n)	38	38	38	38	38	38	38
n > RL	18	15	26	29	37	11	23
% > RL	47%	39%	68%	76%	97%	29%	61%
Minimum (ppm)*	1.4	1.8	1.1	1.1	1.0	0.019	1.1
Maximum (ppm)*	1960	408	984000	637	50100	0.67	40.6

RL = Reporting (quantitation) limit.

Metals RLs = 1.0 ppm; mercury RL = 0.5 ppm.

* Statistic includes only detected results.

Results by metal

Cadmium was detected in 68% of the laboratory samples and ranged in concentrations from < 1 ppm to 984,000 ppm (98.4%). The highest detections of cadmium—98.4%, 93.1%, 53.4%, and 39.7%—were found in four separate necklace pendant/charm components from necklaces packaged with children's dresses. One additional sample—a gold-colored earring—also contained a cadmium at a concentration of 54.3 ppm.

Present in 97% of the laboratory samples, lead had the highest detection frequency of all analytes, with concentrations ranging from < 1 ppm to over 50,100 ppm (> 5.0%). Similar to the highest cadmium-concentration samples, the highest detected level of lead came from a necklace pendant/charm sold with a child's dress. Additional data were acquired for the high (> 5.0%) lead sample, as it was selected as the batch QC MS and MSD sample. Concentrations of 70,600 ppm (7.1%) and 107,000 ppm (10.7%) were recovered in the MS and MSD samples, respectively. These high recoveries suggest that the actual lead concentration in the pendant/charm component, factoring out the small concentration of spike solution (100 ppm), may be up to 10% or even higher. An additional necklace that came with a dress contained lead at a concentration of 846 ppm. A component of a bracelet set contained lead at 107 ppm and another bracelet contained lead at 110 ppm.

The highest levels of antimony, 1,960 ppm and 1,180 ppm, were from silver-colored beads and a silver-colored charm on two bracelets, respectively. In all, 47% (18 of 38) of the tested jewelry contained antimony above the reporting limit.

Arsenic was present in 39% of the samples, detected at concentrations of < 1 ppm to 408 ppm. The highest concentration of arsenic was found in a chain from a necklace packaged with a shirt.

A total of 76% of the samples contained cobalt, with concentrations ranging from < 1 ppm to 637 ppm. Sixty-one percent of the samples contained molybdenum but at much lower concentrations (< 1 – 40.6 ppm). No samples contained mercury at levels higher than 1 ppm.

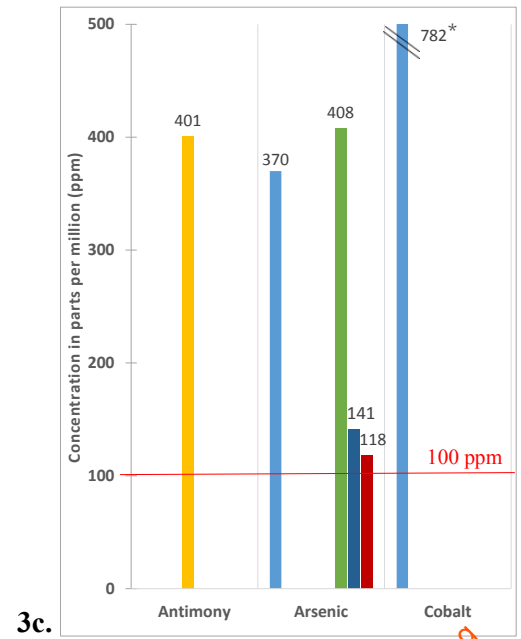
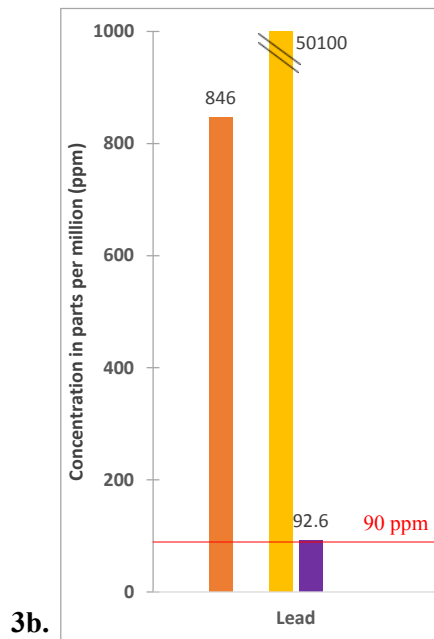
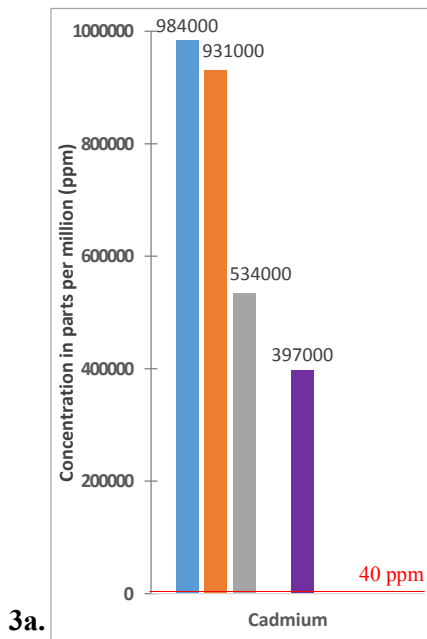
Results in jewelry sold with apparel

The highest levels of toxic metals were found in necklaces packaged with and sold as an independent accessory to children's apparel. All 8 of the children's apparel jewelry samples submitted for testing contained one or more toxic metals above the 100-ppm CSPA threshold for reporting contaminants. Four of the jewelry samples from apparel had extremely high levels of cadmium, and two additional samples contained high levels of lead. Table 3 and Figures 3a-c. illustrate the concentrations of toxic metals found in jewelry items sold with children's apparel.

Table 3. Toxic Metal Concentrations above Compliance Limits in Jewelry Sold with Children's Apparel.

* Sum of cobalt found in two separate components tested from Dress Necklace #1: chain - 637 ppm; pendant - 145 ppm.

Jewelry Item	Cadmium (ppm)	Lead (ppm)	Antimony (ppm)	Arsenic (ppm)	Cobalt (ppm)
Dress Necklace #1	984,000 (98.4%)			370	782*
Dress Necklace #2	931,000 (93.1%)	846			
Dress Necklace #3	534,000 (53.4%)				
Dress Necklace #4		50,100 (5.01%)	401		
Dress Necklace #5	397,000 (39.7%)	92.6			
Dress Necklace #6				408	
Shirt Necklace #1				141	
Shirt Necklace #2				118	



Figures 3a-c: Toxic Metal Concentrations above Compliance Limits in Jewelry Sold with Children's Apparel by Cadmium (3a.), Lead (3b.), and -Antimony, Arsenic and Cobalt- (3c.), Respectively.

Summary and Conclusions

Ecology evaluated children's jewelry for cadmium, lead, and the five additional metals (antimony, arsenic, cobalt, mercury, and molybdenum) to assess compliance with requirements of the Children's Safe Products Act. Ecology staff purchased 159 articles of children's jewelry, separated them into 893 individual components, and cataloged all into Ecology's Product Testing Database. Components were screened for metals with an XRF analyzer, and samples were selected for further laboratory analysis of metals.

Laboratory results from this study indicated the following:

- Cadmium was detected in 16% (26/159) of the overall jewelry products and 68% of the laboratory samples, with significantly higher levels of cadmium—98.4%, 93.1%, 53.4%, and 39.7%—detected in four necklaces sold along with children's dresses. One of these products had high levels of cadmium (93.1%) and lead (846 ppm).
- Lead was the most frequently detected metal, present in 23% (37/159) of the overall jewelry products and 97% of the laboratory samples, with concentrations ranged from < 1 ppm to over 50,100 ppm (> 5.0%).
- The highest detected lead level was over 5.0% (50,100 ppm), with MS and MSD analyses demonstrating that the lead content is possibly as high as 10%. This sample was from a necklace sold with a child's dress.
- Thirteen of the 38 children's jewelry items (34%) that were tested in the laboratory contained a concentration of at least one of the target metals above 100 ppm (the threshold for reporting to Ecology if a contaminant is present).

Observations and summary of this study:

- Results and product information for 13 samples require further assessment against the CSPA guidelines for reporting presence of CHCCs to Ecology.
- Results and product information for eight samples require further assessment against the CSPA standards for total lead and cadmium. This includes five samples with more than 5% cadmium or lead.
- The highest levels of toxic metals were typically found in children's jewelry sold as an accessory with an article of children's clothing.

Compliance and Enforcement

The laboratory data for this project were submitted to Ecology's Children's Safe Products Act (CSPA) enforcement coordinator for assessment of compliance with Washington State and Federal laws. Responsible parties (manufacturers, distributors, and/or retailers) of products that appear to violate restrictions, or have not reported as required by the CSPA reporting rule, have been notified and enforcement actions are ongoing. Results have been provided to the Consumer Product Safety Commission for enforcement of federal law.

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Publication Information

This report is available on the Department of Ecology's website at:

<https://fortress.wa.gov/ecy/publications/1603007.html>

The Quality Assurance Project Plan for this study is available at:

<https://fortress.wa.gov/ecy/publications/SummaryPages/1503125.html>

Data for this project are available at Ecology's Product Testing Database at:

<https://fortress.wa.gov/ecy/ptdbpublicreporting/> Select Study, *Cadmium and Metals in Children's Jewelry*.

Websites

Children's Safe Products Act: <http://www.ecy.wa.gov/programs/hwtr/RTT/cspa/index.html>

Chemicals of High Concern to Children: <http://www.ecy.wa.gov/programs/hwtr/RTT/cspa/chcc.html>

Consumer Product Safety Commission: <http://www.cpsc.gov/en/>

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