

# Evaluating lead exposure & lead in food

Jennifer Gray, PhD, DABT



# Mission

Michigan Department of Health and Human Services (MDHHS) provides opportunities, services, and programs that promote a healthy, safe and stable environment for residents to be self-sufficient.

# Evaluating Lead Exposure

# Evaluating lead exposure

- “The dose makes the poison”
  - If the “safe” dose is greater than the dose ingested/total dose, low/no concern (i.e., traditional risk assessment)
- No safe level of lead in the blood (no toxicity value)
  - Cannot use traditional risk assessment
- Blood lead reference value of 3.5  $\mu\text{g}/\text{dL}$ 
  - Population-based measurement
  - 2.5% of U.S. children aged 1–5 years have BLLs at or above 3.5  $\mu\text{g}/\text{dL}$  (97.5<sup>th</sup> percentile from 2015-2018 NHANES)

# How do we evaluate lead exposure?

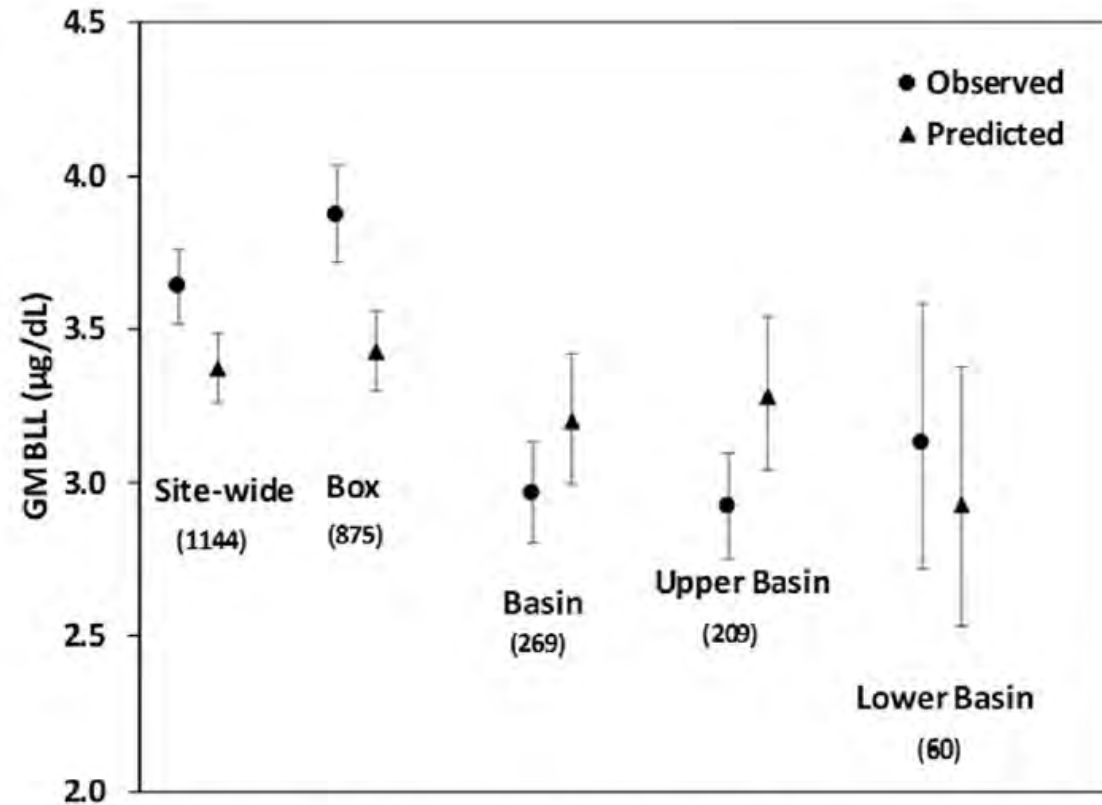
- Model lead exposure and resulting blood lead
  - Exposure scenarios developed based on various exposure factors (for example, water ingested, amount of lead ingested from food, amount of soil/dust ingested)
  - Additional lead amount from various sources can be added (for example, lead amount from cinnamon applesauce)

# Additional sources of lead exposure

- Along with diet lead
- Outdoor air lead concentration and time outside
- Water lead concentration and water consumption
- Outdoor soil lead concentration, indoor dust lead concentration, and ingestion of soil and dust
- Maternal blood lead at childbirth
- “Alternate” lead



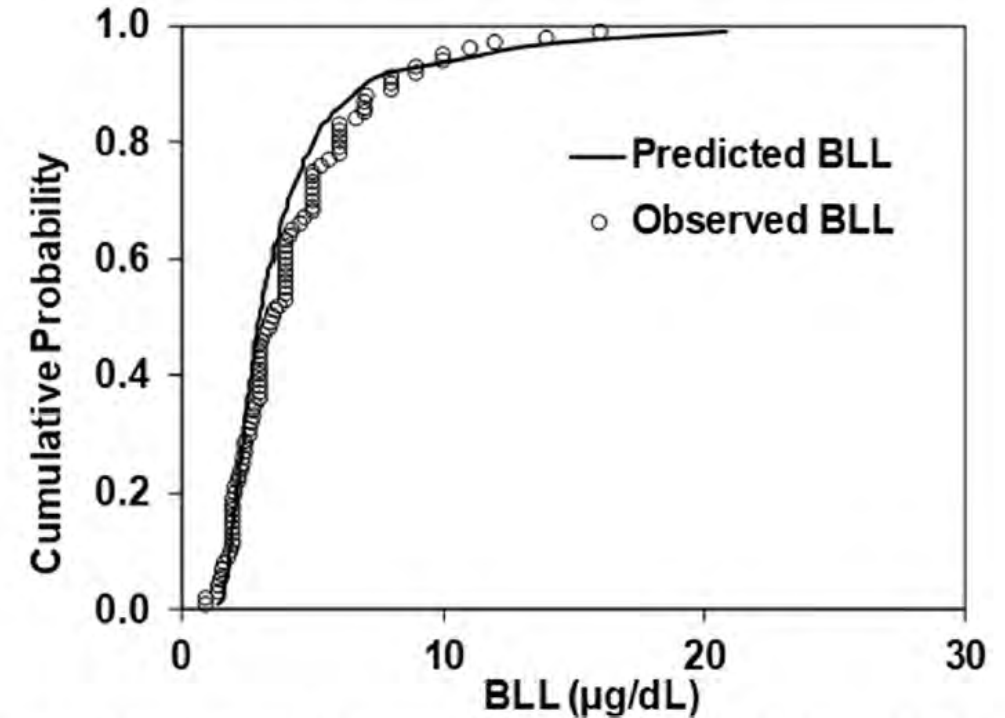
# US EPA IEUBK model



**Fig. 1 Comparison of observed (circles) and predicted (triangles) area-stratified GM BLLs.** Flags are 95% CLs. Values in parentheses are number of BLLs in each area.

# Other modeling outputs

- Predict the probability of similarly exposed children having higher blood lead (greater than  $3.5 \mu\text{g}/\text{dL}$ )
- Not designed to, but distribution of the population did align with individual child blood lead levels



**Fig. 4 Comparison of empirical distribution of observed individual child BLLs (circles,  $N = 1144$ ) with the probability distribution predicted by the IEUBK model (solid line) for GM BLLs. Although visually similar, the distributions were significantly different ( $p \leq 0.05$ , Kolmogorov–Smirnov test).**

# Lead in US commercial foods

# Lead in the US commercial foods

- Estimated mean lead exposures range from 0.7–3.6  $\mu\text{g}/\text{day}$  (depending on the age group and method for handling non-detected values )
  - Three top food groups contributing to children’s lead exposure:
    - Infants not consuming human milk, 0-11 months: processed baby food and infant formula food group (81%), beverages (7.4%) and vegetables (3.6%)
    - Children, 1-6 years: grains/baking (24.6%), dairy (13.1%) and fruit (12.3%)

**Table 1.** Food groupings and types of foods collected in the total diet study (2018–2020).

Food group	Description	Number of foods	Number of samples 2018–2020 <sup>a</sup>
Beverages <sup>b</sup>	Includes all beverages other than 100% fruit juice and 100% vegetable juice (e.g. bottled water, non-dairy beverages, carbonated beverages, and energy drinks)	21	87
Candy/sweets	Includes candy, gelatin, jelly, sugar and syrup	12	36
Condiments/sauces	Condiments and sauces (e.g. ketchup, mustard, salsa, soy sauce)	6	42
Dairy	All dairy products (e.g. butter, cheese, milk, yogurt, creams and ice cream)	20	371
Eggs	Hard-boiled eggs	1	27
Fats/oils	Vegetable fats and oils and salad dressings	8	24
Fruit	All fruits (e.g. apples, bananas, berries, peaches and pineapple)	17	366
Fruit juice	Includes all 100% fruit juices (e.g. apple juice, orange juice and lemon juice)	8	24
Grains/baking	All grains and grain products (e.g. rice, pasta, oatmeal, cereals, breadcrumbs, baked goods and flour)	52	490
Legumes	All legumes (e.g. beans, lentils and tofu)	10	24
Meat/poultry	All meats, poultry, processed meat products (e.g. ground meats, fried chicken and luncheon meats)	19	436
Mixtures	Mixtures of meat/poultry/fish, grains and vegetables (e.g. cheese pizza, macaroni and cheese and soup)	13	63
Peanuts/nuts/seeds	Peanuts, tree nuts, nut butters and seeds	6	35
Processed baby food and infant formula	All processed baby foods (i.e. foods marketed to infants and young children), infant formula and baby water (water marketed to babies)	63	384
Seafood	All fish and shellfish	7	141
Vegetables	All vegetables and 100% vegetable juice (e.g. broccoli, carrots, leafy greens, potatoes and squash)	39	717
NEC	Not elsewhere categorised. Includes salt, cocoa powder, protein powder and chicken broth	5	9
All		307	3276

<sup>a</sup>TDS regional samples were collected twelve times a year and national samples once per year. An additional sampling of baby foods occurred in 2019. Nine TDS collections and/or associated analyses were cancelled due to the federal government furlough in December 2018 through January 2019 and the COVID-19 pandemic in 2020.

<sup>b</sup>Alcoholic beverages were not included as there was no reported consumption of these beverages by infants 0–11 months or children 1–6 years.

2801 (86%) had lead levels below the reporting limit (RL) – lead was not detected in any sample of 194/307 foods (63%)

For 24/307 foods (8%), lead was detected in all samples (includes “chocolate-containing foods (e.g. chocolate cake, chocolate candies, cookies, brownies and chocolate syrup), honey oat ring cereal, processed baby foods, salad dressing”)

Total diet study food group intakes and contributions to lead exposures for children 1–6 years. (Table 5)

Food group	Food intake		Dietary lead exposure <sup>a</sup>	
	g per capita/day	% total	µg/day	% total
Beverages	579	36.0	0.11	7.3
Dairy	349	21.7	0.20	13.1
Grains/baking	148	9.2	0.38	24.6
Fruit	135	8.4	0.19	12.3
Fruit juice	109	6.8	0.13	8.5
Vegetables	74	4.6	0.12	8.1
Meat/poultry	67	4.2	0.11	7.0
Mixtures	47	2.9	0.09	6.2
Candy/sweets	27	1.7	0.05	3.4
Eggs	16	1.0	0.03	2.1
Processed baby food and infant formula	11	0.7	0.02	1.5
Legumes	10	0.6	0.03	0.3
NEC <sup>b</sup>	10	0.6	0.01	0.7
Fats/oils	9	0.6	0.02	1.2
Condiments/sauces	7	0.4	0.02	1.5
Peanuts/nuts/seeds	6	0.4	0.03	1.7
Seafood	4	0.2	0.01	0.5
Total	1608	100	1.5	100

Foods reported in the NHANES “What We Eat in America” are mapped to the FDA Total Diet Study results using the FDA’s Food Disaggregation Database (recipe database).

a: values < reporting limits set to zero for foods with no history of detections (using data from TDS collections 2013–2020) and set to half the RL for foods in the same dataset that have one or more detected values

b: NEC = not elsewhere categorized (salt, cocoa powder, protein powder and chicken broth).

**Table 2.** Dietary exposures to lead among infants 0–11 months and children 1–6 years.

Age group	Dietary lead exposure ( $\mu\text{g}/\text{day}$ ) <sup>a</sup>	
	Mean	90th percentile
	Hybrid <sup>b</sup> (lower bound <sup>c</sup> , upper bound <sup>d</sup> )	Hybrid <sup>b</sup> (lower bound <sup>c</sup> , upper bound <sup>d</sup> )
0–11 months ( $n=316$ )	1.3 (0.9, 2.0)	2.4 (1.9, 3.6)
1–6 years ( $n=740$ )	1.5 (0.7, 3.6)	2.4 (1.2, 5.3)

<sup>a</sup>Data sources: toxic element concentrations in foods: FDA total diet study, 2018–2020 (analysis method: ICP-MS), arithmetic mean concentrations. Food consumption: What We Eat in America (WWEIA)/National Health and Nutrition Examination (NHANES) 2017–2018 (2015–2018 for infants). Estimated exposures do not include contributions from human milk.

<sup>b</sup>Values < reporting limit (RL) set to zero if there were no detections from 2013 to 2020; otherwise, values < RL set to 0.5\*RL.

<sup>c</sup>Values < RL set to zero.

<sup>d</sup>Values < RL set to RL.

FDA’s interim reference level for lead for children 0-6 years old is 2.2  $\mu\text{g}/\text{day}$  (Flannery and Middleton et al. 2022)

# Other lead sources in foods, consumables



## Lead Bullets and Venison

### What Every Hunting Family Should Know

**Studies show that lead fragments are often found in venison shot with lead bullets.**

These pieces of lead are **too small to be seen or felt while chewing**. During processing, lead bullet fragments can get mixed further into the venison. For this reason, ground venison usually has **more** lead fragments than steaks and chops (see photo).

Using a medical imaging device, lead fragments (bright spots) are shown scattered within the ground venison shot with lead bullets.



REV 12/2018



## Venison Processing



Processing Guide and Sanitation Requirements for Retail Food Establishments

Food & Dairy Division  
P.O. Box 30017  
Lansing, MI 48909 Phone:  
(800) 292-3939  
[www.michigan.gov/mdard](http://www.michigan.gov/mdard)

# Lead in venison - MDARD

### Lead Fragments in Venison and Processing of the Carcass

Recent studies have found tiny lead fragments in venison from deer shot with lead ammunition. Some of the fragments have been found far from the wound channel in the meat, and are too small to be seen during processing. There is currently no evidence linking venison consumption to lead poisoning in humans; however, lead is a neurotoxin, meaning it affects the brain and the rest of the central nervous system. The risk depends on how much lead is consumed and how often. It can affect the nervous system even at levels too low to cause outward signs of illness. Care should be taken to minimize any contamination.

You can take steps to keep lead contamination in venison to a minimum by following a few guidelines:

1. Use care when selecting meat for grinding.
2. Do not use deer with excessive shot damage.
3. Trim a generous distance away from the bullet wound channel and discard any meat that is bruised, discolored, or contains hair, dirt, bone fragments or debris.

### Venison Product Storage

- Processors must implement procedures to maintain the identity of venison products so as not to confuse them with commercial meat.
- Processed hunter-owned venison should be wrapped and each package identified with the name of the owner. Packages should be stamped, "Not for Sale."
- Venison held for further processing (jerky, sausage, etc.) should be stored in covered containers, separated from commercial foods by a physical barrier and properly identified.

\* Before you move venison or deer parts from one area to another, make sure you check the MDNR website for guidance.

Lymph nodes and other parts shown here will be removed during normal field dressing. Removing

# Lead in venison – MDNR



Department of Natural Resources



[Things to do](#) ▾ [Places to go](#) ▾ [Buy and apply](#) ▾ [Education and safety](#) ▾ [Managing your resources](#) ▾ [About us](#) ▾ [Events](#)

## Precaution About Lead in Venison

[Home](#) > [Managing your resources](#) > [Wildlife](#) > [Deer Management](#) > [Precaution About Lead in Venison](#)

Deer that are shot with rifle bullets containing lead, particularly copper-jacketed and hollow-point bullets, can have particles of lead remaining in the meat, some too small to be seen or felt.

Lead can be harmful to humans, even in very low amounts. Children under seven years old and pregnant women are at the greatest risk from lead exposure.

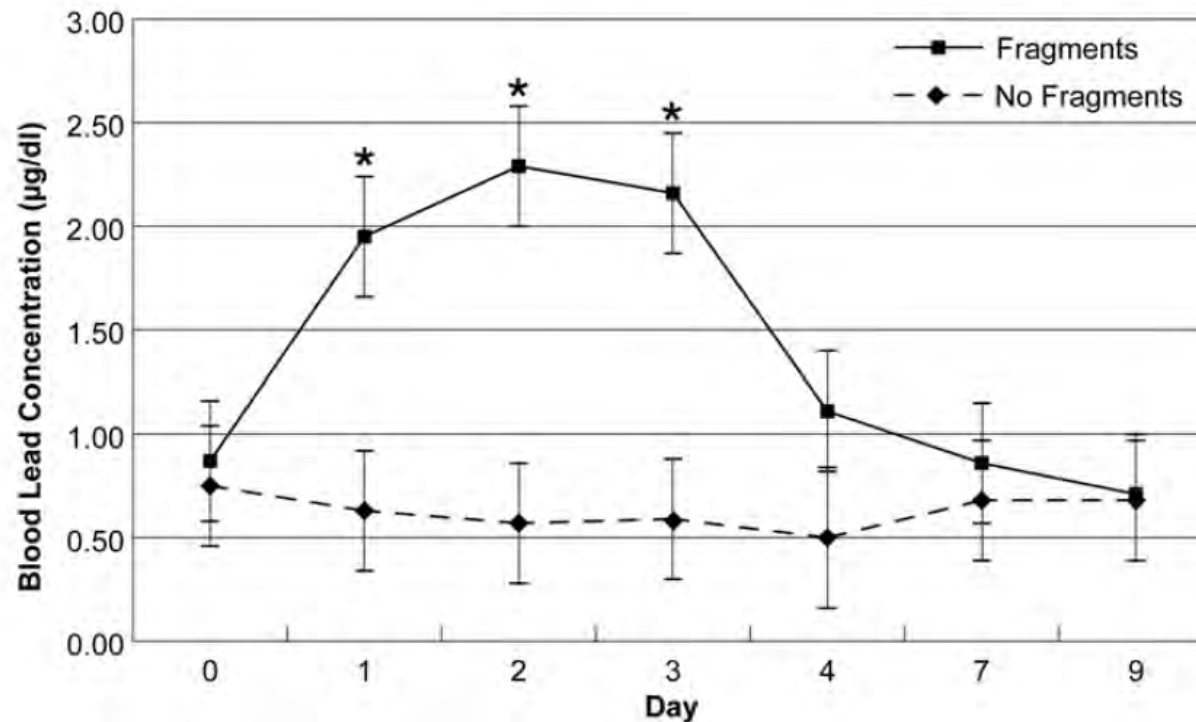
The following suggestions can minimize potential exposure to lead in venison:

- Remind your meat processor to, or if you process your own venison, trim a generous distance away from the wound channel and discard any meat that is bruised, discolored or contains hair, dirt or bone fragments.
- Avoid consuming internal organs.
- Practice marksmanship and outdoor skills to get closer, cleaner, lethal shots away from major muscle areas (don't shoot running deer).

# Associations of wild game consumption to blood lead

- “Participants who consumed wild game had higher PbB than those who did not consume wild game.” (North Dakota, US; Iqbal et al. 2009)
- “Indigenous status and wild game consumption were associated with increased BLLs.” (remote communities in Amazon, Berky et al. 2022)

# Lead in venison – blood lead impact in pigs



**Figure 2. Mean blood lead concentrations observed during swine feeding experiment.** Mean ( $\pm$ SE) blood lead concentrations ( $\mu\text{g}/\text{dL}$ ) in four pigs fed venison containing radiographically dense fragments (Fragments) compared with four control pigs fed venison without visible fragments (No Fragments) on days 0 and 1. Asterisks indicate days when means differed significantly between test and control groups. doi:10.1371/journal.pone.0005330.g002

# Spices and other foods - MDHHS

## Household Items and Imported Goods



[Home](#) > [Learn About Lead](#) > [Household Items and Imported Goods](#)

### Lead in household items and imported goods

Lead might be found in products you have in your home. These items include:

- Painted toys and furniture, especially older toys and furniture
- Toy jewelry
- Cosmetics (makeup)
- Plumbing products like pipes and fixtures
- Cookware including food or liquid containers made of lead crystal, lead-glazed pottery, or porcelain
- Dietary supplements
- Traditional (folk) medicines



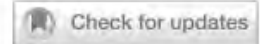
# Recalls for lead in food

- October 2018: Hot Curry Powder and Curry Powder
  - Testing done by MDARD
- July 2022: Freeze-Dried Blueberries
  - 2 lots recalled nationwide (retail and online stores)
- February 2022: “Saladitos” Salted Dried Plums and “Saladitos Con Chile Y Limon” Dried Plums with Chili & Lemon
  - Sold and/or distributed in California, Nevada, and Utah
- February 2022: Plain Dried Salted Plums
  - Southern California only



# Lead in spices, other items that could be consumed

- 1496 samples of more than 50 spices from 41 countries (environmental lead investigations and local store surveys in New York City) (Hore et al. 2019)
  - >50% of the spice samples had detectable lead (>30% had lead concentrations greater than 2 ppm ( $\mu\text{g/g}$ ))
  - Average lead content in the spices was significantly higher for spices purchased abroad than in the US
- Three cases in Washington State (2020-2021) (Tan et al. 2023)
  - Range of spices (including garam masala, turmeric) with lead levels of 120-1700 ppm ( $\mu\text{g/g}$ )
- Blood lead levels  $>3.5 \mu\text{g/dL}$  in a family of five were associated with use of Surma (lead sulfide/galena-based cosmetic) (Hore et al. 2024)

ARTICLE OPEN



# Investigating aluminum cookpots as a source of lead exposure in Afghan refugee children resettled in the United States

Katie M. Fellows<sup>1</sup>, Shar Samy<sup>2</sup>, Yoni Rodriguez<sup>1,2</sup> and Stephen G. Whittaker<sup>1</sup>  <sup>1</sup> 

© The Author(s) 2022

**BACKGROUND:** Afghan refugee children resettled in Washington State have the highest prevalence of elevated blood lead levels (BLLs) of any other refugee or immigrant population. Resettled families brought several lead-containing items with them from Afghanistan, including aluminum cookpots.

**OBJECTIVES:** To evaluate the potential contribution of lead-containing cookpots to elevated BLLs in Afghan children and determine whether safer alternative cookware is available.

**METHODS:** We screened 40 aluminum cookpots for lead content using an X-ray fluorescence (XRF) analyzer and used a leachate method to estimate the amount of lead that migrates into food. We also tested five stainless steel cookpots to determine whether they would be safer alternatives.

**RESULTS:** Many aluminum cookpots contained lead in excess of 100 parts per million (ppm), with a highest detected concentration of 66,374 ppm. Many also leached sufficient lead under simulated cooking and storage conditions to exceed recommended dietary limits. One pressure cooker leached sufficient lead to exceed the childhood limit by 650-fold. In contrast, stainless steel cookpots leached much lower levels of lead.

**SIGNIFICANCE:** Aluminum cookpots used by refugee families are likely associated with elevated BLLs in local Afghan children. However, this investigation revealed that other U.S. residents, including adults and children, are also at risk of poisoning by lead and other toxic metals from some imported aluminum cookpots.

*Journal of Exposure Science & Environmental Epidemiology* (2022) 32:451–460; <https://doi.org/10.1038/s41370-022-00431-y>

**IMPACT STATEMENT:** Some aluminum cookware brought from Afghanistan by resettled families as well as cookpots available for purchase in the United States represent a previously unrecognized source of lead exposure.

# FDA Issues Letter to Retailers and Distributors Concerning Lead in Certain Imported Cookware



## Constituent Update

December 12, 2024

The U.S. Food and Drug Administration (FDA) [issued a letter to retailers and distributors](#) of cookware products to inform them that certain imported cookware products made from aluminum, brass, and aluminum alloys known as Hindalium/Hindolium or Indalium/Indolium, demonstrate the potential to leach lead into food and that this cookware should not be distributed or sold in the U.S. market.

The FDA was made aware of this issue through collaboration with the Public Health Department of Seattle and King County (PHSKC) on their testing of imported cookware

---

**Content current as of:**

12/12/2024

**Regulated Product(s)**

Food & Beverages



# Heavy Metals in Cultural Products

This webpage compiles educational and outreach materials highlighting the risks from heavy metal exposure primarily to children and people who are pregnant from a variety of cultural and religious products. These products include cosmetics, religious powders, spices, traditional medicines, and cookware that may be used by communities in the United States.

## Risks of Heavy Metal Exposure

Cultural products can contain heavy metals such as lead, mercury, arsenic, antimony and cadmium. The presence of heavy metals in these products may come as a surprise to some since these products have been used during their own childhoods and into adulthood without any obvious health impacts. However, health impacts can be subtle, and you may not be able to tell just by looking at someone or may take years to present themselves. For example, health impacts from lead exposure in children may include learning difficulties, reduced IQ, and behavioral issues such as hyperactivity and inability to pay attention.

[Learn more about the health effects of lead exposure.](#)

[Learn more about the health effects of mercury exposure.](#)

## Using these Resources and Search Tool

Click on links in the categories below to narrow your search based on the cultural product, type of contaminant, and language. Further narrow the search by using the drop-down menus located on the first row of the table. Clear your search by clicking *reset filters*.

The resources compiled below are primarily for members of the public who may use these cultural products. In addition, some resources contain case and technical reports which may be useful for public health professionals.

These resources were developed by various federal, state and local government agencies and partners and do not necessarily represent the views and policies of EPA.

[Contact us](#) to add additional resources to this list.

### Related Information

- [Learn about Lead](#)
- [Learn about Mercury](#)

# Summary and next presentation

- Commercial food supply is a source of lead
  - Spices, venison
- Cookware and other items are also sources of lead
- Model provides information to estimate whether lead-containing food/spice plus consumption frequency could result in “unacceptable” lead exposure
- Next: More on modeling with a case study – Dr. Joost van ‘t Erve

Questions and Thank you!