PEHSU Pediatric Environmental Health Specialty Units

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Arsenic in Food

A Resource for Health Professionals

Summary of Key Points

- For children, there is no known safe level of arsenic in food.
- Arsenic can cross the placenta, increasing the likelihood of exposure to the fetus. There is minimal exposure from breast milk.
- Recent reports have described inorganic arsenic levels in a variety of foods, including rice and rice milk; cereal and energy bars sweetened with rice syrup; and apple juice and baby food.
- Low-level inorganic arsenic exposure from food products may be associated with learning development and neuromotor function delays in children.
- Health care providers can encourage families to consume a varied diet.

Health professionals are encouraged to follow the guidance below to help navigate discussions with patients and families who are concerned about arsenic exposure in children.

Arsenic Exposure and Risk Factors

Arsenic occurs naturally in both organic (typically non-toxic) and inorganic forms. Inorganic arsenic is toxic and carcinogenic (cancer-causing). Arsenic is a naturally occurring element, found widely in the environment as an inorganic salt. Groundwater may flow through arsenic-containing bedrock or soil, contaminating drinking water drawn from wells. Past use of arsenic-containing pesticides and fertilizers may also contaminate fields where rice (which selectively absorbs arsenic) and apples are grown.[1,2]

In addition to being naturally present in the environment, it has also been used for many years for industrial purposes, including pest control, animal antimicrobial treatment, wood preservation, petroleum refining, and in the mining/smelting industries. Most industrial uses of arsenic employ the more toxic inorganic forms. Release of arsenic through these processes can lead to increased inorganic arsenic in the atmosphere, in water, and in soil. Workers in industrial processes and communities near these industries may be exposed to arsenic from coal-fired power plants, hardening metal alloys, purifying industrial gases, and in the electronics industry in the form of gallium arsenide and arsine gas as components in semiconductor devices. Arsenic has been reported in imported folk or homeopathic remedies.[3]

Although inorganic arsenic can cross the placenta, increasing the likelihood of exposure to the fetus, arsenic may be found, as noted above, in water and food. In addition to inorganic forms of arsenic, there are organic forms found in seafood (farm-raised and wild) that are generally considered non-toxic.[4]

Health Effects and State of the Science

There is no level of inorganic arsenic in food that is safe. An ingestion of a very high amount of arsenic-containing product can cause a serious sudden illness. Chronic high-level inorganic arsenic exposure, as from elevated water levels, has been associated with chronic skin problems and future development of a variety of adult cancers of the bladder, lungs, skin, kidney, nasal passages, liver, and prostate, as well as respiratory and cardiovascular disease, but patients are unlikely to complain of specific symptoms or signs. Low-level exposure, more typical of some well water or food products, has possible health effects on learning and neuromotor function in children. It is important for health care providers to have an index of suspicion for arsenic based on suspected or confirmed exposure to some well water or food.

Medical Management

Most arsenic exposures are chronic, without obvious symptoms or signs, and so medical management shifts to prevention, mitigation, and risk assessment. If, despite avoidance of arsenic (primarily in water and food), there is remaining concern or clinical suspicion for potential ongoing arsenic exposure; a quantitative timed urine specimen (8 or 12 hours in children 24 hours in adults; a first morning "spot" urine, along with a urine creatinine to correct for concentration, is less accurate). An acid-washed container should be used to avoid sample contamination. If the laboratory reports total arsenic, it should be "speciated" or fractionated to distinguish between the toxic inorganic species (if present) as well as the organic species (currently considered non-toxic) typically found in seafood. Consultation with laboratory staff is recommended before ordering the test. For more information, visit Agency for Toxic Substances and Disease Registry (ATSDR) Arsenic Toxicity website.

Prevention and Risk-reduction Communication

United States (US) Environmental Protection Agency (EPA) has an enforceable maximum contaminant level (MCL) for municipal water supplies of less than or equal to 10 micrograms of arsenic per kg of water (10 parts per billion, or ppb), to protect from chronic arsenic exposures, and a non-enforceable MCL goal of 0 ppb, which reflects the level at which no adverse health effects are expected.[5] Some states have lowered the level to 5 ppb**.** The US Food and Drug Administration (FDA) has tested various foods for arsenic, finding, for example, elevated levels in rice[6], and proposed a limit for inorganic arsenic of 100 ppb in infant rice cereals in 2016[7]; this action level was adopted in 2020.[8]

The risk of chronic exposure to low-level arsenic can be mitigated through a varied diet. Infants who have a restricted diet (e.g., rice cereal as a first solid food and juice) may have arsenic exposures that are proportionately higher than those in older children and adults. FDA conducts routine surveillance for arsenic in apple juice and generally levels have been below 10 ppb, the same level allowable in drinking water[9]. Children's toys are tested and must demonstrate compliance with Consumer Product Safety Commission (CPSC) regulations that limit arsenic in toys that may be mouthed. Until more is known, providers can advise families to:

- Encourage breast milk for the first 6 months of life, as it has little to no arsenic.[10]
- Test well water for arsenic, and consider bottled water if results exceed EPA recommendations, particularly if water is used to reconstitute formula.[11] Reverse-

osmosis filters can mitigate arsenic in water but must be maintained regularly; an iron-impregnated biochar has been shown to perform as a low-cost arsenic sorbent.[12]

- Consult with local or state environmental health agencies to determine the potential for arsenic in drinking water, especially important for private well users, as these systems are not regulated by EPA.
- Choose rice products, including baby food, that are lower in inorganic arsenic.[13]
- As part of a varied diet, limit the serving size and frequency of foods that may have higher inorganic arsenic content, such as rice. Manage fruit juice consumption as part of a healthy diet per the recommendations for children from the American Academy of Pediatrics (AAP).[14]
- Avoid rice milk for younger children.
- Avoid products sweetened with brown rice syrup.
- Parboil rice (brown or white) before cooking, or wash and pre-soak rice (effective only for white) before cooking to reduce inorganic arsenic.[15]
- Avoid smoking, as cigarette smoke contains arsenic.
- Do not use older, arsenic-containing pesticides (now banned in the US).
- Do not allow children to play in areas or structures known to have arsenic contamination. Avoid sawing, sanding, or burning “pressure-treated” chromated copper arsenate (CCA)-containing lumber; do not grow vegetables in planters made of CCA-containing lumber.

References:

1. Carignan CC, Punshon T, Karagas MR, Cottingham KL. Potential exposure to arsenic from infant rice cereal. *Annals of Global Health.* 2016;82:221-4.
2. Gonzalez N, Calderon J, Rubies A, et al. Dietary exposure to total and inorganic arsenic via rice and rice-based product consumption. *Food Chemical Toxicology*. 2020;141:111420.
3. Agency for Toxic Substances and Disease Registry. WB1276 - Arsenic Toxicity. Accessed April 29, 2021. https://www.atsdr.cdc.gov/csem/arsenic/docs/arsenic.pdf . .
4. Taylor V, Goodale B, Raab A, Schwerdtle T, Reimer K, Conklin S, Karagas MR, Francesconi KA. Human exposure to organic arsenic species from seafood. *Science of theTotal Environment*. 2017 Feb 15;580:266-282. doi: 10.1016/j.scitotenv.2016.12.113
5. United States Environmental Protection Agency. Just the facts for consumers: Arsenic in your drinking water. Accessed April 29, 2021. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=60000E1E.txt.
6. United States Food & Drug Administration. Arsenic in food and dietary supplements. Accessed March 25, 2021. https://www.fda.gov/food/metals-and-your-food/arsenic-food-and-dietary-supplements.
7. United States Food & Drug Administration. Proposed limit for inorganic arsenic in infant rice cereal. Accessed March 25, 2021. https://www.fda.gov/food/cfsan-constituent-updates/proposed-limit-inorganic-arsenic-infant-rice-cereal.
8. United States Food & Drug Administration. Supporting document for action level for inorganic arsenic in rice cereals for infants. Accessed March 25, 2021. https://www.fda.gov/media/97121/download.
9. United States Food & Drug Administration. Arsenic in Food and Dietary Supplements. U.S. Food & Drug Administration. Accessed April 7, 2021. https://www.fda.gov/food/metals-and-your-food/arsenic-food-and-dietary-supplements.

10. Carignan CC, Karagas MR, Punshon T, Gilbert-Diamond D, Cottingham KL. Contribution of breast milk and formula to arsenic exposure during the first year of life in a US prospective cohort. *Journal Exposure Science and Environmental Epidemiology.* 2016;26(5):452-7.
11. United States Environmental Protection Agency. Arsenic rule compliance for community water system owners and operators. Accessed March 25, 2021. https://www.epa.gov/dwreginfo/arsenic-rule-compliance-community-water-system-owners-and-operators.
12. Hu X, Ding Z, Zimmerman AR, Wang S, Gao B. Batch and column sorption of arsenic onto iron-impregnated biochar synthesized through hydrolysis. *Water Research.* 2015;68:206-16.
13. Hirsch J. Heavy metals in baby food: what you need to know. *Consumer Reports*. Accessed March 28, 2021. https://www.consumerreports.org/food-safety/heavy-metals-in-baby-food/?fbclid=IwAR02IZ22vz2opEfR7qlAAr-e8vxHVkXb11HPimJ-e_DBBKKRrOCbXsvJSCY.
14. Heyman MB, Abrams SA. Section on Gastroenterology, Hepatology, and Nutrition and Committee on Nutrition. Fruit Juice in Infants, Children, and Adolescents: Current Recommendations. *Pediatrics* 2017;139 (6):e20170967.
15. Menon M, Dong W, Chen X, Hufton J, Rhodes EJ. Improved rice cooking approach to maximise arsenic removal while preserving nutrient elements. *Science Total Environment*. 2021;755(Pt 2):143341.

About PEHSU

The Pediatric Environmental Health Specialty Units (PEHSUs) are a source of medical information and guidance on prevention, diagnosis, management, and treatment of environmental conditions that influence reproductive and children's health. PEHSUs work with health care professionals, parents, schools, community groups, as well as federal, state, and local agencies to address reproductive and children's environmental health issues where families live, learn, play, and congregate. For more information on PEHSUs and available resources, please visit: **https://www.pehsu.net/**.

For additional resources and information on reproductive and children's environmental health topics that offer continuing education for health professionals, visit:
https://www.pehsu.net/nationalclassroom.html

Original PEHSU document authored by Robert J. Geller, MD, FAAP; Revised by Rose H. Goldman, MD, MPH, Mark Miller, MD, MPH, and Carl R. Baum, MD, FAAP

Updated December 2021

This material was supported by the American Academy of Pediatrics (AAP) and funded (in part) by the cooperative agreement award number 5 NU61TS000296-02-00 from the Agency for Toxic Substances and Disease Registry (ATSDR).

Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number DW-75-95877701. The content in this fact sheet represents the views of the authors. It does not represent the views of CDC/ATSDR nor EPA and does not represent endorsement by CDC/ATSDR nor EPA of the purchase of any commercial products or services that are mentioned.