211 Elevated Blood Lead Level

Definition/Cut-off Value

Elevated blood lead level (BLL) is the amount of lead in the blood, measured in micrograms of lead per deciliter of blood (µg/dL), at which follow-up action should be taken for an individual. Elevated BLL is specific to each WIC participant category as follows (1, 2):

Category*	Elevated Blood Lead Level (µg/dL) (within the past 12 months)
Women (all categories)**	≥ 5
Infants	≥ 5
Children	≥ 3.5

* See Clarification section for more information about category specific elevated BLLs.

** See the Nutrition and Lead Exposure section below for recommendations on the initiation and continuation of breastfeeding.

Participant Category and Priority Level

Category	Priority
Pregnant Women	I
Breastfeeding Women	I
Non-Breastfeeding Women	III, IV, V, or VI
Infants	I
Children	III

Justification

Lead exposure is a persistent public health problem in the U.S. and worldwide. A naturally occurring element that has been mined and used by humans for centuries, lead is toxic to humans with impacts ranging from changes in organ function to death. The toxic effects of lead have been observed in every organ system and there is no known safe level of exposure. Even low levels of lead exposure can have harmful and irreversible neurological, renal, cardiovascular, hematological, immunological, reproductive, and developmental effects. In addition to these most extensively studied outcomes, scientific evidence also suggests that lead exposure can have detrimental respiratory, hepatic, endocrine, gastrointestinal, musculoskeletal, and ocular effects, and increase risk of all cancers. (3)

Lead exposure during pregnancy or postpartum can adversely impact the mother as well as the developing fetus and breastfeeding infant during critical stages of development. Lead readily crosses the placenta, and

lead exposure during pregnancy is associated with increased risk of miscarriage, preterm birth, and decreased birth size (weight, length and head circumference); fetal brain, kidney, and nervous system damage; and lifelong learning and behavior problems (2, 3). Lead can also transfer from maternal blood to breastmilk, and ultimately to the breastfeeding infant (2).

Lead exposure is most common in young children because they have greater contact with lead sources and higher gastrointestinal absorption of ingested lead. Additionally, children's developing nervous systems are more vulnerable to the effects of lead exposure. Elevated BLL in children has been associated with adverse neurological and behavioral outcomes including cognitive deficits (e.g., learning and memory), altered behavior and mood (e.g., attention, hyperactivity, impulsivity, irritably, delinquency), and altered neuromotor and neurosensory function (e.g., visual-motor integration, dexterity, postural sway, changes in hearing and visual thresholds). (3)

Prevalence of Lead Exposure

Over the four decades from 1976 to 2016, BLLs decreased significantly among children ages 1 to 5 years and among women of childbearing age (15 to 49 years) in the U.S. (4, 5). Specifically, during this timeframe, population average BLLs decreased from 15.2 to 0.83 µg/dL and 10.37 to 0.61 µg/dL for these groups, respectively. Correspondingly, the prevalence of BLL ≥5 µg/dL decreased from 99.8 to 1.3 percent among children ages 1 to 5 and from 98.3 to 0.7 percent among women of childbearing age. These favorable trends reflect the implementation of federal policies regulating the use of lead in gasoline, paint, plumbing, and other consumer products, among other public health interventions (6).

Despite this progress, sociodemographic disparities have persisted. Low-income and certain racial/ethnic minority populations continue to be disproportionately affected by lead exposure as a result of these groups more commonly living in communities and housing with greater lead contamination (4, 5).

Sociodemographic disparities in lead exposure vary by WIC participant category and are discussed further as follows.

Disparities among Women

According to the most recent NHANES data, over 500,000 women of childbearing age (15 to 49 years) in the U.S. have BLL ≥5 µg/dL. Lead exposure is more prevalent among certain subpopulations, including women with low-income, of older age, born outside the U.S., of "other" race/ethnicity (i.e., other than black, white, Hispanic, or Mexican American), previous pregnancies, and a higher number of live births. (5)

In particular, recent immigrants, migrants, and refugee women are at increased risk of lead exposure since they have commonly lived in areas where ambient lead exposure is relatively high. These groups may also be more likely to consume products contaminated with lead such as traditional remedies, herbal supplements, spices, candies, cosmetics, and jewelries or amulets. (7)

Disparities among Children

Between 2011 to 2016, an estimated 262,235 children ages 1 to 5 years had BLLs ≥5 µg/dL (note: the studies summarized here were conducted prior to October 2021, when the BLRV was ≥5 µg/dL). Subpopulations with greater prevalence of lead exposure include children of younger ages (i.e., 1 to 2 years old), non-Hispanic Black race/ethnicity, low-income (including children participating in WIC), and children born in Mexico, living in older housing, and living in the Northeast or Midwest regions of the U.S. compared to West and South regions. (4)

Between 1999 and 2016, population mean BLL was greatest for non-Hispanic Black children at all ages under 5 years compared to other racial/ethnic groups (non-Hispanic White, Hispanic, and Other) as was the proportion of non-Hispanic Black children ages 1 to 5 with BLL ≥5 µg/dL. Further, greater proportions of non-Hispanic Black children had higher BLLs, with Black children accounting for all children with BLL ≥40 µg/dL. (8)

Lead exposure is also more common among refugee children in the U.S., particularly among children from certain countries of origin and country of last residence (e.g., India, Afghanistan, Burma, and Nepal). Children, as well as adults, may also be at risk for elevated BLL after arrival due to continued use of lead-contaminated spices, candies, traditional cosmetics, and cookware. (7)

Sources of Lead Exposure

Lead exposure among the general population may occur through contact with soil, dust, drinking water, food, and air (3). The most common sources of lead exposure in the U.S. are lead-based paint chips and dust, lead-contaminated soil, and lead in drinking water (1). These exposures generally result from living in housing built before 1978, prior to when lead-based paint was banned, or with lead pipes or plumbing. An estimated 83 percent of privately owned homes and 86 percent of public housing family units built before 1980 contain lead-based paint (3). Additionally, up to 10 million households and 400,000 schools and childcare facilities connect to water through lead pipes and service lines (6, 9). Living near a highway, airport, powerplant, smelter, or hazardous waste site may also cause lead exposure through contaminated soil or air (2, 3).

Other sources of lead exposure include:

- Occupations that involve working with lead-based products, most commonly in the manufacturing, construction, services, and mining industries (10).
- Hobbies or activities that involve working with lead-based products such as casting, stained glass, pottery, painting, glassblowing and screen printing (3).
- Smoking cigarettes or e-cigarettes, chewing tobacco, and exposure to second-hand smoke (3).
- A variety of consumer products such as storage batteries, solders, tire weights, pottery glazes, leaded crystal glassware, cosmetics, hair dyes, jewelry, antiques, gunshot and ammunition, relic fishing sinkers, and imported children's toys (3).
- Imported foods, candies, and spices, including:
    - Candy with ingredients such as chili powder and tamarind (lead can get into the candy when drying, storing, and grinding the ingredients are done improperly). Ink from plastic or paper candy wrappers may also contain lead that leaches or seeps into the imported candy (11).
    - Certain commonly used spices, particularly those purchased abroad in Georgia, Bangladesh, Pakistan, Nepal, and Morocco (12).
- Cultural and traditional medicines, including (7):
    - Ba-baw-san: a Chinese herbal remedy used to treat colic pain or to pacify young children.
    - Daw Tway: a digestive aid used in Thailand and Myanmar (Burma).

    - Greta and Azarcon (also known as alarcon, coral, luiga, maria luisa, or rueda): Hispanic traditional medicines used for an upset stomach, constipation, diarrhea, and vomiting. They are also used on teething babies.
- For additional examples, refer to the CDC's table of Examples of regional or culture-specific exposures associated with elevated blood lead levels in children (7).

Among pregnant and lactating women, the most common sources of lead exposure include (3):

- Working in certain occupations.
- Practicing pica (ingesting non-nutritive substances such as soil or paint chips).
- Using herbal or traditional remedies or imported cosmetics.
- Using traditional lead-glazed ceramic pottery for cooking and storing food.
- Living in an older home during a renovation.
- History of lead exposure since bone lead stores persist for decades and are mobilized into the blood during periods of increased bone turnover including pregnancy and lactation.

The primary source of lead exposure among children ages 1 to 5 in the U.S. is soil and surface dust contaminated with lead. Young children are particularly susceptible to lead exposure due to their increased contact with dust, dirt, and surfaces potentially contaminated with lead and frequent hand-to mouth-activity. Children living in older housing with lead-based paint (especially deteriorated paint), are at higher risk for lead exposure. Among children with lower BLL or living in certain communities, other exposure sources such as lead in drinking water and food may be more significant. (3)

Lead Screening and Testing

Lead exposure prevention and reduction are possible, and such primary prevention strategies are critical to preventing long-term damage that can result from even low-level lead exposure. However, because lead is ubiquitous in the environment, secondary prevention is necessary to identify and follow children who are exposed to lead. CDC recommends that public health and clinical professionals focus screening efforts on neighborhoods and children at high risk based on age of housing and sociodemographic risk factors and work together to develop screening plans responsive to local conditions using local data. CDC supports these efforts through cooperative agreements with state and local health departments that fund lead exposure prevention activities including blood lead testing (13). Where state or local screening plans do not exist, CDC recommends universal BLL testing (1).

For pregnant women, CDC recommends against universal blood lead testing of all pregnant women in the U.S. Instead, state or local public health departments should identify populations at increased risk for lead exposure and provide guidance about community-specific risk factors to assist clinicians in determining the need for blood lead testing for identified populations or individuals at risk. Follow-up blood lead testing is recommended for pregnant women with BLL ≥5 µg/dL and their newborn infants. Pregnant women identified with blood lead levels ≥5 µg/dL should be tested at the time of birth to establish a baseline to guide postnatal care for the mother and infant. Lactating women with BLL ≥5 µg/dL should be referred for follow-up testing at an interval according to the BLL. (2)

For children, CDC recommends blood lead screening for those at high risk for elevated BLL with follow-up screening within 12 months and specific follow-up actions depending on an individual's BLL. For additional information, refer to the CDC's Recommended Actions Based on Blood Lead Levels. (14)

All Medicaid-enrolled children are required to be tested at ages 12 and 24 months, or at age 24–72 months if they have not previously been screened (15).

For infants, the American Academy of Pediatrics recommends a risk assessment at 6 and 9 months, and if positive, appropriate follow up action. Risk assessment questions appropriate to local lead hazards should be developed by local health care professionals in collaboration with state, county, or local health authorities (16).

CDC's specific screening guidelines for newly arrived refugees recommend that all refugee infants and children <16 years old and pregnant and breastfeeding women be screened for lead exposure with a blood test. Refugee adolescents > 16 years of age should be screened if there is a high index of suspicion, or clinical signs/symptoms of lead exposure. Follow up screening should occur 3 to 6 months later for all children under 6 years old, children and adolescents 7 to 16 years of age who had BLLs ≥3.5 µg/dL or who has a risk factor, and pregnant or lactating adolescents (<18 years of age) who had BLLs at or ≥3.5 µg/dL at initial screening. In addition, all newly arrived pregnant or breastfeeding women should be prescribed a prenatal or multivitamin with adequate iron and calcium. (7)

Note: Venous blood samples are the most accurate method of blood lead testing. Elevated BLLs obtained using capillary (finger stick) samples should be confirmed using a venous blood test (2).

Nutrition and Lead Exposure

Adequate intake of certain vitamins and minerals may mediate the absorption of lead and thereby the impacts of lead exposure. Specifically, adequate consumption of both calcium and iron, which compete with lead for intestinal absorption, have been found to decrease lead absorption (2). During pregnancy, adequate calcium intake may reduce maternal bone resorption and thereby reduce the mobilization of lead stored in the bone into the blood (17). Iron deficiency can be an indicator of lead poisoning as they often co-occur (see risk #201 for more information about iron deficiency anemia). Participants with elevated BLL should be provided with nutritional advice emphasizing adequate calcium and iron intake and pregnant participants should be encouraged to take a prenatal vitamin as prescribed by their healthcare provider (7).

While lead can be passed to breastfeeding infants through human milk, research suggests that the amount of blood lead transferred into breastmilk is minimal and hence breastmilk has a relatively small impact on infant BLL (7). CDC has developed breastfeeding recommendations specific to maternal BLL based on the available science.

For breastfeeding women, CDC recommends the following (2):

- Initiation of Breastfeeding:
    - Mothers with BLL <40 µg/dL should breastfeed.
    - Mothers with confirmed BLL ≥40 µg/dL should begin breastfeeding when their blood lead levels drop below 40 µg/dL. Until then, they should pump and discard their breastmilk.
- Continuation of Breastfeeding:
    - Breastfeeding should continue for all infants with BLL <5 µg/dL.
    - Infants born to mothers with BLL ≥5 µg/dL and <40 µg/dL can continue to breastfeed unless there are indications that the breast milk is contributing to elevated BLL.

Implications for WIC Nutrition Services

WIC nutrition services may benefit participants with elevated BLL by:

- Making recommendations for primary prevention of lead exposure, which may include (18):
    - Avoiding relevant risk factors (e.g., certain traditional medicines and cosmetics, imported or antique children's toys, imported or pottery dishes, and imported spices and candies).
    - Referring the participant to a licensed lead inspector to have their home tested for lead.
    - Referring the participant to the local water authority for testing for lead in tap water.
    - Washing children's hands after playing outside, regularly washing pacifiers, toys, etc., and removing shoes when entering the house.
- Encouraging consumption of foods (with an emphasis on the foods available in their WIC food package) with nutrients that help minimize absorption of ingested lead and assist in preventing adverse consequences, including:
    - Calcium: Low-fat dairy, bone-in canned fish, and fortified fruit and vegetable juices (19). For more information see: http://ods.od.nih.gov/factsheets/Calcium-HealthProfessional/
    - Iron: Lentils and beans, fortified cereals, red meats, fish, and poultry (20). For more information see: http://ods.od.nih.gov/factsheets/Iron-HealthProfessional/
- Helping to determine source(s) of lead exposure and counseling participants on avoiding exposure, including by:
    - Assessing pica behavior (for more information, see Risk #427 Inappropriate Nutrition Practices for Women and Risk #425 Inappropriate Nutrition Practices for Children).
    - Working with local lead programs to determine source(s) of lead exposure and to support their recommendations for reducing further exposure.
        - Information about State and local childhood lead poisoning prevention and surveillance programs can be found here (13): Lead Funding Information | CDC
- Referring participants to lead screening/testing: WIC agencies must ask parents/caretakers if the child they are enrolling in WIC has had a blood lead screening test; any child who has not had a test must be referred to a program where they can obtain one.
- Providing a referral to a lead treatment program via the local health departments.
- Working with healthcare providers to support breastfeeding according to CDC guidelines. This may include providing breastfeeding support to mothers with elevated BLLs who need to temporarily pump and discard their breast milk.

Clarification

The Definition/ Cut-off Value for each WIC participant category is based on current CDC guidelines. It is important to note that these values are not a health standard or toxicity threshold, but a guide to help determine when medical or environmental follow-up actions should be taken for an individual.

For women and infants, the values are adopted from CDC's Guidelines for the identification and management of lead exposure in pregnant and lactating women (cdc.gov) (2). For more information, refer to the following tables in this guidance:

- For infants, Tables 5-1 and 5-2 for Infants (pages 58-59). For simplicity and consistency, WIC is applying BLL ≥5 for all infants (CDC guidance varies by infant <1 month vs <6 month and does not address infants 6-12 months).
- For women, Tables 5-3 (page) and 9-1 (page 103).

For children, the value is the current Blood Lead Reference Value (BLRV), a population measure developed by the Centers for Disease Control and prevention (CDC) to identify children ages 1 to 5 years old with higher levels of lead in their blood compared to 97.5 percent of children in the United States (U.S.). The CDC established the BLRV in 2012 and updated it in 2021 (from 5 to 3.5 µg/dL) based on current national BLL data from the National Health and Nutrition Examination Survey (NHANES). (1)

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