Appendix F: Nutritional Material

Prelude to Nutritional Focus Article

The following *Nutrition Focus* article "Childhood Lead Poisoning and the Role of Nutrition" was written in 2002 and therefore does not reflect the 2012 CDC recommendation to begin diagnostic (venous) testing for all children who have an initial blood lead test result ≥5 µg/dL.

However, the article's information about the health effects of lead, sources and pathways of lead exposure in children, the role of nutrition, nutrition assessment methodology and lead poisoning prevention, education and intervention is still accurate and relevant for childhood lead poisoning prevention.

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Childhood Lead Poisoning and the Role of Nutrition

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Editor's Note – This edition is an update of an earlier Nutrition Focus, Lebeuf, JS and Norman, EH. Nutritional Implications of Lead Poisoning in Children. Nutrition Focus. Volume 8, #5, September/ October 1993. Lead poisoning is still a health problem for children and this issue provides current information about this continuing public health issue.

BACKGROUND

Childhood lead poisoning is a major, preventable, environmental health problem. The persistence of lead poisoning in light of present knowledge about the sources, pathways and prevention of lead exposure, continues to challenge clinicians and public health authorities. Lead has no known physiological value and children are particularly susceptible to its toxic effects. Most poisoned children have no apparent symptoms, and consequently, many cases go undiagnosed and untreated. Recent studies suggest that even blood lead levels (BLLs) below 10 micrograms per deciliter (μg/dL) can adversely affect children's ability to learn, and their behavior. No socioeconomic group, geographic area, racial or ethnic population is spared.

The percentage of children ages 1-5 in the United States with elevated blood lead levels has decreased from 88.2% (1976 – 80) to 4.4% (1991 – 1994) according to data from the Second and Third National Health and Nutrition Examination Surveys (NHANES). However, the Centers for Disease Control and Prevention (CDC) estimate that approximately 890,000 children in the United States have blood lead levels ≥10 μg/dL.[1] Moreover, among U.S. children ages 1-5 who had BLLs ≥20 μg/dL, 83% were Medicaid enrollees, as were 60% of those with BLLs ≥10 μg/dL.[2] For some states, the Medicaid burden is even greater. For example, from 1998 to 2000 in North Carolina, more than 75% of children with BLLs ≥10 μg/dL were Medicaid enrollees. Unfortunately, while Medicaid children have a prevalence of elevated BLLs three times that of children in the same age group who are not Medicaid enrollees, 65% of them are not screened according to recent estimates by the Government Accounting Office (GAO).[3] As a result, the CDC recommended targeted screening for all high-risk children at ages one and two in 1998. An example of targeted screening is the establishment of different screening strategies for low and high-risk zip codes, based on the age of housing stock and the number of children with elevated BLLs.

Sources of lead exposure are listed in Table 1 and include lead-based paint, soil, house dust and drinking water. While lead-based paint is still the major source of exposure, the concern has shifted from children eating paint chips to ingestion of lead-contaminated dust. There have even been, through hand-to-mouth activities, documented cases of childhood lead poisoning resulting from a pet whose fur was contaminated with lead dust. Imported vinyl mini-blinds made with a lead formula have poisoned children. The growing immigrant population in the United States is a challenge for public health professionals to be aware of the cultural differences and traditional products that may put these children at high risk. For example, many household items from Mexico have been found to contain lead including ceramic bean pots and tamarind candy. Some imported traditional medicines, aphrodisiacs and other herbal preparations have also been found to contain high levels of lead.

HEALTH EFFECTS

Severe lead exposure (≥70 μg/dL) can cause lethargy, convulsions, coma and even death in young children. Lower levels can cause adverse effects on the kidneys, and the hematopoietic and central nervous systems. According to the CDC, even blood lead levels below 10 μg/dL, which do not cause specific symptoms, are associated with decreased intelligence and impaired neurobehavioral development. Other adverse effects begin at low levels of exposure, including decreased growth and growth velocity, decreased hearing acuity, decreased ability to maintain a steady posture and impaired synthesis of vitamin D. Lead also competes with iron for incorporation into the heme molecule and can contribute to iron-deficiency anemia. Epidemiologic studies provide ample evidence on the association between low-level lead exposure and the effects on child development.

A recent study analyzed data on 4,835 children, ages 6-16 years, from the NHANES III.[4] The relationship between blood lead concentration and performance on tests of arithmetic, reading, nonverbal reasoning and short-term memory was assessed. The researchers found an inverse relationship between blood lead concentrations and deficits in cognitive functioning and academic achievement in children at levels below 5.0 μg/dL. Reading abilities were especially affected. Behaviorally, the study suggests that attention, judgment and decision-making abilities, visual-motor reasoning skills, and social behavior are particularly affected. These results argue for a reduction in blood lead levels that are considered acceptable. No detectable threshold for the adverse effects of exposure was found by these researchers.

In a number of prospective studies, prenatal exposures have been associated with delayed sensory-motor and early cognitive development. However, these effects appear to diminish as children grow older, given low postnatal exposure and favorable socioeconomic conditions.[5]

Table 1

Sources and Pathways of Lead Exposure in Children

Lead-based paint: The most common source of lead exposure for young children is lead-based paint. The use of lead-based paint for homes, furniture and toys is now prohibited; however, it is still found in homes built before 1978, and homes built before 1950 can contain paint with high concentrations of lead exceeding 50% by weight.

Soil and house dust: Contaminated by deteriorated paint, leaded gasoline and industry emissions, soil containing lead is found near the foundation of homes, in industrial areas and near major roads. The phase-out of lead in gasoline mandated by the EPA was completed in 1987. Remodeling and renovation, which is done without using lead-safe work practices, can generate lead dust. Dust in deteriorated window areas is often contaminated with lead.

Ceramic ware: Imported and decorated dishes or handmade pottery can be frequent sources of lead for immigrants and others. Foods stored or served in leaded crystal or food cooked and/or stored in improperly fired ceramic dishes can contain lead.

Drinking water: Water can be contaminated by plumbing in homes with lead pipes or copper pipes soldered with lead.

Food and supplements: Some imported canned products, "natural" dietary supplements such as bone meal, and some calcium supplements such as dolomitic limestone and oyster shells, while not widely recommended for young children, can be a source of lead. Levels vary considerably from trace amounts to higher levels.

Air: Emissions from active lead smelters and other lead-related industry can be inhaled.

Occupations and hobbies: Workers may take home lead dust on their clothing or bring scrap material home from work with radiators, car batteries, dirt near freeways, paint removal, smelters and factories. Hobbies such as making stained glass, pottery, fishing weights, or jewelry; reloading or casting ammunition; and refinishing furniture are sources of lead.

Traditional medicines: Folk remedies from Latin America used to treat "empacho" (upset stomach) such as greta and azarcon (also known as Rueda, Coral, Maria Luisa, Alarcon or Liga) have been found to contain more than 90% lead by weight. Pay-loo-ah is a reddish powder used by the Hmong to treat fever and rash. Some Chinese herbal remedies and teas have also been found to contain high levels of lead. Lead has also been found in aphrodisiacs imported from India and Africa.

Cosmetics: Cosmetics used by some Indian, African and Middle Eastern immigrants such as surma and kohl contain lead.

Vinyl Products: As they age and deteriorate, imported, lead containing vinyl mini-blinds may have lead dust on their surfaces. In 1996, the Arizona and North Carolina Departments of Health first alerted the U.S. Consumer Product Safety Commission (CPSC) to the problem of lead in the imported vinyl mini-blinds. Lead was added to stabilize the plastic in imported blinds. Using electron microscopy, it was confirmed that as the blinds deteriorated from sunlight and heat, lead-containing dust formed on the surface of the blind slats, posing a potential risk to young children. Young children can ingest lead by touching the mini-blinds and then putting their hands in their mouths, mouthing the window, or mouthing the blinds themselves. In some tested blinds, the levels of lead in the dust was so high that a child ingesting dust from less than one square inch of blind a day for 15 – 30 days could result in blood levels at or above 10 μg/dL. Children's vinyl toys may be another source of lead for young children. Studies done at the University of North Carolina in Asheville have demonstrated that as some soft vinyl toys are exposed to light and to chewing they can release lead as well as cadmium, another toxic heavy metal. This was particularly true among soft vinyl toys from Asia. Highest levels of cadmium were found in toys, soft lunchboxes and rainwear that were bright yellow.[6]

RECOMMENDATIONS FROM THE CENTERS FOR DISEASE CONTROL

The CDC's level of concern remains at 10 μg/dL. Targeted screening, based on geographic areas or demographic populations of highest risk, is recommended. Some states screen by evaluating blood from a finger stick. If the level is equal to or greater than 10 μg/dL then a venous blood draw is the next step. All children receiving Medicaid are required to be tested at 12 and again at 24 months of age, or upon their first entry into the health care system at a later age. A multi-tier approach to follow-up is recommended (Table 2)[1].

Children with blood leads <10 μg/dL at 12 months of age are not considered to have an elevated exposure, however, those at risk should be rescreened at 2 years of age. Table 3 lists questions to ask parents or caregivers to determine if a child is at risk for lead exposure. Additional questions may be added to tailor the questionnaire for likely sources of exposure in different communities (e.g., questions related to industry or traditional medicines). If the answers to all questions are negative, the child is considered to be at low risk for lead exposure. If the answer to any question is positive or "I don't know," the child is considered high risk for lead exposure.

Community-wide education (primary prevention activities) is recommended when many children in an area are found to have blood lead levels ≥ 10 μg/dL. In most states, children with blood lead levels ≥10 μg/dL are medically eligible for participation in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC Program). Individual case management, including nutrition and education interventions (described below and in Table 5) and frequent retesting, is recommended for children with blood leads ≥ 15 μg/dL. In many areas, families of children with BLLs ≥10 μg/dL are offered environmental investigations.

More involved medical and environmental interventions are indicated for children with blood lead levels ≥ 20 μg/dL. The medical evaluation consists of a careful history and a physical examination as well as evaluation of iron status and other special diagnostic tests. A medical evaluation should be conducted whether or not symptoms are present. Environmental interventions are aimed at identifying the source of exposure (home investigation) and reducing lead hazards (abatement or remediation). For BLLs ≥ 20 μg/dL an abdominal x-ray is recommended if particulate lead ingestion is suspected. If positive, bowel decontamination is indicated.

Table 2
Interpretation of Screening Test Results and Recommended Follow-up

Blood Lead Level (μg/dL)	Comments
<10	A child with this Blood Lead Level (BLL) is not considered to have an elevated level of exposure. Reassess or rescreen in one year. No additional action is necessary unless exposure sources change.
10-14	The CDC considers 10 μg/dL to be a level of concern. Perform diagnostic test on venous blood within three months. If the diagnostic test is confirmatory, the child should have follow-up tests at three month intervals until the BLL is <10 μg/dL. Provide family lead education. Refer for nutrition counseling.
15-19	A child in this category should also receive a diagnostic test on venous blood within three months. If the diagnostic test is confirmatory, the child should have additional follow-up tests at three month intervals. Children with this level of exposure should receive clinical management. Parental education and nutritional counseling should be conducted. A detailed environmental history should be taken to identify any obvious sources of lead exposure.
20-44	A child with a BLL in this range should receive a confirmatory venous test within one week to one month. The higher the screening test, the more urgent the need for a diagnostic test. If the diagnostic test is confirmatory, coordination of care and clinical management should be provided. An abdominal x-ray is completed if particulate lead ingestion is suspected. Nutrition and education interventions, a medical evaluation, and frequent retesting (every 3 months) should be conducted. Environmental investigation and lead hazard control is needed for these children.
45-69	A child in this category should receive a confirmatory venous test within 48 hours. If the screening blood lead level is between 60-69 μg/dL, the child should have a venous blood lead level within 24 hours. If confirmatory, case management and clinical management should begin within 48 hours. Environmental investigation and lead hazard control should begin as soon as possible. A child in this exposure category will require chelation therapy and an abdominal x-ray is completed if particulate lead ingestion is suspected.
≥70	A child with a BLL ≥70 requires immediate hospitalization as lead poisoning at this level is a medical emergency. Confirmatory venous testing should be done as soon as possible. An abdominal x-ray is completed if particulate lead ingestion is suspected and chelation therapy should begin immediately. Case and clinical management including nutrition, education, medical and environmental interventions, must take place as soon as possible.

Information from Centers for Disease Control and Prevention. Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Offices. November 1997. Atlanta, Georgia. United States Department of Health and Human Services, Public Health Services, CDC, 1997 and Centers for Disease Control and Prevention. Managing Elevated Blood Lead Levels Among Children: Recommendations from the Advisory Committee on ChildhoodLead Poisoning Prevention. March 2002

Chelation therapy (the administration of a drug(s) that bind with lead to remove it from the body) is recommended for children with BLLs ≥45μg/dL.[7] An oral chelating agent, "succimer", that can be used on an outpatient basis, was approved for use in children with blood leads ≥ 45 µg/dL. Chelation therapy may be considered if the BLLs are ≥25 µg/dL however recent studies concluded that this treatment offers limited benefits to children with BLLs < 45 µg/dL. A randomized, placebo-controlled, double blind trial of chelation therapy in 780 children with BLLs less than 45 µg/dL was undertaken by NIEHS at the Triangle Research Institute. In an article published in the New England Journal of Medicine, the researchers reported that treatment with succimer did not lead to better scores on cognitive, neuropsychological or behavioral tests than placebo.[8] Care must be taken to keep recently chelated children away from environmental lead hazards during outpatient chelation therapy, as this type of therapy increases internal lead mobilization and can increase the absorption of lead.

THE ROLE OF NUTRITION

Young children, particularly one- and two-year-old children, are at greatest risk for lead poisoning due to their increased mobility and hand-to-mouth activity. With greater access to lead hazards and normal "mouthing" of hands and other items, there is greater ingestion of lead. Nutrition, in its broadest application, plays an integral role in young children's susceptibility to lead. Young children's dietary intake and nutritional status can influence the absorption, retention and effects of lead toxicity through total food intake and lead-nutrient interactions involving iron, calcium, Vitamin C, and zinc. In turn, lead can influence nutritional status through its effect on growth in stature, iron status and vitamin D metabolism.

Ingestion and Absorption of Lead in Young Children

Lead poisoning begins with ingestion and inhalation of lead. Studies show that children absorb close to 50 percent of the lead they ingest or inhale in contrast to adults who absorb only approximately 10 percent. It is estimated that young children's absorption rates of lead from non-food sources exceed 50 percent. Rates are closer to 40 percent when the lead source is infant formula, milk, and other beverages.[9] Reasons for more efficient lead absorption by young children include their lower body weights and the lack of effective mechanisms adults develop for clearing lead once ingested or inhaled. Young children also have an enhanced capacity to absorb lead from the gastrointestinal tract which is possibly due to the higher density of intestinal transport proteins during periods of growth. In turn, the effects of lead in children generally occur at lower blood lead levels than in adults. For example, the developing nervous system in children can be affected adversely at levels even below 10 µg/dL compared to adults.

Table 3
Questions for Families to Assess the Risk of Exposure to Lead

Does your child:

- Receive the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) Program Services or is your child enrolled in Medicaid?
- Live in or regularly visit a house built before 1978, including home childcare centers or homes of relatives with peeling or chipped paint with recent, ongoing, or planned renovation or remodeling?
- Have a brother or sister, housemate, or playmate being followed or treated for lead poisoning (blood lead ≥15 µg/dL)?
- Live in or regularly visit a house that contains vinyl mini-blinds?

Consumption-Related Exposure to Lead

Efforts to limit exposure to lead-containing paints, gasoline, and food and beverage containers have made a tremendous impact. The U.S. Food and Drug Administration's 1994-1996 Total Diet Studies showed that, since 1982-1984, daily intakes of lead from food dropped 96 percent in 2- to 5-year-olds (from 30 to 1.3 micrograms).[10] However, the most common source of lead exposure for young children continues to be deteriorating lead-based paint chips and dust inside and outside homes, particularly those built before 1950 when paint containing as much as 50% or more lead by weight was still widely used. Children can ingest loose paint as a result of pica (compulsive eating of non-food items).

When food contains lead, it may be from the environment or from containers used for food or beverage storage. Agricultural vehicles are not required to use unleaded gasoline; consequently lead can be deposited on and retained by crops, particularly leafy vegetables. Lead in soil can also be taken up by plants as they grow. Lead glazes are used in making pottery and ceramicware which may be used for cooking or storage of food. Traditional pottery imported from Mexico or other countries often use glazes which may contain large amounts of lead. Foods stored in cans made with lead solder have been found to contain lead. For the last decade, lead solder in canning has been banned from use in the United States but other countries continue to use lead solder. This is particularly a problem with imported canned meats and acidic foods like tomatoes. If lead crystal is used for storing acidic beverages such as orange or tomato juice, the acid can facilitate leaching of lead into the beverage.

It is estimated that drinking water contributes 10-20% of total lead exposure in young children. Typically, lead gets into the water supply after it leaves the treatment plant or well. The source of lead in homes is most likely leaded pipe or lead-soldered plumbing despite the Environmental Protection Agency's ban in 1988 on using lead solder and other lead-containing materials in connecting household plumbing to public water. Many older structures still have lead pipe or lead-soldered plumbing which may substantially increase the lead content of water at the tap. Also, lead solder is still widely available and may be misused.

Calcium supplements from natural sources, such as dolomitic limestone and oyster shells, while not widely recommended for young children, can be a source of lead. Levels vary considerably from trace amounts to higher levels.

As previously defined in Table 1, some traditional medicines which may contain lead may be used by immigrant families. Children who are given these powders may actually be ingesting lead, and they may develop the same symptoms that these medicines are intended to treat.

Human Milk

Lead levels in human milk are lower than would be expected based on maternal blood lead levels. Lead's inability to attach to the fat in human milk prevents it from becoming concentrated. However the Health Resources and Services Administration recommends that women with blood lead levels of 40 µg/dL or above not breastfeed their infants.

Nutritional Influences on Lead Absorption

There is wide individual variation in the gastrointestinal absorption of lead. Factors which impact absorption and susceptibility to lead toxicity include age, frequency of eating, quality of the diet, and nutritional status. The state of satiety affects lead absorption. When adults ingest lead on a "full stomach", about 8% of the lead is absorbed compared to about 35% when ingested after a brief fast.[9] As previously stated, lead absorption rates are much higher in children. Absorption is further enhanced, and in many situations, exposure to lead occurs more frequently, in children who have not eaten recently. Children playing in lead-contaminated soil, eating paint chips or inhaling lead dust hours after their last meal are at significant risk. Parents and caretakers of young children should be encouraged to provide frequent meals and snacks to children at risk for lead exposure.

Nutrients: Calcium, Iron, Vitamin C, Zinc and Fat

Dietary recommendations which are typically made in an effort to help protect children from lead poisoning are still not consistently backed up with scientific evidence. These recommendations are not controversial from a nutrition point of view, and in fact, can be easily endorsed for all children regardless of their risk of lead exposure. But, care must be taken not to make assumptions about specific nutrients and their efficacy in helping prevent lead poisoning.

Animal absorption studies have demonstrated that dietary calcium can decrease gastrointestinal lead absorption. Human studies in adult and children indicate there may be a direct interaction between lead and calcium which are consumed simultaneously, suggesting possible competition for absorptive sites in the gut. Furthermore, it has been postulated that when lead interferes with normal calcium absorption, normal growth and development may be affected. But the evidence is not strong enough to demonstrate that dietary calcium can actually reduce lead toxicity.

It has been known for a long time that iron deficiency and lead toxicity frequently coexist. In the mid-1980's, the American Academy of Pediatrics, in their *Statement on Childhood Lead Poisoning*, stated that "Iron deficiency, even in the absence of anemia, appears to be the single most important predisposing factor for increased absorption of lead".[11] One theory for the association between iron and lead levels in the blood comes from the fact that the two are biochemically similar and symptoms of severe iron deficiency even mimic those of lead poisoning including lethargy, inattentiveness and delays in cognitive development. This theory has also postulated that the absence of iron creates a nutrient deficit in the body, which responds by grabbing more of the lead that is ingested by the child, or hanging onto the lead more strongly once it is in the body. However, as in the case of calcium, more recent studies indicate there is no strong evidence that increasing dietary iron will definitely decrease lead absorption and lead toxicity.

Zinc status influences lead absorption at the gastrointestinal level. Animal research has demonstrated an increase in tissue lead levels and lead toxicity as dietary zinc content decreases. There is some clinical data associating zinc status and elevated lead levels in children. For proper brain development in children, the body relies on the trace mineral zinc to help regulate genes that coordinate brain cell growth. In findings that shed new light on understanding how lead affects the developing brains of children, researchers believe that when lead is introduced into the body in sufficient quantities, it displaces zinc and ultimately disrupts brain cell growth.

Although several animal studies suggest a protective relationship between blood lead concentrations and ascorbic acid, there are no conclusive results regarding the beneficial effect of vitamin C on lead concentrations in human studies. Serum ascorbic acid concentrations were inversely associated with the prevalence of elevated blood lead concentrations, but there was no significant relationship between dietary vitamin C intake and blood lead

Table 4
NUTRITION ASSESSMENT FOR CHILDREN WITH ELEVATED BLOOD LEAD LEVELS

Anthropometric

Assess growth parameters including:
- weight-for-age
- appropriate rate of weight gain if indicated
- length/height-for-age
- weight-for-length for infants and children < 2 years, or BMI children ≥ 2 years of age
- calculate mid-parental height if height-for-age is below the 5th percentile

Biochemical
- Assess test results for blood lead level
- Review tests for iron deficiency

Clinical
- determine nutritional implications of medical management of lead toxicity

Dietary

Assess dietary intake for:
- adequate food supply
- number of meals and snacks eaten on a typical day
- water supply and usage patterns for infant formula, beverages and foods
- adequacy of calcium iron, and zinc, and vitamin C intake
- food storage techniques
- use of imported canned foods/candy
- use of traditional medicines that might contain lead

Ecosocial
- Review findings from environmental assessment if available
- Ask questions regarding pica or excessive mouthing behaviors
- Assess home sanitation:
- meal preparation area
- hand washing practices
- washing pacifiers/bottle nipples/toys

concentrations. There is however enough evidence to support the beneficial effect vitamin C has on iron absorption thereby improving iron status and helping prevent lead absorption.[12]

Fat Intake

There is limited scientific evidence showing that increased intakes of dietary fat increase absorption and retention of lead. Dietary fat intake was found to enhance the absorption of lead in animal studies but these results have not been replicated in children.

PREVENTION, EDUCATION AND INTERVENTION

Primary Prevention

Public health departments and health care practitioners should, at a minimum, support, oversee, and monitor the activities necessary to prevent childhood lead poisoning. Primary prevention activities include public education and providing anticipatory guidance to families about the causes of lead poisoning.

Participation of young children in targeted public health programs, such as the WIC Program, has helped lead poisoning prevention and detection efforts. Nutrition education, referrals and supplemental foods are the cornerstones of helping families; and foods provided by WIC are nutritious and include nutrients previously mentioned. A study published in 1998 used data from the 1989-1991 Continuing Survey of Food Intakes by Individuals (CSFII) conducted by the U.S. Department of Agriculture. The study found that the WIC Program had major effects in improving nutrient intakes among low-income preschoolers.[13] WIC had significantly positive effects on preschoolers' intakes of ten nutrients including three of the four nutrients most frequently deficient in the diet of preschoolers—iron, zinc, and vitamin E. The researchers noted that iron deficiency is the single most prevalent nutritional deficiency in the United States and that anemia rates are still high among young low-income children. They also noted that previous studies indicate zinc deficiencies may be related to growth retardation.

Table 5
Preventing Lead Poisoning in Young Children - Guidelines for Education, Nutrition and Hygiene

Recommendation	Rationale
Offer young children breakfast and other meals and snacks at regular, well spaced intervals, such as every 2-3 hours.	Lead is more readily absorbed when the body is in a fasting state, such as when the body has been without food for an extended period (e.g. after a night's sleep). Children exposed to lead absorb less when they have recently consumed food.
Ensure that young children's daily intake of calcium, iron,Vitamin C, and zinc meet recommendations.	Children with diets adequate in these nutrients may absorb and retain less lead than children with inadequate intakes.
Use fully-flushed cold water for drinking and food preparation.	Lead or lead-soldered pipes leach lead into the water supply. Hot tap water leaches more lead from pipes and pipe solder than cold water. Water that has been sitting in the pipes for several hours or overnight has higher lead levels than water from flushed pipes. If the cold water hasn't been used for more than two hours, run it for 30-60 seconds before drinking it or using it for cooking.
Store food and beverages in glass, plastic or other lead-free containers	Lead soldered cans (used sometimes for imported foods), improperly glazed ceramic pottery, and lead crystal can contribute to a child's overall lead level. Food stored in or regularly consumed from leaded containers may contain significant amounts of lead.
Avoid use of traditional medicines which have been found to contain lead, such as: azarcon, greta, payloo-ah	Traditional medicines may contain significant amounts of lead and cause the same symptoms for which they are taken in addition to contributing to elevated lead exposure
Be aware of and limit opportunities for pica. Also keep children from chewing on or licking anything painted like windowsills.	Pica, or the consumption of non-food items such as paint chips or lead-contaminated soil, is the leading cause of lead poisoning in young children. Children may ingest lead from places which have been painted with lead-based paint.
Wash the child's hands and face before every meal and snack. Wash toys, pacifiers and cups after each time they fall on the floor or ground.	Hand and face washing before eating cuts down on the possibility of lead-laden dust being transferred to the food and into the child's mouth. Washing items which go into the child's mouth will also decrease the amount of dust and dirt ingested.
Discourage "cruising" while eating meals or snacks. Food needs to be eaten at a clean table or kitchen counter under the supervision of an adult.	Food eaten "on the run" gets dropped on the floor, dragged over furniture, or placed on a window sill and then retrieved and eaten along with the potentially lead-laden dust it has collected.

Secondary Prevention

Secondary prevention activities include conducting blood lead level screenings, providing medical management when problems are identified and providing education to manage lead poisoning and prevent further lead exposure. In most of the target communities in North Carolina, for example, families of children with elevated BLLs receive a home visit, a cleaning kit and instructions on how to do specialized cleaning to remove lead dust. Clinical management of individuals with elevated BLLs includes a nutrition assessment, obtaining the ABCDE parameters: anthropometric, biochemical, clinical, dietary, eco-social. See Table 4. Within these parameters are areas which warrant special consideration when assessing the nutritional status of children exposed to lead or at high-risk for lead poisoning.

Secondary preventive measures include nutrition education and counseling aimed at:

- ensuring an intake of calcium, iron, Vitamin C, and zinc sufficient to meet daily requirements
- ensuring the young child's total dietary intake over three meals and at least two snacks
- preparing infant formula, beverages and foods with cold tap water from fully flushed pipes
- storing foods in lead-free containers
- washing hands before eating, and cleaning bottle and pacifier nipples, and toys each time they fall on the ground
- limiting opportunities to eat non-food items such as lead-contaminated soil or lead-based paint chips.

Table 5 provides additional guidelines for the prevention of lead poisoning in young children.

SUMMARY

Lead is the number one environmental pollutant affecting the health of children in the United States. The CDC guidelines were developed in response to evidence that blood lead levels even below 10 µg/dL in young children are associated with decreased intelligence, impaired neurobehavioral development, decreased growth in stature, decreased hearing acuity, and other adverse effects. There is a growing body of evidence that levels as low as 2.5 µg/dL are associated with decreased reading skills and antisocial behavior. No lower limit or threshold has been established below which no health effects occur. It is imperative that pre-school children be tested for lead poisoning, especially at ages 1 and 2 years. Healthcare and education professionals as well as parents and caretakers of young children should be informed about the sources of lead exposure and trained in both primary and secondary lead poisoning prevention activities, especially the importance of nutrition.

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RESOURCES

1. **The National Lead Information Center,**
   1-800-424-LEAD
   www.epa.gov/lead/nlicdocs.htm
   This Center provides information about lead prevention, lead poisoning, testing for lead in your home, and home repairs when lead paint is present. Information is available in English and Spanish. Written information includes:

a. **Lead Poisoning and Your Children**, developed by the Environmental Protection Agency, is a colorful, attractive brochure which reviews possible sources of lead exposure and suggests how to reduce the risk of exposure. The brochure unfolds into an 11" x 17" poster which can be displayed in a clinic, office, or school setting. The poster lists seven methods to protect children from lead poisoning. The seven methods are explained in more detail on the reverse of the poster. Single copies of the poster are available by calling the National Lead Information Center.

b. **Fight Lead Poisoning with a Healthy Diet: Lead Poisoning Prevention Tips for Families** is a colorful, attractive brochure which provides parents and caretakers information on preventing lead exposure in young children. The brochure focuses on nutrition and healthy foods and includes simple recipes. It was developed by the Environmental Protection Agency's Office of Pollution Prevention. For a copy of the brochure contact the National Lead Information Center.

c. **Lead in Your Home: A Parent's Reference Guide** is a 70-page paperback book that discusses environmental lead, sources of lead in the home, how to reduce the risk of lead in your home, protecting your children, repair, remodeling, interim controls, abatement, cleaning up lead waste and resources for further information. The book is published by the Environmental Protection Agency and can be ordered by calling the National Lead Information Center.

2. **The Environmental Protection Agency's Safe Drinking Water Hotline** provides information on lead hazards in your drinking water. Call the hotline at 1-800-426-4791.

3. **Resources on the World Wide Web**
   www.epa.gov/lead for the Environmental Protection Agency Lead Program
   www.cdc.gov/nceh/lead for Center for Disease Control and Prevention's lead program
   www.hud.gov/offices/lead for Housing and Urban Development's lead program and activities

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For those with access to the internet we have a web page at
http://depts.washington.edu/chdd/ucedd/CO/co_NutriFocus.html

Future issues of
NUTRITION FOCUS

July/August - Vol 17 #4
Nutrition and Attention Deficit Hyperactivity Disorder

CLPPP Nutrition Assessment	Potential "Red Flags"	Notes/Referrals
Anthropometric • Assess growth parameters including: - weight-for-age and length/height-for-age - weight-for-length for infants and young children < 24 months of age OR BMI-for-age ≥ 2 years of age - appropriate rate of weight gain if indicated	• *Child's weight-for-age is tracking above or below the highest or lowest growth channels or deviating from the child's "normal".* • *Child's length/height-for-age is deviating from the child's "normal".* • *Child is failing to track their "normal" growth channel for weight-for-length or BMI-for-age percentile.* • *Child (one year or older) is gaining excessively (> 1lb in 6 months) or inadequately (< 1 lb in 6 months).*	
Biochemical • Assess test results for blood lead level • Asses hemoglobin or hematocrit for iron	• *Child's BLL ≥ 5 ug/dL.* • *Child's hgb/hct < 11.0 or 33%.*	
Clinical • Determine nutritional implications of medical management of lead toxicity	→	*Coordinate care with child's health care provider.*
Dietary • Screen dietary intake for: - number of meals and snacks eaten on a typical day - adequacy of diet including sources of iron, vitamin C, calcium and zinc - water supply source and usage patterns - food storage techniques and receptacles - use of imported canned foods - use of traditional home remedies that might contain lead	• *Child is eating < 3 meals and 2 snacks daily.* • *Child is not consuming a varied diet; refer to a nutritionist if there is a concern with getting adequate variety or sources of iron-, vitamin C-, calcium- and zinc-rich foods.* • *Tap water is not flushed before using or warm water from tap is used for food preparation or drinking.* • *Food may be exposed or stored in containers that have lead, i.e. high-acid foods such as orange juice or tomatoes are stored in lead-glazed containers.* • *Child is eating imported, canned foods or spices.* • *Child is given traditional remedies with high lead content.*	
Ecosocial • Review findings from environmental assessment if available • Question regarding pica or excessive mouthing behaviors • Assess home sanitation: - meal preparation area - hand-washing practices - washing pacifiers/bottle nipples/toys	• *Child is eating non-food items.* • *Child has normal (developmental stage) mouthing behaviors that may increase exposure to lead.* • *Child's food is prepared in an area that may be exposed to lead dust.* • *Child's hands are not routinely washed before eating.* • *Child's toys, pacifiers and bottle nipples are not washed regularly.*	
		Referrals: ❒ WIC ❒ Other:______________________