Getting the lead out: important exposure science contributions

Referenced from National Center for Environmental Assessment, RTP Division, Office of Research and Development, US Environmental Protection Agency, Research Triangle Park, Media and other Scientific sources

Lead is a highly useful metal, but has long been feared because of the risks it poses to human health. The characterization of human lead-exposure pathways and internal lead burdens is an important exposure science advance that has contributed to an impressive public health success story not yet finished.

Exposure to lead has long been known to exert toxic effects on the nervous system, with the greatest concern typically being for unborn fetuses, infants and young people. It is recognized that people of all ages can be affected and lead impacts virtually all organ systems.

Both ancient and modern societies have used lead in diverse ways (e.g., in water distribution systems, paints, fuel additives, dietary supplements and electrical and electronics applications). (Nero, the Roman Emperor who burned Rome, was thought to be mad because of drinking wine boiled in lead pots) This has led to widespread environmental dispersal of the metal, elevated lead exposures among many human populations, and increased public health risks. Over the past 50 years or so, major exposure science advances have contributed notably to the characterization of human lead exposures and consequent public health threats. Of special note are advances in key areas such as air, food, water, soil and calcium, (particularly when used in dietary supplements) are a serious threat to human exposures and internal lead body burdens between external exposures and impacts on internal lead burdens. Health science findings of toxic lead effects at lower and lower exposure levels, have led to worldwide recognition of the need to reduce human lead exposures and associated public health threats, with much progress having been made toward this goal. Numerous reviews of the extensive literature documenting the above advances have been published (e.g., EPA, 1986, 2006; Grant, 2009).

IMPACT AND IMPLICATIONS FOR EXPOSURE SCIENCE

Characterization of lead-exposure pathways has enabled identification of effective approaches to reduce lead health risks. As reviewed by the US Environmental Protection Agency (EPA, 1986, 2006) and Grant (2009), exposure science has identified modern sources of lead, quantified associated emissions, delineated dispersal pathways (e.g., via air, soil, water, or food) leading to exposures, quantified lead levels encountered in such exposure pathways, and estimated impacts of lead exposures via various pathways on internal lead burdens (as indexed by lead levels in blood, bone, and other tissue or by effects on blood hemoglobin or other lead-exposure biomarkers) in pediatric and adult populations. Lead exposure impacts on human lead burdens for people up to 90 years of age, as well as to predict impacts of maternal lead exposures on lead burdens in fetuses or newborns.

Multiple sources and pathways of lead exposure exist (EPA, 1986, 2006). Reduction of air pollution from the use of leaded gasoline, and of consequent human lead exposure, is a classic example of successful regulation (see figure). The phase-out of leaded gasoline has led to substantial reductions of US urban airborne lead levels. Also, as other significant exposure pathways have been identified, additional mitigation steps have been taken. For example, in the United States lead is banned from house paint, lead solder is no longer used in manufacturing food cans, and the use of leaded solder in indoor plumbing to carry drinking water has been discontinued. These regulations have been effective, but exposure continues, sometimes raising health concerns. For example, increased tap water lead levels have been found in some homes with older lead-soldered plumbing following changes in drinking water treatment procedures in some cities. Also, lead persists in soil from past deposition of airborne lead from gasoline and the weathering of old lead-based house paint. Children may play in such dirt. Recent exposure science studies highlight the importance of house dust contaminated by lead from soil or air as a vector for exposure in young children. Several studies have shown the effectiveness of certain cleaning approaches for removal of house dust and of lead-contaminated soil around residential structures in reducing blood lead levels in young children.

As new information has emerged on exposure and health effects over the past few decades, designations of “unacceptable” lead levels have been repeatedly revised downward. For example, questions still persist as to how safe still lower levels might or might not be. Defining safe exposure levels is complicated by the

fact that many different organ systems and physiological functions (neurological, hematological, cardiovascular, renal, immune, and other functions) are affected by lead, even at extremely low exposure levels, for both children and adults (EPA, 2006).

The lead story is not finished yet. Consideration of a need for further downward revision of the designated "unacceptable" lead-exposure levels will probably ultimately hinge not only on new health findings but also on exposure research. Extensive information already exists regarding lead toxicity, ***even at rather low exposure levels***. Therefore, improved knowledge of modern lead-exposure pathways and levels is critical for characterizing and reducing adverse exposures. New sources and pathways are being identified through exposure research (e.g., disposal of computers and other electronic devices containing lead components). Some older sources are becoming more recognized through exposure research (e.g., imported toys, lead naturally occurs in combination with calcium and poses serious issues with calcium based supplements now found to be contaminated by lead. (CDC, 2010b)). Exposure research is crucial to pointing the way for future protection strategies.

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