

University of New Hampshire

University of New Hampshire Scholars' Repository

Institute on Disability

College of Health & Human Services (CHHS)

2-1-2016

Characterization of Lower Blood Lead Levels Reported for New Hampshire Adults from 2009–2013

Karla R. Armenti

University of New Hampshire, Durham, Karla.Armenti@unh.edu

I. Kaul

Follow this and additional works at: https://scholars.unh.edu/iod_chhs

Recommended Citation

Armenti, K, Kaul, I. Issue brief (2016) Characterization of Lower Blood Lead Levels Reported for New Hampshire Adults from 2009–2013, NH Occupational Health Surveillance Program, Institute on Disability, University of New Hampshire, Durham, NH

This Article is brought to you for free and open access by the College of Health & Human Services (CHHS) at University of New Hampshire Scholars' Repository. It has been accepted for inclusion in Institute on Disability by an authorized administrator of University of New Hampshire Scholars' Repository. For more information, please contact Scholarly.Communication@unh.edu.

Characterization of Lower Blood Lead Levels Reported for New Hampshire Adults from 2009–2013



BACKGROUND

Despite significant reductions in lead exposure in the United States, elevated blood lead levels (EBLLs) in adults remain a significant occupational health problem. According to the Centers for Disease Control and Prevention (CDC), about 95% of EBLLs in adults are related to their work. Lead is used in over 100 industries. Lead exposure occurs mainly in the battery manufacturing, foundry, lead and zinc ore mining, and painting and construction/restoration industries (1). The Occupational Safety and Health Administration (OSHA) regulates lead exposure in industrial settings at ≥ 40 $\mu\text{g}/\text{dL}$.

Over the last 18 years, a 54% decrease in the national prevalence rates of EBLL greater than or equal to 25 micrograms per deciliter ($\geq 25\mu\text{g}/\text{dL}$) has been documented using the National Institute for Occupational Safety and Health (NIOSH) Adult Blood Lead Epidemiology and Surveillance (ABLES) data. Despite this decrease, current ABLES data indicate that lead exposure at all levels remains a national occupational health problem (in 2010, ABLES reported 31,459 new adult cases in the United States with EBLLs ≥ 10 $\mu\text{g}/\text{dL}$; among these, 1,388 had EBLLs ≥ 40 $\mu\text{g}/\text{dL}$) and that continued efforts to reduce lead exposures are needed (2).

Adverse health effects have been found with cumulative exposure at EBLLs < 25 $\mu\text{g}/\text{dL}$ (3). Lead adversely affects multiple organ systems and can cause permanent damage. Exposure to lead in adults can cause anemia, nervous system dysfunction, kidney damage, hypertension, decreased fertility, and miscarriage (4–11).

As a result of this evidence, NIOSH has designated 10 $\mu\text{g}/\text{dL}$ of whole blood as the reference blood lead level for action in adults. In 2009, the Council for State and Territorial Epidemiologists (CSTE) made the same recommendation. The U.S. Department of Health and Human Services recommends that EBLLs among all adults be reduced to < 10 $\mu\text{g}/\text{dL}$. Medical management guidelines for lead-exposed adults now recommended action for EBLLs ≥ 10 $\mu\text{g}/\text{dL}$ (12). Finally, the Healthy People 2020

occupational health goal for adult lead has been revised to reduce EBLLs of 10 $\mu\text{g}/\text{dL}$ or greater in all persons aged 16 years and older.

Currently, the Healthy Homes and Lead Poisoning Prevention Program (HHLPPP) at the Division of Public Health Services in the New Hampshire Department of Health and Human Services receives all adult blood lead reports for New Hampshire residents from labs and medical providers in accordance with State law. For all EBLLs ≥ 25 $\mu\text{g}/\text{dL}$, a report is sent to the NIOSH ABLES system for inclusion in national estimates. Adult blood lead levels ≥ 40 $\mu\text{g}/\text{dL}$ are reported to the Occupational Safety and Health Administration (OSHA), as per the federal OSHA Lead Standard.

This study was conducted in order to better characterize blood lead levels in the New Hampshire adult working population. The objective is to gain additional insights into the occupational risk for lower level exposures to lead.

METHODS

New Hampshire adult blood lead results ≥ 10 $\mu\text{g}/\text{dL}$ were analyzed for the years 2009–2013 ($n=650$) by blood lead level and industry type. Information was collected using the HHLPPP surveillance database. The data included gender, age, blood lead level, and employer industry. For cases where no employer information was listed on the report, the HHLPPP staff made phone calls to providers and laboratories to collect occupation and employer information for patients where it was available.

The cases were ordered by client ID number, and duplicate tests were removed. The final data set contained 650 cases, and reflected the highest blood lead result available for a patient within the time period of 2009–2013. Data were analyzed by age, gender, and blood lead level. Blood lead levels were split into two groups: 10–24 $\mu\text{g}/\text{dL}$ and ≥ 25 $\mu\text{g}/\text{dL}$ (with some distribution analysis at 40 $\mu\text{g}/\text{dL}$ and higher).

Employment information was obtained for 458 of the 650 cases. This includes patients listed as self-employed,

retired, unemployed, and deceased. The 2012 North American Industry Classification System (NAICS) codes were used to categorize each case by industry. The NAICS

General Industry Category was determined by the first 2 digits of the NAICS code for the employer.

RESULTS

Figure 1 shows the yearly number of New Hampshire adults aged greater than 16 years old that had a blood lead level ≥ 10 $\mu\text{g}/\text{dL}$ from 2009 to 2013. In 2013, 106 such cases were identified in New Hampshire.

Figure 1: Number of Elevated Blood Lead Levels (≥ 10 $\mu\text{g}/\text{dL}$) in NH Adults, 2009-2013

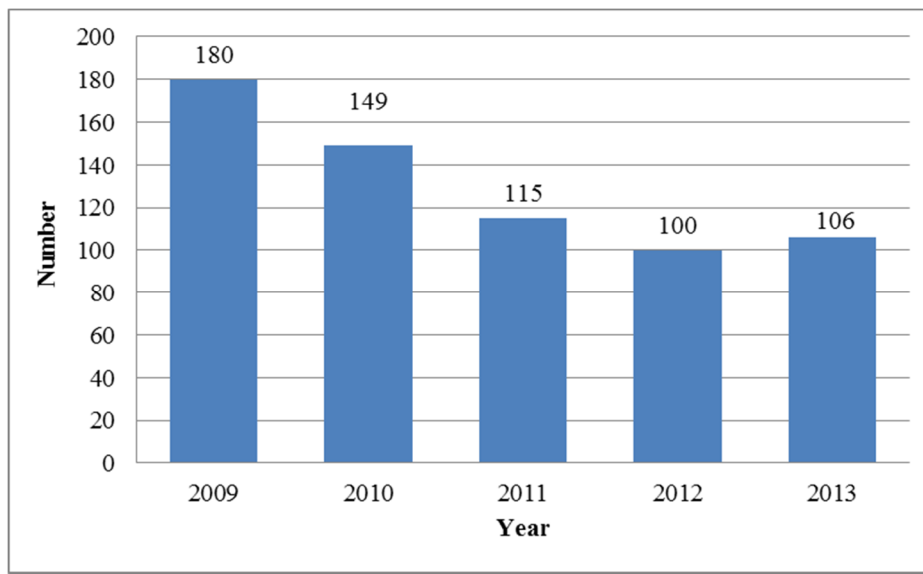


Table 1 shows the percentage breakdown of EBLLs for each year from 2009 to 2013. Over the 5-year period, approximately 90% of cases represented lower blood lead levels between 10- 24 $\mu\text{g}/\text{dL}$ and nine percent of cases represented EBLLs 25 - 39 $\mu\text{g}/\text{dL}$. Only 1% of cases were at or above the OSHA exposure limit of 40 $\mu\text{g}/\text{dL}$. Of the 106 cases in 2013, 95% represented EBLLs between 10 - 24 $\mu\text{g}/\text{dL}$ and 5% of the cases in 2013 represented EBLLs ≥ 25 $\mu\text{g}/\text{dL}$.

Table 1: Blood Lead Test Results by Level, 2009 - 2013

| Year | Blood Lead Level Test Result | | | | | | Total No. of Cases for Year |
|--------------|---------------------------------|------------------|---------------------------------|------------------|-----------------------------------|------------------|-----------------------------|
| | 10 - 24 $\mu\text{g}/\text{dL}$ | | 25 - 39 $\mu\text{g}/\text{dL}$ | | ≥ 40 $\mu\text{g}/\text{dL}$ | | |
| | No. of cases | % of total cases | No. of cases | % of total cases | No. of cases | % of total cases | |
| 2009 | 162 | 90% | 16 | 9% | 2 | 1% | 180 |
| 2010 | 128 | 86% | 18 | 12% | 3 | 2% | 149 |
| 2011 | 103 | 90% | 10 | 9% | 2 | 2% | 115 |
| 2012 | 88 | 88% | 12 | 12% | 0 | 0% | 100 |
| 2013 | 101 | 95% | 4 | 4% | 1 | 1% | 106 |
| Total | 582 | 90% | 60 | 9% | 8 | 1% | 650 |

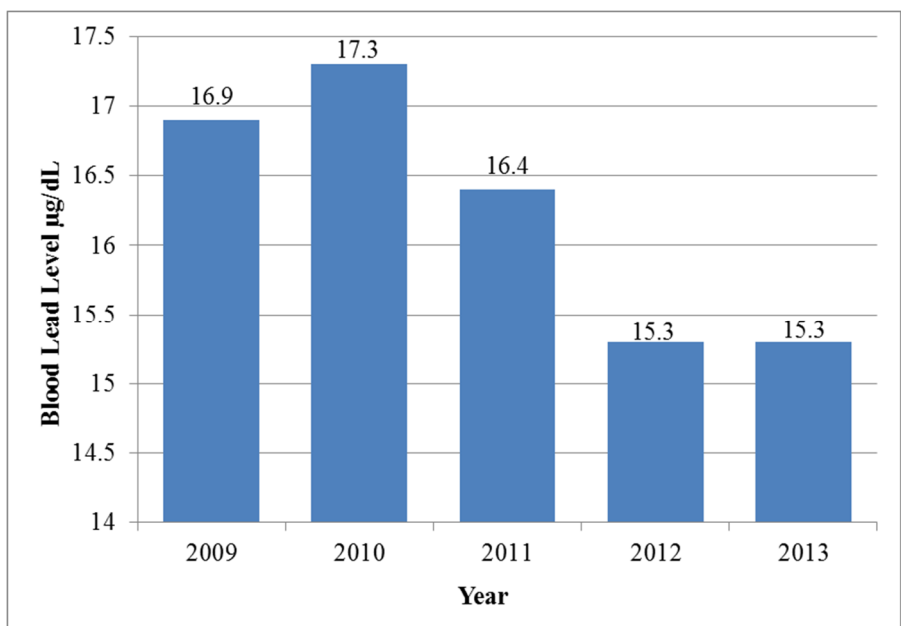
Table 2 shows the distribution of lead levels by gender and age group from 2009 to 2013. Of the 650 adult cases, almost 25% (n=161) were between 51 and 60 years old, while 21% (n=138) were between 21 and 30 years old. For the 33 female cases, 33% (n=11) occurred between the ages of 51-60. Among males of all ages, only 11% (n=67) of cases represented EBLs > 25 µg/dL. For females of all ages, only 3% (n=1) of cases represented EBLs > 25 µg/dL. The gender distribution of all adults with EBLs >10 µg/dL from 2009–2013 was 95% (n=617) male and 5% (n=33) female.

Table 2: Lead Test Results by Gender and Age, 2009–2013

| Age Group (Years) | Blood Lead Level Test Result | | | | Total No. of Cases for Age Group |
|-------------------|------------------------------|----------------|--------------|----------------|----------------------------------|
| | 10- 24 µg/dL | | ≥25 µg/dL | | |
| | No. of Males | No. of Females | No. of Males | No. of Females | |
| 16 to 20 | 11 | 1 | 3 | 0 | 15 |
| 21 to 30 | 124 | 6 | 7 | 1 | 138 |
| 31 to 40 | 100 | 4 | 10 | 0 | 114 |
| 41 to 50 | 115 | 6 | 14 | 0 | 135 |
| 51 to 60 | 128 | 11 | 22 | 0 | 161 |
| 61 and up | 72 | 4 | 11 | 0 | 87 |
| Total | 550 | 32 | 67 | 1 | 650 |

Figure 2 shows average EBLs by year. On average, blood lead levels in 2013 were 15.3 µg/dL, which is 5 µg/dL higher than the 10 µg/dL level at which adults are recommended action be taken to reduce the BLL.

Figure 2: Average Blood Lead Level of those Adults Tested, by Year, 2009–2013



Of the 650 total adult cases, 192 had an unknown employer; 26 were self-employed; and 21 were deceased, disabled, not employed, or retired by the time the HHLPPP collected the information from the provider and/or lab. **Table 3** shows a breakdown of EBLLs by industry for the 411 adults for whom employer information was available. Forty three percent (n=175) were in the manufacturing industry and 28% (n=116) were in the construction industry at the time of their blood lead test. For each industry, fewer than 50% of reported cases reflected EBLLs ≥ 25 $\mu\text{g}/\text{dL}$.

Table 3: Lead Test Results by General Industry, 2009–2013

| NAICS General Industry | Blood Lead Level Test Result | | Total No. of Cases for Industry |
|--|--------------------------------|-----------------------------------|---------------------------------|
| | 10- 24 $\mu\text{g}/\text{dL}$ | ≥ 25 $\mu\text{g}/\text{dL}$ | |
| | No. of cases | No. of cases | |
| Manufacturing | 161 | 14 | 175 |
| Construction | 103 | 13 | 116 |
| Waste Management and Remediation Services | 57 | 4 | 61 |
| Repair and Maintenance Services | 13 | 1 | 14 |
| Wholesale Trade | 6 | 5 | 11 |
| Professional, Scientific, and Technical Services | 7 | 0 | 7 |
| Transportation and Warehousing | 7 | 0 | 7 |
| Educational Services | 5 | 0 | 5 |
| Public Administration | 3 | 0 | 3 |
| Retail Trade | 2 | 1 | 3 |
| Utilities | 3 | 0 | 3 |
| Arts, Entertainment, and Recreation | 2 | 0 | 2 |
| Information | 2 | 0 | 2 |
| Finance and Insurance | 1 | 0 | 1 |
| Real Estate and Rental and Leasing | 1 | 0 | 1 |
| Total | 373 | 38 | 411 |

Table 4 shows ten industry subcategories with the highest number of adults with elevated blood lead levels (EBLLs 10–24 µg/dL and ≥25 µg/dL). Industry text for each NAICS code was used to categorize employers. One hundred thirty adults were employed in the foundries, valves, and inline plumbing and heating industry at the time of blood lead testing, which is more than double the number employed in any other industry. Another 50 adults were employed in bridge and highway industries, 47 in firearms, and 44 in environmental remediation services.

Table 4: Lead Test Results by Top 10 Industry Subcategories, 2009–2013

| NAICS Industry Text | Blood Lead Level Test Result | | Total No. of Cases for Industry |
|---|------------------------------|--------------|---------------------------------|
| | 10- 24 µg/dL | ≥25 µg/dL | |
| | No. of cases | No. of cases | |
| Foundries, Valves and Inline Plumbing and Heating | 117 | 13 | 130 |
| Bridge and Highway Painting/Construction | 40 | 10 | 50 |
| Firearms, Ammunition Manufacturing and Wholesale | 41 | 6 | 47 |
| Environmental remediation services | 42 | 2 | 44 |
| Residential Construction and Renovation | 15 | 0 | 15 |
| Waste recovery facilities | 13 | 1 | 14 |
| Antique furniture repair and restoration shops | 7 | 1 | 8 |
| Acid plant construction | 4 | 0 | 4 |
| Door and Window Installation | 4 | 0 | 4 |
| Heating boiler installation | 4 | 0 | 4 |

LIMITATIONS

The collection of elevated adult blood lead cases is based on provider testing of BLLs prompted by a work-related exposure or regulatory requirements. It therefore does not represent all workers in New Hampshire with exposure to lead. For this reason, we are unable to calculate rates based on how many workers there are in New Hampshire. Another critical limitation is the large number of cases with unknown occupation and employer information. Additionally, much of the employer information collected from labs and providers contained patient self-reported data at the time of the test, which may not accurately reflect actual employment status or occupation of the patient.

DISCUSSION

While New Hampshire is a small state, it is concerning that over 100 people are at risk for adverse health effects from exposure to lead each year. The majority of adults in our study have a BLL between 10 and 24 mcg/dL, with an average 5 mcg/dL greater than the recommended level at

which adults should have intervention to reduce BLL. The presence of lower EBLLs was most significant in males of all ages. Adults employed in the manufacturing and construction industries, foundries, painting, and firearms represented a large number of these lower EBLLs.

Our analysis indicates that long-term lead exposure continues to be a problem in our New Hampshire businesses and industries. OSHA rules impact those with EBLLs >40 µg/dL, however, no such regulation protects those with lower blood lead levels. OSHA regulations have also not been changed substantially since the late 1970s and thus are primarily based on health studies from over three decades ago. **Therefore the current occupational standards are not sufficiently protective and should be strengthened.**

Adult exposure to lead at work also has implications for the worker’s family, especially children, through the possibility of “take-home” lead. Even small amounts of lead can pose a serious threat to the health and development of young children.

State adult lead programs often do not have the resources to follow up on all adult lead cases in their states. Funding cuts in the Adult Blood Lead Epidemiology and Surveillance (ABLES) program has impacted states' ability to collect, code, and analyze data for lower EBLs, including industry information. Intervention activities with individuals, worksites, and others are also impacted. The loss of surveillance support to identify worker exposures will mean fewer referrals to OSHA and a lack of identifying and addressing lead and other workplace hazards. Surveillance identifying worker exposures in industries with little or no OSHA oversight (e.g., small radiator shops, firing ranges, renovation work) and emerging technologies (e.g., electronics recycling) will leave these workplaces and hazards unidentified as well (13).

With the knowledge we now have about the health impact of chronic low level exposure to lead, it is critical that public health experts work with occupational health and safety professionals to not only monitor adults for lead exposure but to also ensure that adequate protections are in place. This includes support of medical staff who can assist with tracking, monitoring, and reporting all adult lead cases, with a focus on follow-up to ensure appropriate protections are taken to reduce or eliminate the risk. Ultimately, however, permissible exposure levels in the workplace need to be reduced in

order to provide the most effective protection at the source of exposure.

ACKNOWLEDGMENTS



Healthy Homes and Lead Poisoning Prevention Program
Division of Public Health Service
NH Department of Health & Human Services
<http://www.dhhs.nh.gov/DPHS/bchs/clpp/index.htm>



NH Occupational Health Surveillance Program
Institute on Disability, University of New Hampshire
<http://www.nhohsp.unh.edu>

*Grant sponsor: CDC-NIOSH; Grant Number # OH 010910.
Contents are solely the responsibility of the authors and
do not necessarily represent the official views of NIOSH.*

REFERENCES

1. CDC. Adult blood lead epidemiology and surveillance—United States, 2005–2007. *MMWR Morb Mortal Wkly Rep* 2009;58:365–9.
2. Sussell A, Ashley K, Burr G, Gittleman J, Mickelsen L, Nagy H, Piacitelli G, Roscoe R, Whalen E. Protecting Workers Exposed to Lead-Based Paint Hazards: A NIOSH Report to Congress, Cincinnati, OH: U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, CDC 1997.
3. Kenneth D. Rosenman, MD, Amy Sims, BS, Zhehui Luo, MS, Joseph Gardiner, PhD, Occurrence of Lead-Related Symptoms Below the Current Occupational Safety and Health Act Allowable Blood Lead Levels, *JOEM* • Volume 45, Number 5, May 2003
4. Hogstedt C, Hane M, Agrell A, Bodin L. Neuropsychological test results and symptoms among workers with well-defined long-term exposure to lead. *Br J Ind Med* 1983;40:99-105.
5. Seppäläinen AM, Hernberg S, Vesanto R, Kock B. Early neurotoxic effects of occupational lead exposure: A prospective study. *Neurotoxicology* 1983;4(2):181-192.
6. Piomelli S. Chemical toxicity of red cells. *Environ Health Perspectives* 1981;39:65-70.
7. Goyer RA. Mechanisms of lead and cadmium nephrotoxicity. *Toxicology Letters* 1989;46:153-162.
8. Goyer RA. Transplacental transport of lead. *Environ Health Perspectives* 1990;89:101-105.
9. Mushak P, Davis JM, Crocetti AF, Grant LD. Prenatal and postnatal effects of low-level lead exposure: Integrated summary of a report to the U.S. Congress on childhood lead poisoning. *Environ Res* 1989;50:11-36.
10. Schwartz J. Lead, blood pressure, and cardiovascular disease in men. *Environ Hlth* 50, 1995.
11. Hertz-Picciotto I, Croft J. Review of the relation between blood lead and blood pressure. *Epidemiologic Reviews* 1993;15(2):352-73.
12. Association of Occupational and Environmental Clinics (AOEC) at http://www.aoec.org/documents/positions/MMG_FINAL.pdf
13. Survey results from 33 ABLES States on the Impact of ABLES Program Funding Cuts, 2014.