Summary of Findings from the North Carolina Adult Blood Lead Epidemiology and Surveillance (ABLES) Program, 2013

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More information about ABLES can be found at:
http://epi.publichealth.nc.gov/oee/programs/ables.html

Summary

In 2013, the ABLES program received 4,445 blood lead results from 4,007 adults aged 16 or older in North Carolina. Among these results, 219 adults (6%) had elevated blood lead levels (EBLLs). An EBLL is defined as a blood lead level (BLL) ≥ 10 micrograms per deciliter (µg/dL). Among 219 adults with EBLLs, 23 people (11%) had EBLLs at or above 40 µg/dL. The National Institute of Occupational Safety and Health (NIOSH) considers levels at or above 40 µg/dL to be very high blood lead levels and if persistent, can put individuals at increased risk of adverse health effects[1]. EBLLs are associated with acute, mild symptoms such as headaches, fatigue, muscle aches, and can progress to multi-organ failure. Symptoms typically worsen with increasing BLLs [2]. In 2013, a decrease in prevalence (existing cases) and incidence (new cases) of individuals with EBLLs was observed compared to the previous four years. However, the prevalence and incidence rates for BLLs greater than or equal to 40µg/dL have remained constant at approximately 0.5 and 0.3 per 100,000 employed people, respectively. Occupational exposures represented 87 % of EBLLs, a decrease from 90% in 2011. Industries with the highest proportion of workers found to have EBLLs were inorganic chemical manufacturing and primary battery manufacturing. Shooting firearms accounted for the largest proportion of EBLLs due to a non-occupational exposure.

Background

Adults are exposed to lead primarily at work. The Occupational Safety and Health Administration (OSHA) is responsible for the regulation of lead exposures in the workplace through the biomonitoring of blood lead levels of employees. Workers in construction, mining, wholesale trade, transportation, remediation, and manufacturing industries are at greatest risk for lead exposure [3]. Standards are in place for workers in construction and general industries. OSHA stipulates that workers be removed from lead exposure if the BLL is ≥ 50 µg/dL (construction) or ≥ 60 µg/dL (general industry) and be allowed to return to work once the BLL is < 40 µg/dL [4]. Newer data suggest a need for an updated threshold. It has been recommended to remove workers from exposure when the BLL ≥ 30 µg/dL and returned to work when the BLL is < 15 µg/dL [2,5].

Exposure to lead may also occur in the community through hobbies and activities such as: home remodeling; using products that contain lead; consuming alternative medicine or moonshine; creating lead fishing sinkers; and target shooting [3]. Secondary lead exposure to family members may occur through contact with lead-contaminated clothing, skin, and hair [1]. EBLLs are associated with acute, mild symptoms such as headaches, fatigue, muscle aches, and can progress to multi-organ failure. Symptoms typically worsen with increasing BLLs [2].

In 1987, the ABLES project was created to track BLLs in the workplace. The project's aims are to meet the Healthy People 2020 objective: to reduce the number of people older than 16 years of age who have BLLs of 10µg/dL or greater. The ABLES project collects data from laboratories that are required to report blood lead levels greater than or equal to 40µg/dL, for those 18 or older (10 A NCAC 41C .0701 - .0703). Although not required, the North Carolina Division of Public Health's ABLES program requests laboratories to provide all BLLs for people 16 or older.

A partnership between the North Carolina Occupational Safety and Health Administration (NC OSHA) and NC ABLES was created to address those industries where elevated BLLs are most prevalent. The NC ABLES program shares lead exposure data with NC OSHA to assist them with targeting inspections and training. The ABLES program also conducts its own targeted prevention programs. According to the Centers for Disease Control and Prevention (CDC), over the past 18 years, this nationwide OSHA and ABLES partnership has contributed to a 54% reduction in lead exposures among adults in the U.S. [1].

Data Sources and Methods

BLL reports, which included demographic and exposure information, were received from medical laboratories nationwide via fax, courier mail, or electronically for residents of North Carolina aged 16 years or older. For individuals with more than one BLL reported for 2013, only the highest BLL was used for analysis. Incidence and prevalence rates were both calculated according to NIOSH/CSTE Occupational Health Indicator #13 standards [6]. Rates were computed by using the number of new/existing adult cases of EBLL in NC during 2013, divided by the total annual number of employed adults in NC [7], and calculated per 100,000 employed individuals in North Carolina.

Findings

In 2013, the ABLES program received 4,445 BLL laboratory reports of (Figure 1) from 4,007 adults aged 16 years or older in North Carolina (Figure 2). Among all reports, the mean BLL was 3.9 µg/dL and the median was 3 µg/dL (range: 1 to 136 µg/dL). About 6% (219 adults) had BLLs ≥ 10 µg/dL. Among those with EBLLs ≥ 10µg/dL, 11% (23 adults) had EBLLs of 40 µg/dL or greater (Table 1).

The prevalence rate of having an elevated BLL of greater than 10 µg/dL was 5.1 per 100,000 employed people in North Carolina and the prevalence of those with a BLL of 40 µg/dL or greater was 0.5 in 2013. The incidence rate for BLLs greater than 10 µg/dL was 3.2 per 100,000 employed individuals in North Carolina in 2013. The incidence rate for those with a BLL of 40 µg/dL or greater was 0.3 (Figures 3 & 4).

Males accounted for 94% (204 adults) of EBLLs (Table 2). There were no reports of EBLL ≥ 10 µg/dL for those between 16 and 18 years of age (Table 2).

The exposure source for most EBLLs (87%) was in the occupational setting (Table 1). Industries that accounted for the highest proportion of EBLLs were: all other basic inorganic chemical manufacturing (14%); primary battery manufacturing (14%); painting and wall covering contractors (11%); and amusement/recreation industries (10%) (Table 3). Among laboratory reports of BLLs from non-occupational exposures, shooting firearms was the most common, accounting for 62% of all non-occupational exposures.

Among industries that comprised the largest proportion of EBLLs ≥ 40 µg/dL, "all other basic inorganic and chemical manufacturing" workers were 2.2 times more likely than "electrical contractors" to have an EBLL ≥ 40 µg/dL. These manufacturers were also 3.7 times more likely to have an EBLL ≥ 40 compared to "painting and wall covering contractors" and 7.3 times more likely than the workers in the "all other amusement and recreation industries" to have a BLL ≥ 40 µg/dL.

Limited information was available about the counties where adults were exposed. For cases where county of exposure was known, the counties with the highest number of EBLLs were: Forsyth (26%); Mecklenburg (8%); Onslow (6%); Sampson (5%); Wake (4%); and Randolph (4%). County of exposure was unknown for 55 (25%) people.

Public Health Significance

In 2013, ABLES received the least number of cases with EBLL (≥ 10 µg/dL) for the report period. This decrease may be attributed to factory closings, industry downsizing or the downturn in the economy. In 2013, among the total number of adults tested for lead (4,007), only a small number 219 (6%) were elevated (≥ 10 µg/dL). Likewise, the prevalence and incidence for EBLLs has decreased when compared with the previous four years. However, the rate of individuals with BLLs ≥ 40 µg/dL has remained constant during this timeframe.

Higher prevalence of EBLLs was observed among workers in "all other basic inorganic chemical manufacturing" (i.e. aluminum, arsenic, beryllium) and "primary battery manufacturing". These findings are consistent with both 2009 and 2012 NC ABLES reports. The most common source of non-occupational exposures in 2013 was from shooting firearms. These groups have the greatest need for targeted interventions such as consultation services and awareness training.

North Carolina remains under the national average for the prevalence of EBLLs ≥ 10µg/dL (5.1 compared with 6.4 per 100,000 employed individuals) [6]. The proportion of adults found to have EBLLs was modified by gender: only 1% (13/1,155) of women tested for blood lead had an EBLL ≥ 10µg/dL compared with 7% (205/2,762) of males tested for blood lead.

Limitations

Misclassification bias could have occurred during the coding of new and existing EBLL cases. This error could potentially over- or under-estimate incidence rates. Underreporting is likely for two reasons: some employers might not provide BLL testing to all lead-exposed workers as required by OSHA regulations, and some laboratories might not report all tests as required by state regulations.

Appendix

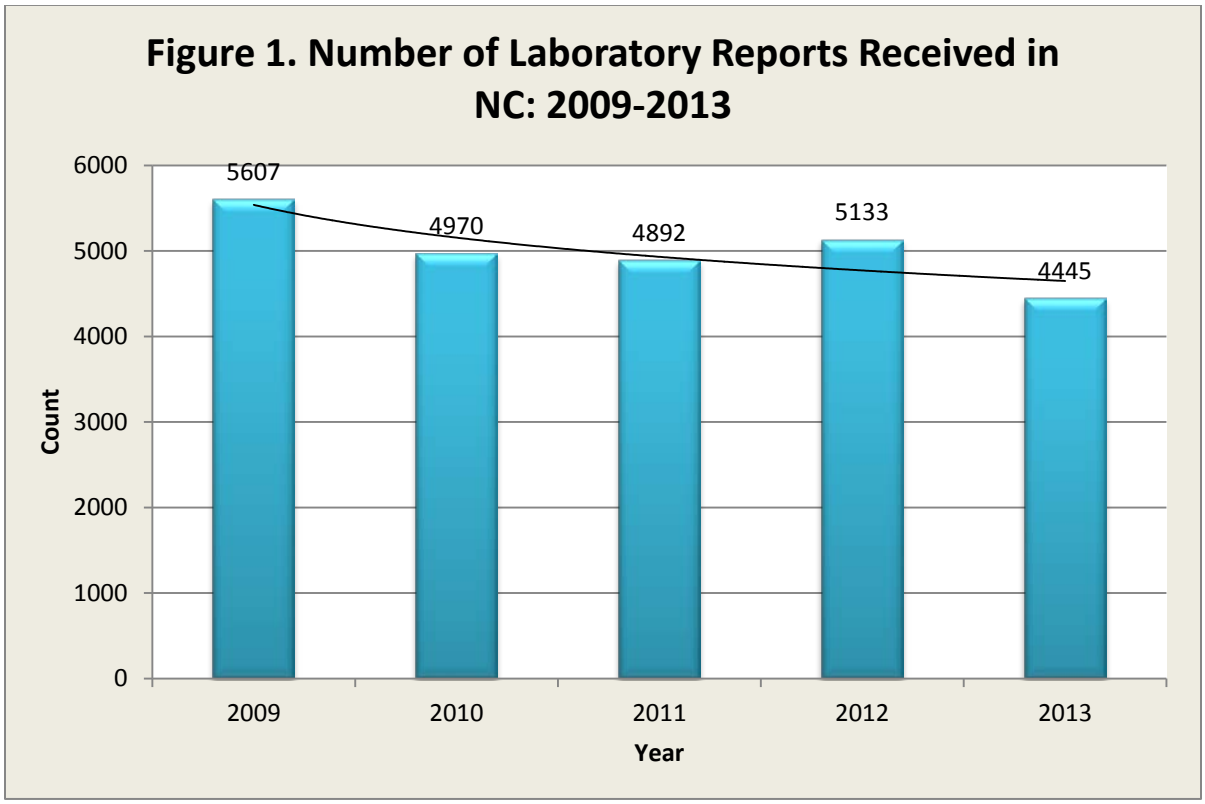


Figure 1. Number of Laboratory Reports Received in NC: 2009-2013
6000
5000
4000
3000
2000
1000
0
Count
5607
4970
4892
5133
4445
2009
2010
2011
2012
2013
Year

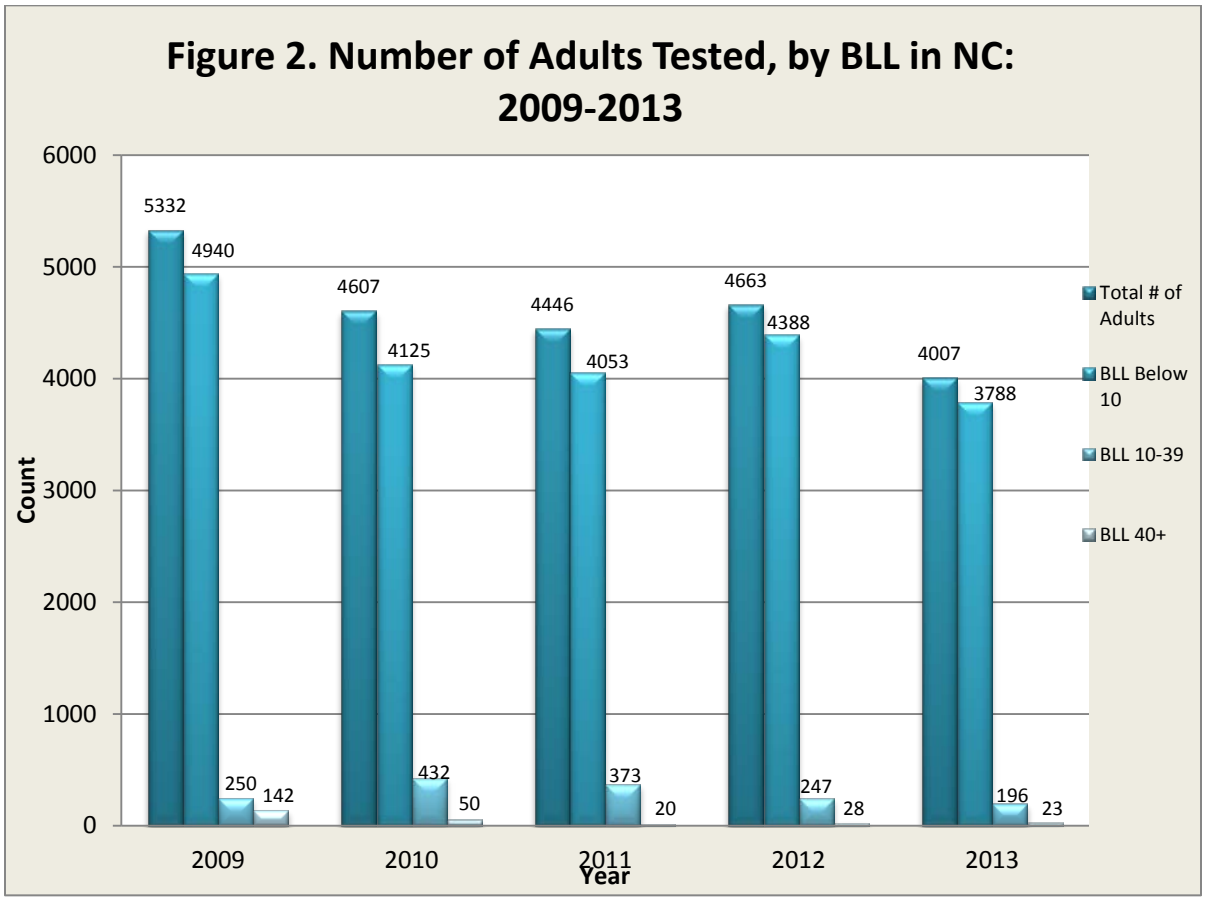


Figure 2. Number of Adults Tested, by BLL in NC: 2009-2013
6000
5000
4000
3000
2000
1000
0
Count
5332
4940
250
142
4607
4125
432
50
4446
4053
373
20
4663
4388
247
28
4007
3788
196
23
2009
2010
2011
2012
2013
Year
Total # of Adults
BLL Below 10
BLL 10-39
BLL 40+

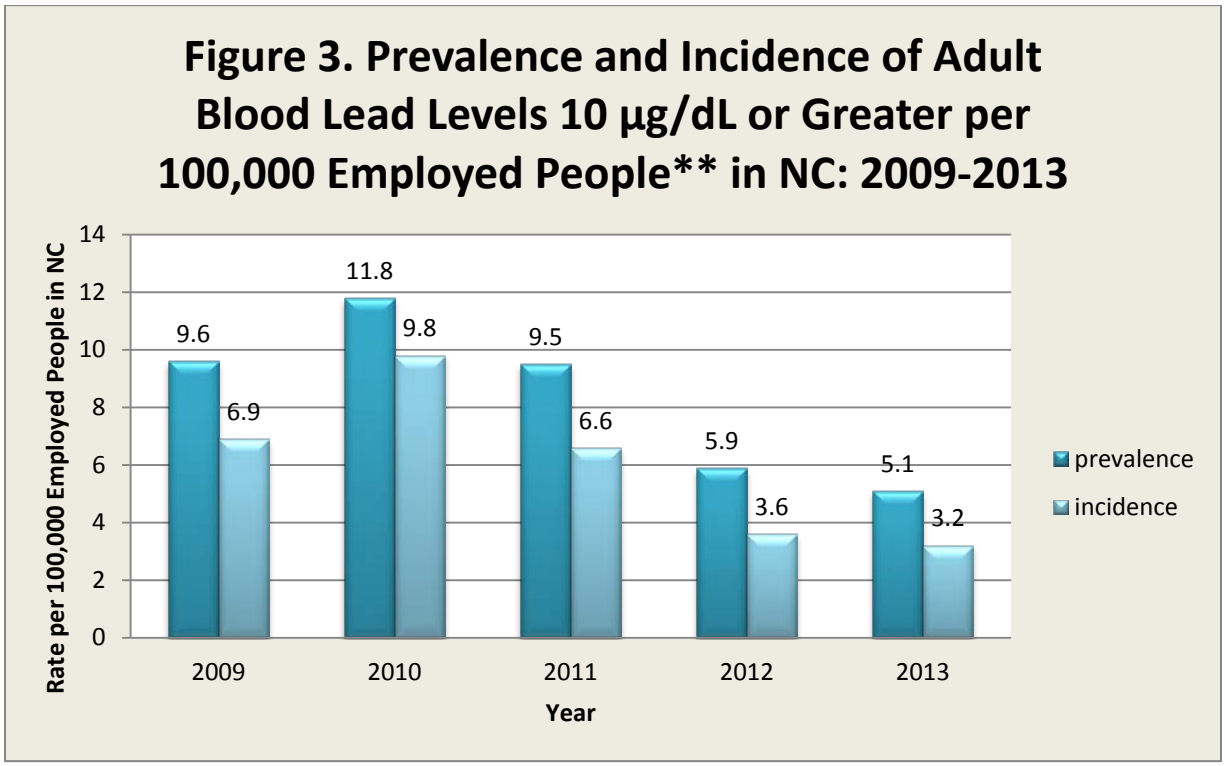
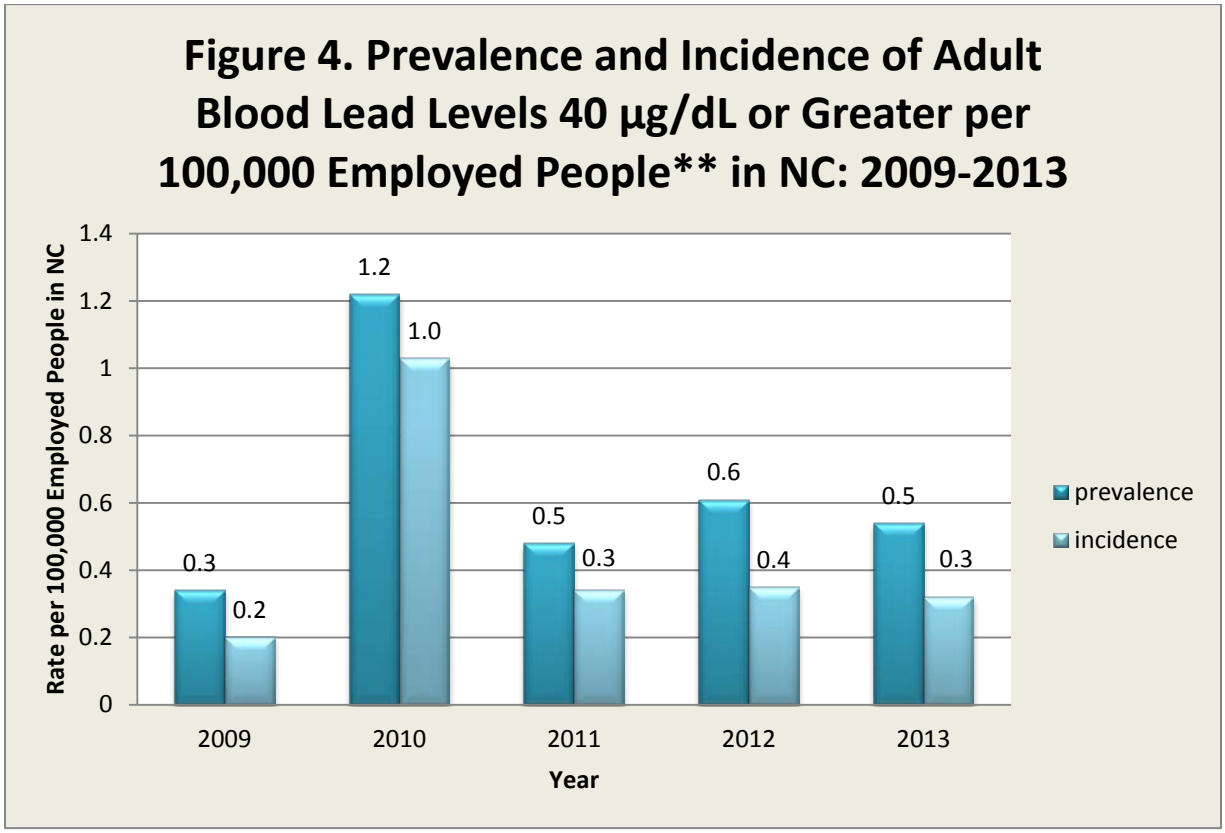


Figure 3. Prevalence and Incidence of Adult Blood Lead Levels 10 µg/dL or Greater per 100,000 Employed People** in NC: 2009-2013
Rate per 100,000 Employed People in NC
14
12
10
8
6
4
2
0
9.6
6.9
11.8
9.8
9.5
6.6
5.9
3.6
5.1
3.2
2009
2010
2011
2012
2013
Year
prevalence
incidence



***Employment data was obtained from the US Bureau of Labor Statistics*

Table 1. Distribution of Exposure Source among Adults with EBLL in NC: 2013

Blood Lead Level in µg/dL (BLL)	Exposure Source		
	Occupational	Non-Occupational	**Total**
	N (%)	N (%)	N (%)
10 to 24	99 (45.2)	21 (9.6)	120 (54.8)
25 to 39	68 (31.1)	8 (3.7)	76 (34.7)
40 to 60	19 (8.7)	0 (0)	19 (8.7)
60+	4 (1.8)	0 (0)	4 (1.8)
Total	**190 (86.8)**	**29 (13.2)**	**219 (100)**

Table 2. Distribution of Gender and Age among Adults with EBLL in NC: 2013

Gender	Blood Lead Level in µg/dL (BLL)		
	10-40	**40+**	**Total**
	N (%)	N (%)	N (%)
Female	12 (5.5)	1 (.5)	13 (6)
Male	182 (83.9)	22 (10.1)	204 (94)
Total	**194 (89.4)**	**23 (10.6)**	**217 (100)**
**Gender missing for 2 individuals*			
Age	Blood Lead Level in µg/dL (BLL)		
	10-40	**40+**	**Total**
	N (%)	N (%)	N (%)
16-17	0 (0)	0 (0)	0 (0)
18-24	22 (10.0)	1 (.5)	23 (10.5)
25-34	40 (18.3)	4 (1.8)	44 (20.1)
35-44	43 (19.6)	4 (1.8)	47 (21.5)
45-54	46 (21.0)	11 (5.0)	57 (26.0)
55-64	24 (11.0)	2 (.9)	26 (11.9)
65+	21 (9.6)	1 (.5)	22 (10)
Total	**196 (89.5)**	**23 (10.5)**	**219 (100)**

Table 3. Distribution of Exposure Source by Category among Adults with EBLL in NC: 2013

NAICS* code	Industry Title	Blood Lead Level in µg/dL (BLL)		
		10-40	40+	Total
		N (%)	N (%)	N (%)
Occupational Exposures				
236118	Residential Remodelers	0 (0)	1 (.5)	1 (.5)
236220	Commercial and Institutional Building Construction	1 (.5)	0 (0)	1 (.5)
237310	Highway Street And Bridge Construction	6 (3.2)	1 (.5)	7 (3.7)
238120	Structural Steel and Precast Concrete Contractors	1 (.5)	0 (0)	1 (.5)
238210	Electrical Contractors	10 (5.3)	2 (1.1)	12 (6.4)
238290	Other Building Equipment Contractors	0 (0)	2 (1.1)	2 (1.1)
238320	Painting and Wall Covering Contractors	19 (10.0)	2 (1.1)	21 (11.1)
238990	All Other Specialty Trade Contractors	1 (.5)	0 (0)	1 (.5)
325188	All Other Basic Inorganic Chemical Manufacturing	16 (8.4)	9 (4.7)	25 (13.1)
327211	Flat Glass Manufacturing	1 (.5)	0 (0)	1 (.5)
331111	Iron and Steel Mills	8 (4.2)	0 (0)	8 (4.2)
331524	Aluminum Foundries (except dye-casting)	5 (2.6)	0 (0)	5 (2.6)
332116	Metal Stamping	5 (2.6)	0 (0)	5 (2.6)
332312	Fabricated Structural Metal Manufacturing	1 (.5)	0 (0)	1 (.5)
332510	Hardware Manufacturing	2 (1.1)	0 (0)	2 (1.1)
332992	Small Arms Ammunition Manufacturing	1 (.5)	0 (0)	1 (.5)
332994	Small Arms Manufacturing	7 (3.7)	0 (0)	7 (3.7)
332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	10 (5.3)	0 (0)	10 (5.3)
333515	Cutting Tool and Machine Tool Accessory Manufacturing	1 (.5)	0 (0)	1 (.5)
335911	Storage Battery Manufacturing	1 (.5)	0 (0)	1 (.5)
335912	Primary Battery Manufacturing	25 (13.1)	0 (0)	25 (13.1)
339920	Sporting and Athletic Goods Manufacturing	0 (0)	1 (.5)	1 (.5)
423830	Farm and Garden Machinery and Equipment Merchant Wholesalers	2 (1.1)	1 (.5)	3 (1.6)
493110	General Warehousing and Storage	0 (0)	2 (1.1)	2 (1.1)
561612	Security Guards and Patrol Services	2 (1.1)	0 (0)	2 (1.1)
562910	Remediation Services	4 (2.1)	0 (0)	4 (2.1)
562920	Materials and Recovery Facilities	1 (.5)	0 (0)	1 (.5)
562998	All Other Miscellaneous Waste Management Services	10 (5.3)	0 (0)	10 (5.3)
611310	Colleges, Universities and Professional Schools	1 (.5)	0 (0)	1 (.5)
713990	All Other Amusement and Recreation Industries	18 (9.5)	1 (.5)	19 (10.0)
811490	Other Personal and Household Repair and Maintenance	1 (.5)	0 (0)	1 (.5)
928110	National Security	1 (.5)	0 (0)	1 (.5)

NAICS* code	Industry Title	Blood Lead Level in µg/dL (BLL)		
		10-40	**40+**	**Total**
		N (%)	N (%)	N (%)
Occupational Exposures (Continued)				
811490	Other Personal and Household Repair and Maintenance	1 (.5)	0 (0)	1 (.5)
928110	National Security	1 (.5)	0 (0)	1 (.5)
999	Unknown	4 (2.1)	1 (.5)	5 (2.6)
TOTAL Occupational Exposures		**167 (87.9)**	**23 (12.1)**	**190 (100)**
Non-Occupational Exposures				
	Taking Alternative Medicines	1 (3.4)	0 (0)	1 (3.4)
	Shooting Firearms	18 (62.1)	0 (0)	18 (62.1)
	Bullet Making/Casting	6 (20.7)	0 (0)	6 (20.7)
	Retained Bullets	3 (10.4)	0 (0)	3 (10.4)
	Eating from Leaded Cookware	1 (3.4)	0 (0)	1 (3.4)
TOTAL Non-Occupational Exposures		**29 (100)**	**0 (0)**	**29 (100)**

References

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