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Research Article

Work-Related and Non-Work Related Lead Poisoning Among Adults in Florida

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Abstract

Objective: The aim of this study is to know if adults with lead poisoning (blood lead level ≥10µg/dL) due to their exposure to lead at their work place will have higher concentration of blood lead level compare to those with lead poisoning who are not exposed to lead due to their job.

Methods: Data for this study was collected from the Florida Blood lead Epidemiology Surveillance (ABLES) Program from 2008 to 2010. A total of 2246 adults' were analyzed between the ages 15 and 92. The analyses were performed for both qualitative characteristics and quantitative characteristics for this population.

Results: The demographic characteristics of the population shows that adult 47years of age have the highest number of cases with blood leads level of 10ug/dL or greater compare to other ages. Also, Male, white and Not Hispanic or Latino has the highest number of population with blood lead level of 10 µg/dL or greater. Considering the distribution of lead poisoned among the population, most cases were exposed to lead in Hillsborough County. Also, most of the cases with lead poisoned reside in Hillsborough with 34.4% county of exposure and 35.8% county of residence. Most of the cases were job related accounting for 54.9% of the cases (21.75 bridge painters and 18.9% battery manufacturing company) representing their job duties and industry. Those with lead poisoning due to their exposure to lead at their work place will have an average concentration of blood lead level that is 2.5 µg/dL more than those who are not exposed to lead due to their job.

Conclusion: This study shows that individual exposed to lead due to their job are more likely to have their blood lead level ≥10µg/dL increased compare to those not expose to lead due to their job.

Keywords: Lead poisoning; Florida Blood lead Epidemiology Surveillance (ABLES)

Introduction

Lead remains one of the major public health problems particularly an environmental problem which can affect the nervous system, hematopoietic, endocrine, renal and reproductive system, causing a permanent and possibly fatal consequence, especially in young children [1,2]. Classically, "lead poisoning" or "lead intoxication" has been defined as exposure to high levels of lead typically associated with severe health effects [3]. Poisoning is a pattern of symptoms that occur with toxic effects from mid to high levels of exposure; toxicity is a wider spectrum of effects, including subclinical ones (those that do not cause symptoms) [3]. However, professionals often use "lead poisoning" and "lead toxicity" interchangeably, and official sources do not always restrict the use of "lead poisoning" to refer only to symptomatic effects of lead [2].

Chronic poisoning usually presents with symptoms affecting multiple systems but is associated with three main types of symptoms: gastrointestinal, neuromuscular, and neurological [1,2]. Central nervous system and neuromuscular symptoms usually result from intense exposure, while gastrointestinal symptoms usually result from exposure over longer periods [1].

Diagnosis includes determining the clinical signs and the medical history, with inquiry into possible routes of exposure [2]. Clinical toxicologists, medical specialists in the area of poisoning, may be involved in diagnosis and treatment. The main tool in diagnosing and assessing the severity of lead poisoning is laboratory analysis of the Blood Lead Level (BLL) [2]. Blood film examination may reveal basophilic stippling of red blood cells (dots in red blood cells visible through a microscope), as well as the changes normally associated with iron-deficiency anemia (microcytosis and hypochromasia) [2]. However, basophilic stippling is also seen in unrelated conditions, such as megaloblastic anemia caused by vitamin B12 (colbalamin) and folate deficiencies [1]. In most cases, lead poisoning is preventable, the way to prevent it is to prevent exposure to lead [4,5]. Prevention strategies can be divided into individual (measures taken by a family), preventive medicine (identifying and intervening with high-risk individuals), and public health (reducing risk on a population level) [6,7].

The aim of this study is to know if adults with lead poisoning (blood lead level ≥10µg/dL) due to their exposure to lead at their work place will have higher concentration of blood lead level compare to

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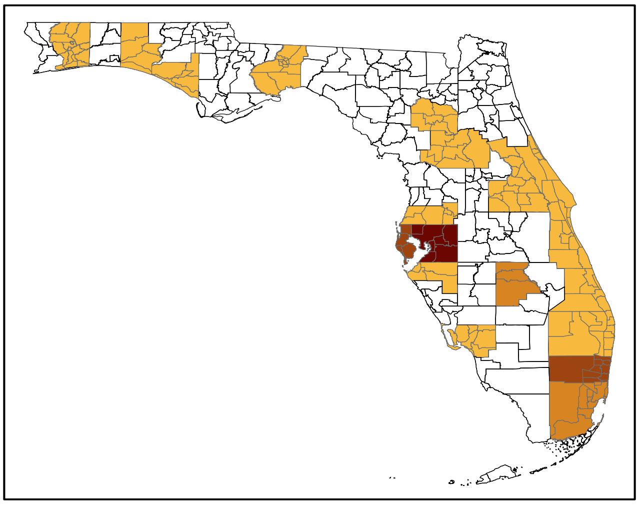

Figure 1: Total cases of lead poisoning.

Table 1: Demography characteristics (n=2246).

Gender	Frequency	Percent	Cumulative Percent
Male	2101	93.5	93.5
Female	136	6.1	99.6
Unknown	9	.4	100.0

Race				
	American Indian & Alaska Native	12	.5	.5
	Asian	15	.7	1.2
	Black	342	15.2	16.4
	White	939	41.8	58.2
	Mixed race	1	.0	58.3
	Unknown	937	41.7	100.0
Ethnicity				
	Not Hispanic or Latino	586	26.1	26.1
	Hispanic or Latino	247	11.0	37.1
	Unknown	1413	62.9	100.0

those with lead poisoning who are not exposed to lead due to their job.

Materials and Methods

The data for this study was collected from the Florida Adult Blood Lead Epidemiology Surveillance (ABLES) program from 2008 to 2010 [8]. This data consist of the age, gender, race, ethnicity, county, industry and occupation/job duties of the cases. In 2009, the Florida ABLES program adopted the federally updated case definition for an elevated blood lead level for surveillance purposes as a blood lead concentration ≥ 10µg/dL. The Florida ABLES program work with the county health department and health care providers to identify the source of lead exposures to assure proper medical guidance, including follow-up blood lead tests; encourage adequate mitigation of lead sources to reduce or eliminate the risk of further exposure; and ensure the household members, particularly children, are tested for lead poisoning. Data collected on individual exposures is used

Table 2: Work related (n=2246).

Work Related	Frequency	Percent	Cumulative Percent
Work Related	1233	54.9	54.9
Not Work Related	59	2.6	57.5
Both jobs and not job Related	4	.2	57.7
Unknown	950	42.3	100.0
Total	2246	100.0	

to better understand trends in sources and pathways of exposure. This information will be used to improve lead poisoning prevention efforts.

Aggregate, de-identified blood lead test data is reported bi-annually to the National Institute of Occupational Safety and Health (NIOSH). In addition to reporting demographic information, ABLES reports the source of exposure, when known, for individuals with blood lead level ≥ 10µg/dL. The industry and job duty of the exposed person is also reported if exposure occurred at a work site. NIOSH shares de-identified aggregated adult lead poisoning data with Federal Occupational Health and Safety Administration (OSHA). The information provided by NIOSH enables OSHA to better understand trends in adult lead exposure based on industry and job type. OSHA may use the information provided by NIOSH to target enforcement action within select industry in Florida and other States that do not have OSHA- approved State plan.

The data for each individuals collected was de-identify by removing the name, date of birth and the social security numbers. After de-identifying for this, the client ID was used as an identifier. The NAICS and SIS codes was used in coding the industry and occupation/job duties of the patient and was decoded using the US Census Bureau North American Industry Classification System (NAICS) and the Standard Industrial Classification (SIC) which is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

Statistical analysis

All analysis was done using the IBM SPSS Statistics 24 windows version. This analysis includes descriptive and Generalized Linear Model to analyze the association between the dependent and independent variables [9].

Generalized Linear Model

Generalized linear models were popularized by McCullagh and Nelder in 1982. In these models, the response variable γi is assumed to follow an exponential family distribution with mean μ_i, which is assumed to be some (often nonlinear) function of (xi)^Tβ. Some would call these "nonlinear" because μ_i is often a nonlinear function of the covariates, but McCullagh and Nelder consider them to be linear, because the covariates affect the distribution of γi only through the linear combination (xi)^Tβ [10]. Some of the assumptions for generalized linear models are:

The cases that is Y1, Y2, ..., Yn are independently distributed

The dependent variable Yi does NOT need to be normally distributed, but it typically assumes a distribution from an exponential

Table 3: Parameter estimates for univariate analysis.

Independent Variable: AGE Dependent Variable: Blood lead level ≥10 µg/dL						
Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	21.935	.788	27.832	.000	20.389	23.480
AGE	-.012	.017	-.703	.482	-.047	.022

Independent Variable: RACE Dependent Variable: Blood lead level ≥10 µg/dL						
Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	22.963	.373	61.601	.000	22.231	23.694
[RACE=BLACK]	-1.179	.721	-1.634	.102	-2.594	.236
[RACE=WHITE]	0[a]	.	.	.	.	.

Independent Variable: ETHNICITY Dependent Variable: Blood lead level ≥10 µg/dL						
Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	22.328	.778	28.682	.000	20.800	23.856
[ETHNICITY= Not Hispanic or Latino]	4.008	.928	4.319	.000	2.186	5.830
[ETHNICITY= Hispanic or Latino]	0[a]	.	.	.	.	.

Independent Variable: SEX Dependent Variable: Blood lead level ≥10 µg/dL						
Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	17.669	.981	18.016	.000	15.746	19.592
[SEX=Male]	3.960	1.012	3.913	.000	1.975	5.944
[SEX=Female]	0[a]	.	.	.	.	.

Independent Variable: WORK-RELATED Dependent Variable: Blood lead level ≥10 µg/dL						
Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	19.965	.360	55.532	.000	19.260	20.670
Work-Related	2.585	.485	5.331	.000	1.634	3.535
Not-Work-Related	0[a]	.	.	.	.	.

family (e.g. binomial, Poisson, multinomial, normal etc.)

Generalized linear models (GLM) does NOT assume a linear relationship between the dependent variable and the independent variables, but it does assume linear relationship between the transformed response in terms of the link function and the explanatory variables; e.g., for binary logistic regression log it (π) = $\beta 0 + \beta X$.

Independent variables can be even the power terms or some other nonlinear transformations of the original independent variables.

The homogeneity of variance does NOT need to be satisfied and over dispersion maybe present.

Errors need to be independent but NOT normally distributed.

It uses Maximum Likelihood Estimation (MLE) rather than Ordinary Least Squares (OLS) to estimate the parameters, and thus relies on large-sample approximations.

Goodness-of-fit measures rely on sufficiently large samples, where a heuristic rule is that not more than 20% of the expected cells counts are less than 5.

Results

A total of 2246 adult cases of blood lead level ≥10 µg/dL were recorded between the ages 15 and 92 from 2008 to 2010. The age distribution of the blood lead level ≥ 10µg/dL collected is from age 15 to 92 (minimum 15 and maximum 92). The mean, median and mode of the distribution are 42.92,43 and 47 respectively. The sex distribution is categorized into three Male, Female and unknown. From the 2246 number of cases collected Male recorded the highest number of cases with 2101 cases (93.5%), Female 136 (6.1%) and 9 (0.4%) cases were unknown (Table 1). The races are categorized into American Indian & Alaska Native, Asian, Black, White, Mixed, and Unknown. White has the highest number of cases with 939 (41.8%) with mixed race having the lowest number of cases with 1 (0%). American Indian & Alaska Native with 12 cases (0.5%), Asian 15 cases (0.7%), Black 342 cases (15.2%) and 937 cases were unknown which is equivalent to 41.7% of the total race (Table 1). The ethnicity was classified into Not Hispanic, Hispanic or Latino and Unknown. Most of the cases which is 1413 (62.9) cases did not identify themselves of any ethnic groups and is labeled unknown. Not Hispanic or Latino

Table 4: Parameter estimates for multivariate analysis.

Parameter Estimates						
Dependent Variable: Blood lead level ≥10 μg/dL						
Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	11.703	3.329	3.515	.000	5.166	18.239
Work-Related	1.344	1.093	1.230	.219	-.801	3.489
Work-Related	0[a]	.	.	.	.	.
ETHNICITY=Not Hispanic	3.338	1.304	2.561	.011	.779	5.898
ETHNICITY=Hispanics	0[a]	.	.	.	.	.
RACE=Black	-1.907	1.137	-1.677	.094	-4.140	.326
RACE=White	0[a]	.	.	.	.	.
SEX=Male	9.632	2.830	3.404	.001	4.076	15.189
SEX=Female	0[a]	.	.	.	.	.
AGE	.034	.035	.963	.336	-.035	.103

recorded the highest number of known cases with 586 (26.1%) and Hispanic or Latino has the lowest with 247 (11%) (Table 1).

Lead poisoning based on individual work is classified into four: 1) work related (lead poison associated with patient job duty), 2) Not work related (lead poison not associated with job duty), 3) Both (lead poison associated with both job duty and not associated with job duty), 4) Unknown (lead poison associated with unknown exposure). Overall, the most cases of lead poisoning was work related accounting for 54.9% of the total cases, 42.3% cases is unknown, 2.6% is not work related and while 0.18% cases are associated with both jobs and not job related. Table 2 present the distribution of lead poisoning due to their relation with their job.

Lead poisoning is also described based on their county of exposure. The county of exposure represents the county of the patient work place. Hillsborough accounted for the most cases with 772 cases (34.4%), Pinellas County with second highest with 123 cases (5.5%), Broward county with 96 (4.3%) (Figure 1). Figure 1 shows the county of residence for lead poisoning in Florida. The county of residence which can be defined as the counties were the patient lived, this is different from the county of exposure, which is defined as the county they were exposed to lead. Hillsborough county accounted for the highest number of cases with 805 cases (35.8%), Pinellas with the second highest number of cases with 305 cases (13.6%) and Miami-Dade with the third highest with 126 cases (5.65%). 323 (14.4%) cases were unknown. For lead poisoning due to the person work, Hillsborough has the highest with 707 cases, Pinellas with the second highest number of cases with 130 cases and Pasco with the third highest with 64 cases (Figure 1). For lead poisoning not due to the person work, Miami Dade has the highest with 18 cases, Broward with the second highest number of cases with 6 cases and Pinellas with the third highest with 5 cases (Figure 1). For unknown causes of lead poisoning, Pinellas has the highest with 169 cases, Hillsborough with the second highest number of cases with 97 cases and Miami Dade with the third highest with 84 cases (Figure 1).

The job duties were defined as the job description of the cases. Bridge Painter recorded the highest number of cases with 248 (11%) cases. Laborer accounted for the second highest with 197(8.8%) cases and Unloader/Operator Group Leader accounted for the third highest with 66 (2.9%) cases. The industry is defined as the manufacturing company were the patient are been exposed to lead poisoning. Battery manufacturing company recorded the highest number of cases with 414 (18.4%), Lead Recycling Company is second with 319 (14.2%) cases and Paint and Wall covering contractors was third with 246(11%). While 952 (42.4%) cases were unknown.

Five different Generalized Linear Models were developed to analyze the association between age, race, ethnicity, gender, work relation to lead exposure. In order to have an accurate statistical analysis, variables containing other, unknown, missing or no values and with sample size less than twenty were excluded from the analyses. For work related cases, those cases not related to their jobs and cases with unknown causes of lead poisoning was added together. In all, a total of 681 cases were used for this analysis.

Table 3 presents the parameter estimates for the univariate analysis for the association between ages, race, ethnicity, sex and work related and blood lead level ≥10 μg/dL. The result shows that there is no association between age and blood lead level ≥10 μg/dL and no association between race (black and white) and blood lead level ≥10 μg/dL. Non-Hispanic or Latino with lead poisoning that is blood lead level ≥10 μg/dL will have an average concentration of blood lead level that is 4 μg/dL more than Hispanic or Latino with lead poisoning that is blood lead level ≥10 μg/dL (Table 3). For gender, male with lead poisoning that is blood lead level ≥10 μg/dL will have an average concentration of blood lead level that is almost 4 μg/dL more than female with lead poisoning that is blood lead level ≥10 μg/dL. While, those with lead poisoning due to their exposure to lead at their work place will have an average concentration of blood lead level that is 2.5 μg/dL more than those who are not exposed to lead due to their job (Table 3).

The final model which includes sex, work related, ethnicity, race and age as the independent variables and Lead poisoning (blood lead level ≥10 μg/dL) as dependent variables shows that ethnicity and sex are the only significant variables after controlling for other variables.

The multivariate analysis shows that male with lead poisoning that is blood lead level ≥10 μg/dL will have an average concentration of blood lead level that is almost 9.6 μg/dL more than female with lead poisoning that is blood lead level ≥10 μg/dL. While, non-Hispanic or Latino with lead poisoning that is blood lead level ≥10 μg/dL will have an average concentration of blood lead level that is 3.3μg/dL more than Hispanic or Latino with lead poisoning that is blood lead level ≥10 μg/dL (Table 4).

Conclusion

This study examined if individuals who were exposed to lead will have their lead poisoning (blood lead level ≥10μg/dL) increase compare to those who are not exposed to lead.

The findings for this study showed that lead poisoning (blood lead level ≥10μg/dL) is associated with the type of work ones does. The finding suggests that Non-Hispanic or Latino is more likely to have lead poisoning compare to Hispanic or Latino. Male are more likely to have lead poisoning compare to female while person exposed to lead due to their job are more likely to have lead poisoning compare to those not expose to lead due to their job. But there is no statistical difference between lead poisoning and age of the individual and their race.

This study shows that individual exposed to lead due to their job are more likely to have their blood lead level ≥10μg/dL concentration higher than those that are not expose to lead due to their job.

References

1. Elliot P, Arnold R, Barltrop D, Thornton I, House I, Henry J. Clinical Lead Poisoning in England: An Analysis of Routine Sources of Data. Occupational and Environmental Medicine. 1999; 56: 820-824.
2. Pirkle J, Kaufmann R, Brody D, Hickman T, Gunter E, Pascal D. Exposure of the U.S. Population to Lead, 1991-1994. Environmental Health Perspectives. 1998; 106: 745-750.
3. Kosnett M, Wedeen R, Rothenberg J, Hipkins L, Materna B. Schwartz BS, et al. Recommendations for Medical Management of Adult Lead Exposure. Environmental Health Perspectives. 2007; 115: 463-471.
4. Schwartz S, Hu H. Adult Lead Exposure Time for Change. Environmental Health Perspectives. 2007; 115: 451-454.
5. Shannon M. Lead Poisoning from an Unexpected Source in 4-Month-Old Infant. Environmental Health Perspectives. 1998; 106: 313-316.
6. Hu H, Shih R, Rothenberg S, Schwartz B. The Epidemiology of Lead Toxicity in Adults: Measuring Dose and Consideration of Other Methodologic Issues. Environmental Health Perspectives. 2007; 115: 455-462.
7. Shih R, Glass T, Bandeen,-Roche K, Carlson M, Bolla K, Todd A, et al. Environmental lead exposure and cognitive function in community-dwelling older adults. The Official Journal of the American Academy of Neurology. 2006; 67: 1556-1562.
8. Florida Department of Health. Adult Blood Lead Epidemiology Surveillance (ABLES) Program.
9. Penn State Eberly College of Science. Analysis of Discrete Data: Introduction to Generalized Linear Models.
10. SPSS Inc. Released 2016. PASW Statistics for Windows, Version 24.0. Chicago: SPSS Inc.

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