

An Exploratory Analysis to Determine Priority Areas for Lead Poisoning Prevention Education Programs in Missouri

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Abstract Lead is a strong poison and toxic to many vital organs and body systems especially in the central nervous system of children, who are more vulnerable to lead poisoning than adults. The purpose of the study described in this article was to examine the relationship between elevated blood lead level (BLL) cases of children in the state of Missouri and pre-1980 home construction, lead mine proximity, and median household income and to determine counties and areas for statewide prevention education. Results of the regression analysis indicated that these combined variables were significant predictors ($F[3,111] = 19.106, p < .05, R^2 = .341$), accounting for 34.1% of the explained variance in the number elevated BLL cases. Number of houses built prior to 1980 ($\beta = .606, p < .05$) and median household income ($\beta = -.186, p < .05$) were specifically revealed to be significant predictors of elevated blood lead cases. In addition to screening in identified counties, Missouri's statewide plan should expand to include prevention education in all low-income counties.

Introduction

Lead, which is a heavy, soft, bluish-gray metal that occurs naturally in the rocks and soil of the Earth's crust, has no distinctive taste or smell and today is used in the production of batteries, ammunition, pipes, tank linings, construction materials, glazes, and glassware (Missouri Department of Health and Senior Services [MDHSS], 2012). Lead is a strong poison and toxic to many vital organs and body systems especially in the central nervous system of children, who are more vulnerable to lead poisoning than adults. No safe blood lead level (BLL) exists for children. Even a small amount of lead (a chip of paint smaller than a dime) can affect blood as well as slow growth

and development, and larger exposures may potentially lead to brain damage, anemia, kidney damage, colic, and muscle weakness (Agency for Toxic Substances and Disease Registry, 2011). Repeated low levels of exposure to lead can alter a child's normal mental and physical growth and result in learning or behavioral problems (MDHSS, 2012).

Children in about four million U.S. homes today are being exposed to high levels of lead (Centers for Disease Control and Prevention [CDC], 2013). Although lead-based paints for homes, toys, and furniture have been banned in the U.S. since 1978, lead-based paint is still found on the walls of many older homes. In addition, lead pipes, brass plumbing fixtures,

and copper pipes soldered with lead can release lead particles into tap water (National Institutes of Health [NIH], 2012). Lead poisoning is linked to the more than six million substandard housing units in this country, and our national health goals call for a 52% reduction in the number of these units (CDC, 2013).

The risk of exposure is exceptionally high for children in Missouri as the state produces more lead than any other state in the U.S. Missouri's major lead-producing area is known as the New Lead Belt, a 35-mile long ore-producing area in Iron County, southeast Missouri. Mining waste from the New Lead Belt includes high levels of lead in dust, air, and soil that may contaminate places in which children frequent such as yards and play areas (MDHSS, 2011). In addition, 65% of Missouri homes were built prior to 1978 and contain leaded paint (MDHSS, 2002). In 62 of the 115 Missouri counties, including the New Lead Belt, at least 24% of homes were constructed before 1950 (MDHSS, 2011).

A little over 1% of Missouri children possess elevated BLLs (MDHSS, 2012). According to recent Missouri BLL testing data, 712 children under six years of age were identified with elevated BLLs. Fortunately, lead poisoning is both a preventable and treatable condition, and Missouri's statewide screening plan calls for providing BLL screening and primary prevention for patients six years of age and younger in both high-risk and targeted testing areas and counties: Kansas City, Jackson County, St. Louis County, and southeast Missouri (MDHSS, 2011). Therefore, the purpose of our study was to examine the relationship between elevated BLL cases of children in the state of Missouri

TABLE 1

Report of Independent Regression Variables Used to Predict Elevated Blood Lead Levels

Variable	<i>B</i>	Standard Error	β
Houses built prior to 1980	0.017	0.002	.606*
Number of lead mines	-0.018	0.389	-0.004
Median household income	-0.024	0.010	-0.186*

* $p < .05$.

and pre-1980 home construction, lead mine proximity, and median household income and to identify counties and areas in need of lead poisoning prevention education.

Methods

Data Sources and Procedure

The main data source for our study was a comprehensive, ongoing collection of data about environmental hazards, exposures, and health effects for the state of Missouri: Missouri's Environmental Public Health Tracking System (EPHT). The public portal can be found at http://ephtn.dhss.mo.gov/EPHTN_Data_Portal/. A Centers for Disease Control and Prevention partner, Missouri's EPHT has collaborated with national and state system partners to protect communities by providing them with information to identify and reduce environmental public health exposures. By conducting studies using EPHT (identifying clusters of noninfectious health effects, tracking conditions, and taking actions to control environmentally related diseases), health care and public health professionals can promote health and prevent disease. Privacy of the data including both the public and secure portals is maintained by public health agencies, and all requests for information from the secure portal must first be reviewed using a strict procedure (MDHSS, 2002).

The other data source for our study was a comprehensive collection of statewide GIS data, the Missouri Spatial Data Information Service (MSDIS), which can be found at www.msdis.missouri.edu/index.html. Operating under the guidance of the Missouri Geographic Information System Advisory Committee, MSDIS is a spatial data retrieval and archival system for GIS data and is also

responsible for data standardization, compilation of metadata, and statewide GIS user information networks (Missouri Spatial Data Information Service [MSDIS], 2011).

During spring and summer 2013, data from the Missouri EPHT public portal metadata bank (MDHSS, 2002) and the Missouri Spatial Data Information Service Web site (MSDIS, 2011) were collected and analyzed. The specific variables analyzed included lead mines in Missouri (inventory of mines, occurrences, and prospects), elevated BLL cases in 2001–2012 (noted the number of children 71 months and younger, in all Missouri counties, with an elevated BLL), housing before 1980, and median household income. All metadata were downloaded to Microsoft Excel for ease of viewing, double-checked during analysis, and stored in a password-protected site.

Analysis

A multiple regression was conducted to predict the number of recorded elevated BLL cases (2001–2012) from the number of houses in each county built before 1980, the number of lead mines (active and inactive) in each county, and the median household income for each county.

Results

Results of the regression analysis (Table 1) indicated that these combined variables were significant predictors of elevated BLL cases in Missouri ($F[3,111] = 19.106, p < .05, R^2 = .341$), accounting for 34.1% of the explained variance in the number of elevated blood lead cases. More specifically, the number of houses built prior to 1980 ($\beta = .606, p < .05$) and median household income ($\beta = -0.186, p < .05$) were revealed to be significant predictors of elevated BLL cases. The number of

lead mines in the state of Missouri was not a significant predictor.

Discussion

This initial exploratory analysis was conducted to clarify and help to define the nature of the problem of lead exposure risk in Missouri children as well as to determine counties and areas in need of lead poisoning prevention educational programming. Results of the current study are consistent with previous research and provide support to suggest that living in substandard older homes may predict a child's risk for elevated BLLs (MDHSS, 2002, 2011). Because Missouri is the number-one lead-producing state in the nation, Missouri children are already at heightened risk for lead exposure, especially in the New Lead Belt counties where most lead is produced (MDHSS, 2011).

In order to focus more specifically on where lead poisoning prevention educational programs should be targeted, however, all high-risk counties and conditions need to be identified. Homes built before 1980 and median household income were significant predictors of total elevated BLLs and accounted for 34% of the explained variance in our study. Sixty-five percent of Missouri homes were built prior to 1978 with numerous homes built prior to 1950 (MDHSS, 2002, 2011). Because of the possibility of lead-based paint as well as older fixtures that may leach lead, these homes should be considered high risk (NIH, 2012). Risk is also increased in homes where lead-based paint is on deteriorated surfaces such as windows and window trim that are easily accessible to children. Opening and closing of these windows wears away the paint and creates lead dust that may increase lead exposure in children (CDC, 1991).

Median household income was also a predictor, as it would be expected that those with lower incomes may only be able to afford older less expensive homes. Many of these types of homes would possibly be substandard and contain lead in paint or fixtures. In addition to concentrating on the lead-belt counties and BLL screening of children in designated high-risk counties and areas (MDHSS, 2011), other counties that contain an abundance of pre-1980 home construction and especially all lower socioeconomic status counties should also be identified for educational prevention programming.

Conclusion

The risk of lead exposure is exceptionally high for children in the number-one lead-producing state in the nation. Because the number of houses in each county built before 1980 and the median household income for each county were found to be significant predictors of elevated BLL cases, all counties and areas with low socioeconomic status levels need to be identi-

fied for educational prevention activities. Our study may be limited as other variables may lend themselves to further exploration such as older homes with or without more recent renovations and number of children who have previously received screenings and education in schools or through state or county programs (MDHSS, 2011). Further research using Missouri EPHT is recommended as it may lead

to other actions or expanded conditions to control environmentally related diseases such as lead poisoning (MDHSS, 2002).

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