Associations Between Pediatric Blood Lead Levels and Social Determinants of Health in Chemung County, New York

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♦ Abstract

According to pre-COVID-19 census estimates, seventy-five percent of the housing in Chemung County, NY was constructed before the 1978 federal mandate to remove lead paint.[1] Thus, residents are at increased risk of lead exposure. Exposure often occurs through inhalation of lead-based paint and dust. Screening is important as the biological effects of lead toxicity are widespread and long lasting. Even at lower blood lead levels (BLLs) (5-15 ug/dL), children can experience irreversible sequelae, such as reduced IQ, auditory processing difficulties, and emotional dysregulation. Children in Chemung County have higher rates of elevated BLLs (11% in 2014) compared to children across New York state (5% in 2014). While elevated BLLs rates in New York state have experienced significant decline between 2000 and 2014, this trend has not been observed since 2010 for Chemung County. Furthermore, Chemung County Health Department data demonstrates yearly identification of children with BLLs >15 ug/dL, which correlate with symptoms of encephalopathy, seizures, and even death.[2]

Pre-COVID-19, forty-seven percent of Elmira residents lived in poverty. In children under the age of 18, poverty was even more widely distributed, affecting upwards of seventy percent of the pediatric population. Therefore, children in Chemung County experience significant barriers to positive future health outcomes. The purpose of this study was to evaluate BLLs of children enrolled in the Elmira Head Start Program, which preferentially assists children of low socio-economic status (SES). In doing so, we aimed to investigate the associations of BLL in relation to SES and other social determinants of health.

Methods

Data was collected from children enrolled in the EOP Head Start program through the ACCEL Community Health Clinic from May 19 - September 22, 2022. Blood samples were collected from a finger stick collected via capillary tube. The sample was analyzed using the "Lead care II" machine. Readouts were stratified into three categories. <3.3 µg/dL (low), >3.3 µg/dL and <65 µg/dL (measured reading), and >65 µg/dL (high). Demographic information was collected from the families of the pediatric participants.

Results

Thirty-nine of the participants tested <3.3 µg/dL, while 11 had measured readings >3.3 µg/dL. Six tested positive (>5 µg/dL) for elevated BLLs. The rate of elevated BLLs in this population is currently measured at 8.6 percent. The clinic was used by a population whose household income was less than 10 thousand dollars 45 percent of the time. Eighty-five percent of participant guardians reported a low educational background.

Conclusion

Preliminary data from the ACCEL clinic is promising. Previous estimates for Chemung County reported that 10 percent of tested children had elevated BLLs. This clinic is ongoing and will collect data into 2023. Combined family income does not seem to be predictive of blood lead level outcome at this time; however, level of guardian education is possibly associated. All participants with elevated BLLs were from families who guardians had maximally achieved a high school diploma.

♦ Introduction

Social determinants of health (SDOH) include a broad range of considerations that affect health outcomes in the general population. Some of these factors include access to quality healthcare and education, community living standards, and environmental and economic stability. Of these SDOH, several conditions have been studied extensively and linked to negative health outcomes. For example, successful smoking cessation is linked to barrier-free insurance coverage in affected populations.[3] Likewise, improving the overall SES of a community is associated with lower rates of type 2 diabetes mellitus.[4] Lead toxicity itself can also impact disadvantaged communities.[5] In the city of Elmira, NY (Chemung County), the Head Start program exists to support the pediatric population from low-income families. Through this program, children are provided ancillary services that can be expensive or impossible to obtain with a low combined family income.

According to 2021 U.S. Census data, fourteen and a half percent of Chemung County residents experienced poverty.[6] This is 3.1 percent higher than the national average.[7] Education level has been studied in relation to elevated BLLs; however, poverty has not.[8] Early identification of elevated BLLs is important for reporting purposes and to provide available interventions and social supports to the pediatric patients. Interventions include: removal of lead-based paint and dust, changes in diet to promote reduced lead uptake, and connection to educational services.[9] We hypothesize that elevated pediatric blood lead levels are associated with low SES (combined family income) and low guardian educational achievement.

Specific aim:

1) Assess possible associations between SDOH and elevated pediatric BLLs

♦ Materials and Methods

1 → 2 → 3 → 4 → 5

1 — Inclusion Criteria

- Age: 18 months - 12 years old
- Zip code: 14845, 14901, 14904, 14903,14892, 14905, 14871, 14812
- Members of the Economic Opportunity Program Inc. of Chemung County, NY (EOP) or referred to the ACCEL Clinic

2 — Sample Collection

- Blood for sample is collected from a finger stick
- Sample collected via a capillary tube

Image 1. *capillary tube*

3 — Sample Collection

- Capillary tube is placed in a reagent tube and a plunger is used to expel the fluid
- The tube is capped and inverted 8-10 times to mix the sample
- Mixing is considered sufficient when the mixed solution demonstrates a brown coloration

4 — Sample Collection

- The sample is analyzed via the "Lead care II" machine
- Readouts take 3 minutes

5 — Interpretation of Results and Counseling

- BLLs are reported in µg/dL
- results < 3.3 µg/dL are reported as "low"
- Results >65 µg/dL are reported as "high"
- Results between are assigned a number
- Children with a BLL >5 µg/dL are referred for confirmatory testing and medical intervention

♦ Results

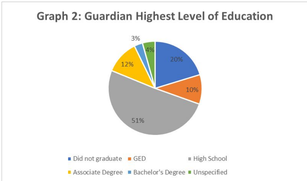
Data was collected from children enrolled in the EOP Head Start program through the ACCEL (Arnot, Chemung County, EOP, LECOM) Community Health Clinic from May 19 - September 22, 2022. Sixty-nine children were tested. 91.3% of children recorded BLLs <3.3 µg/dL (n=63), while six children of the cohort tested positive for elevated BLLs (Table 2). Table 1 details the cohort demographics. Graphs 1 and 2 depict the SDOH associated with the children in the cohort. Forty-five percent of children have a household net income between 0-10k dollars (Graph 1), while 85 percent have guardians who do not have advanced degrees up to and beyond high school. (Graph 2). The average combined family income among participants with negative results was $16, 034 and $19,747 for participants with elevated blood lead levels. All guardians of participants with a positive BLL had a high school education.

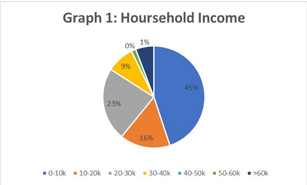
Table 1
Demographic Descriptors of Participants (N=69)

Demographic	Frequency	Percent
Sex		
Male	37	*54*
Female	32	*46*
Age		
(0-2)	15	*22*
(3-4)	37	*54*
(5-6)	6	*9*
(7-8)	5	*7*
(9-10)	4	*6*
(11-15)	2	*2*
Ethnicity		
Caucasian	31	*45*
African American	14	*20*
Hispanic	2	*3*
Multi Racial	20	*29*
Other	2	*3*

Table 2
BLLs of Participants Ages 18 Months – 12 Years (N=69)

Interpretation	BLL (µg/dL)	Frequency
Low	<3.3	58
Measured	3.3 - 65	
Negative	3.4 - 4.9	5
Positive	5.5 – 7.8	6
High	>65	0





♦ Discussion

- Preliminary pediatric blood lead levels have demonstrated mixed results. Six participants measured above the safe cutoff of 5µg/dL. Some parents self-reported that their children had at least one previous high result, which was negative on follow-up testing. Future surveys should include a question about previous testing to assess trends over time. However, the rate of elevated BLLs is lower in our population than previously measured in Chemung County, NY.
- Combined family income does not seem to be predictive of blood lead level outcome at this time.
- According to a 2019 report from the University of Rochester Finger Lakes Coalition to Stop Lead Poisoning, 10 percent of the children tested in Chemung County had elevated blood lead levels. This is among the highest in the state.[10] Therefore, continued testing efforts should expect to record elevated BLLs as the clinic continues its screenings.
- This study will continue collecting data for one calendar year. Among the participants with elevated BLLs, all had guardians with a high school education. There is not enough data to make any conclusions about income at this time. Future research will explore this and other associations.

♦ Conclusions

- Pediatric blood lead levels are still a health concern in the United States. Historically, Chemung County, NY has suffered from high than average positive cases.
- Research is ongoing about current elevated blood lead level rates as well as how social determinants of health impact risk of elevated results. Understanding risk factors can help inform childhood screening, funding, and health policy.

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