Lead Exposure, IQ, Neurological Effect, and Developmental Problems in Children Six Years and Under

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Abstract

Medical studies show that lead exposure is associated with neurological effect, low IQ, behavioral and developmental impairment in children six ages and under. The purpose of the study was to determine the association between elevated blood lead concentrations in children six years and under, and how their immediate environment influences their blood lead levels (EBLL). Data were collected from 170 six-to-six-year-olds at the University of Nebraska Medical Center Pediatric Clinic. Between January and March 2005, the samples were collected by capillary method, followed by venous puncture. Results showed that of the 170 samples tested, 42 were eliminated from the study for various reasons. Of the 128 tested, 43 had elevated blood lead levels (EBLL) at 10 ug/dl and all subjects reside in EPA designated lead site in Omaha.

Introduction

The purpose of the study was to determine the association between elevated blood lead concentrations in children six years and under, and how their immediate environment influences their blood lead levels (EBLL). Data were collected from 170 six-to-six-year-olds at the University of Nebraska Medical Center Pediatric Clinic. Between January and March 2005, the samples were collected by capillary method, followed by venous puncture. Results showed that of the 170 samples tested, 42 were eliminated from the study for various reasons. Of the 128 tested, 43 had elevated blood lead levels (EBLL) at 10 ug/dl and all subjects reside in EPA designated lead site in Omaha.

Methods

Sample size:

Table 1 shows the priority of elevated blood lead levels in children six years and under, and the order in which their immediate environment gives them influence their elevated blood lead levels (EBLL), neurological effect, behavioral and developmental impairment.

<table>
<thead>
<tr>
<th>Priority Category</th>
<th>EBLL ug/dl</th>
<th>Neurological Effect</th>
<th>Behavioral and Developmental Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Priority</td>
<td>70-79</td>
<td>Slowed nerve conduction</td>
<td>Behavior and development impairment</td>
</tr>
<tr>
<td>Second Priority</td>
<td>30-69</td>
<td>Impaired vision</td>
<td></td>
</tr>
<tr>
<td>Third Priority</td>
<td>21-25</td>
<td>Lower IQ, slower reaction time</td>
<td></td>
</tr>
<tr>
<td>Fourth Priority</td>
<td>10-15</td>
<td>Deficits in neurobehavioral development</td>
<td>Reduced growth rate and weight at birth</td>
</tr>
</tbody>
</table>

Source: Childhood Lead Poisoning Prevention Program, Omaha, 1999-2000

Results

Table 1. Shows the Blood Levels in Micrograms per Deciliter by Zip Code from January to March 2005. Elevated Blood Levels in ug/dl

<table>
<thead>
<tr>
<th>Zip Code</th>
<th>0-9</th>
<th>10-14</th>
<th>15-24</th>
<th>25-44</th>
<th>45-68</th>
<th>79+</th>
<th>Total</th>
<th>% Tested</th>
</tr>
</thead>
<tbody>
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<td>68102</td>
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<td>0</td>
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<tr>
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<tr>
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<tr>
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<tr>
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<tr>
<td>68114</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>31</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Data collected from UNMC Pediatrics Clinic, January to March 2005

Home visits:

One family whose two year old son had an EBLL >70 ug/dl, reported that they were on Medicaid, which took care of the medical bills. Her husband works full time and the mother stays at home since they have three other children. However, the child had not been evaluated for behavior and development impairment, IQ testing, or early school intervention. The landlord had replaced some windows to the house and two were still waiting to be replaced. The EPA had excavated the soil around the house, repainted the house and cleared the carpet. They reside in zip code 68108, which is EPA designated lead site area in Omaha.

Recommendations to the family:

- Based on these three major sources of Lead in Omaha, in 1999, EPA designated Douglas County in Omaha as a priority site for clean up.
- Based on the lead due to the battery recycling plant, Gould, Inc. which operated a lead battery recycling plant and a secondary lead smelter in the area but closed down in 1982.
- The sources of lead in Omaha, according to the Health and Human Services Department, Douglas County, with the highest number of children six years and under (46%), the highest percentage (46%) of older homes and residences built prior to 1978, and the highest levels of lead poisoning in children compared to the state.
- Gould, Inc. operated a lead battery recycling plant and a secondary lead smelter in the area but closed down in 1982.
- Eleven zip codes surrounding downtown Omaha, including the seven zip code areas for EPA designated areas for study to establish the association between elevated blood lead levels and lead based paint in children six years and under who reside in homes and residences built prior to 1978 in Omaha.

Conclusion

It is clear that blood lead levels have fallen significantly over the last 40 years in some states in the United States and elsewhere in the developed world. Despite this fall in lead exposure, it could be argued that current baseline blood lead levels continue to constitute health risk for children residing in the 11 EPA designated zip codes as demonstrated by tables 3 for the year 2003, and table 4 for the year 2004, showing the number of children tested and the trend of EBLL in Omaha. With the recent evidence demonstrating an inverse association between blood lead levels and cognitive function in children exposed to low levels of lead, there is no safety margin at existing exposures in Douglas County. Aggressive mandatory efforts to continue to test all children six years and under who reside in Omaha and the rest of the state in order to ensure minimization of childhood exposures is important.

Services Received:

- One family whose two year old son had an EBLL >70 ug/dl, reported that they were on Medicaid, which took care of the medical bills. Her husband works full time and the mother stays at home since they have three other children. However, the child had not been evaluated for behavior and development impairment, IQ testing, or early school intervention. The landlord had replaced some windows to the house and two were still waiting to be replaced. The EPA had excavated the soil around the house, repainted the house and cleared the carpet. They reside in zip code 68108, which is EPA designated lead site area in Omaha.
- The services received from the Omaha Public School District since the family resides in the OPS jurisdiction.

Discussion:

- The magnitude of the lead -IQ dose response relationship is small on a population basis and should be set against the far greater combined effect of socioeconomic status (SES) and quality of the caregiving environment. Instead of “chasing after an ever receding lead threshold”, attention and EPA funds should be focused on the more important and effective strategies to ensure minimization of childhood exposures is important.
- The exposure accounts for a very small amount of variance in cognitive ability (4%) from tables 3 and 4, whereas covariates such as social and parenting factors account for 40% or more (My clinical experience at Munroe-Meyer Institute).
- The current evidence indicates that lower IQ is associated with continued lead exposure in small segments of low income housing in inner city minorities in Omaha. Current lead exposure accounts for a very small amount of variance in cognitive ability (4%) from tables 3 and 4, whereas covariates such as social and parenting factors account for 40% or more (My clinical experience at Munroe-Meyer Institute).
- Genetic predisposition can also affect vulnerability to lead-induced neurotoxicity. Lutsky and Schneider (2003) have recently reviewed this area of research and found that three genes are currently believed to play a role in lead neurotoxicity: the ALAD gene, which codes for 5 (alpha) hydroxymethylbilane dioxygenase, the vitamin D receptor (VDR) gene, and the hemochromatosis gene coding for a defective protein known as HFE.
- There are two types of ALAD protein, ALAD1 and ALAD2; lead has a higher affinity for ALAD2. Children with ALAD1 phenotype are more resistant to the effects of lead or have higher blood lead levels (EBLL) than children with ALAD2 phenotype.
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- Other organizations

Experiences and the burden of caring for their children

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Gaps in the services provided

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