Prevalence of Elevated Blood Lead Levels in an Inner-city Pediatric Clinic Population

Shoshana T. Melman,[1] Joseph W. Nimeh,[2] and Ran D. Anbar[3]

[1]MCP•Hahnemann School of Medicine, Philadelphia, PA 19107 USA; [2]Allegheny University of the Health Sciences, Philadelphia, PA 19107 USA; [3]SUNY Health Science Center at Syracuse, Syracuse, NY 13210 USA

In November 1997, the Centers for Disease Control and Prevention (CDC) released revised guidelines for lead poisoning screening, including a recommendation that states and regions individualize screening policies based on local prevalence of elevated lead levels. The purpose of this study was to collect prevalence data for a Philadelphia, Pennsylvania, inner-city pediatric outpatient population previously not known to have elevated blood lead levels in order to determine its risk for lead exposure and screening requirements. Charts were reviewed for 817 children of 10 months through 6 years of age whose venous blood lead levels were obtained as part of their routine health care over a 12-month period ending October 1992. None of these children had a history of previously elevated lead levels. Prevalence of elevated lead levels was determined for this population and correlated with patient age, sex, race, and insurance type. More than two-thirds (68%) of the study patients had a blood lead level of ≥10 µg/dl. Elevated blood lead levels were associated with black race (p<0.0001), but not with sex or insurance type. The percentage of children with elevated blood lead levels was highest at ages 37–48 months. A majority of the children screened had lead levels in excess of the CDC threshold for an abnormal lead level (10 µg/dl). This is the highest reported prevalence within a U.S. pediatric clinic population. In view of this extremely high prevalence, clinicians and public health personnel caring for children in Philadelphia inner-city clinics must follow the intent of the new CDC guidelines by increasing their efforts in the areas of screening, follow-up, and environmental interventions. To ensure a lead-safe upbringing for children in the United States, state health officials nationwide should perform local risk assessments before considering policy transitions from universal to targeted screening. *Key words*: lead poisoning, pediatric, prevalence, screening, urban. *Environ Health Perspect* 106:655–657 (1998). [Online 14 September 1998]
http://ehpnet1.niehs.nih.gov/docs/1998/106p655-657melman/abstract.html

Despite significant national efforts, lead poisoning continues to be a serious problem for American children. In 1991 the Centers for Disease Control and Prevention (CDC) issued guidelines stating that virtually all children were at risk for lead poisoning. The CDC then recommended universal screening of blood lead levels for all children (*1*). The National Health and Nutrition Examination Surveys (NHANES III) reported in 1994 that an estimated 1.7 million American children had blood lead levels exceeding 10 µg/dl. Black race, male sex, and urban environment were cited by the NHANES III report as substantial risk factors for lead poisoning (*2*).

Studies have documented highly variable and geographically diverse prevalences of blood lead levels ≥10 µg/dl, ranging from 5.6% in suburban clinics (*3*) to 71% in an inner-city emergency department (*4*). Large variations in lead poisoning prevalences were reported within the confines of a single city (*5*). Additionally, it was reported that children in rural areas can also be at significant risk for lead poisoning (*6,7*).

Given these widespread regional differences in elevated blood lead prevalence data, in late 1997 the CDC released new guidelines regarding lead screening (*8*). These guidelines continue to reflect the many adverse effects of childhood lead poisoning, which have been documented at levels as low as 10 µg/dl (*9–23*). The new guidelines replaced the blanket recommendation for universal screening with a preference for regional screening policies. These policies are based on several factors including local prevalences of elevated blood lead levels and the percentage of houses built before 1950 (*8*), which are more likely to have lead-containing paint (*24,25*). The purpose of the present study was to determine the prevalence of elevated blood lead levels in an inner-city Philadelphia, Pennsylvania, pediatric population in order to help develop local screening policies.

Methods

We reviewed the charts of all 2,334 patients of 10 months through 6 years of age undergoing blood lead level testing at the inner-city Hahnemann University General Pediatric Clinic in the 12-month period ending 7 October 1992. Of these, 1,517 patients were excluded from the study due to a history of lead poisoning. Therefore, the study population consisted of the remaining 817 patients who underwent blood lead screening as part of their routine health care in this pediatric clinic.

Venous blood samples were obtained from each child as per the 1991 CDC recommendations for lead specimen sample collection (*1*). Samples were analyzed by the Philadelphia Department of Public Health using the atomic absorption spectrophotometry method. The Philadelphia Department of Public Health lead testing laboratory is registered with the Pennsylvania State Quality Assurance Program, which requires daily quality control measures. Statistical comparisons were performed using chi-square analysis.

Results

The 817 subjects (45.7% male) averaged 24.8 months of age; 702 (85.8%) were black, 59 (7.2%) were Hispanic, and 34 (4.1%) were white. Medical insurance distribution was as follows: 628 (76.9%) received medical assistance or the equivalent; 151 (18.4%) were privately insured; and 38 (4.7%) had no insurance. The patient blood lead levels were distributed as follows: 265 (32%) had levels below 10 µg/dl; 275 (34%) had levels of 10–14 µg/dl, 137 (17%) had levels of 15–19 µg/dl, and 140 (17%) had levels ≥20 µg/dl.

In this study population, the prevalence of elevated blood lead levels peaked in children 37–48 months of age (Fig. 1). Seasonality findings were similar to those of previous studies (*26,27*), with the prevalence of elevated blood lead levels lowest in winter months (December and January) and highest in May. Black children were much more likely to demonstrate elevated blood lead levels in comparison to other subjects in this study (p<0.0001). There was no significant correlation between the patient's sex and type of insurance coverage and the risk of elevated blood lead levels.

Discussion

The results of this study indicate that 68% of the Philadelphia inner-city pediatric clinic population tested at our site had blood lead levels ≥10 µg/dl. This is the highest reported prevalence in a U.S. general pediatric clinic population. This finding is consistent with

Address correspondence to S.T. Melman, St. ChrisCare Pediatric Services, Center City, 231 N. Broad Street, Philadelphia, PA 19107 USA.
Received 18 February 1998; accepted 28 May 1998.

previous documented associations between high prevalance of elevated blood lead levels and urban environments (*8,28*). Other studies conducted in pediatric clinic settings have reported much lower prevalence data, ranging from 6.1% (*29*) to 30% (*30*). In contrast, the handful of previous studies that reported similarly high prevalences of elevated blood lead levels investigated specialized patient populations (*4,31,32*). For example, Flaherty (*31*) screened a population of abused and neglected children in Chicago, Illinois, and found that 64.7% had blood lead levels ≥10 µg/dl. A report from Oakland, California, showed a 67% prevalence of elevated blood lead levels, but the screening site was selected on the basis of its older housing (*32*). Finally, Wiley et al. (*4*) demonstrated 50–71% prevalences of elevated blood lead levels in children screened during emergency room visits (*4*).

We believe that our findings from the 1991–1992 screening are representative of a continuing lead hazard in the Philadelphia area because a recent report by the Philadelphia Department of Public Health found only a small decrease (from 44.3% to 39.9%) in the overall prevalence of elevated blood lead levels between 1993 and 1996 (*33*). The higher prevalence of elevated blood lead levels in our study in comparison to the Philadelphia Department of Public Health report may reflect the higher concentration of inner-city patients in our clinic's population.

The prevalence results reported in this study are not those of the full pediatric clinic population. Children with previously known elevated blood lead levels were excluded from the study in order to avoid oversampling those children recalled to the clinic for management of elevated blood lead levels. Projection of our data to the full pediatric clinic population would therefore underestimate the actual prevalence of elevated blood lead levels.

When the 1991 CDC guidelines called for universal screening, studies documented significant numbers of physicians (8–10%) who were noncompliant with this recommendation (*34,35*). Some public health personnel therefore may use the new CDC guidelines to justify an overall decrease in the effort and resources expended on blood lead screening. However, the new CDC guidelines clearly mandate that state and regional public health agencies must determine that a population in an individual region is at low-risk for lead poisoning before initiation of selective screening procedures.

The new CDC guidelines also emphasize the need to focus screening efforts on children 1–2 years of age. Our study findings indicate that a majority of our 3–6-year-old patients had blood lead levels ≥10 µg/dl even though they were not previously known to have had lead poisoning. Therefore, normal blood lead levels at ages 1 and 2 years may not reliably predict negative results at ages 3–6 years. Further studies may be required to establish appropriate ages during which to screen patients in areas with a high prevalence of elevated blood lead levels.

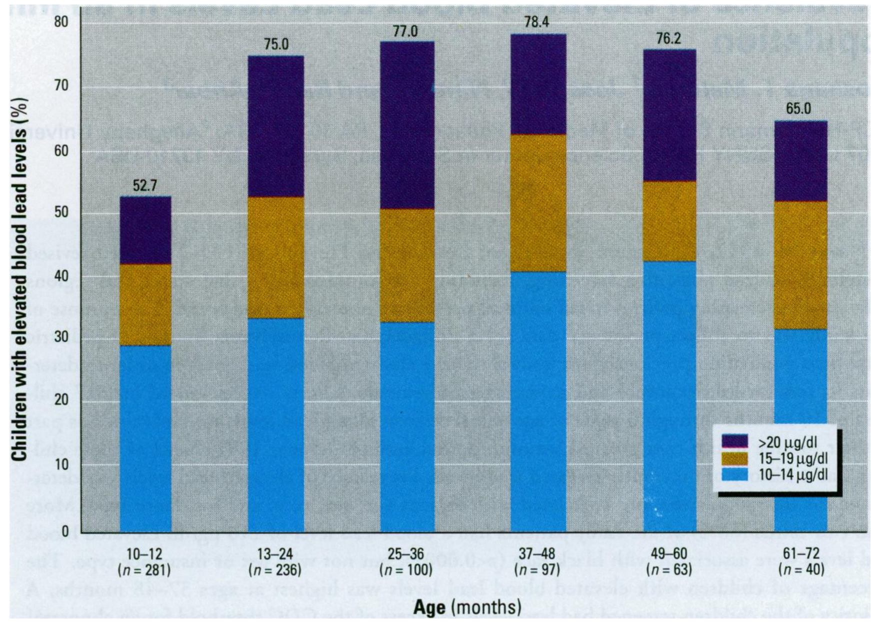

Figure 1. Distribution of elevated blood lead levels by age.

Our findings of an unexpectedly high prevalence of elevated blood lead levels in a Philadelphia inner-city clinic population support the new CDC recommendations regarding the need for careful documentation of blood lead prevalence data in individual regions. Clinicians and public health personnel caring for children in Philadelphia inner-city clinics must follow the intent of the new CDC guidelines by increasing their efforts in screening, follow-up, and environmental intervention. Finally, in order to ensure a lead-safe upbringing for children in the United States, state health officials nationwide should perform local risk assessments before considering policy transitions from universal to targeted screening.

References and Notes

1. CDC. Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control. Atlanta, GA:Centers for Disease Control and Prevention, 1991.
2. Brody DJ, Pirkle JL, Kramer RA, Flegal KM, Matte TD, Gunter EW, Paschal DC. Blood lead levels in the US population. Phase 1 of the Third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1991). JAMA 272:277–283 (1994).
3. Striph KB. Prevalence of lead poisoning in a suburban practice. J Fam Pract 41:65–71 (1995).
4. Wiley JF 2nd, Bell LM, Rosenblum LS, Nussbaum J, Tobin R, Henretig FM. Lead poisoning: low rates of screening and high prevalence among children seen in inner-city emergency departments. J Pediatr 126:392–395 (1995).
5. Mazur LJ, Moyer VA, Lally PA, Chan W. Evaluation of a lead screening program in Houston, Tex. Tex Med 92:54–57 (1996).
6. Blatt SD, Weinberger HL. Prevalence of lead exposure in a clinic using 1991 Centers for Disease Control and prevention recommendations. Am J Dis Child 147:761–763 (1993).
7. Norman EH, Bordley WC, Hertz-Picciotto I, Newton DA. Rural–urban blood lead differences in North Carolina children. Pediatrics 94:59–64 (1994).
8. CDC. Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials. Atlanta, GA:Centers for Disease Control and Prevention, 1997.
9. Bellinger DC, Stiles KM, Needleman HL. Low-level lead exposure, intelligence and academic achievement: a long-term follow-up study. Pediatrics 90:855–861 (1992).
10. Wigg NR, Vimpani GV, McMichael AJ, Baghurst PA, Robertson EF, Roberts RJ. Port Pirie cohort study: childhood blood lead level and neuropsychological development at age two years. J Epidemiol Community Health 42:213–219 (1988).
11. Benetou-Marantidou A, Nakou S, Micheloyannis J. Neurobehavioral estimation of children with life-long increased lead exposure. Arch Environ Health 43:392–395 (1988).
12. Bhattacharya A, Shukla R, Bornschein RL, Dietrich KN, Keith R. Lead effects on postural balance of children. Environ Health Perspect 89:35–42 (1990).
13. Goldstein GW. Lead poisoning and brain cell function. Environ Health Perspect 89:91–94 (1990).
14. Needleman HL, Achell A, Bellinger D, Leviton A, Allred EN. The long-term effects of exposure to low doses of lead in childhood: an 11-year follow-up report. N Engl J Med 322:83–88 (1990).
15. Sciarillo WG, Alexander G, Farrell, KP. Lead exposure and child behavior. Am J Public Health 82:1356–1360 (1992).
16. Needleman HL, Gunnoe C, Leviton A, Reed R, Peresie H, Maher C, Barrett P. Deficits in psychologic and classroom performance of children with elevated dentine lead levels. N Engl J Med 300:689–695 (1979).
17. Baghurst PA, Tong S, McMichael AJ, Robertson EF, Wigg NR, Vimpani GV. Determinants of blood lead concentrations to age 5 years in a birth cohort study of children living in the lead smelting city of Port Pirie and surrounding areas. Arch Environ Health 47:203–210 (1992).

18. Needleman HL, Bellinger D. The health effects of low level exposure to lead. Annu Rev Public Health 12:111–140 (1991).
19. Needleman HL, Gatsonis CA. Low-level lead exposure and the IQ of children: a meta-analysis of modern studies. JAMA 263:673–678 (1990).
20. Bellinger D, Leviton A, Waternaux C, Needleman HL, Rabinowitz M. Longitudinal analyses of prenatal and postnatal lead exposure and early cognitive development. N Engl J Med 316:1037–1043 (1987).
21. McMichael AJ, Baghurst PA, Wigg NR, Vimpani GV, Robertson EF, Roberts RJ. Port Pirie cohort study: environmental exposure to lead and children's abilities at the age of four years. N Engl J Med 319:468–475 (1988).
22. Bellinger D, Sloman J, Leviton A, Rabinowitz M, Needleman HL, Waternaux C. Low-level lead exposure and children's cognitive function in the preschool years. Pediatrics 87:219–227 (1991).
23. Dietrich KN, Krafft KM, Bornschein RL, Hammond PB, Berger O, Succop PA, Bier M. Low-level fetal lead exposure effect on neurobehavioral development in early infancy. Pediatrics 80:721–730 (1987).
24. ATSDR. The Nature and Extent of Lead Poisoning In Children in the United States: A Report to Congress. Atlanta, GA:Agency for Toxic Substances and Disease Registry, 1988.
25. HUD. Comprehensive and Workable Plan for the Abatement of Lead-based Paint in Privately Owned Housing: Report to Congress. Washington:U.S. Department of Housing and Urban Development, 1990.
26. Hunter JM. The summer disease: an integrative model of the seasonality aspects of childhood lead poisoning. Soc Sci Med 11:691–703 (1977).
27. Hunter JM. The summer disease: some field evidence on seasonality in childhood lead poisoning. Soc Sci Med 12:85–94 (1978).
28. Mielke HW, Dugas D, Mielke PW Jr, Smith KS, Smith SL, Gonzales CR. Associations between soil lead and childhood blood lead in urban New Orleans and rural Lafourche Parish of Louisiana. Environ Health Perspect 105:950–954 (1997).
29. Snyder DC, Mohle-Boetani JC, Palla B, Fenstersheib M. Development of a population-specific risk assessment to predict elevated blood lead levels in Santa Clara County, California. Pediatrics 96:643–648 (1995).
30. Casey R, Wiley C, Rutstein R, Pinto-Martin J. Prevalence of lead poisoning in an urban cohort of infants with high socioeconomic status. Clin Pediatr 33:480–484 (1994).
31. Flaherty EG. Risk of lead poisoning in abused and neglected children. Clin Pediat 34:128–132 (1995).
32. Blood lead levels among children in high-risk areas—California, 1987–1990. MMWR Morb Mortal Wkly Rep 41:291–294 (1992).
33. Philadelphia Department of Public Health. Childhood Lead Poisoning Prevention Program. Childhood Lead Poisoning Update. Fall 1997. Philadelphia, PA: Philadelphia Department of Public Health, 1997.
34. Campbell JR, Schaffer SJ, Szilagyi PG, O'Connor KG, Briss P, Weitzman M. Blood lead screening practices among US pediatricians. Pediatrics 98:372–377 (1996).
35. Ferguson SC, Lieu TA. Blood lead testing by pediatricians: practice, attitudes, and demographics. Am J Public Health 87:1349–1351 (1997).