MARY JEAN BROWN, SCD RN ■ EDMOND SHENASSA, SCD
THOMAS D. MATTÉ, MD MPH ■ SANDRA N. CATLIN, PHD

Children in Illinois with Elevated Blood Lead Levels, 1993–1998, and Lead-Related Pediatric Hospital Admissions in Illinois, 1993–1997

Dr. Brown is an Instructor, Department of Maternal Child Health, Harvard School of Public Health, Boston. Dr. Shenassa is an Epidemiologist, Center for Behavioral and Preventive Medicine, Brown University Medical School and Miriam Hospital, Providence, Rhode Island. Dr. Matté is a Medical Epidemiologist, Division of Environmental Hazards and Health Effects, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta. Dr. Catlin is an Assistant Professor, Department of Mathematical Sciences, University of Las Vegas, Nevada.

SYNOPSIS

Objective. This study uses screening and hospitalization data to describe the prevalence of childhood lead poisoning in Chicago and the rest of the state of Illinois.

Methods. The authors used aggregate data published by the Illinois Department of Public Health on blood lead testing of children ages 0–6 years and data on lead-related hospital admissions of children ages 0–6 years, drawn from an administrative dataset compiled as part of a state initiative.

Results. No clear time trends in the percentage of children with elevated blood lead levels (defined as >15 micrograms per deciliter [µg/dL] or >45 µg/dL) were evident in either Chicago or the rest of Illinois. The proportions of children with elevated blood lead levels in Chicago and in the rest of Illinois did not decline at the dramatic rate seen in the US as a whole during the 1990s. Over a five-year period, in-hospital charges of $7.7 million were generated for the care of lead-poisoned children ages 6–16 in Chicago alone.

Conclusion. Surveillance data, analyzed at the appropriate geographic level, can be used to focus resources on high-risk areas and to evaluate prevention efforts.

Address correspondence to:
Dr. Brown, Dept. of Maternal and Child Health, Harvard School of Public Health, 677 Huntington Ave., Boston, MA 02115; tel. 617-432-1080; fax 617-432-3755; e-mail <mbrown@hsph.harvard.edu>.

The influence of lead exposure on children's development and later success in the adult world is well understood.[1–4] Blood lead levels (BLLs) as low as 10 micrograms per deciliter (μg/dL) or lower have been shown to adversely affect the behavior and development of children.[5,6] [*Ed. note: See related article on pages 521-9.*]

The risk for lead poisoning is greatest among black children,[7] children living in poor, urban communities,[8] and children ages 18 to 36 months.[9] Paint, dust, and soil are the most common sources of lead exposure for US children.[10,11]

Geometric mean BLLs among children in the United States have fallen since the mid-1970s.[7,12,13] Between the time of the Second National Health and Nutrition Examination Survey (NHANES II), conducted in 1976–1980, and Phase 1 of NHANES III, conducted in 1988–1991, the proportion of children in the US with BLLs ≥10 μg/dL decreased from 88.2% to 8.9%, due in large part to the removal of lead from gasoline, a voluntary ban on lead solder in food cans, and other public health interventions. This public health success continued during the early 1990s. From 1991 to 1994, the geometric mean BLL for children ages 1 to 5 years fell from 3.6 μg/dL to 2.7 μg/dL.[12] The proportion of children with BLLs ≥15 μg/dL decreased from 2.7% of children ages 0–6 years in Phase 1 of NHANES III to 1.3% of children ages 0–6 years during the second phase, conducted in 1991–1994.[12] However, large disparities in exposure remain between high- and low-risk populations. Data from NHANES III Phase 2 revealed high rates of elevated BLLs (defined as BLLs ≥10 μg/dL) for children from low-income families, children living in older housing, children living in large metropolitan areas, and African American children.[12]

NHANES does not provide state or local estimates of rates of elevated BLLs. However, surveillance data collected by some state and local health departments suggest that there is considerable geographic variation in the proportion of children with elevated BLLs. In some areas, large numbers of children continue to be at high risk for exposure to leaded paint and lead paint–contaminated house dust and soil.[13]

We report here a cross-sectional analysis of the rates of elevated BLLs, defined as ≥15 μg/dL and ≥45 μg/dL, among children ages 0–6 years in Illinois for the years 1993–1998 and the rates of lead-related hospital admissions among children ages 0–6 years in Illinois for the years 1993–1997.

METHODS

The state of Illinois recommends testing of all 1- and 2-year-old children in specific high-risk ZIP Codes and requires evidence of a blood lead test for enrollment in day care or kindergarten. Since 1995, Illinois also requires that the results of all blood lead tests be reported to the Illinois Department of Public Health.

For the present study, we used aggregated data on blood lead testing of children ages 0–6 years from the annual surveillance reports published by the Illinois Department of Public Health for the years 1993–1998.[14–19] We estimated the proportions of children tested in Chicago and the rest of the state using population denominators from the 1990 US Census.[20]

To determine the proportions of children with elevated BLLs in Chicago and the rest of the state, we used two definitions of elevated BLLs: ≥15 μg/dL and ≥45 μg/dL. For children who had more than one blood lead test in a given year, we used the highest venous BLL measured in that year or, if there was no venous BLL recorded, the highest capillary BLL measured that year.

We abstracted information on 1993–1997 lead-related inpatient admissions of children ages 0–6 years to the 217 acute care hospitals in the state from administrative hospital admission data files compiled by the state of Illinois as part of a state initiative.[21] We defined lead-related admissions as those for which the International Classification of Disease (ICD-9-CM)[22] code 984.0, 984.1, 984.8, or 984.9 was listed as the primary admission diagnosis.

The admissions data were stripped of identifiers. Data abstracted included child's date of birth, ZIP Code, length of stay, total charges related to the admission, payer type, and ICD-9-CM code.

RESULTS

Results of screening. The proportions of children <7 years of age tested in Chicago ranged from a low of 33% to a high of 59% (see Table). The high rate of testing in 1993 most likely resulted from the many 4- and 5-year-olds tested that year, when the requirement for blood lead testing prior to entry into school or licensed day care was implemented. Testing rates were lower elsewhere in the state, but increased from a low of 5% in 1995 to ≥14% for each year from 1996 through 1998.

Each year, both the proportion of children ages 0–6 with BLLs ≥15 μg/dL and the proportion of children ages

Table. Children ages 0–6 years tested for blood lead and children ages 0–6 with BLLs ≥15 µg/dL and ≥45 µg/dL, Illinois, 1993–1998, by year, and hospital admissions for lead poisoning among children ages 0–6, Illinois, 1993–1997, by year

	Children tested for blood lead				Children with BLLs ≥15 µg/dL				Children with BLLs ≥45µg/dL				Number of pediatric admissions for lead poisoning	
	Chicago		Rest of state		Chicago		Rest of state		Chicago		Rest of state			
Year	Number	Percent[a]	Number	Percent[a]	Number	Percent[b]	Number	Percent[b]	Number	Percent[c]	Number	Percent[c]	Chicago	Rest of state
1993	175,731	59	100,231	11	19,410	11	3,658	4	378	0.2	50	0.1	212	38
1994	130,008	44	85,284	9	14,738	11	2,873	3	351	0.3	55	0.1	252	53
1995	99,097	33	49,242	5	11,675	10	2,271	5	288	0.2	39	0.1	216	16
1996	111,517	38	123,773	14	13,560	12	6,115	5	301	0.3	144	0.1	164	29
1997	111,217	38	133,876	15	12,847	12	5,750	4	346	0.3	114	0.1	155	25
1998	111,410	38	123,007	14	8,771	8	3,191	3	254	0.2	70	0.1	—	—

[a]Number of tested children <7 years old as a percentage of number of children <7 years old. Source of denominator data: Reference 14.
[b]Number of tested children <7 years old with BLLs ≥15 µg/dL as a percentage of number of tested children <7 years old.
[c]Number of tested children <7 years old with BLLs ≥45 µg/dL as a percentage of number of tested children <7 years old.

BLL = blood lead level
µg/dL = micrograms per deciliter

0–6 with BLLs ≥45 µg/dL were substantially higher in Chicago than in the rest of Illinois. No time trends in the proportions of children with elevated BLLs were evident in either Chicago or the state as a whole.

Ninety-four percent of the children in Chicago with BLLs ≥15 µg/dL and nearly 40% of those in the rest of Illinois lived in ZIP Codes designated by the state health department as high risk for childhood lead poisoning.

Hospital admissions. From 1993 through 1997, lead poisoning accounted for 1,160 hospital admissions among children ages 0–6 years in Illinois. Slightly more than half were among children <3 years old; slightly more than half of the children were male. Eighty-six percent (999) of the admissions were in Chicago. Chicago ZIP Codes in which the proportion of dwellings built before 1950 exceeded the national average of 27%[20] accounted for 43% of the city's children ages 0–6 years[20] but 99% of the hospitalizations for lead poisoning among children in that age range.

The average length of hospital stay was 5.7 days, and the average cost of an admission was $6,673. Over the five-year period, $7.7 million was spent on inpatient care of lead-poisoned children ages 0–6 years in Chicago alone. Medicaid paid for 67% of the admissions in Chicago and 53% of those in the rest of the state.

DISCUSSION

These findings suggest that the proportions of children living in Chicago and in the rest of Illinois with elevated BLLs, as defined in this study, did not decline at the dramatic rate seen in the United States as a whole during the 1990s. It is important to note that the use of national or even statewide prevalence estimates may mask important disparities in lead exposure rates and the effectiveness of efforts to reduce lead exposure. Because the distribution of childhood lead exposure varies widely in the US, it is essential that surveillance data be analyzed at the appropriate geographic level to give an accurate picture of the distribution of lead exposure.[23]

The number of children identified each year in Illinois with BLLs ≥45 µg/dL, a level generally agreed as high enough to require chelation therapy,[24] was considerable and showed no signs of declining from 1993 to 1998. While not all children receiving chelation therapy are hospitalized, the costs of inpatient care alone are

considerable. In addition, societal costs include lower lifetime earnings associated with cognitive impairment and limited educational attainment. These indirect costs have been conservatively estimated at $13,000 per child for an increase in BLL from 10 µg/dL to 20 µg/dL.[25] By comparison, the estimated median cost of controlling lead hazards in low-income housing was in the $4,001–$6,000 range for multi-family dwellings and in the $8,001–$10,000 range for single family detached homes in a grant program sponsored by the US Department of Housing and Urban Development (HUD).[26]

The proportion of children tested in Illinois who had BLLs ≥15 µg/dL was substantially higher than the estimated 1991–1994 national prevalence of 1.3%.[6] However, certain limitations of the Illinois blood lead surveillance data should be noted. First, prevalence data collected annually underestimate the proportion of children in the population who have ever had a blood lead elevation. Second, reported rates reflect testing patterns on the part of health care providers. Consistent with Centers for Disease Control and Prevention (CDC) guidelines,[24] blood lead testing in Illinois is recommended only for children 1 and 2 years old living in specific areas with high risks of exposure; however, other children may be tested because of individual risk factors, as identified by health care providers. Thus, testing is more likely for children with specific risk factors. As a result, our results may overestimate the prevalence of elevated BLLs in the general population.

Given that 94% of the children in Chicago with BLLs ≥15 µg/dL and nearly 40% of those in the rest of Illinois lived in ZIP Codes designated by the state health department as high risk for childhood lead poisoning, deteriorated leaded paint and lead-contaminated dust and soil likely explain much of the geographic variation observed in lead poisoning risk.

These data also provide convincing evidence that efforts to prevent childhood lead poisoning should be strengthened. CDC, along with HUD, the Environmental Protection Agency, and other federal agencies have developed a strategy to work with state and local agencies and the private sector to increase the number of homes where lead paint hazards have been controlled, to expand screening programs, and to provide additional services to children with elevated BLLs.[27] Blood lead surveillance data like that collected in Illinois can be used to target such efforts to communities and populations where the needs are greatest and to monitor progress toward reducing exposures.

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