Lead Testing of Children and Homes: Results of a National Telephone Survey

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SYNOPSIS

Objectives. This study was designed to estimate the percentage of young children in the United States who have been tested for lead and the percentage of dwellings in the United States in which the paint has been tested for lead.

Methods. A national random digit dial telephone survey of 5238 households was conducted in 1994. Weighted national estimates and 95% confidence intervals for outcomes of interest were calculated.

Results. About 24% of U.S. children ages 0 to 6 years were estimated to have been tested for lead. Higher rates of testing were reported for children living in homes constructed prior to 1960, those living in homes with low household income, those living in rental units, and those living in the Northeast. Lead paint testing was performed for only an estimated 9% of U.S. housing units. Older homes were not more likely to have been tested than newer ones.

Conclusion. A high proportion of pre-school children have apparently not been screened for lead exposure, even among subgroups at increased risk. Most dwellings of pre-school children have not been tested for lead paint. These data suggest that most at-risk children are not being reached by current approaches to lead poisoning prevention.

Childhood lead poisoning is a major public health problem in the United States. About 1.7 million children ages 1 through 5 have blood lead levels (BLLs) greater than or equal to 10 ug/dL, the current BLL of concern.[1] For most of these children, the source of lead exposure is believed to be in their home environments.[2]

The worst lead hazards in housing are found in homes built before 1960 (and in particular before 1950) since the highest concentrations of lead (up to 50%) are found in paint manufactured in the first half of the century. Paint with some lead added continued to be used in most parts of the United States until 1978, after which adding lead to paint was banned by the Consumer Product Safety Commission.[2] Lead hazards tend to be greatest in homes whose residents are of low socioeconomic status, in part because the paint in such homes is likely to be in poorer condition.

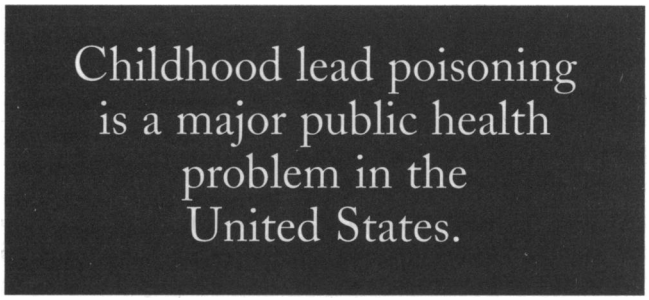
Currently, only limited data are available on the frequency with which homes are tested for lead or with which children are tested for lead poisoning.

This analysis was undertaken to determine the lead screening rates for U.S. children and homes.

Methods

To collect information on risk factors for and the occurrence of injuries (which will be reported on elsewhere), the National Center for Injury Prevention and Control conducted a random digit dial telephone survey from 28 April through 18 September 1994. We drew a random sample from a proprietary listing of all telephone exchanges in the 50 states and the District of Columbia that included two or more working numbers. At least six attempts were made to contact each number that was selected. (Details about the sampling procedure may be requested in writing from Dr. Sacks.)

Because injury risks differ by sex, we sought to ensure equal numbers of male and female respondents. Once a household was reached, we determined the number of men and women residents ages 18 and older. We randomly assigned one of the two gender categories to each household containing at least one adult man and one adult woman; if more than one adult belonged to the assigned gender category, we asked for the individual with the most recent birthday. If an English- or Spanish-speaking adult household member agreed to participate, he or she answered questions about the household, including the year the dwelling was constructed and total pretax household income, and about lead paint testing of the dwelling. After the respondent enumerated the age and sex of children under 7 in the household, he or she was asked whether each child had been tested for lead poisoning. In order to produce the most conservative estimates, we classified "don't know" responses to questions about testing as negative answers. "Don't know" responses were received for 7.1% of homes and 4.6% of children.



To derive national estimates, weights were used to adjust for unequal selection probabilities and nonresponse. Household weights are the product of a sampling weight and a ratio adjustment. The sampling weight is the inverse of the probability of selecting a particular household. The ratio adjustment scales up individual households or children to represent all similar individuals nationally. The ratio is the number of households in the March 1994 Current Population Survey (CPS) divided by the study estimates, by Census region and location in a metropolitan statistical area. Each child in the household was further ratio adjusted to reflect the March 1994 CPS estimates for the relevant age-sex-race group.

To account for the complex survey design, we used SUDAAN[3] to generate weighted estimates and 95% confidence intervals (CIs) for the U.S. population. SUDAAN makes appropriate adjustments to the estimated standard errors and accounts for intracluster correlations. We used the log-likelihood chi-square test in SUDAAN to assess independence between selected variables and childhood and household testing for lead. To produce adjusted estimates of variables associated with lead testing in bivariable analysis, we conducted logistic regression in SUDAAN. We used the adjusted Wald-F test to assess the importance of each variable in the model, after adjusting for other variables.

Results

Of 22,435 numbers attempted, 12,725 were working, residential numbers. Of these potentially valid numbers, 2182 were called six or more times with no response, 918 did not meet the eligibility criteria, and in 283 instances we were unable to reach the selected respondent, leaving 9342 eligible households. Twelve completed interviews were unusable because of technical problems. The survey resulted in 5238 completed usable interviews, which translates into a response rate of 56.1%, calculated as 5238 completed / (5238 completed + 3630 refusals + 462 breakoffs). Of these 5238 households, 1116 contained one or more children under the age of 7, for a total of 1626 children in this age group.

Of 1626 children ages 0 through 6 years, 395 were reported to have been tested for lead exposure, which we extrapolated to a U.S. estimate of 23.9% (see Table 1). Higher testing rates were reported for children residing in homes constructed prior to 1960, those living in rental units, those living in homes with low household income, and those living in the Northeast.

Of the respondents, 92.9% (4864) provided information about whether lead testing had been performed on the paint in their homes. Of these, 505 were reportedly tested for lead, which we extrapolated to 8.9% of homes in the United States. (See Table 2). Testing rates did not vary by age of home or total household income. Homes in the Northeast were most likely to have been tested, and homes in which children were living were more likely to have been tested than homes without children.

For 3.6% of the homes that had been tested, respondents said that they did not know the test results. Overall, 7.7% (CI 5% to 10.4%) of tested homes (which can be extrapolated to 662,337 homes nationwide) were reported to have tested positive for lead paint. Pre-1960 homes were reported to have tested positive for lead paint 14.1% of the time (CI 8.4% to 19.7%), in contrast to 5.7% (CI 1.3% to 10.1%) of homes built from 1960 to 1979 and 2.3% (CI 0 to 5.8%) of homes built in 1980 or later.

Table 1. Lead screening of children 0–6 years old: survey results and U.S. estimates, 1994

Characteristic	Number of children (sample)	Number of children screened (sample)	Weighted number of children screened	Weighted percent of children screened (95% CI)
Year home built				
Before 1960	501	153	2,498,250	29.4 (23.9,35.0)
1960–1979	427	94	1,812,108	23.4 (17.7,29.0)
1980 on	507	86	1,398,723	16.0 (11.8,20.2)
Unknown	191	62	929,246	33.9 (25.3,42.5)
Rental unit				
Yes	632	202	3,373,062	33.0 (27.9,38.0)
No	976	191	3,236,509	18.8 (15.5,22.2)
Household income				
<$20,000	445	159	2,571,187	35.3 (29.1,41.5)
$20,000–34,999	384	75	1,260,222	18.7 (13.6,23.7)
$35,000–49,999	257	53	885,571	20.2 (13.8,26.7)
$50,000 or more	414	75	1,310,231	18.0 (12.9,23.0)
Unknown	126	33	611,118	30.3 (18.0,42.5)
Census region				
Northeast	255	121	2,544,652	46.1 (37.9,54.3)
North Central	304	89	1,565,970	25.3 (19.1,31.6)
South	631	130	1,748,991	19.2 (15.3,23.1)
West	436	55	778,714	11.2 (7.4,15.1)
Total	1,626	395	6,638,327	23.9 (21.1,26.8)

NOTE: Numbers for a given characteristic may not sum to the sample or weighted total because of missing data or rounding.

Analysis of households with children under 7 years of age showed that children from homes that had been tested for lead paint were more likely to have been screened for lead poisoning. Of 160 homes that had been tested for lead paint, 80 (49.3%) were reported to include at least one child who had been screened for lead poisoning, while only 195 (21.0%) of the 888 homes that had not been tested were reported to include one or more children who had been tested ($P<0.01$). Among the homes with young children, of the 13 in which lead paint had been found, 10 (88%) had at least one child who had been screened for lead poisoning, while only 70 (45.3%) of the 147 homes for which paint testing results were negative had one or more children who had been tested ($P<0.05$).

Of 1626 children ages 0 through 6 years, 395 were reported to have been tested for lead exposure, which we extrapolated to a U.S. estimate of 23.9%.

Multivariable modeling confirmed regional differences in lead screening of children as well as higher frequencies of screening in children from the lowest income category and those living in rental units (Table 3). The presence of children in the household and location in the Northeast were the strongest adjusted predictors for testing of homes for lead paint (Table 3).

Discussion

Recent Federal guidelines and legislation have attempted to address the childhood lead poisoning problem in this country. In 1991, the Centers for Disease Control and Prevention recommended virtually universal blood lead testing of young children.[4] These guidelines suggest that screening start by 1 year of age (and at 6 months of age among high-risk children).[4] In 1992, Congress passed the Residential Lead-Based Paint Hazard Reduction Act, also known as Title X (P.L. 102-550). This legislation was designed to markedly increase the amount of testing for lead and reduction of lead hazards in housing. For example, Title X requires disclosure of potential lead hazards when homes are leased or sold and allows potential home buyers 10 days to arrange for an evaluation of lead hazards. We believe that such provisions will markedly increase the frequency of lead testing of housing units.

Despite recommendations for universal screening, our survey suggests that only about 24% of children ages 0–6

Table 2. Lead paint testing of homes: survey results and U.S. estimates, 1994

Characteristic	Number of homes (sample)	Number of homes tested (sample)	Weighted number of homes tested	Weighted percent of homes tested (95% CI)
Year home built				
Before 1960	1,851	187	3,127,283	9.1 (7.7,10.5)
1960–79	1,586	150	2,653,177	8.9 (7.3,10.4)
1980 or later	1,342	120	2,089,190	8.3 (6.7,9.9)
Unknown	459	48	729,763	9.7 (6.7,12.7)
Rental unit				
Yes	1,745	181	3,009,850	10.0 (8.4,11.5)
No	3,434	317	5,467,068	8.3 (7.3,9.3)
Household income				
<$20,000	1,317	147	2,443,057	10.2 (8.4,11.9)
$20,000–$34,999	1,123	109	1,790,232	8.5 (6.8,10.3)
$35,000–$49,999	864	80	1,471,964	8.9 (6.8,11.0)
$50,000 or more	1,278	114	1,949,471	8.4 (6.7,10.1)
Unknown	656	55	944,689	7.7 (5.5,10.0)
Census region				
Northeast	839	114	2,356,713	12.1 (9.8,14.5)
North Central	1,069	103	1,859,818	8.0 (6.3,9.6)
South	2,181	197	2,814,175	8.3 (7.1,9.6)
West	1,149	91	1,568,707	7.7 (6.0,9.4)
Presence of children in household[a]				
Child 0–6 years	1,116	160	2,668,563	13.0 (10.8,15.2)
Other age child	824	106	1,761,743	11.6 (9.3,14.0)
No child	3,271	235	4,116,956	6.8 (5.8,7.7)
Total	5,238	505	8,599,413	8.9 (8.0,9.7)

[a]Child age was unknown for 27 households, 4 of which were tested for lead paint.

NOTE: Numbers for a given characteristic may not sum to the sample or weighted total because of missing data or rounding.

years have been screened for lead. Even among children living in the highest risk, pre-1960 homes, only an estimated 29% have been screened. Although poverty is associated with a substantially increased risk of lead poisoning,[1] families with low incomes did not report testing their homes more frequently than other groups. Children in households with low income, however, were most likely to be tested, possibly because of government-supported programs that require or provide testing of low-income children. Families living in rental units (another risk factor for lead poisoning) were generally more likely to report having tested their children for lead poisoning although the housing they lived in was not more likely to be tested than owner-occupied homes. Children living in older, owner-occupied homes were also more likely to be tested. In the Northeast, where there is a long history of attention to childhood lead poisoning prevention and where several states have laws related to childhood lead poisoning, homes and children were reportedly tested more frequently than those in other parts of the country.

Recently, the recommendation to conduct universal blood lead screening of children has been questioned.[5,6] Although universal screening may not be appropriate for all populations, the data from this survey indicate that there are probably a substantial number of children with well-known risk factors who are not currently being tested.

Despite widespread publicity about childhood lead poisoning and its causes, our data show that only about 9% of homes have been tested for lead paint, including homes built when lead paint was most widely used. This percentage, however, may be an underestimate of the total percentage of homes that have had some kind of lead testing. Recently, there has been increased emphasis on identifying lead hazards (for example, high levels of lead in dust) rather than merely measuring paint lead levels.[7] (Lead paint that is intact and not on a chewable surface is not likely to constitute an immediate hazard for a child.) However, dust testing is not yet in widespread use, so its contribution to underestimation is likely to be minimal. The low rate of testing may also be related to its cost (around $50–150 per unit[7]), lack of awareness about lead hazards, or, in some communities, lack of personnel trained to conduct testing. It is also possible that some people, particularly those who rent their dwellings, may not be aware that their homes have been inspected. Nevertheless, our estimate that 8.9% of U.S. dwellings have undergone lead testing suggests a change from 1991, when less than 5% of dwellings had been tested.[8]

Respondents to our telephone survey reported positive lead results in 7.7% of homes tested; this figures is lower than

Table 3. Relationship between selected household characteristics and the likelihood of lead screening of children and homes, 1994

Characteristic[a]	Likelihood of child testing[b] OR[a] (95%CI)	Likelihood of home testing[c] OR[a] (95%CI)
Household income		
<$20,000	2.36 (1.33–4.17)	1.27 (0.91–1.78)
$20,000–34,999	0.98 (0.57–1.71)	1.02 (0.72–1.44)
$35,000–49,999	1.33 (0.74–2.40)	1.15 (0.80–1.65)
$50,000 or more	1.00 (referent)	1.00 (referent)
Region		
Northeast	6.94 (3.75–12.86)	1.76 (1.19–2.62)
North Central	2.87 (1.54–5.32)	1.06 (0.72–1.58)
South	1.93 (1.10–3.38)	1.29 (0.91–1.82)
West	1.00 (referent)	1.00 (referent)
Rental unit/year home built		
Yes Before 1960	1.89 (0.97–3.65)	1.10 (0.71–1.71)
1960–1979	3.20 (1.67–6.14)	1.64 (1.07–2.52)
1980 on	2.09 (0.98–4.44)	0.65 (0.38–1.11)
No Before 1960	2.11 (1.17–3.82)	1.06 (0.73–1.53)
1960–1979	1.05 (0.55–2.00)	0.92 (0.63–1.36)
1980 on	1.00 (referent)	1.00 (referent)
Children in the household		
Child ≤ 6 years	Not applicable	2.41 (1.82–3.20)
Child 7–14 years		2.22 (1.62–3.03)
No children		1.00 (referent)

[a]Odds ratios (ORs) are relative to the referent groups after adjusting for all other factors in the model. There was a significant interaction between the year the home was built and rental status, so the variables are presented combined.

[b]All variables significant at $p < 0.05$.

[c]All variables significant at $p < 0.05$ except for income group.

that reported in a national survey conducted in 1990.[2] For that study, multiple surfaces in each home were tested; 74% of homes built before 1980 were found to have some lead paint. Even though the methodologies differed—our survey used self-reported information and the 1990 survey reported on tests performed as part of the study—it is unclear why the discrepancies in the results should be so large.

Some differences in results may be related to other limitations of this survey. The response rate of 56% is relatively low for a telephone survey. Although a comparison of the respondent households with census data suggests that this survey includes a fairly representative cross-section of the U.S. population (J. Sacks, written communication, 1995), average socioeconomic status and educational attainment was higher than in the general population, as is true for most telephone surveys. The underrepresentation of lower socioeconomic status households is particularly problematic for this study because lead hazards tend to be greatest in low-income homes. In addition, because the data are self-reported and subject to recall problems, the information provided by respondents may have been inaccurate.

The elimination of childhood lead poisoning as a public health problem is an achievable goal.[9] Traditionally, childhood lead poisoning prevention has focused on secondary prevention—waiting until children become poisoned before identifying and remediating their sources of lead exposure. There is now general agreement that the preferred approach to childhood lead poisoning is primary prevention—eliminating lead hazards before children are poisoned. Successful primary prevention will require that identification and remediation of lead hazards in housing become routine and proactive. Although the extent of testing seems to have increased, the vast majority of homes have not been evaluated for the presence of lead in paint and have probably not been evaluated for the presence of lead hazards of any kind. This is of particular concern in older housing, where the risk of exposure to lead is likely to be greatest. Until testing for lead, particularly in high-risk housing, becomes a widely used strategy for childhood lead poisoning prevention, the screening of children themselves will remain critical.

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