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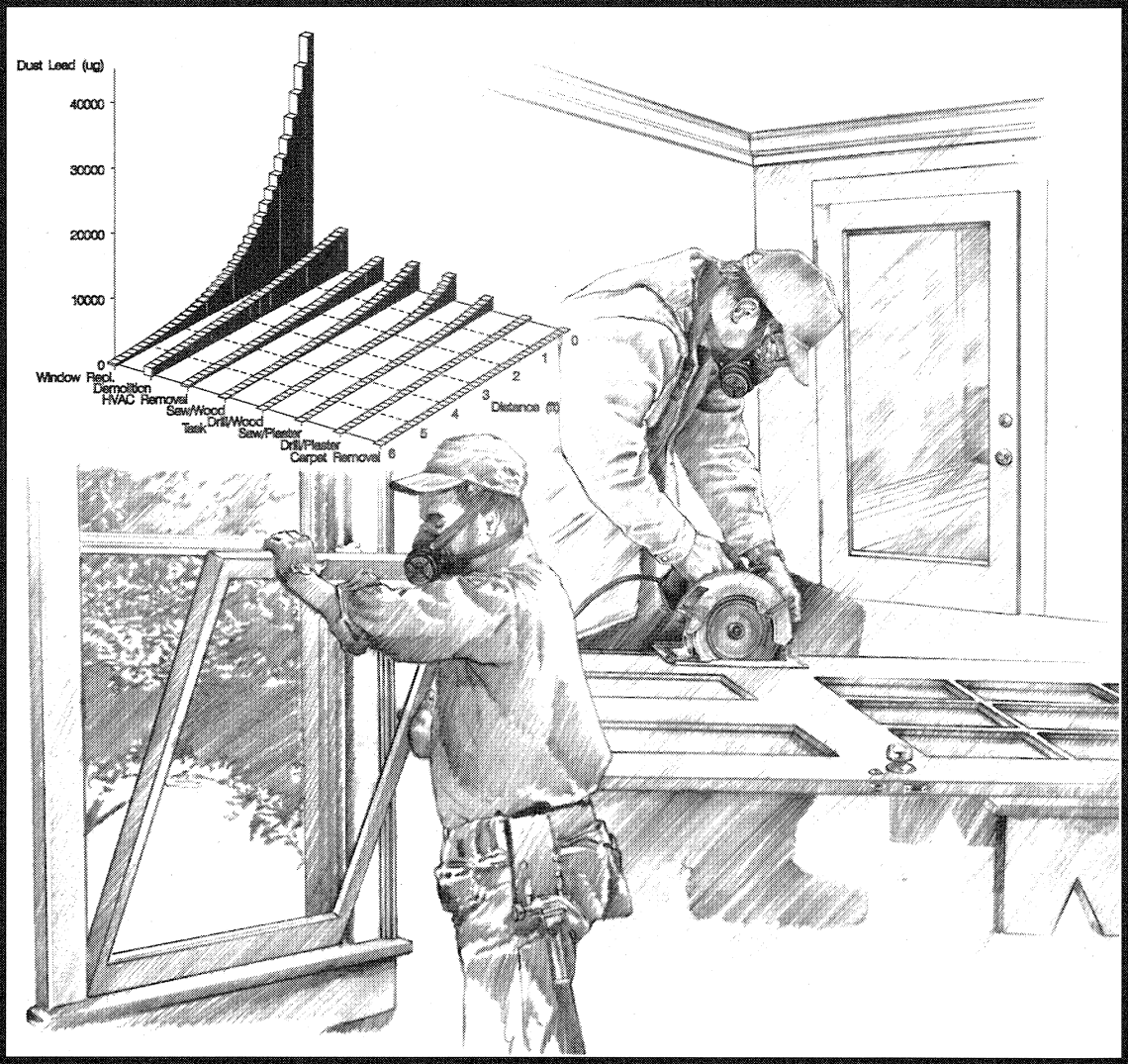
Lead Exposure Associated with Renovation and Remodeling Activities: Phase III

Wisconsin Childhood Blood-Lead Study



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LEAD EXPOSURE ASSOCIATED WITH RENOVATION AND REMODELING ACTIVITIES: PHASE III

WISCONSIN CHILDHOOD BLOOD-LEAD STUDY

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ACKNOWLEDGMENTS

Five institutions participated in designing and conducting the Wisconsin Childhood Blood-Lead Study. The State of Wisconsin Bureau of Public Health, in cooperation with the University of Wisconsin-Madison, conducted the retrospective study. Key personnel were Dr. Marty Kanarek (Principal Investigator) and Tiffany Taha of the Department of Preventive Medicine at the University of Wisconsin and Joe Schirmer of the State of Wisconsin. The University of Wisconsin-Madison was responsible for human subjects approval, preparing the database, and coordinating between the University and the State of Wisconsin. Dr. Kanarek designed the study and questionnaire and provided overall guidance. Joe Schirmer developed the initial questionnaire. Larry Hanrahan, Wisconsin Bureau of Public Health, helped design the study; and Barbara Haley, U.S. Department of Housing and Urban Development, helped develop the questionnaire.

Telephone interviews were conducted by the University of Wisconsin Extension Survey Research Lab. Lead personnel were Nancy Davenport and Stig Nelson. The Survey Research Lab was also responsible for quality assurance. Battelle assisted in designing the study and questionnaire, conducted the data analysis, and prepared this report. Drs. Nancy McMillan and Ron Menton were the key Battelle personnel involved.

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This report benefitted significantly from comments and suggestions provided by four peer reviewers. The reviewers were Mr. John Rogers (Westat) and Drs. Janie Gittleman (NIOSH), Bruce Lanphear (Children's Hospital Medical Center), and Dori Reissman (CDC).

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EXECUTIVE SUMMARY

Lead poisoning is considered a serious threat to health in the United States. Since the use of lead in gasoline has been phased out, exposure to lead is now primarily from lead-based paint, particularly for children and construction workers. Federal programs undertaken to mitigate exposure to lead-based paint have focused on deteriorated paint and methods of abatement. As a result, the potential for exposure of workers and building occupants to lead resulting from renovation and remodeling (R&R) conducted with no abatement intent has not been evaluated.

To address this potential, the United States Congress directed the U.S. Environmental Protection Agency (EPA) to

- Determine the extent to which persons engaged in various types of residential R&R activities are exposed to lead

- Determine the extent to which persons engaged in various types of R&R activities disturb lead and create a lead-based paint hazard (on a regular or occasional basis) to building occupants or other exposed individuals.

To meet these objectives, the EPA launched a series of studies in 1993 collectively known as the R&R study. The first of these studies was the Environmental Field Sampling Study (EFSS or Phase I). In this study, lead levels in settled dust and in breathing zone air resulting from a variety of R&R activities (window replacement, sanding, paint preparation, demolition, cutting painted wood, etc.) were measured. These lead measurements were assumed to indicate the potential for lead exposure to construction workers and to building occupants as a result of R&R activities.

The second study, the Worker Characterization and Blood-Lead Study (WCBS or Phase II), examined the relationship between the blood-lead concentrations of construction workers and their R&R activities, work habits, medical histories, hobbies, etc.

In general, the results of Phases I and II indicated that, for some R&R activities, airborne lead levels within workers' breathing zones often exceeded the Occupational Safety and Health Administration's permissible exposure limit, but the blood-lead concentrations of workers that regularly engage in these activities were not likely to be elevated (≥ 10 μg/dL). The implications for building occupants (especially children), however, were not as clear. The potential for exposure to occupants was characterized in the EFSS (Phase I) by measuring lead levels in dust that was generated by various R&R activities. The results of Phase I indicated that most R&R activities have a potential to disturb substantial amounts of lead and that occupants could be exposed to lead if appropriate containment and cleanup precautions are not employed. However, much uncertainty remained concerning the extent to which this potential for lead exposure translated to an actual internal dose for occupants (especially children).

Because children represent the population that is most likely to be sensitive to lead exposure from R&R activities, it became imperative that the EPA acquire additional data to assess the impact of residential R&R on children. Therefore, a third study, the Wisconsin

Childhood Blood-Lead Study was conducted to determine the impact of residential R&R on the blood-lead concentrations of children occupying the residences.

The Wisconsin Childhood Blood-Lead Study (Phase III) was a retrospective case-control study designed to systematically examine the association between R&R activities and elevated blood-lead (EBL) levels (≥ 10 µg/dL) among children. The primary objective of the study was to compare the incidence of R&R activities in the residences of children with EBLs to R&R activities in the residences of children without EBLs. Another objective of the study was to determine if specific R&R activities were more prevalent in households with an EBL child than in households with a non-EBL child. The study targeted children under the age of six who were included in the Wisconsin Bureau of Public Health's blood-lead registry. These children resided in communities other than Milwaukee and Racine and were screened between March 1996 and December 1996.

To meet these objectives, telephone interviews were conducted with the parents or guardians of 3,654 children under the age of six about R&R activities in their residences. Responses during the telephone interview, as well as the child's blood-lead concentration as recorded in the Wisconsin Bureau of Public Health's blood-lead registry, were used to assess whether R&R, in general, increases a child's risk of having an elevated blood-lead concentration. The telephone questionnaire and blood-lead information were also used to determine if specific R&R activities were associated with an increased risk of an elevated blood-lead concentration.

The questionnaire was designed to determine whether R&R activities such as inside painting, outside painting, carpet and floor repair or replacement, and other repairs (such as window repair) were conducted in the residences of the children in the study. Although it is difficult to generalize the information beyond the study population, the frequency of general and specific R&R activities in residences populated by young children is a valuable product of this study. While the main objective of this study was to investigate the relationship between incidences of R&R activities and EBL children, a dose-response type relationship, this information is most useful when the degree of exposure is also known. In this case, if a slight increase in risk due to childhood lead exposure as a result of R&R activity is detected, the implications are best considered in light of the numbers of children likely to be exposed.

Analysis of the exposure data related to these activities revealed that at least one R&R activity had been conducted in 67.2 percent of the residences in the previous 12 months. Inside painting occurred in 50 percent of residences and outside painting, carpet and floor repair or replacement, or other repairs occurred in 20 percent. Some form of surface preparation was involved in 42.3 percent of R&R activities. Approximately 65 percent of the outside painting involved surface preparation, compared to 15 percent to 30 percent for each of the other types of activities. Most surface preparation involved hand scraping or sanding. Heat guns were used 7 percent of the time, and chemical paint removers were used 13.6 percent of the time. Surface preparation for painting was usually performed by the owner of the residence, the building superintendent, or apartment staff, while preparation for carpet and floor repair or replacement or other repairs was usually performed by paid professional contractors.

Univariate and multivariate logistic regression models developed from the questionnaire and blood-lead data collected for this study were used to

1. Determine if the incidence of R&R in residences was associated with an increased risk of an EBL ($\geq$10 µg/dL).

2. Determine if *specific* R&R activities were associated with an increased risk of a child having an EBL.

The study demonstrated that residential R&R is associated with an increased risk of an EBL in children. The study also demonstrated that specific R&R activities are associated with an increase in the risk of an EBL in children. In particular, painting inside or outside, removing paint (using open flame torch, using heat guns, using chemical paint removers, and wet scraping\sanding), preparing surfaces by sanding or scraping, and living in a home when R&R work was done significantly increased the risk of EBLs. An EBL was more likely when a relative or friend not living in the household did the R&R work. In addition, the more rooms involved in the total R&R project, the more likely a child was to have an EBL. Any type of R&R work in the kitchen increased the odds of an EBL.

Overall, these results agree with those from earlier phases of the R&R Study — R&R activities that disturb lead-based paint increase the risk of exposure to occupants. For example, children living in a residence while R&R was conducted were 1.3 times more likely to have EBLs than children who did not live in a residence while R&R was conducted.

Further, the study has identified specific R&R activities and other conditions (such as age and type of residence) that are associated with increased risk to children as a result of lead exposure. This information can be used to develop regulations that focus on particular R&R activities (e.g., using a heat gun to remove paint), groups of persons (e.g., a household member other than the head of household or spouse) who perform the activities, and the other conditions (e.g., adult exposure, age of child) that significantly increase the risk to children. The results of this study concerning activities associated with increased risk (e.g., using a heat gun to remove paint) also can be combined with the worker profile results from Phase II to perform an overall assessment of the worker groups or situations where interventions are needed to reduce exposure from R&R.

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1.0 INTRODUCTION AND BACKGROUND

Lead poisoning is considered a serious threat to health in the United States. Since the use of lead in gasoline has been phased out, exposure to lead is now primarily from lead-based paint (CDC, 1991). To address the potential for this type of exposure, in 1992, the United States Congress enacted the Residential Lead-Based Paint Hazard Reduction Act (Public Law 102-550), which required the U.S. Environmental Protection Agency (EPA) to conduct a study of lead exposure associated with renovation and remodeling activities (R&R study). In particular, paragraph (2) of Section 402(c) states:

> *The Administrator shall conduct a study of the extent to which persons engaged in various types of renovation and remodeling activities in target housing, public buildings constructed before 1978, and commercial buildings are exposed to lead in the conduct of such activities or disturb lead and create a lead-based paint hazard on a regular or occasional basis.*

The overall objectives of the R&R study were to

- Determine the extent to which persons engaged in various types of residential R&R activities are exposed to lead
- Determine the extent to which persons engaged in various types of R&R activities disturb lead and create a lead-based paint hazard (on a regular or occasional basis) to building occupants or other exposed individuals.

To meet these objectives, a series of studies, known collectively as the R&R Study, was launched in 1993 by EPA:

- Phase I: The Environmental Field Sampling Study (EFSS). The EFSS was conducted to measure the airborne lead levels and lead levels in settled dust resulting from R&R activities (EPA, 1997a, and EPA, 1997b).
- Phase II: The Worker Characterization and Blood-Lead Study (WCBS). The WCBS was designed to collect questionnaire and blood-lead data that could be used to assess the relationship between R&R activities and lead exposure for the R&R workers conducting these activities (EPA, 1997a, and EPA, 1997c).

In Phase I, lead levels in settled dust and in breathing zone air that resulted from a variety of R&R activities (window replacement, sanding, paint preparation, demolition, cutting painted wood, etc.) were measured. These environmental lead measurements were assumed to indicate the potential for lead exposure to R&R workers and to building occupants resulting from R&R activities. In Phase II, the relationship between blood-lead levels among R&R workers and variables such as their work activities, work habits, medical histories, and hobbies, was examined.

In general, Phases I and II indicated that, for some R&R activities, airborne lead levels within workers' breathing zones often exceeded the Occupational Safety and Health Administration's permissible exposure limit, but worker blood-lead concentrations were not likely to be elevated. The implications for building occupants (especially children), however, were not as clear. The potential for exposure to occupants was characterized in Phase I by measuring lead levels in settled dust that was generated or released by various R&R activities. Phase I indicated that most R&R activities have the potential to disturb substantial amounts of lead to which occupants could be exposed if appropriate containment and cleanup precautions were not employed. However, much uncertainty remained concerning the extent to which this potential for lead exposure translated to an actual internal dose for occupants (especially children).

Because children represent the population that is most likely to be sensitive to lead exposure from R&R activities, it became imperative that the EPA acquire additional data to assess the impact of residential R&R on children. Therefore, a third study, the Wisconsin Childhood Blood-Lead Study was conducted to determine the impact of residential R&R on the blood-lead concentrations of children occupying the residences.

The Wisconsin Childhood Blood-Lead Study (Phase III) was designed to systematically examine the association between R&R activities and elevated blood-lead levels (EBL ≥ 10 µg/dL) among children. To overcome the major obstacles associated with collecting children's blood samples for a prospective study (problems with human subjects approval, parental permission, low participation rates, etc.), Phase III used the Wisconsin Bureau of Public Health's registry of children's blood-lead measurements.

The primary objective of the study was to compare the incidence of R&R activities in the residences of children with an EBL to incidence of R&R activities in the residences of those without an EBL. Furthermore, the study was designed to determine if specific R&R activities were more prevalent in residences of EBL children than in residences of children who did not have EBLs. To meet these objectives, telephone interviews were conducted with the parents or guardians of 3,654 EBL and non-EBL children about R&R activities in their residences. The study targeted children under the age of six who resided in communities other than Milwaukee and Racine and whose blood-lead concentrations were screened between March 1996 and December 1996.

1.1 PEER REVIEW

This report has benefitted significantly from comments and suggestions provided by four external peer reviewers. Each of the reviewers recommended publishing the report after minor revisions. Comments which had a significant impact on the report or which aid in interpreting the study results are discussed below.

In response to comments by a number of the reviewers, more details regarding the study design were provided. In particular, certain design decisions which placed limitations on the study results were emphasized. Because recall bias was a concern for several reviewers a table was added (Table 2-1) to summarize time delays between blood sampling and administration of

the questionnaire. The questionnaire used in this study was designed to facilitate recall, and therefore, minimize recall bias.

The requirement that all study participants have known medical assistance status is a limitation of this study that was noted by multiple reviewers. Prior to performing the study, it was hypothesized that the impact of R&R activities on EBLs may be different between the two medical assistance populations. If this hypothesis were true, separating these two populations would have been instrumental in determining the relationship between R&R activities and EBLs. Since the Wisconsin registry did not contain numbers of medical assistance and non-medical assistance children typical of Wisconsin in general, representativeness of the study data with respect to medical assistance status was not affected by this decision. The effect of medical assistance status on incidence of EBLs was accounted for by incorporation of the medical assistance status variable in a baseline model of EBL incidence prior to consideration of the effect of R&R activities. Thus, study results are believed to be applicable to both medical assistance and non-medical assistance populations. However, the limitation inherent in the decision to only include children with known medical assistance status is that a large number of children, possibly many with EBLs, were excluded from the study.

At the request of several reviewers, more detail on the Wisconsin blood-lead registry was provided. In particular, quality control during blood sample collection and analysis was an issue for the reviewers. Quality control of analysis is regulated by CLIA, the clinical laboratory improvement amendments of 1988. However, quality control of the sample collection is up to the sample collector. Several Wisconsin state organizations work with sample collectors to inform them of quality control issues that may arise.

In regard to the Wisconsin blood-lead registry, another issue of concern among the reviewers was how representative the registry is of the state population. A comparison of the racial distribution across the state (excluding Milwaukee and Racine counties) to the racial distribution selected for this study revealed that minorities are likely over represented in the registry. This finding does not limit the main study conclusions as exact representativeness of the data with respect to an explanatory variable is not essential for determination of the relationship between another explanatory variable (R&R activities) and a response (incidence of EBL).

Based on the comments of one reviewer, a new multivariate analysis of the study data was added to the report. This analysis demonstrates the impact of simultaneously considering many R&R activities to determine those most associated with increased odds of an EBL. Results from this analysis were very consistent with analyses considering R&R activities individually.

At least one reviewer was concerned that there appeared to be no difference in risk between R&R activities performed in pre- and post-1980 homes. Additional discussion of the statistical analysis used to determine this finding was added to the report to allay this concern. There are many possible reasons for this finding, including:

1. Age of residence was an interview reported variable, and, thus, may have been reported inaccurately for some homes.

2. Only the manufacturing of lead-based paint was banned in 1978. Residences may have been painted with old lead-based paint.

3. R&R activities in residences may increase risk due to childhood lead exposure by stirring up lead contaminated dust from sources other than lead-based paint.

EPA has established a public record for the peer review under administrative record AR-209. The record is available in the TSCA Nonconfidential Information Center, which is open from noon to 4 PM Monday through Friday, except legal holidays. The TSCA Nonconfidential Information Center is located in Room NE-B607, Northeast Mall, 401 M Street SW, Washington, D.C.

2.0 STUDY DESIGN

The Wisconsin Childhood Blood-Lead Study was a retrospective case-control study of the association between EBLs in children and the incidence of R&R activities in their residences. Blood-lead concentration data were obtained from screening data recorded in the Wisconsin Bureau of Public Health's blood-lead registry. A subset of children were selected from the registry for participation in the study based on several eligibility requirements (Section 2.1). All eligible children with a blood-lead concentration greater than or equal to 7 μg/dL were selected into the study. Random selection was used to select among the eligible children with blood-lead concentrations less than 7 μg/dL. Sample selection (Section 2.2) was a sequential process consisting of separate samples drawn monthly from screening data compiled between the months of March and December 1996. Information on R&R activities in participating children's residences was obtained by administering a questionnaire (Section 2.3) over the telephone. To the extent feasible, this study collected interview data as soon as possible once each month's blood screening data was available in the registry.

2.1 ELIGIBILITY REQUIREMENTS

The sampling frame consisted of children under the age of six who were screened for blood-lead concentrations from March 1996 to December 1996. Only one child per household was eligible for the study. All eligible children with a blood-lead concentration greater than or equal to 7 μg/dL were selected into the study. Random selection was used to select among the eligible children with blood-lead concentrations less than 7 μg/dL.

All the children selected were from communities outside Milwaukee and Racine. Children from these cities were omitted for two reasons. First, these cities have a higher incidence of lead poisoning compared to the state as a whole. This higher incidence of lead poisoning may be a result of a greater density of older, deteriorated housing, which would make it more difficult to isolate the effect of lead exposure from renovation activities on the children. Second, the health departments in these communities manage their data independently, which would have resulted in delays in contacting the families directly. In designing the study, it was hoped that the possibility of finding an effect on blood-lead concentrations resulting from R&R would be maximized by studying a large, non-inner city population.

In Wisconsin, blood-lead screening is mandatory for children receiving medical assistance (Medicaid) and voluntary for others. As a result, the proportion of families receiving medical assistance in the Wisconsin blood-lead registry may be higher than the proportion of such families in the state. Therefore, separate sampling frames were constructed for families on medical assistance and for families not on medical assistance. Known medical assistance status was required for inclusion of a child into the study.

2.2 SAMPLE SELECTION

Using screening data collected from March 1996 to December 1996, a sample was drawn from the Wisconsin blood-lead registry for each month. Monthly samples were selected approximately sequentially; i.e., the May sample was selected before the June sample. (Because

sample sizes achieved each month were smaller than anticipated, samples for the months of March and April were added to the study after the May and June samples were completed.) The sampling frame for each month contained all eligible children whose first blood-lead sample was collected in that month, and who did not have another household member already included in the study. When first blood-lead data were collected during the same month for more than one child in the same family, one child was randomly selected to be eligible for the study.

Initially, 100 percent sampling was conducted for cases (children with a blood-lead concentration greater than or equal to 10 μg/dL), and a random sample was drawn from the controls (children with a blood-lead concentration less than 10 μg/dL). For each sampling frame, however, the number of children with an EBL was smaller than expected. Therefore, the number of cases selected, even with complete sampling, was smaller than anticipated. To compensate for this, the study design was modified prior to selecting the August sample to include 100 percent sampling for children with a blood-lead concentration between 7 and 10 μg/dL. Thus, before the August sample was collected eligible children from the months of March through July with blood-lead concentrations between 7 and 10 μg/dL were added to the study.

Random selection of children with blood-lead concentration less than 7 μg/dL was performed separately for medical assistance and non-medical assistance children. Monthly samples for March though September targeted 450 children with blood-lead concentration less than 10 μg/dL from each group. Monthly samples for October through December targeted 250 children with blood-lead concentration less than 7 μg/dL from each group. Some months, one of the groups did not have enough children to meet the target. For that group, 100 percent sampling was performed.

Table 2-1 provides information regarding the monthly samples selected for this study. In Table 2-1 the month that each sample was selected is noted. To minimize the time between blood sampling and interview data collection, the sample drawn for each month was immediately sent to Survey Research Labs to begin telephone interviewing. On average, there was a 4-month delay between blood screening and administration of the questionnaire. In general, the lag time was smaller toward the end of the study. The change in numbers of low blood-lead concentration children targeted in the monthly sampling that occurred between September and October can be clearly seen in Table 2-1.

2.3 QUESTIONNAIRE DESIGN AND IMPLEMENTATION

The limited resources available to conduct this study in an area as geographically diverse as the State of Wisconsin precluded in-person interviews as a method for obtaining the questionnaire information. Further, to obtain information quickly (thus reducing the potential for recall bias), and to increase the participation rate, a telephone interview approach was adopted rather than a mail questionnaire. (Groves et al., 1988, discusses the advantages and disadvantages of telephone survey methods.)

Table 2-1. Sample Selection Summary

Month	Sample Selection Date	Number of Children Eligible	Children Selected		
			PbB<7 µg/dL	7 µg/dL≤PbB<10 µg/dL	PbB≥10 µg/dL
May	September 1996	1458	855	134	85
June	September 1996	1328	767	75	71
April	October 1996	1286	709	104	92
March	October 1996	1153	686	93	76
July	October 1996	1528	805	120	121
August	January 1997	1499	843	132	113
September	January 1997	1405	745	114	79
October	January 1997	1240	493	91	61
November	February 1997	1005	486	66	64
December	February 1997	914	474	63	41

With any survey requesting information on events that occurred in the past, one potential for bias is due to the inherent difficulty of recalling past activities. Activities conducted in the recent past are more easily recalled than activities conducted in the more distant past. Therefore, delays between blood-lead sampling and administering the questionnaire could bias results (i.e., R&R activities occurring further in the past may not be "remembered" or participants may provide less reliable information). As noted in the previous section, the time delay between blood-lead sampling and questionnaire administration was, on average, four months. The questionnaires used in this study were designed to facilitate recall and, therefore, minimize this source of bias. For example, in addition to asking participants when and for how long (hours or days) they performed an activity, the participants were also simply asked whether or not they performed that activity (easier questions to recall and therefore less prone to recall bias).

An attempt was made to contact by telephone the parent or guardian of each child selected for the study. Because phone numbers and addresses were missing for some children, it was not possible to contact a parent or guardian for each selected child. If the parent or guardian was contacted, a telephone questionnaire (see Appendix A) was administered. The telephone interview collected data on, among other things, specific R&R activities that may have been related to the child's blood-lead concentration. Table 2-2 summarizes the type of information elicited by the questionnaire.

The questionnaire was pretested using 13 respondents. The interviews averaged 13.4 minutes. As a result of the pretest, questions about the occupations and hobbies of adults in the household, eating habits, painting preparations, and painting done inside the home were added to the questionnaire, which was tested on an additional 32 people. Obtaining this additional information added an average of 4.6 minutes to the interview.

Most of the respondents in the study were interviewed in English; but, because a substantial number of Hmong and Spanish families were expected in the sample, the interview was translated into Hmong and Spanish to ensure consistent questioning. Interviews were conducted in Hmong with 103 families, or 2.8 percent of the interviewees, in Spanish with 44, or 1.2 percent of the interviewees, and in English with 3,508, or 96.0 percent of the interviewees.

Table 2-2. Summary of Questionnaire

Type of Information	Rationale
Child's Residence	Includes questions on age of dwelling, if buying or renting, and presence of peeling paint. This information may be related to child's blood-lead concentration.
Duration of Residence	Includes questions on whether child lived in current home longer than 12 months. This information was used to ensure that information regarding child's residence (i.e., age of residence) was accurate at time of blood collection.
R&R Activities	Includes questions about the conduct of specific R&R activities in the past 12 months, such as how was the work done, who did it, and where it was done. Targeted activities were interior painting, exterior painting, window repair, carpet removal, and wall repair.
Blood Sampling	Includes questions on how many and why blood samples were taken. This information was used to help ensure that blood-lead concentration was not reduced due to medical treatment.
Household Information	Includes questions on number of household residents, education attained by parent or guardian, and family dining habits. This information may be related to lead exposures.
Adult Occupations	Includes questions about occupations that may be confounded with lead exposures in the household.
Hobbies	Includes questions about hobbies that may be confounded with lead exposures in the household.
Income and Address	Includes questions on income and child's address. Income and neighborhood may be associated with child's blood-lead concentration.

2.4 STUDY LIMITATIONS

As with all studies, there are limitations associated with study design decisions. Limitations of this study include

1. Restriction to only registry children with known medical assistance status
2. Differential selection probabilities among the low blood-lead concentration children (<7 µg/dL) across the study months
3. Exclusion of Milwaukee and Racine children
4. Recall bias due to the time delay between blood-lead sampling and questionnaire administration
5. Exclusion of possible confounding variables from the questionnaire.

Each of the above limitations is due to the inevitable trade-off between the practical issues associated with implementing a study and the desire to obtain the best data possible.

The study was restricted to include only children with known medical assistance status because, prior to performing the study, it was hypothesized that the impact of R&R activities on EBLs may be different between the two medical assistance populations. If this hypothesis were true, separating these two populations would have been instrumental in determining the relationship between R&R activities and EBLs. Since the Wisconsin registry did not contain numbers of medical assistance and non-medical assistance children typical of Wisconsin in general (screening of medical assistance children is mandatory), representativeness of the study data with respect to medical assistance status was not affected by this decision. However, the limitation inherent in the decision to only include children with known medical assistance status is that a large number of children, possibly many with EBLs, were excluded from the study.

Differential selection probabilities among the low blood-lead concentration children (<7 μg/dL) across the study months adversely affects the ability to detect seasonality effects in the data. While this limitation is unfortunate, interviewing low blood-lead concentration children during the last months of the study was restricted to boost the number of EBLs in the study. Having only a small percentage of the study children in the elevated group reduces the power to detect the effect of R&R activities on the incidence of EBLs.

Exclusion of Milwaukee and Racine children from the study has the unfortunate side effect of reducing the number of EBL children eligible for the study. However, a number of practical concerns, as discussed in Section 2.1, dictated this decision.

As with any survey requesting information on events that occurred in the past, one potential for bias in the relationship between the conduct of R&R activities and children's blood-lead levels is due to inherent difficulties associated with recalling activities that occurred in the past. This limitation is described in Section 2.3.

The extensive telephone interview employed in this study required about 18 minutes per interview. A variety of information (adult occupations, hobbies, household information) was solicited during this interview in addition to the R&R activity data. However, other variables that affect the relationship between R&R activities and incidence of EBLs may not have been obtained. Possible candidates include use of traditional medicines or use of ceramics in cooking and serving food. These variables are particularly important among the Hmong and Spanish households surveyed.

In spite of the above limitations, this study provides valuable data for estimating the effect of R&R activities on the incidence of EBLs among a diverse population of children.

3.0 DATA SUMMARY AND STATISTICAL ANALYSIS

This study evaluated the impact of residential R&R on children's blood-lead concentrations by comparing the incidence of R&R activities in residences with an EBL child to R&R in residences with a non-EBL child. Specifically, analyses were conducted to

- Determine if the incidence of R&R activities in residences was associated with an increased risk of an EBL
- Determine if *specific* R&R activities were associated with an increased risk of a child having an EBL.

Based on the data collected, exposure of residents to R&R activities in study homes was also characterized. This information provides an assessment of the portion of residences affected by hazards due to R&R activities. This chapter contains a discussion of the data collected and characterization of exposure to R&R activities (Section 3.1), the potential problems with the data (Section 3.2), and the analysis of the data to determine the impact of R&R on the probability of an elevated blood-lead concentration in children (Section 3.3).[1]

The data, summarized in Section 3.1, includes information on 8,651 Wisconsin children residing outside of Milwaukee and Racine whose first blood-lead concentration measurement was collected (and recorded in the Wisconsin Bureau of Public Health's blood-lead registry) between March and December of 1996. Interview data was collected for approximately 42 percent (3,654) of these children and is reported in Section 3.1.

A number of data quality concerns, specifically quality control procedures used during the collection of blood-lead registry and interview data, are discussed (Section 3.2.1). Because nonresponse and sampling bias are of considerable concern when interview data are collected, nonresponse and sampling bias are also discussed (Section 3.2.2). Skin contamination was a concern in this study because the Wisconsin blood-lead registry consists primarily of measurements collected by the capillary method. Confirmatory venous blood-lead measurements (taken when a child's first blood-lead measurement is very high) indicated the possibility of skin contamination for four samples (Section 3.2.3).

Data collected in this study were analyzed using logistic regression, a statistical method used to explain the relationship between a dichotomous (yes/no) response variable and a suite of explanatory variables (McCullagh and Nelder, 1989). A number of social and demographic variables are known to be associated with elevated blood-lead concentrations (Bornschein et al., 1985; Brody et al., 1994; and Lanphear et al., 1996). Analysis were conducted to examine the impact of these variables prior to considering the effects due to R&R. A baseline logistic regression model was developed to explain the odds of an elevated blood-lead concentration as a function of such social and demographic variables as the child's age, the age of the residence,

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[1] Elevated blood-lead concentrations are defined as ≥10 μg/dL (CDC, 1994) and nonelevated blood-lead concentrations as less than 7 μg/dL.

and family income. R&R variables were then entered into this model and their statistical significance assessed. Conclusions on the magnitude and significance of particular R&R variables, calculated in this manner, are found in Section 3.3.2. Appendix B provides background information on logistic regression, including an explanation of why this method was used to analyze data from this study.[2]

3.1 DATA SUMMARY

Between March and December of 1996, the first blood-lead concentration measurements of approximately 50,000 children residing outside of Milwaukee and Racine were recorded in the Wisconsin Bureau of Public Health's blood-lead registry. Multiple blood-lead measurements were reported for some of these children, generally as confirmatory measurements when the first measurement was elevated. (See CDC, 1991, for childhood blood-lead screening recommendations.) A total of 8,651 of these children were selected to participate in this study. Interviews were conducted for 3,654 of the 8,651 children. Four children who were interviewed had blood-lead concentrations that were believed to be mistaken and were dropped from the study (see Section 3.2.3).

This study consists of data on the remaining 3,650 children. Some analyses presented in this report used the larger database consisting of all 8,651 children selected to the study. This larger database is referred to as the registry database. Analyses based on the registry database are clearly indicated.

3.1.1 Available Blood-Lead Concentration Data

The Wisconsin blood-lead registry contained data on the following variables:

- Medical assistance status (Medicaid)
- Race
- Gender
- Blood sample collection technique
- Month that first blood-lead sample was collected
- Age
- Blood-lead group (number of low, medium, and high observations)
- Blood-lead concentration.

The first nine and the last columns of Table 3-1 present a summary of the data available for each of these variables. Appendix A shows similar descriptive statistics for data resulting from the interview responses. In addition to counts of children by levels of demographic variables and blood-lead group, geometric means and geometric standard deviations are calculated by levels of demographic variables.

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[2] Since the individual observations were selected into the study based on blood-lead concentration, using blood-lead concentration as a response variable was not appropriate. Logistic regression of the categorical high/low blood-lead group variable is the appropriate analytical procedure.

Table 3-1. Summary Statistics for Medical Assistance, Race, Gender, Method of Blood Draw, Date Samples Collected, and Age of Child

		Number of Observations for Low (PbB<7 μg/dL), Medium (7≤PbB<10 μg/dL), and High (PbB≥10 μg/dL) Blood-Lead Concentration (n = 3650)			Blood-Lead Concentration				Log Odds Difference[1]			
					Geometric Mean		Geometric Standard Deviation					
	Response Category	Low (n = 2999)	Medium (n = 366)	High (n = 285)	Estimate	Confidence Interval[2]	Estimate	Confidence Interval[2]	Estimate	Standard Error	P-Value	Percent of Obs. With Censored Blood-Lead
Medical Assistance	Medical Assistance	1127	113	113	2.62	(2.40,2.85)	2.60	(2.41,2.80)				67.8%
	Other	1872	253	172	2.41	(2.24,2.59)	2.66	(2.50,2.83)	-0.09	0.13	0.4910	70.7%
Race	Caucasian	2368	276	203	2.43	(2.28,2.59)	2.63	(2.49,2.78)				70.5%
	African American	56	10	12	3.36	(2.48,4.55)	2.62	(1.99,3.46)	0.92*	0.33	0.0050	59.0%
	Asian	121	19	29	3.14	(2.47,3.99)	3.00	(2.41,3.73)	1.03*	0.22	0.0001	60.4%
	Native American	49	2	3	2.22	(1.37,3.60)	2.22	(1.50,3.28)	-0.34	0.60	0.5743	77.8%
	Unknown	405	59	38	2.67	(2.34,3.06)	2.43	(2.15,2.73)	0.09	0.18	0.6250	68.9%
Gender	Male	1506	181	170	2.51	(2.32,2.71)	2.73	(2.55,2.93)				68.8%
	Female	1481	183	114	2.47	(2.29,2.67)	2.53	(2.36,2.70)	-0.38*	0.13	0.0025	70.6%
	Unknown	12	2	1	3.51	(2.19,5.61)	1.90	(1.24,2.93)	-0.30	1.04	0.7713	60.0%
Blood Sample Collection Technique	Venous	2901	355	275	2.50	(2.36,2.64)	2.63	(2.50,2.76)	-0.07	0.34	0.8274	69.6%
	Capillary	98	11	10	2.22	(1.56,3.17)	2.91	(2.15,3.95)				71.4%
Month Blood Collected	March	337	34	28	2.77	(2.41,3.19)	2.40	(2.11,2.71)	0.13	0.63	0.8400	66.9%
	April	346	49	46	2.81	(2.42,3.26)	2.83	(2.47,3.24)	0.60	0.62	0.3342	63.9%
	May	427	57	33	2.60	(2.27,2.97)	2.44	(2.17,2.75)	0.05	0.62	0.9303	69.4%
	June	362	27	26	2.03	(1.66,2.48)	2.63	(2.23,3.10)	-0.02	0.63	0.9765	76.4%
	July	414	54	55	2.76	(2.41,3.16)	2.69	(2.38,3.04)	0.60	0.62	0.3322	65.8%
	August	403	49	36	2.23	(1.87,2.65)	2.75	(2.37,3.19)	0.20	0.62	0.7487	72.7%
	September	365	45	26	2.27	(1.91,2.71)	2.61	(2.25,3.03)	-0.03	0.63	0.9661	73.2%
	October	239	37	24	2.47	(2.03,3.01)	2.66	(2.24,3.16)	0.32	0.64	0.6183	70.0%
	November	65	3	8	2.49	(1.72,3.61)	2.46	(1.78,3.39)	0.52	0.71	0.4612	71.1%
	December	41	11	3	3.18	(2.31,4.37)	2.18	(1.63,2.92)				63.6%
Age	Less than 1 yr	362	29	31	2.01	(1.64,2.47)	2.81	(2.37,3.34)	-0.23	0.21	0.2949	75.4%
	1 year old	923	131	99	2.76	(2.52,3.02)	2.61	(2.41,2.82)				66.0%
	2-year old	435	48	51	2.62	(2.28,3.01)	2.64	(2.34,2.99)	0.09	0.18	0.6247	67.6%
	3-year old	418	69	46	2.90	(2.56,3.27)	2.47	(2.21,2.75)	0.03	0.19	0.8914	65.1%
	4-year old	420	44	38	2.40	(2.05,2.79)	2.59	(2.27,2.96)	-0.17	0.20	0.3942	71.3%
	5-year old	424	44	19	1.91	(1.56,2.33)	2.67	(2.27,3.14)	-0.87*	0.26	0.0007	78.0%
	6-year old	17	1	1	0.54	(0.02,12.2)	5.07	(0.64,40.0)	-0.60	1.03	0.5614	89.5%

Note: Shaded cells (and asterisk) indicate statistically significant results.

[1] The log odds difference compares the odds (and hence the risk) of a child having an EBL concentration between one category and a reference category within each variable. The reference groups in the table are the row with blanks in the log odds difference column. For example, the reference group for "Age" is "1 year old". A negative log odds difference indicates that the category has lower risk than the reference category, and vice versa for positive log odds difference. For example, a log odds difference of -0.87 indicates that 5-year olds have significantly lower risk than 1 year olds. See Appendix B for more details on log odds differences.

[2] The confidence intervals for the geometric mean and geometric standard deviations are calculated by constructing the approximate confidence interval (± 2 standard errors) for the logarithm of each statistic and then taking the exponential of the confidence bounds.

Geometric means and standard deviations are often used instead of their arithmetic counterparts when the data are known to have positive values and the upper limit of the values is unknown. The data in such cases are often assumed to follow a lognormal distribution, and the geometric mean and standard deviation are natural parameters for describing the distribution (in the same way the arithmetic mean and standard deviation are natural parameters for describing the normal (Gaussian) distribution). The use of the geometric measures to describe the distribution of blood-lead concentrations is common in the literature (e.g., Brody et al.,1994).

The geometric means and geometric standard deviations of blood-lead concentration reported in Table 3-1 (and Appendix A) were calculated using censored data techniques. Censored data techniques are useful when, for some observations, exact values are not reported. For example, when chemically analyzing a sample for some substance present only in trace amounts, the reported result can be less than the limit of detection (LOD). Thus, the only real information obtained from the analysis is that the value is less than the LOD. Such a data point is referred to as left censored. A right censored data point is one for which all that is known is that data point is above some value. Using censored data techniques allows inexactly reported data (i.e., values only known to be in some interval) to be appropriately considered.

According to the Wisconsin Bureau of Public Health, for many of the laboratories reporting blood-lead measurements to the state registry, 4 μg/dL is the limit of detection for blood-lead concentrations. Therefore, no blood-lead concentrations less than 4 μg/dL are in the registry, and blood-lead concentrations reported as 4 μg/dL were assumed to be some value less than or equal to 4 μg/dL (left censored at 4 μg/dL). The distribution of blood-lead concentrations was assumed to be lognormal, and the method of maximum likelihood was used to estimate the geometric means and geometric standard deviations. The assumption of lognormality can be a limitation of the censored data approach. However, a lognormal distribution has been extensively shown to be reasonable for blood-lead concentrations. Use of censored data techniques was critical because, the percent of blood-lead concentrations that were censored, listed in the last column of Table 3-1, generally is somewhere between 60 percent and 80 percent, except for cases when the number of observed blood-lead concentrations in the category is low (e.g., when "Age" = "6 years old").

Six blood-lead concentration measurements in the *study* database were greater than 40 μg/dL. (Eleven additional children in the *registry* database had first blood-lead concentrations >40 μg/dL.) All these samples were collected using the capillary technique, which can result in erroneous blood-lead measurements because of skin contamination (CDC, 1991). Follow-up measurements for each of the six children in the study database indicated that two had elevated blood-lead concentrations and four did not. The two observations for which follow-up blood-lead measurements indicated an elevated blood-lead concentration were treated as right censored at 40 μg/dL for estimating of the geometric means and geometric standard deviations. The four children for whom subsequent blood-lead measurements were <10 μg/dL were deleted from the study database. This is discussed in more detail in Section 3.2.3.

Geometric means and geometric standard deviations of blood-lead concentration based on data derived from this study should be considered with care. Because this study was a

retrospective study (children were differentially selected for the study based on their blood-lead concentrations), these values do not characterize blood-lead concentrations in Wisconsin or even in the registry. Every child from the Wisconsin blood-lead registry with an elevated blood-lead concentration was a candidate for the study, while only a fraction of the children with blood-lead concentrations <7 μg/dL were included. Thus, geometric mean blood-lead concentrations reported based on this study may be higher than those based on the full registry.

An adjustment was made to the study database before the data summaries presented in Appendix A were prepared or any statistical analysis begun. The adjustment was made to remove R&R activities that occurred *after* blood sampling.

For each type of R&R activity about which questions were asked (inside painting, outside painting, other repairs, and carpets and floors), the respondent was also asked when these activities began and ended. Because of the time delay between blood sampling and the interviews, some R&R activities that did not begin until after the blood sampling were included. Therefore, if the start date of an activity was after the blood sampling date, then that activity was treated as if it did not occur. For example, if the inside painting start date (Question 21) was after the blood sampling date, then the responses to questions 10 through 25 were changed to "no" or "missing" as appropriate in the study database. Many start dates were missing from the interview data. This was interpreted to mean that the R&R activity began before the blood sampling.

In 432 (of 3,654) cases, some R&R activity occurred after blood collection. However, 266 of these had either another R&R activity before blood collection or one with a missing start date. Thus, only 166 (432 minus 266) fewer children were considered to have had *any* exposure to R&R as a result of this filtering of R&R activity data.

For homes constructed after the 1978 ban on lead-based paint, R&R activities are not expected to disturb any lead. Thus, R&R activities in these residences may not impact lead exposures in the same manner as those conducted in pre-1980 homes. However, in this report, R&R activities in post-1980 residences were treated identically to R&R activities in pre-1980 homes. Some statistical analysis were performed attempting to identify differences in risk due to lead exposure between R&R activities performed in pre- versus post-1980 homes (see Section 3.3.2), but available data did not support the differences.

3.1.2 Characteristics of Sampled Children

Below are some key characteristics of children represented in the study database (n=3650):

- Blood-lead concentrations
  - — 82 percent of children had blood-lead concentrations ≤6 μg/dL (not elevated)
  - — 10 percent of children had blood-lead concentrations of 7, 8 or 9 μg/dL (not included)
  - — 8 percent of children had blood-lead concentrations ≥10 μg/dL (elevated).

- Blood sample collection technique
  — 97 percent of blood samples were collected via the capillary technique (which sometimes results in skin contamination).

- Medical assistance status
  — 37 percent of children received medical assistance.

- Race
  — 78 percent of children were Caucasian.

- Year residence built
  — 25 percent of children lived in residences built after 1978 (R&R activities in these homes should result in lower lead exposure).

- Tenure at current residence
  — 22 percent of children lived in their current residences less than 1 year.

- Peeling paint
  — <4 percent of children resided in residences with "a lot of peeling paint"[3] (inside)
  — <8 percent of children resided in residences with "a lot of peeling paint"[3] (outside).

- Prevalence of R&R activities
  — in >40 percent of homes some interior painting occurred within the last 12 months; and, in most cases (nearly 90 percent), it was done by someone living at the home
  — in 12 percent of homes some exterior painting occurred within the last 12 months
  — in 22 percent of homes windows were repaired or new windows were installed
  — in 22 percent of homes carpets were repaired or replaced.

- Child's age at blood sample collection
  — 12 percent of children were less than 1 year old
  — 32 percent of children were 1 year old
  — 15 percent of children were 2 years old
  — 15 percent of children were 3 years old
  — 14 percent of children were 4 years old
  — 13 percent of children were 5 years old
  — <0.5 percent of children were 6 years old.

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[3] Because the definitions of lead-based paint hazards in the HUD guidelines (HUD, 1995) or the §403 Risk Analysis (EPA, 1997) were too complicated for use during a telephone interview, "a lot of peeling paint" was the terminology used in the questionnaire. See, for example, Question 6 in Appendix A.

- Occupational or hobby related exposure
  - — 31 percent of study children may have been exposed to lead as a result of the occupation of a household member
  - — 43 percent may have been exposed to lead as a result of a hobby of a household member.

- Household income
  - — 43 percent of children lived in households with annual incomes above $30,000
  - — 57 percent of children lived in households with annual incomes below $30,000.

- Respondents education (most respondents were female)
  - — 52 percent of respondents had a high school education or less
  - — 33 percent of respondents had some education beyond high school
  - — 16 percent of respondents were college graduates.

Because of the extended period (March to December) over which the blood samples of children in this study were collected, blood-lead concentrations were examined to assess possible seasonality. Previous work (EPA, 1995, and EPA, 1996) has indicated that there is a tendency for children's blood-lead concentrations to be higher in the summer (warmer months) and lower in the winter (colder months), possibly due to different activity patterns. Because longitudinal blood-lead concentration data for individual children included in this study were not available, blood-lead concentration trends were examined at an aggregate level. Figure 3-1 presents the geometric mean blood-lead concentration in the registry database plotted as a function of sample collection month with pointwise confidence intervals. Blood-lead concentrations appear to be lower in the summer than the winter, which is inconsistent with previously reported work (EPA, 1995, and EPA, 1996). However, since the confidence intervals suggest that any evidence of a seasonal trend in the blood-lead concentrations of children in the study is fairly weak, this effect was not pursued further. Additionally, fewer nonelevated blood-lead concentration children were sampled in October, November, and December, likely leading to the slight increase in blood-lead concentrations observed in the data for those months.

3.1.3 R&R Exposure Characterization

Information on the frequency of general and specific R&R activities in residences populated by young children is a valuable product of this study. While the main objective of this study was to investigate the relationship between incidences of R&R activities and EBL children (a dose-response type relationship), this information is most useful when the degree of exposure is also known. In this case, if a slight increase in risk due to childhood lead exposure as a result of R&R activity is detected, the implications must be considered in light of the numbers of children likely to be exposed.

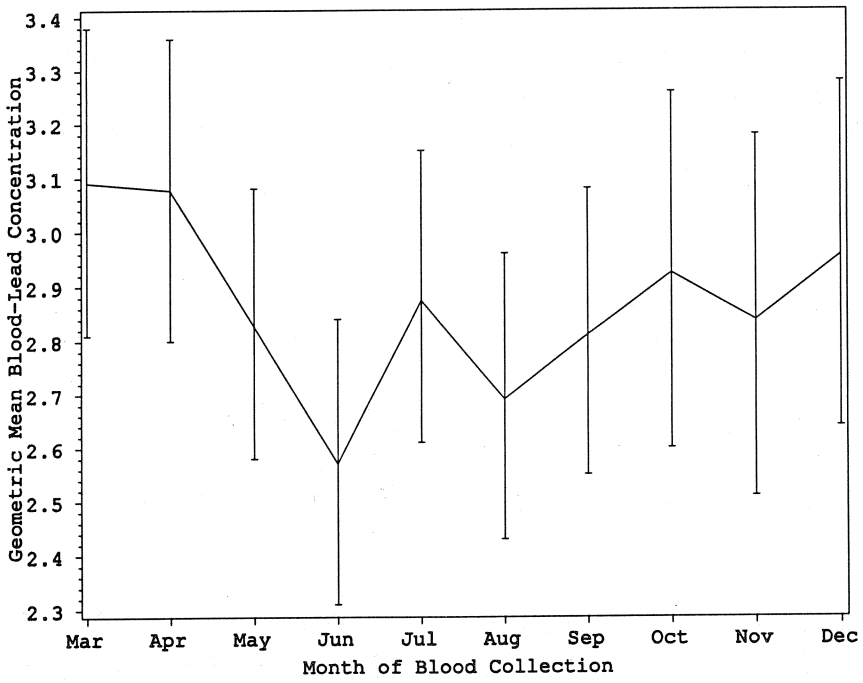

Figure 3-1. Trend Plot to Assess the Seasonality of Blood-Lead Concentrations in the Registry Database

Tables 3-2 and 3-3 list the frequencies and percentages summarizing the responses to each question in the R&R activities portion of the questionnaire (Questions 10 through 71 in Appendix A). The R&R activities portion is subdivided into four parts, with each part relating to one of four distinct types of R&R activities that may increase lead contamination in homes: "inside painting," "outside painting," "other repairs (windows)," and "carpets and floors (repair or replacement)." An examination of the questionnaire shows that each of the four parts contains a set of similar questions concerning details common to all four types of R&R activity, such as the method of surface preparation carried out for the activity. The first column in Table 3-2 lists these questions, accompanied by the question numbers identifying the four interview questions related to each type of activity (i.e., inside painting, outside painting, other repairs, carpets and floors). The question numbers are in the same order as the activities listed in the columns (e.g., Q19 related to using chemical paint removers for inside painting). The remaining questions from the R&R activities portion of the questionnaire are unique to only one of the four activities and can be found in the first column of Tables 3-3a (inside painting), 3-3b (other repairs), and 3-3c (carpets and floors) with their respective question numbers.

Table 3-2. R&R Activity Exposure Summary

Question	Response	R&R Activity (n=3654)									
		Inside Painting		Outside Painting		Other Repairs (Windows)		Carpets and Floors (Repair or Replacement)		Any R&R Activity	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Was the R&R activity carried out in the last 12 months? Q10, Q28, Q39, Q54	Yes	1858	50.8%	703	19.2%	805	22.0%	816	22.3%	2456	67.2%
	No	1786	48.9%	2924	80.0%	2839	77.7%	2825	77.3%	1179	32.3%
	Don't Know	10	0.3%	27	0.7%	10	0.3%	13	0.4%	19	0.5%
Was the surface prepared by methods such as sanding or scraping? Q13, Q29, Q43 ,Q57	Yes	541	29.1%	445	63.3%	125	15.5%	206	25.2%	1038	42.3%
	No	1241	66.8%	225	32.0%	630	78.3%	537	65.8%	1274	51.9%
	Don't Know	76	4.1%	33	4.7%	50	6.2%	73	8.9%	144	5.9%
Was hand scraping or hand sanding used? Q14, Q30, Q44, Q58	Yes	482	89.1%	413	92.8%	114	91.2%	163	79.1%	937	90.3%
	No	42	7.8%	22	4.9%	9	7.2%	35	17.0%	72	6.9%
	Don't Know	17	3.1%	10	2.2%	2	1.6%	8	3.9%	29	2.8%
Was power sanding, grinding or sandblasting used? Q15, Q31, Q45, Q59	Yes	166	30.7%	64	14.4%	33	26.4%	64	31.1%	288	27.7%
	No	356	65.8%	359	80.7%	89	71.2%	133	64.6%	705	67.9%
	Don't Know	19	3.5%	22	4.9%	3	2.4%	9	4.4%	45	4.3%
Was an open flame torch used? Q16, Q32, Q47, Q60	Yes	6	1.1%	5	1.1%	2	1.6%	1	0.5%	11	1.1%
	No	519	95.9%	427	96.0%	120	96.0%	196	95.1%	991	95.5%
	Don't Know	16	3.0%	13	2.9%	3	2.4%	9	4.4%	36	3.5%
Were heat guns used? Q17, Q33, Q48, Q61	Yes	44	8.1%	24	5.4%	11	8.8%	5	2.4%	73	7.0%
	No	476	88.0%	402	90.3%	111	88.8%	190	92.2%	917	88.3%
	Don't Know	21	3.9%	19	4.3%	3	2.4%	11	5.3%	48	4.6%
Was washing, wet scraping, wet sanding or water blasting used? Q18, Q34, Q49, Q62	Yes	160	29.6%	111	24.9%	33	26.4%	38	18.4%	292	28.1%
	No	352	65.1%	310	69.7%	89	71.2%	158	76.7%	687	66.2%
	Don't Know	29	5.4%	24	5.4%	3	2.4%	10	4.9%	59	5.7%

Table 3-2. (Continued)

Question	Response	R&R Activity									
		Inside Painting		Outside Painting		Other Repairs (Windows)		Carpets and Floors (Repair or Replacement)		Any R&R Activity	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Were chemical paint removers used? Q19, Q35, Q50, Q63	Yes	96	17.7%	24	5.4%	14	11.2%	28	13.6%	141	13.6%
	No	428	79.1%	389	87.4%	107	85.6%	167	81.1%	841	81.0%
	Don't Know	17	3.1%	32	7.2%	4	3.2%	11	5.3%	56	5.4%
Who did the work? (Head or Spouse) Q20-1, Q36-1, Q51-1, Q64-1	Yes	421	77.8%	305	68.5%	93	74.4%	139	67.5%	762	73.4%
	No	119	22.0%	135	30.3%	31	24.8%	65	31.6%	267	25.7%
	Don't Know	1	0.2%	5	1.1%	1	0.8%	2	1.0%	9	0.9%
Who did the work? (Other Person in Household) Q20-2, Q36-2, Q51-2, Q64-2	Yes	76	14.0%	36	8.1%	6	4.8%	30	14.6%	121	11.7%
	No	464	85.8%	404	90.8%	118	94.4%	174	84.5%	908	87.5%
	Don't Know	1	0.2%	5	1.1%	1	0.8%	2	1.0%	9	0.9%
Who did the work? (Relative/Friend Not in Household) Q20-3, Q36-3, Q51-3, Q64-3	Yes	67	12.4%	29	6.5%	12	9.6%	23	11.2%	112	10.8%
	No	473	87.4%	411	92.4%	112	89.6%	181	87.9%	917	88.3%
	Don't Know	1	0.2%	5	1.1%	1	0.8%	2	1.0%	9	0.9%
Who did the work? (Owner, Building Superintendent, Apt. Staff) Q20-4, Q36-4, Q51-4, Q64-4	Yes	54	10.0%	73	16.4%	5	4.0%	14	6.8%	130	12.5%
	No	486	89.8%	367	82.5%	119	95.2%	190	92.2%	900	86.7%
	Don't Know	1	0.2%	5	1.1%	1	0.8%	2	1.0%	8	0.8%
Who did the work? (Paid Professional Contractor) Q20-5, Q36-5, Q51-5, Q64-5	Yes	51	9.4%	53	11.9%	24	19.2%	45	21.8%	155	14.9%
	No	489	90.4%	387	87.0%	100	80.0%	159	77.2%	874	84.2%
	Don't Know	1	0.2%	5	1.1%	1	0.8%	2	1.0%	9	0.9%
Did anyone in household live at home while work was being done? Q22, Q38, Q53, Q66	Yes	458	84.7%	423	95.1%	115	92.0%	155	75.2%	918	88.4%
	No	83	15.3%	22	4.9%	10	8.0%	51	24.8%	120	11.6%
	Don't Know	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Table 3-3a. Inside Painting Specific Exposure Summary

Inside Painting (n = 3654)			
Question	**Response**	**Frequency**	**Percent**
Was the R&R activity carried out in the last 12 months? Q10	Yes	1858	50.8%
	No	1786	48.9%
	Don't Know	10	0.3%
Was any work done to repair broken plaster or damaged walls in the room/rooms you painted in the last 12 months? Q11		1	
	Yes	1005	27.5%
	No	2636	72.2%
	Don't Know	12	0.3%
Was any work done where old walls were taken down or moved, while working in your home? Q12	Yes	395	10.8%
	No	3252	89.0%
	Don't Know	7	0.2%
Was the surface prepared by methods such as sanding or scraping? Q13 ('Yes' to Q10)	Yes	541	29.1%
	No	1241	66.8%
	Don't Know	76	4.1%
In how many rooms in your home was this work done? Q23 ('Yes' to Q13)		8	.
	None	1	0.2%
	1	205	38.5%
	2	119	22.3%
	3	67	12.6%
	4	141	26.5%
Was any work done in the kitchen? Q24 ('Yes' to Q13)	Yes	222	41.0%
	No	318	58.8%
	Don't Know	1	0.2%
Was any work done in the bathroom? Q25 ('Yes' to Q13)	Yes	239	44.2%
	No	301	55.6%
	Don't Know	1	0.2%

Table 3-3b. Other Repairs (Windows) Specific Exposure Summary

Other Repairs (Windows) (n = 3654)			
Question	**Response**	**Frequency**	**Percent**
Was the R&R activity carried out in the last 12 months? Q39	Yes	805	22.0%
	No	2839	77.7%
	Don't Know	10	0.3%
Was any work done to repair broken plaster or damaged walls while repairing or putting in the windows? Q40 ('Yes' to Q39)		1	
	Yes	153	19.0%
	No	637	79.2%
	Don't Know	14	1.7%
Was any work done where old walls were taken down or moved while repairing or putting in the windows? Q41 ('Yes' to Q39)	Yes	109	13.5%
	No	691	85.8%
	Don't Know	5	0.6%
Was there any painting or were any surfaces prepared for paint with the installation of the new windows? Q42 ('Yes' to Q39)	Yes	235	29.2%
	No	561	69.7%
	Don't Know	9	1.1%

Table 3-3c. Carpets and Floors (Repair or Replacement) Specific Exposure Summary

Carpets and Floors (Repair or Replacement) (n = 3654)			
Question	**Response**	**Frequency**	**Percent**
Was the R&R activity carried out in the last 12 months? Q39	Yes	816	22.3%
	No	2825	77.3%
	Don't Know	13	0.4%
As a result of the work that was done in your home, were dust and dirt spread to .... ? Q71		1206	
	Only in the Work Area	903	36.9%
	In the Room next to the Work	264	10.8%
	Through the House	335	13.7%
	No Dirt or Dust Generated	857	35.0%
	Don't Know	89	3.6%
Do you have any wall-to-wall carpeting in your home? Q55 ('Yes' to Q54)	Yes	639	78.3%
	No	176	21.6%
	Don't Know	1	0.1%
Did you replace or remove a wall-to-wall or other large carpet in the last 12 months? Q56 ('Yes' to Q54)	Yes	543	66.5%
	No	269	33.0%
	Don't Know	4	0.5%

The complexity of the tables reflect the complexity of the skip patterns used in the questionnaire. To illustrate how the setup in Table 3-2 works, take as an example the first row (which is subdivided further into three subrows in all except the first column) and find the number "703" in the fifth column of the first subrow. The first level label for the column is "Frequency" and the second level label is "Outside Painting." The first column labeled "Question" for that entry contains the question "Was the R&R activity carried out in the last 12 months?" and the second column labeled "Response" contains the response "Yes." Therefore, "703" is the frequency of people who responded "Yes" to the R&R question that asked whether any painting outside the house was carried out within the last 12 months. To pinpoint the actual question in the questionnaire, go back to the first column, where four question numbers ("Q10, Q28, Q39, Q54") are listed in the same order of R&R activity type as the columns. Since "Outside Painting" is the second R&R activity type in the columns, the question of whether any painting outside the house was carried out within the last 12 months was asked in Question 28. The percentage "19.2%" in the column to the right of "703" refers to the same 703 who answered "Yes" out of the 3,654 (which equals 703+2924 +27, the sum of the frequency of all possible responses in the first row) who responded to Question 28.

The numbers in the last two columns of Table 3-2, however, are slightly different from the others, in that they summarize the responses across the four types of activities using an amalgamation of the responses. Take again, for example, the first rows. If a respondent answered "Yes" to any of Q10, Q28, Q39 or Q54, then the amalgamated response was set to "Yes." If a respondent answered "No" to all of Q10, Q28, Q39 or Q54, then it was set to "No." Otherwise, the response was set to "Don't know." This amalgamation can be interpreted as a response to the question "Was **any R&R activity** carried out in the last 12 months?," hence the label "Any R&R Activity" in the second level of the column labels.

The double lines between some rows of Table 3-2 take into account the skip patterns in the questionnaire, where only those respondents who answered "Yes" to a question above the double line were allowed to answer the questions below the double line. For example, the second and fourth rows are separated by a double line. Only those 541 people who were responded "Yes" to Question 13 were asked to respond to Question 15 (notice that 541=166+356+19). Hence, the percentages below the double lines are conditional on answers to previous questions. For example, the percentage of people who responded "Yes" to Question 15 is 30.7 percent (166/541).

Table 3-2 reveals the pattern of R&R activities for study participants. Based on all participants, at least one of the four R&R activities had been conducted in 67.2 percent of the residences in the last 12 months, with around 50 percent conducting some inside painting and approximately 20 percent each conducting outside painting, other repairs, and carpets and floors (repair or replacement) (row 1). Of the 2,456 houses where at least one of the four R&R activities was carried out, some form of surface preparation (row 2) was performed in 42.3 percent. Approximately 65 percent of outside painting involved some surface preparation, compared to 15 percent to 30 percent for each of the other activities. This difference is not too surprising since outside painting tends to require more paint removal than the other activities. As for the type of surface preparation techniques employed, the conditional percentages do not vary much within the rows (rows 3 to 8). Therefore, if any surface preparation was carried out, the

type of R&R activity does not appear to affect the surface preparation technique used for the activity. Most surface preparation involved some sort of hand scraping or hand sanding (80 percent to 90 percent), whereas the use of open flame torches was rare (1 percent to 2 percent). Heat guns were used 7 percent of the time, and chemical paint remover was used 13.6 percent of the time.

The conditional percentages for the type of individual who carried out the surface preparation also did not change much within the rows; although owner, building superintendent, and apartment staff were more likely to have been involved in any surface preparation for inside or outside painting, whereas paid professional contractors were more likely to have been involved in the other two R&R activities, which tend to require more skilled labor (rows 9 to 13). The head of household or spouse was involved in surface preparation work approximately 70 percent of the time, whereas others were involved 10 percent to 15 percent of the time.

Finally, some person was usually living at the home while surface preparation work was being done. The percentages for inside painting and carpets and floors (repair or replacement), which occurred inside the house, were lower than the percentages for outside painting and other repairs (window), which involved more outside work (row 14).

Tables 3-3a (inside painting), 3-3b (other repairs), and 3-3c (carpets and floors) contain similar statistics for the questions unique to each R&R activity. Additional nonunique questions from Table 3-2 are duplicated in some rows so that Tables 3-3a through 3-3c are set up similarly to Table 3-2. The double lines separate the questions into components as before, where participants were required to respond to a question in a component only if they gave a "Yes" response to a particular question in the previous component. The parentheses next to the question number contain the particular response and interview question. Note, for example, that the frequencies in row 4 of Table 3-3a, where the question was responded to only by those individuals who answered "Yes" to Question 10, add up to the frequency of "Yes" responses in row 1 (541 + 1241 + 76 = 1858).

Table 3-3a shows that very little of the painting activities required any nonsurface preparation activities such as repairs to broken plaster or damaged walls (row 2) and taking down or moving walls (row 3). In the homes where surface preparation was carried out for inside painting, most were jobs involving one to three rooms, with just over a quarter involving more (row 5). The results from Table 3-3b indicate that in homes where windows were either repaired or replaced, broken plaster or walls were repaired 19 percent of the time (row 2), walls were taken down or moved 13.5 percent of the time (row 3), and painting or surface preparation for painting was carried out 29.2 percent of the time (row 4). Finally, of the homes where carpets and floors were repaired or replaced, 78.3 percent had wall-to-wall carpeting and 66.5 percent had wall-to-wall or other large carpet replaced or removed (rows 3 and 4 in Table 3-3c).

3.2 DATA QUALITY

Data from two sources are analyzed in this report: blood-lead registry data from Wisconsin children outside of Milwaukee and Racine and interview data collected specifically for this study from a subset of these same children. The blood-lead registry data reflect a

continuing problem with reporting race and ethnicity in Wisconsin. (Ethnicity data are not analyzed in this report due to these problems.) For example, of the 3,650 children in this study, ethnicity was unknown for 97 percent of children. Medical assistance status was also unknown for a portion of the children in the registry. This is not reflected in Table 3.1 because one of the criteria for a child being in this study was known medical assistance status. (This variable was used in the study design. See Section 2.0.)

Although this study was designed to separately assess the impact of R&R activities on blood-lead concentrations for children receiving medical assistance and children not receiving medical assistance, the results reported in Table 3-1, Section 3.3, and Appendices A, C, and D are based on both groups. Analysis of the preliminary data set, containing approximately one-third of the full data set, indicated that similar relationships were observed for both groups.

Other potential data quality concerns include quality control procedures employed during collection of blood-lead registry and questionnaire data, possible nonresponse and sampling biases, and skin contamination in the blood-lead registry data. Section 3.2.1 discusses measures for ensuring the quality of the blood-lead registry and questionnaire data. Section 3.2.2 discusses nonresponse and sampling biases. Section 3.2.3 addresses skin contamination.

3.2.1 Blood-Lead Registry and Interview Data

Elevated blood-lead concentration ($\geq 10\mu g/dL$) has been a reportable condition in Wisconsin since 1979. In 1993 the law changed to require that all blood-lead tests be reported for children under 6 years old. The Wisconsin State Health Department has encouraged laboratories to report blood-lead concentration, but the law required a person who screens to report results of testing of blood-lead concentrations of children under six. The law also requires any person including doctors, nurses, hospital administrators, directors of clinical laboratories and health officers who diagnoses lead poisoning ($\geq 10\mu g/dL$) to report it regardless of the age of the person tested.

The state department of health and family services is considering issuing rules to clarify reporting responsibilities, but as of today only the statute ensures compliance with reporting. In practice, this is a lab based system. Labs report to the health department. The health department staff contact labs and doctors offices to obtain any missing demographic information and pass on information about children with elevated levels to local health departments for follow-up.

Quality control of analysis is regulated by CLIA, the clinical laboratory improvement amendments of 1988. All commercial labs must participate in a HCFA approved proficiency testing program such as the programs operated by the University of Wisconsin and the College of American Pathologists.

Quality control of the sample collection is up to the sample collector. In practice, the state department of health and family services, the state lab of hygiene, and local health agencies work with health care providers to inform them of quality control issues that arise, especially with capillary specimens.

A number of measures were used to ensure interview data quality. When frequency counts were run, a separate file was created for codes that were out of the range for the variable. Errors were corrected using the original interviews. Consistency errors were infrequent. In some cases, field sections were checked to clarify a problem, and sometimes the respondent was recontacted to solve the problem. Finished codebooks and frequency runs were reviewed to make sure that all data corrections were made.

3.2.2 Assessment of Nonresponse and Selection Bias

Whenever a sample is selected, there is a potential for bias. For example, bias can be introduced if careful interviewing practices are not followed. In this study, the interviewers were specifically trained in administering telephone interviews. Further, the interviewers followed a pre-designated script to collect the information from and to recruit participants. Training and following a set script minimizes the potential for interviewer bias. Nonresponse is also a potential source for bias in the sample estimates.

In general, bias in sample estimates is caused by differences between the population parameters of participants and nonparticipants and, therefore, can be investigated by comparing characteristics of participants in a study to those of nonparticipants (Thompson, 1992). Due to the mandatory screening of medical assistance children, it is unlikely that the Wisconsin blood-lead registry is representative of the children of Wisconsin in many demographic features. For example, the 1990 census reported that 95 percent of Wisconsin children outside of Wisconsin and Racine counties are Caucasian. Only 67 percent of the children selected for the study were Caucasian and only 78 percent of those participating. The registry sample had larger percentages of African-Americans, Asians, and Native Americans than percentages reported by the census. However, some of the difference between the census and registry sample racial distributions may be due to the large percentage of unknown race children reported in the registry sample (17%) as compared to the census (<1%).

Although incomplete reporting, i.e., the large percentage of unknown race children, is a problem for any study, the data selected for this study does <u>not</u> need to be representative of a particular group of children to achieve the primary study objectives. The primary purpose of this study was to establish a dose-response type relationship between incidence of general and specific R&R activities and EBLs. This dose-response relationship is assumed to be applicable to many similar populations.

In this nonresponse assessment, "participants" are children selected for inclusion and participating in the study. "Nonparticipants" are children who were selected for inclusion in the study, but did not participate for some reason (e.g., the child's guardian refused to be interviewed or study personnel were unable to reach the child's guardian). However, even extreme differences between participants and non-participants may not cause severe bias as long as the participation rate is the same between children with blood-lead levels below 7 μg/dL (controls) and children with blood-lead levels ≥10 μg/dL (cases). Therefore, to investigate bias it is important to examine the participation rate among the cases to that among the controls. This does not mean that comparisons between characteristics of participants and nonparticipants are without merit; these comparisons will serve to indicate the overall representativeness of the

selected sample of children compared to the registry population. In this section, we present the results of both types of comparisons beginning with comparing the characteristics of the interviewed children to the sampled population.

A limited amount of information on the characteristics of study participants was available in the Wisconsin Bureau of Public Health's blood-lead registry. Besides blood-lead concentrations, this information included the gender of the child, race of the child and parent, child's birthday, and the child's age when the first blood-lead sample was collected. Table 3-4 presents a summary of demographic information for participants and nonparticipants. The last column in the table presents the p-value for a statistical test comparing characteristics of participants and nonparticipants. For the two continuous variables (child's age and blood-lead concentration), the p-value corresponds to a t-test comparing the mean levels between participants and nonparticipants. For the categorical characteristics, the p-value corresponds to a likelihood ratio chi-square statistic comparing the proportions of participants and nonparticipants in the levels of the characteristic.

With the exception of gender, characteristics of study participants were statistically different from those of nonparticipants. However, in practical terms, these differences may not be meaningful. For example, study participants were significantly older than nonparticipants; but they were, on average, only 0.137 years or approximately 1.6 months older (95 percent confidence interval from 0.81 to 2.5 months). The geometric mean blood-lead concentrations for participants were significantly lower than that of nonparticipants; on average, 1.26 times lower, with a 95 percent confidence interval of 1.18 to 1.35 times. The proportion of children with blood-lead concentrations ≥ 10 µg/dL was also significantly smaller for participants than nonparticipants. It can be concluded that fewer EBL children could be located or agreed to participate in the study (nonresponse bias).

Table 3-4. Summary of Demographic Information for Participants and Nonparticipants

Variable	Description	Nonparticipants	Participants	P-value[a]
Sample Size		5,004	3,654	
Age (Years)	25th Percentile	1.1	1.1	0.0001
	Mean (Standard Error)	2.55 (0.022)	2.69 (0.028)	
	75th Percentile	3.9	4.1	
Blood-Lead Concentration (μg/dL)	25th Percentile	1.68	1.27	0.0002
	Geometric Mean[b] (Log Standard Error)	3.11 (0.019)	2.47 (0.028)	
	75th Percentile	5.75	4.80	
Blood-Lead Concentration Group	<10 μg/dL	89.73%	92.09%	0.001
	>10 μg/dL	10.27%	7.91%	
Gender of Child	Female	47.96%	48.74%	0.171
	Male	51.3%	50.85%	
	Unknown	0.70%	0.41%	
Race of Child	Asian	9.19%	4.63%	0.001
	African-American	9.37%	2.13%	
	Native-American	3.24%	1.48%	
	Caucasian	59.29%	78.02%	
	Unknown[c]	18.90%	13.74%	
Race of Parent	Asian	9.19%	4.60%	0.001
	African-American	9.37%	2.13%	
	Hispanic	8.05%	2.71%	
	Native-American	3.24%	1.48%	
	Caucasian	59.17%	77.94%	
	Unknown	10.97%	11.14%	

(a) This p-value corresponds to testing for significant differences between the study participants and nonparticipants. The p-value is based upon a t-test for continuous variables and a χ^2 test for categorical variables.

(b) Geometric means and log standard errors were calculated accounting for censored values. Blood-lead concentrations reported as 4 μg/dL or lower were considered to be left-censored, and values reported at or above 40 μg/dL were considered to be right-censored. There were 3,095 left-censored and 13 right-censored values for nonparticipants. There were 2,540 left-censored and 6 right-censored values for participants.

(c) A distinct identifier identifying Hispanic children is not present in the Wisconsin registry. Therefore the Unknown category contains these children.

Greater differences were found when comparing the race of participants and non-participants. In particular, a larger percentage of participants were Caucasian. This result was true for both parents and their children. Thus, it will be important to consider race when interpreting the results of this study.

Potential bias in the statistical results presented in Section 3.3 were investigated by comparing the participation rate among cases to that among controls. Unfortunately, we were only able to investigate the potential bias for those variables included in the registry database.

Bias in the R&R results could not be fully investigated. The potential for bias was determined by comparing the distribution of participation across the levels of a particular demographic factors changed with blood-lead group. Using log-linear models, these comparisons were performed by investigating the three-way interaction between the factor of interest, participation, and blood-lead group. A significant three-way interaction indicates that the effect of the demographic variable on blood-lead is confounded with participation. Table 3-5 presents frequency tables that formed the basis for the tests, as well as the p-value associated with the significance of the interaction term. The results of these tests indicate that the effect of a child's age on blood-lead is confounded with participation. Therefore, the age of the child needs to be included in the logistic regression models so that this source of variability can be accounted for. However, care needs to be taken when interpreting the model estimates for this variable, because of its potential confounding with participation.

3.2.3 Assessment of Skin Contamination

Six blood-lead concentrations were >40 μg/dL in the *study* database. (Eleven additional children in the *registry* database had blood concentrations >40 μg/dL.) All six measurements were based on capillary samples (which can result in skin contamination of a sample) and had one or two follow-up blood-lead measurements. Table 3-6 presents first, second, and third blood-lead concentration measurements for these six children. In all cases presented, second and third blood-lead samples were collected within a month of the first sample, making them reasonable follow-up blood-lead measurements. [One month is the longest time span recommended by CDC for confirming an elevated capillary blood-lead result (CDC, 1991).]

The four children whose first blood-lead concentrations were greater than 40, but for whom second and third measurements indicated nonelevated blood-lead concentrations (1, 2, 4, and 6), were deleted from the study database. The two children for whom the confirmatory blood-lead measurements supported a diagnosis of elevated blood-lead concentration were not deleted from the database.

Blood-lead concentration data from the blood-lead registry database were examined for possible biases due to blood sampling technique (i.e., capillary vs. venipuncture). Table 3-7 presents, for six age groups of children, confidence intervals for the ratio of capillary to venipuncture geometric mean and logarithmic standard deviation blood-lead concentrations. The blood-lead screening data available in the registry were collected primarily by the capillary method. Thus, the sample size for the venous calculations is small. Based on Table 3-7, it can be concluded that blood-lead concentration measurements taken via the capillary method were not, on average, significantly higher than those taken via venipuncture for any age group. In fact, it appears that, for children less than 1 year of age, there is a tendency for venipuncture blood-lead measurements to be higher than capillary measurements.

Table 3-5. Comparison of Participation Between Cases and Controls

Variable	Description		Children with PbB≥10 (Cases)	Children with PbB<7 (Controls)	P-value
Gender of Child	Female:	% Participants Total No. of Records	34.3% 341	43.8% 3378	0.629
	Male:	% Participants Total No. of Records	37.4% 457	43.7% 3349	
	Unknown:	% Participants Total No. of Records	20.0% 5	33.3% 36	
Race of Child	Asian	% Participants Total No. of Records	26.1% 111	29.2% 414	0.867
	African-American	% Participants Total No. of Records	12.4% 97	15.4% 364	
	Native-American	% Participants Total No. of Records	37.5% 8	25.3% 194	
	Caucasian	% Participants Total No. of Records	45.2% 458	49.8% 4760	
	Unknown[a]	% Participants Total No. of Records	29.5% 129	35.8% 1131	
Race of Parent	Asian	% Participants Total No. of Records	25.5% 110	29.2% 414	0.920
	African-American	% Participants Total No. of Records	12.4% 97	15.4% 364	
	Hispanic	% Participants Total No. of Records	20.3% 59	19.4% 371	
	Native-American	% Participants Total No. of Records	37.5% 8	25.3% 194	
	Caucasian	% Participants Total No. of Records	45.1% 452	49.8% 4757	
	Unknown	% Participants Total No. of Records	39.0% 77	43.6% 763	
Age of Child	Less than 1 Year	% Participants Total No. of Records	49.2% 63	38.6% 937	0.0004
	1 Year Old	% Participants Total No. of Records	37.6% 266	43.5% 2123	
	2 Years Old	% Participants Total No. of Records	34.2% 152	44.3% 981	
	3 Years Old	% Participants Total No. of Records	37.0% 127	40.1% 1042	
	4 Years Old	% Participants Total No. of Records	31.4% 121	40.8% 1030	
	5 Years Old	% Participants Total No. of Records	28.2% 71	59.4% 714	
	6 Years Old	% Participants Total No. of Records	33.3% 3	47.2% 36	

(a) A distinct identifier identifying Hispanic children is not present in the Wisconsin registry. Therefore the Unknown category contains these children.

Table 3-6. Six Capillary Blood-Lead Concentration Measurements with Possible Skin Contamination Bias

	Blood-Lead Concentration Measurement (μg/dL)		
Child	First	Second	Third
1	58	8	*
2	61	4	4
3	62	59	29
4	76	4	*
5	85	21	17
6	140	8	*

* Elevated blood-lead measurements in the shaded rows were assumed not to be from contamination. Measurements in nonshaded rows were assumed due to skin contamination and were removed from the study database.

Table 3-7. Assessment of Skin Contamination of Capillary Blood Samples for Six Age Groups of Children[a]

Age Group (years)[b]	Capillary			Venipuncture		
	Sample Size	Geometric Mean	Logarithmic Standard Deviation	Sample Size	Geometric Mean	Logarithmic Standard Deviation
<1	1048	1.76	0.0057	31	3.93	0.021
1-2	2639	3.05	0.00070	89	3.28	0.021
2-3	1250	3.22	0.0014	41	4.30	0.032
3-4	1318	3.19	0.0012	38	4.15	0.019
4-5	1248	2.80	0.0018	39	3.73	0.021
5-6	821	2.33	0.0041	52	2.42	0.053
Age Group (years)	Geometric Mean Ratio (Capillary/Venipuncture)			Logarithmic Standard Deviation Ratio (Capillary/Venipuncture)		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
<1	0.45	[0.32, 0.62][c]		1.67	[1.09, 2.55][c]	
1-2	0.93	[0.69, 1.24]		0.94	[0.72, 1.24]	
2-3	0.75	[0.52, 1.08]		0.97	[0.68, 1.38]	
3-4	0.77	[0.58, 1.02]		1.29	[0.89, 1.87]	
4-5	0.75	[0.56, 1.01]		1.40	[0.94, 2.09]	
5-6	0.96	[0.60, 1.55]		1.18	[0.74, 1.88]	

(a) Results calculated using censored data techniques. Blood-lead concentrations of 4 μg/dL were treated as left-censored at 4 μg/dL and blood-lead concentrations >40 μg/dL were treated as right-censored at 40 μg/dL.

(b) The categorization scheme for the age group categories is:

< 1: 0 months ≤ age < 12 months
1-2: 12 months ≤ age < 24 months
2-3: 24 months ≤ age < 36 months
etc.

(c) Statistically significant results at the 5 percent significance level.

There may be some selection factors that relate to type of blood sampling method. CDC 1991 states that elevated blood-lead results obtained on capillary specimens are presumptive and must be confirmed using venous blood and that children at the highest risk should be given the highest priority for screening. Thus, physicians are more likely to perform initial venous screenings on high risk children. Non-random selection of children for initial venous screenings may be the reason venipuncture blood-lead measurements are higher than capillary measurements among children less than 1 year of age. This does not preclude the possibility of skin contamination affecting individual blood-lead concentration measurements, but suggests that, in general, blood-lead concentration measurements taken by the capillary method should not be adjusted downward.

The variation in blood-lead concentrations, as measured by the ratio of logarithmic standard deviations, was statistically different between the two groups only for children less than 1 year of age. Variability in blood-lead concentration measurements among children less than 1 year of age was larger among those children sampled by the capillary method. This could be because children less than 1 year of age who receive venous blood-lead screening are mostly alike in that they are at high risk of lead exposure.

3.3 STATISTICAL ANALYSIS

Children were selected into this study based on their observed blood-lead concentrations. Since the purpose of this study was to assess the impact of R&R activities on children's blood-lead concentrations, an analysis methodology that respects the fact that observations were chosen based on the value of the response variable must be used. One such inference mechanism is the odds ratio. The odds ratio is the natural form of inference based on logistic regression.

The data collected in this study were analyzed using logistic regression. Logistic regression is a statistical method used to explain the relationship between a dichotomous response variable and a suite of explanatory variables. The dichotomous response variable analyzed is an indicator of elevated or nonelevated concentration. The explanatory variables provide information on social and demographic factors affecting children (e.g., household income), as well as on R&R activities conducted in children's residences (e.g., surface preparation for indoor painting). Appendix B discusses logistic regression and the odds ratio in detail.

Two types of logistic regression analyses were conducted. First, univariate regressions were performed for each explanatory variable. Both blood-lead registry variables and questionnaire responses were analyzed. Only six blood-lead registry variables were available. The statistical significance for each of the blood-lead registry variables was assessed and is presented in Table 3-1. Because of the large number of interview questions (and possible responses), the univariate logistic regression results based on the interview questions were considered together to assess statistical significance. Univariate logistic regression results are presented in Section 3.3.1. When the univariate logistic regressions were carried out for every single question in the questionnaire, the research question being asked was "Are any of the variables related to incidence of elevated blood-lead?," which is, in effect, the universal hypothesis. In this stage of the analysis, the Holm procedure, a modification of the Bonferonni

method (Holm, 1979) was used to adjust for the many simultaneous inferences being made. Later, in the multivariate analysis, specific questions such as "Is there an increased risk due to any R&R activity?," were each considered independently, without adjustment for multiple comparison (Savitz et al., 1995).

Second, because it is known that a number of social and demographic factors affect children's blood-lead concentrations (Bornschein et al., 1985; Brody et al., 1994; Lanphear et al., 1996), multivariate logistic regression analyses were performed to assess the significance of certain R&R variables after accounting for known effects. To account for known factors affecting blood-lead concentration, a baseline (multivariate) logistic regression model was developed to explain the risk of an elevated blood-lead concentration. This baseline model, as well as the results from introducing R&R variables into the baseline model, are presented in Section 3.3.2.

3.3.1 Univariate Statistical Analyses

Univariate logistic regression was used to assess the odds of an elevated blood-lead concentration among various groups of children. A separate logistic regression analysis was performed for each interview question and blood-lead registry variable. Odds ratios were estimated to compare the odds of elevated blood-lead concentrations for children in each response category.

An odds ratio is a fraction, with the odds for one group of children in the denominator and the odds for a second group in the numerator (see Appendix B). The odds are the probability that a subject has some condition over the probability that a subject does not have the condition. If the odds are about the same for the two groups, then the ratio is close to 1. An odds ratio statistically greater than 1 indicates that the second group of children (numerator group) is at higher risk for the specified condition than the first group (denominator group). For these analyses, the odds are the probability of a child having an elevated blood-lead concentration relative to the probability of a child not having an elevated blood-lead concentration. The two groups of subjects are defined by their responses to a particular question or values of a registry variable. For example, the odds ratio for males versus females could be estimated.

In preliminary statistical analysis, logistic regression using two possible definitions of nonelevated blood-lead concentrations was performed. For the first statistical analysis, blood-lead concentrations ≥ 10 µg/dL were considered elevated, but only those blood-lead concentrations <7 µg/dL were considered not elevated.[4] Subjects with blood-lead concentrations between 7 and 10 µg/dL were not considered. For the second statistical analysis, all blood-lead concentrations <10 µg/dL were considered not elevated. Elevated blood-lead concentration was always defined as ≥ 10 µg/dL based on the Centers for Disease Control and Prevention definition (CDC, 1994).

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[4] The cutoff for nonelevated blood-lead concentrations was chosen arbitrarily based on the study design, which dictated 100 percent sampling of children with blood-lead concentrations >7 µg/dL.

The second definition of not elevated (<10 μg/dL) is appealing because it allows all observations to be used in the analysis and, thus, increases its statistical power by increasing the sample size. However, the sample size of the nonelevated group is much larger than that of the elevated group by either definition. Because excluding medium blood-lead concentrations (7 μg/dL – 10 μg/dL) may magnify the difference between high and low groups, the first definition may permit better detection of the covariates that affect a child's risk of an elevated blood-lead concentration. Preliminary analysis suggested that the results would be similar based on both definitions of nonelevated blood-lead concentration. Therefore, **the first definition of <7 μg/dL was used for nonelevated blood-lead concentration in all further analysis.** Blood-lead concentrations ≥10 μg/dL were considered elevated.

Columns 10, 11 and 12 of Table 3-1 present univariate logistic regression results for each of the blood-lead registry variables. Column 10 is the estimated log odds difference, 11 the standard error of the log odds difference, and 12 a p-value indicating statistical significance. The log odds difference is the logarithm of the odds ratio. Thus, exponentiating the log odds difference yields the odds ratio.

For each of the six variables for which results are presented in Table 3-1, there is one level with no values recorded in columns 10, 11 and 12. This was the reference group for the log odds differences reported for the other levels of the variable. For example, no log odds difference values are reported for the "Caucasian" level of the race variable. Thus, each of the other levels ("African-American," "Asian," "Native-American," and "Unknown") of log odds differences compare that level to "Caucasian."

Based on the logistic regression results reported in Table 3-1, African-Americans and Asians are estimated to be $e^{0.92} = 2.5$ and $e^{1.03} = 2.8$, respectively, more likely to have elevated blood-lead concentrations than Caucasians. Males are more likely than females to have elevated blood-lead concentrations ($e^{+0.34} = 1.4$), and 1 year olds are more likely than 5-year olds ($e^{+0.87} = 2.4$). Other results were not statistically significant.

A complete presentation of the logistic regression results from the questionnaire data is provided in Appendix A. Of the variables in Appendix A, Appendix C lists all variables significant at the 10 percent level. Of the variables in Appendix C, Table 3-8 lists those significant at a 10 percent experiment-wise level based on the Holm multiple comparison procedure.

When many tests of significance are conducted, some statistically significant results might be obtained due to chance, even if there were no "real" effects. Thus, for 181 simultaneous tests, 18 significant results could be expected at the 10 percent significance level, even if there were no responses related to the probability of elevated blood-lead concentrations.

The Holm procedure, a modification of the Bonferroni procedure (Holm, 1979), was used to protect against making errors due to random chance (assigning significance when there is no real effect, "false positive") while simultaneously making 181 inferences, i.e., interpreting 181 tests of significance. This procedure yielded an overall "experiment-wise" confidence level of 90 percent. That is, when determining significance, all 181 tests are considered together,

controlling the probability of making a "false positive" claim simultaneously across all 181 tests. Table 3-8 presented questions that were significant at the 90 percent confidence level using the Holm procedure.

Table 3-8. Significant (Based on the Holm Procedure) Univariate Odds Ratio Estimates and Confidence Intervals[a]

All Children with Blood-Lead Concentrations <7 μg/dL or ≥10 μg/dL n = 3,288					
	Question	Higher Risk Group	Lower Risk Group	Odds Ratio	
				Estimate	95% Confidence Interval
Q17	Heat guns used (inside)	Yes	No	3.456	[1.584, 7.538]
Q4C	Year residence was built	Pre-1940	Post-1980	3.32	[1.105, 9.974]
Q1	Rent or own current residence	Fee Free[b]	Rent	2.974	[1.209, 7.316]
Q6	Very little, some, or a lot of peeling paint (inside)	A lot of Peeling Paint	None or Very Little Peeling Paint	2.691	[1.665, 4.349]
Q1A	Type of building (current)	Apartment/ Condo with 4 or Fewer Units	Single Family Home	2.612	[1.786, 3.819]
Q2	Year current residence was built	Pre-1940	Post-1980	2.586	[1.699, 3.935]
Q2	Year current residence was built	Pre-1940	1970-79	2.226	[1.377, 3.597]
Q4B	Type of building (previous)	Apartment/ Condo with 4 or Fewer Units	Single Family Home	1.859	[0.923, 3.743]
Q4B	Type of building (previous)	Duplex	Single Family Home	1.804	[0.951, 3.421]
Q1A	Type of building (current)	Duplex	Single Family Home	1.522	[1.105, 2.096]
Q6	Very little, some, or a lot of peeling paint (inside)	Some Peeling Paint	None or Very Little Peeling Paint	1.462	[1.041, 2.054]
Q13	Surface prepared by sanding or scraping (inside)	Yes	No	1.419	[1.03, 1.954]
Q1	Rent or own current residence	Rent	Own	1.405	[1.083, 1.822]
Q3	Has the tested child lived in (current) home longer than 12 months	No	Yes	1.336	[1.01, 1.768]
Q11	Any repair to broken plaster or damaged walls in the room/rooms painted	Yes	No	1.31	[0.99, 1.733]

(a) These question responses are significant using the Holm's procedure at a 10 percent experiment-wise significance level.

(b) "Fee free" means the respondent and child live free (no rent). For example, they live with grandparents.

However, the Holm procedure conservatively corrects for the possibility of "false positives" by possibly creating "false negatives"[5] (Savitz et al., 1995). Therefore, test-wise significant results were preserved and are presented in Appendix C. Based on what is already known about lead exposure and elevated blood-lead concentration, some of these results may represent useful information.

To save time during the telephone interview, the questionnaire was designed so that groups of questions regarding a particular R&R activity would be skipped if the response to the first question was negative (see Section 3.1.3). Thus, for questions such as "Were heat guns used?," a large number of values are missing. Those missing values indicate that heat guns were not used because paint removal did not occur at all. Therefore, for the logistic regression analyses reported in Appendix A and summarized in Table 3-8 (and Appendices C and D), missing values such as these were treated as "No" responses.

In Table 3-8, "Higher Risk Group" and "Lower Risk Group" refer to the odds of having an elevated blood-lead concentration and indicate the group more or less likely to have elevated blood-lead concentrations, respectively. For example, the table can be read "Children *in the higher risk group* are *odds ratio* times more likely than children *in the lower risk group* to have elevated blood-lead concentrations." Specifically, children who live in homes where *heat guns* were used (to prepare a surface for interior painting) are *3.45* times more likely to have elevated blood-lead concentrations than children in homes where *heat guns were not* used. Here "not used" can mean either heat guns were not used while preparing a surface for interior painting or no interior painting was done.

Table 3-8 presents 95 percent confidence intervals for each of the significant odds ratios given. Some of these intervals include "1" because this is a more stringent confidence level than that used for determining whether a question was significant. Odds ratios presented in Table 3-8 were sorted by magnitude.

Three R&R-related questions had (experiment-wise) statistically significant odds ratios. The ratio was significant for using heat guns (inside), preparing surfaces by sanding or scraping (inside), and repairing broken plaster or damaged walls (interior). Odds ratios were also (experiment-wise) significant for a number of demographic, housing-related, and occupational/hobby questions. As seen in Appendix C, the following additional R&R-related questions were *test-wise* significant:

- The number of rooms where work was done
- Whether windows were repaired or new windows put in
- Whether work was done in the bathroom
- Whether work was done in the kitchen
- Whether heat guns were used (floor surface or covering disturbed)
- Whether carpet was replaced or removed or painted floors refinished
- Who did the (carpet or floor) work (owner, building superintendent, staff)

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[5] Not assigning significance when there is a real effect is a "false negative."

- Whether chemical paint removers were used (inside)
- Whether washing, wet scraping, wet sanding, or water blasting were used (outside)
- Whether power sanding, grinding, or sandblasting was used (outside)
- Whether chemical paint removers were used (outside)
- Whether there was any outside painting
- Whether an open flame torch was used (outside)
- Whether heat guns were used (outside)
- Who did the (outside) work (relative/friend not in household)

Given the conservative nature of the adjustments used to account for simultaneous inference, it is likely that some of these results may be of public health significance. Recall that considering only the experiment-wise statistically significant results and not the test-wise statistically significant results increases the chance of not detecting significance when there is a real effect (false negatives). The experiment-wise results do, however, properly ensure against the chance of detecting significance when there is no real effect (false positive).

3.3.2 Multivariate Statistical Analyses

The basic approach for the multivariate statistical analysis consisted of the following steps:

1. Combine responses from various social, demographic, and other non-R&R variables, based on the results of the univariate analyses, for use in a multivariate logistic regression model explaining blood-lead concentration

2. Construct a *baseline logistic regression model* of the probability of a child's blood-lead concentration being greater than or equal to 10 µg/dL as a function of the social, demographic, and other non-R&R-related variables

3. Define composite R&R variables that characterize R&R activities based on the questionnaire responses

4. Assess whether R&R activities are associated with a significant increase in the probability that blood-lead concentrations will be greater than or equal to 10 µg/dL by introducing the R&R variables into the baseline model.

Baseline Model. Steps 1 and 2 of this analysis yielded a baseline logistic regression model. The variables considered in constructing the baseline model are detailed in Table 3-9. These variables were constructed from a combination of data provided from the blood-lead registry and the questionnaire. The variables considered for the baseline model can be divided into three types: 1) variables defining the type and condition of the child's residence, 2) demographic factors describing the child and the child's family, and 3) variables identifying known sources of lead exposure affecting the child.

Table 3-9. Variables Considered for the Baseline Logistic Regression Model

Variable	Levels	Basis
Type and Condition of Residence		
Peeling Paint Inside or Outside[a]	Yes/no	Q6 or Q7 of questionnaire
Home Age	<1960; ≥1960	Q2 or Q4c of questionnaire
Rent or Own	Rent/Own	Q1 of questionnaire
Type of Residence	Single family; duplex; apt. with four or fewer units; apt. with five or more units; mobile home/trailer; don't know/refused	Q1a or Q4b of questionnaire
Demographic Factors		
Medical Assistance Status	Medical Assistance/Nonmedical Assistance	Blood-lead registry variable
Income	<30,000; ≥30,000	Q335 of questionnaire
Number of People	1, 2, 3, ...	Q333 of questionnaire
Education Level	High school or less; some education beyond high school; college graduate	Q333d of questionnaire
Age	Quadratic and linear effects of age were considered.	Age in days was calculated from the blood-lead registry variables for samples called on date and birthdate.
Other Known Lead Exposures		
Adult Exposure[a]	Yes/no	Q306 - Q322 or Q324 - Q332 of questionnaire

(a) If the answer to any of the following questions was yes, this indicator variable was set to 1.

Because 22 percent of the children in this study moved during the year prior to their telephone interviews (see Appendix A, Question 3) and because telephone interviews were collected several months after blood sampling, dates of blood sampling were compared to the reported move date for each of the 809 families who moved. The child's residence during the month of blood collection was used to determine the home age and type of residence variables. Peeling paint and rent-versus-own questions were not asked for the respondent's previous residence. Thus, these variables were set according to current residence responses for all children. Three hundred sixty-eight families moved after the month of blood collection.

Backwards variable selection was used to select the baseline logistic regression model using the variables provided in Table 3-9 (Neter and Wasserman, 1974). Three variables describing the type and condition of the child's residence were significant in the baseline model: age of home, type of residence, and peeling paint. Five demographic variables describing the child and the child's family were significant in the model: education level, medical assistance status, family income, number of household residents, and child's age (both the linear and

quadratic effects). Adult exposure, the only variable indicating possible exposure from a source other than lead-based paint, was also significant in the model.

Income and medical assistance status are related variables. However, because children were selected into the study with their medical assistance status taken into consideration and income is believed to be a more reliable data response, both terms were kept in the model. Older housing was defined to be pre-1960 housing. This decision was made based on the univariate analysis of the age of house variable provided in Appendix A (Q2). This analysis suggested that only post-1970 housing could be statistically distinguished from pre-1940 housing in terms of the odds of an elevated blood-lead concentration. In order to achieve a more even distribution of observations between the older and newer housing groups, 1960-1970 homes were added to the newer group.

Table 3-10 presents estimated odds ratios and corresponding 95 percent confidence intervals for each of the categorical baseline model variables. Figures 3-2 and 3-3 present plots of estimated odds ratios for a child's age and number of household residents. In the odds ratios depicted in Figures 3-2 and 3-3, the reference group for the numerator of the odds ratio is specified by the x-axis value. The reference group for the denominator of the odds ratio is held constant in these figures. For Figure 3-2, the reference group for the denominator is 1-year-old children. Figure 3-2 shows that a child's risk of having an elevated blood-lead concentration level peaks at around age 2. By age 4, the risk is lower than it is for 1 year olds. Note how the confidence interval narrows as age increases due to the negative correlation between the estimated effects of the linear and quadratic terms. In Figure 3-3, the reference group for the denominator is children living in a home with three residents. Figure 3-3 indicates that more people living in a child's home increases the risk of an elevated blood-lead concentration. Odds ratios are provided rather than parameter estimates for the baseline model to aid in interpreting the model.

Addition of R&R Variables into Baseline Model. The next step was to construct R&R variables from questionnaire responses for incorporation into the baseline model. Following that, the R&R variables were added as explanatory variables to the baseline model, and the significance of the added variables was assessed.

Both individual R&R variables, based on questionnaire responses from a single question, and composite R&R variables, based on responses from multiple questions, were constructed. The composite R&R variables generally correspond to the variables constructed for the "Any R&R Activity," column of the "R&R Activity Exposure Summary" table (Table 3-2), and the individual R&R variables generally correspond to the variables constructed for Table 3-3. As noted in the discussion of these tables, most of the composite variables (particularly the specific surface preparation activities) exhibited similar exposure patterns across all four types of R&R activity. Use of the composite R&R variable rather than the individual question responses in the multivariate analysis assumes that the effect of activities like "use of a heat gun" on blood-lead concentration was the same any time a heat gun was used to remove paint, regardless of whether

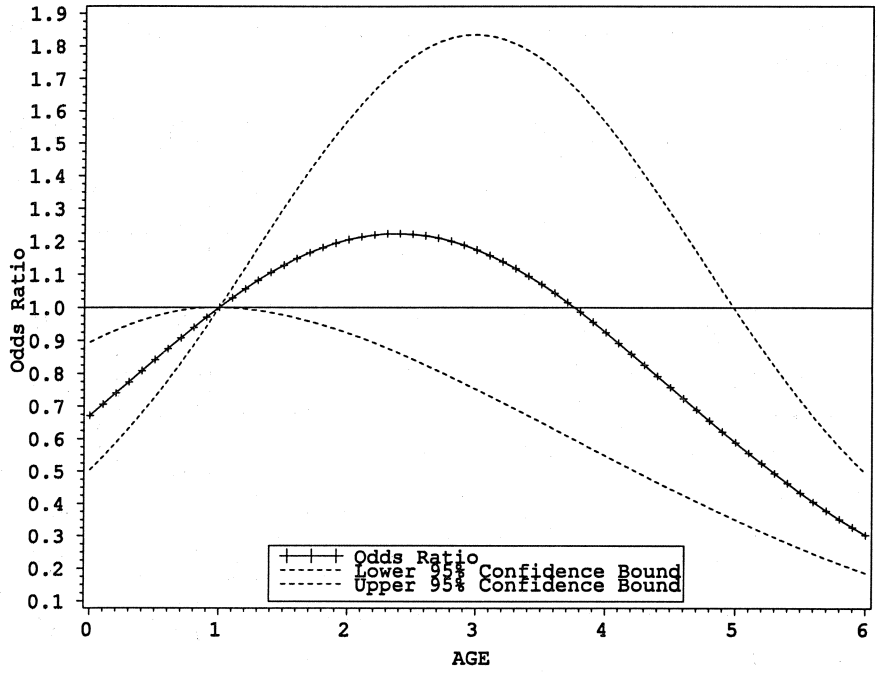

Figure 3-2. Odds Ratio Comparing Odds of an Elevated Blood-Lead Concentration for a Child of Age Specified by the x-Axis to a 1-Year-Old Child's Odds

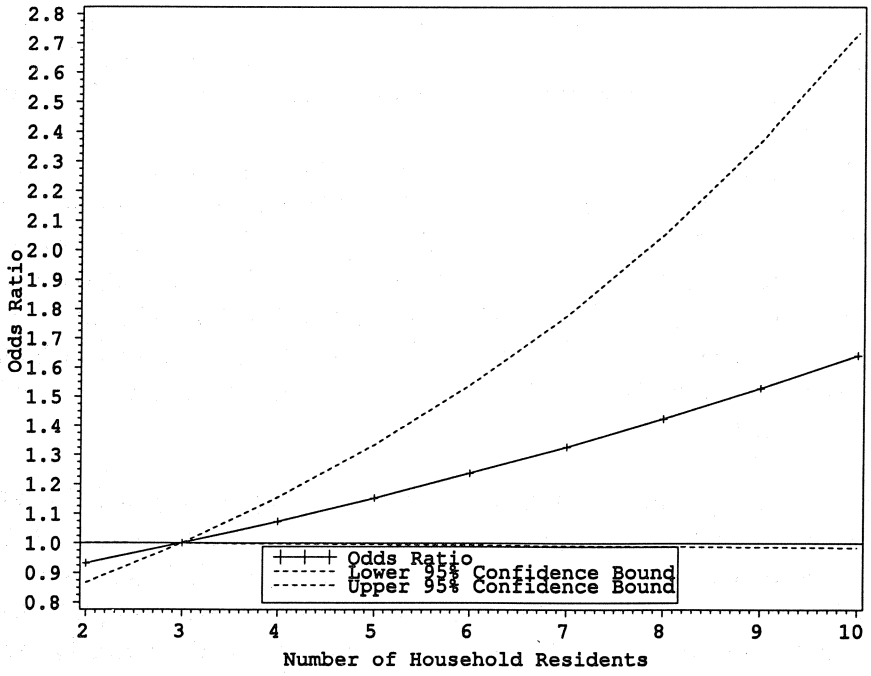

Figure 3-3. Odds Ratio Comparing Odds of an Elevated Blood-Lead Concentration for a Child in a Household with Number of Residents Specified by the x-Axis to a Child in a Household with Three Residents

Table 3-10. Odds Ratio Estimates and Confidence Intervals for Baseline Logistic Regression Model

Variable	Higher Risk Group	Lower Risk Group	Odds Ratio Estimate	95% Confidence Interval
Adult Exposure	Yes	no	1.318	[1.055, 1.646]
Education Level	High School or less	College Graduate or More	1.385	[0.999, 1.919]
	High School or less	Some College	1.305	[1.032, 1.651]
Home Age	Older	Newer	2.104	[1.632, 2.713]
Income	< $30,000	> $30,000	1.901	[1.492, 2.422]
Medical Assistance Status	No	Yes	1.360	[1.078, 1.715]
Peeling Paint Indicator	Yes	no	1.487	[1.191, 1.857]
Type of Residence	Single	Apt.≥ Five Units	2.127	[1.130, 4.003]
	Mobile	Single	1.166	[0.749, 1.817][a]
	Apt.≤ Four Units	Single	1.658	[1.098, 2.504]
	Duplex	Single	1.864	[1.371, 2.534]

(a) Not a statistically significant odds ratio.

it occurred during interior or exterior painting, other repairs, or carpets and floor repair or replacement, or any combination of the four R&R activity types. Table 3-11 presents the R&R variables constructed, as well as the questions that provided the basis for the variables.

The constructed R&R variables for the multivariate analysis were coded a little differently from those constructed for Tables 3-2 and 3-3. If respondents who were not asked a particular question because of the skip patterns in the questionnaire, the R&R variable for the question was coded as "No" instead of "Missing." (Questions with ordinal responses such as the "number of rooms in which work was done" had the respective R&R variable set to 0 instead of "Missing"). This coding change resulted in more observations being included in the multivariate analysis, where any observation with an explanatory variable set to "Missing" would have been excluded in the logistic regression.

Five sets of logistic regression models were created using the constructed R&R variables in increasing order of complexity. In the first set, each R&R variable in Table 3-11 was the single exploratory variable in a set of univariate logistic regressions. This univariate analysis was carried out as a preliminary step in the multivariate analysis for exploring the effect of the R&R variables. In the second set of models, each R&R variable was individually included as an explanatory variable in the baseline model (i.e., each model could only have one R&R explanatory variable). The third set of models was developed from the second set by including all the other R&R variables that "nest" the single R&R variable already in the model. A variable is said to "nest" another if the value of the former restricts the value of the latter. In the case of R&R variables, "nesting" occurs due to the skip patterns in the questionnaire, where the response to one R&R question can determine whether another question is skipped (remembering that

variables were coded "No" or 0 if the question was skipped). The fourth set consisted of a single model that was created by including all the R&R variables in Table 3-11 as additional explanatory variables in the baseline model. A restricted form of stepwise backward elimination was carried out on this model, where explanatory variables could be eliminated only if they were insignificant variables that did not nest another variable in the model. In the final set of models, a single interaction term between an R&R variable and an age-of-house variable (pre- versus post-1980) was added to the baseline model to test whether a ban on lead paint in 1978 reduced the association between incidence of R&R activities and elevated blood-lead concentrations in children. Note that all sets of models except the first use the baseline model as a basis on which to build the models. Hence, in the interpretations to follow, the R&R effect in the last four sets of models should always be implicitly qualified with the expression "taking into account the effect of non-R&R factors on the risk of elevated blood-lead concentrations in children."

Table 3-11. Renovation and Remodeling Variables Used to Assess Relative Risk

Variable Indicator of R&R Activity	Levels	Basis[a]
Any R&R Work	Yes/No	Q10, Q28, Q39, Q54
Inside Painting	Yes/No	Q10
Window Repair or Replacement	Yes/No	Q39
Inside or Outside Painting	Yes/No	Q10, Q28
Prepared Surface	Yes/No	Q13, Q29, Q42, Q57
Prepared Surface for Inside Painting	Yes/No	Q13
Hand Sanding or Scraping	Yes/No	Q14, Q30, Q44, Q58
Power Sanding, Grinding, Sandblasting	Yes/No	Q15, Q31, Q45, Q59
Open Flame Torch	Yes/No	Q16, Q32, Q47, Q60
Heat Gun	Yes/No	Q17, Q33, Q48, Q61
Washing, Wetscraping, Water Blasting	Yes/No	Q18, Q34, Q49, Q62
Chemical Paint Removers	Yes/No	Q19, Q35, Q50, Q63
Who Did the Work?		
Head of the Household or Spouse	Yes/No	Q20_1, Q36_1, Q51_1, Q64_1
Other in Household	Yes/No	Q20_2, Q36_2, Q51_2, Q64_2
Relative or Friend Not in Household	Yes/No	Q20_3, Q36_3, Q51_3, Q64_3
Owner or Apartment Staff	Yes/No	Q20_4, Q36_4, Q51_4, Q64_4
Professional	Yes/No	Q20_5, Q36_5, Q51_5, Q64_
Lived in Home While R&R Was Done	Yes/No	Q22, Q30, Q53, Q66
Number of Rooms	0-14	Q23
R&R Work in Kitchen	Yes/No	Q24

(a) If the answer to any of the following questions was yes, this indicator variable was set to 1.

Appendix D presents univariate logistic regression results from the first set of models and some descriptive statistics for each of the R&R variables described in Table 3-11. Significant R&R activity results were indicated for:

- Conducting any R&R work
- Painting done inside or outside
- Preparing surfaces
- Power sanding, grinding, sandblasting
- Using heat guns
- Washing, wetscraping, waterblasting
- Using chemical paint removers
- Who did the work (owner or apartment staff)
- Living in the home while R&R work was done
- Number of rooms
- Work done in kitchen.

Table 3-12 lists the p-values of the estimated coefficients, the odds ratios, and confidence intervals of the odds ratios for the R&R variables from the second set of models. The odds ratios in this set of models *compare the odds of a child having elevated blood-lead concentrations when a particular R&R activity occurred against the odds of a child having elevated blood-lead concentrations when the particular R&R activity did not occur.* To illustrate, take the case where "Open Flame Torch" was included as the single R&R explanatory variable. The odds ratio compares the risk of a child having elevated blood-lead concentrations when an open flame torch was used against the risk of a child having elevated blood-lead concentrations when no open flame torch was used, which included the case when no surface preparation (or, for that matter, any R&R activity) was carried out. The reason for calling these odds ratios "unconditional" will become clear when the "conditional" odds ratios are defined.

The significant results in Table 3-12 indicate that R&R activities of some kind significantly increase the odds of a child having elevated blood-lead concentration, although this result appears to be partially driven by the effect of "Outside Painting," as evidenced by the significance of "Inside or Outside Painting" and the insignificance of "Inside Painting." Many of the particular R&R activities lead to significantly increased risk. The odds are higher when a greater number of rooms are worked on. Results also indicate that the odds of an elevated blood-lead concentration is higher if R&R work is either not done or conducted by someone that is not an "Other in household" than the odds if R&R is conducted by an "Other in household." The odd feature of this result is that no R&R work done is a subset of the higher risk group. This last result is the only statistically significant result in this study that indicates that an R&R activity of any type conducted by any individual could reduce the risk due to lead exposure. The univariate logistic regression also showed that someone not in the household carrying out the work reduced the odds of an EBL, although the result was not statistically significant (Appendix D).

Table 3-13 lists the p-values of the estimated coefficients, the odds ratios, and the confidence intervals of the odds ratios of all the R&R variables from the third set of models,

Table 3-12. Unconditional Odds Ratios from Logistic Regression with Single R&R Variables

Variable [a]	Higher Risk	Lower Risk	P-Value	Odds Ratio	Confidence Interval
Any R&R Work	Yes	No	0.0220	1.309*	(1.035,1.656)
Inside Painting	Yes	No	0.9267	1.010	(0.814,1.252)
Window Repair or Replacement	Yes	No	0.4652	1.095	(0.855,1.402)
Inside or Outside Painting	Yes	No	0.0116	1.322*	(1.060,1.649)
Prepared Surface	Yes	No	0.0038	1.430*	(1.117,1.830)
Prepared Surface for Inside Painting	Yes	No	0.0645	1.325	(0.977,1.796)
Hand Sanding or Scraping	Yes	No	0.1158	1.226	(0.946,1.588)
Power Sanding, Grinding, Sandblasting	Yes	No	0.1035	1.372	(0.930,2.025)
Open Flame Torch	Yes	No	0.0101	4.883*	(1.423,16.759)
Heat Gun	Yes	No	<0.0001	4.597*	(2.715,7.782)
Washing, Wetscraping, Water Blasting	Yes	No	0.0092	1.625*	(1.119,2.360)
Chemical Paint Removers	Yes	No	0.0046	1.969*	(1.220,3.176)
Who Did the Work?					
Head of the Household or Spouse	Yes	No	0.1696	1.214	(0.915,1.611)
Other in Household	No	Yes	0.0355	3.000*	(1.055,8.531)
Relative or Friend Not in Household	Yes	No	0.0015	2.231*	(1.344,3.705)
Owner or Apartment Staff	Yes	No	0.4787	1.244	(0.672,2.305)
Professional	Yes	No	0.1195	1.490	(0.893,2.486)
Lived in Home While R&R Was Done	Yes	No	0.0163	1.365*	(1.054,1.769)
Number of Rooms	1 [b]	0 [b]	0.0007	1.119*	(1.047,1.197)
R&R Work in Kitchen	Yes	No	0.0243	1.569*	(1.052,2.340)

Note: Shaded area (and asterisk) indicates statistically significant results.
(a) See Table 3-11 for variable definitions.
(b) "Number of Rooms" was included as an ordinal variable. The risk groups were chosen for illustration. More generally, the odds ratio between n+k and n rooms is 1.119^k.

Table 3-13. Conditional Odds Ratios from Logistic Regressions with Single R&R Variables (and Any Other R&R Variables Nesting Them)

Variable [a]	Higher Risk	Lower Risk	P-Value	Odds Ratio	Confidence Interval
Any R&R Work	Yes	No	0.0220	1.309*	(1.035,1.656)
Inside Painting	Yes	No	0.9267	1.010	(0.814,1.252)
Window Repair or Replacement	Yes	No	0.4652	1.095	(0.855,1.402)
Inside or Outside Painting	Yes	No	0.0116	1.322*	(1.060,1.649)
Prepared Surface [b]	Yes	No	0.0152	1.383*	(1.059,1.806)
Prepared Surface for Inside Painting [c]	Yes	No	0.0349	1.419*	(1.018,1.976)
Hand Sanding or Scraping [d]	No	Yes	0.0085	2.385*	(1.232,4.614)
Power Sanding, Grinding, Sandblasting [d]	Yes	No	0.8079	1.055	(0.678,1.643)
Open Flame Torch [d]	Yes	No	0.0280	3.870*	(1.129,13.264)
Heat Gun [d]	Yes	No	0.0000	4.091*	(2.345,7.137)
Washing, Wetscraping, Water Blasting [d]	Yes	No	0.2101	1.313	(0.850,2.029)
Chemical Paint Removers [d]	Yes	No	0.0507	1.654	(0.988,2.769)
Who Did the Work?					
Head of the Household or Spouse [d]	No	Yes	0.1132	1.439	(0.909,2.279)
Other in Household [d]	No	Yes	0.0065	4.160*	(1.460,11.853)
Relative or Friend Not in Household [d]	Yes	No	0.0250	1.831*	(1.067,3.141)
Owner or Apartment Staff [d]	No	Yes	0.8726	1.053	(0.553,2.004)
Professional [d]	Yes	No	0.5364	1.184	(0.686,2.041)
Lived in Home While R&R Was Done [d]	No	Yes	0.8720	1.049	(0.577,1.907)
Number of Rooms [e]	1 [f]	0 [f]	0.0023	1.178*	(1.058,1.311)
R&R Work in Kitchen [e]	Yes	No	0.1668	1.470	(0.842,2.568)

Note: Shaded area (and asterisk) indicates statistically significant results.
(a) See Table 3-11 for variable definitions.
(b) Odds ratio conditional on "Any R&R Work" = 'Yes'.
(c) Odds ratio conditional on "Inside Painting" = 'Yes'.
(d) Odds ratio conditional on "Prepared Surface" = 'Yes'.
(e) Odds ratio conditional on "Prepared Surface for Inside Painting" = 'Yes'.
(f) "Number of Rooms" was included as an ordinal variable. The risk groups were chosen for illustration. More generally, the odds ratio between n+k and n rooms is 1.178^k.

which adds a single R&R variable and any other R&R variables nesting that particular variable to the baseline model. (Recall that, a variable is said to "nest" another if the value of the former restricts the value of the latter. In the case of R&R variables, "nesting" occurs due to the skip patterns in the questionnaire, where the response to one R&R question can determine whether another question is skipped.) By including these nested R&R variables, the models are taking the skip patterns into account. The odds ratio in this set of models *compares the odds of a child having an EBL when a R&R event occurred against the odds of a child having an EBL when some alternative R&R activity (or activities) occurred instead.* To illustrate, take the case in which "Open Flame Torch" and all the R&R variables that nest it ("Any R&R Work" and "Prepared Surface") were included as explanatory variables. The skip pattern in the questionnaire ensured that only those respondents who answered "Yes" to "Any R&R Work" and "Prepared Surface" could answer the question concerning whether they used an open flame torch. The odds ratio therefore compares the odds of a child having elevated blood-lead concentrations when an open flame torch was used to prepare the surface against the odds of a child having elevated blood-lead concentrations when some method(s) other than an open flame torch was (were) used instead to prepare the surface. Alternatively, the "Open Flame Torch" odds ratio could be interpreted as comparing the risk of using an open flame torch against not using an open flame torch, *given* that at least some form of surface preparation was carried out. This explains the use of "conditional" to describe the odds ratios from the third set of models.

The results in Table 3-13 are fairly consistent with the results in Table 3-12. In Table 3-13, the odds of an EBL were significantly higher by a factor of 1.419 if the surface was prepared for inside painting, given that some inside painting was carried out; but in Table 3-12 the unconditional odds for the same variable bordered on insignificant. The unconditional odds ratio for "Hand Sanding or Scraping" in Table 3-12 (1.226) is insignificant but much lower than the unconditional odds ratio for "Prepared Surface" (1.430). This explains the difference in the conditional odds ratios of Table 3-13, where the odds are significantly *lower* if hand sanding or scraping is carried out, given that the surface is prepared. Note that the results for the first four rows are the same for Tables 3-12 and 3-13 since the R&R variables in those rows are not nested by any other R&R variables.

Table 3-14 lists the p-values of the estimated coefficients, the odds ratios, and the confidence intervals of the odds ratios for all the R&R variables from the model created by including all the R&R variables from Table 3-11 as additional explanatory variables in the baseline model and eliminating the insignificant R&R variables using stepwise backward elimination. The backward elimination was restricted so that only those R&R variables that did not nest another significant R&R variable could be eliminated at each step.

Note that some insignificant R&R variables were retained in the final model due to the restriction in the backward elimination that accounted for the skip patterns. The final model is fairly consistent with the results from the previous two sets of models with single R&R variables. "Any R&R Work," which was significant in the analysis of single R&R variables, becomes insignificant, probably due to including the two painting variables that are closely associated with the variable. The significance of "Inside Painting" lowering the risk is misleading since the effect is negated by the "Inside or Outside Painting" variable. "Prepared Surface for Inside Painting" is insignificant probably due to its close association with "Prepared Surface."

Table 3-14. Conditional Odds Ratios from Logistic Regression with Multiple R&R Variables

Variable [a]	Higher Risk	Lower Risk	P-Value	Odds Ratio	Confidence Interval
Any R&R Work	Yes	No	0.8518	1.039	(0.690,1.565)
Inside Painting	No	Yes	<0.0001	2.432*	(1.605,3.685)
Inside or Outside Painting	Yes	No	0.0005	2.517*	(1.484,4.268)
Prepared Surface [b]	Yes	No	0.0099	2.537*	(1.232,5.224)
Prepared Surface for Inside Painting [c]	No	Yes	0.1189	1.629	(0.871,3.048)
Hand Sanding or Scraping [d]	No	Yes	0.0026	2.795*	(1.411,5.538)
Heat Gun [d]	Yes	No	0.0001	4.138*	(2.269,7.548)
Other in Household [d]	No	Yes	0.0060	4.456*	(1.502,13.225)
Relative or Friend Not in Household [d]	Yes	No	0.0028	2.339*	(1.324,4.131)
Number of Rooms [e]	1 [f]	0 [f]	0.0014	1.194*	(1.069,1.334)

Note: Shaded area (and asterisk) indicate statistically significant results.
(a) See Table 3-11 for variable definitions.
(b) Odds ratio conditional on "Any R&R Work" = 'Yes'.
(c) Odds ratio conditional on "Inside Painting" = 'Yes'.
(d) Odds ratio conditional on "Prepared Surface" = 'Yes'.
(e) Odds ratio conditional on "Prepared Surface for Inside Painting" = 'Yes'.
(f) "Number of Rooms" was included as an ordinal variable. The risk groups were chosen for illustration. More generally, the odds ratio between n+k and n rooms is 1.194^k.

The surprising result that was consistent across all the multivariate models is that the odds of a child having an elevated blood-lead concentration is significantly lower if the surface preparation was carried out by someone in the household other than the head of household or spouse. Compared to professionals who had (insignificantly) higher odds, the non-head-of-households might be expected to be less careful about the spread of lead from R&R work. There was some concern that the unexpected results obtained for work done by some household member other than the head of household may be due to the type of R&R activity performed or the size of the job. Table 3-15 presents information on the number and percentage of specific R&R activities performed by various types of individuals.

Based on Table 3-15, it can be concluded that all types of individuals use the various R&R techniques considered with similar frequencies. It appears that professionals and owners undertake larger jobs than those living in the household and relatives and that different sized jobs are tackled by different methods. However, since the odds ratio in the final model with multiple R&R variables accounts for the differences in the number of rooms, there is no obvious indication of why work performed by a household member other than the head of household (or spouse) should decrease the odds of an elevated blood level concentration. No conclusive resolution to this counter-intuitive result could be produced.

Table 3-15. Breakdown of Type of Specific R&R Activity by Type of Individual Who Did Work

R&R Activity	Who Did the Work					Number of Rooms
	Head of Household or Spouse (n=488)	Other in Household (n=69)	Relative or Friend not in Household (n=71)	Owner or Apartment Staff (n=52)	Professional (n=70)	
Any R&R Work[a]	488 (100%)	69 (100%)	71 (100%)	52 (100%)	70 (100%)	2.8
Inside Painting[a]	417 (85%)	59 (86%)	59 (83%)	31 (60%)	60 (86%)	2.9
Window Repair or Replacement[a]	169 (35%)	28 (41%)	30 (42%)	17 (33%)	36 (51%)	3.2
Inside or Outside Painting[a]	469 (96%)	63 (91%)	68 (96%)	51 (98%)	69 (99%)	2.9
Prepared Surface[b]	488 (100%)	69 (100%)	71 (100%)	52 (100%)	70 (100%)	2.9
Prepares Surface for Inside Painting[c]	281 (67%)	49 (93%)	47 (80%)	18 (58%)	33 (55%)	2.9
Hand Sanding or Scraping[d]	461 (94%)	65 (94%)	68 (96%)	47 (90%)	64 (91%)	2.9
Power Sanding, Grinding, or Blasting[d]	146 (30%)	23 (33%)	35 (49%)	10 (19%)	24 (34%)	3.4
Open Flame Torch[d]	6 (1%)	–	–	–	4 (6%)	5.3
Heat Gun[d]	43 (9%)	3 (4%)	5 (7%)	3 (6%)	5 (7%)	3.5
Washing, Wetscraping, Water Blasting[d]	160 (33%)	25 (36%)	27 (38%)	7 (13%)	17 (24%)	3.2
Chemical Paint Removers[d]	80 (16%)	13 (19%)	13 (18%)	6 (12%)	10 (14%)	4.2
Lived in Home While R&R Done[d]	452 (93%)	64 (93%)	59 (83%)	40 (77%)	59 (84%)	2.8
Number of Rooms	2.9	3.4	3.3	4.3	3.6	

a. Percentage in parentheses is in relation to n in column labels.
b. Percentage in parentheses is in relation to frequency in "R&R Work" row.
c. Percentage in parentheses is in relation to frequency in "Inside Painting" row.
d. Percentage in parentheses is in relation to frequency in "Prepared Surface" row.

For the final set of models, a single interaction between each R&R variable and an age of house variable was included as an additional explanatory variables in the baseline model. The significance of the interactions was examined in an attempt to identify differences in risk due to

lead exposure between R&R activities performed in pre- and post-1980 homes. When the age of house variable was defined as either pre- or -post-1980, the interaction term in all the models were insignificant. Hence, the available data did not provide any evidence that the 1978 ban on lead-based paint affected the odds of elevated blood-lead concentrations in children as a result of R&R activities. Similar analysis using a three-level age of house variable (pre-1960, 1960-1980, and post-1980) produced the same results. There are many possible reasons for this finding:

1. Age of residence was an interview reported variable, and, thus, may have been reported inaccurately for some homes.

2. Only the manufacturing of lead-based paint was banned in 1978. Residences may have been painted with lead-based paint using old paint.

3. R&R activities in residences may increase risk due to childhood lead exposure by stirring up lead-contaminated dust from sources other than lead-based paint.

3.3.3 Statistical Results

Although medical assistance status was a design variable in this study, it was not treated as such in the analysis of the data. Table 3-1 indicates the univariate relationship between medical assistance status and odds of an elevated blood-lead concentration. This relationship is not statistically significant. Medical assistance status is, however, a significant factor in the multivariate baseline logistic regression model. Its inclusion in this model accounts for the effect of medical assistance status in the multivariate analysis. In preliminary analysis, univariate regression results were calculated separately for children receiving medical assistance and children not receiving medical assistance, as might normally be done for a design variable. The results (the effects of other demographic and R&R variables on odds of an elevated blood-lead concentration) were similar for both medical assistance statuses; and, thus, a decision was made to pool the data across medical assistance status. The fact that medical assistance status was accounted for in the multivariate model is one reason for preferring the results based on the multivariate analysis to the univariate results.

The multivariate results reported are based on the statistical significance of composite R&R activity variables when introduced into a baseline logistic regression model. The composite R&R variables were constructed from responses to multiple interview questions. The baseline model accounted for the effects of a number of housing factors, demographics, and other lead exposures. This approach identified more statistically significant effects than univariate analysis of individual question responses (Section 3.3.1) for two reasons:

1. Variability due to other known lead exposure factors was reduced by using a baseline model when assessing the impact of an R&R activity.

2. The overall incidence of the composite R&R activity variables was higher. This makes it easier to assess the effect of a variable on the odds of an elevated blood-lead concentration.

The analysis documented in this report demonstrated a statistically significant relationship between R&R activities and the odds of elevated blood-lead concentrations. Specifically, children residing in residences in which some R&R activity was conducted in the last 12 months were estimated to have odds of an elevated blood-lead concentration 1.3 times greater than children residing in residences where no R&R was conducted. One reason for this increase in odds appeared to be due to the significant increase in odds in residences where outside painting was carried out. When paint removal using a heat gun was performed at a residence, the odds of an elevated blood-lead concentration were highly significant (4.6 times greater) than if the work was not performed. (The odds were over 4 times greater when compared to the case when some other type of surface preparation was carried out and to the case when the effects of other R&R factors were taken into account). Conversely, hand sanding and scraping appeared to have significantly smaller odds given that some alternative form of surface preparation was carried out. Increasing the number of rooms in which surface preparation was carried out for inside painting also increased the risk of EBL in children. Finally, a relative or friend not in the household increased the risk of elevated blood-lead concentrations in children significantly, possibly due to the lack of care taken in preventing the spread of lead in the house during the R&R activities. The significant and unexpected reduction in odds when someone in the household other than the head or spouse carried out the R&R activity could not be explained.

4.0 CONCLUSIONS

This study demonstrated that general residential R&R is associated with an increased risk of EBLs in children and that specific R&R activities are also associated with an increase in the risk of EBLs in children. In particular, removing paint (using open flame torches, using heat guns, using chemical paint removers, and wet scraping/sanding) and preparing surfaces by sanding or scraping significantly increased the risk of EBLs. Overall, these results agree with those from earlier phases of the R&R Study—R&R activities that disturb lead-based paint increase the risk of exposure to occupants. Additionally, children living in a residence while R&R was conducted were 1.3 times more likely to have EBLs than children who did not live in a residence while R&R was conducted.

The study also characterized the exposure of residents to R&R activities. At least one R&R activity such as inside painting, outside painting, carpet and floor repair or replacement, or other repairs (e.g., window repair) had been conducted in 67.2 percent of the study residences in the previous 12 months. Some form of surface preparation was involved in 42.3 percent of R&R activities. Most surface preparation involved hand scraping or sanding. Heat guns were used for surface preparation 7 percent of the time, and chemical paint removers were used 13.6 percent of the time.

The results of this study point toward a continuing need to educate parents and guardians about avoiding more risky R&R activities. Parents or guardians also could be educated about the positive benefits of relocation while R&R is being performed in a residence.

Further, the study has identified specific R&R activities and other conditions (such as age and type of residence) that are associated with increased risk to children as a result of lead exposure. This information can be used to develop regulations that focus on particular R&R activities (e.g., using a heat gun to remove paint), the groups of persons (e.g., a household member other than the head of household or spouse) who perform the activities, and the other conditions (e.g., adult exposure, age of child) that significantly increase the risk to children. The results of this study concerning activities associated with increased risk (e.g., using a heat gun to remove paint) also can be combined with the worker profile results from other phases of the R&R study to perform an overall assessment of the worker groups or situations where interventions are needed to reduce exposure from R&R.

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APPENDIX A:

EXPLORATORY ANALYSIS OF WISCONSIN CHILDHOOD BLOOD-LEAD STUDY QUESTIONNAIRE DATA

Exploratory Analysis of Wisconsin Childhood Blood-lead Study Questionnaire Data

Skip Patterns

To save time during the telephone interviews, groups of questions regarding a particular R&R activity were skipped if the response to the first question was negative (see Section 3.1.3). The table on the next page shows the pattern of skipping questions.

Most of the questions concerning R&R activities were introduced with the phrase "In the last 12 months...." as in the first cell of the table on the next page. Reading across the table gives the type of R&R activity that fills in the blank for the question number indicated in parentheses. The first column gives the specific question, and the two columns below each activity type specify the question number and who answered the question.

For example, for "any painting or surfaces prepared for paint INSIDE home?," the second column indicates that this is question 10, and column three indicates that everyone answered that question. Further down the first column, for the question "surface prepared by sanding/scraping . . .?," column two indicates that this is question 13, and column three indicates that anyone who answered "Yes" to question 10 answered question 13. Likewise for the question "Handsanding/handscraping used?" (question 14), anyone who answered "Yes" to question 13 answered question 14. This pattern can be followed down the table for a specific R&R activity and across the table for types of R&R activities.

In the last 12 mos was any of _____ work done?	Inside Painting (q10)		Outside Painting (q28)		Windows repaired or replaced (q39)		Carpets replace/removed or painted floors refinished (q54)	
	Question Number	Who Answered	Question Number	Who Answered	Question Number	Who Answered	Question Number	Who Answered
Any painting or surfaces prepared for paint INSIDE home	q10	Everyone						
Any painting or surfaces prepared for paint OUTSIDE home			q28	Everyone				
Any windows repaired or new windows put in					q39	Everyone		
Any carpets replace/repaired or painted floors refinished							q54	Everyone
Repair broken plaster or damaged walls in the rooms painted	q11	Everyone			q40	Yes to q39		
Old walls taken down or moved	q12	Everyone			q41	Yes to q39		
Any painting or surfaces prepared for paint with the installation of windows					q42	Yes to q39		
Do you have wall-to-wall carpet							q55	Yes to q54
Repair/replace wall-to-wallor other large carpet							q56	Yes to q54
Surface prepared by sanding/scraping off old paint (adhesive, chemicals o.t. primer)	q13	Yes to q10	q29	Yes to q28	q43	Yes to q39	q57	yes to q56
Handsanding/handscraping	q14	Yes to q13	q30	Yes to q29	q44	Yes to q43	q58	Yes to q57
Powersanding/grinding/sandblasting	q15	Yes to q13	q31	Yes to q29	q45	Yes to q43	q59	Yes to q57
Open flame torch	q16	Yes to q13	q32	Yes to q29	q47	Yes to q43	q60	Yes to q57
Heatguns	q17	Yes to q13	q33	Yes to q29	q48	Yes to q43	q61	Yes to q57
Wetscraping/wet sanding/water blasting	q18	Yes to q13	q34	Yes to q29	q49	Yes to q43	q62	Yes to q57
Chemical paint removers	q19	Yes to q13	q35	Yes to q29	q50	Yes to q43	q63	Yes to q57
Who did the work	q20_1-q20_5	Yes to q13	q36_1-q36_5	Yes to q29	q51_1-q51_5	Yes to q43	q64_1-q64_5	Yes to q57
Did anyone live there while the work was being done?	q22	Yes to q13	q38	Yes to q29	q53	Yes to q43	q66	Yes to q57
Number of rooms where work was done	q23	Yes to q13						
Work in Kitchen	q24	Yes to q13						
Work in Bathroom	q25	Yes to q13						
Were dust and dirt spread							q67	Everyone

HOUSING

Q1: First, I would like to ask you some questions about your housing. Do you own or rent your home?

1. RENTING
2. OWN
3. FEE FREE*
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1245	169	141	2.67	2.67			
2	1719	188	139	2.30	2.66	-0.34	0.13	0.0062
3	21	5	7	3.61	2.57	1.08	0.45	0.0147
8	13	3	2	3.78	2.97			
.	1	1	0	5.92	1.18			

* "Fee free" means the respondent and child live free (no rent). For example, they live with grandparents.

Q1a: What kind of building do you live in now? Is it a single family home, a duplex, an apartment or condominium with 4 or fewer units, an apartment or condominium with 5 or more units, or a mobile home or trailer?

1. SINGLE FAMILY HOME
2. DUPLEX
3. APARTMENT/CONDOMINIUM WITH 4 OR FEWER UNITS
4. APARTMENT/CONDOMINIUM WITH 5 OR MORE UNITS
5. MOBILE HOME OR TRAILER
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2327	268	187	2.35	2.64			
2	457	54	56	2.53	2.74	0.42	0.16	0.0087
3	200	41	42	3.78	2.36	0.96	0.19	0.0001
.	15	3	0	4.18	1.56			

Q2: About what year was your residence built? (If you don't know for sure, please guess in which decade it was built.)

ENTER COMPLETE YEAR, E.G. 1888, d OR r

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
Pre 1940	1048	154	123	2.95	2.49			
1940-49	162	16	13	2.11	2.63	-0.38	0.30	0.2105
1950-59	181	25	15	2.26	2.79	-0.35	0.29	0.2222
1960-69	179	24	14	2.56	2.53	-0.41	0.29	0.1666
1970-79	398	41	21	2.25	2.49	-0.80	0.24	0.0010
Post 1980	638	41	29	1.70	2.81	-0.95	0.21	0.0001
.	393	65	70	3.02	2.69			

Q3: Has {0l} lived in your current home longer than 12 months? (If no, then all questions apply to current home as well as any other one lived in during the past year.)

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2371	258	210	2.36	2.66			
2	627	108	74	2.96	2.53	0.29	0.14	0.0439
.	1	0	1	4.79	2.73			

Q4: In what moth and year did your family move into your current home?

ENTER MONTH AND YEAR E.G. 11/85

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
Pre 1980	83	11	7	2.92	2.16			
1980-1989	399	35	42	2.00	3.02	0.22	0.43	0.6026
1990	166	8	14	1.96	2.86	-0.00	0.48	1.0000
1991	178	16	8	2.05	2.54	-0.63	0.53	0.2388
1992	208	25	14	2.22	2.63	-0.23	0.48	0.6390
1993	305	39	27	2.57	2.57	0.05	0.44	0.9127
1994	408	51	36	2.69	2.47	0.05	0.43	0.9164
1995	574	58	53	2.33	2.68	0.09	0.42	0.8288
1996	627	108	74	2.98	2.54	0.34	0.41	0.4151
1997	29	9	3	3.28	2.45	0.20	0.72	0.7776
.	22	6	7	3.29	2.94			

Q4b: What kind of building do you live in before your current residence?

1. SINGLE FAMILY HOME
2. DUPLEX
3. APARTMENT/CONDOMINIUM WITH 4 OR FEWER UNITS
4. APARTMENT/CONDOMINIUM WITH 5 OR MORE UNITS
5. MOBILE HOME OR TRAILER
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	283	42	28	2.82	2.50			
2	106	20	19	3.24	2.73	0.59	0.32	0.0619
3	76	13	14	3.79	2.21	0.62	0.35	0.0773
4	106	18	8	2.47	2.58	-0.27	0.42	0.5159
5	55	13	3	2.77	2.52	-0.60	0.63	0.3408
8	0	2	0	8.00	1.00			
.	2373	258	213	2.36	2.67			

Q4c: In what year was your previous residence build? (If you don't know for sure, please guess in which decade it was built)

ENTER COMPLETE YEAR, E.G. 1888. D or R

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
Pre 1940	190	35	24	3.26	2.46			
1940-49	28	4	7	2.76	3.21	0.68	0.47	0.1505
1950-59	38	7	4	2.50	2.76	-0.18	0.57	0.7485
1960-69	41	5	5	1.78	3.91	-0.04	0.52	0.9462
1970-79	82	17	5	2.21	2.76	-0.73	0.51	0.1525
Post 1980	105	17	4	3.12	1.95	-1.20	0.55	0.0304
refused	5	0	2	3.54	3.00			
.	2510	281	234	2.42	2.65			

Q5: Does (tested child) live in your household most of the time?

1. YES
2. NO
3. ALL OF THE TIME (VOL)*
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2565	309	234	2.50	2.60			
2	23	0	3	1.25	3.96	0.36	0.62	0.5627
3	408	57	48	2.47	2.80	0.25	0.17	0.1282
.	3	0	0	2.76	1.05			

Q6: Would you say that there is no or very little peeling paint, some peeling paint or a lot of peeling paint inside your home.

1. NONE OR VERY LITTLE PEELING PAINT (surface intact)
2. SOME PEELING PAINT (less than 2 sq ft)
3. A LOT OF PEELING PAINT (involves than 2 sq ft)
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2537	288	219	2.33	2.70			
2	353	64	46	3.05	2.56	0.41	0.17	0.0312
3	104	14	24	3.92	2.37	0.98	0.24	0.0001
.	5	0	0	2.76	1.05			

* "(Vol)" indicates that this response was volunteered and was not originally listed as a response to the question.

Q7: Would you say that there is no or very little peeling paint, some peeling paint or a lot of peeling paint on the outside of your home.

1. NONE OR VERY LITTLE PEELING PAINT (surface intact)
2. SOME PEELING PAINT (less than 2 sq ft)
3. A LOT OF PEELING PAINT (involves more than 2 sq ft)
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2327	268	190	2.33	2.69			
2	457	54	57	2.50	2.80	0.42	0.16	0.0079
3	200	41	42	3.78	2.36	0.94	0.19	0.0001
.	15	3	0	4.18	1.56			

INSIDE PAINTING

We are trying to learn what people are doing to keep up their homes or to make major changes to them. First, I would like to start by asking you about any work that has been done or is being done inside your home or apartment.

Q10: During the past 12 months, was there any painting or were any surfaces prepared for paint inside your home?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1181	163	121	2.65	2.61			
2	1810	203	162	2.39	2.64	-0.14	0.13	0.2828
8	8	0	2	0.88	6.62			

Q11: Was any work done to repair broken plaster or damaged walls in the room/rooms you painted in the last 12 months?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	635	101	74	2.93	2.49			
2	2353	265	209	2.36	2.68	-0.27	0.14	0.0566
8	10	0	2	2.62	2.87			
.	1	0	0	2.76	1.05			

Q12: Was any work done where old walls were taken down or moved, while working in your home?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	279	48	33	2.92	2.47			
2	2717	317	249	2.43	2.65	-0.26	0.20	0.1922
8	3	1	3	6.84	2.01			

ASK Q's 13 THROUGH 27 IF INSIDE OF HOME WAS PAINTED.

Q13: Was the surface prepared for the new paint, by methods such as sanding or scraping off the old paint?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	412	76	53	3.26	2.44			
2	1023	129	89	2.31	2.76	-0.35	0.16	0.0309
8	65	4	7	2.32	2.90			
.	1499	157	140	2.34	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

How was the surface prepared for the new paint?

Q14: Was hand scraping or hand sanding used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	374	68	40	3.19	2.35			
2	27	7	8	4.25	2.69	-0.14	0.18	0.4479
8	11	1	5	4.59	2.83			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q15: Was power sanding, grinding, or sandblasting used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	128	22	16	3.20	2.56			
2	270	51	35	3.29	2.39	-0.28	0.27	0.3115
8	14	3	2	3.51	2.30			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q16: Was an open flame torch used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2	3	1	6.05	1.79			
2	399	71	49	3.23	2.44	-1.66	1.23	0.1769
8	11	2	3	3.62	2.64			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q17: Were heat guns used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	28	7	9	4.40	2.92			
2	370	67	39	3.17	2.34	-1.24	0.39	0.0014
8	14	2	5	4.86	2.41			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q18: Was washing, wet scraping, wet sanding, or water blasting used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	119	24	17	3.55	2.29			
2	269	49	34	3.19	2.51	-0.41	0.27	0.1220
8	24	3	2	2.68	2.34			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q19: Were chemical paint removers used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	70	14	12	3.83	2.48			
2	331	60	37	3.13	2.39	-0.61	0.32	0.0575
8	11	2	4	4.54	2.65			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q20: Who did the work?

1. HEAD OR SPOUSE
2. OTHER PERSON IN HH
3. RELATIVE/FRIEND NOT IN HH
4. OWNER, BUILDING SUPERINTENDENT, APT STAFF
5. PAID PROFESSIONAL CONTRACTOR

ENTER ALL THAT APPLY SEPARATED BY SLASHES, d OR r, a FOR ALL
(FOR EACH ITEM, THE ANSWER WILL BE:

1. YES
2. NO
8. DON'T KNOW
9. REFUSED)

1.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	324	61	36	3.20	2.41			
2	87	15	17	3.56	2.49	-0.16	0.19	0.3916
8	1	0	0	2.76	1.05			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

2.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	63	8	5	2.96	2.33			
2	348	68	48	3.33	2.45	0.20	0.47	0.6724
8	1	0	0	2.76	1.05			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

3.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	48	11	8	3.64	2.26			
2	363	65	45	3.22	2.46	-0.56	0.39	0.1482
8	1	0	0	2.76	1.05			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

4.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	39	8	7	3.48	2.48			
2	372	68	46	3.25	2.43	-0.63	0.42	0.1273
8	1	0	0	2.76	1.05			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

5.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	42	4	5	2.21	3.10			
2	369	72	48	3.37	2.39	-0.21	0.48	0.6532
8	1	0	0	2.76	1.05			
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q21: When was this job started and when was it completed? (If more than one job was done, then record the start of the first job and the end of the last one.)

ENTER MONTH AND YEAR FOR EACH ON SEPARATE LINES d OR r
ENTER n FOR COMPLETION DATE IF WORK IS STILL IN PROGRESS

Q22: Did anyone in your household live in the home while the work was being done?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	351	64	43	3.30	2.38			
2	61	12	10	3.07	2.77	-0.28	0.17	0.1135
.	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q23: In how many rooms in your home was this work done?

ENTER NUMBER OF ROOMS d OR r OR 0 FOR NONE

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	161	31	13	3.20	2.19			
2	94	13	12	2.80	2.72	0.46	0.42	0.2764
3	55	9	3	3.15	2.32	-0.39	0.66	0.5518
= >4	98	18	25	3.87	2.56	1.15	0.37	0.0016
None	0	1	0	7.00	1.00	0.12	0.30	0.6842
.	2591	294	236	2.34	2.72			

Q24: Was any of this work done in the kitchen?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	155	39	28	3.33	2.68			
2	256	37	25	3.24	2.26	-0.68	0.22	0.0017
8	1	0	0	5.00	1.00			
	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q25: Was any of this work done in the bathroom?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	182	31	26	3.42	2.40			
2	229	45	27	3.12	2.48	-0.43	0.22	0.0527
8	1	0	0	5.00	1.00			
	2587	290	236	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

OUTSIDE PAINTING

Q28: During the past 12 months, was there any painting or were any surfaces prepared for paint on the outside of your home?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	340	49	49	2.74	2.72			
2	2640	313	232	2.45	2.62	-0.49	0.17	0.0031
8	19	4	4	3.55	2.57			

Q29: Was the surface for this outside job prepared for the new paint, by methods such as sanding or scraping off the old paint?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	358	45	42	2.58	2.76			
2	186	21	18	2.04	2.98	-0.23	0.18	0.1925
8	24	6	3	3.86	2.40			
.	2431	294	226	2.47	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

How was the surface prepared for the new paint?

Q30: Was hand scraping or hand sanding used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	331	43	39	2.56	2.79			
2	19	1	2	3.10	2.15	-0.23	0.18	0.2057
8	8	1	1	2.27	3.14			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q31: Was power sanding, grinding, or sandblasting used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	47	8	9	3.30	2.38			
2	294	35	30	2.40	2.87	-0.71	0.37	0.0553
8	17	2	3	3.32	2.46			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q32: Was an open flame torch used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	3	0	2	5.25	2.17			
2	348	42	37	2.47	2.80	-1.95	0.91	0.0332
8	7	3	3	5.33	1.98			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q33: Were heat guns used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	14	1	9	4.77	3.22			
2	331	41	30	2.47	2.67	-1.93	0.43	0.0001
8	13	3	3	4.03	2.20			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q34: Was washing, wet scraping, wet sanding, or water blasting used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	84	13	14	2.83	2.67			
2	257	29	24	2.40	2.84	-0.58	0.30	0.0506
8	17	3	4	3.79	2.33			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q35: Were chemical paint removers used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	17	1	6	3.90	2.28			
2	317	41	31	2.46	2.78	-1.32	0.48	0.0057
8	24	3	5	3.25	2.78			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q36: Who did the work?

1. HEAD OR SPOUSE
2. OTHER PERSON IN HH
3. RELATIVE/FRIEND NOT IN HH
4. OWNER, BUILDING SUPERINTENDENT, APT STAFF
5. PAID PROFESSIONAL CONTRACTOR

ENTER ALL THAT APPLY SEPARATED BY SLASHES, d OR r, a FOR ALL
(FOR EACH ITEM, THE ANSWER WILL BE:

1. YES
2. NO
8. DON'T KNOW
9. REFUSED)

1.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	246	30	29	2.56	2.75			
2	108	14	13	2.67	2.79	-0.22	0.21	0.2868
8	4	1	0	2.07	2.28			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

2.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	32	2	2	1.30	3.69			
2	322	42	40	2.70	2.71	0.44	0.73	0.5492
8	4	1	0	2.07	2.28			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

3.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	19	5	5	4.43	1.99			
2	335	39	37	2.45	2.85	-1.01	0.51	0.0452
8	4	1	0	2.07	2.28			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

4.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	59	6	8	2.62	2.87			
2	295	38	34	2.59	2.74	-0.35	0.38	0.3617
8	4	1	0	2.07	2.28			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

5.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	41	5	7	2.64	3.01			
2	313	39	35	2.59	2.72	-0.58	0.41	0.1599
8	4	1	0	2.07	2.28			
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q37: When was this job started and when was it completed (If more than one job was done, then record the beginning date of the first job and the ending date of the last one)?

ENTER MONTH AND YEAR FOR EACH ON SEPARATE LINES d OR r
ENTER n FOR COMPLETION DATE IF WORK IS STILL IN PROGRESS

Q38: Did anyone in your household live in the home while the work was being done?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio*		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	339	43	41	2.54	2.81			
2	19	2	1	3.32	1.90	-0.26	0.18	0.1442
.	2641	321	247	2.46	2.66			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

OTHER REPAIRS

Next I would like to ask you about repairs and major changes to the rest of your home during the past 12 months.

Q39: Were any windows repaired or new windows put in?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	528	86	65	3.10	2.43			
2	2466	278	217	2.34	2.68	-0.34	0.15	0.0245
8	5	2	3	4.64	2.78			

Q40: Was any work done to repair broken plaster or damaged walls while repairing or putting in the windows?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio*		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	128	13	12	2.55	2.46			
2	497	83	57	3.04	2.52	0.02	0.31	0.9458
8	9	2	3	3.61	2.69			
.	2365	268	217	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q41: Was any work done where old walls were taken down or moved, while repairing or putting in the windows ?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio*		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	90	10	9	2.64	2.73			
2	540	87	64	2.99	2.51	-0.04	0.36	0.9174
8	4	1	0	3.64	1.84			
.	2365	268	216	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q42: Was there any painting or were any surfaces prepared for paint with the installation of the new windows?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio*		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	182	37	16	3.00	2.36			
2	445	61	55	2.94	2.57	0.09	0.27	0.7301
8	7	0	2	3.30	3.69			
.	2365	268	216	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q43: Did the window work involve preparing surfaces for paint, by methods such as sanding, scraping, using heat guns or the use of chemicals other than prime painting?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio*		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	96	19	10	2.96	2.42			
2	502	72	56	2.91	2.53	-0.09	0.34	0.7823
8	36	7	7	3.57	2.61			
.	2365	268	216	2.33	2.72			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

How was the surface prepared for the new paint?

Q44: Was hand scraping or hand sanding used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio*		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	87	18	9	3.04	2.36			
2	8	1	0	2.25	2.22	-0.08	0.36	0.8300
8	1	0	1	5.07	3.76			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q45: Was power sanding, grinding, or sandblasting used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio*		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	23	8	2	3.19	2.26			
2	71	11	7	2.92	2.39	0.10	0.74	0.8918
8	2	0	1	2.22	5.56			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q46: On which surfaces was power sanding, grinding, or sandblasting used?

1. EXTERIOR WALLS
2. TRIM / EAVES
3. PORCHES
4. DOORS / WINDOWS
5. ROOF

ENTER ALL THAT APPLY SEPARATED BY SLASHES, d OR r, a FOR ALL (delete)

Q47: Was an open flame torch used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	0	1	1	9.80	1.22			
2	94	18	8	2.91	2.35			
8	2	0	1	2.22	5.56			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q48: Were heat guns used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	7	3	1	4.55	1.89			
2	87	16	8	2.82	2.42	-0.40	1.07	0.7104
8	2	0	1	2.22	5.56			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q49: Was washing, wet scraping, wet sanding, or water blasting used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	21	9	3	3.56	2.48			
2	73	10	6	2.86	2.24	-0.40	0.62	0.5191
8	2	0	1	2.22	5.56			
	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q50: Were chemical paint removers used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	10	2	2	3.39	3.02			
2	83	17	7	3.04	2.21	-0.74	0.78	0.3434
8	3	0	1	1.20	7.10			
	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q51: Who did the work?

1. HEAD OR SPOUSE
2. OTHER PERSON IN HH
3. RELATIVE/FRIEND NOT IN HH
4. OWNER, BUILDING SUPERINTENDENT, APT STAFF
5. PAID PROFESSIONAL CONTRACTOR

ENTER ALL THAT APPLY SEPARATED BY SLASHES, d OR r, a FOR ALL (FOR EACH ITEM, THE ANSWER WILL BE:

1. YES
2. NO
8. DON'T KNOW
9. REFUSED)

1.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	68	17	8	3.35	2.30			
2	28	1	2	1.49	3.20	-0.20	0.38	0.5891
8	0	1	0	7.00	1.00			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

2.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	6	0	0	3.48	1.47			
2	90	18	10	2.90	2.49			
8	0	1	0	7.00	1.00			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

3.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	11	0	1	0.38	5.67			
2	85	18	9	3.15	2.36	0.06	1.05	0.9554
8	0	1	0	7.00	1.00			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

4.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	5	0	0	2.48	1.82			
2	91	18	10	2.95	2.45	20.03	0.00	
8	0	1	0	7.00	1.00			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

5.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	22	1	1	1.70	2.90			
2	74	17	9	3.20	2.36	0.76	1.02	0.4609
8	0	1	0	7.00	1.00			
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q52: When was this job started and when was it completed? (If more than one job was done, then enter the start date of the first job and the ending date of the last one.)

ENTER MONTH AND YEAR FOR EACH ON SEPARATE LINES d OR r
ENTER n FOR COMPLETION DATE IF WORK IS STILL IN PROGRESS

Q53: Did anyone in your household live in your home while the work was being done?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	86	19	10	3.22	2.34			
2	10	0	0	2.76	1.05	-0.19	0.34	0.5683
.	2903	347	279	2.45	2.69			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

CARPETS AND FLOORS

Q54: Were any carpets replaced or removed or painted floors refinished in the last 12 months?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	517	91	65	2.94	2.54			
2	2472	272	220	2.38	2.66	-0.35	0.15	0.0206
8	10	3	0	3.49	1.79			

Q55: Do you have any wall-to-wall carpeting in your home?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	499	79	61	2.74	2.67			
2	144	23	9	2.99	2.14	-0.67	0.37	0.0694
8	1	0	0	2.76	1.05			
.	2355	264	215	2.41	2.66			

Q56: Did you replace or remove a wall-to-wall or other large carpet in the last 12 months?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	432	61	50	2.59	2.74			
2	209	40	20	3.14	2.26	-0.22	0.16	0.1868
8	3	1	0	2.51	2.13			
.	2355	264	219	2.38	2.71			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

READ IF FLOOR SURFACE OR COVERING DISTURBED

Q57: Was the surface for this carpet or flooring job prepared by methods such as sanding or scraping off old paint or adhesive?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	165	21	20	2.15	3.14			
2	417	76	44	3.03	2.40	-0.24	0.25	0.3182
8	62	5	6	2.49	2.54			
.	2355	264	219	2.38	2.71			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

How was the surface prepared for the carpet or flooring?

Q58: Was hand scraping or hand sanding used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	132	17	14	2.21	2.86			
2	26	4	5	2.64	3.59	-0.10	0.29	0.7241
8	7	0	1	0.15	18.4			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q59: Was power sanding, grinding, or sandblasting used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	51	7	6	2.86	2.82			
2	106	14	13	1.95	3.17	-0.20	0.44	0.6396
8	8	0	1	0.11	20.2			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q60: Was an open flame torch used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1	0	0	2.76	1.05			
2	157	21	18	2.22	3.04			
8	7	0	2	1.00	6.84			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q61: Were heat guns used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	3	0	2	1.53	42.0			
2	153	21	16	2.34	2.77	-1.94	0.91	0.0336
8	9	0	2	0.51	10.6			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q62: Was washing, wet scraping, wet sanding, or water blasting used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	30	6	2	2.10	2.92			
2	127	15	16	2.27	3.02	0.37	0.73	0.6163
8	8	0	2	0.64	9.86			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q63: Were chemical paint removers used?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	22	4	2	1.98	4.43			
2	133	17	17	2.30	2.86	0.06	0.74	0.9370
8	10	0	1	0.84	5.62			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q64: Who did the work?

1. HEAD OR SPOUSE
2. OTHER PERSON IN HH
3. RELATIVE/FRIEND NOT IN HH
4. OWNER, BUILDING SUPERINTENDENT, APT STAFF
5. PAID PROFESSIONAL CONTRACTOR

ENTER ALL THAT APPLY SEPARATED BY SLASHES, d OR r, a FOR ALL
(FOR EACH ITEM, THE ANWER WILL BE:

1. YES
2. NO
8. DON'T KNOW
9. REFUSED)

1.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	110	18	11	2.31	3.00			
2	53	3	9	1.87	3.47	-0.04	0.32	0.9067
8	2	0	0	2.76	1.05			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

2.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	27	2	1	2.22	2.29			
2	136	19	19	2.22	3.22	0.96	1.02	0.3455
8	2	0	0	2.76	1.05			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

3.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	18	2	3	1.83	3.65			
2	145	19	17	2.21	3.08	-0.55	0.63	0.3788
8	2	0	0	2.76	1.05			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

4.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	9	2	3	4.17	2.58			
2	154	19	17	2.04	3.17	-1.25	0.67	0.0624
8	2	0	0	2.76	1.05			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

5.

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	42	1	2	1.45	2.77			
2	121	20	18	2.49	3.08	0.71	0.73	0.3265
8	2	0	0	2.76	1.05			
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q65: When was this job started and when was it completed? (If more than one job was done, then enter the start date of the first job and the ending date of the last one.)

ENTER MONTH AND YEAR FOR EACH ON SEPARATE LINES d OR r
ENTER n FOR COMPLETION DATE IF WORK IS STILL IN PROGRESS

Q66: Did anyone in your household live in the home while the work was being done?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	129	14	12	1.86	3.22			
2	36	7	8	3.14	2.85	0.04	0.31	0.9048
.	2834	345	269	2.49	2.65			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

Q71: As a result of the work that was done in your home were dust and dirt spread to 1. Only the work area 2. The rooms next to the work area 3. Throughout the house or 4. No dirt or dust was generated?

1. ONLY IN THE WORK AREA
2. IN THE ROOMS NEXT TO THE WORK
3. THROUGHOUT THE HOUSE
4. NO DIRT OR DUST GENERATED
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	725	101	77	2.63	2.67			
2	211	29	24	2.75	2.73	0.07	0.25	0.7809
3	266	43	26	2.89	2.39	-0.08	0.24	0.7270
4	706	91	60	2.35	2.74	-0.20	0.15	0.1712
8	70	7	12	3.07	2.61			
.	1021	95	90	2.23	2.70			

*Log-odds ratios were calculated assuming that missing values were 'No' response because people who didn't do this R&R activity were not asked this question.

TESTING FOR BLOOD LEAD

Q200: Now I'd like to ask you about your child's blood test for lead. Was your child tested because you asked for it, or because your nurse or doctor told you that your child needed the test?

1. I ASKED FOR IT
2. DR/NURSE/CLINIC RECOMMENDED IT
3. WIC RECOMMENDED
4. SCHOOL REQUIRED
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	976	132	83	2.72	2.48			
2	1241	136	126	2.31	2.79	0.18	0.15	0.2302
3	385	44	53	2.51	2.83	0.48	0.19	0.0095
4	163	22	12	2.36	2.58	-0.14	0.32	0.6524
8	232	32	11	2.63	2.22			
.	2	0	0	2.76	1.05			

Q200a: If someone else recommended it, was he or she from either the WIC program or from a health department?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1438	160	145	2.45	2.67			
2	405	50	44	2.15	2.93	0.07	0.18	0.6805
8	178	24	13	2.23	2.69			
.	978	132	83	2.71	2.48			

Q200b: Has the children has a subsequent blood test?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	150	26	139	5.81	2.70			
2	2761	327	138	2.43	2.37	-2.92	0.15	0.0001
8	88	13	8	2.59	2.66			

Q201: How many blood lead tests has {0l} had in the past 12 months?

1. ONE
2. TWO
3. THREE
4. FOUR OR MORE
8. DON'T KNOW
9. REFUSED

(delete this question)

Q201a: In which month and year was the first blood test?

ENTER MONTH/YEAR, E.G. 12/96 d OR r

Q201b: For this test did they take the blood from the finger, the arm or someplace else?

1. FINGER (capillary)
2. ARM (venous)
3. SOMEPLACE ELSE(specify:____)
4. FOOT
5. TOE
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2377	296	179	2.52	2.47			
2	179	19	85	4.02	3.26	1.84	0.15	0.0001
3	6	0	0	3.65	1.30	-19.8	29E3	0.9995
4	42	5	1	2.36	2.11	-1.15	1.01	0.2565
5	82	3	6	2.09	2.47	-0.03	0.43	0.9467
8	313	42	14	2.34	2.36			
.	0	1	0	7.00	1.00			

Q201c: What was the lead level?

ENTER NUMBER FROM 0 TO 100 d OR r

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
0-4	245	24	21	1.98	2.88			
5-9	93	9	14	2.53	3.01	0.56	0.37	0.1238
10-19	3	0	1	1.20	7.10	1.36	1.18	0.2485
unknown	2561	286	141	2.40	2.41			
refused	9	4	1	3.61	2.45			
.	88	43	107	7.41	2.21			

Q221: What is (TESTED CHILD)'s birthdate?

ENTER MONTH, DAY AND YEAR E.G. 11/18/92 d OR r

(Analysis is based on the year of birth)

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
90	202	20	10	1.97	2.70			
91	408	41	23	2.02	2.66	0.13	0.39	0.7380
92	419	55	44	2.59	2.67	0.75	0.36	0.0371
93	396	47	46	2.63	2.59	0.85	0.36	0.0177
94	482	70	58	2.93	2.47	0.89	0.35	0.0118
95	954	118	90	2.52	2.65	0.64	0.34	0.0595
96	115	9	10	1.61	3.09	0.56	0.46	0.2229
.	23	6	4	3.82	2.32			

HOUSEHOLD INFORMATION

Q300: *How many persons live in your household...counting all adults and children and including yourself?*

ENTER #, d OR r
(Q300 -Q300m are not in data set)

So that we can make the correct reference to everyone there, please tell me just the first name (or some other way to identify those in the household), RELATIONSHIP TO {0l}, sex, and age of all persons who live in your household. Let's start with you.....

Name	Relationship	Sex	Age	Delete
300d	300e	300f	300g	300h

Q300i: *Correct number of people in household.*

ENTER NUMBER

Q300l: *Did respondent supply correct number of people in household?*

1. Yes
2. No

Q300m: *I've listed you, and (READ NAMES). Have I missed anyone who usually lives there but is now away from home?*

1. YES, NEED TO ADD SOMEONE TO ROSTER (PRESS 2 OR 3 TIMES AS NECESSARY)
2. NO, TABLE IS CORRECT AS IS
3. I NEED TO CORRECT OR CHANGE A CELL
4. I NEED TO DELETE ONE PERSON FROM THE ROSTER

I would like to ask a few questions about {0l}'s eating habits.

Q302: Does your family usually sit down together for one or more meals per day?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2853	346	266	2.48	2.63			
2	145	20	19	2.68	2.62	0.34	0.25	0.1773
8	1	0	0	2.76	1.05			

Q303: How often does {0l} usually sit at the dining or kitchen table for meals? Would you say always, sometimes, seldom or never?

1. ALWAYS
2. SOMETIMES
3. SELDOM
4. NEVER
6. TOO YOUNG
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2184	255	187	2.40	2.62			
2	643	80	73	2.64	2.68	0.28	0.15	0.0519
3	73	12	10	3.22	2.43	0.47	0.35	0.1740
4	44	15	6	3.76	2.04	0.47	0.44	0.2922
6	53	4	9	2.09	3.38			
8	2	0	0	2.76	1.05			

Q304: How often does {0l} wash his/her hands before eating? Would you say always, sometimes, seldom or never?

1. ALWAYS
2. SOMETIMES
3. SELDOM
4. NEVER
6. TOO YOUNG
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1225	151	110	2.47	2.66			
2	1441	180	146	2.49	2.64	0.12	0.13	0.3608
3	200	28	14	2.69	2.43	-0.25	0.29	0.3967
4	73	4	7	2.57	2.40	0.07	0.41	0.8721
6	55	3	7	1.72	3.31			
8	5	0	1	2.91	2.21			

Q305: How often does {0l} use a plate when eating? Would you say always, sometimes, seldom or never?

1. ALWAYS
2. SOMETIMES
3. SELDOM
4. NEVER
6. TOO YOUNG
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	2414	321	228	2.55	2.60			
2	353	30	32	2.47	2.60	-0.04	0.20	0.8351
3	52	7	9	2.15	3.43	0.61	0.37	0.0994
4	101	5	8	1.79	2.79	-0.18	0.37	0.6378
6	76	3	8	1.69	3.28			
8	3	0	0	2.76	1.05			

ADULT OCCUPATIONS

Now I would like to ask a series of questions about your occupation or the occupation of any other adult who lives in the household.

Q306: First, in the past 12 months has any adult held a job doing paint removal including scraping and sanding?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	222	44	25	3.16	2.31			
2	2768	321	259	2.43	2.67	-0.19	0.22	0.4013
8	8	1	1	1.64	3.04			
.	1	0	0	2.76	1.05			

Q307: (In the past 12 months, has any adult held a job in) Home remodeling and repair?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	284	49	29	2.95	2.36			
2	2709	317	255	2.44	2.67	-0.08	0.21	0.6923
8	5	0	1	1.05	4.21			
.	1	0	0	2.76	1.05			

Q308: (In the past 12 months, has any adult held a job in) Plumbing?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	117	22	14	2.97	2.46			
2	2877	344	269	2.47	2.63	-0.25	0.29	0.3948
8	4	0	2	4.47	4.30			
.	1	0	0	2.76	1.05			

Q309: (In the past 12 months, has any adult held a job in) Building demolition?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	104	22	16	3.30	2.30			
2	2886	344	266	2.45	2.65	-0.51	0.28	0.0635
8	8	0	3	3.65	2.79			
.	1	0	0	2.76	1.05			

Q310: (In the past 12 months, has any adult held a job in) Welding?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	297	43	29	2.76	2.44			
2	2691	323	256	2.47	2.66	-0.03	0.21	0.8990
8	10	0	0	2.76	1.05			
.	1	0	0	2.76	1.05			

Q311: (In the past 12 months, has any adult held a job in) A battery manufacturing plant?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	19	2	2	2.34	2.95			
2	2975	363	283	2.49	2.63	-0.10	0.75	0.8920
8	4	1	0	3.64	1.84			
.	1	0	0	2.76	1.05			

Q312: (In the past 12 months, has any adult held a job in) The salvage of batteries or radiators?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	34	4	10	3.98	2.53			
2	2960	360	275	2.47	2.63	-1.15	0.37	0.0016
8	4	2	0	4.36	1.77			
.	1	0	0	2.76	1.05			

Q313: (In the past 12 months, has any adult held a job in) Ship building or repair?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	21	4	3	3.54	2.28			
2	2977	361	281	2.48	2.64	-0.41	0.62	0.5041
8	0	1	1	10.4	1.15			
.	1	0	0	2.76	1.05			

Q314: (In the past 12 months, has any adult held a job in) Other lead-related industry work?

(delete)

Q315: (In the past 12 months, has any adult held a job in) Smelter or foundry work?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	94	18	14	3.72	2.23			
2	2888	345	270	2.44	2.66	-0.47	0.29	0.1126
8	16	3	1	3.27	2.25			
.	1	0	0	2.76	1.05			

Q316: (In the past 12 months, has any adult held a job in) Oil refinery work?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	9	1	0	3.72	1.51			
2	2989	364	284	2.48	2.64			
8	0	1	1	8.94	1.12			
.	1	0	0	2.76	1.05			

Q317: (In the past 12 months, has any adult held a job in) Auto body work?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	157	34	16	3.05	2.33			
2	2835	332	269	2.46	2.66	-0.07	0.27	0.7914
8	6	0	0	2.89	1.42			
.	1	0	0	2.76	1.05			

Q318: (In the past 12 months, has any adult held a job in) Glass work?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	53	11	5	2.97	2.52			
2	2943	354	280	2.48	2.64	0.01	0.47	0.9857
8	2	1	0	2.88	2.62			
.	1	0	0	2.76	1.05			

Q319: (In the past 12 months, has any adult held a job in) A chemical plant?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	43	4	2	3.35	1.84			
2	2951	361	283	2.47	2.65	0.72	0.73	0.3189
8	4	1	0	3.67	1.59			
.	1	0	0	2.76	1.05			

Q320: (In the past 12 months, has any adult held a job in) Sandblasting?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	97	21	6	2.94	2.41			
2	2894	344	278	2.48	2.64	0.44	0.43	0.3007
8	7	1	1	1.06	6.22			
.	1	0	0	2.76	1.05			

Q321: (In the past 12 months, has any adult held a job in) Other lead related occupations?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	65	12	13	3.21	2.77			
2	2888	345	266	2.46	2.64	-0.78	0.31	0.0125
8	45	9	6	3.34	2.12			
.	1	0	0	2.76	1.05			

Q322: (Has any one in the household worked at another lead related occupation in the past 12 months?) What jobs were they?

ENTER EACH ADULT OCCUPATION AND INDUSTRY ON SAME LINE, d OR r,

(Response was either 'other' or 'missing')

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
0	5	3	1	4.80	1.89			
1	11	2	3	3.74	2.18	0.31	1.27	0.8077
2	8	1	2	3.04	2.58	0.22	1.35	0.8688
3	2	0	0	2.76	1.05	-23.8	23E4	0.9999
4	6	1	1	3.07	2.73	-0.18	1.54	0.9057
5	5	0	1	0.44	10.6	0.00	1.55	1.0000
6	3	0	1	4.30	2.21	0.51	1.59	0.7483
7	11	3	3	4.05	2.56	0.31	1.27	0.8077
8	4	0	0	3.32	1.35	-23.8	16E4	0.9999
9	5	1	1	0.35	69.5	-0.00	1.55	1.0000
998	1	0	0	6.00	1.00			
.	2938	355	272	2.48	2.63			

HOBBIES

Now I would like to ask a series of questions about hobbies of anyone who lives in the household.

Q324: Within the past 12 months, has anyone in the household removed paint or varnish from furniture?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	334	48	36	2.85	2.43			
2	2664	318	248	2.44	2.66	-0.15	0.19	0.4347
8	1	0	1	4.96	3.35			

Q325: (Within the past 12 months, has anyone in the household) Soldered pipes or repaired plumbing?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	465	66	54	2.76	2.57			
2	2529	298	231	2.44	2.65	-0.24	0.16	0.1319
8	5	2	0	2.56	2.43			

Q326: (Within the past 12 months, has anyone in the household) Joined pieces of stained glass with solder?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	12	3	2	4.70	1.67			
2	2986	363	283	2.47	2.65	-0.56	0.77	0.4613
8	1	0	0	5.00	1.00			

Q327: (Within the past 12 months, has anyone in the household) Painted pictures or jewelry with artists paint?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	214	29	22	2.52	2.66			
2	2774	336	263	2.49	2.64	-0.08	0.23	0.7282
8	11	1	0	2.92	1.64			

Q328: (Within the past 12 months, has anyone in the household) Glazed pottery or ceramic objects?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	94	8	7	2.06	2.84			
2	2903	358	277	2.50	2.63	0.25	0.40	0.5321
8	2	0	1	2.04	7.15			

Q329: (Within the past 12 months, has anyone in the household) Performed auto maintenance or body repair near the house?

(REFERS TO BODY WORK, BATTERY WORK OR RADIATOR REPAIR - DOES NOT INCLUDE OIL CHANGES, LUBRICATION, ETC.)

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	655	90	71	2.79	2.56			
2	2342	275	213	2.40	2.65	-0.18	0.14	0.2229
8	1	1	1	7.82	3.37			
.	1	0	0	6.00	1.00			

Q330: (Within the past 12 months, has anyone in the household) Molded lead into bullets, sinkers or other objects?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	40	4	6	1.94	3.60			
2	2956	362	279	2.50	2.62	-0.46	0.44	0.2949
8	3	0	0	2.76	1.05			

Q331: Has any one in the household worked at another lead related hobby in the past 12 months?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	45	9	7	3.52	2.59			
2	2939	355	274	2.47	2.63	-0.51	0.41	0.2131
8	15	2	4	3.27	2.43			

Q332: What hobbies were they?

ENTER ALL HOBBIES AND PERSON NUMBER'S ON SEPARATE LINES, d OR r,

(The following analysis is based on the number of hobbies)

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
0	6	0	0	2.89	1.42			
1	6	1	1	3.17	2.36			
2	7	2	2	4.41	3.97			
3	15	3	4	4.22	2.32			
4	6	1	0	3.02	1.72			
5	1	1	0	4.38	1.67			
6	2	1	0	5.33	1.50			
98	2	0	0	4.27	1.45			
.	2954	357	278	2.47	2.63			

BACKGROUND

Now we just have a few background questions to help us to interpret the results of this study.

Q333: How many people live in your household...counting all adults and children and including yourself?

ENTER #, d OR r

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
< = 2	111	18	10	2.91	2.46			
3	602	75	46	2.45	2.53	-0.16	0.36	0.6509
4	1046	119	89	2.30	2.66	-0.06	0.35	0.8696
5	704	64	65	2.28	2.81	0.02	0.35	0.9448
6	293	52	33	2.91	2.47	0.22	0.38	0.5545
> = 7	241	38	42	3.25	2.54	0.66	0.37	0.0746
.	2	0	0	2.76	1.05			

Q333a: What was your marital status?

1. DIVORCED
2. WIDOWED
3. SEPARATED
4. NEVER BEEN MARRIED
5. MEMBER OF AN UNM
6. MARRIED
8. DON'T KNOW/NOT SURE
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	224	28	23	2.52	2.59			
2	10	5	1	3.82	1.96	-0.03	1.07	0.9803
3	102	13	10	2.39	2.83	-0.05	0.40	0.9073
4	311	45	31	2.70	2.68	-0.03	0.29	0.9182
5	110	13	18	2.87	2.63	0.47	0.34	0.1649
6	2235	261	206	2.41	2.68	-0.11	0.23	0.6399
8	2	0	0	2.76	1.05			
	5	1	0	1.77	2.41			

Q333d: What was the highest grade or year in school that (you have /{:B} has) completed?

0. 8TH GRADE OR LESS
1. 9TH - 11TH GRADE
2. H.S. GRADUATE OR HAS G.E.D.
3. SOME TECHNICAL SCHOOL OR VOCATIONAL TRAINING
4. TECHNICAL SCHOOL GRADUATE
5. SOME COLLEGE OR ASSOCIATE DEGREE
6. COLLEGE GRADUATE
7. POST GRADUATE OR PROFESSIONAL DEGREE
9. DON'T KNOW / REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
0	67	12	23	4.06	2.67			
1	244	40	38	3.39	2.37	-0.79	0.30	0.0080
2	1188	157	118	2.55	2.65	-1.24	0.26	0.0001
3	254	30	24	2.54	2.59	-1.29	0.32	0.0001
4	153	17	15	2.76	2.63	-1.25	0.36	0.0006
5	595	61	36	2.20	2.54	-1.74	0.30	0.0001
6	364	42	20	2.16	2.53	-1.83	0.33	0.0001
7	126	6	11	1.39	3.50	-1.37	0.40	0.0006
	8	1	0	2.59	1.81			

Q333p: What was the highest grade or year in school that (your partner/spouse have /{:B} has) completed?

0. 8TH GRADE OR LESS
1. 9TH - 11TH GRADE
2. H.S. GRADUATE OR HAS G.E.D.
3. SOME TECHNICAL SCHOOL OR VOCATIONAL TRAINING
4. TECHNICAL SCHOOL GRADUATE
5. SOME COLLEGE OR ASSOCIATE DEGREE
6. COLLEGE GRADUATE
7. POST GRADUATE OR PROFESSIONAL DEGREE
9. DON'T KNOW / REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
0	76	11	19	3.34	2.69			
1	200	24	30	3.18	2.58	-0.51	0.32	0.1134
2	995	134	85	2.62	2.52	-1.07	0.28	0.0001
3	155	17	11	2.30	2.63	-1.26	0.40	0.0018
4	150	15	10	2.31	2.35	-1.32	0.42	0.0015
5	340	34	34	2.13	2.85	-0.92	0.31	0.0034
6	299	32	20	1.90	2.96	-1.32	0.35	0.0001
7	119	7	10	1.39	3.69	-1.09	0.42	0.0090
.	665	92	70	2.62	2.67			

INCOME

Q335: Is your household income more or less than $30,000 per year?

1. MORE THAN 30,000
2. LESS THAN 30,000
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1299	139	83	2.12	2.67			
2	1606	213	193	2.78	2.59	0.63	0.14	0.0001
8	65	11	8	2.54	2.68			
.	29	3	1	2.54	2.18			

Q335a: Thank you very much for your help with these questions. I have some information for you on lead poisoning prevention. Would you like me to send it to you?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1537	188	150	2.58	2.59			
2	1457	178	135	2.39	2.69	-0.05	0.12	0.6758
8	2	0	0	4.15	1.23			
.	3	0	0	2.76	1.05			

Q335b: The address we have for you is {0k} Is that correct?

1. YES
2. NO
8. DON'T KNOW
9. REFUSED

Response Category	Number of			Blood-Lead Concentration		Log-Odds Ratio		
	PbB < 7 μg/dL	7 ≤ PbB < 10 μg/dL	PbB ≥ 10 μg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	162	17	18	2.37	2.80			
2	29	3	2	3.53	1.87	-0.48	0.77	0.5368
.	2808	346	269	2.46	2.68			

Q336: What is your correct address?

ENTER COMPLETE ADDRESS INCLUDING ZIP CODE ON SEPARATE LINES

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APPENDIX B:

LOGISTIC REGRESSION BACKGROUND

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APPENDIX B: LOGISTIC REGRESSION BACKGROUND

Logistic regression (McCullagh and Nelder, 1989) is a commonly used method for analyzing the data from a retrospective case control study. In this study, children were selected based on their observed blood-lead concentrations. Since the purpose of this study was to assess the impact of renovation and remodeling activities on children's blood-lead concentrations, an analysis methodology that respects the fact that observations were chosen based on the value of the response variable must be used.

One inference mechanism useful for retrospective, binomial data is the odds ratio. An odds ratio is a fraction with the odds for one group of children in the denominator and the odds for a second group in the numerator. The odds for a group are the probability that a subject in that group has some condition over the probability that a subject does not have the condition. In this study, the odds of interest are the probability of an elevated blood-lead concentration divided by the probability of a nonelevated blood-lead concentration. Groups are defined by responses to particular questions. An odds ratio statistically greater than 1 indicates that the numerator group of children is at higher risk as a result of lead exposure.

In a prospective study a group of children with a specified risk factor are first identified and then blood-lead concentrations are measured. In a retrospective study, risk factors are determined for a group of children whose blood-lead concentrations were previously measured.

The odds ratio for a retrospective study:

$$\Psi_{Retrospective\ Study} = \frac{Pr(RR \mid Case) \,/\, Pr(No\ RR \mid Case)}{Pr(RR \mid Control) \,/\, Pr(No\ RR \mid Control)}$$

is identical (in interpretation) to that for a prospective study:

$$\Psi_{Prospective\ Study} = \frac{Pr(Case \mid RR) \,/\, Pr(Control \mid RR)}{Pr(Case \mid No\ RR) \,/\, Pr(Control \mid No\ RR)}$$

where

$$\Psi_{Retrospective\ Study} = \frac{Pr(RR \mid Case) \,/\, Pr(No\ RR \mid Case)}{Pr(RR \mid Control) \,/\, Pr(No\ RR \mid Control)}$$

is identical (in interpretation) to that for a prospective study:
where

Pr(RR|Case) = the conditional probability of renovation and remodeling having been performed in a house with a child whose blood-lead concentration exceeds 10 µg/dL,

Pr(No RR|Case)	=	the conditional probability of no renovation and remodeling having been performed in a house with a child whose blood-lead concentration exceeds 10 μg/dL,
Pr(RR|Control)	=	the conditional probability of renovation and remodeling having been performed in a house with a child whose blood-lead concentration does not exceed 10 μg/dL, and
Pr(no RR|Control)	=	the conditional probability of no renovation and remodeling having been performed in a house with a child whose blood-lead concentration does not exceed 10 μg/dL.
Cases	=	Residences containing children with a blood-lead concentration exceeding 10 μg/dL.

The odds ratio is used to test whether the incidence of elevated blood-lead concentrations in homes in which renovation and remodeling occurred is greater than that in which renovation and remodeling did not occur. For example, an odds ratio of 2 may be interpreted as the odds of a child's blood-lead concentration exceeding 10 μg/dL increases twofold with the conduct of renovation and remodeling.

The odds ratio is the natural form of inference based on logistic regression. Logistic regression models the probability of an event in the following form

$$p(x_1,x_2,x_3,\ldots,x_p) = \frac{1}{1+e^{-(\beta_0+\beta_1x_1+\beta_2x_2+\ldots+\beta_px_p)}}$$

where $x_1, x_2,\ldots, x_p$ are predictors of the event and $p(x_1, x_2,\ldots, x_p)$ is the probability of the event given the values of the predictor variables. Alternatively, the logistic regression model can be written as

$$\ln\left(\frac{p(x_1,x_2,x_3,\ldots,x_p)}{1-p(x_1,x_2,x_3,\ldots,x_p)}\right) = \beta_0+\beta_1x_1+\beta_2x_2+\ldots+\beta_px_p \quad . \qquad (1)$$

Therefore, the logistic regression model assumes that the log-transformed odds ratio at one set of predictor variables is a linear function of the parameters $\beta_0, \beta_1, \beta_2,\ldots, \beta_p$.

Log odds differences are calculated to compare the odds at one set of predictor variables to the odds at another set of predictor variables by differencing the appropriate linear functions of the parameters,

$$ln\psi = ln\left(\frac{p(x_1, x_2,\ldots, x_p)}{1-p(x_1, x_2,\ldots, x_p)}\right) - ln\left(\frac{p(y_1, y_2,\ldots, y_p)}{1-(y_1, y_2,\ldots, y_p)}\right)$$

Odds ratios, ψ, are calculated by exponentiating the log odds difference. To compare the odds for two groups that are different only in one predictor variable, for example, the log odds difference is equal to the parameter associated with that predictor multiplied by the difference in the predictor variable between the two groups. The odds ratio is calculated by exponentiating that value.

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APPENDIX C:

TEST-WISE SIGNIFICANT RESULTS

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APPENDIX C: TEST-WISE SIGNIFICANT RESULTS

This appendix presents all the univariate logistic regressions for which the test-wise significance level was less than 10 percent, but the result failed to qualify for significance with the Holm Bonferroni correction. Results are sorted by magnitude of the odds ratios under the restriction that odds ratios based on a single question remain together.

Table C-1. Odds Ratio Estimates and 95 percent Confidence Intervals, Test-Wise Significant Question Responses

All Children with Blood-Lead Concentrations <7μg/dL or ≥10 μg/dL n = 3,288					
				Odds Ratio	
	Question	Higher Risk Group	Lower Risk Group	Estimate	95% Confidence Interval
Q32	Open flame torch (outside)	Yes	No	7.029	[1.139, 43.38]
Q61	Heat gun (carpet & floor)	Yes	No	6.959	[1.127, 42.948]
Q33	Heat gun (outside)	Yes	No	6.89	[2.915, 16.281]
Q201b	Blood drawn from finger, arm or someplace else	Arm (venous)	Finger (capillary)	6.297	[8.499, 4.665]
Q333d	Highest grade completed by respondent	8th Grade or less	Some College	5.697	[3.127, 10.381]
Q333d	Highest grade completed by respondent	8th Grade or less	Tech. Grad.	3.49	[1.699, 7.171]
Q333d	Highest grade completed by respondent	8th Grade or less	College Grad.	6.234	[3.222, 12.061]
Q333d	Highest grade completed by respondent	8th Grade or less	Post Grad.	3.935	[1.768, 8.758]
Q333d	Highest grade completed by respondent	8th Grade or less	H.S. Grad or GED	3.456	[2.054, 5.812]
Q333d	Highest grade completed by respondent	8th Grade or less	Some Tech or Vocational	3.633	[1.916, 6.89]
Q333d	Highest grade completed by respondent	8th Grade or less	9th - 11th Grade	2.203	[1.209, 4.015]
Q35	Chemical paint remover (outside)	Yes	No	3.743	[1.433, 9.777]
Q64_4	Owner, staff did work (carpet & floor)	Yes	No	3.49	[0.914, 13.33]
Q23	In how many rooms	≥4	1	3.158	[1.507, 6.619]
Q312	Adult occupation in salvage of batteries or radiators	Yes	No	3.158	[1.507, 6.619]
Q36_3	Relative not in household did work (outside)	Yes	No	2.746	[0.99, 7.614]
Q221	Date of birth for tested child	95	90	1.896	[3.743, 0.961]

Table C-1a. (Continued)

All Children with Blood-Lead Concentrations <7μg/dL or ≥10 μg/dL n = 3,288					
				Odds Ratio	
	Question	Higher Risk Group	Lower Risk Group	Estimate	95% Confidence Interval
Q221	Date of birth for tested child	93	90	2.34	[4.807, 1.139]
Q221	Date of birth for tested child	94	90	2.435	[4.904, 1.209]
Q221	Date of birth for tested child	92	90	2.117	[4.349, 1.03]
Q321	Adult occupation in other lead related occupation	Yes	No	2.181	[1.174, 4.055]
Q31	Power sanding, grinding or sandblasting (outside)	Yes	No	2.034	[0.97, 4.263]
Q24	Any work in kitchen	Yes	No	1.974	[1.271, 3.065]
Q55	Any wall to wall carpet in home	Yes	No	1.954	[0.932, 4.096]
Q333	How many people live in household	≥7	≤2	1.935	[4.055, 0.923]
Q335	Household Income	lt 30,000.	gt 30,000.	1.878	[2.484, 1.419]
Q19	Chemical paint remover (inside)	Yes	No	1.84	[0.97, 3.49]
Q305	How often does the tested child use a plate	Seldom	Always	1.84	[3.857, 0.878]
Q34	Washing, wet scraping, wet sanding or water blasting (outside)	Yes	No	1.786	[0.98, 3.254]
Q309	Adult occupation in building demolition	Yes	No	1.665	[0.951, 2.915]
Q28	Any outside painting	Yes	No	1.632	[1.162, 2.293]
Q200	Who asked for blood test	Wisconsin recommended	I asked for it	1.616	[2.363, 1.105]
Q25	Any work in bathroom	Yes	No	1.537	[0.99, 2.387]
Q54	Carpets replaced or removed or painted floors refinished	Yes	No	1.419	[1.051, 1.916]
Q303	Does the tested child sit at the table	Sometimes	Always	1.323	[1.786, 0.98]

APPENDIX D:

UNIVARIATE REGRESSION OF CONSTRUCTED R&R VARIABLES

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Univariate Regression of Constructed R&R Variables

Any R&R Work

Was any renovation and remodeling work done in the last 12 months, including interior painting or exterior painting or were windows replaced, walls moved, carpets replaced, or floors resurfaced?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference*		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1836	251	187	2.61	2.63			
2	1151	113	92	2.28	2.61	-0.48	0.16	0.0024
.	12	2	6	4.27	2.99			

Inside Painting

During the last 12 months, was there any painting or were any surfaces prepared for paint inside the home?

.1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1371	181	128	2.54	2.63			
2	1620	185	155	2.45	2.63	-0.14	0.14	0.3222
.	8	0	2	0.88	6.62			

Other Repairs (Window)

Were any windows repaired or new windows put in?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	592	93	68	3.00	2.46			
2	2402	271	214	2.35	2.68	-0.25	0.17	0.1283
.	5	2	3	4.64	2.78			

Inside or Outside Painting

During the last 12 months, was there any painting or were any surfaces prepared for paint inside or outside the home?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	1535	203	155	2.55	2.65			
2	1451	161	125	2.43	2.58	-0.31	0.14	0.0304
.	13	2	5	2.51	4.22			

Prepared Surface

Were any surfaces prepared for interior painting, exterior painting, window installation/wall repair or carpet replacement, or floor resurfacing by methods such as sanding, scraping, or use of chemicals other than prime painting?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	527	84	66	2.87	2.60			
2	2348	266	204	2.38	2.65	-0.51	0.16	0.0019
.	124	16	15	2.98	2.51			

Prepared Surface for Inside Painting

Were any surfaces prepared for interior painting by methods such as sanding, scraping, or use of chemicals other than prime painting?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	283	48	34	3.22	2.40			
2	2651	314	244	2.41	2.66	-0.39	0.21	0.0627
.	65	4	7	2.32	2.90			

Hand Sanding or Scraping

Was hand scraping or hand sanding used to prepare surfaces for inside painting, outside painting, window installation or wall repair, or when carpets were replaced or floors resurfaced?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	481	76	54	2.84	2.50			
2	2503	289	227	2.42	2.65	-0.32	0.17	0.0671
.	15	1	4	2.41	4.21			

Power Sanding, Grinding, Sandblasting

Was power sanding, grinding, or sandblasting used to prepare the surface for interior painting, exterior painting, window installation/wall repair, carpet replacement, or floor resurfacing?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	146	29	22	3.33	2.47			
2	2829	334	260	2.44	2.64	-0.68	0.25	0.0063
.	24	3	3	2.59	2.85			

Open Flame Torch

Was an open flame torch used to prepare surfaces for inside painting, outside painting, window installation or wall repair, or for carpet replacement or floor resurfacing?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	6	0	2	3.04	2.78			
2	2978	363	278	2.48	2.63	-1.54	0.82	0.0604
.	15	3	5	3.62	2.75			

Heat Guns

Were heat guns used to prepare surface for inside painting, outside painting, window installation or wall repair, or for carpet replacement or floor resurfacing?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	33	5	13	4.38	2.56			
2	2947	358	266	2.47	2.62	-1.58	0.36	0.0001
.	19	3	6	3.44	3.10			

Washing, Wetscraping, Waterblasting

Was washing, wet scraping, wet sanding, or water blasting used to prepare surfaces for inside painting, outside painting, window installation or wall repair, or for carpet replacement or floor resurfacing?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference*		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	144	30	22	3.23	2.44	0.00	0.00	
2	2824	333	257	2.45	2.64	-0.53	0.27	0.0465
.	31	3	6	2.43	3.26			

Chemical Paint Removers

Were chemical paint removers used to prepare for inside painting or for outside painting, when windows or walls were replaced/moved, when carpets were replaced, or when floors were resurfaced?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	73	12	12	3.49	2.62			
2	2904	352	266	2.47	2.61	-0.78	0.33	0.0190
.	22	2	7	2.52	4.18			

Who did the work for interior painting, exterior painting, window work, or carpet or floor work?

1. YES
2. NO

Head of Household or Spouse

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	394	66	41	2.96	2.41			
2	2605	300	244	2.41	2.68	-0.23	0.19	0.2329

Other (than head) Person in Household

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	64	6	3	2.21	2.18			
2	2935	360	282	2.48	2.64	-0.45	0.59	0.4483

Friend or Relative not in Household

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	54	10	13	3.39	2.52			
2	2945	356	272	2.47	2.63	-0.59	0.41	0.1494

Who did the work for interior painting, exterior painting, window work, or carpet or floor work? (Continued)

Owner or Apartment Staff

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	64	11	12	2.78	3.11			
2	2935	355	273	2.49	2.62	-0.79	0.35	0.0237

Professional

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB < 7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	81	6	10	1.94	3.35			
2	2918	360	275	2.50	2.62	-0.43	0.36	0.2258

Live in Home While R&R was Done

Did anyone live in your household while the work (inside painting, outside painting, window work or floor work) was being done?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	457	71	55	2.87	2.56			
2	2542	295	230	2.42	2.65	-0.42	0.17	0.0151

Number of Rooms

In how many rooms in your home was this work done?

ENTER NUMBER OF ROOMS d OR r OR 0 FOR NONE

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference *		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
0	2720	322	251	2.41	2.66			
1	95	13	6	2.85	2.25	0.13	0.05	0.0089
2	63	10	7	2.99	2.47			
3	34	8	3	3.71	2.32			
≥4	87	13	18	3.56	2.49			

* Number of Rooms was entered as a continuous variable. Hence the log-odds difference compares n+1 to n rooms. (See Appendix B for details.)

R&R Work in Kitchen

Was any of this (indoor painting and surface preparation) work done in the kitchen?

1. YES
2. NO

Response Category	Number of			Blood-Lead Concentration		Log-Odds Difference*		
	PbB <7 µg/dL	7 ≤ PbB < 10 µg/dL	PbB ≥ 10 µg/dL	Geometric Mean	Geometric Standard Deviation	Estimate	Standard Error	P-value
1	117	27	20	3.18	2.69			
2	2881	339	265	2.46	2.63	-0.66	0.28	0.0164
.	1	0	0	5.00	1.00			

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16. Abstract (Limit 200 words)

In 1992, the United States Congress enacted the Residential Lead-Based Paint Hazard Reduction Act, which required (Section 402(c)) the U.S. Environmental Protection Agency to conduct a study of lead exposure associated with renovation and remodeling activities (R&R Study). This report documents Phase II of that study. Phase III is a retrospective study of the association between elevated blood lead (EBL) concentrations (≥ 10 μg/dL) in children and the incidence of R&R activities in their residences.

A subset of children were selected for participation from the Wisconsin Bureau of Public Health's blood lead registry. Information on R&R activities in participating children's residences was obtained by telephone interview. The study included 3,654 children. Logistic regression was used to determine if incidence of general or specific R&R activities in residences was associated with increased risk of an EBL.

Based on statistical analysis, children residing in residences in which some R&R activity was conducted were estimated to have odds of an EBL 1.3 times greater than children residing in residences where no R&R was conducted. When paint removal using a heat gun was performed. the odds of an EBL was 4.6 times greater than if the work was not performed. Other significant associations were found.

17. Document Analysis

a. Descriptors: Blood-lead concentration, childhood health risks, lead-based paint, lead hazard, renovation and remodeling, elevated blood-lead concentration

b. Identifiers/Open-Ended Terms: Section 402, Renovation and Remodeling Study

c. COSATI Field/Group

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