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# Environmental lead contamination in Miami inner-city area

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**Objectives:** The purpose of the study was to evaluate the magnitude of environmental lead contamination in the downtown area of Miami. **Methods:** Lead inspections took place at 121 homes in Little Haiti and Liberty City and involved the collection of representative samples from floors, window wells, tap water, soil and air. Community health workers (CHWs) trained in interview and safety techniques went from door to door to enlist participation. On-site investigations were tailored to areas most utilized by children under the age of 6 years. The presence of lead-containing paint was also investigated *in situ* via X-ray fluorescence (XRF) analysis. **Results:** Of the sampling areas, the window wells area had the most abundant occurrence of lead. On analysis, 24% of sites returned window well samples with lead levels above Department of Housing and Urban Development (HUD) guidelines. Of the soil samples, the playgrounds around the house had the highest concentration of lead. Soil sampling demonstrated that 27.5% of sites returned samples with lead levels (400 to 1600 ppm) in excess of HUD/Environmental Protection Agency (EPA) standards. Positive XRF readings in one or more components were returned by 18% of sites. **Conclusions:** More than half of the houses in these two neighborhoods exhibited unacceptably high levels of lead dust and soil in areas where children live and play. Limitations of this study did not allow the assessment of how many children in this area are affected. A more comprehensive study including other areas of Miami-Dade County with older housing stock is recommended.
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**Keywords:** *African American, childhood lead poisoning, child under 6 years of age, environmental sampling, Hispanics, pre-1950 housing.*

## Introduction

### *Lead Poisoning Background in the United States*

In the United States, lead exposure has been dramatically reduced over the last two decades because of the phase-out of lead from gasoline, food, beverage cans, house paint, as well as limitations of its use in industrial emissions, drinking water, consumer goods, hazardous waste sites, and other sources. Nevertheless, it remains a primary public health problem that needs to be addressed especially in old major US metropolitan areas.

Lead is highly toxic, especially to children under 2 years of age. In the second year of life, the still unfinished maturation of the brain coincides with peak blood-lead concentration as children explore their environments with increasing ambulatory and oral intensity. Lead not only diminishes intellectual capacity, but it also causes loss of hearing, reduces hand–eye coordination, impairs the ability to pay attention, and creates a propensity toward violence, diminishes the ability to handle stress, and may lead to violent outbursts. In addition, lead can harm a child's kidneys, bone marrow, and other body systems. At higher levels, lead can cause coma, convulsions, and death.

Numerous studies have shown that there is no "safe" dose of lead in children's blood. According to the National Research Council (NRC, 1993), there is growing evidence that even very small exposures to lead can produce subtle effects in humans. Therefore, safety guidelines should drop below 10 $\mu$g/dl as the mechanisms of lead toxicity are now better understood. The NRC offered evidence that lead at 5 $\mu$g/dl (half the official "safe" level) can cause attention deficit in children and in monkeys; reduced birth weight in children; and hearing loss in children (NRC, 1993). At the recent Joint Meeting of the Pediatric Academic Societies and American Academy of Pediatrics in Boston, Lanphear et al. (2000) reported that the current limit of 10 $\mu$g/dl is "inadequate to protect the children," and should be at least half that amount. Inverse associations were observed between blood-lead concentration and deficits in cognitive

1. Abbreviations: MDCHD, Miami-Dade County Health Department; XRF, X-ray fluorescence; HUD, Housing and Urban Development; EPA, Environmental Protection Agency; CLPP, Childhood Lead Poisoning Prevention; FIU, Florida International University; WHO, World Health Organization; CHW, community health worker; $\mu$g/dl, micrograms per deciliter; $\mu g/m^3$, micrograms per cubic meter; ppm, parts per million; ppb, parts per billion; $\mu g/ft^2$, micrograms per square foot

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functioning and academic achievement in children at levels below 5.0 μg/dl (Lanphear et al., 2000).

*Lead Poisoning Background in Miami, Florida*

Recent findings in urban dwellings of Miami-Dade County invalidated the assumption that Miami did not have any old housing stock with lead based paint and that the ban of the use of lead in gasoline had eliminated the lead poisoning problem. In fact, Miami-Dade County has 12% of older housing built before 1950 (Florida has 7.7%), where an overwhelming majority of African American and Hispanic families reside in old and deteriorating housing. Census data indicate that over 230,000 children under 6 years living in this area are at risk for lead poisoning. However, blood-lead screening of these children-at-risk does not surpass 10%. It is therefore not surprising that the Miami-Dade County Health Department (MDCHD) has received per year more than 500 reports of newly diagnosed children with elevated blood-lead levels since 1995.

During the period 1995–1998, the Miami-Dade County Childhood Lead Poisoning Prevention (CLPP) Program received 2006 reports of newly diagnosed children with elevated blood-lead levels in the county. The analysis of these reports revealed a small area in Miami that contained the highest number of cases of lead poisoning (more than 50% of the reported cases in Miami-Dade County for the period 1995–1998). Indeed, according to forecasts developed by CACI (1997) from the 1990 US Census database, about 50% of the housing units were built in or before 1959 in this area. The area is located in zip codes 33125, 33127, 33128, 33136, 33137, 33138, 33142, 33147, and 33150 (Figure 1).

The CLPP Program additionally examined the 1990 Census data to identify zip code areas in the county where more than 25% of housing was pre-1950 (MDCHD, 1999). Of the 11 such zip code areas in the county (Figure 1), only 3 (33139 and 33140 in Miami Beach, and 33134 in Coral Gables) were found to have small populations of children under 6 years of age. Small proportions of these children were reported with lead poisoning. The housing stock is generally in good repair.

The remaining eight zip code areas — zip codes 33138, 33137, 33127, 33136, 33128, 33130, 33135, 33145 — with high percentages of old housing comprise the inner-city urban area of Little Haiti, Liberty City, and Little Havana (MDCHD, 1999).

These areas have high proportions of at-risk children and most of the housing stock is in deteriorating and dilapidated condition. The inner-city urban area is composed mainly of one-story wood-framed houses in poor repair. In the South Florida climate, windows and often doors are kept open most of the year. Many homes in the inner-city urban area lack air conditioning, increasing the need to keep the house well ventilated and open. This combination of small, open

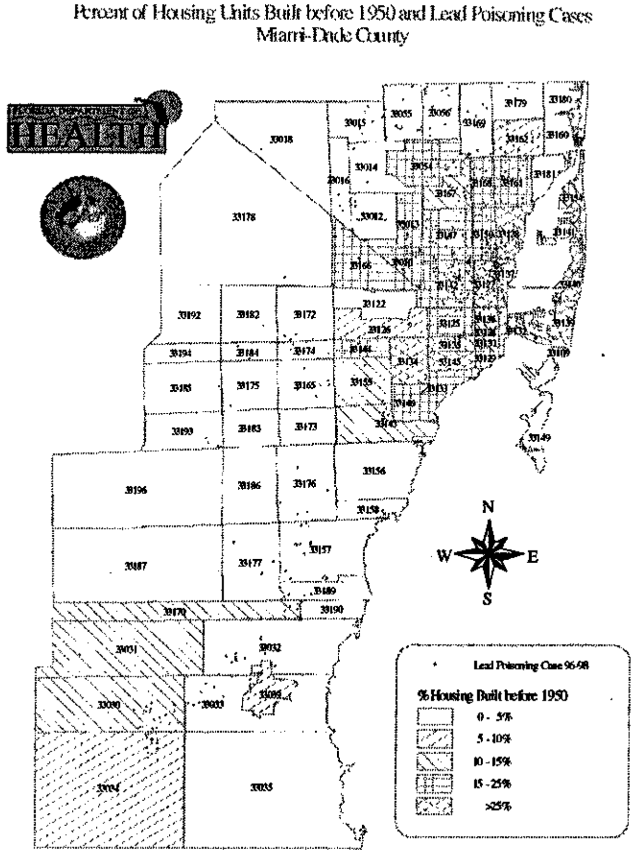


**Figure 1.** Lead poisoning cases (1996–1998) and percent of housing built before 1950 in Miami, FL.

homes surrounded by uncovered dirt yards in areas known to contain lead-contaminated soil contributes to another significant problem: lead-contaminated house dust. House dust is contaminated by lead-based paint in the home as well as by lead-containing soil in the yard. The CLPP Program has identified lead-contaminated soil and potentially house dust containing lead from soil as major sources of childhood lead poisoning in the county (MDCHD, 1999). A statewide study also identified having a dirt yard as the most important risk factor for 2-year-olds developing lead poisoning in Florida (Hopkins et al., 1995). Children's yearlong outdoor play greatly increases the duration of their potential exposure to lead in soil. In addition, children often take food outdoors and eat in the yard.

There is little information about the number of children screened for lead poisoning in Miami-Dade County because only children with elevated levels are reported to the CLPP Program. The Florida Childhood Lead Poisoning Surveillance Program states that of Florida's seven most populous counties, Miami-Dade County ranks last in screening children for lead poisoning, estimating that only 4% of children under 6 years of age in the county were screened during the period 1993–1998. Federal investigators say most states are flouting a 1989 law requiring that young children on Medicaid be tested for lead poisoning. As a result, they say, hundreds of thousands of children exposed to dangerously high levels of lead are neither screened nor treated. The General Accounting Office, an investigative arm of Congress, found that "few Medicaid children are screened for blood-lead levels," even though lead poisoning is concentrated in low-income communities with children on Medicaid.

While African Americans comprise only 21% of the population of Miami-Dade County, 53% of the reported cases of childhood lead poisoning from 1995 to 1998 were among African American children. However, the study area is mostly inhabited by African Americans (more than half), followed by Hispanics (more than one third) and white and other (about 10%). Uncovered dirt yards in the inner-city urban area of Miami-Dade County are the sources of exposure for the majority of cases of childhood lead poisoning. A well-kept dirt yard has a wide acceptance among African American and Caribbean Black communities. The packed-dirt yard, which is often swept, has its origins in Africa where it is still common. This tradition was reestablished by African slaves in the southern US, including Georgia and Florida, and endures to this day. New Haitian and other Caribbean immigrants who settle in Miami's inner-city urban area often continue this tradition of a well-kept, packed-dirt yard. This is most likely associated with this high number of cases in black children. Hispanics make up 59% of the county's population and accounted for 31% of the reported childhood lead poisoning cases (MDCHD, 1999).

Additionally, an increase in the number of lead poisoning cases has been detected by the MDCHD in the children of Cuban and Haitian immigrants, who are tested at refugee centers on arrival. There may be children from other countries. The Health Department officials simply don't have the data.

## Methods

### *Design*

Using Bresser's Criss-Cross Directory CD-ROM, the personnel of the Project drew a random sample of 137 children under 6 years of age in the two areas heavily affected by lead poisoning (Liberty City and Little Haiti) from the total number (24,682) of children at risk of lead poisoning. A team of community health workers (CHWs) trained in interview and safety techniques went from door to door to enlist participation. Case subjects were defined as any child under the age of 6 years old at risk of lead poisoning and were recruited through direct contact with the caretaker of the child (mother, father, grandmother, etc.). No more than one subject was recruited from any one home site, and consent for participation of the child obtained from the caretaker.

Eligibility for recruitment also included the willingness of parents to accompany their child to the Liberty City Health Services Center for a blood test (in a van rented by the project), and submission of the household to lead inspection. Parents were additionally required to answer questions on their child's risk for lead poisoning. Subjects were given T-shirts and educational brochures on lead exposure as an incentive for participation.

### *Sample*

Power analysis indicated that a sample size of 137 was sufficient to test the hypothesis. A random sample of 137 children from households in areas located in downtown Miami, namely Little Haiti and Liberty City, was drawn. Of the 137 eligible participants, only 121 children participated in the study, yielding an average response rate of 88.3%. Barriers to children participating included absence of the consenting participants and refusal by some parents on the day of the survey, and access restrictions to certain households.

The results of the survey showed a study population that is made of 56% of African Americans, 35% of Hispanics, and 9% of white and other. This was expected since the target areas were to represent the minority population who are considered the most at-risk group for lead exposure. The survey also showed that the majority (70%) of study subjects were in the age range of birth to 5 years. Data also revealed that approximately 50% of the households were run by single parents, with 68% of these aforementioned families having an annual household income of $8,000.00 — an economic indicator of living 100% below the poverty level.

### *Measurements and Analysis*

Lead inspections were performed at 121 homes in the 33127, 33137, 33138, 33142, 33147, and 33150 zip code areas. Inspections involved the collection of representative samples from the floors, windowsills, window wells, tap water, soil, and air. In addition to samples collected for analysis, the presence of lead-containing paint was investigated *in situ* via X-ray fluorescence (XRF) analysis. The inspections of the homes were tailored to the subject of the investigation. Areas indicated as most utilized by the subject child were targeted during the on-site investigations.

The environmental sampling methods used during this study were conducted following a modified version of the US Housing and Urban Development's (HUD) "Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing" and "Workable Plan for the Abatement of Lead-based paint in Private Owned Housing," together with Environmental Protection

Agency (EPA) potable water and OSHA air sampling methods.

The on-site inspection of lead-based paint consisted of testing a maximum of three rooms. Rooms were selected by time and motion studies as defined by the parent's or child's representative description of child activities. The component type of and the substrate in each room was identified and combined for a representative sample. Lead-based analyses were conducted by direct reading XRF using a Niton XL spectrum analyzer (Billerica, MA).

A composite air sample was collected from three indoor locations within each housing unit included in the project, namely in the bedroom, the living room, and the dining room. An average of 860 l of air was collected during the study utilizing a Gast Allegro high-flow pump (Benton Harbor, MI). The sampling media was placed at a height predetermined to be most representative of the child's primary breathing area. Once in the laboratories, air samples were prepared according to US EPA method 3050 and analyzed following US EPA methods 7420 and 7421.

For each housing unit, two representative water samples were collected from the faucet used to supply the child with potable water: one "plug" (first draw) followed by a "flow" sample (after 30 s). Efforts were made to conduct the water sampling in early morning; however, most occupants preferred to have their home tested later in the day. Once in the laboratory, samples were digested, prepared, and analyzed according to the 18th edition of Standards Methods via Atomic Absorption Spectrophotometer or Inductively Coupled Plasma.

Surface dust testing for lead was executed using the wipe sampling technique. Three dust samples were taken from each dwelling using commercially available wipes moistened with a nonalcoholic wetting agent. Surface sampling was conducted utilizing an SKC wipe acrylic template for lead (Eighty Four, PA) (Cat. No. 225-2406), and when dwelling floor characteristics impeded the use of the template, the surface to be sampled was measured using retractable measurement tape and its values were recorded in the chain of custody for sampling area computational purposes. Samples were prepared according to US EPA method 3050 and analyzed following US EPA method 7082. A flame atomic absorption spectrophotometer and inductively coupled plasma analyzer (Perkin Elmer, Norwalk, CT) were utilized for the analyses.

A five-part composite sample was collected from bare, unvegetated areas located near the dwelling in the child's play areas, or near the dripline. Samples were collected by coring, or scooping the top half-inch of soil from five independent areas and combining them into a composite sample. In the laboratory, samples were digested and analyzed according to the 18th edition of Standards Methods via atomic Absorption Spectrophotometer or Inductively Coupled Plasma.

## Results and discussion

### *Study Sample Composition*

The final subject base included 121 households. As shown in Table 1, blacks constituted the majority of the participants (56%) and Hispanics, 35%, while they only represented, respectively, 13% and 12.5% of the US population in the 2000 census data. Whites, however, represented 2% in the study population, while they represented 64% of the US population. The "Other" category was 6.9%, while it usually represented 10% of the US population.

The survey showed that the study participants had the worst annual household income as compared to the general US population. For example, 48% had income under \$2500.00 while households with an income under \$2500.00 in the general US population were only 1.6%. Of the study participants, 31% had an income of more than \$7500.00 compared to 63% of the general US population. The participating households had more children under 5 years of age (70%) compared to 48% in the general US population.

Considering marital status, the "single/never been married" people were 50% compared to 26% in the general US population.

**Table 1.** Demographic characteristics of study population (121 subjects) comparison with US population and/or appropriate segments of US population.

| | Study population, % | US population, %, 2000 census |
|---|---|---|
| *Race/ethnicity* | | |
| Black | 55.9 | 13 |
| Hispanic | 35.2 | 12.5 |
| White | 2 | 64.4 |
| Other | 6.9 | 10.1 |
| *Annual household income** | | |
| Under \$2500 | 48.2 | 1.6 |
| 2500 to \$4999 | 10.3 | 1.23 |
| 5000 to \$7499 | 10.3 | 3.11 |
| >\$7500 | 31.2 | 62.86 |
| *Age* | | |
| Under 5 years | 70.4 | 48.27 |
| 5 to 9 years | 29.6 | 51.72 |
| *Marital status* | | |
| Single/never married | 49.65 | 26.44 |
| Legally married | 41.37 | 53.52 |
| Separated | 3.44 | 2.27 |
| Divorced | 2.06 | 8.32 |
| Widowed | 3.44 | 7.39 |
| *Gender* | | |
| Male | 50.3 | 48.86 |
| Female | 49.7 | 51.13 |

*US population annual household income taken from 1999 US census.

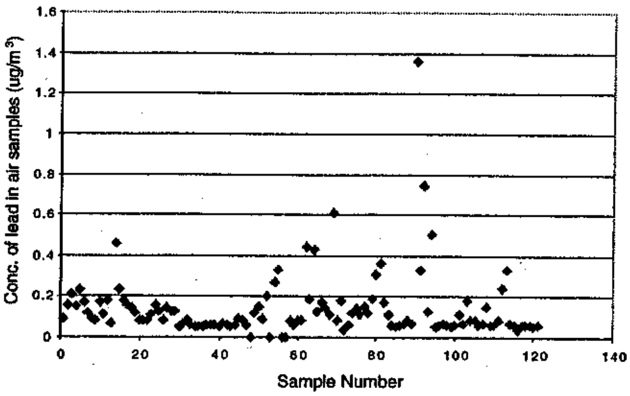


**Figure 2.** Distribution of lead in air samples ($n$ = 121).

Most of the people in the study area did not know anything about childhood lead poisoning. Some of the study subjects were Haitians, and they do not trust strangers coming to their doors and asking personal questions. To convince them and the rest of the study subjects we relied on CHWs. With the help of Miami-Dade Resident College, the research team was able to apply the concept of the primary health care worker or CHW, a concept that originated with United Nations World Health Organization (WHO) and which has been widely used by many countries across the world (WHO, 1978). These CHWs were lay people from the study area that were trained in interview and safety techniques. They went from door to door, they contacted and explained to the families that first, they had to answer questions on their child's risk for lead poisoning; second, they had to take their child to the local Health Center (Liberty City Health Services Center) for a blood-lead test on a van rented by the Project; and third, a team of environmental specialists had to go to their home and perform lead assessment inside and outside their home where the child spent most of his/her time, to test paint, dust, soil, air, and drinking water for their lead content. Most of the families refused to let their children give blood in order to figure out their blood-lead levels. That was why the research team concentrated their efforts on the survey and the assessment of the environmental lead levels.

**Table 3.** Summary of lead poisoning results as compared to HUD/EPA standards.

| Medium | HUD/EPA Standard | No. of samples (%) | |
|---|---|---|---|
| | | Above HUD/EPA Standard | Below HUD/EPA Standard |
| Air ($\mu g/m^3$) ($n$ = 121) | 15 | 0 (0) | 121 (100) |
| Water plug (ppb) ($n$ = 120) | 15 | 3 (2.5) | 117 (97.5) |
| Water flow (ppb) ($n$ = 121) | 15 | 1 (0.8) | 120 (99.2) |
| Floor dust ($\mu g/ft^2$) ($n$ = 121) | 40 | 13 (10.7) | 108 (89.3) |
| Window sill ($\mu g/ft^2$) ($n$ = 121) | 250 | 7 (5.8) | 114 (94.2) |
| Window well ($\mu g/ft^2$) ($n$ = 118) | 400 | 28 (24) | 90 (76) |
| Soil (ppm) ($n$=121) | 400 | 33 (27.3) | 88 (72.7) |

## *Analysis of Lead in Different Media*

*Lead-Based Paint Determination by XRF* Lead-based paint analyses were conducted by direct reading XRF using a Niton XL spectrum analyzer. Sampling was conducted in accessible areas in the child's sleeping quarters and additional rooms where the child spent the majority of the day. Twenty-one sites (18%) returned positive XRF readings in one or more components while 98 (82%) returned negative XRF readings in one or more components. Heads of two households refused the use of the XRF analyzer in their houses. The majority of lead-based paint was encountered on the doors and window casings.

*Air Samples* Air samples were collected in 121 houses. The volume of air collected for each representative sample ranged from 540 to 1277 l. A single site exhibited slightly elevated levels at 1.36 $\mu g/m^3$. The remaining sites returned levels below 0.75 $\mu g/m^3$ (Figure 2). The mean was 0.14 with a standard deviation of 0.2 while the median was 0.08 (Table 2). All samples collected were below the HUD/EPA National Ambient Air Quality Standards Lead permissible levels of 1.5 $\mu g/m^3$ (Table 3).

**Table 2.** Distribution of lead analysis results in different media.

| Medium | HUD/EPA Standard | Sum | Mean | SD | Median | Mode | Max. | Min. | Range |
|---|---|---|---|---|---|---|---|---|---|
| Air ($\mu g/m^3$) ($n$ = 121) | 15 | 17 | 0.14 | 0.2 | 0.08 | 0.06 | 1.36 | 0 | 1.36 |
| Water plug (ppb) ($n$ = 120) | 15 | 514 | 4.25 | 15 | 1 | 1 | 150 | 1 | 149 |
| Water flow (ppb) ($n$ = 121) | 15 | 214 | 1.77 | 3 | 1 | 1 | 34 | 1 | 33 |
| Floor dust ($\mu g/ft^2$) ($n$ = 121) | 40 | 1,667 | 13.77 | 20 | 8.30 | 13 | 150 | 0.80 | 149 |
| Window sill ($\mu g/ft^2$) ($n$ = 121) | 250 | 11,709 | 96.77 | 417 | 11 | 17 | 3,500 | 0.69 | 3499 |
| Window well ($\mu g/ft^2$) ($n$ = 118) | 400 | 127,583 | 1054.4 | 7248 | 170 | 120 | 78,000 | 4 | 7796 |
| Soil (ppm) ($n$=121) | 400 | 33,283 | 275 | 315 | 153 | 25 | 1,612 | 25 | 1587 |

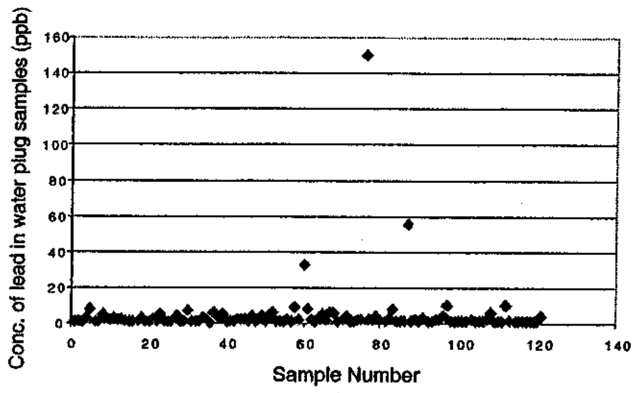


**Figure 3.** Distribution of lead in water plug samples ($n$ = 120).

*Potable Water Analysis Results* One plug sample accompanied by a flow sample was collected from each site participating in the study. A total of 120 sites were sampled. Potable water plug sample results ranged from 1 to 150 ppb (Figure 3). The mean was 4.25 ppb with a standard deviation of 15 ppb while the median was 1 ppb (Table 2). Three plug samples (2.5% of the sites) (Table 3) returned levels above the HUD/EPA guidance level (15 ppb), namely site nos. 76, 87, 60 of concentrations 150, 56, and 33 ppb, respectively, while 118 (97.5% of the sites) returned levels below the HUD/EPA guidance level (15 ppb). Of the samples taken from the faucets, 87.5% had concentrations below 5 ppb, 12 sites (10%) between 6 and 10 ppb and none between 11 and 15 ppb.

Lead levels in the flow samples ranged mostly from 1 to 13 ppb (Figure 4). A single home (0.8 ppb) returned high levels of 34 ppb above the EPA 15-ppb standard while 120 homes (99.2%) returned levels below the HUD/EPA 15-ppb standard (Table 3). One hundred sixteen sites (96% of the homes) returned concentrations below 5 ppb. Five sites (4% of the homes) returned values above 6 ppb. The mean was 1.77 ppb with a standard deviation of 3 while the median was 1 (Table 2). High concentrations in the flow samples are indicative of a potential system-wide lead problem. If a plug sample returns a lead concentration that is considerably greater than is encountered in the flow sample, the localized lead source of lead is most likely at the distal outlet (faucet and/or fittings themselves). In this case the problem is relatively simple to correct, unlike in cases where both the plug and flow samples have high lead concentrations, a more widespread problem may exist possibly requiring the replacement of the entire plumbing system. This is the case of the site no. 87, which had 56 and 34 ppb in plug sample and flow sample, respectively.

*Floor Dust Wipe Sample Results* The lead concentrations in the floor dust samples ranged from 0.8 to 150 $\mu g/ft^2$ (Figure 5). One site (no. 101) was found with a concentration nearly four times higher than the HUD/EPA guidelines of 40 $\mu g/ft^2$. The mean was 13.77 ppb with a standard deviation of 20 while the median was 8.30 (Table 2). Thirteen (11%) of sites tested were found to be above HUD/EPA guidelines while 108 (89%) were below HUD/EPA guidelines (Table 3). Thirty-five sites (29%) had concentrations in the range of 11 to 40 $\mu g/ft^2$. Seventy-three sites (60% of the sites) returned concentrations below 10 $\mu g/ft^2$.

*Window Sill Dust Wipe Sample Results* Windowsills and window well areas are the primary areas where lead is likely to be encountered in homes. This results from the common practice of using lead-based paint on windows and their associated components as a result of its durability. The friction caused by the repetitive motions associated with the opening and closing of the windows results in the breakdown and accumulation of the paint in these areas. Many

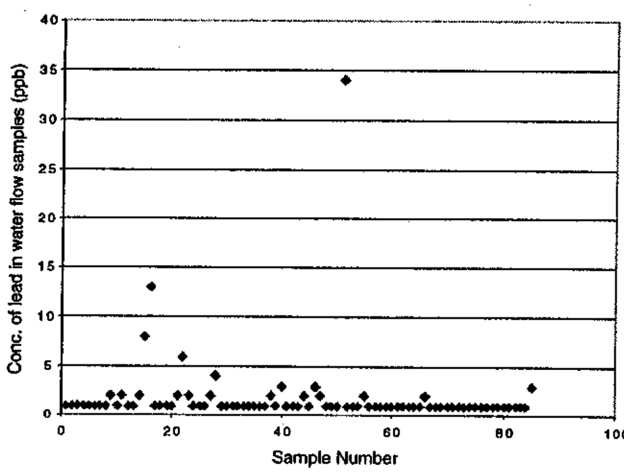


**Figure 4.** Distribution of lead in water flow samples ($n$ = 121).

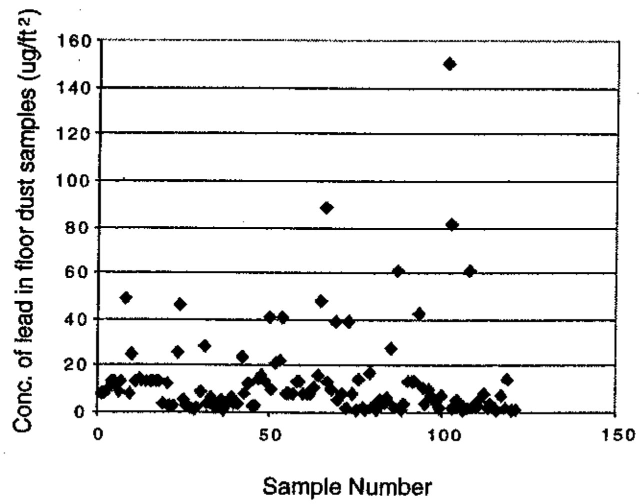


**Figure 5.** Distribution of lead in floor dust samples ($n$ = 121).

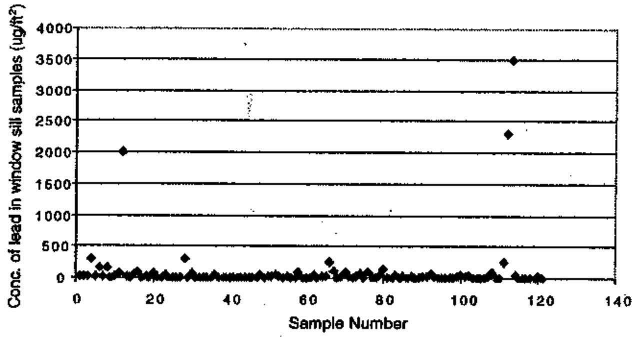


**Figure 6.** Distribution of lead in window sill samples ($n$ = 121).

homes included in the survey did not have traditional window wells. The typical window well is a trough, which the base of a window slots into when closed. These windows are opened and closed by sliding up and down. Many windows in the homes inspected did not open vertically, but opened outwards on hinges. In these cases, samples were collected from the ledge below the lowest windowpane. Dust wipe samples were collected from windowsill areas at 121 sites. The lead concentrations ranged from 0.69 to 3500 $\mu g/ft^2$ (Figure 6 and Table 2). The mean was 96.77 ppb with a standard deviation of 417 while the median was 11 (Table 2). HUD/EPA guidelines call for levels below 250 $\mu g/ft^2$. Seven sites (6%) returned levels in excess of 250 $\mu g/ft^2$ while 114 (94%) returned levels below 250 $\mu g/ft^2$. Ninety-three sites (77% of the sites) returned values below 40 $\mu g/ft^2$, and of these, 84 sites (69%) were below 25 $\mu g/ft^2$. Twenty-one sites (17%) returned values ranging between 40 and 250 $\mu g/ft^2$.

*Window Well Dust Wipe Sample Results* A total of 118 sites had window well samples collected from them (3 sites did not have window well areas). Window well dust concentrations ranged from 4 to 78,000 $\mu g/ft^2$ (Figure 7 and Table 2). The levels encountered in the window well areas reflect the highest concentration of lead and the most abundant occurrence for all the sample areas investigated. The mean was 1054.4 $\mu g/ft^2$ with a standard deviation of 7248 $\mu g/ft^2$ while the median was 170 $\mu g/ft^2$ (Table 2). HUD/EPA guidelines call for levels below 400 $\mu g/ft^2$. Twenty-eight sites (24%) returned levels above the HUD/EPA guidelines while 90 sites (76%) returned levels below the HUD/EPA guidelines (Table 3). Fifteen (13%) returned levels between 300 and less than 400 $\mu g/ft^2$, 11 sites (9%) between 200 and less than 300 $\mu g/ft^2$, twenty-three sites (19%) between 100 and less than 200 $\mu g/ft^2$, and forty-one sites (35%) below 100 $\mu g/ft^2$.

*Soil Sample Results* Lead is encountered in soil due to weathering of exterior lead-based paints, from airborne contamination from leaded gasoline, or industrial point-source pollution. A five-part composite sample was collected from exposed areas around 121 sites. There are currently no Federal health based standards for lead in soil. HUD and the EPA have developed guidelines to assist with lead hazard determination. The concentrations cited in this guideline are based on exposed soil with given areas and specific criteria associated with usage.

Lead concentrations ranged from 0.0025% (25 ppm) to 0.1612% (1,612 ppm) (Figure 8 and Table 2). Thirty-three sites (27.5%) returned levels ranging from 0.04% (400 ppm) to 0.16% (1600 ppm), significantly higher than the HUD/EPA 0.04% (400 ppm) guidance levels for high-contact play areas while 88 sites (72.5%) returned levels below HUD/EPA guidance levels (Table 3). Forty-five sites (37%) had concentrations ranging from 0.01% (100 ppm) to less than 0.04% (400 ppm). Forty-three sites (35.5%) had concentrations below 0.01% (100 ppm).

The findings of our study showed that 55% of the homes inspected returned elevated lead levels in one or more areas when compared to USEPA/HUD guidelines. The area has about 50% of the housing units built in or before 1959 and it is characterized by the presence of old buildings in deteriorating conditions and abandoned car parts. The study results confirmed the fact that the area has consistently reported more than 50% of the cases of elevated blood-lead levels in Miami-Dade County for the period 1995–1998.

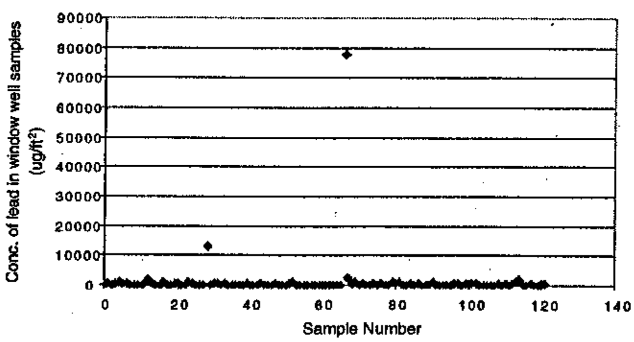


**Figure 7.** Distribution of lead in window well samples ($n$ = 118).

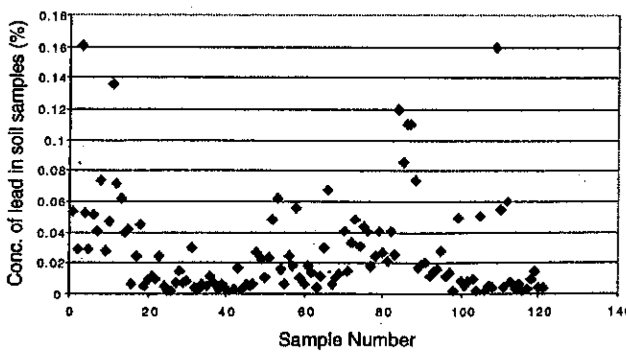


**Figure 8.** Distribution of lead in soil samples ($n$ = 121).

## Conclusion

The target study area was primarily inhabited by blacks (56%) followed by Hispanics (35%). The study participants had the lowest annual household income in the country. The CHWs were able to get a very good response rate (88%) at least with regard to the environmental lead assessment. Among the media that had lead levels above the HUD/EPA standards, the soil samples had the most (27.5%) followed by window well dust wipe samples (24%), floor dust samples (11%), and windowsill dust wipe samples (6%). The overall picture of the results showed that more than half of the houses (55%) in Liberty City and Little Haiti had unacceptably high levels of lead dust and soil in areas (both inside and out) where children lived and played. The study results supported the fact that the area has consistently reported more than 50% of the cases of elevated blood-lead levels in Miami-Dade County for the period 1995–1998.

More than 24,000 children in Liberty City and Little Haiti are at risk of lead poisoning. At least as many children in other zip code areas such as Little Havana, Homestead, and Florida City are also at risk of lead poisoning. These zip code areas have similar high-risk characteristics, pre-1950 housing with lead-based paint in dilapidated condition, inner-city location, low-income neighborhood.

Unlike cities in the Northeast or Midwest, which have older housing stocks, Miami has paid very little attention to lead risks because the houses by comparison are relatively new. People tend to forget that soil contaminated with lead is the legacy of decades of use of lead additives in gasoline (for more than 70 years) and paints (for more than 80 years). There is a common perception that lead-based paints alone account for the amount of lead in the environment. In reality, both sources of lead contribute to the problem as just revealed by the results of this study in Miami.

According to the Alliance Against Childhood Lead Poisoning, Miami-Dade County had 10 times more homes — 15,000 — with a high risk of lead exposure than Broward County, and 3 times more than any other Florida county. Alliance's calculations are based on the number of homes in each county built before 1950 — the period when lead-based paint was widely used.

HUD officials report that our findings are consistent with lead hazards of homes that have young children in other inner-city areas. Officials say that 39% of homes that have one or more children younger than six have dust lead levels that exceed the agency's safety standard. This study was the first attempt to gauge the level of lead in older homes in South Florida in selected neighborhoods in Liberty City and Little Haiti. There was no way to assess how many children have been affected. Most of the families refused to have their children give blood for lead test. After all the prejudice and discrimination they had faced with regard to HIV/AIDS, the residents in the target area had good reason to distrust outsiders asking to get the blood from their children. A larger and more comprehensive study is recommended including areas of Miami-Dade County that have older housing stocks in dilapidated condition.

## Acknowledgments

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