CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

A SURVEY FOR CHILDREN EXPOSED TO LEAD PAINT
IN THE SOUTHEAST HEALTH DISTRICT
OF LOS ANGELES COUNTY

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Science in
Health Science

by

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June, 1974
I would like to dedicate this thesis
to my wife Vera,
to my daughter Cheryl,
and to my son Dericks.
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## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedication</td>
<td>iii</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>iv</td>
</tr>
<tr>
<td>List of Tables</td>
<td>viii</td>
</tr>
<tr>
<td>Abstract</td>
<td>ix</td>
</tr>
</tbody>
</table>

### CHAPTER

#### I. INTRODUCTION

- Purpose                                           | 1  
- Null Hypothesis                                   | 3  
- Assumption                                         | 3  
- Importance of the Study                            | 4  
- Limitations of the Study                           | 5  
- Definitions of Significant Terms                   | 6  
  - Used in the Study                                 | 6  

#### II. REVIEW OF THE LITERATURE

- Some Campaign Histories                            | 7  
- Hospital Survey                                    | 11 |
- Factors Related to Cause and Incidence of Childhood Lead Poisoning | 14 |
  - Pica, Psychological and Social Factors            | 14 |
  - Dilapidated Housing                               | 15 |
  - Lack of Awareness                                 | 16 |
Medical Aspects of Childhood
Lead Poisoning ........................................ 17
Signs and Symptoms .................................. 17
Tests ...................................................... 17
Diagnosis ............................................... 18
Treatment .............................................. 18

Prevention and Control ............................. 18

Summary .............................................. 19

III. METHODOLOGY OF THE STUDY ............... 22

Location of the Study ............................... 22

Procedure for the Study ......................... 24

Test Used for the Study ......................... 24
Test Method ......................................... 25

IV. RESULTS ........................................... 27

Findings from Samples ............................. 27

Children Present ................................. 31

Findings of Other Related Factors Which May Enhance the Risk of
Plumbism ............................................. 36
Pica ..................................................... 36
Crowding Conditions .............................. 38
Family Relationships .............................. 40
State of Occupancy ................................. 42
Duration of Occupancy ............................ 42
Ethnic Background ................................. 45

Feasibility of the Test Used in the Study .... 45

Environmental Sanitarians Are Trained Personnel ........................................ 47
Some Academic Requirements for Sanitarians .............................................. 47
One Duty Performed by Sanitarians ................. 48

"T" Test Formular ................................ 49
### V. CONCLUSIONS, RECOMMENDATIONS AND SUMMARY

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conclusions</td>
<td>50</td>
</tr>
<tr>
<td>Recommendations</td>
<td>50</td>
</tr>
<tr>
<td>Lead Test Administered by Sanitarians</td>
<td>50</td>
</tr>
<tr>
<td>Legislation</td>
<td>51</td>
</tr>
<tr>
<td>Expand Lead Screen Project</td>
<td>52</td>
</tr>
<tr>
<td>Education</td>
<td>52</td>
</tr>
<tr>
<td>Summary</td>
<td>52</td>
</tr>
<tr>
<td>Bibliography</td>
<td>55</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Samples Collected from Interior and Exterior Surfaces</td>
<td>29</td>
</tr>
<tr>
<td>2.</td>
<td>Lead Levels Found in Households Sampled</td>
<td>30</td>
</tr>
<tr>
<td>3.</td>
<td>Age of Children Living in Homes Sampled</td>
<td>32</td>
</tr>
<tr>
<td>4.</td>
<td>Lead Levels Accessible to Susceptible Children</td>
<td>33</td>
</tr>
<tr>
<td>5.</td>
<td>Susceptible Age Children Separated Into Two Groups: Highest Risk (0 - 2 Years) and High Risk (3 - 5 Years)</td>
<td>34</td>
</tr>
<tr>
<td>6.</td>
<td>Parents' Knowledge of Children Afflicted with Pica</td>
<td>37</td>
</tr>
<tr>
<td>7.</td>
<td>Crowding Conditions</td>
<td>39</td>
</tr>
<tr>
<td>8.</td>
<td>Family Relationship</td>
<td>41</td>
</tr>
<tr>
<td>9.</td>
<td>State of Occupancy</td>
<td>43</td>
</tr>
<tr>
<td>10.</td>
<td>Duration of Occupancy</td>
<td>44</td>
</tr>
</tbody>
</table>
ABSTRACT

A SURVEY FOR CHILDREN EXPOSED TO LEAD PAINT
IN THE SOUTHEAST HEALTH DISTRICT
OF LOS ANGELES COUNTY

by

Carl Burns Charles

Master of Science in Health Science

June, 1974

This study was conducted to determine the actual risk (not the incidence) of plumbism among small children who lived in homes where chipped and peeling paint contained high levels of lead. It was believed that a knowledge of the lead content of paint associated with old housing within the environment of small children would permit the application of preventive measures to situations that are potentially hazardous. This matter was approached directly by analyzing paint samples collected from the environment of infants and small children. A special sodium sulfide test was utilized to analyze paint samples. The test was selected because it was found to be economical, simple to administer and valid.
It was stated in null hypothesis that: no more than twenty-five percent of the households included in the study would consist of flaking paints that contain potentially hazardous levels of lead, and no more than twenty-five percent of the susceptible children present would be exposed to paint chips which contain excessive contents of lead. Based upon analyses of data collected and lead test findings, the null hypothesis was rejected and recommendations were made, suggesting that sanitarians become more actively involved by routinely utilizing the sodium sulfide test during housing inspections and in assisting with the elimination of this environmental problem.
CHAPTER I
INTRODUCTION

Man's use of lead probably antedates recorded history. By examining artifacts recovered from ancient civilizations it is possible to detect lead in numerous ornaments, water pipes, and eating and drinking utensils. Very likely the occurrence of lead poisoning has paralleled man's use of the element. Although modern man has learned to avoid the use of lead in water pipes and food containers, the heavy metal continues to appear in increasing volume in his environment. Over one million tons of lead are used in the United States by manufacturers each year. It has been estimated that approximately two pounds of lead per person per year are emitted in automobile exhausts (1).

Lead poisoning, (plumbism) was once considered an occupational disease, commonly associated with painters, devotees of moonshine liquor and occasionally a curious child. However, much progress has been made within industries to prevent and control lead poisoning among both adults and children. Even in lead processing and lead-using industries where the possibility of over-exposure
seems greatest, plumbism among adults is rare today. Much of this improvement is due to increasing knowledge concerning the physiological effects of lead, the application of necessary controls and safeguards to prevent over-exposure to lead and improved treatment of lead poisoning.

One problem area remains as a challenge to health workers today. This is the ingestion of lead by children who usually live in city slum areas. The problem results from children eating leaded paints that were applied to walls and other woodwork on the interior surfaces of old buildings, often more than thirty years ago. The New York City Health Department now estimates that there may be as many as 25,000 slum children who pick up lead from chipping leaded points in old buildings, thus creating a "silent epidemic." Some experts feel that the statistics that are used to illustrate the "epidemic" charges are inadequate. This inadequacy of statistics is not only a reflection of the lack of records, but of years of undiagnosed lead poisoned children (2).

A Lead Screening Project aimed at determining the extent of plumbism among children in Los Angeles County is now in progress. The project was initiated during the summer of 1972, by the Department of Community Health Services. At present, results are not conclusive. However,
there are some preliminary indications that plumbism is a problem in Los Angeles County and there appears to be a need for an even broader lead detection program than the one which is now in progress (3).

The aim of this study was to determine if an additional method of detecting lead in paint and plaster samples could be used in a routine inspection by trained personnel. This thesis will consist of a review of the literature on plumbish, a description of a survey of housing in a selected area of Los Angeles County, an analysis of data from the survey, and a summary, including recommendations.

Purpose

The purpose of this study was two-fold: (1) to determine if there was leaded flaking paints and broken plaster associated with housing in Southeast Los Angeles which is accessible to small children, and (2) to determine if a specific simple, inexpensive, but valid test could be used on a routine basis to test the samples of paint and plaster for lead content.

Null Hypothesis

A - No more than twenty-five percent of the households included in the study will consist of
peeling paint that contains hazardous lead levels.

B - No more than twenty-five percent of the children five years of age or younger, who live in households included in the study, will be exposed to paint chips that contain potentially hazardous amounts of lead.

Assumption

A selected economical test that could be administered by trained personnel to determine the lead content in paint samples is not practical.

Importance of the Study

Children who are exposed to hazardous sources of lead may acquire clinically identifiable conditions and subclinical biologic effects. It has been found that clinical lead poisoning in children may result in death, encephalopathy, neuromuscular impairment and general malaise. Subclinical conditions may cause impairment of learning capability and mental retardation (4).

The "high risk" areas for childhood plumbism, especially in large cities, are strongly related to those locations where old deteriorating housing is found. It has been reported that in these areas, because of the
accessibility to flaking paints, broken plaster, pica and a lack of parental supervision, an optimum environment for lead poisoning is provided (5).

If during routine investigations trained personnel collected and tested paint samples for lead content, more complete information could be gathered to aid medical personnel in their evaluation of children who might be suspected of being a lead poisoning victim. Too, action might be taken to rehabilitate the affected environment so that plumbism could be intercepted before children become involved.

Limitations of the Study

The study was limited to a selected area of Los Angeles County. The findings may or may not be representative of other areas of the county. The study was further limited in that the method of collecting samples was not randomized. Homes where samples were collected were chosen mainly on the basis of their external state of disrepair. The test used to determine the lead levels in the samples collected was not a quantitative test, but rather a qualitative reaction. The test, however, produced results very much similar to those found by quantitative methods.
Definitions of Significant Terms Used in the Study

CHELATING AGENTS - Chemicals used for the treatment of lead poisoning. These chemicals bind the lead ions and remove them from body tissues.

HIGH LEAD LEVEL - Paint chips which contained a quantity of lead equal to one percent or more by weight of the dried paint film.

PICA - A condition causing an abnormal craving for non-nutritious substances such as paint, plaster, clay, ashes and charcoal.

PLUMBISM - A term used synonymously with or meaning the same as lead poisoning.

SUSCEPTIBLE CHILDREN - For the purpose of this study susceptible children will refer to those children five years of age or younger.
CHAPTER II

REVIEW OF THE LITERATURE

The etiology, pathophysiology, and epidemiology of plumbism are known. Too, there are practical means available for screening, diagnosis and treatment. However, each year plumbism causes death, mental retardation and other neurological handicaps in a large number of small children (4). DuBois stated, "The problem is so well defined, so neatly packaged, with both causes and cures known, that if we don't eliminate this social crime, our society deserves all the disasters that have been forecast for it" (2).

This chapter will give an analysis of some of the facets of lead poisoning in children based on a review of the literature, and will summarize a personal survey conducted in Los Angeles County during 1970.

Some Campaign Histories

Children suffering from plumbism were admitted to the Hospital for Sick Children in Brisbane, Australia as early as 1891. Evidence was presented in 1904 that plumbism among Brisbane's children was caused by lead paint which
was associated with housing. By 1909 approximately 260 cases of plumbism had been reported in the Brisbane Hospi-
tal and some twenty children were being admitted every year (6) (7).

In 1923 two cases of childhood lead poisoning were reported in Los Angeles, California. In one of the cases, which involved a three-year old boy, it was felt that the correct diagnosis could have been made by any physician who might have called at the child's home. Evidence supporting this feeling consisted of observations of gnawed or chewed paint as high as the child could reach on porch railings, window sills, chairs and enameled door casings. The other case involved a two-year old girl. The girl's mother had observed the child gnawing paint from window sills, and stated that the girl had an uncontrollable desire to chew on any painted objects (8).

Baltimore's Health Department recognized the hazard to children associated with leaded paints as early as 1931. Since 1935, free blood lead determinations have been provided by the Health Department's Bureau of Laboratories to physicians and hospitals. In 1951, Baltimore City adapted a regulation barring the use of paints containing more than one percent lead to be used in interiors of dwellings. In 1957, Baltimore's City Health Commissioners
organized a prevention committee of staff personnel in order to pinpoint sources of lead paint. Through this committee, 667 dwelling units were surveyed and more than seventy percent of the dwellings were found to contain more than one percent of lead in paint samples (9).

Baltimore conducted an intensive "hard sell" during 1962 through 1964 to prevent lead paint poisoning in three census tracts of the city. In this program it was believed that even though urban renewal and reformulations of paints would reduce the amount of lead paint in the home, the presence of lead paint in the older homes would remain for a long period of time. Efforts proved very costly and time consuming for sanitarians to see that all peeling and flaking paints were removed from walls and ceilings of the dwellings located in the census tracts studied (9) (10).

During the early 1960's four census tracts in Cleveland were chosen from "lead belt" sections which consisted of three areas of old housing and one relatively new housing project area. Public Health Nurses made door to door surveys seeking children in desired age ranges by contacting consecutive families. The following information was recorded: the child's birth date, type of home, number of rooms, size of family, physical environment (re: flaking paint, teeth marks on woodwork or holes in plaster), and
the identification of those who cared for the children. A record was made on the history of pica and previous poisonings from a variety of non-food items. Urine samples were collected and analyzed for lead. This study revealed that thirty-eight children from old housing, but none from new housing, had sufficient evidence of lead intoxication (11).

As a result of blood specimens on suspected cases of lead poisoning in New York having been sent to the City Health Laboratories by physicians, the number of cases reported increased from 80 in 1954 to 725 in 1968. During the same period the fatalities among reported cases declined from fifteen percent (twelve deaths) to less than one percent (five deaths) in 1968. During the first eleven months of 1970, 2,500 cases of plumbism were discovered in New York City, and seventy-six percent of the paint samples obtained from dwellings where children with lead poisoning lived revealed positive findings (12).

Since 1956, the Philadelphia Department of Public Health has had a program with the cooperation of realtors, landlords, various industries, and the Society of Friends which has enabled the department to issue specifications and safety standards for the removal of lead paint from interiors (13).
It was once thought by many health officials that the problem of plumbism among children existed only in large cities in the eastern part of the United States. However, a 1971 Illinois survey which involved more than 6,000 children who lived in fourteen intermediate size cities (10,000 to 150,000 population), revealed that almost nineteen percent of the children had high lead levels in their blood. Another survey of twenty-seven cities representing twenty-three states located in the Midwest, South, West, North and East of the United States, involving more than 2,300 children revealed high blood lead levels among children in all but four cities.

The prevalence of plumbism appears to be lower among children who live in rural areas, however, they are not spared from this health problem. A recent survey which was conducted in rural counties located in New York and Connecticut revealed that nine percent of the children had high blood lead levels (14).

Hospital Survey

During the Spring of 1970, after a thorough review of the literature on plumbism resulting from children ingesting leaded paints and plaster from old housing, it was revealed that the literature did not show any reported
cases of such illnesses in Los Angeles County since 1923.

As a result of this finding, the author conducted a survey of major hospitals located throughout Los Angeles County in order to determine if possibly there had been cases of childhood plumbism related to leaded paints and plaster reported but not published. The hospitals were contacted by a personal visit or by a telephone call from the author to the Pediatric Departments.

It was learned from Childrens Hospital that there had been four reported cases of childhood lead poisonings (one each--1960, 1964, 1967 and 1968) since 1960. However, the author was informed that the sources of the lead poisonings were not known and no investigation was made to determine this information (15).

The writer was told that there had been a few cases of childhood plumbism treated in General Hospital since 1960, but the sources of the illnesses had not been determined (16). A Pediatrician stated that he could not recall a single case of childhood lead poisoning in Harbor General within the last ten years. The physician felt that lead poisoning was not a problem among children in California because, "we do not use interior lead based paints any longer" (17).
Cedars of Lebanon had recently treated a small Mexican child for lead poisoning. The source of the lead poisoning was believed to have been either leaded house paint or Mexican pottery containing lead (18). Several other hospitals throughout Los Angeles County were contacted by telephone calls made to the Pediatric Departments. None of these hospitals had treated any lead poisoning cases that were known to have been associated with leaded house paints and plaster.

The Los Angeles County Health Department Laboratory had recently diagnosed three positive cases of childhood lead poisoning which were associated with leaded house paints and plaster. The author was informed that the Los Angeles County Health Department had initiated a limited screening program. Blood samples were being collected and analyzed in an effort to determine if lead poisoning was a problem in Los Angeles County among children who live in older housing. At the time of the survey no conclusive results had been obtained from the program (19).

More recently the author was informed that during the summer of 1972, the Department of Community Health Services of Los Angeles County received Federal Funds to initiate a Lead Screening Project. The objective of the project was to screen small children who live in the Central,
Southeast, Northeast, and East Los Angeles Health Districts, in order to determine if lead poisoning is a problem among small children who live in these particular districts. The above mentioned districts were chosen because statistics indicated that the greatest number of pre-1940 housing was located in these areas. The project commenced during the fall of 1972, and to date, approximately 12,000 children have been screened. Between five and seven percent of the children screened contained more than 40 ug per 100 ml of lead in the blood (3).

The homes of children with high lead levels in their blood are inspected by a Project Sanitarian. Readings for lead content in paints and plaster are taken with an X-Ray Fluorescent (XRF) machine. These readings are made from interior walls, ceilings, floors, window and door frames, baseboards, cribs, toys and furniture. Lead readings are also made on exterior walls of dwellings and play areas. When XRF readings of 1 mg/cm² or more are observed, corrective measures with limited specific enforcement powers are instituted (20).

**Factors Related to Cause and Incidence of Childhood Lead Poisoning**

1. **Pica, Psychological and Social Factors**

   Thirty pica afflicted lower class Black children were
compared with twenty-eight controls in a study conducted by the Research Foundation of Children's Hospital in Washington, D.C. There was no difference between the IQ of the two groups of children. The families of the pica afflicted children were more disorganized, consisted of a number of mothers who were unmarried, and moved more frequently than the families whose children did not have pica (21). Wiener (22) cited work done by Millican and co-workers, which found that the etiology of pica and lead poisoning is often an indicator of a disturbed mother-child relationship. The report stated that mothers of children with pica were more immature, did not relate well with their children, and encouraged their children to practice oral habits.

Studies indicated that in some large cities of the United States pica is most prevalent among Black families who recently arrived from the rural South. It is believed that these families respond to the social and economic deprivations experienced in their traditional rural behavior patterns. One such behavior is clay eating among black women (23).

2. Dilapidated Housing

A special study conducted in Cleveland revealed that 216 of 801 children living in old housing, as compared with
only three of 105 children of similar socioeconomic backgrounds who lived in a new housing project, produced urine samples that were abnormal for lead content. Thirty-eight children from old housing and none from new housing had sufficient evidence of lead intoxication. Flaking leaded paint was the environmental factor most frequently associated with abnormal urine (11).

3. Lack of Awareness

It appears that many physicians are not aware of the magnitude of lead poisoning. Perhaps this is because some physicians seldom encounter plumbism in their practice or because when plumbism is encountered, it is improperly diagnosed. Several hundred confirmed cases of lead poisoning are reported annually in New York City. However, in that same city a large medical center reported that it observed no cases of plumbism over a three-year period (4).

There are those today who equate the manufacture of lead-free paint with the extinction of lead poisoning in children. The fact is that: old housing often still contains several layers of leaded paints; many paints manufactured today for exterior use still contain lead; and people who are unaware of the hazards of lead paint may apply exterior paints on interior surfaces (4).
Medical Aspects of Childhood Lead Poisoning

1. Signs and Symptoms

It is believed that there are many children who have consumed dangerous quantities of lead and have never become convulsive, consequently, never diagnosed nor treated. Lead poisoning in children was often ignored because the preliminary symptoms are: stomach cramps, vomiting, irritability, and constipation, which are so closely related to less severe and more familiar childhood diseases. Severe lead intoxications may cause seizures, ataxia, paraesthesia, and coma, because of the involvement of the central nervous system (2) (5) (9).

2. Tests

A variety of tests have been used to determine lead absorption in the body. Some of the tests used are: peripheral blood studies for hypochronic, microcytic, anemia, and basophilic stippling; urinary coproporphyrin III determinations; serum lead determinations; and x-rays of the long bones and gastrointestinal tracts. Any combination of positive findings by two of the above tests may suggest a tentative diagnosis for lead poisoning (9).
3. Diagnosis

Early diagnosis of lead poisoning depends on early identification of the high-risk child, the high-risk parent, and the high-risk dwelling. Usually the child is a toddler with exaggerated oral activity, the high-risk parent is a mother who does not have adequate resources, either physical or emotional, to cope with the family's needs; and the high-risk dwelling is a neglected housing unit where leaded flaking paints are in reach of small children (24). When diagnosis is not prompt there may be an undue delay in treatment and loss of invaluable time during which irreparable damage may occur (4).

4. Treatment

Treatment of lead poisoning cases usually involves hospitalization for several days as the child is treated with chelating agents (2) (5).

Prevention and Control

There has not been an effective program of prevention developed for the disadvantaged urban child and family. Such a program would require a clear recognition of the pattern of etiologic factors, and a firm commitment of responsibility by the physicians, public health workers, government officials, and the aroused public (23).
Some suggested preventive methods for childhood lead poisoning are as follows: (a) Parents and other responsible persons should be warned of the potential hazards associated with leaded paint interiors and informed to keep children from eating paint chips or chewing painted surfaces. Paint chips should be kept off the floor and out of reach of infants; (b) Flaking paints and plasters should be swept from floors and scraped from walls and ceilings, and effectively covered with approved safe sources; (c) Physicians, public health nurses and others should watch for early symptoms of lead absorption and proceed without delay to see that appropriate tests are made; (d) Diagnosis of suspected lead poisoning victims should be quick and accurate; (e) Proper treatment should begin immediately after positive diagnosis; and (f) Other children in the family should be checked for possible signs of lead absorption whenever a case is found (9) (25).

Summary

The literature has indicated that childhood plumbism was somewhat rare in the general population as a whole. However, lead poisoning is still a problem among children five years of age or younger who live in areas where old housing prevails. Lead poisoning existing in these
sections of the cities is almost directly traceable to the fact that children, many of whom suffer from pica, eat chips of flaking paints from walls and ceilings of old dwellings which were constructed when leaded paints were used on the interior surfaces.

Childhood lead intoxication is neither a new nor simple problem. Medical treatment programs can only be stop-gap measures unless they are accompanied by extensive lead removal efforts. It has been observed in some cities that these programs cannot be conducted effectively under existing housing and health codes, which for the most part do not forbid the existence of peeling paint. Local programs need money in order to improve on research techniques of detection and treatment of plumbism and leaded environments (2).

Until recently, Los Angeles County health officials apparently had made little or no effort to determine the extent of childhood plumbism associated with old housing existing within the county. A Lead Screening Project is now in progress in Los Angeles County. The project was recently initiated by the county Department of Community Health Services. At present, results are not conclusive, however, there are some indications that there is a need for an even broader lead detection program than the one
which is currently being conducted.
CHAPTER III

METHODOLOGY OF THE STUDY

The actual risk associated with children who live in homes that contain high levels of lead paint is not known. It does appear, however, that knowledge of the lead content of paint and plaster associated with old homes within the environment of small children, would permit the application of preventive measures to situations that are potentially hazardous. One of the objectives of this study was to approach the matter directly by analyzing paint samples collected from the environment of infants and children (26).

This chapter will describe the area selected to conduct the study; methods and procedures utilized during the study; and the test that was used to analyze paint samples for lead content.

Location of the Study

The Southeast Health District of Los Angeles County was the location selected to conduct the study. This district was chosen chiefly because it contains a large number
of pre-1940 built dwelling units; is located within the inner city area; and is inhabited by a large number of small children.

Some of the characteristics of the Southeast District are as follows: The District is the smallest geographic unit of the Los Angeles County Community Health Service Department's twenty-three districts. Within its 8.8 square mile area there is an estimated population of 121,377. The population density is 13,793 persons per square mile, which is nearly three times the county average. Eighty-seven percent of the population is Black and this percentage is rapidly increasing. The area is a "portal of entry" for economically, educationally and culturally deprived Blacks, mostly from the rural South. The average resident is an unskilled "school dropout" with a median education of nine years of school. Seventy-five percent of the dwelling units were built before 1939, and approximately the same percentage of the dwellings are controlled by absentee landlords. Nearly thirty-two percent of the population is under twenty years of age. The Southeast District consists of much of the area generally described under the term "Watts" (27).
Procedure for the Study

A questionnaire designed to gather information concerning the following subject matter was prepared: Address and physical condition of the dwelling, areas within and around the home where peeling paint and broken plaster existed and samples were collected, number and age of children living in the household, information regarding parents' knowledge of children suffering from pica, crowding conditions within the home, family relationships, ethnic background, state of occupancy and duration of occupancy.

Personal interviews were conducted with families of the households where samples were collected. The samples were collected and placed in envelope that was attached to each questionnaire. A test for lead content of the samples was performed by the author. The households were selected chiefly on the basis of their exterior state of disrepair. When exterior paint was chipped, flaking, or badly faded and/or the yard area was not properly maintained, an attempt was made to interview the family and collect samples from the dwelling.

Test Used for the Study

The test used in the study was developed and validated by research workers in Rochester, New York. The
test involved the precipitation of lead as an insoluble black sulfide. The reaction was qualitative and the intensity of color change varied directly with the amount of lead present. The test was simple, inexpensive, specific, and could have been performed in the home where peeling paint was found if so desired (18).

1. Test Method

An eight percent solution of sodium sulfide was prepared. The author received assistance with the preparation of the solution from a chemist and the Director of Los Angeles County Public Health Laboratories (29) (30). The solution was dispensed in five ml. polyethylene squeeze bottles. A label "Poison: Harmful to Eyes or if Swallowed" was affixed to the bottle (28).

Two specimens of white paint with known compositions were obtained from a local paint manufacturer (31). One specimen contained approximately twenty percent lead in its dried film. The other specimen contained less than one percent lead in the dried film. The two specimens were used to prepare paint of successive dilutions with lead content as follows: Less than one percent, two percent, four percent, eight percent, twelve percent, sixteen percent, and twenty percent. These dilutions were applied to
small block wood surfaces. The blocks were allowed to dry and then tested with the sodium sulfide solution. When the solution was applied to the painted blocks, gradations in color change ranged from light gray through dark gray to black. The lowest dilution of less than one percent produced a faint gray color. Gradations above twelve percent produced dark colors (made it difficult to approximate lead concentrations over this amount) (28).
CHAPTER IV

RESULTS

The findings of the study are analyzed and discussed in this chapter. A summary of data is presented in tabular form. The data consist of: the number of households included in the study, the total number of children through fourteen years of age living in households where samples were collected, the number of households that revealed potentially hazardous lead contents, and the percentage of children at risk of becoming potential lead poisoning victims. Some demographic data such as: crowding conditions, family relationships, state of occupancy, and duration of occupancy, also are analyzed and discussed. Finally, this chapter discusses the feasibility of the test used in the study and the qualifications of environmental sanitarians to administer the test.

Findings from Samples

Personal interviews were conducted and samples were collected from sixty-seven different households. Each of the households included in the study contained flaking
paint which could have been reached by small children five years of age or younger. Samples from fifty-five dwellings were collected from interior surfaces. Samples were taken from exterior surfaces of twelve households. Data in Table I shows that approximately eighteen percent of the samples were collected from the exterior surfaces of the households. One hundred percent of the exterior samples had more than eight percent lead content. Table 1 further reveals that the lead content ranged from one to more than eight percent in seventy-eight percent of samples collected from interior surfaces.

Table 2 summarizes the percentage of dwellings sampled that contained potentially hazardous levels of lead. An analysis of data presented in Table 2 reveals the following: samples from approximately thirty percent of the households contained lead levels ranging from one to four percent; thirty-one percent of the dwellings had lead levels that ranged from five through eight percent; almost eighteen percent of the dwellings contained lead levels above eight percent; and less than eighteen percent of the households sampled had flaking paint that contained safe lead levels. The table illustrates that eighty-two percent of the households contained peeling paint with potentially hazardous lead contents. A*"t" test produced
<table>
<thead>
<tr>
<th>Samples Collected From</th>
<th>Households Frequency</th>
<th>Households Percent</th>
<th>Lead Levels Below 1%</th>
<th>Lead Levels 1 - 8%</th>
<th>Lead Levels Above 8%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Surfaces</td>
<td>55</td>
<td>82.1</td>
<td>17.9%</td>
<td>61.5%</td>
<td>- *</td>
</tr>
<tr>
<td>Exterior Surfaces</td>
<td>12</td>
<td>17.9</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>67</strong></td>
<td><strong>100.0</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*No Effort Was Made to Determine Whether Interior Samples Contained More Than Eight Percent Lead.*
<table>
<thead>
<tr>
<th>Percent Lead Found</th>
<th>Dwellings Frequency</th>
<th>Dwellings Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less Than One Percent</td>
<td>12</td>
<td>17.9</td>
</tr>
<tr>
<td>One Through Four Percent</td>
<td>22</td>
<td>32.8</td>
</tr>
<tr>
<td>Five Through Eight Percent</td>
<td>21</td>
<td>31.4</td>
</tr>
<tr>
<td>More Than Eight Percent</td>
<td>12</td>
<td>17.9</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>67</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
a score of 12.1. The "t" score appears to show clearly that the eighty-two percent of dwellings that produced samples with positive findings for lead content is significant. In other words, this score is greater than that which could have been expected by chance alone. Therefore, Part "A" of the null hypothesis which states, "no more than twenty-five percent of the dwelling units included in the study will consist of peeling paint that contains hazardous lead levels," is rejected.

**Children Present**

Table 3 contains a summary of data on children living in the households sampled. Data from Table 3 were analyzed as follows: the sixty-seven households included in the study were inhabited by a total of 220 children whose ages ranged from less than one year of age through fourteen years of age; almost fifty-three percent of the children were five years of age or younger; and less than forty-eight percent of the children's ages were above what is considered the most susceptible age range.

Tables 4 and 5 give further analysis of the data by comparing high-risk children with different lead levels found in paint from the households sampled. From Table 4 the following observations were made: less than ten percent
### TABLE 3

**AGE OF CHILDREN LIVING IN HOMES SAMPLED**

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Children Frequency</th>
<th>Children Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>52</td>
<td>23.6</td>
</tr>
<tr>
<td>3 - 5</td>
<td>64</td>
<td>29.0</td>
</tr>
<tr>
<td>6 - 14</td>
<td>104</td>
<td>47.4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>220</td>
<td>100.0</td>
</tr>
<tr>
<td>Percent Lead Found</td>
<td>Children (0-5 years) Frequency</td>
<td>Children Percent</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Less Than One Percent</td>
<td>11</td>
<td>9.6</td>
</tr>
<tr>
<td>One Through Four Percent</td>
<td>24</td>
<td>20.6</td>
</tr>
<tr>
<td>Five Through Eight Percent</td>
<td>36</td>
<td>31.0</td>
</tr>
<tr>
<td>More Than Eight Percent</td>
<td>45</td>
<td>38.8</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>116</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
**TABLE 5**

SUSCEPTIBLE AGE CHILDREN SEPARATED INTO TWO GROUPS: HIGHEST RISK (0 - 2 years) AND HIGH RISK (3 - 5 years)

<table>
<thead>
<tr>
<th>CHILDREN AGE</th>
<th>LESS THAN 1% LEAD</th>
<th>1 - 4% LEAD</th>
<th>5% LEAD OR MORE</th>
<th>TOTAL FREQUENCY</th>
<th>TOTAL PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CHILDREN FREQUENCY</td>
<td>%</td>
<td>CHILDREN FREQUENCY</td>
<td>%</td>
<td>CHILDREN FREQUENCY</td>
</tr>
<tr>
<td>0 - 2</td>
<td>8</td>
<td>15.4</td>
<td>8</td>
<td>15.4</td>
<td>36</td>
</tr>
<tr>
<td>3 - 5</td>
<td>3</td>
<td>4.7</td>
<td>16</td>
<td>25.0</td>
<td>45</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>116</td>
</tr>
</tbody>
</table>
of the most susceptible age children lived in households where safe lead levels were found; paint chips containing more than eight percent lead were accessible to approximately thirty-nine percent of the children five years of age or younger; and ninety percent of the children within the susceptible age range were exposed to flaking paints containing potentially hazardous amounts of lead. Table 5 separates the susceptible children into two age groups: those children whose ages were within the range of zero through two years (the highest risk group); (32) and those children whose ages were three through five years. Flaking paints containing potentially hazardous lead levels were accessible to almost eighty-five percent of the children in the zero through two age group. Paint chips containing potentially hazardous amounts of lead were accessible to ninety-five percent of the children whose ages ranged from three through five years of age. A "t" test designed to test Part B of the null hypothesis which stated, "no more than twenty-five percent of the children five years of age or younger, living in households included in the study are exposed to paint chips that contain potentially hazardous amounts of lead", produced a score of 23.2. This score indicated that the number of children in the susceptible age range who were exposed to paint chips that contained
potentially hazardous lead levels was significantly greater than the estimated maximum population of twenty-five percent. Therefore, based upon the data presented in Tables 4 and 5, and the "t" score, Part B of the null hypothesis was rejected.

Findings of Other Related Factors Which May Enhance the Risk of Plumbism

1. Pica

Table 6 was designed to show parents' knowledge of children who could be suffering from pica. The table presents data that indicate: parents from thirteen percent of the households stated that their children did not have a habit of eating or putting non-food substances into their mouths; parents from thirty-eight percent of the households did not know whether or not their small children had developed a habit of eating paint chips or other non-food substances; and parents from almost forty-eight percent of the households answered "yes", their children did eat paint chips and/or other non-food substances.

The fact that parents from thirty-eight percent of the sampled households did not know whether or not their small children ate paint chips or other non-food substances, may have been an indicator that there was a lack of


<table>
<thead>
<tr>
<th>Do Children Eat Non-Food Substances?</th>
<th>Households Frequency</th>
<th>Households Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>9</td>
<td>13.4</td>
</tr>
<tr>
<td>Yes</td>
<td>32</td>
<td>47.8</td>
</tr>
<tr>
<td>Don't Know</td>
<td>26</td>
<td>38.8</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>67</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
adequate parental supervision in those particular households. Inadequate parental supervision is believed by some authors to contribute to pica conditions among small children (22).

2. Crowding Conditions

Table 7 contains data that were collected from thirty-two of the sixty-seven households sampled. The following observations were based upon data from Table 7: forty percent of the family members either slept alone or shared their bedrooms with only one other person; sixty percent of the persons who lived in households which are included in this table shared their bedrooms with at least two other persons; and almost fourteen percent of the persons included in Table 7 slept in bedrooms which were shared by four or more other persons. Interviews conducted in households included in this table also revealed that twenty family members slept in rooms that were non-bedrooms. These rooms included: living rooms, dining rooms, and one person (a child) slept in a large closet area.

Based upon the findings that are presented in Table 7, it does appear that several of the households were overcrowded. The literature indicates that overcrowdedness results in poor maintenance and high deterioration of
### TABLE 7 *

CROWDING CONDITIONS

<table>
<thead>
<tr>
<th>Number Persons Per Bedroom</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2</td>
<td>58</td>
<td>40.0</td>
</tr>
<tr>
<td>3 - 4</td>
<td>67</td>
<td>46.2</td>
</tr>
<tr>
<td>5 or more Persons</td>
<td>20</td>
<td>13.8</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>145</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

* Data presented in this table were collected from 32 of the 67 Households Sampled.
dwelling units, consequently increasing the probability of peeling paint and broken plaster (33).

3. Family Relationships

Table 8 summarizes data pertaining to family relationships as they relate to heads of households. Findings from Table 8 were as follows: both parents were present in less than thirty-two percent of the households; more than sixty-eight percent of the homes were headed by only one parent; only one household was headed by a father in the absence of the mother; and sixty-seven percent of the homes were headed by mothers only.

After analyzing the data presented in Table 8, one might assume that because the father was absent from approximately sixty-eight percent of the households sampled, the risk of peeling paint and broken plaster becoming accessible to small children was increased. This belief was based on the assumption that the father of the household, (more frequently than the mother), would make minor maintenance repairs around the home when necessary. The literature reveals that one-third of the plumbism cases among children occur in homes with broken families. Some experts believe that when families are unstable, the risk of pica among small children is greater, resulting in an
TABLE 8

FAMILY RELATIONSHIP

<table>
<thead>
<tr>
<th>Head of Household</th>
<th>Households Frequency</th>
<th>Households Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Parents Present</td>
<td>21</td>
<td>31.5</td>
</tr>
<tr>
<td>Mother Only</td>
<td>45</td>
<td>67.0</td>
</tr>
<tr>
<td>Father Only</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>67</td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
increased risk of lead ingestion by small children who live in old housing (21).

4. State of Occupancy

Table 9 shows that more than eighty-nine percent of the households included in the study were tenant occupied (inhabited by renters). A review of the literature points out that rented housing is often associated with low maintenance upkeep and more frequent change of households. Therefore, one might expect a higher deterioration rate in tenant-occupied housing than in owner-occupied households (33).

5. Duration of Occupancy

Table 10 was designed to show how long the families had lived in their current households at the time the study was conducted. A summary of data presented in the table revealed the following: almost thirty-three percent of the families had lived in their households less than one year; approximately thirty-three percent of the families had lived at their current addresses from one to two years; less than eighteen percent of the families had lived in their homes from three to four years; and less than seventeen percent of the families had lived in their current households five years or longer.
## TABLE 9

**STATE OF OCCUPANCY**

<table>
<thead>
<tr>
<th>Occupant</th>
<th>Households Frequency</th>
<th>Households Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>7</td>
<td>10.4</td>
</tr>
<tr>
<td>Tenant</td>
<td>60</td>
<td>89.6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>67</td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
TABLE 10

DURATION OF OCCUPANCY

<table>
<thead>
<tr>
<th>Number of Years Lived in Household</th>
<th>Families Frequency</th>
<th>Families Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less Than One</td>
<td>22</td>
<td>32.8</td>
</tr>
<tr>
<td>One</td>
<td>13</td>
<td>19.4</td>
</tr>
<tr>
<td>Two</td>
<td>9</td>
<td>13.4</td>
</tr>
<tr>
<td>Three</td>
<td>4</td>
<td>6.0</td>
</tr>
<tr>
<td>Four</td>
<td>8</td>
<td>11.9</td>
</tr>
<tr>
<td>Five or More</td>
<td>11</td>
<td>16.5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>67</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Data presented in Table 10 indicate there was a frequent change of occupancy among families who lived in a large number of the households that were included in the study. As stated earlier, literature findings revealed that frequency of occupancy changes result in low maintenance upkeep and a high deterioration rate (33).

6. Ethnic Background

Households included in the study consisted of fifty-six Black families and eleven Mexican-American families. The literature indicates plumbism in small children occurs most often among Blacks, Puerto Ricans and Spanish Americans (23).

Feasibility of the Test Used in the Study

In the past, the detection of environmental lead on painted surfaces generally has been done by one of two methods: collecting samples from suspected surfaces and submitting them to a laboratory for lead analyses by spectroscopic methods; or by the use of a portable X-Ray Fluorescent (XRF) Analyzer. While spectroscopic methods are quite accurate, they have been found to be tedious, expensive and time consuming (28). The XRF Analyzer appears to be an improvement over the spectroscopic methods, however, it is still somewhat expensive. It has also been
discovered that one person will find it difficult to record
data and operate the XRF machine simultaneously (34). The
sodium sulfide method used in this study (described in
Chapter III), is simple, inexpensive and valid (28).

Some advantages of the sodium sulfide test method
are listed as follows:

1. The sodium sulfide test involves a minimum of
chemicals and equipment. The small dropper bottle can eas­
ily be carried in one's pocket or the glove compartment of
a car. The bottles can be obtained from most pharmacies.

2. Little training is required for the interpreta­
tion of the color change. It is possible to test each lay­
er of paint down to and including the bare wood or plaster.

3. Testing can and preferably should be done in the
home, especially in areas accessible to children. However,
samples may be collected and taken to a selected location
for testing. With this test, it is also possible to test
loose paint chips found on floor surfaces or exterior
ground surfaces.

4. Because of the simplicity of performance and
ease of interpretation, the sodium sulfide test could be an
adjunct during screening campaigns to identify early cases
of lead poisoning (28).
Due to the discovery and to the effectiveness of the sodium sulfide test, the assumption: "a selected economical test that could be administered by trained personnel to determine the lead content in paint samples is not practical," has been rejected.

Environmental Sanitarians Are Trained Personnel

The sodium sulfide test used for the detection of lead on painted surfaces has been proven to be an economical, specific and valid test that can easily be administered by trained personnel. The writer believes that the academic background, experience and duties of sanitarians qualify them to administer the test with a minimal of technical instructions.

1. Some Academic Requirements for Sanitarians

The minimum academic requirements of a registered sanitarian in the State of California include a Bachelor's degree in environmental health science or a related science field. The degree must have been received from an accredited college. The degree includes a minimum of thirty semester units of basic sciences acceptable to the California State Department of Health with at least one laboratory course in each of the following fields: chemistry, physics, microbiology and biology. The
sanitarian's academic background also includes courses in: environmental health administration, epidemiology, statistics, mathematics, and behavioral science (35).

2. One Duty Performed by Sanitarians

The duties of sanitarians are many and varied. However, one duty of sanitarians includes the inspection of housing (dwelling units), both routinely and upon receiving housing-related complaints from various sources. In Southeast Los Angeles and other similar communities, investigations by sanitarians frequently reveal peeling paint and/or broken plaster associated with dwelling units.

Considering the educational background, training, experience and duties of sanitarians, the writer believes that once proper instructions have been given regarding the sodium sulfide test, sanitarians are quite capable of administering the test on paint samples and painted surfaces for the detection of lead.
* The formula for the "t" test utilized in the study is listed below:

\[ t = \frac{P - \hat{P}}{\sqrt{\frac{P(1-P)}{n}}} \]

\*P = Estimated Population

P = Sample Population

For test on dwellings: P = the proportion of households that contained high lead levels.

For test on children: P = the proportion of susceptible children present in households exposed to leaded peeling paint.

n = Total number of households or susceptible children included in the study.
CHAPTER V

CONCLUSIONS, RECOMMENDATIONS AND SUMMARY

Conclusions

The study revealed that flaking paints containing potentially hazardous lead levels occurred in a significantly greater number of dwellings sampled than the twenty-five percent maximum number of households that was projected. The study further revealed that the number of children present in the susceptible age range who were at risk of becoming victimized by plumbism was significantly greater than the twenty-five percent maximum proportion which was projected in the hypothesis. The study confirmed that a selected, simple, economical and valid test that could be used for the detection of lead in paint is available for use by trained personnel.

Recommendations

1. Lead Test Administered by Sanitarians

   Regulations and policies should be enacted by Los Angeles County Bureau of Environmental Management to permit sanitarians to test flaking paint and other painted
painted surfaces of households for lead content. The sodium sulfide test (used and described in this study) is recommended for use by sanitarians who inspect old housing during routine investigations. The test should be administered whenever peeling paint is observed or when painted surfaces of dwelling units are suspected to contain hazardous lead levels. This would enable valuable information to be gathered to aid medical personnel in their evaluation of children who might be suspected of being lead poisoning victims. Positive test findings could facilitate actions taken to rehabilitate the affected environment so that plumbism could be intercepted before children become involved.

2. Legislation

California state and local health and safety codes pertaining to housing should be amended to include codes and regulations that would forbid the existence of peeling paint associated with dwelling units. Housing codes should also forbid painted surfaces of households from containing excessive lead levels. This would give the sanitarians greater enforcement powers to ensure that hazardous leaded surfaces are reduced to safe levels.
3. Expand Lead Screening Project

The Lead Screening Project conducted by Los Angeles County Department of Community Health Services should seek sufficient funding and flexibility so as to provide lead screening for children in any area of the county where a high risk of lead poisoning associated with housing has been determined by sanitarians.

4. Education

Sanitarians, jointly with health educators, should conduct an extensive innovative program to educate the general public on the dangers and preventions of lead poisoning.

Summary

This study was designed to determine the actual risk (not the incidence) of plumbism among small children who live in homes with peeling paint containing high levels of lead. It was felt that knowledge of the lead content of paint associated with old housing within the environment of small children would permit the application of preventive measures to situations that are potentially hazardous. This matter was approached directly by analyzing paint samples collected from the environment of infants and children.
The study was conducted within the Southeast Health District in Los Angeles County. This community was selected chiefly because it contains a large number of pre-1940 built housing; is located within the inner city area; is a low income community; and the area is inhabited by a large number of small children.

Samples were collected and personal interviews were conducted in sixty-seven different households. A qualitative test for the detection of lead content in the samples was performed. Analyses of data collected during the interviews and lead test findings revealed that eighty-two percent of the households sampled had peeling paint that contained excessive lead levels. These findings also revealed that ninety percent of the children five years of age or younger were exposed to peeling paint that contained potentially hazardous amounts of lead. Parents who represented almost forty-eight percent of the households had observed their children eating paint chips and/or other non-food substances. Parents from thirty-eight percent of the households did not know whether or not their small children had developed a habit of eating paint chips or other non-food substances. This lack of knowledge may have been an indicator that there was inadequate parental
supervision in those particular households. Some authors believe that inadequate parental supervision contributes to pica conditions among infants and small children. The risk of lead poisoning is increased among children who are afflicted with pica.
BIBLIOGRAPHY


