

# Childhood Lead Poisoning and Inadequate Child Care

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● Sixteen caretakers of children hospitalized for their first episode of lead poisoning and 16 caretakers of children with normal lead levels were interviewed in their homes to determine if caretakers of children with lead poisoning provided more inadequate child care than the comparison group of caretakers. Children were matched according to age, race, and sex. Correlations were found between children's lead levels and caretakers' scores on the measures of inadequate child care. Differences were evident in the overall physical and cognitive emotional care provided to these children. No differences were found in the caretakers' ages, number of years of education and family monthly income, number of occupants in the household, and family mobility. Implications of the intertwined roles of inadequate child care, subclinical lead poisoning, and later developmental sequelae are discussed.

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After completing extensive research that explored the personality characteristics of mothers of children who had pica for lead-containing substances, Lourie speculated that unavailable mothering played an essential role in promoting lead poisoning.<sup>1,2</sup> Children with pica for lead-containing substances were noted to have limited social contact with their caretakers. In turn, these children resorted to repeated ingestion of objects containing substantial amounts of lead as a means of dealing

with frustration that emanated from insufficient child care.

The present study investigates caretakers of children with lead poisoning and focuses on a specific aspect of caretaker functioning, the level of child care. We hypothesize that caretakers of children who have lead poisoning provide more inadequate child care than caretakers of children without lead poisoning. We also hypothesize that more inadequate child care might be evident in particular areas of child care, including physical and cognitive emotional areas.

Selected studies of caretakers of disadvantaged children reported on the relation between inadequate child care and developmental deficits. Polansky et al<sup>3</sup> undertook a study of caretakers of poor children to determine if inadequate child care had an effect on children's intellectual functioning, emotional development, and social adjustment. The childhood level of living scale (CLL), a multidimensional instrument that measures many aspects of child care, was specifically designed by them to detect inadequacies evident in two major areas of child care, the physical and cognitive emotional areas. This scale was used to record caretakers' responses to interview questions pertaining to child care practices, to list investigators' observations of the physical condition of the home, to note absence of educational and cultural objects used for stimulation and enhancement of cognitive development, and to measure caretakers' behaviors that support children's emotional growth. Children of these caretakers were psychologically tested to measure their intellectual and emotional functioning. In order to assess children's social

adjustment, day-care teachers were asked to complete behavioral characteristics inventories for children participating in this study.

This original research found that the caretakers' scores on the CLL scale correlated significantly ( $P < .01 = .05$ ) with measures of children's intellectual functioning, attachment to family members, and involvement with other adults, as well as with behavior in the day-care setting. In general, children who received more inadequate child care had lower levels of intellectual functioning than children who received less inadequate child care. Also, day-care teachers reported that these children formed immediate attachments to unfamiliar adults outside the family, even though contact with these adults was fairly restricted. In a similar fashion, teachers described the classroom behavior of these children as withdrawn, unsociable, clinging, and lethargic.

Building on this initial research with rural poor children, Hepner and Maiden<sup>4,5</sup> used the CLL scale to interview caretakers of urban children in order to detect if inadequate child care was evident among children who had low or borderline nutritional status. Further, the relation among inadequate child care, nutritional status, and cognitive functioning was explored. A relation between inadequate child care and children's nutritional status was found and these two variables were associated with aspects of children's intellectual functioning. Children who received inadequate child care had both marginal nutritional status and borderline nonverbal intellectual functioning.

Results of these limited studies offer some empirical support for

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relating inadequate child care with deficits in children's intellectual, emotional, and social functionings, as well as with deficits in their nutritional status. In general, more inadequate child care appears to unfavorably influence some disadvantaged children's performance in these selected areas of developmental and physical functioning.

In a population of inner-city disadvantaged children, there are children with varying lead levels who may experience more or less inadequate child care. Perhaps children who have lead poisoning also receive more inadequate child care than children without lead poisoning. Establishing the association between childhood lead poisoning and the level of inadequate child care is an important step toward identifying another psychosocial factor that may contribute to the promotion of this illness and developmental deficits in children.

The present study investigated caretakers of children hospitalized for lead poisoning to determine whether these children had more inadequate child care than nonhospitalized children without lead poisoning. Inadequate child care was defined as a high score on the CLL scale. The level of child care provided to children with lead poisoning was compared with that made available to children without lead poisoning. Comparisons between groups were made without the confounding effects of low birth weights and atypical gestational ages. Subjects were matched for age, sex, and race. All subjects lived in privately owned, inner-city dwellings.

## SUBJECTS AND METHODS

Caretakers of preschool children with and without lead poisoning were the subjects of this study. The admissions officer of the Mt Washington Pediatric Hospital, Baltimore, and pediatric nurse practitioners of the Community Pediatric Center, Baltimore, recruited subjects for this study. Before approaching potential subjects, recruiters were informed that the purpose of this research was to study caretakers of children with and without lead poisoning. When they were told that an interviewer planned to go to the caretakers' homes, conduct a home visit, and interview caretakers, no mention was made of the interview format, the type of instru-

	Study Children		Comparison Children	
	Mean	Range	Mean	Range
Blood Lead, $\mu\text{g/dL}$	65	45-100	30	18-44
FEP, $\mu\text{g/dL}$ of RBCs	882	179-2,618	109	41-264

	Children With Lead Poisoning	Children Without Lead Poisoning	P
Birth weights, gm	3,331 $\pm$ 656	3,266 $\pm$ 370	NS
Gestational ages, wk	40 $\pm$ 2.1	40.2 $\pm$ 1.3	NS
Ages of children, mo	21.9 $\pm$ 4.9	21.5 $\pm$ 3.9	NS

\*NS indicates not significant.

Children's Levels	Childhood Level of Living (CLL) Scale		
	Full CLL	Physical Care	Cognitive Emotional Care
Blood Lead	.76†	.62†	.78†
FEP	.65†	.53†	.66†

\*FEP indicates free erythrocyte protoporphyrin.

†P < .001.

Scales	Children With Lead Poisoning	Children Without Lead Poisoning	P
CLL*	59.0 $\pm$ 11.2†	25.4 $\pm$ 10.9	< .0001
Physical care	28.6 $\pm$ 7.7	13.9 $\pm$ 7.5	< .0005
Emotional/cognitive care	30.3 $\pm$ 5.7	11.5 $\pm$ 6.0	< .0001

\*The CLL is scored so that a high score means more inadequate child care and a low score means less inadequate child care.

†Mean  $\pm$  SD.

ment used, or the data sought for collection. Recruiters had a general idea of the intent of the study, but particular aspects of caretaker functioning to undergo study were not known to them.

Children hospitalized with their first episode of lead poisoning were referred for enlistment into this study by the medical admissions officer. Pediatric nurse practitioners referred children without lead poisoning. Caretakers of hospitalized children were study subjects and caretakers of children without lead poisoning were comparison subjects. Caretakers of children participating in this study were referred on the basis of children's reported lead status, birth weights, gestational ages, and chronological ages. Respected professionals at the two institutions explained to the

caretaker of each child that the research involved an interview in the home conducted by a health professional, access to birth and health records, and, in the case of a child with lead poisoning, access to a hospital record. Then, the caretaker's consent for participating in this study was sought.

Sixteen caretakers of children hospitalized at Mt Washington Pediatric Hospital who met selection criteria entered the study. Selection criteria for the study group included primary hospitalization for chelation therapy; venous blood lead concentration of at least 50  $\mu\text{g/dL}$  of blood or free erythrocyte protoporphyrin (FEP) at least 288  $\mu\text{g/dL}$  of RBCs (Table 1); birth weight of more than 2,500 g; gestational age, 38 to 42 weeks; chronological age, 15 to

Table 5.—Analysis of Physical Care Subscales for Caretakers of Children With and Without Lead Poisoning

Physical Care Subscales*	Children With Lead Poisoning	Children Without Lead Poisoning	P
Comfort	1.4 ± 1.5†	0.8 ± 1.2	NS‡
Safety of the home	1.3 ± 1.3	0.5 ± 0.9	NS
State of repair	2.7 ± 1.9	1.0 ± 1.3	< .01
Hygienic conditions	2.5 ± 1.4	0.9 ± 1.4	< .005
Feeding patterns	3.0 ± 0.8	1.0 ± 0.8	< .0005
Safety precautions	4.1 ± 1.1	2.0 ± 1.8	< .0005
Disease prevention	2.9 ± 0.5	0.9 ± 1.1	< .0005
Use of medical facilities	1.2 ± 0.7	0.4 ± 0.6	< .005
Clothing	0.6 ± 1.0	0.9 ± 1.1	NS
Sleeping arrangements	1.7 ± 1.0	0.8 ± 0.9	< .01
Regularity of provision of rest	1.3 ± 1.0	0.5 ± 0.8	< .025
Grooming	1.3 ± 1.5	0.6 ± 0.8	NS
Home comforts	3.5 ± 1.8	3.6 ± 1.9	NS

\*Physical care subscales are scored so that a high score means more inadequate physical child care and a low score means less inadequate physical child care.

†Mean ± SD.

‡NS indicates not significant.

Table 6.—Analysis of Cognitive Emotional Care Subscales for Caretakers of Children With and Without Lead Poisoning

Cognitive Emotional Care Subscales*	Children With Lead Poisoning	Children Without Lead Poisoning	P
Cultural artifacts	5.8 ± 2.1†	2.6 ± 2.2	< .0005
Parental play with child	4.5 ± 0.8	1.4 ± 1.3	< .0001
Promoting curiosity	6.0 ± 1.8	2.1 ± 2.3	< .0005
Consistency in encouraging super-ego development	4.0 ± 1.0	2.0 ± 1.4	< .0005
Level of disciplinary techniques	3.3 ± 1.0	2.0 ± 1.2	< .005
Providing reliable role image	5.0 ± 1.6	2.2 ± 1.3	< .0005
Providing reliable evidence of affection	1.8 ± 1.4	0.1 ± 0.3	< .0005

\*Cognitive emotional care subscales are scored so that a high score means more inadequate cognitive emotional child care and a low score means less inadequate cognitive emotional child care.

†Mean ± SD.

Table 7.—Marital Status of Caretakers of Children With and Without Lead Poisoning

	Marital Status				
	Single	Separated	Divorced	Widowed	Married
Caretakers of children with lead poisoning	5	6	1	1	3
Caretakers of children without lead poisoning	9	1	2	1	3
Total	14	7	3	2	6
% of total	44	22	9	6	19

30 months; resident of nonpublic housing; and no previous history of plumbism (Table 2). The comparison group consisted of 16 caretakers of children who met previously stated selection criteria, but who had medically acceptable blood lead and FEP levels and had no history of hospitalization for chelation therapy. The children of comparison caretakers were matched

with children of study caretakers by sex and race.

The study medical librarian requested birth records from the hospitals of birth of children of caretakers who consented to participate. Children's records were reviewed by the medical librarian to determine if the potential subjects met selection criteria. Children who did not meet selec-

tion criteria were not accepted into the study.

Names of caretakers of children with and without lead poisoning were assigned to an interview schedule by the medical librarian. A single interviewer visited the homes of the caretakers inducted into the study and administered the CLL scale. The interviews of caretakers were conducted without prior knowledge of the children's lead status. The interview and tour of the house lasted approximately 90 minutes.

The CLL scale was the major instrument used to interview caretakers about child care routines and activities, and to record the interviewer's observations of the physical condition of the households. The scale is a reliable<sup>3,6</sup> instrument that was originally used to study caretakers of white, rural Appalachian children and later, black, rural families who received Aid to Families with Dependent Children services. The Kuder Richardson formula 20 (KR-20) reliability coefficients were computed as measures of the scales' internal consistency. The reliability coefficients were .87 for the physical care scale and .86 for the cognitive emotional care scale. The intercorrelation between physical and cognitive emotional scales was also significant (.67).

This scale measured 20 dimensions of child care that were organized into two major areas, physical care with 13 subscales and cognitive emotional care with seven subscales. Physical and cognitive emotional care items indicating inadequate child care were summed within each subscale and a single score was obtained for each of the 20 separate subscales. Scores for each of the subscales were added together and total scores for the physical care scale and the cognitive emotional care scale were derived. The total scores on the physical and cognitive emotional care scales were combined and yielded a full scale score that represented the general level of inadequate child care. A high score on any one of these scales meant the caretakers provided more inadequate child care, while a low score meant that caretakers provided less inadequate child care.

The physical care scale quantified caretaker activities and practices, such as ones that provided safe living conditions within the household, minimal necessary hygienic practices, adequately organized feeding patterns, and effective sleep routines. The cognitive emotional care scale measured psychosocial aspects of child care, such as availability of actual resources for cognitive stimulation and caretakers' provision of sources of emotional support and security. The scale also documented the caretakers' use of additional community-based

Table 8.—Ages, Education, Family Income, Occupants of Household, and Number of Months Living in Home for Caretakers of Children With and Without Lead Poisoning

	Children With Lead Poisoning	Children Without Lead Poisoning	P
Caretakers ages, yr	26.7 ± 6.8*	23.6 ± 7.1	NS†
Education, yr	10.3 ± 1.3	9.8 ± 1.4	NS
Family monthly income, \$	319.5 ± 159.2	248.4 ± 110.0	NS
No. of adults	2.9 ± 2.0	2.5 ± 1.3	NS
No. of children	5.3 ± 4.7	3.2 ± 2.2	NS
No. of months living in present home	34.8 ± 38.2	79.6 ± 86.5	NS

\*Mean ± SD.

†NS indicates not significant.

sources for stimulation that complemented activities taking place in the home.

## RESULTS

Children's blood lead and FEP levels correlated significantly ( $P < .001$ ) with caretakers' scores on the full CLL scale, the physical care scale, and the cognitive emotional care scale (Table 3).

Caretakers of children with lead poisoning scored significantly higher than caretakers of children without lead poisoning on the CLL scale ( $P < .0001$ ), on the physical care scale ( $P < .0005$ ), and on the cognitive emotional care scale ( $P < .0001$ ) (Table 4).

Caretakers of children with lead poisoning indicated that physical care was inadequate in many areas. The physical condition of the household indicated need for repair. Hygienic conditions of the household were poor. Feeding practices that promote adequate nutrition were insufficient. Routines that maintained a clean household and prevented disease were neglected. Medical facilities were used infrequently. Both sleep arrangements and routines that lead to adequate rest were unsatisfactory. However, in selected areas of physical care, safety of the home, clothing, grooming, and home comforts, the level of inadequacy was not different in the two groups (Table 5).

The pattern of inadequate cognitive emotional care was significantly ( $P < .001 = .005$ ) evident in all dimensions of the scale. Caretakers of children with lead poisoning made available fewer resources for stimulation and maintained child care practices

with limited structure and organization. Appropriate objects and opportunities for cognitive stimulation were underrepresented. Caretakers' play involvement with children and their efforts to enhance children's curiosity through family participation and community social activities were limited. These caretakers placed less value on child care practices that promoted children's increased impulse control and capacity to distinguish between appropriate and inappropriate behavior. Caretakers' participation and maintenance of practices that further children's understanding of right and wrong also were limited. Caretakers demonstrated an immature attitude toward maintaining appropriate disciplinary practices and an inappropriate attitude toward sustaining a consistent role image. Indicators of affection also were less consistent (Table 6).

The social and demographic characteristics of the two groups of caretakers were no different. The greatest proportion of caretakers were single (44%) and the next sizable group of caretakers were separated (22%). Only 19% were married. On inspection of the information contained in Table 7, no significant differences in marital status appeared among the groups.

Most of the caretakers who attended to the daily care of these children were also their birth mothers. Two children, one from each group, received daily care from caretakers who were not their birth mothers. No differences appeared in the caretakers' ages or number of years of education. Family monthly income

also was not different. The average number of adults and children living in these households was not statistically different. However, slightly more children were present in households of caretakers of children with lead poisoning. The number of months living in the present location also was not different (Table 8).

## COMMENT

The present study found that inner-city, preschool children hospitalized for lead poisoning experienced more inadequate child care than children who did not have lead poisoning. In addition to providing support for the hypothesis that a psychosocial factor, unavailable mothering, plays an important part in the promotion of lead poisoning, specific areas of inadequate child care were noted. Inadequate child care was evident in both the physical care and cognitive emotional care scales. The pattern of inadequate child care extended throughout most of the physical care subscales and all of the cognitive emotional care subscales. Children who had lead poisoning received a combination of inadequate physical and cognitive emotional child care.

Steps were taken to interview subjects without the interviewer knowing the children's lead and hospitalization status. Although the interviewer had no prior knowledge of these children's lead levels, there was no way of preventing some caretakers from disclosing their children's hospitalization status. In some cases, caretakers indicated that their children were hospitalized. The caretakers' perception of the quality of care provided to these children with lead poisoning was perhaps influenced by their reactions to the hospitalization of these children. In turn, some of these caretakers responded more negatively to interview questions than customarily expected. Also, mentioning this information in the presence of the interviewer might have contributed toward influencing these results. Future studies of children with lead poisoning and inadequate child care should use a double-blind study design that controls for these sources of error by including additional comparison groups of care-

takers of children hospitalized for other illnesses.

The case control design used in this study did not control adequately for selection bias. Although the medical admissions officer and pediatric nurse practitioners approached different caretakers, only those caretakers who readily cooperated with the research project were chosen as subjects. In turn, those caretakers who demonstrated less cooperation or who refused outright to participate in the study were not interviewed. Caretakers in the present study were a select sample of subjects and were not drawn from a cross section of caretakers of children hospitalized for other illnesses or of children who attended other pediatric outpatient clinics.

In the lead-poisoning literature, environmental factors<sup>7</sup> are customarily measured to determine the extent to which these factors are associated with the occurrence of lead poisoning. Indicators of family income, crowding conditions of the home, and mobility of the family are used frequently to characterize the environment. Limited family income, crowded living conditions, and greater mobility may exist among families with children hospitalized for lead poisoning. However, in this study no differences were found among these variables. In this context, inadequate child care took on increased importance and was a prominent environmental factor associated with the occurrence of lead poisoning.

Other environmental factors, namely, the availability of family and community supports, must be explored. The kind and frequency of supports available to caretakers are known to vary.<sup>8</sup> Families who have children with lead poisoning possibly provide fewer supports to these caretakers. Also, caretakers of children with lead poisoning may live in neighborhoods with limited community resources. In this study, the majority of caretakers were single parents. Often, single parents utilize different supports in order to provide additional resources for their children. Future studies should explore the relation among sources of support and extent of family and community resources, as well as the care-

takers' use of these supports and resources with regard to the promotion of lead poisoning and inadequate child care.

Follow-up research is important, because slightly more children were present in the households of caretakers of children with lead poisoning. Providing child care to many children places additional demands on caretakers' time and energy and may function as a burden.

All but two of the caretakers gave birth to the children in this study. This finding suggests that caretakers had long-standing involvement with these children, and disturbances in caretaker functioning may have antedated the occurrence of lead poisoning. The birth histories of these children were unremarkable; no congenital disorders were noted and no disturbances in growth or development appeared in their health records. However, stressful life events may have occurred in the lives of these caretakers and children at any time during the period from infancy onward through the second year of life. The impact that specific life events have on caretakers' coping capacity, as well as on their overall adjustment to stressful circumstances, may influence the provision of child care. The frequency of stressful life events, as well as caretakers' coping capacity, may or may not be reflected in the degree of inadequate child care. Studying children from birth through the second year of life may determine the effect varying levels of stress have on the lives of these caretakers and children and clarify the contribution that these events make to promotion of this illness and inadequate child care.

This study did not assess children's psychological functioning or social adjustment. An outcome study is necessary to evaluate the cognitive emotional functioning and behavioral adjustment of children who have lead poisoning and inadequate child care. This need for further research is compatible with current interest in lead poisoning research to determine the effects of lead on children's later psychological functioning and social adjustments.<sup>9</sup> A recent report on the

sequelae of lead poisoning made no mention of the effect of inadequate child care.<sup>10</sup> Inadequate child care is known to influence children's developmental functioning and further studies are necessary to explore the potential contribution inadequate child care makes to the developmental sequelae commonly attributed to otherwise asymptomatic, elevated blood concentrations of lead. For example, separate studies,<sup>3,5</sup> conducted at different times and under varying conditions, found intellectual, emotional, and nutritional deficits among rural and urban children who were recipients of inadequate child care. However, the body concentrations of lead for the children participating in these studies were not reported. Although the findings from these studies suggest that inadequate child care may work alone or in some combination with lead to produce developmental deficits in some children, only further research will help to determine the precise contribution that this psychosocial variable makes to the promotion of developmental deficits in children.

J. Julian Chisolm, Jr, MD, measured blood lead and free erythrocyte protoporphyrin levels in the children of this report, and set policies for hospitalization and treatment of children with lead poisoning at Mt Washington Hospital.

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