

The Effects of a Family-Based Educational Intervention on the Prevention of Lead Poisoning in Children

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Abstract: Parents completed a survey measuring their knowledge of lead poisoning. Children, 24 to 36 months old received two blood lead level screens. Parents in the treatment group showed significantly higher scores on the posttest, and their children showed greater decreased blood lead levels than participants in the control group.

Introduction

Statement of the Problem

Lead exposure even in asymptomatic cases may endure through one's lifetime and may be an accurate indicator of neurobehavioral defects as well as intellectual educational performance (U.S. Department of Health and Human Services, 1991). Children who survive the effects of lead poisoning exhibit neurological disorders along with behavioral manifestations presenting as attention deficits and aggressive behavior (Marlowe, Schneider & Bliss, 1991). An 11-year longitudinal study demonstrated the effects of lead exposure sustained in childhood on adults. Children exposed to lead had a seven-fold risk of not graduating from high school, and had reading scores two grades lower than expected. This study indicated that lower socioeconomic individuals had higher lead levels, lower intelligence quotients (IQ) and lower teacher scores related to classroom behavior. This supports the findings that the effects of lead are greater for those with a low socioeconomic status (Needleman, Schell, Bellinger, Leviton, & Allred, 1990).

Significance of the Study

While the link between the cause and effects of lead poisoning has been identified and well studied, the application of lead health education as the mechanism of disease prevention has not. Although epidemiological, environmental and medical research have isolated the problem of lead intoxication in lower socioeconomic populations, there is a dearth of studies that have identified educational programs designed to be used in conjunction with such scientific findings. The Centers for Disease Control and Prevention CDC (1997) suggests that to improve lead poisoning prevention strategies, additional research is needed in "the effectiveness of family education about lead poisoning prevention in preventing BLL elevations or in reducing already elevated blood lead levels" (p. 115).

Purpose of the Research

The purpose of this study is to examine whether caregiver participation in a family-based educational intervention can result in a decrease in lead body burden in low socioeconomic children.

Hypotheses

1. Three to four months post intervention, children whose caregivers received the educational intervention will have lower blood lead levels (BLLs) than children whose caregivers were in the control group.
2. Following the intervention, caregivers who received the educational intervention will have higher scores on the Chicago Lead Knowledge Test (CLKT) than caregivers in the control group.

Method

Participants

Sixty-three (n=63) children aged one to three years, with MediPass (Medicaid) as their health insurance, were randomly selected from among those families who chose the Children's Diagnostic and Treatment Center (CDTC) as their health care provider. These participants were randomly assigned to two groups with 32 and 31 participants in each group, respectively. The group of 32 was designated the treatment group while the group of 31 served as the control group. The mean ages of the participants in the pediatric sample were 23.5 months in the treatment group and 21.5 months in the control group.

Design

The experimental design of this study involved two clinic visits. Parents in the treatment group were given the educational intervention during the first clinic visit while those in the control group were given the intervention during the second clinic visit. The intervention was reinforced with a lead education information brochure written by the researcher coupled with a video on childhood lead poisoning. The primary care physician at CDTC supervised the child's medical care during the two clinic visits, and a well-trained phlebotomist in the CDTC laboratory drew the child's blood via venipuncture for blood lead testing. Blood lead levels were drawn about three to four months apart as determined by well-child check-up schedules.

Instrumentation

One instrument, the Chicago Lead Knowledge Test (CLKT) was used to test parental knowledge of lead poisoning during the first and second clinic visits. The test was administered as a pre- and post-intervention measure. The instrument consisted of 24 questions with a true, false or "do not know" response. The score revealed parental knowledge about lead in the categories of health education, environmental exposure, prevention and nutrition (Mehta & Binns, 1998).

Procedures

The first clinic visit. The first visit consisted of two components: a well-child check-up with blood lead screening for all pediatric participants, followed by parental lead education for the treatment group only. The trainer presented parents in both the treatment and the control groups with general information about the study and about blood lead testing. They were offered the opportunity to ask questions about the study. After the research was thoroughly discussed, the trainer read the informed consent to the parent if requested to do so by the parent. Parents were asked to sign the informed consent after all their questions about the study were answered. Then parents were asked to complete the CLKT (pre-intervention) to determine their previous knowledge of lead poisoning. The trainer assisted the parent in reading the test if requested. After the test, parents in the control group were asked to return to clinic in three to four months for their intervention, while parents in the treatment group were given the intervention.

The second clinic visit. This visit consisted of two components: a well-child check-up with blood lead screening for all child participants, followed by parental lead education for the control group. Both groups were given the CLKT (Post-test) at this visit. The control group parents were given the test to determine parental knowledge of lead poisoning prior to the intervention, as well as to ascertain knowledge, if any, that the parents may have learned from other sources during the three to four month period between well-child check-ups. Parents were given the option of having the test read to them by the trainer or by reading it themselves.

Stimulus Materials. A print-based module written by the researcher was used as the basis of parental lead education. The educational intervention occurred interactively between the trainer and parent. A video was used to show methods they could use in the home to prevent lead poisoning (Needham, 1994). After a question and answer period geared to the needs of the family, parents were given an informational brochure written by the researcher highlighting the risks of childhood lead exposure including factors that affect the home environment, behaviors that mitigate risk, and the need for proper nutrition. The brochure was used as a reinforcement measure summarizing the intervention and enabling family members to review the brochure as a reference guide.

Results

An analysis of covariance (ANCOVA) was used as a statistical measure to test the two hypotheses. All child participants regardless of their group assignment made appointments approximately three to four months between the first and second clinic visits. After this period of time, 13 caregivers (four in the treatment group and nine in the control group) were "no-shows" to clinic, i.e., they did not bring their child to CDTC for their follow-up well-child check-up. Consequently, these individuals did not keep their second clinic appointment to conclude this study. All "no-shows" were eliminated from the study. Since 50 families ($n=50$) completed the study--28 in the treatment group and 22 in the control group--all subsequent data reported in this study will account for only those families.

The blood lead data resulting from the first clinical visit showed that 46 (92%) children had BLLs within normal limits ranging from 0.6 to 7.1 $\mu\text{g/dL}$. Twenty-four children (86%) in the treatment group presented BLLs ranging from 0.9 to 6.8 $\mu\text{g/dL}$, while 22 (100%) of the children in the control group presented BLLs ranging from 0.6 to 7.1 $\mu\text{g/dL}$. However, four (8% of the whole sample) children in the treatment exhibited BLLs ranging from 10.2 to 16.6 $\mu\text{g/dL}$ determined abnormal by the Centers for Disease Control and Prevention (CDC) were found in the treatment group.

Data from the second clinic visit indicated that the BLLs of the children ($n=50$) ranged from 2.0 to 12.3 $\mu\text{g/dL}$. Children in the treatment group ($n=28$) who had BLLs within normal limits after the first clinic visit presented BLLs ranging from 1.1 to 9.8 $\mu\text{g/dL}$ after the second visit. Those children ($n=4$) with elevated BLLs after the first clinic visit presented BLLs ranging from 7.5 to 12.3 $\mu\text{g/dL}$ after the second clinical visit. Two of the four (50%) had BLLs that dropped into the normal range after the intervention. Pediatric participants in the control group ($n=22$) had BLLs ranging from 2.0 to 6.7 $\mu\text{g/dL}$. None of the participants in the control group presented elevated BLLs.

Hypothesis 1

The first hypothesis was tested using an analysis of covariance (ANCOVA) using the first clinical visit (pretreatment) BLL as the covariate, the second clinic visit (post treatment) BLL as the dependent variable, and the group membership (either treatment or control) as the independent variable. Table 1 presents the descriptive statistics for the variables.

Table 1

Descriptive Statistics for Blood Lead Levels and the Chicago Lead Knowledge Test

	First Clinic Visit		Second Clinic Visit	
	Mean	SD	Mean	SD
Experimental Group (n = 28)				
Blood Lead Level ($\mu\text{g}/\text{dL}$)	4.54	3.71	4.50	20.36
Chicago Lead Knowledge Test	13.94	4.64	20.36	2.33
Control Group (n = 22)				
Blood Lead Level ($\mu\text{g}/\text{dL}$)	2.64	1.43	3.77	1.45
Chicago Lead Knowledge Test	10.68	3.79	9.95	3.44

Table 2 presents the source table for the analysis of covariance.

Table 2

ANCOVA Source Table

Source	df	F	η	p
First clinical visit blood lead level	1	109.94	.701	.000*
Group	1	2.18	.044	.147
Error	47	(1.86)		

Note. Values enclosed in parentheses represent mean square errors

* $p < .01$.

An important statistic that should be noted in the ANCOVA is a low observed power ($1 - \beta = .304$), which can probably be attributed to the low number of participating families in the study and the homogeneity of the groups, and consequently it is very possible that the failure to reject the null hypothesis about differences between groups in adjusted second clinical visit blood lead levels was a result of Type II error.

An alternative way to examine this data might be to note the changes of blood lead levels of participants between the first and second clinic visits as shown in Table 3. The proportion of participants whose blood lead levels decreased at least 10% from the first to the second clinic visit was higher in the treatment group (10 participants or 35.7%) than in the control group (1 participant or 4.5%). Fisher's Exact Test of the null hypothesis, that the proportion of participants receiving treatment who had a greater than 10% decrease in blood lead level is equal to or less than the proportion of those in the control group who had a greater than 10% decrease in blood lead level between clinic visits yields $p = .008$ ($\Phi = .373$), allowed for the conclusion that participants in the treatment group were more likely to show decreases in blood lead levels than those in the control group.

Table 3

Changes in Blood Lead Level Between the First and Second Clinical Visits

	Treatment Group		Control Group	
	n	%	n	%
Decrease > 10%	10	35.7	1	4.5
Change ≤ 10%	8	28.6	4	18.2
Increase > 10%	10	35.7	17	77.3
Total	28	100	22	100

Further, the goal of an educational program designed to deal with blood lead levels of children could also be thought of as preventing the increase of this phenomenon. In that case, it can be seen in Table 3 that only 10 (35.7%) of the participants whose caregivers received the educational treatment presented increased blood lead levels of more than 10% while 17 (77.3%) of the participants whose caregivers did not receive the educational treatment presented similar increases. Fisher's Exact Test of the null hypothesis, that the proportion of participants receiving treatment who had a greater than 10% increase in blood lead level is equal to or greater than the proportion of those in the control group who had a greater than 10% increase in blood lead level between clinic visits yields $p = .004$ ($\Phi = .414$), allowed for the conclusion that participants in the treatment group were less likely to show increases in blood lead levels than those in the control group.

Hypothesis 2

An ANCOVA was used to test the second hypothesis where the covariate is the pretreatment CLKT score, the posttreatment CLKT scores as the dependent variable, and the group membership (either treatment or control) as the independent variable. The Pearson's Product Moment correlation between the first clinic visit CLKT score and the second clinic visit CLKT score was .541 ($p < .01$).

Table 4 presents the source table for the analysis of covariance.

Table 4

ANCOVA Source Table

Source	df	F	η	p
First CLKT	1	25.06	.348	.000*
Group	1	175.94	.789	.000*
Error	47	(5.49)		

Note. Values enclosed in parentheses represent mean square errors

* $p < .01$

The findings support the hypothesis that caregivers in the treatment group have significantly higher scores on the second clinic visit scores on the CLKT than the caregivers in the control group. This suggests that the educational treatment is effective in increasing the knowledge of caregivers about the dangers of lead poisoning and prevention strategies.

Discussion

This research demonstrated that parents are capable of learning lead education, are competent in applying the training in the home, and are able to retain the knowledge taught in the intervention over time. The education was the significant factor in lowering blood lead levels in children. Parents who have completed a lead education intervention are aware of the dangers of pediatric lead intoxication, and understand the need for being proactive in family lead poisoning prevention.

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