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Lead and Childhood Propensity to Infectious and Allergic Disorders: Is There an Association?

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Lead appears to impair both antibody and cellular responses of laboratory animals to a variety of bacteria (Cook et al, 1975, Blakey and Archer, 1981, Lawrence 1981). These immunosuppresive effects of lead appear at levels below those associated with overt toxicity, and might, therefore, be present among urban children exposed to subtoxic amounts of lead. To examine the role of lead exposure on rates of infectious and allergic diseases in children, we compared the prevalence of these illnesses in children classified by the lead level in their umbilical cord blood, and in the dentine of their deciduous teeth. Information about illness was obtained from a mailed questionnaire completed by parents.

MATERIALS AND METHODS

The base population consisted of 4354 babies born at the Boston Hospital for Women between April 1979 and April 1981. Details of this population and cord blood sampling have been published (Rabinowitz et al, 1987). During the years 1985 through 1987, 2448 deciduous teeth were submitted by 1982 children. When we received multiple teeth from a child, we used the value of first tooth in the statistical analysis.

The environmental lead exposure of these children is not unusual for current urban Americans. Based on samples from a representative sub-group of 249 infants, the median concentrations of lead in soil was 700 ug/g, indoor air 0.11 ug/M^3, and tap water 4 ug/L. Lead paint above 1.5 mg/sq cm was found in 35 percent of their homes (Rabinowitz et al 1985).

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Tooth lead was determined by anodic stripping voltammetry in two specimens of post-natal dentine, taken from sliced tooth sections. These values were averaged if they differed by 2.5 ug/g or less. Otherwise, two additional portions of the tooth were prepared, andthe three closest values for the tooth averaged. This was necessary for fewer than 15 % of the teeth. Details of the method have been published (Rabinowitz, et al 1989). Procedural lead blanks averaged 3.0 ng (std dev = 2.3) per sample and represent about 6% of the lead present. The concentration of lead in working standards was determined by isotope dilution mass spectrometry.

A multipage questionnaire returned by the parents solicited information about the child's health, ear infections, asthma, eczema, and the absence from school for illness. These were interspersed amid questions about colic, headache, other health problems, and emergency room visits. In response to the open-ended question about "other medical conditions", hundreds of parents provided information about allergic, respiratory, and infectious disorders. No attempts were made to confirm parents' responses.

Complete data, cord blood and tooth lead values and questionaires, were available for 1768 children and were analyzed with SAS (SAS Institute Inc, Cary, NC) using a Dell System 310 PC (Dell Computer Corp., Austin, TX).

In order to test for any association between lead in blood or tooth and each of the several health questions of interest, children whose lead level was in an approximation of the highest decile were compared to the other children. The approximate highest decile included cord blood lead values greater than or equal to 10 ug/dl and tooth lead values equal to or greater than 5.0 ug/g. The relative risks, defined as the incidence in the highest exposure group divided by the incidence in the rest of the population, and 95 percent confidence intervals of their relative risks are the measures of effect. No attempt was made to consider possible confounders of the lead-illness association.

RESULTS AND DISCUSSION

The risk of having any of the disorders that might reflect disturbed immunological function does not appear to be different among those children with the highest lead levels compared to those with lower

Table 1. Relative Risks (and 95% Confidence Intervals) of Several Medical Conditions among the Children with the Highest Decile of Lead Based on Either Cord Blood (≥ 10 ug/dl) or Shed Tooth (≥ 5 ug/g) Compared to the Rest of the Children.

Condition	N	Relative Risk in High Pb Group	
		Blood	Tooth
Asthma	204	1.3 (.8-2.0)	1.1 (.7-1.6)
Eczema	159	1.0 (.6-1.6)	0.9 (.6-1.4)
Ear Infections			
Any	1398	1.0 (.9-1.0)	0.9 (.9-1.0)
5 or more	563	1.1 (.9-1.3)	0.8 (.6-1.0)
10 or more	362	1.1 (.9-1.5)	0.8 (.6-1.1)
Severe	283	1.2 (1.0-1.4)	0.9 (.8-1.2)
Other Respiratory	140	1.5 (1.0-2.3)	1.3 (.9-1.9)
Other Infections	207	1.0 (.7-1.5)	0.9 (.6-1.2)
Other Immune	125	1.2 (.8-2.0)	1.0 (.6-1.6)
School Absence in the Past Year for			
Illness Other than Cold or Flu	499	1.3 (1.0-1.5)	1.0 (.8-1.2)
Cold or Flu	1088	1.0 (.9-1.1)	0.9 (.8-1.0)

N is number with that condition of the 1768 respondents with complete data.

lead levels (Table 1). Severe ear infections, "other" respiratory infections, and school absence for illness other than cold or flu have modestly elevated risk ratios for cord blood lead elevations. Their 95 th percentile confidence intervals include 1 in every case. Because we have considered nearly 20 multiple comparisons of outcomes and lead levels, a stricter p value for significance is warranted. Using the Bonferroni method, a 99 th percentile confidence interval would be more appropriate and even wider. Even in subsets of the population grouped by sex, none of the risk ratios had a 99 th percent confidence interval that did not include 1.0.

Although each of these illness has causes other than lead, we considered the possibility that lead exposure at current levels might influence the occurrence or severity of these conditions, based on reports of lead's effects on the immune response of laboratory animals. Umbilical cord blood lead levels are viewed as a measure of late intrauterine exposure and levels of lead in the central dentine of deciduous incisors appear to reflect exposure during the years just before tooth loss (Rabinowitz,

et al 1989). Our failure to demonstrate any increased occurrence of allergic or infectious diseases in children with the highest umbilical cord or dentine levels of lead suggests that neither recent nor remote sub-toxic exposure adversely effects immunological function in children.

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