

The Effect of Lead Exposure on Behavior Problems in Preschool Children

The Research By:

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Introduction

This presentation will show the associations between child lead levels and symptoms of hyperactivity, including inattention and disruptiveness. Subsequent studies in children selected for either high lead exposure or behavior problems showed inconsistent findings.



Introduction

These inconsistencies likely resulted from failure to adequately control for sociodemographic variables, such as family poverty and parenting practices, that are associated with both lead exposure and behavioral disturbances.



Introduction

Two studies of school aged children used the well standardized Rutter Behavior Questionnaires. In both, after control for social confounders, log blood lead was significantly associated with teacher reported problems, but the impact of blood lead was very small, then have found small associations between blood lead and symptoms of hyperactivity.





Methods

The study was conducted in 2 towns in Yugoslavia beginning in 1985. Mitrovica, the exposed site contains a lead smelter, a refinery, and a battery factory and Pristina, the non exposed site. Children selected from a prospective series of 1502 pregnant women living in those towns, participated in the 3-year assessment. The Child Behavior Checklist was used to assess behavior problems in 379 children of 3-year-olds, controlling for sociodemographic factors and difficult infant temperament.

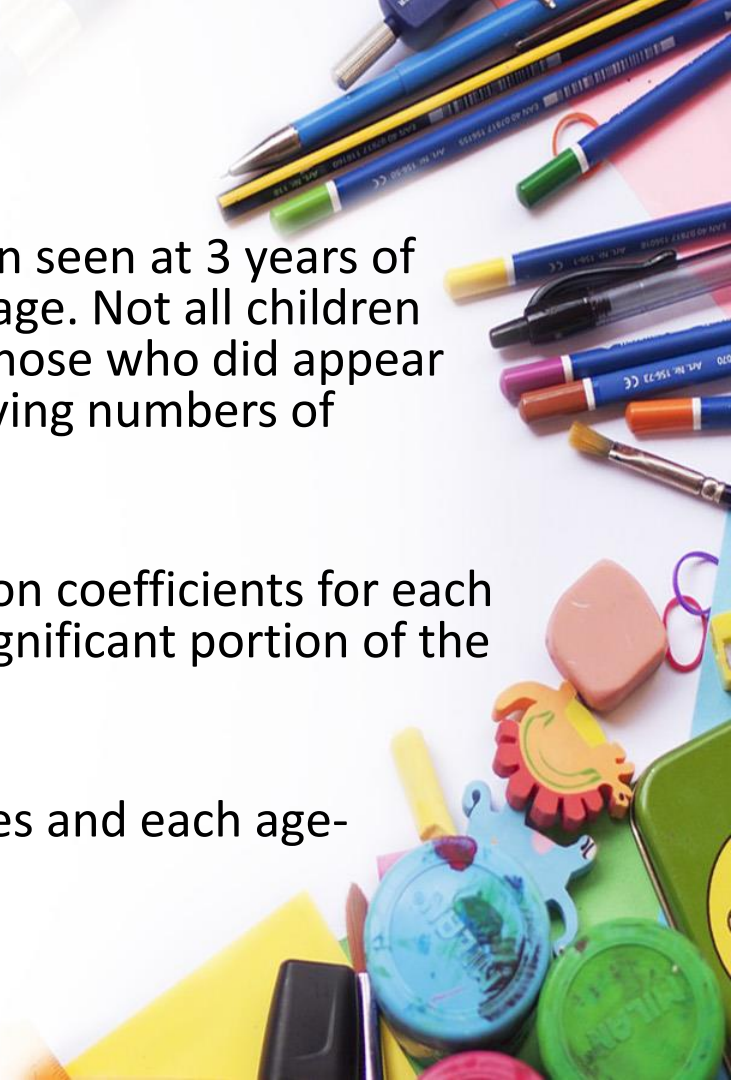


Methods

Previous reports have described the effects of lead exposure on pregnancy outcomes and on child intelligence at 2 and 4 years. At midpregnancy, at delivery, and half-yearly through age 3, venous blood samples were taken to measure blood lead, serum ferritin, erythrocyte protoporphyrin, and hemoglobin concentrations. Mothers were interviewed about child and family health and demographics.

Results

- Table 1 presents sample characteristics for children seen at 3 years of age and those enrolled but not seen at 3 years of age. Not all children appeared regularly for followup, and sometimes those who did appear refused to provide blood samples. As a result, varying numbers of subjects were available for data analyses.
- Table 2 presents unstandardized multiple regression coefficients for each confounder. The set of confounders explained a significant portion of the variance (range, 7% to 18%) on each subscale.
- Table 3 shows associations between CBCL subscales and each age-related assessment of blood lead.



Results

TABLE 1—Sample Characteristics of Children Assessed and Not Assessed at Age 3 Years for Lead Exposure and Behavior Problems

	Not Assessed ^a (Towns Combined) (n = 176)	Assessed ^a (Towns Combined) (n = 379)	Assessed ^b (Pristina only) (n = 145)	Assessed ^b (Mitrovica only) (n = 148)
Mitrovica, %	59.7	52.2
Pristina, %	40.3	47.8
Birthweight (SD)	3217 (512)	3347 (516)	3326 (480.6)	3342 (526.1)
Sex, % male	54.8	50.7	51.7	51.4
Maternal education, y	9.8 ^{c*} (3.9)	9.0 (3.9)	9.6 ^{d*} (3.7)	8.6 (3.4)
Parity, no. previous births (SD)	1.2 ^{c**} (1.2)	1.7 (1.7)	1.70 (1.8)	1.6 (1.8)
Ethnicity, %				
Albanian	49.4 ^{c**}	59.5	62.8	56.5
Serbian	39.7	23.5	24.1	20.4
Other	10.9	16.9	13.1	23.1
Maternal age, y (SD)	26.1 (4.6)	26.3 (4.9)	26.8 (5.0)	26.4 (5.0)
Living in apartments, %	21.6	26.4	26.9	27.7
Midpregnancy BPb, $\mu\text{g}/\text{dL}$ (SD)	14.0 (9.3)	12.6 (8.8)	5.5 ^{d**} (2.0)	19.3 (7.0)
Umbilical cord BPb, $\mu\text{g}/\text{dL}$ (SD)	15.5 (10.3)	14.0 (10.2)	5.5 ^{d**} (3.4)	22.0 (8.1)
Midpregnancy Hb, g/dL (SD)	12.3 (1.2)	12.4 (1.2)	12.3 (1.3)	12.4 (1.1)
Umbilical cord Hb, g/dL (SD)	16.1 (2.5)	16.1 (2.6)	16.3 (2.3)	15.9 (2.0)
BPb at 36 mo, $\mu\text{g}/\text{dL}$ (SD)	NA	25.8 (19.1)	9.8 ^{d**} (3.4)	40.9 (14.9)
HOME ^e total score (SD)	29.1 (8.1)	29.2 (7.6)	29.7 (7.8)	28.9 (7.2)
Difficult Temperament ^f score (SD)	22.2 (6.6)	22.4 (7.0)	24.7 ^{d**} (7.6)	20.6 (5.8)
CBCL/2-3 ^g total score (SD)	NA	53.8	61.4 ^{d**} (27.9)	46.3 (32.5)

Note. Pristina is the nonexposed town; Mitrovica contains a lead smelter, a refinery, and a battery factory. BPb = blood lead;

Hb = hemoglobin; NA = not available.

^aIncludes subjects with missing data on some measures.

^bIncludes only subjects with complete data.

^cDifference between Assessed and Not Assessed is significant.

^dDifference between towns is significant.

^eHome Observation for Measurement of the Environment.²⁹

^fFrom the Infant Characteristics Questionnaire.³⁶

^gChild Behavior Checklist, ages 2–3.¹⁵

* $P < .05$; ** $P < .001$.



Results

TABLE 2—Associations between Sociodemographic Factors and Child Behavior Checklist/2-3 Subscale Scores¹⁵ in Children Assessed at Age 3 Years

	Anxious-Depressed			Withdrawn			Sleep Problems			Somatic Problems			Aggressive			Destructive		
	B ^a	SE	P	B ^a	SE	P	B ^a	SE	P	B ^a	SE	P	B ^a	SE	P	B ^a	SE	P
Town	-2.53	0.51	.000	-3.54	0.68	.000	-0.74	0.34	.029	-1.66	0.50	.001	-3.18	0.76	.000	-1.05	0.44	.017
Sex ^b	-0.27	0.51	.591	-0.12	0.68	.863	-0.43	0.34	.205	-0.13	0.50	.792	-0.26	0.77	.730	-0.79	0.44	.075
Ethnicity 1 ^c	-0.56	0.70	.430	-0.97	0.94	.305	-0.80	0.47	.090	-0.35	0.69	.612	-0.69	1.06	.514	-0.24	0.61	.698
Ethnicity 2 ^d	-2.26	0.83	.007	-2.59	1.12	.022	-1.14	0.56	.042	-1.27	0.82	.121	-3.58	1.26	.005	-1.50	0.72	.038
Maternal Education	0.07	0.07	.354	0.26	0.09	.006	0.10	0.05	.032	0.11	0.07	.113	0.32	0.11	.003	0.14	0.06	.019
HOME total score	-0.44	0.15	.005	-0.62	0.20	.003	-0.41	0.10	.000	-0.12	0.15	.429	-0.91	0.23	.000	-0.35	0.13	.008
Home type	-0.22	0.60	.716	-0.33	0.80	.676	-0.23	0.40	.566	-1.44	0.58	.452	-1.46	0.90	.105	-0.44	0.51	.388
Overall R ²	0.16*			0.18*			0.13*			0.07*			0.18*			0.10*		

^aEstimated regression coefficient.

^bBoys = 0; girls = 1.

^cCompares Albanians with others

^dCompares Serbians with others.

* $P < .001$; ** $P < .05$.

Results

TABLE 3—Effects of Blood Lead Concentrations Measured at Various Time Points on Child Behavior Checklist/2-3 Subscale Scores¹⁵ in Children Assessed at Age 3 Years

	Anxious-Depressed				Withdrawn				Sleep Problems				Somatic Problems				Aggressive				Destructive			
	B ^a	SE	P	ΔR^2	B	SE	P	ΔR^2	B	SE	P	ΔR^2	B	SE	P	ΔR^2	B	SE	P	ΔR^2	B	SE	P	ΔR^2
Umbilical cord	1.16	0.58	.046	0.01	1.52	0.76	.046	0.01	1.00	0.39	.011	0.02	1.14	0.60	.058	0.01	1.25	0.85	.145	0.01	0.79	0.48	.097	0.01
6 mo	0.62	0.67	.354	0.00	1.52	0.89	.089	0.01	0.86	0.47	.067	0.01	0.37	0.70	.597	0.00	2.11	1.00	.036	0.02	1.21	0.55	.030	0.02
12 mo	0.41	0.73	.575	0.00	1.02	0.96	.290	0.00	0.61	0.49	.217	0.01	0.40	0.76	.599	0.00	0.85	1.08	.435	0.00	0.64	0.61	.294	0.00
18 mo	0.14	0.70	.846	0.00	0.93	0.96	.332	0.00	0.19	0.48	.687	0.00	0.03	0.76	.966	0.00	0.85	1.04	.417	0.00	0.82	0.59	.162	0.01
24 mo	0.95	0.64	.143	0.01	2.36	0.82	.004	0.03	0.74	0.43	.091	0.01	0.73	0.66	.268	0.00	1.32	0.93	.159	0.01	1.21	0.53	.023	0.02
30 mo	0.53	0.78	.499	0.00	2.60	1.30	.013	0.02	0.36	0.54	.505	0.00	1.30	0.82	.113	0.01	0.11	1.14	.923	0.00	1.37	0.63	.032	0.02
36 mo	1.45	0.72	.044	0.01	3.07	0.95	.001	0.04	1.09	0.48	.024	0.02	1.71	0.70	.016	0.02	1.85	1.08	.089	0.01	2.07	0.61	.001	0.04

Note. The change in R^2 represents the proportion of variance accounted for by blood lead, measured at each specific time point, after control for the variables in the core model. Each ΔR^2 is calculated as the difference in total model F^2 , with and without the blood lead measure.

^aEstimated regression coefficient for log blood lead, adjusted for town, child's sex and ethnicity, maternal education, Home Observation for Measurement of the Environment²⁹ score (Acceptance and Modeling subscales), and residence type.



Discussion

Among 3-year-old children, after control for sociodemographic confounders, concurrent blood lead explained independent variance in the Destructive and Withdrawn behavior problem subscales. Blood lead measured at other time points was inconsistently related to behavior problems. Unadjusted levels of reported behavior problems differed across sites and were higher in the unexposed town (Pristina).



Discussion

On the other hand, there were no interactions between site and blood lead, so that the lead-behavior association was the same in each town. The results of this study suggest that postnatal exposure is more detrimental than prenatal exposure. Alternatively, blood lead levels measured at age 3 may better reflect cumulative exposure than those measured earlier. Despite support for an impact of lead on early behavior problems, the magnitude of lead effects is very small.





Discussion

After control for confounders, lead accounts for only 2% to 4% of the variance in subscale scores As log blood lead increased from 10 $\mu\text{g}/\text{dL}$ to 20 $\mu\text{g}/\text{dL}$.

Compared with the more powerful impact of social factors, such changes in behavior are likely to be of minimal clinical significance.



Conclusion

Lead/behavior associations are significant but small compared with the effects of social factors.



References (Mendeley)

(Wasserman, Staghezza-jaramillo and Shrout, 1997) 'The Effect of Lead Exposure on Behavior Problems in Preschool Children' American Journal of Public Health Briefs , Page (481 – 482 – 483 – 484 – 485) March 1998, Vol.88, No. 3.



THANK YOU

