

Rachel's Environment & Health News

#529 - Toxics Affect Behavior

January 15, 1997

The toxic metal, lead, is associated with aggressive behavior, delinquency, and attention disorders in boys between the ages of 7 and 11, according to a study by Herbert Needleman published in 1996 in the JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION (JAMA).[1] Aggressive behavior, delinquency and attention disorders in youth are, themselves, predictors of criminal behavior later in life.[2] This is not the first study linking lead exposure to behavioral disorders, but it is one of the most carefully done.

Needleman's study examined 301 boys in public schools in Pittsburgh, Pennsylvania, measuring the lead in their bones and relating it to behaviors reported by the boys' teachers and parents, and by the boys themselves. Boys with more lead in their bones consistently had more reports of aggressive and delinquent behavior, and problems paying attention. The boys' behavior was measured at age 7 and again at age 11, and the behavior of boys with more lead in their bones got worse as they grew older; on the other hand, behavior did not change among boys with less lead in their bones.

Aggressive behavior, delinquency, and attention disorders in boys and young men are also associated with poverty, minority status, and disorganized homes, so lead is not the only factor at work in many cases. However, the 1996 Needleman study examined 9 variables in addition to lead (such as parent's socioeconomic status, mother's age, presence or absence of a father in the home, and so forth), to see if they might explain the boys' behavior. The relationship between lead and behavior disorders held up.

"These data argue that environmental lead exposure, a preventable occurrence, should be included when considering the many factors contributing to delinquent behavior," the authors of the study said.

What is remarkable is the degree to which environmental lead exposure has been ignored in the past by people concerned about the growing problem of aggressive, anti-social behavior in boys and young men in the U.S. An estimated 20% of American children now exhibit mental or behavioral problems.[3] As early as 1943, Randolph Byers and Elizabeth Lord[4] examined 20 children who had recovered from "mild lead poisoning in infancy." They reported that none of the children had exhibited overt signs of lead poisoning, yet the growth and development of their nervous systems had been "seriously impaired." Among the 20 children examined, only one had progressed satisfactorily in school. Furthermore, many of the children were emotionally impaired as well. Byers and Lord characterized the behavior of many of the children as "unreliable impulsive behavior, cruel impulsive behavior, short attention span, and the like." Three of the 20 children were expelled from school, one for setting fires, another for repeatedly getting up and dancing on the desks, and a third for sticking a fork into another child's face. In 1986, Byers recalled that others in the group he had studied in 1943 had attacked teachers with knives and scissors.[5] Byers's 1943 report should have set off alarm bells, but it didn't.

After the 1943 report, for the most part lead researchers ignored the newly-revealed connection between lead, aggressive behavior and impaired attention. Instead they went on to demonstrate conclusively that intellectual power (as measured by IQ) was consistently reduced by exposure to low levels of lead. For every 10 microgram rise (in each deciliter of blood), there is a 6 point loss of IQ.[6] [A deciliter is a 10th of a liter, and a liter is about a quart.] Reduced IQ power can be measured when lead is as low as 7 micrograms per deciliter of blood (7 ug/dl).[7] In fact, there is no apparent threshold for this effect: any amount of lead seems to diminish mental power in children.[8] Furthermore, brain damage from lead exposure persists for many years; the IQ reduction caused by lead in childhood is essentially permanent. [9]

Nevertheless, some work on lead and behavioral disorders did appear: [10]

** In Virginia in 1975, researchers compared 67 lead-exposed 7-year-olds to 70 non-exposed children to see if lead exposure was related to increased behavior problems in school.[11] Nineteen of the lead-exposed children were described as "hyperactive, impulsive, and explosive, and as having frequent temper tantrums." Only five among the non-exposed group were described this way.

The group was re-evaluated a year later, emphasizing behavior in the home. The examination of 8-year-olds revealed 14 lead-exposed children with "severe abnormalities," defined as lying, stealing, running away, and setting fires, vs. six with such abnormalities among the non-exposed group.

** In rural Tennessee in 1982, researchers asked teachers to identify "problem children" among their students, using the Walker Problem Behavior Identification Checklist, a screening device designed for elementary school teachers to help them identify troubled kids. Average lead levels in the hair of 26 "problem children" was nearly twice as high (11.6 ppm vs. 6.5 ppm) as in a control group of 29 students identified as not having problems.[12]

** In Scotland in 1989, researchers showed that lead was related to attention disorders and aggressive behavior (as reported by parents and teachers) among a group of 501 students between the ages of six and nine. These children had average (mean) blood lead levels of 10.4 ug/dl.[13]

** In Baltimore in 1992, blood lead levels among 201 African-American children aged two to five were compared to the children's behavior as reported by their mothers on a well-known standardized questionnaire (the Child Behavior Checklist, or CBCL).[14] Of these, 123 were in the "high exposure" group (blood lead levels of 15 ug/dl, or more) and 78 were in a "low exposure" group. The high-lead group consistently had more maternal-reported troublesome behaviors. For example, 8.1% of the high-lead group were "aggressive" vs. 1.4% in the low-lead group. Mothers reported 4.1% of the high-lead children had "destructive" behavior vs. no such behavior in the low-lead group.

** In New Zealand in 1993, researchers examined lead in the teeth of 1265 children aged 6-8, compared to behavior of those children as measured seven years later.[15] They found a small but consistent relationship between increasing lead and increasing social adjustment problems in youngsters.

** In Boston in 1994, a study of 1782 children related the amount of lead in their teeth to behavior in school (using the CBCL).[3] Problem behaviors increased systematically as lead levels in the children's teeth increased.

In recent years, lead in the blood of Americans has diminished substantially, because the government outlawed lead in gasoline and lead in tinned cans used for food.[16] The biggest reduction has occurred among white children, but all populations have benefitted to some extent. Nevertheless, in 1994, an estimated 1.7 million American children between the ages of one and five (mostly African Americans living in large cities) had average blood lead levels of 10 ug/dl or more, and a million children had blood lead levels of 15 ug/dl or more. Among African American children in large cities, 36.7% have blood lead levels above 10 ug/dl, and 17.0% of Mexican-American children in large cities have similar levels of toxic lead in their blood.[17]

In the mid-1970s, 40% of American children under age 5 had average (mean) lead levels of 20 ug/dl or more.[18] Among African-American children in the mid-1970s, more than half had blood-lead levels greater than 15 ug/dl.[16] This is the generation that is presently in its mid-20s. How is this generation doing?

In 1993, 1.53 million Americans were in jail or prison --triple the number that had been incarcerated in 1980.[19] In 1980, one in every 453 Americans was in state or federal prison; by 1993, the

number had risen to one in every 189.[20] In 1993, the incarceration rate among blacks was seven times as high as among whites. Between 1990 and 1993, the number of drug offenders increased dramatically by 55,500, but the number of violent offenders grew even more rapidly (by 82,100). In 1994, the prison/jail population increased at the rate of 1600 each week and almost 1200 (75%) of these new inmates were black or hispanic.

It seems possible that the observed connection between brain-damaging lead and destructive behavior explains a portion of these increases. [21]

Prevention is the key. The main source of the toxic lead in children today is dust and soil,[22] but the source of the lead in the dust and soil is lead-based paint coming out of older buildings.[23] The federal Centers for Disease Control (CDC) in Atlanta has calculated the cost of removing all lead-based paint from old buildings, along with the benefits that society would realize from such a removal (reduced costs for medical care and for special education, plus increased salaries that go with higher IQs). According to CDC, American taxpayers would realize a net profit of \$28 billion by removing all lead-based paint. [24]

Why then do you suppose Congress is delaying?

--Peter Montague (National Writers Union, UAW Local 1981/AFL-CIO)

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[1] Herbert L. Needleman and others, "Bone Lead Levels and Delinquent Behavior," *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION* Vol. 275, No. 5 (February 7, 1996), pgs. 363-369. In the same issue of *JAMA*, see the editorial: Terrie E. Moffitt, "Measuring Children's Antisocial Behaviors," *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION* Vol. 275, No. 5 (February 7, 1996), pgs. 403-404. And see: B. Bower, "Excess lead linked to boys' delinquency," *SCIENCE NEWS* Vol. 149 (February 10, 1996), pg. 86.

[2] Needleman and others, cited above in note 1, citing D.P. Farrington, "Childhood aggression and adult violence," in D.J. Pepper and K. Rubin, editors, *THE DEVELOPMENT AND TREATMENT OF CHILDHOOD AGGRESSION* (Hillsdale, N.J.: Lawrence Erlbaum Associates, 1991), pgs. 189-197, which we have not seen. And see: D.R. Offord and others, "Delinquency and Hyperactivity," *The JOURNAL OF NERVOUS AND MENTAL DISEASE* Vol. 167, No. 12 (1979), pgs. 734-741. And see: Thomas M. Achenbach and others, "Six-Year Predictors of Problems in a National Sample of Children and Youth. II. Signs of Disturbance," *JOURNAL OF THE AMERICAN ACADEMY OF CHILD AND ADOLESCENT PSYCHIATRY* Vol. 34, No. 4 (April 1995), pgs. 488-498.

[3] David Bellinger and others, "Pre-and Postnatal Lead Exposure and Behavior Problems in School-Aged Children," *ENVIRONMENTAL RESEARCH* Vol. 66 (1994), pgs. 12-30.

[4] Randolph K. Byers and Elizabeth E. Lord, "Late Effects of Lead Poisoning on Mental Development," *AMERICAN JOURNAL OF DISEASES OF CHILDREN* Vol. 66, No. 5 (November 1943), pgs. 471-494.

[5] Randolph K. Byers, unpublished data described by Needleman, cited above in footnote 1.

[6] John F. Rosen, "Health Effects of Lead at Low Exposure Levels," *AMERICAN JOURNAL OF DISEASES OF CHILDREN* Vol. 146 (November 1992), pgs. 1278-1281.

[7] John F. Rosen, "Effects of Low Levels of Lead Exposure," *SCIENCE* Vol. 256 (April 17, 1992), pg. 294.

[8] Herbert L. Needleman and others, "Deficits in Psychologic and Classroom Performance of Children with Elevated Dentine Lead Levels," *NEW ENGLAND JOURNAL OF MEDICINE* Vol. 300, No. 13 (March 29, 1979), pgs. 689-695. And see: Joel Schwartz, "Low-Level Lead Exposure and Children's IQ: A Meta-analysis and Search for a Threshold," *ENVIRONMENTAL RESEARCH* Vol. 65 (1994), pgs. 42-55. And see: Herbert L. Needleman and Constantine A. Gastonis, "Low-Level Exposure and the IQ of Children," *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION* Vol. 263, No. 5 (February 2, 1990), pgs. 673-678.

[9] Herbert L. Needleman and others, "The Long-term Effects of Exposure to Low Doses of Lead in Childhood," *NEW ENGLAND JOURNAL OF MEDICINE* Vol. 322, No. 2 (1990), pgs. 83-88.

[10] The few studies examining lead and behavior in the period 1944- 1980 are reviewed in Herbert L. Needleman and Philip J. Landrigan, "The Health Effects of Low Level Exposure to Lead," *ANNUAL REVIEW OF PUBLIC HEALTH* Vol. 2 (1981), pgs. 277-298.

[11] Brigitte de la Burde and McLin S. Choate, "Early Asymptomatic Lead Exposure and Development at School Age," *JOURNAL OF PEDIATRICS* Vol. 87, No. 4 (1975), pgs. 638-642.

[12] Mike Marlowe and John Errera, "Low Lead Levels and Behavior Problems in Children," *BEHAVIORAL DISORDERS* Vol. 7 (1982), pgs. 163- 172.

[13] G.O.B. Thomson and others, "Blood-Lead Levels and Children's Behaviour--Results from the Edinburgh Lead Study," *JOURNAL OF CHILD PSYCHOLOGY AND PSYCHIATRY* Vol. 30, No. 4 (1989) pgs. 515-528.

[14] William G. Sciarillo and others, "Lead Exposure and Child Behavior," *AMERICAN JOURNAL OF PUBLIC HEALTH* Vol. 82, No. 10 (October 1992), pgs. 1356-1360. 17 (April 23, 1987), pgs. 1037-1043.

[15] David M. Fergusson and others, "Early Dentine Lead Levels and Subsequent Cognitive and Behavioural Development," *JOURNAL OF CHILD PSYCHOLOGY AND PSYCHIATRY* Vol. 34, No. 2 (1993), pgs. 215-227.

[16] James L. Pirkle and others, "The Decline in Blood Lead Levels in the United States," *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION* Vol. 272, No. 4 (July 27, 1994), pgs. 284-291.

[17] Debra J. Brody and others, "Blood Lead Levels in the U.S. Population," *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION* Vol. 272, No. 4 (July 27, 1994), pgs. 277-283.

[18] David Bellinger and others, "Longitudinal Analyses of Prenatal and Postnatal Lead Exposure and Early Cognitive Development," *NEW ENGLAND JOURNAL OF MEDICINE* Vol. 316, No. 17 (April 23, 1987), pgs. 1037-1043.

[19] Fox Butterfield, "More in U.S. Are in Prisons, Report Says," *NEW YORK TIMES* August 10, 1995, pg. A14.

[20] Allen J. Beck and Darrell K. Gilliard, "Prisoners in 1994," *BUREAU OF JUSTICE STATISTICS BULLETIN [NCJ-151654]*, August, 1995, pgs. 1-13.

[21] Bernard Weiss, "Intersections of Psychiatry and Toxicology," *INTERNATIONAL JOURNAL OF MENTAL HEALTH* Vol. 14,

No. 3 (1985), pgs. 7- 25.

[22] Evan Charney and others, "Increased Lead Absorption in Inner City Children: Where Does the Lead Come From?" PEDIATRICS Vol. 65, No. 2 (February 1980), pgs. 226-231.

[23] Brian L. Gulson and others, "Paint as a source of recontamination of houses in urban environments and its role in maintaining elevated blood leads in children," SCIENCE OF THE TOTAL ENVIRONMENT Vol. 164 (1995), pgs. 221-235.

[24] Herbert L. Needleman and Richard J. Jackson, "Lead Toxicity in the 21st Century: Will We Still Be Treating It?" PEDIATRICS Vol. 89, No. 4 (April 1992), pgs. 678-680, citing a 1991 CDC study.

Descriptor terms: lead; herbert needleman; behavior; criminality; delinquency; heavy metals; IQ; central nervous system; attention disorders; aggressiveness;