

DARTMOUTH NEWS

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STUDY FINDS CORRELATION BETWEEN FLUORIDES IN WATER AND LEAD LEVELS

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HANOVER, N.H. —Although the dangers of lead poisoning have been known for years, substantial numbers of children continue to suffer from blood lead above danger level of 10 micrograms per deciliter of blood (10µg/dL).

A study published this month in the International Journal of Environmental Studies, and led by Roger Masters, Emeritus professor of government at Dartmouth, describes a factor that is correlated with higher lead levels in children. Analyzing a survey of over 280,000 Massachusetts children, the investigators found that silicofluorides — chemicals widely used in treating public water supplies — are associated with an increase in children's absorption of lead. The research team included Myron J. Coplan, retired Vice President of Albany International and principal of Intelleguity, Natick, Mass., and Brian T. Hone, research associate at Dartmouth College.

In their analysis, the investigators found that levels of lead in children's blood was significantly higher in Massachusetts communities using the silicofluorides fluosilicic acid and sodium silicofluoride than in towns where water is treated with sodium fluoride or not fluoridated at all. Compared to a matched group of 30 towns that do not use silicofluorides, children in 30 communities that use these chemicals were over twice as likely to have over 10µg/dL of blood lead.

"Silicofluorides are largely untested," said Professor Masters, who pointed out that over 90 percent of America's fluoridated drinking water supplies are treated with silicofluorides. "Virtually all research on fluoridation safety has focused on sodium fluoride, even though the studies in the 1930s showed important biological differences between these chemicals. The correlation with blood levels is especially serious because lead poisoning is associated with higher rates of learning disabilities, hyperactivity, substance abuse and crime."

Since completing the Massachusetts study, the investigators have analyzed data from rural counties in six additional states as well as in the National Health and Nutrition Evaluation Survey (NHANES III). The results, which have not yet been published, find a correlation between silicofluorides and blood lead levels, as well as higher rates of violent crime and substance abuse.

Masters will summarize these findings in a plenary lecture at a meeting of the Association for Politics and the Life Sciences at the Four Seasons Hotel in Atlanta, Georgia on Thursday, Sept. 2, at 9 a.m.

The research was funded by the Environmental Protection Agency's Office of Criminal Enforcement, Forensics and Training and by the Earhart Foundation, which integrates scientific discoveries in neuroscience, environmental chemistry, and human behavior.

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INFORMATION NOT ON ORIGINAL RELEASE -- About the Authors

Roger D. Masters heads the Dartmouth Foundation for Neuroscience and Society. For several decades he has researched the causes of violence and other dysfunctional human behavior such as ADD, ADHD and drug abuse.

Myron J. Coplan is retired Vice President of Albany International Corp., a registered Professional Chemical Engineer and a private consultant in chemical engineering at Intelleguity. His fields include water chemistry and the treatment of water and wastewater via membranes.

RELATED ARTICLE:

Moss ME, Lanphear BP, Auinger P. Association of dental caries and blood lead levels. JAMA 1999 Jun 23-30;281(24):2294-8.
Comment in: JAMA 1999 Jun 23-30;281(24):2340-2.

CONTEXT: Experiments show that dental caries rates are higher among lead-exposed animals, but this association has not been established in humans.

OBJECTIVE: To examine the relationship between blood lead levels and dental caries.

DESIGN: Cross-sectional survey conducted from 1988 to 1994 that included a dental examination and venipuncture blood lead assay.

SETTING AND PARTICIPANTS: A total of 24901 persons aged 2 years and older who participated in the Third National Health and Nutrition Examination Survey, which assessed the health and nutritional status of children and adults in the United States.

MAIN OUTCOME MEASURES: For children aged 2 to 11 years, the sum of decayed and filled deciduous or primary surfaces; for persons aged 6 years and older, the sum of decayed and filled permanent surfaces; for those 12 years and older, the sum of decayed, missing, and filled surfaces.

RESULTS: The log of blood lead level was significantly associated with the number of affected surfaces for both deciduous and permanent teeth in all age groups, even after adjusting for sociodemographic characteristics, diet, and dental care. Among children aged 5 to 17 years, a 0.24-micromol/L (5-microg/dL) change in blood lead level was associated with an elevated risk of dental caries (odds ratio, 1.8; 95% confidence interval, 1.3-2.5). Differences in blood lead level explained some of the differences in caries prevalence in different income levels and regions of the United States. We estimated the population attributable risk of lead exposure to be 13.5% and 9.6% of dental caries occurring in 5- to 17-year-olds exposed to the high and moderate levels, respectively.

CONCLUSIONS: Environmental lead exposure is associated with an increased prevalence of dental caries in the US population.

Findings may help explain the distribution of caries by income and region of the United States.

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Plenary Address to
Annual Conference of the Association for Politics and the
Life Sciences
Four Seasons Hotel, Atlanta, GA -- 9:00AM, Sept. 2,
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POISONING THE WELL
Neurotoxic Metals, Water Treatment, and Human
Behavior

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Summary: Heavy metals compromise normal brain development and neurotransmitter function, leading to long-term deficits in learning and social behavior. At the individual level, earlier studies revealed that hyperactive children and criminal offenders have significantly elevated levels of lead, manganese, or cadmium compared to controls; high blood lead at age seven predicts juvenile delinquency and adult crime. At the environmental level, our research has found that environmental factors associated with toxicity are correlated with higher rates of anti-social behavior. For the period 1977 to 1997, levels of violent crime and teenage homicide were significantly correlated with the probability of prenatal and infant exposure to leaded gasoline years earlier. Across all U.S. counties for both 1985 and 1991, industrial releases of heavy metals were -- controlling for over 20 socio-economic and demographic factors -- also a risk-factor for higher rates of crime. Surveys of children's blood lead in Massachusetts, New York, and other states as well as NHANES III and an NIJ study of 24 cities point to another environmental factor: where silicofluorides

are used as water treatment agents, risk-ratios for blood lead over 10µg/dL are from 1.25 to 2.5, with significant interactions between the silicofluorides and other factors associated with lead uptake. Communities using silicofluorides also report higher rates of learning disabilities, ADHD, violent crime, and criminals who were using cocaine at the time of arrest.

Research conducted with Myron J. Coplan (Intelleguity, Natick, MA) and Brian Hone under grants from the Office of Criminal Enforcement, Forensics and Training, Environmental Protection Agency, the Earhart Foundation, and the Rockefeller Center for the Social Sciences, Dartmouth College

Poisoning the Well: Neurotoxic Metals, Water Treatment, and Human Behavior

Roger D. Masters

I. Heavy metals, Neurotransmitter deregulation, and Anti-social Behavior

A. Toxic heavy metals such as lead, manganese and cadmium, combined with prenatal or neonatal developmental insults, dietary deficits, and stress, damage the brain structures and down-regulate essential neurotransmitters. Previous research in this area has found:

1. Because lead and other toxic metals are retained in bone and astroglial cells in the brain, uptake during fetal development and early childhood has long-lasting effects on development and behavior.

2. Among the toxic effects of lead is a reduction of dopamine function (which disturbs the behavioral inhibition mechanisms in the basal ganglia) and glutamate (which plays an essential role in the long term learning associated with the hippocampus).

3. Manganese can downregulate serotonin function, reducing sociability and increasing aggressiveness or depression.

B. Prior research at the individual level showed that the uptake of heavy metals is associated with higher levels of learning

disabilities, hyperactivity, substance abuse, violent crime, and other forms of anti-social behavior.

1. In seven different samples of prison inmates, violent offenders had significantly higher levels of lead, cadmium, or manganese in head hair than non-violent offenders or controls.

2. In two prospective studies, high lead levels at age 7 (one measuring lead in blood, the other bone lead) predicted juvenile delinquency and adult crime.

3. A substantial proportion of individuals diagnosed with ADD/ADHD are likely to have dangerously high levels of lead, manganese, or cadmium in bodily tissues.

4. Because alcohol, cocaine and other drugs temporarily restore neurotransmitter functions that are abnormal, substance abuse may often be crude self-medication in response to the effects of toxicity. For example, because lead downregulates dopamine and cocaine is a non-selective dopamine reuptake inhibitor, lead toxicity could increase the risk of cocaine abuse.

II. Heavy Metals, Blood Lead and Crime

A. Our own research shows that, for all U.S. counties, communities with industrial releases of lead or manganese had, controlling for socio-economic and demographic factors, higher violent crime rates in 1991. The comparable multiple regression analysis for 1985 replicates this finding.

B. Across the U.S., rates of violent crime and drug use have fallen continuously since 1993. This effect may be explained by long-term benefits of the ban on leaded gasoline in the 1970's. The delay reflects the years needed before the appearance of teenage cohorts that had not been exposed to leaded fumes during fetal development and early childhood.

1. Leaded gasoline was worse than lead toxicity in paint or water, since aerosol lead is absorbed 40-50% whereas only 5-15% of ingested lead is retained in the body.

2. Leaded gasoline sales from 1950 to 1980 are highly correlated with the overall violent crime rate 18 years or later (r

= .902 or higher).

3. The effect confirmed by correlating leaded gasoline sales from 1950 to 1980 with homicides by teenagers aged 14 to 17, which drop more sharply after 1993 than those by older offenders.

4. The negative effects of leaded gasoline on impulse control are also suggested by the high correlation ($r = .811$) between leaded gas sales between 1949 and 1993 and the contemporary year's sales of hard liquor -- a pattern that is not found for the consumption of beer or wine.

III. Water Treatment Procedures, Lead toxicity and crime.

A. The agent used to fluoridate public water supplies was shifted from sodium fluoride (NaF) to fluosilicic acid (H_2SiF_6) or sodium silicofluoride (Na_2SiF_6) -- the silicofluorides (SiF) -- on the basis of questionable biochemical assumptions and without adequate testing.

1. Although virtually all studies of fluoridation have continued to use NaF, over 90% of Americans drinking fluoridated are exposed to supplies treated with SiF.

2.2. Although it is claimed that SiF is completely dissociated after injection in water supplies, this assumption is inconsistent with published research and is highly unlikely under the actual conditions of water treatment.

B. Because sodium fluoride and silicofluorides have very different biological effects, undissociated SiF residues may be dangerous.

1. As early as 1935, animal studies showed that excess fluoride derived from SiF is excreted through the kidneys, whereas fluoride residues from NaF are more likely to be excreted in feces (indicating more active fluorine transport across the gut-blood barrier after exposure to SiF).

2. Recent research on dental preparations shows that SiF compounds may be as much as 19 times more biologically active than NaF.

3. Through one of several plausible mechanisms, SiF treated water can increase the transport of heavy metals across the gut-blood and blood-brain barriers, increasing rates of toxic uptake and behavioral dysfunction.

IV. Communities using SiF have higher levels of lead in children's blood and higher rates of anti-social behavior than locations with nonfluoridated or NaF treated water.

A. In Massachusetts, communities using SiF to fluoridate have higher rates of children with over 10µg/dL of blood lead and higher rates of crime. Average levels of lead in children's blood were: H₂SiF₆ = 2.78 µg/dL; Na₂SiF₆ = 2.66 µg/dL; NaF = 2.07 µg/dL; non-fluoridated = 2.02 µg/dL.

1. Within Massachusetts, those communities where the EPA reported lead levels in water over 15ppb, this effect was more pronounced: H₂SiF₆ = 3.27 µg/dL; Na₂SiF₆ = 4.38 µg/dL; NaF = 1.90 µg/dL; non-fluoridated = 2.18 µg/dL.

2. These effects were confirmed in a matched sample of 30 SiF and 30 non-SiF suburban middle-class communities:
1.94% of children exposed to SiF treated water had blood lead over 10µg/dL, whereas on 0.76% of children not so exposed had blood lead over this level (risk ratio = 2.55).

3. Rates of crime were also higher in Massachusetts communities using SiF fluoridation.

4. Similar effects were confirmed in rural counties in six additional states (Georgia, Wisconsin, Texas, Illinois, Alabama, and North Carolina).

B. Among 30,000 criminals in 24 cities studied by NIJ, those living where SiF is in water were more likely to have been using cocaine at the time of their arrest (H₂SiF₆ = 44%; Na₂SiF₆ = 43%; non-fluoridated = 32%).

1. There was no comparable difference for other drugs whose usage is not associated with chemicals influenced by lead toxicity.

2. Crime rates in the cities using SiF were significantly higher than in non-fluoridating cities (H₂SiF₆ = 1486 per

100,000; Na₂SiF₆ = 1480 per 100,000; non-fluoridated = 1100 per 100,000), as were rates of death from alcoholism (H₂SiF₆ = 56.1 per 100,000; Na₂SiF₆ = 53.8 per 100,000; non-fluoridated = 44.1 per 100,000).

C. Geographic analysis of data from NHANES III shows that in counties where over 90% of the children receive SiF treated water, average blood lead is 5.1 µg/dL, compared to 3.7µg/dL where less than 10% of the children are exposed (risk ratio = 1.38). This effect is highly significant ($p < .0001$) both for children 3-5 and for those 5-17.

1. Minorities are especially at risk. In high SiF exposure counties, blood lead levels average 6.26 µg/dL among Black children, 4.86 µg/dL among Mexican-Americans, and 3.05 µg/dL among Whites; in low SiF exposure counties, Blacks average 4.37µg/dL, Mexican-Americans 3.86µg/dL, and Whites 2.03µg/dL (risk ratios between 1.26 and 1.50). For both 3-5 and 5-17 age-groups, the interaction effect between a child's race and SiF exposure as factors in higher blood lead is highly significant ($p < .0001$).

2. Although NHANES III data also shows some benefits of fluoridation on lower tooth decay, these effects are weaker and are not found among White children aged 5-17. Moreover, lower rates of caries are not found among children 15-17 (perhaps because fluoride can slow tooth eruption, which could lead to misleading data when comparisons match age for children of different races).

D. A preliminary survey of high school nurses and administrators in sixteen comparable middle sized New York cities shows higher rates of ADHD cases treated with medication and higher rates of learning disabilities in communities using SiF (risk ratio = 1.38).

V. Conclusion: the need to integrate neurotoxicology, environmental research and the study of human behavior.

A. The brain is the most sensitive chemical organ in the body. While discussions of toxins heretofore focused on cancer and disease, ADD/ADHD, alcoholism, substance abuse, and crime need to be studied in terms of the latest biology and neuroscience of early development and brain function.

B. The effects of toxic heavy metals are consistent with the perspective of Darwinian medicine: since lead and manganese are widely found in soils but uptake depends on dietary deficits in calcium and other key elements, for most of hominid evolution the effects discussed above would only have occurred in time of dietary shortfall, when increased male-male conflict was not necessarily maladaptive.

C. In contemporary society, these effects take on a different character. Environmental pollution and dangerous water treatment procedures are human activities whose results are both economically costly and morally unjust. Innocent children should not be poisoned by public water supplies.