

# Low-Level Lead Exposure and Infant Development in the First Year<sup>1</sup>

DAVID BELLINGER,<sup>2</sup> ALAN LEVITON, HERBERT L. NEEDLEMAN, CHRISTINE WATRNAUX AND MICHAEL RABINOWITZ

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BELLINGER, D., A. LEVITON, H. L. NEEDLEMAN, C. WATRNAUX AND M. RABINOWITZ. Low level lead exposure and infant development in the first year. *NEUROBEHAVIORAL TOXICOL TERATOL* 8(2): 151-161, 1986. The developmental impact of prenatal and early postnatal low-level lead exposure was assessed in a prospective study of 249 middle and upper-middle class infants with umbilical cord blood lead levels in the range currently considered "normal." Infants were classified into three exposure groups: "low" ( $<3 \mu\text{g/dl}$ ), "mid" (6 to 7  $\mu\text{g/dl}$ ), and "high" ( $>10 \mu\text{g/dl}$ ). At 6 and 12 months, the lead concentration of capillary blood was measured, and the Bayley Scales of Infant Development administered. At both ages, Mental Development Index scores, adjusted for confounding, were inversely related to infants' umbilical cord blood lead levels. The difference between the mean adjusted scores of the infants in the low and high cord blood lead groups was 5.8 points at 6 months and 7.3 points at 12 months. At neither age were scores significantly related to postnatal blood lead levels. Prenatal exposure to lead levels relatively common among urban populations appear to be associated with less favorable development through the first year of life.

Human studies

Prenatal and postnatal lead studies

Infant development

WE previously reported an inverse relationship between infants' umbilical cord blood lead concentrations and their scores at 6 months of age on the Mental Development Index (MDI) of the Bayley Scales of Infant Development [2,3]. This relationship was dose-dependent over 0 to 25  $\mu\text{g/dl}$ , the range of lead levels observed in our sample. The difference between the adjusted MDI scores of the infants in the "low" ( $<3 \mu\text{g/dl}$ ) and "high" ( $\geq 10 \mu\text{g/dl}$ ) exposure groups was approximately 6 points (0.4 SD).

Although this finding suggests that lead has adverse effects at blood concentrations prevalent among young children [12], its implications for regulatory policy depend on the magnitude of the association and its stability over time. Among the relevant questions are the following. Do the performance differences between exposure groups persist beyond 6 months of age? Does the lower mean performance of infants with "high" cord blood lead levels reflect the enhanced susceptibility of a subgroup of these infants or does the effect extend to most of them? Does level of postnatal exposure alter the relationship between cord blood lead concentration and MDI? In this report we address these and related issues by including follow-up assessments of the infants at age 12 months in a re-examination of the association between pre- and postnatal lead exposure and performance on the Bayley Scales in the first year of life.

## Sample Selection

The infants enrolled in this study were selected from a

Population of 11,837 infants whose umbilical cord blood lead concentration was measured. These infants represent approximately 97% of the births at the Brigham and Women's Hospital in Boston, MA, between April 1979 and April 1981. The mean cord blood lead level of this population was 6.6  $\mu\text{g/dl}$  (SD=3.2, range=0-37) (16).

Our goal was to select three groups of infants for study: those with cord blood lead levels in the lowest tenth percentile for the population of births at this hospital (the "low" lead group), those with levels very close to the mean (the "mid" lead group), and those with levels exceeding the ninetieth percentile (the "high" lead group). The distribution of cord blood lead levels for the approximately 2,500 infants born in the first 4.5 months of blood sample collections was used to establish criteria for eligibility in these three groups ( $<3.6$  to 7, and  $\geq 10 \mu\text{g/dl}$  for the low, mid, and high lead groups, respectively). The study sample was chosen from the 9,489 infants born between August 10, 1979 and April 30, 1981.

Not all eligible infants and families were invited to participate. Infants were excluded because of a serious medical condition evident at birth or in the early postnatal period (e.g. Down's syndrome, gestational age less than 34 weeks, cleft palate), location of residence (greater than 12 miles from the Children's Hospital or in an area judged unsafe for home visitors), language barrier, failure to seek or obtain consent, an intention to relocate out of the immediate region, or our inability to locate them (Table I). Additional details about the sample selection process and ascertainment bias are presented elsewhere [3].

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# Low Level Lead Exposure The Clinical Implications Of Current Research

**Tom Clarkson**



## **Low Level Lead Exposure The Clinical Implications Of Current Research:**

*Low Level Lead Exposure* Herbert L. Needleman,1980      **Environmental Health Perspectives** ,2004      Human Lead Exposure Herbert L. Needleman,1991-12-07 Human Lead Exposure consists of scientific reviews and important contributions intended to increase the understanding of the legal social and economic forces that have delayed effective prevention of lead toxicity Chapters discuss the history both ancient and recent of lead explore its neurobiology and toxicology review the sources and routes to humans and examine evidence that indicates that lead may affect humans at levels previously thought to be harmless Neurobiologists epidemiologists public health officials and others concerned about the effects of lead on the human population will find a tremendous amount of useful information in this timely volume      Reproductive and Developmental Toxicity of Metals Tom Clarkson,2012-12-06 The Permanent Commission and International Association on Occupational Health PCIAOH established in 1969 a Subcommittee on the Toxicology of Metals under the chairmanship of Lars Friberg This committee which later was named the Scientific Committee on the Toxicology of Metals has organized a number of previous meetings that have led to publications in three major areas of metal toxicology a preliminary meeting in Slanchev Bryag Bulgaria in 1971 followed by a meeting in 1972 in Buenos Aires Argentina which produced two reports Dukes and Friberg 1971 Task Group on Metal Accumulation 1973 that discussed the metabolism of metals with special reference to absorption excretion and biological half times The effects and dose response relationships of toxic metals including a discussion of general principles was the second major topic addressed by the Scientific Committee at a meeting in Tokyo in 1974 Nordberg 1976 The philosophy of this conference as well as the previous one in Buenos Aires was based on the concept of a threshold dose for the occurrence of adverse effects In a conference held in Atlanta USA in 1980 the scope of discussion on metal effects was broadened to include the role of metals in carcinogenesis Thus for the first time the Scientific Committee took under consideration the possibility of non threshold relationships Belman and Nordberg 1981 In addition the Scientific Committee on the Toxicology of Metals organized a workshop on metal interactions in Stockholm 1977 Nordberg et al      **The Vulnerable Brain and Environmental Risks** R.L. Isaacson,K.F. Jensen,2013-03-07 Contributors to this second volume discuss metal and toxicant toxicity their environmental sources and methods of action and their regulation by courts and agencies      Illness and the Environment J. Stephen Kroll-Smith,Philip M. Brown,Valerie Gunter,2000-08 In 25 papers academics and a few environmental scientists activists discuss profound social policy and competing paradigm issues concerning the contested environment disease link in a postnatural world Include discussion questions Kroll Smith is a professor of sociology at the U of New Orleans Annotation copyrighted by Book News Inc Portland OR      *Advances in Behavioral Pharmacology* N. Krasnegor,D. B. Gray,T. Thompson,2014-06-03 First published in 1986 This monograph is based on a conference sponsored by the Human Learning and Behavior Branch of the National Institute of Child Health and Human Development NIH The meeting that was held at the Xerox Center in Leesburg Virginia in August 1983 brought together a

group of leading researchers for the purpose of providing an overview of the emerging field of developmental behavioral pharmacology More specifically as is evidenced by the chapters in this volume the intent was to put the field into historical perspective render a working definition and outline strategies and tactics for conducting behavioral pharmacological research in the developing organism

**The Developmental Neurotoxicity of Lead** C. Winder, 2012-12-06 Over the past two millennia environmental lead levels have risen dramatically Patterson 1980 Most of this increase has occurred since the beginning of the present century Murozami et al 1969 and taken into perspective a typical individual living in the industrialized world sustains a lead burden 500 times that of his prehistoric ancestors Patterson 1983 Lead is unique in being an environmental pollutant where the levels deemed clinically toxic are less than an order of magnitude from those that are normally encountered in the population The clinical limit for lead exposure 70 µg Pb / 100 ml blood is about three times the normal value in the range 15-30 µg Pb / 100ml blood This small difference is remarkable from the toxicological standpoint The key concept here is control of dispersal The industrial actions of man bring contact with a wide variety of substances some of which are poisonous or dangerous In such cases protective measures are taken to keep hazardous exposure to a minimum In the case of lead compounds stringent regulations are production and distribution enforced The exception to this is in the dispersal of lead from vehicle exhausts following purchase from the petrol pump Perhaps man's long standing acquaintance with lead in home and industry is responsible for a complacency which until only recently has been unquestioned Beginning in the late 1960s evidence began to accumulate suggesting that lead at relatively low levels of exposure might be causing negative effects on neurobiological function

*Cost Increases on Four Watershed Projects of the Soil Conservation Service* United States. Congress. Senate. Committee on Environment and Public Works. Subcommittee on Water Resources, 1984

*Morbidity and Mortality Weekly Report*, 1990-07 MMWR, 1990 Changing Metal Cycles and Human Health J.O. Nriagu, 2012-12-06

of metal interactions with subcellular biochemical systems usually either are metabolites of the system affected porphyrinurias or represent some specific function of a cellular system being impaired proteinurias One typically finds a continuum of symptoms from the subtle or so called no effect biochemical and physiological indicators of exposure to severe clinical disease and death This continuum is the basis of much of the controversy since many health officials follow the traditional practice of applying the threshold health effect concept in evaluating the problems of environmental exposure to metals The past decade or so however has seen a vast increase in our understanding of the effects of elevated concentrations of toxic metals in local populations and ecosystems At the same time there is a growing awareness that the effects of the metals which occur naturally in the environment must be distinguished from those imposed by the pollutant fraction This point was amply documented in a recent study of cadmium intake and cadmium in a number of human tissues in Sweden Japan and the United States which showed fairly conclusively that the background exposure in Japan was about threefold higher than in the other two countries

2 One immediate implication is

that any health effect studies of cadmium in Japan using control groups within that country are liable to underestimate the difference between the exposed and the control groups simply because of the the high background intake Lead Contamination United States. Congress. House. Committee on Energy and Commerce. Subcommittee on Health and the Environment,1988 **Neurotoxicology** Kenneth Blum,L. Manzo,1985-07-30 Lead Pollution From Motor Vehicles 1974-1986 P. Farmer,2003-09-02 This bibliography brings together a wide range of material on the problem of environmental lead pollution from motor vehicles published during 1974 1986 It includes research and surveys from a number of countries and covers the effects of exhaust gas lead on humans including children Neurotoxicity : identifying and controlling poisons of the nervous system : new developments in neuroscience. , *The Nature and Extent of Lead Poisoning in Children in the United States* ,1988 *Hazardous Waste Contamination of Water Resources* United States. Congress. House. Committee on Public Works and Transportation. Subcommittee on Investigations and Oversight,1984 **Beyond the Individual** Abraham Wandersman,Robert Hess,1985 Here is a stimulating volume on the psychological damage caused by our exposures to ills in the environment Topics include case studies from environmental catastrophes Love Canal Three Mile Island and research on how groups respond to and cope with environmental stresses This timely book is aimed at environmental policymakers public health personnel agency staff and mental health personnel all professionals concerned with the impact of the environment on our physical and psychological health Environmental and Chemical Toxins and Psychiatric Illness James S. Brown,2008-08-13 During the past 60 years the number of chemical disasters worldwide from military occupational and environmental sources has risen at an alarming rate The profound controversy surrounding many chemicals makes objective analysis nearly impossible Yet now more than ever with the daily exposure to a wide range of chemicals and the increased threat of chemical terrorism it is critical that we understand the role of chemicals in causing psychiatric illness Unlike related books this remarkable reference is intended specifically for psychiatric applications and is thus the definitive sourcebook for the many professionals called on to respond to these events This work stands alone as the first on this topic to be written by a psychiatrist and the first to bring together the military occupational and environmental exposures causing psychiatric illness including multiple chemical sensitivities mass hysteria radiation exposures community stress reactions and Gulf War and other syndromes Unique highlights include A summary of the reported psychiatric symptoms attributed to each chemical class chemical weapons pesticides fumigants metals solvents gases PCBs Agent Orange and other miscellaneous chemicals in tables for easy reference We use personal care products take prescription drugs pump gasoline drink alcohol and spray insecticides as part of our everyday lives Yet rarely do we realize that significant exposures to the chemicals described in this book many of which we are exposed to in daily activities can damage the central nervous system causing psychiatric illness A comprehensive bibliography in every chapter of all the important material in English language medical journals and books that has appeared on this subject since the late 19th century These

bibliographies cover everything from the first published reports of the dangers of carbon disulfide in the French rubber industry dangers that American medicine ignored for years through more recent large scale chemical exposures that have serious long term consequences e g Love Canal The latest information about terrorist and military uses of chemical weapons of critical relevance in psychiatry today from World War I combatants exposed to chlorine phosgene mustard gas arsenic and cyanide to the first organophosphate or nerve gases such as tabun and sarin developed by the Germans before and during World War II and used by Iraq in the Gulf War and by a religious cult in the terrorist subway attacks in Tokyo and Matsumoto Japan Quite simply this book is a must have for psychiatric and medical professionals everywhere with extended appeal among laypersons such as environmental consumer advocates attorneys insurance professionals industrial hygienists disaster planners and medical librarians

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## **Table of Contents Low Level Lead Exposure The Clinical Implications Of Current Research**

1. Understanding the eBook Low Level Lead Exposure The Clinical Implications Of Current Research
  - The Rise of Digital Reading Low Level Lead Exposure The Clinical Implications Of Current Research
  - Advantages of eBooks Over Traditional Books
2. Identifying Low Level Lead Exposure The Clinical Implications Of Current Research
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Low Level Lead Exposure The Clinical Implications Of Current Research
  - User-Friendly Interface
4. Exploring eBook Recommendations from Low Level Lead Exposure The Clinical Implications Of Current Research
  - Personalized Recommendations
  - Low Level Lead Exposure The Clinical Implications Of Current Research User Reviews and Ratings
  - Low Level Lead Exposure The Clinical Implications Of Current Research and Bestseller Lists
5. Accessing Low Level Lead Exposure The Clinical Implications Of Current Research Free and Paid eBooks
  - Low Level Lead Exposure The Clinical Implications Of Current Research Public Domain eBooks
  - Low Level Lead Exposure The Clinical Implications Of Current Research eBook Subscription Services
  - Low Level Lead Exposure The Clinical Implications Of Current Research Budget-Friendly Options
6. Navigating Low Level Lead Exposure The Clinical Implications Of Current Research eBook Formats

- ePub, PDF, MOBI, and More
  - Low Level Lead Exposure The Clinical Implications Of Current Research Compatibility with Devices
  - Low Level Lead Exposure The Clinical Implications Of Current Research Enhanced eBook Features
7. Enhancing Your Reading Experience
    - Adjustable Fonts and Text Sizes of Low Level Lead Exposure The Clinical Implications Of Current Research
    - Highlighting and Note-Taking Low Level Lead Exposure The Clinical Implications Of Current Research
    - Interactive Elements Low Level Lead Exposure The Clinical Implications Of Current Research
  8. Staying Engaged with Low Level Lead Exposure The Clinical Implications Of Current Research
    - Joining Online Reading Communities
    - Participating in Virtual Book Clubs
    - Following Authors and Publishers Low Level Lead Exposure The Clinical Implications Of Current Research
  9. Balancing eBooks and Physical Books Low Level Lead Exposure The Clinical Implications Of Current Research
    - Benefits of a Digital Library
    - Creating a Diverse Reading Collection Low Level Lead Exposure The Clinical Implications Of Current Research
  10. Overcoming Reading Challenges
    - Dealing with Digital Eye Strain
    - Minimizing Distractions
    - Managing Screen Time
  11. Cultivating a Reading Routine Low Level Lead Exposure The Clinical Implications Of Current Research
    - Setting Reading Goals Low Level Lead Exposure The Clinical Implications Of Current Research
    - Carving Out Dedicated Reading Time
  12. Sourcing Reliable Information of Low Level Lead Exposure The Clinical Implications Of Current Research
    - Fact-Checking eBook Content of Low Level Lead Exposure The Clinical Implications Of Current Research
    - Distinguishing Credible Sources
  13. Promoting Lifelong Learning
    - Utilizing eBooks for Skill Development
    - Exploring Educational eBooks
  14. Embracing eBook Trends
    - Integration of Multimedia Elements
    - Interactive and Gamified eBooks



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the sidewalls of the castings and other features perpendicular to the parting line must be drafted as much as possible the draft angle will depend upon the type of material and varies inversely with height of the wall dfmpro for casting provides casting design guidelines including draft angles fillet radius mold wall thickness undercuts

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the following five tips will help you in designing a good casting product and in preparing a correct casting drawing 1 deciding parting line the parting line is the line around a casting component where two molds meet each other the parting line should be decided by the casting component design engineer and should be shown in the casting

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