



Neurobehavioural effects of developmental toxicity

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Neurodevelopmental disabilities, including autism, attention-deficit hyperactivity disorder, dyslexia, and other cognitive impairments, affect millions of children worldwide, and some diagnoses seem to be increasing in frequency. Industrial chemicals that injure the developing brain are among the known causes for this rise in prevalence. In 2006, we did a systematic review and identified five industrial chemicals as developmental neurotoxicants: lead, methylmercury, polychlorinated biphenyls, arsenic, and toluene. Since 2006, epidemiological studies have documented six additional developmental neurotoxicants—manganese, fluoride, chlorpyrifos, dichlorodiphenyltrichloroethane, tetrachloroethylene, and the polybrominated diphenyl ethers. We postulate that even more neurotoxicants remain undiscovered. To control the pandemic of developmental neurotoxicity, we propose a global prevention strategy. Untested chemicals should not be presumed to be safe to brain development, and chemicals in existing use and all new chemicals must therefore be tested for developmental neurotoxicity. To coordinate these efforts and to accelerate translation of science into prevention, we propose the urgent formation of a new international clearinghouse.

Introduction

Disorders of neurobehavioural development affect 10–15% of all births,¹ and prevalence rates of autism spectrum disorder and attention-deficit hyperactivity disorder seem to be increasing worldwide.² Subclinical decrements in brain function are even more common than these neurobehavioural developmental disorders. All these disabilities can have severe consequences³—they diminish quality of life, reduce academic achievement, and disturb behaviour, with profound consequences for the welfare and productivity of entire societies.⁴

The root causes of the present global pandemic of neurodevelopmental disorders are only partly understood. Although genetic factors have a role,⁵ they cannot explain recent increases in reported prevalence, and none of the genes discovered so far seem to be responsible for more than a small proportion of cases.⁶ Overall, genetic factors seem to account for no more than perhaps 30–40% of all cases of neurodevelopmental disorders. Thus, non-genetic, environmental exposures are involved in causation, in some cases probably by interacting with genetically inherited predispositions.

Strong evidence exists that industrial chemicals widely disseminated in the environment are important contributors to what we have called the global, silent pandemic of neurodevelopmental toxicity.^{7,8} The developing human brain is uniquely vulnerable to toxic chemical exposures, and major windows of developmental vulnerability occur in utero and during infancy and early childhood.⁹ During these sensitive life stages, chemicals can cause permanent brain injury at low levels of exposure that would have little or no adverse effect in an adult.

In 2006, we did a systematic review of the published clinical and epidemiological studies into the neurotoxicity of industrial chemicals, with a focus on developmental neurotoxicity.⁷ We identified five industrial chemicals that could be reliably classified as developmental neurotoxicants: lead, methylmercury, arsenic, polychlorinated biphenyls, and toluene. We also noted 201 chemicals that had been reported to cause injury

to the nervous system in adults, mostly in connection with occupational exposures, poisoning incidents, or suicide attempts. Additionally, more than 1000 chemicals have been reported to be neurotoxic in animals in laboratory studies.

We noted that recognition of the risks of industrial chemicals to brain development has historically needed decades of research and scrutiny, as shown in the cases of lead and methylmercury.^{10–12} In most cases, discovery began with clinical diagnosis of poisoning in workers and episodes of high-dose exposure. More sophisticated epidemiological studies typically began only much later. Results from such studies documented developmental neurotoxicity at much lower exposure levels than had previously been thought to be safe. Thus, recognition of widespread subclinical toxicity often did not occur until decades after the initial evidence of neurotoxicity. A recurring theme was that early warnings of subclinical neurotoxicity were often ignored or even dismissed.¹³ David P Rall, former Director of the US National Institute of Environmental Health Sciences, once noted that “if thalidomide had caused a ten-point loss of intelligence quotient (IQ) instead of obvious birth defects of the limbs, it would probably still be on the market”.¹⁴ Many industrial chemicals marketed at present probably cause IQ deficits of far fewer than ten points and have therefore eluded detection so far, but their combined effects could have enormous consequences.

In our 2006 review,⁷ we expressed concern that additional developmental neurotoxicants might lurk undiscovered among the 201 chemicals then known to be neurotoxic to adult human beings and among the many thousands of pesticides, solvents, and other industrial chemicals in widespread use that had never been tested for neurodevelopmental toxicity. Since our previous review, new data have emerged about the vulnerability of the developing brain and the neurotoxicity of industrial chemicals. Particularly important new evidence derives from prospective epidemiological birth cohort studies.

In this Review, we consider recent information about the developmental neurotoxicity of industrial chemicals

Neurobehavioural Effects Of Developmental Toxicity

Fabio Capello, Antonio Vittorino Gaddi



Neurobehavioural Effects Of Developmental Toxicity:

Disability Studies and the Environmental Humanities Sarah Jaquette Ray, Jay Sibara, 2017-06 Although scholars in the environmental humanities have been exploring the dichotomy between wild and built environments for several years few have focused on the field of disability studies a discipline that enlists the contingency between environments and bodies as a foundation of its scholarship On the other hand scholars in disability studies have demonstrated the ways in which the built environment privileges some bodies and minds over others yet they have rarely examined the ways in which toxic environments engender chronic illness and disability or how environmental illnesses disrupt dominant paradigms for scrutinizing disability Designed as a reader for undergraduate and graduate courses Disability Studies and the Environmental Humanities employs interdisciplinary perspectives to examine such issues as slow violence imperialism race toxicity eco sickness the body in environmental justice ableism and other topics With a historical scope spanning the seventeenth century to the present this collection not only presents the foundational documents informing this intersection of fields but also showcases the most current work making it an indispensable reference

Health Impacts of Developmental Exposure to Environmental Chemicals Reiko Kishi, Philippe Grandjean, 2019-12-13 This book provides concise and cutting edge studies on threats resulting from exposure to environmental chemicals that can affect human health and development with a particular emphasis on the DOHaD concept The book is divided into five main parts the first of which includes an introduction to the impacts of developmental exposure to environmental chemicals and historical perspectives while the second focuses on how environmental chemicals can affect human organs including neurodevelopment immune functions etc In turn the third part addresses the characteristics of specific chemicals and their effects on human health and development while the fourth part provides a basis for future studies by highlighting the latest innovations in toxicology remaining challenges and promising strategies in children s environmental health research as well as ideas on how to bridge the gap between research evidence and practical policymaking The fifth and last part outlines further research directions and related policymaking aspects Health Impacts of Developmental Exposure to Environmental Chemicals will appeal to young and veteran researchers students and physicians especially gynecologists and pediatricians who are seeking comprehensive information on how children s health can be affected by harmful chemicals and other environmental toxicants

Neurotoxicology of Fish: Navigating Toxicological and Environmental Impacts on Aquatic Ecosystems Mr. Darshan Kumar T, Ms. Spoorthi K R, 2025-05-05

The Neuroscience of Dementia Colin R Martin, Victor R Preedy, 2020-12-23 The Neuroscience of Dementia brings together different fields of dementia research into a single book covering a wide range of subjects including Alzheimer s disease Lewy body dementia mixed dementia vascular dementia physical activity risk factors mortality biomarkers SPECT CT MRI questionnaires nutrition sleep delirium hearing loss agitation aggression delusions anxiety depression hallucinations psychosis senile plaques tau and amyloid beta neuroinflammation molecular biology and

more This foundational comprehensive book compiles the latest understanding on all forms of dementia and their common features in a single source It is an invaluable resource for neuroscientists neurologists and anyone in the field Offers comprehensive coverage of a broad range of topics related to dementia Contains in each chapter an abstract key facts mini dictionary of terms and summary points to aid in understanding Provides unique sections on specific subareas intellectual components and knowledge based niches that will help readers navigate key areas for research and further clinical recommendations Features preclinical and clinical studies to help researchers map out key areas for research and further clinical recommendations Serves as a one stop source for everything you need to know about dementia

Genetics, Neurology, Behavior, and Diet in Dementia Colin R Martin, Victor R Preedy, 2020-08-11 Genetics Neurology Behavior and Diet in Dementia The Neuroscience of Dementia Volume 2 consolidates different fields of dementia research into a single book covering a range of subjects including Alzheimer s disease Lewy body dementia mixed dementia vascular dementia physical activity risk factors mortality biomarkers SPECT CT MRI questionnaires nutrition sleep delirium hearing loss agitation aggression delusions anxiety depression hallucinations psychosis senile plaques tau and amyloid beta neuroinflammation and molecular biology This foundational comprehensive book assembles the latest understanding on all dementias and their common features in a single source It is an invaluable resource for neuroscientists neurologists and anyone in the field Offers comprehensive coverage of a broad range of topics related to dementia Serves as a foundational collection for neuroscientists and neurologists on the biology of dementia and brain dysfunction Contains in each chapter an abstract key facts mini dictionary of terms and summary points to aid in understanding Provides unique sections on specific subareas intellectual components and knowledge based niches that will help readers navigate key areas for research and further clinical recommendations Features preclinical and clinical studies to help researchers map out key areas for research and further clinical recommendations Serves as a one stop source for everything you need to know about dementia

Preserving Brain Health in a Toxic Age Arnold R. Eiser, 2021-10-11 Learn how to reduce the impact of environmental toxins on brain development functioning and health The human brain is a marvelously complex organ that has evolved great new capabilities over the past 250 000 years During most of that period daily life was vastly different from our lives today Exercise was not optional one literally had to run for one s life livelihood and sustenance The Stone Age diet was not a fad but the only food available Periods of fasting arose from food scarcity and hence the earliest keto diet was commonplace Life changed greatly with the advent of agriculture and industry Diseases that were previously unknown or uncommon began to surface as by products of civilization s advance Changes in our ways of living have altered the nature of illness as well as its diagnosis and treatment From the 1970s to the present tens of thousands of chemicals with applications in all aspects of our lives have grown more than 40 fold Exposure to these new substances has impacted many aspects of our health especially the delicate parts of the brain and nervous system In parallel with the changes in our environment we have seen the growth

of brain disorders including Alzheimer's Disease and autism in previously unimaginable ways Here Arnold Eiser elucidates some features of diseases affecting the nervous system that are increasing in incidence with a focus on those disorders that appear related to environmental toxins that modern life has introduced He takes readers behind the scenes of the science itself to discover the human stories involved in the discovery and management of these illnesses Offering insights from a variety of scientific disciplines Eiser clearly and succinctly illustrates the impact of toxins on our brains and how we might better protect ourselves from negative outcomes With interviews from leading authorities in the field of neuroscience environmental toxicology integrative medicine neurology immunology geriatrics and microbiology re the gut microbiome this book offers a robust understanding of the complex threats to our brains and the healthy brain's dependence upon many other systems within our bodies This is a voyage of discovery into the science history and human struggle regarding disorders challenging the brain as well as their possible prevention

Routledge Handbook of Agricultural Biodiversity Danny Hunter, Luigi Guarino, Charles Spillane, Peter C. McKeown, 2017-10-03 The world relies on very few crop and animal species for agriculture and to supply its food needs In recent decades there has been increased appreciation of the risk this implies for food security and quality especially in times of environmental change As a result agricultural biodiversity has moved to the top of research and policy agendas This Handbook presents a comprehensive overview of our current knowledge of agricultural biodiversity in a series of specially commissioned chapters It draws on multiple disciplines including plant and animal genetics ecology crop and animal science food studies and nutrition as well as social science subjects which explore the socio economic cultural institutional legal and policy aspects of agricultural biodiversity It focuses not only on the core requirements to deliver a sustainable agriculture and food supply but also highlights the additional ecosystem services provided by a diverse and resilient agricultural landscape and farming practices The book provides an indispensable reference textbook for a wide range of courses in agriculture ecology biodiversity conservation and environmental studies

Chemical agriculture and pollinators: signs of a Planet in danger Giuseppe Zicari, 2023-02-24 Bees that have inhabited the Planet for over 100 million years are the common thread that tells the story of various ecological challenges such as the reduction of biodiversity climate change soil degradation and energy transition Paradoxically agriculture is one of the major causes of irreversible and therefore unsustainable changes such as global warming and the extinction of pollinators from which it derives its benefits and wealth The massive use of fossil fuels the distribution of poisons such as pesticides persistent toxic and bioaccumulative the loss of fertility in monocultures of plants selected to satisfy economic needs are some of the main causes of an ecologically unsustainable food production system The book tries to show a different vision of the World we are building a story of backstories and underestimated dangers This book received two prizes Steli di Pace Stems of Peace by the Union of European Journalists and Communicators in 2023 and it was the winner of the Concorso Nazionale per la divulgazione scientifica Kerit LC Edizioni National Competition for science dissemination in 2024

Endocrine Disruptors, Brain, and Behavior Heather B. Patisaul, Scott M. Belcher, 2017-04-10 Our world and bodies are becoming increasingly polluted with chemicals capable of interfering with our hormones and thus possibly our present and future neural and mental health As authors Heather Patisaul and Scott Belcher outline there is a large lack of data and evidence in this causal relationship which begs a need for further study to accelerate progress in the endocrinology and neuroendocrinology fields Endocrine Disruptors Brain and Behavior focuses on if and how these chemicals known as endocrine disrupting compounds EDCs affect the development and function of the brain and might be contributing to neural disorders rapidly rising in prevalence The book provides an overall synthesis of the EDC field including its historical roots major hypotheses key findings and research gaps The authors explain why even the concept of endocrine disruption is controversial in some circles how differing definitions of endocrine disruption and what constitutes an adverse outcome on the brain shape public policy and where the current capacity by different stakeholders industry academia regulatory agencies to evaluate chemicals for safety in a regulatory context begins and ends The book concludes with suggestions for future research needs and a summary of emerging technology which might prove capable of more effectively evaluating existing and emerging chemicals for endocrine disrupting properties As such it provides the context for interdisciplinary and innovative input from a broad spectrum of fields including those well schooled in neuroscience evolutionary biology brain behavior sex differences and neuroendocrinology

The Microbiome and Neurotoxicity, 2024-05-03 Advances in Neurotoxicology Volume 11 presents interesting chapters written by an international board of authors Chapters in this new release include Gut microbiota as a mediator on the neurotoxicity of mercury Relationships between lead induced learning and memory impairments and gut microbiota disturbance in mice Utility of zebrafish based models in understanding molecular mechanisms of neurotoxicity mediated by the gut brain axis Alterations of gut microbiota linking environmental exposures to neurotoxicity Iron Toxicity Ferroptosis and Microbiota in Parkinson s Disease Implications for Novel Targets and Modulation of gut microbiota with probiotics as a strategy to counteract endogenous and exogenous neurotoxicity Provides the latest information on Neurotoxicology Offers outstanding and original reviews on Neurotoxicology Serves as an indispensable reference for researchers and students alike

Parenting at Your Child's Pace Joel Warsh, 2024-08-06 More adults with young children are committed to integrative and holistic health but the available information can be overwhelming and confusing Through accessible evidence based guidance Dr Joel Warsh helps parents work through the health concerns and developmental changes that come up during the first three years of life and navigate the unique realities of parenting today He addresses questions about holistic health frequently Googled by parents What is placental encapsulation and is it right for me Should I try baby led weaning This book will empower parents to make informed and confident choices for the health of their children from newborns to toddlers

Optimizing brain health across the life course World Health Organization, 2022-07-31

How Can I Get Better? Richard Horowitz, 2017-02-14 From one of the

country's foremost doctors and now New York Times bestselling author comes a step by step plan for diagnosing treating and healing Lyme and other chronic diseases **Pediatric Neurotoxicology** Cynthia A. Riccio, Jeremy R. Sullivan, 2016-08-10

This book focuses on children and the impact of neurotoxins on the developing brain to guide the practice of psychologists working with children in clinical and school settings Each chapter covers a distinct neurotoxin or group of neurotoxins with particular emphasis on the impact of the neurotoxin exposure on the developing brain and long term cognitive and psychosocial outcomes This is more complex than studying neurotoxins with adults because of the rapid development occurring in the child's brain Further children are more susceptible than adults to the effects of neurotoxins due to their developmental status Many of the effects discussed in this volume occur in utero thus setting the stage for an altered developmental trajectory **Rare Conditions, Diagnostic Challenges, and Controversies in Clinical**

Neuropsychology Jessica Fish, Shai Betteridge, Barbara A. Wilson, 2023-06-23 This book highlights those rare difficult to diagnose or controversial cases in contemporary clinical neuropsychology The evidence base relevant to this type of work is almost by definition insufficient to guide practice but most clinicians will encounter such cases at some point in their careers By documenting the experiences and learning of clinicians who have worked with cases that are out of the ordinary the book addresses an important gap in the literature The book discusses 23 challenging and fascinating cases that fall outside what can be considered routine practice Divided into three sections the text begins by addressing rare and unusual conditions defined as either conditions with a low incidence or cases with an atypical presentation of a condition It goes on to examine circumstances where an accurate diagnosis and or coherent case formulation has been difficult to reach The final section addresses controversial conditions in neuropsychology including those where there is ongoing scientific debate disagreement between important stakeholders or an associated high stakes decision This text covers practice across lifespan and offers crucial information on specific conditions as well as implications for practice in rare disorders This book will be beneficial for clinical neuropsychologists and applied psychologists working with people with complex neurological conditions along with individuals from medical nursing allied health and social work backgrounds It will further be of appeal to educators researchers and students of these professions and disciplines *Disconnected Kids, Third Edition* Dr. Robert

Melillo, 2024-08-06 A revised and updated edition of the proven drug free program to treat the cause not just the symptoms of autism spectrum disorders ADHD and related neurological conditions Diagnosis rates of neurological disorders including autism spectrum disorders ADHD dyslexia and obsessive compulsive disorders are climbing at an alarming rate Yet psychiatric drugs don't cure the problems they only disguise the symptoms Dr Robert Melillo's pioneering work that began in the 1990s with the creation of his groundbreaking Brain Balance program has brought a new understanding to the cause of these conditions an imbalance between the left and right sides of the child's developing brain Today more than fifty thousand children have successfully completed the Brain Balance program and have experienced dramatic improvements in behavioral

emotional social and academic outcomes Disconnected Kids is a comprehensive at home guide to the Brain Balance program which involves no medication or medical interventions but focuses instead on movement and sensory exercises that stimulate proper brain development This updated and revised edition also features new exercises and the latest research findings on how the retention of primitive reflexes the involuntary movements babies are born with that typically are replaced with intentional movements by their first birthday plays an integral role in the development of neurological issues Through the exercises in this book these reflexes can be diminished making brain balance easier to attain Disconnected Kids helps readers guide children susceptible to a brain imbalance to overcome challenges and allow their true gifted selves to shine

The Sociology of Education Jeanne Ballantine,Jenny Stuber,Judson Everitt,2021-07-29 The ninth edition of The Sociology of Education examines the field in rare breadth by incorporating a diverse range of theoretical approaches and a distinct sociological lens in its overview of education and schooling Education is changing rapidly just as the social forces outside of schools are and to present the material in a meaningful way the authors of this book provide a unifying framework an open systems approach to illustrate how the issues and structures we find in education are all interconnected Separate chapters are devoted to how schools help shape who has access to educational opportunities and who does not issues of race class and gender the organization of schools and the roles that make up educational settings and more Throughout the book readers will have an opportunity to engage with theories and issues that are discussed and to apply their newly obtained understanding in response to emerging and persistent problems in the educational system The new edition continues to be a critical point of reference for students interested in exploring the social context of education and the role education has in shaping our society It is perfect for sociology of education and social foundations of education courses at the undergraduate or early graduate level

Neurodevelopmental Processes in Health and Disease: Bridging Basic and Clinical Research Edna Grünblatt,Susanne Walitza,Tanja Maria Michel,Tracey Petryshen,2021-12-03 **Clinical Handbook of Air Pollution-Related Diseases** Fabio Capello,Antonio Vittorino Gaddi,2018-02-21 This book examines in detail the clinical implications of those diseases that either are primarily triggered by air pollution or represent direct consequences of air pollutants The aim is to provide medical practitioners with practical solutions to issues in diagnosis and treatment while simultaneously furnishing other interested parties with crucial information on the field The book introduces the concept that air pollution related diseases constitute a new class of pathologies A wide range of conditions mainly attributable to air pollution are discussed covering different body systems and pollution impacts in subsets of the population In addition to presenting state of the art overviews of clinical aspects the book carefully examines the implications of current knowledge for social and public health strategies aimed at disease prevention and prophylaxis The Clinical Handbook of Air Pollution Related Diseases will greatly assist doctors and healthcare workers when dealing with the consequences of air pollution in their everyday practice and will provide researchers industry and policymakers with valuable facts and insights

Advanced Clinical Naturopathic Medicine Leah Hechtman, 2020-10-15 Advanced Clinical Naturopathic Medicine engages the reader and evolves their knowledge and understanding from the fundamental Clinical Naturopathic Medicine to a more specialised focus. Written by Leah Hechtman, it concentrates on advanced topics commonly encountered in clinical practice, including new advancements and cutting edge research as well as foundational aspects of clinical practice. This new title showcases how transformative and effective naturopathy is and offers insight into the depth of naturopathic practice and its vital role in the healthcare system. With the profession constantly evolving and naturopathy more often incorporated into specialty practices, this publication is a timely resource to guide clinicians and students through complicated areas of expertise and specialisation while keeping the primary principle of patient centred care at the forefront of the reader's mind. Systematic text structure to support reader engagement that follows on from the Clinical Naturopathic Medicine format. Integrative naturopathic treatments for all complex conditions and topics. Detailed and extensively referenced interaction tables for nutritional, supplemental, and dietary and herbal medicines plus pharmaceutical medications. Rigorously researched from the latest scientific papers and historical texts. Skilfully bridges foundational traditional principles and practice of naturopathy with evidence based medicine to assist readers with their integration into the current healthcare system. Enhanced eBook version included with purchase.

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