Children are exposed to toxic chemicals throughout development and the long-term consequences of this exposure can be profound. Despite decades of research documenting the vulnerability of the developing brain to environmental contaminants, there has been little progress in protecting against developmental neurotoxicity. This symposium will discuss recent research in developmental neurotoxicology using a "developmental origins of health and disease" (DOHaD) framework that examines the context in which environmental contaminants exert their effects. We will examine the timescale for developmental toxicity, windows of vulnerability, and the bases of individual differences in vulnerability, including sex-specific effects of chemical exposures. This symposium will feature new pregnancy and birth cohort studies that have implicated fluoride as a developmental neurotoxin and endocrine disruptor. In addition, we will discuss emerging issues in epidemiology, including how environmental contaminants may interact with non-chemical stressors and have lifelong impacts on cognition and behaviours. This symposium will be capped with a discussion of the public's knowledge, attitudes, and behaviours related to developmental toxicity and strategies to reduce exposure. All speakers will be asked to draw conclusions on research priorities, and discuss how to balance regulators' need for "ideal evidence" with a public health strategy that aims to protect the public from critical environmental hazards.
The symposium will consist of the following five presentations, each 12 minutes in length, followed by a 15 minute discussion.
1. John Krzeckowski, PhD, York University, Toronto, Canada.
TITLE: *Applying a Dimensional Framework to the Study of Developmental Neurotoxicity*
2. Carly Goodman, PhD candidate, York University, Toronto, Canada
TITLE: *Sex difference of Developmental Neurotoxicants on Intellectual abilities: A systematic review and meta-analysis*
3. Meaghan Hall, PhD candidate, York University, Toronto, Canada.
TITLE: *Fluoride Exposure and Hypothyroidism in Pregnant Women: A Potential Mechanism of Fluoride Neurotoxicity*
4. Ashley Malin, PhD, University of Florida, Florida, USA.
TITLE: *Urinary Fluoride Levels and Metal Co-Exposures among Pregnant Women in Los Angeles, California*
5. Rivka Green, PhD, The Hospital for Sick Children, Toronto, Canada.
TITLE: *Translating developmental neurotoxicity for the public: A large, multi-country, randomized-control trial investigating children's environmental health literacy*
Keyword 1: neurotoxicity
Keyword 2: environmental pollutants / exposures

Keyword 3: prenatal factors

1 Applying a dimensional framework to the study of developmental neurotoxicity

John Krzeczkowski
York University, Toronto, ON, Canada

Objective: In recent decades, a large body of evidence has linked prenatal exposure to environmental neurotoxins to adverse intellectual, neurodevelopmental, and psychiatric outcomes in offspring. This evidence has clearly highlighted the widespread impact of neurotoxin exposure on the developing brain; however, it is unclear how and why these exposures alter brain development in a way that appears to increase risk for multiple, seemingly disparate outcomes.
Participants and Methods: Shifting our focus from describing links between neurotoxin exposure and symptoms of offspring mental/cognitive problems considered categorically, to investigating how neurotoxins adversely affect domains of functioning known to cut across risk for multiple problems in offspring may be critical to answering these questions. This presentation will discuss how combining research in developmental neurotoxicology with novel systems that take dimensional approaches to understanding emotions, cognition, and behaviour (i.e., the NIHM Research Domain Criteria (RDoC)) may provide a fruitful future research direction for the field. The RDoC framework aims to understand neuropsychological outcomes (i.e., mental health, mental illness, IQ) across major domains

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of human emotion, cognition, behaviour, and social functioning, rather than within distinct diagnostic categories.
Results: Using lead exposure as an example, this presentation will outline a framework for how researchers can use this dimensional approach to develop more specific hypotheses that can reveal how and why neurotoxin exposure increases risk for multiple adverse outcomes and elucidate the mechanisms that may underly these links.
Conclusions: Additionally, given that adverse development within domains of functioning can be detected prior to the onset of full-blown diagnoses, this research could enable us to develop more precise, targeted prevention and risk reduction campaigns. Adopting a dimensional framework will provide a more complete picture of the overall impact of prenatal exposure to neurotoxins – critical for informing public health policy.

Categories: Drug/Toxin-Related Disorders (including Alcohol)
Keyword 1: transdisciplinary research
Keyword 2: neurotoxicity
Keyword 3: brain development
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2 Sex difference of Developmental Neurotoxicants on Intellectual Abilities: A Systematic Review and Meta-Analysis

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Objective: Early life exposures to lead, mercury, polychlorinated biphenyls (PCBs), polybromide diphenyl ethers (PBDEs), organophosphate pesticides (OPPs), and phthalates have been associated with diminished IQ scores in children. Some studies suggest that these neurotoxicants impact boys and girls differently. We conducted a systematic review and meta-analysis to identify and quantify sex differences in IQ deficits from pre- and post-natal exposures to these developmental neurotoxicants.
Participants and Methods: We used PubMed and PsychINFO to screen abstracts of articles published between January 1, 1950 and December 31, 2021 for empirical studies of six neurotoxicants [lead, mercury, PCBs, PBDEs, OPPs, and/or phthalates] that (1) used an individualized biomarker; (2) measured exposure during the prenatal period or within the first six years of life; and (3) provided different effect estimates on children's intellectual abilities by sex. We assessed each study for risk of bias using Navigation Guide (Woodruff & Sutton, 2014). For studies with combinable data, we performed separate random effects meta-analyses for boys and girls with subgroup analyses by neurotoxicant. To homogenize the magnitude of effect observed in each study, we recalculated results to be expressed as the absolute change in intellectual abilities for a relative change of 1.5 times (i.e., 50% increase) in the exposure variable.
Results: Of 3205 studies screened, 53 met inclusion criteria: 34 evaluated prenatal exposure, 11 postnatal exposure, and 8 both pre- and post-natal exposure. We generally rated these studies as "low" to "probably low" risk of bias. Among the studies examining prenatal exposure, 27 reported no significant differences between the sexes, 7 found negative associations in boys, 4 found negative associations in girls, 5 found negative nonsignificant associations in boys and positive nonsignificant associations in girls, and 3 found no clear pattern, where differences by sex depended on the specific phthalate compound or outcome measurement. Among the studies examining postnatal exposure, 14 reported no significant differences between the sexes, 1 found a negative association in boys, 2 found negative associations in girls, and 2 found positive associations for either boys or girls. In our meta-analysis of 16 studies (4 lead, 4 mercury, 2 PBDEs, 2 OPPs, 4 phthalates), we found that prenatal exposure to developmental neurotoxicants was associated with decreased full-scale intelligence in boys (B = -0.26; 95% CI: -0.45, -0.08), but not girls (B = 0.09; 95% CI: -0.14, 0.31). In subgroup analyses by neurotoxicant, prenatal exposure to lead (B = -1.07; 95% CI: -1.63, -0.52), and ΣPBDEs (B = -0.57; 95% CI: -1.14, -0.01) were associated with decreased full-scale intelligence in boys, whereas the girls' effect sizes were consistently near zero.
Conclusions: During fetal development, boys appear to be more vulnerable than girls to IQ

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