Project Title

The consequences of exposure to plastic particles on children's neurodevelopment

Investigators

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Statement of Purpose

The project will examine the associations between prenatal and early childhood exposure to MP/NPs, their chemical additives (i.e., bisphenols, phthalates), and the combination of these exposures on children's neurodevelopment.

Project Summary

Plastic pollution is a growing Canadian and global concern. Small plastic particles (microplastics, (MP), nanoplastics (NP)) are found in every terrestrial environment, as well as in the human food chain. Oral ingestion, dermal absorption, and inhalation are common routes of exposure and there is evidence that MP/NP translocate from the gut via blood into many if not all organs, including the liver, lungs, kidneys, placenta, and brain. They trigger a localized immune response and release chemicals (i.e., bisphenols, phthalates) added during plastic production. Recent animal research also reports that nanopolystyrene particles can cross the placental barrier and deposit in fetal tissues (i.e., liver, lungs, heart, kidney, brain). The additive chemicals (i.e., bisphenols and phthalates) in plastic particles, have their own toxicological properties that are known to negatively impact children's neurodevelopment, underscoring the urgency of addressing this public health issue. At the present time, there is no scientific data available on the association between prenatal or early childhood exposure to MP and NP and children's neurodevelopment.

We are uniquely able to address this objective because of access to one of the largest pregnancy cohorts in the world that has collected data on prenatal exposure to plastics chemical additives (i.e., bisphenols, phthalates) and children's neurodevelopment; the Alberta Pregnancy Outcomes and Nutrition (APrON) cohort. We will quantify exposures to MP/NP in maternal blood samples obtained during pregnancy in women, and in their children from blood samples obtained at 3-4 years of age. Plastic particles will be extracted and analysed using pyrolysis gas chromatography mass spectrometry (Py-GC/MS). Specific polymers used in common plastic applications and included in high production volume materials such as polyvinyl chloride (PVC), poly(methyl methylacrylate) (PMMA) polypropylene (PP), polymerized styrene (PS), polyethylene (PE) and polyethylene terephthalate (PET) will be targeted. Maternal spot urine samples collected in women during pregnancy and in the children at 3-4 years have been used to estimate prenatal exposure and child exposure to plastic chemicals (i.e., bisphenols, phthalates). Child neurodevelopment outcomes have been assessed at 2, 3-5 and 5-7 years age using standardized neuropsychological assessment measures of intelligence, executive function, language, memory, and behaviour. Univariate linear regression models will be developed to explore the unadjusted association between NP/MP exposure and neurodevelopmental outcomes. Least absolute shrinkage and selection operator (LASSO) regression will be used to identify the best predictors (e.g., MP/NP, bisphenols, phthalates) of neurodevelopmental outcomes.

This novel and timely project will generate some of the first data on the association between MP/NP in maternal blood during pregnancy and children's neurodevelopment**.** The knowledge gained could improve long-term outcomes in children by providing ground-breaking evidence that these small plastic

particles have adverse neurodevelopmental consequences. This could lead to policy changes and reduced health care costs and social burdens, increased productivity, and higher quality of life for children and their families.