

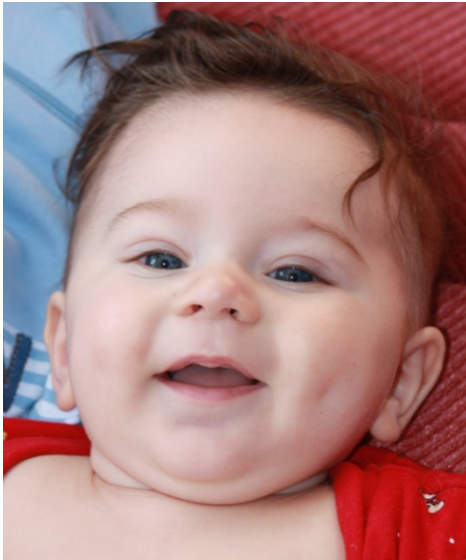


CPCHE – OCDPA Collaborative Project

OVERVIEW OF THE SCIENTIFIC EVIDENCE LINKING EARLY ENVIRONMENTAL EXPOSURES TO TOXIC CHEMICALS AND SPECIFIC CHRONIC DISEASES/DISORDERS

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Early Exposures to Chemicals



Even before birth, we are exposed to a multitude of chemicals, many of which have not been tested for reproductive or developmental toxicity, or for impacts on neurological, endocrine and immune function.

If crucial developmental stages – from preconception through adolescence – are disrupted by exposure to chemicals and pollutants, permanent harm can result.

Chronic Diseases



This report focuses on chronic diseases that affect large numbers of Ontarians:

- Asthma and respiratory diseases
- Cancer
- Cardiovascular diseases
- Diabetes
- Impacts on brain function:
Alzheimer and Parkinson diseases

The term “*Western disease cluster*” encompasses most of these diseases.

Asthma and Respiratory Diseases



- Asthma affected 13% of children in Canada in 2000/2001. Levels quadrupled in 20 years. Prevalence is also increasing in adults.
- 3.9 per cent of men and 4.8 per cent of women over the age of 34 reported being diagnosed with COPD.
- EAF: 26 to 53% of asthma cases and between 10 to 30% of COPD cases – from 1 to above 3 billion in 2006 (CAN\$)

Asthma and Respiratory Diseases

- Lung development is not complete until adolescence, making it vulnerable to harm.
- Prenatal exposures and those that occur in the first two years of life can play a role in asthma.
- Exposures to chemicals in early life can cause temporary symptoms or may determine the course of development of lung tissue and lead to permanent alteration.
- Changes associated with urbanization/westernization are suspected of playing a role. Which of these influences are actually responsible is still unclear.

Asthma and Respiratory Diseases

Strong human evidence exists for asthma exacerbation and exposure to:

- Outdoor air pollutants: particulate matter, ozone, nitrogen oxides, carbon monoxide, sulfur dioxide
- Indoor air pollutants: environmental tobacco smoke, metal dust, pesticides, formaldehyde, and solvents (VOCs)
 - Suggestive evidence for phthalates (DEHP)
- Suggestive evidence that exposures to environmental tobacco smoke and high levels of arsenic in drinking water may predispose to COPD.

Cancer



Nearly half of the Canadian population will develop cancer in their lifetime. Since the 1980s, overall rates of cancer in adult men have been stable and increasing only slightly in women.

Incidence of cancer in adolescents and young adults (ages 15 to 44) have increased for particular types of cancer. In young women: thyroid cancer, non-Hodgkin lymphoma and epithelial cancers. In young men: thyroid and testicular cancers, and soft tissue sarcoma (since 2001).

Cancer

- Exposures that occur when cells are rapidly dividing likely pose the greatest risk.
- Cancers develop after a long latency period.
- For breast cancer, exposures *in utero*, during puberty or in the early reproductive years have been shown to be important for radiation and DDT and may also matter for other exposures.
- Hence, exposures *in utero*, or postnatally in early childhood, are of special concern.
- EAF: 5 to 15% of all cancer cases with associated costs of \$854 to \$2,563 million in 2006 CAN\$

Cancer

Early exposures (including prenatal exposures) to the following chemicals has been linked to cancer later in life:

- Strong evidence for : Maternal smoking, some pesticides (DDT/DDE), radiation, DES, cadmium, arsenic, benzene
- Good evidence for: Air pollution (including motor vehicle exhaust, petroleum products, hydrocarbons, fuels, etc.), PCBs, lead, mercury, some pesticides (organochlorines), some solvents (trichloroethylene, tetrachloroethylene)
- Suggestive evidence for many endocrine disruptors including BPA and some phthalates esp. in relation to reproductive system cancers.

Cardiovascular Disease (CVD)



Despite declines over the past 40 years, CVD is the second major cause of death and disability after cancer in Ontario. CVD accounts for 35% of premature deaths.

Recent studies show increases in CVD risk factors, especially in young men.

EAF: 7.5 to 15% of cases, with associated costs between 1.6 to 3.3 billions in 2006 CAN\$

Cardiovascular Disease

- Heart attacks and strokes generally occur in older adults but cardiovascular diseases can be “silent” for many years prior to these clinical events.
- Fatty deposits can start early in life and get progressively worse if unchecked and lead to CVD.
- Hypertension and obesity are also early warning signs.
- Many studies indicate that low birth weight babies have a higher probability of CVD later in life. Other studies show that *in utero* exposures can affect birth weight.

Cardiovascular Disease

Prenatal and early childhood exposure to tobacco smoke is suspected of contributing to hypertension and other CVD risk factors.

Lead exposure in adults has been shown to cause hypertension and is strongly suspected of other cardiovascular outcomes.

Long-term exposure to air pollution in adults is linked to CVD.

There is a need for further research into the potential links between early exposures to toxic chemicals and CVD.

Diabetes



Prevalence of diabetes continues to climb in Canada. Between 1995 and 2005, it increased by more than 6% per year. The greatest increase is in young adults (ages 20 to 49). It is expected to nearly double between 2000 and 2016.

Most of the increase is attributed to cases of type 2 diabetes. Health care costs of diabetes were projected to increase from 1.7 to 3.1 billion between 2000 and 2016 in 1996 CAN\$. No EAF has been estimated.

Diabetes

- More than 90% of cases are of Type 2 diabetes.
- Rates of diabetes among First Nations people in Canada are three to five times higher than those of the general Canadian population.
- Diabetes has been shown to be inversely related to income with highest prevalence and steepest increases in lowest income brackets.
- Diabetes is a contributing factor to other chronic diseases, particularly CVD and cerebrovascular diseases as well as being a risk factor for cognitive impairment.

Diabetes

Recent studies suggest a link between exposures to chemicals and diabetes but not specifically early environmental exposures :

For Type 1 diabetes: nitrate, nitrites, nitrosamines and PCBs. For Type 2 diabetes: arsenic, dioxin (TCDD), some occupational exposures, some pesticides (tributyltin and chlorinated pesticides).

Low and high birth weight babies are at higher risk of type 2 diabetes in later in life.

Obesity is also a risk factor for diabetes.

Impacts on Brain Function



Parkinson and Alzheimer are the two most common neurodegenerative diseases in Ontario. They are typically thought of as diseases of the elderly but may have their roots in early life.

- About 1% of adults in Canada suffer from Parkinson. About 20% of people with Parkinson are under the age 50.
- Nearly 8% of Canadians over the age of 65 have Alzheimer's.

Impacts on the Brain

Exposures that would lead to a marginally less efficient brain due to impaired development may not be detectable until “aggravated by the aging process”

Moceri et al., 2000

Brain development starts in early pregnancy and continues through the teenage years.

Many neurological disorders are life-long while others may develop only later in life.

The areas of the brain that show the earliest signs of Alzheimer’s disease are the same areas of the brain that take the longest to mature during childhood and adolescence.

Impacts on the Brain

- Early lead exposure can increase the risk of Alzheimer.
- Pesticides have long been suspected to increase the risk of Parkinson particularly rotenone, paraquat, maneb, dieldrin and some pyrethroids. In addition, PCBs and some solvents may also be linked to Parkinson.
- Over 200 chemicals used in industry and in common household products are known to be toxic to the brain: metals (lead and mercury), solvents such as benzene, pesticides (and particularly organophosphates).
- Air pollution has also been shown to result in impacts on the brain.

Risk Factors: Birth Weight



Low birth weight has been linked to cardiovascular disease, type 2 diabetes, and obesity.

High birth weight babies may also suffer from these same health impacts as well as cancer.

In utero exposures to tobacco smoke, air pollution, arsenic, mercury, chlorophenols, aromatic amines, phthalates and perfluorinated chemicals can affect fetal growth.

Risk Factors: Obesity



Genetically identical agouti mice, the yellow one fed a diet of bisphenol A. (Dolinoy et al. 2007)

Direct costs of obesity in Canada estimated to be \$1.8 billion in 1997 and when health care costs associated with co-morbidities including hypertension, type 2 diabetes and coronary artery disease to reach \$ 3.5 billion.

Suspected “environmental obesogens” include many endocrine disruptors: Organotins, dieldrin, hexachlorobenzene, DDT, phthalates, bisphenol A

Risk Factors: Inflammation



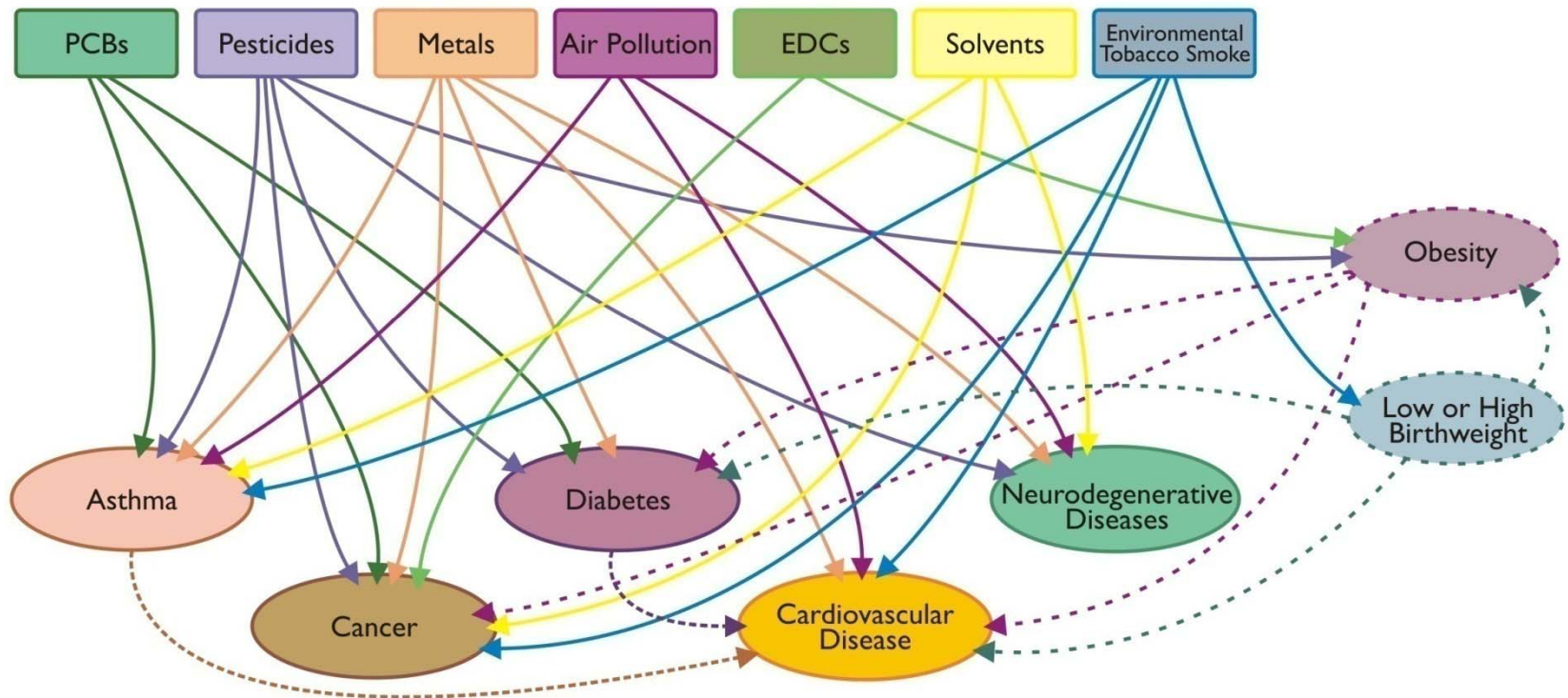
*Time Magazine,
February 2004*

Systemic inflammation is implicated in many chronic diseases including asthma, COPD, cardiovascular diseases, diabetes, obesity, even some cancers, and neurodegenerative diseases.

Environmental influences including chemical exposures may contribute to inflammation.

Health Impacts

Early Environmental Exposures Linked to Five Chronic Diseases and Risk Factors



Conclusions



Evidence is accumulating that exposures to many common chemicals and pollutants in early life can lead to potential chronic disease outcomes. There remain gaps in our knowledge. In the face of this uncertainty, protective, preventive actions based on the currently available evidence should be taken.