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Inspired by research. Driven by compassion. Inspiré par la recherche. Guidé par la compassion.

ESCALATING CHRONIC DISEASE IN YOUNG CANADIANS

SURVEILLANCE FOR ENVIRONMENTAL LINKS

MEG SEARS PHD

MAY 29, 2018

The Ottawa Hospital RESEARCH INSTITUTE | L'Hôpital d'Ottawa INSTITUT DE RECHERCHE

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Disclosure Statement

I have no affiliation (financial or otherwise) with a pharmaceutical, medical device or communications organization.

GOING BEYOND FRUITS AND VEGGIES, EXERCISE AND NOT SMOKING AND DRINKING … *WHAT IS MAKING US SICK?*

"Pollution is the largest environmental cause of disease and premature death in the world today."

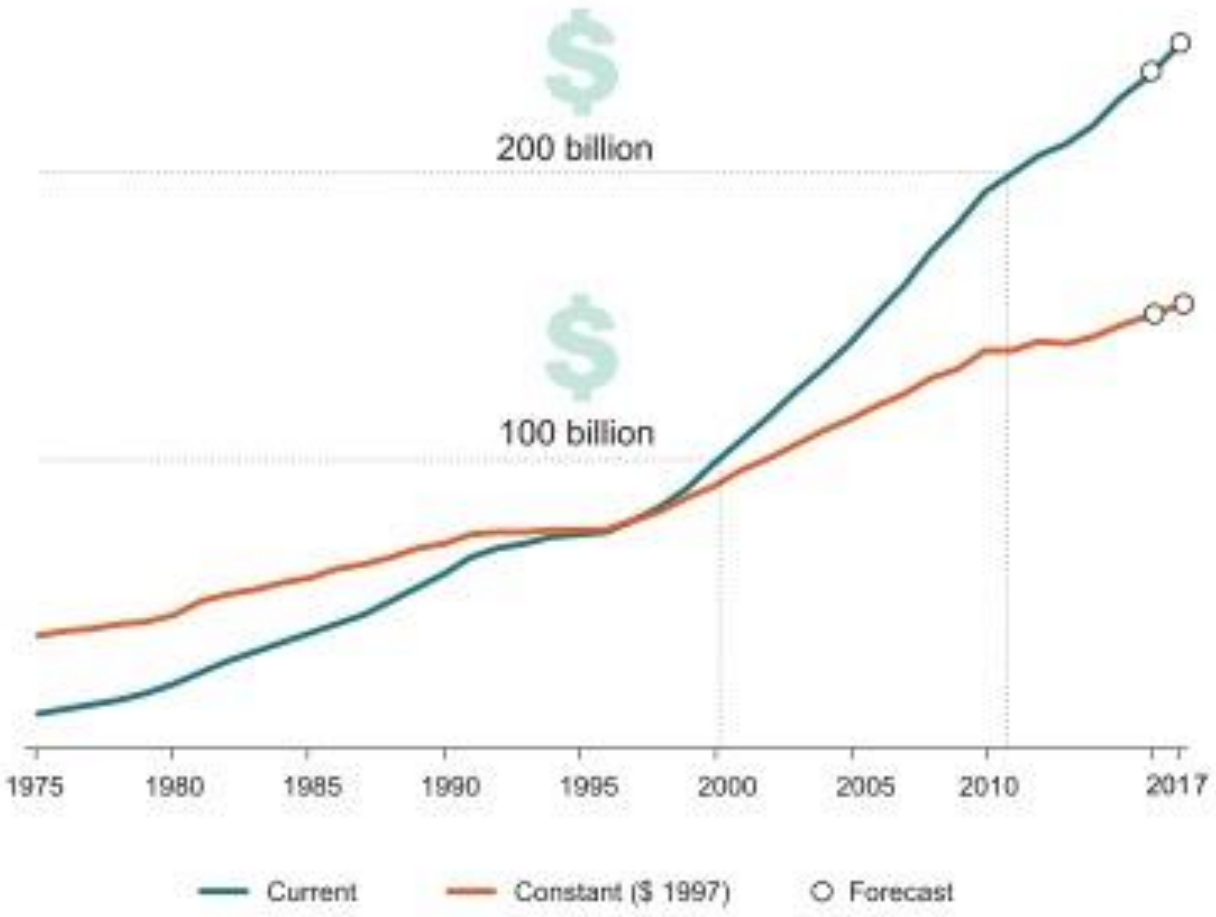
The *Lancet* Commission on pollution and health (October 2017)
www.thelancet.com/commissions/pollution-and-health

Known: air pollution, persistent organic pollutants, metals, radionuclides…

Emerging*:* chemicals that interfere with hormones and development, act at low doses
E.g., pesticides, plastics, personal and household products, pharmaceutical wastes, nanomaterials (and wireless radiation)

HOW MUCH DOES CANADA SPEND ON HEALTH CARE?

Canadian Institutes for Health Information (2017)



Source
National Health Expenditure Database, Canadian Institute for Health Information.

ESCALATING DISEASES POTENTIALLY RELATED TO ENVIRONMENTAL EXPOSURES IN YOUNG CANADIANS

- Chronic diseases overall
- Blood cancers
- Brain tumours
- Colorectal cancer
- Obesity-related cancers (also hormone-related)
- Inflammatory bowel disease
- Autism spectrum disorders
- Infertility

Early and ongoing adverse exposures contribute to various conditions

"ENVIRONMENT" BROADLY DEFINED

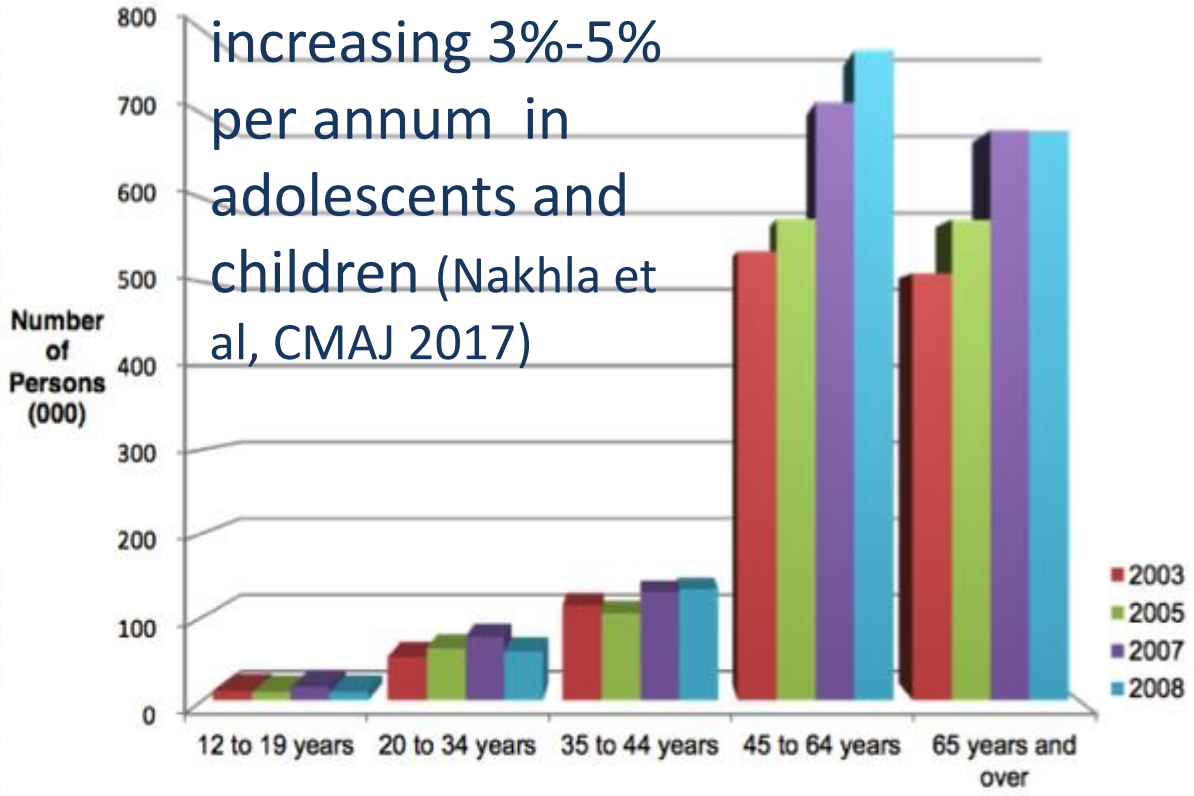
- Nurturing, socio-economic, education, employment
- Nutrition
- Toxicants – air, water, soil/dust, food, goods, …
- Radiation – e.g., daylight, screen-light, microwave/RF radiation, ionizing radiation (radon, x-rays)
- "Green-ness" (vegetation, natural areas)

Timing is of the essence.

CHRONIC DISEASES INCREASING AND SHIFTING TO YOUNGER CANADIANS (2003-2008, PHAC)

Cancer + cardiovascular disease + diabetes + hypertension
Public Health Agency of Canada (2012)

Diabetes increasing 3%-5% per annum in adolescents and children (Nakhla et al, CMAJ 2017)

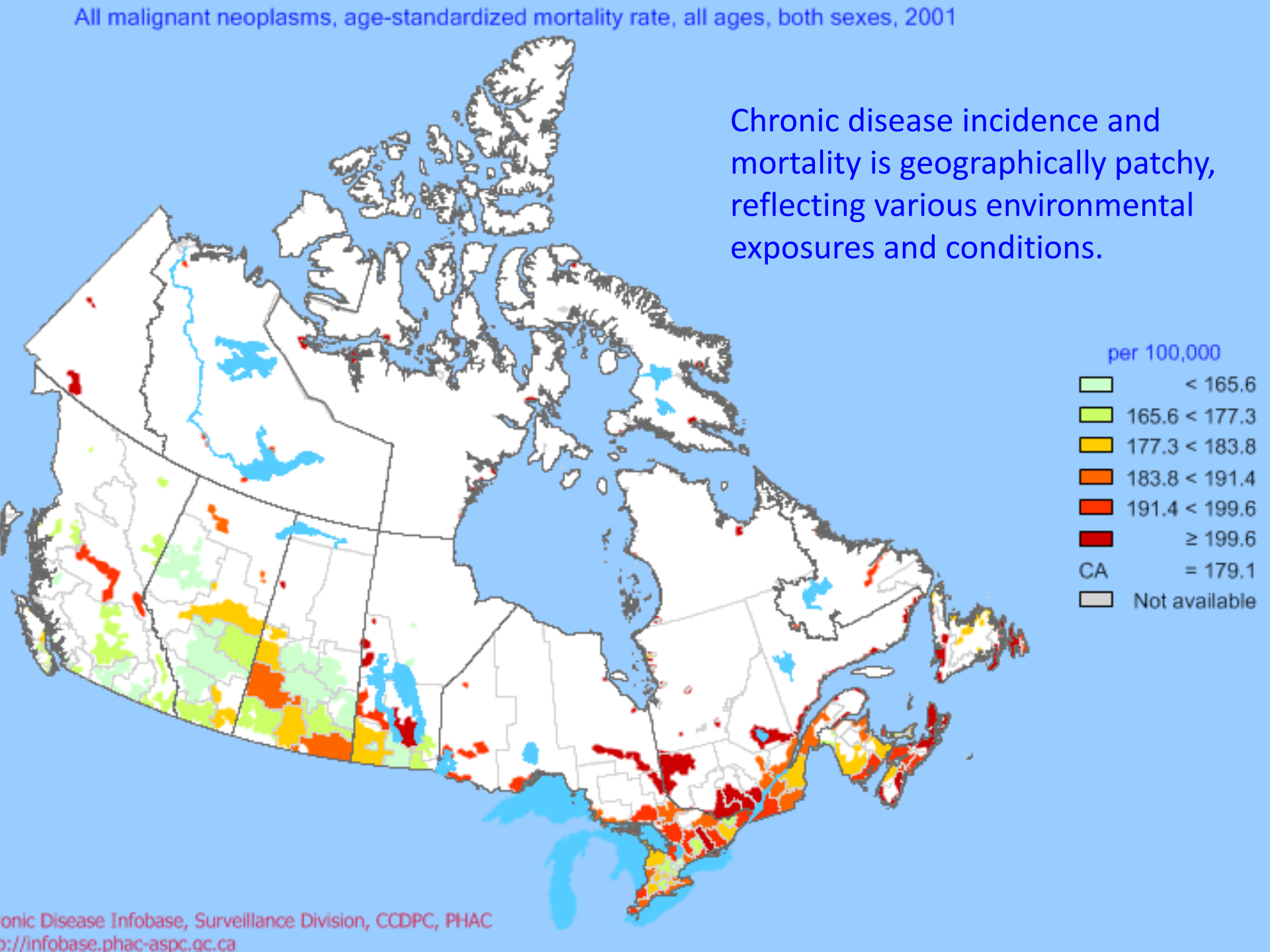


More working age Canadians are living with diabetes

Increase of **1%** per year in 35-44 year age group

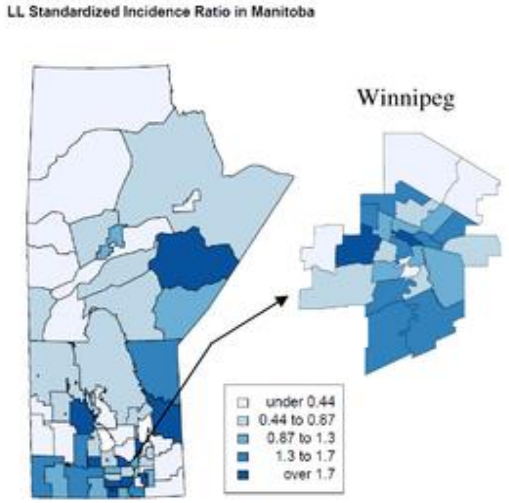
Increase of **1.5%** per year in 45-64 year age group

Source: Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada, using data from Labour Force Survey, Statistics Canada.


All malignant neoplasms, age-standardized mortality rate, all ages, both sexes, 2001
Chronic disease incidence and mortality is geographically patchy, reflecting various environmental exposures and conditions.
per 100,000
< 165.6
165.6 < 177.3
177.3 < 183.8
183.8 < 191.4
191.4 < 199.6
≥ 199.6
CA = 179.1
Not available
onic Disease Infobase, Surveillance Division, CCDPC, PHAC
://infobase.phac-aspc.gc.ca

GEOGRAPHICAL VARIATIONS IN LYMPHOID LEUKEMIA (LL), AND HODGKIN LYMPHOMA (HL) INCIDENCE: 1984–2013 CHILDREN AND ADOLESCENTS IN MANITOBA

A



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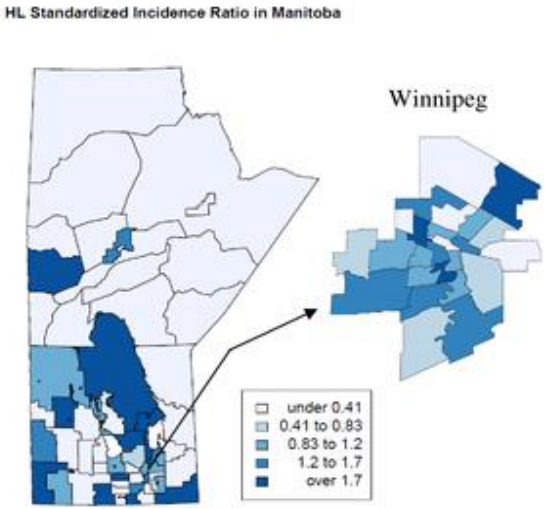
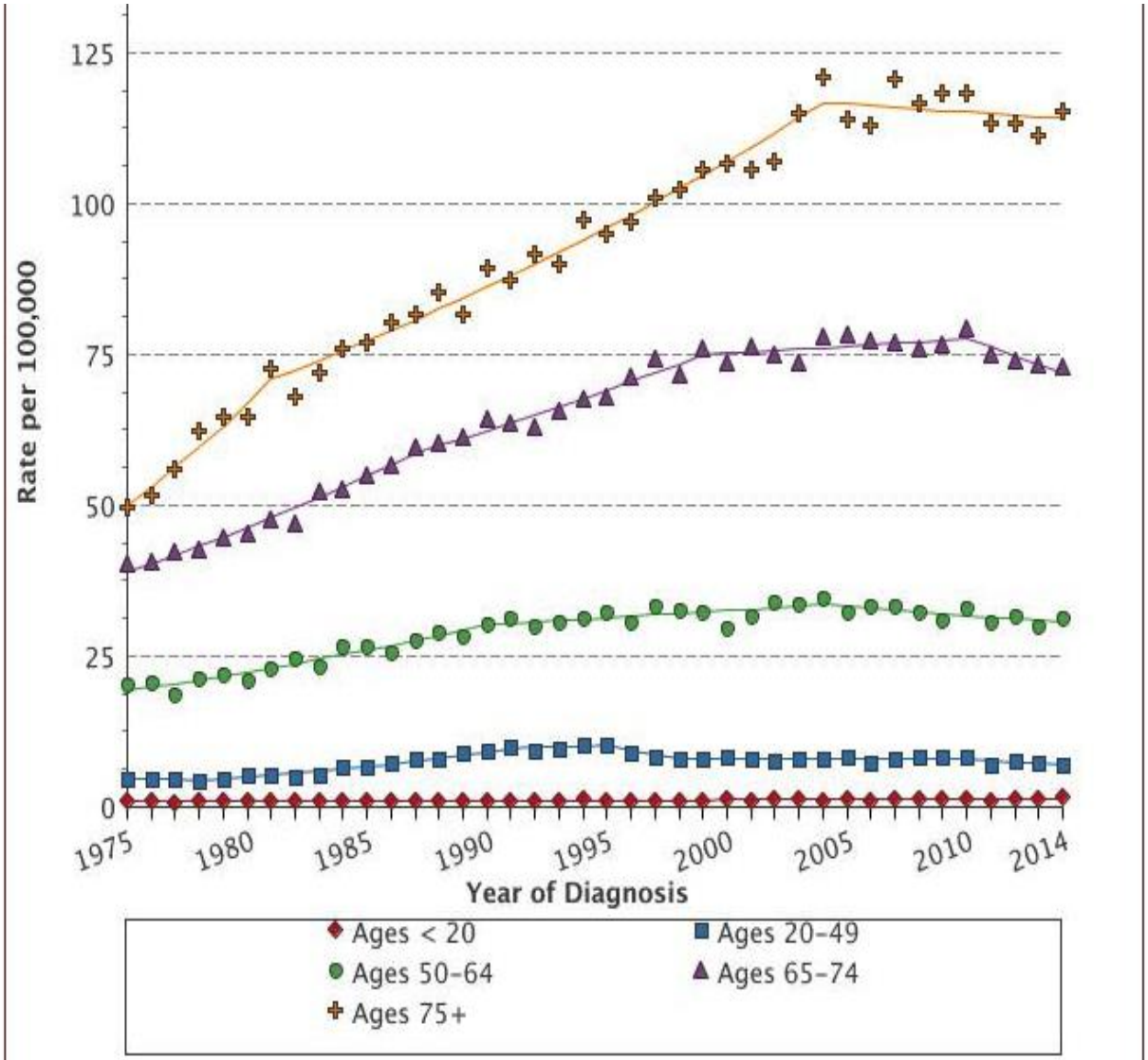


Lymphoid leukemia incidence rates in Manitoban children and adolescents increased 1.4% per year, 1984–2013.

Ye et al., 2017 PLOS One

PLOS ONE | TENTH ANNIVERSARY

AGE-ADJUSTED SEER INCIDENCE RATES BY AGE (US)
NON-HODGKIN LYMPHOMA, ALL RACES, BOTH SEXES, 1975-2014



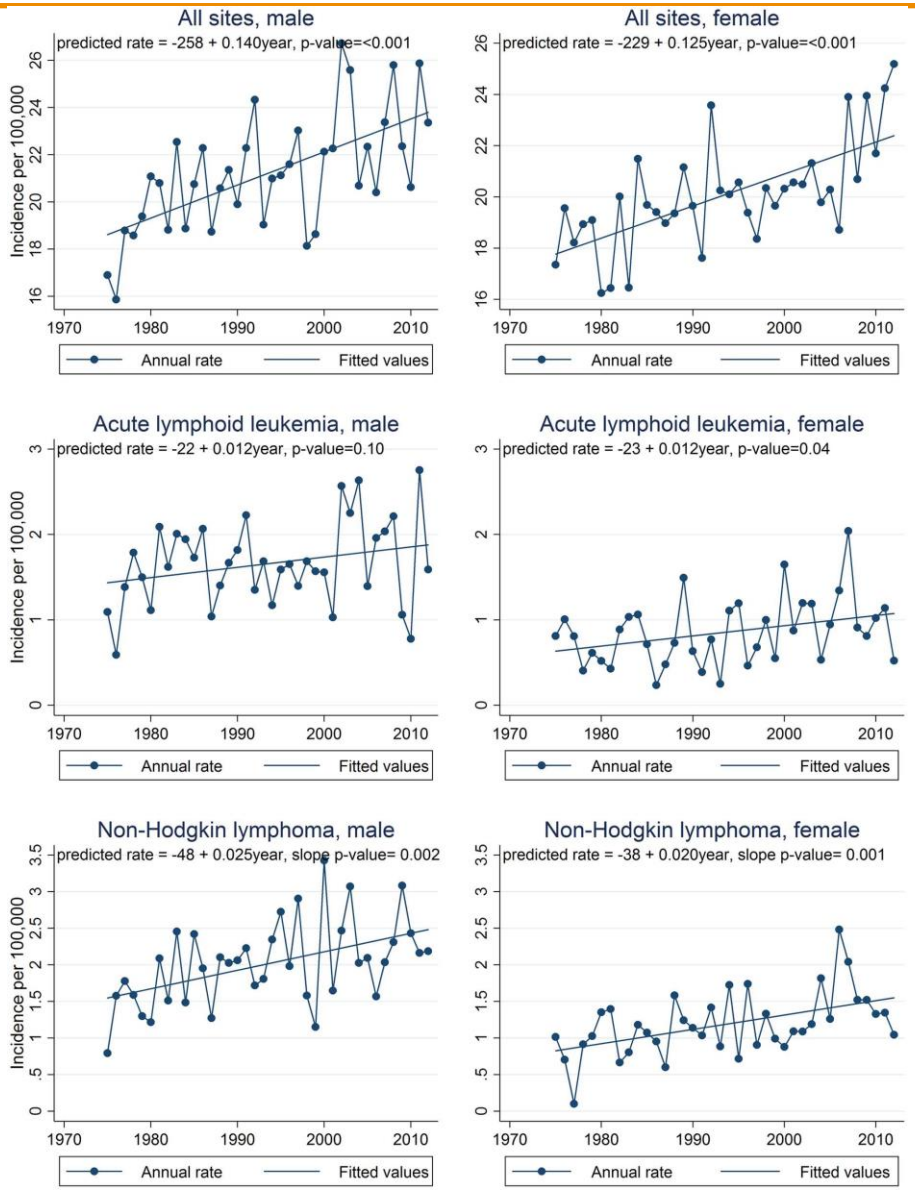
Cancer sites include invasive cases only unless otherwise noted.

THE INCREASING TOLL OF ADOLESCENT CANCER INCIDENCE IN THE US (BURKHAMER ET AL., PLOS 2017)

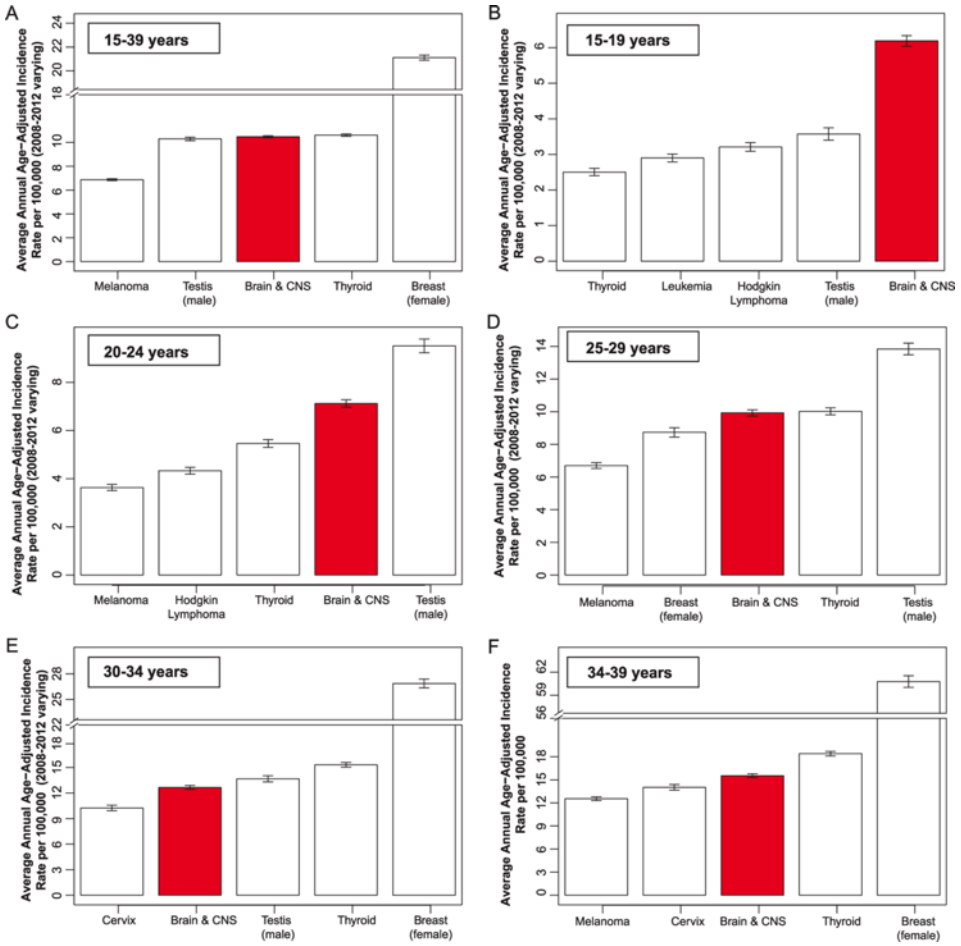
Annual incidence trends for 15-19 y

1. ALL and NHL
2. Acute lymphoid leukemia, and
3. Non-Hodgkin lymphoma

1975– 2012
SEER (USA)
9 registries



AGGRESSIVE BRAIN TUMOURS INCREASING IN THE YOUNG (CENTRAL BRAIN TUMOR REGISTRY OF THE US - CBTRUS. OSTROM, 2015)



Brain tumours shifted to most common malignancies in US teens age 15-19 y, over lymphoma and testicular cancer.

Canadian neuro-oncologist Dr. Easaw raises concerns that as in the US, the most aggressive forms of brain tumours are increasing rapidly in Canadian adolescents and young adults.

American Brain Tumor Association Adolescent and Young Adult Primary Brain and Central Nervous System Tumors Diagnosed in the United States in 2008-2012

Neuro Oncol. 2015;18(suppl_1):i1-i50. doi:10.1093/neuonc/nov297

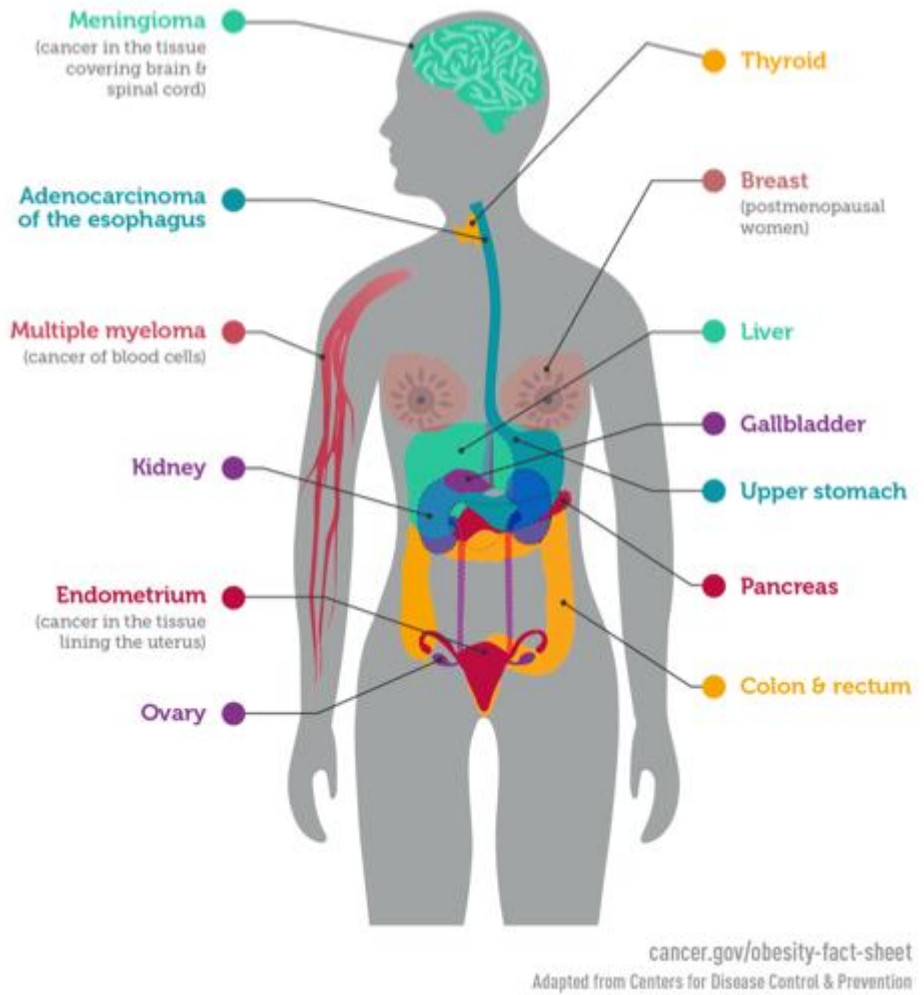
CANCERS ASSOCIATED WITH BEING OVERWEIGHT OR OBESE

WHY?

Inflammation and *Obesogens* contribute to cancers and other chronic diseases

www.cancer.gov/about-cancer/causes-prevention/risk/obesity/overweight-cancers-infographic

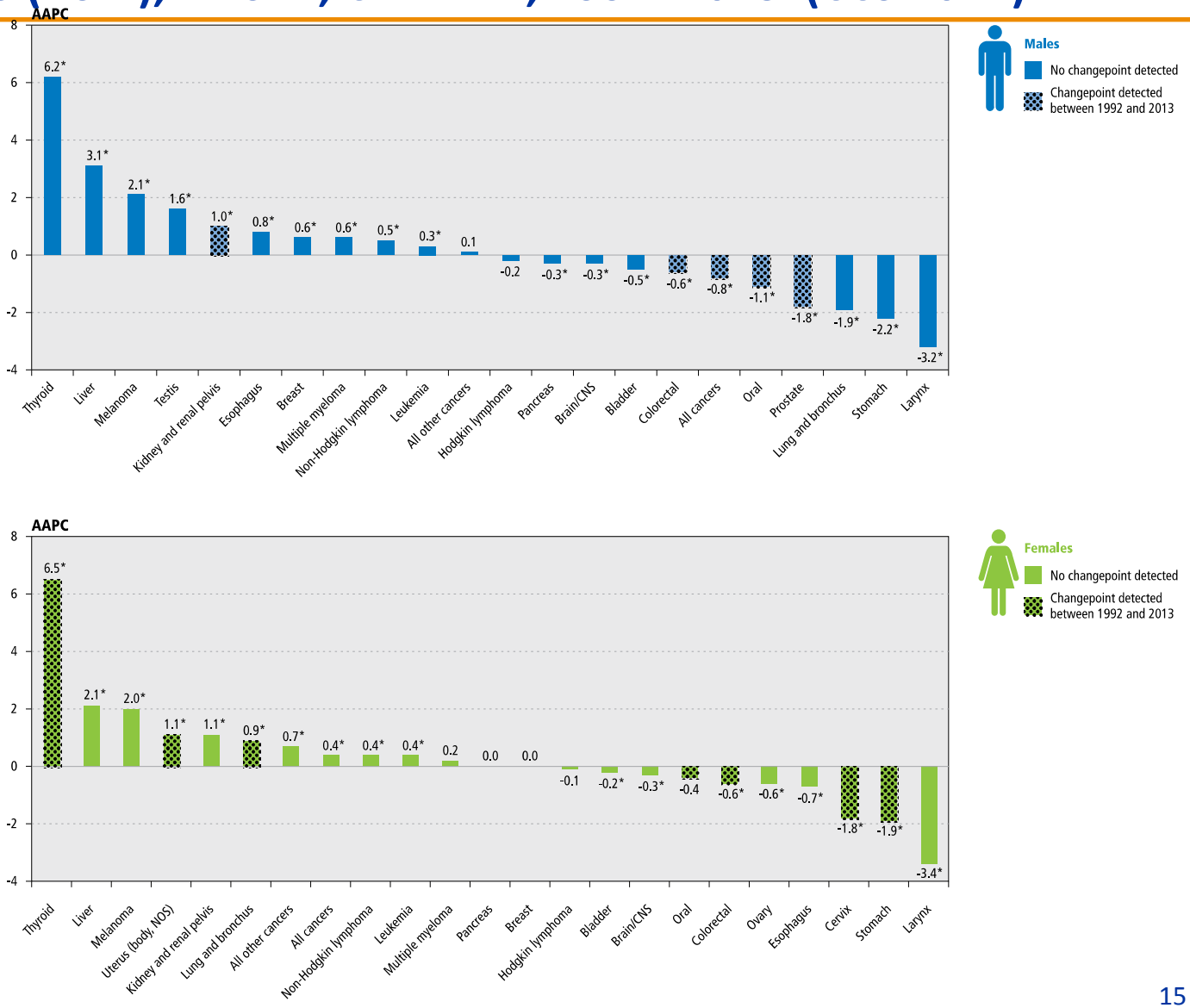
www.niehs.nih.gov/health/topics/conditions/obesity/obesogens/index.cfm



AVERAGE ANNUAL PERCENT CHANGE (AAPC)† IN AGE-STANDARDIZED INCIDENCE RATES (ASIR), BY SEX, CANADA, 1992–2013 (CCS 2017)

Decreasing:
tobacco-associated cancers

Increasing:
thyroid, liver, melanoma, testis, uterus, kidney/renal, eosophagus, breast, hematological, "all cancers"
[EDCs play roles]



Analysis by: Surveillance and Epidemiology Division, CCDP, Public Health Agency of Canada
Data sources: Canadian Cancer Registry database at Statistics Canada

COLORECTAL CANCER INCREASING
SINCE 1996 IN CANADIAN ADULTS <50 Y

6.7% per annum (15-29 y)

1.4% (30-39 y)

0.8% (40-49)

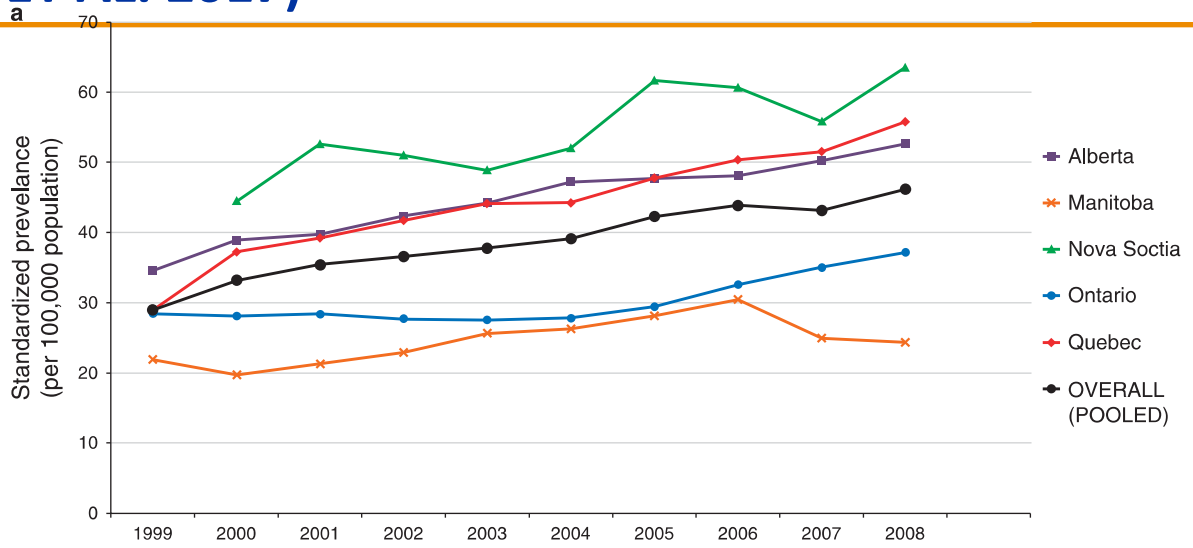
Large increases in excess weight

DESPITE

- Significant decreases in alcohol consumption and smoking
- Small increases in fruit and vegetable intake, and activity

Patel et al. 2017 Cancer Epidemiology

CHILDHOOD ONSET INFLAMMATORY BOWEL DISEASE (BENCHIMOL ET AL. 2017)



Canada among highest prevalence of childhood IBD globally

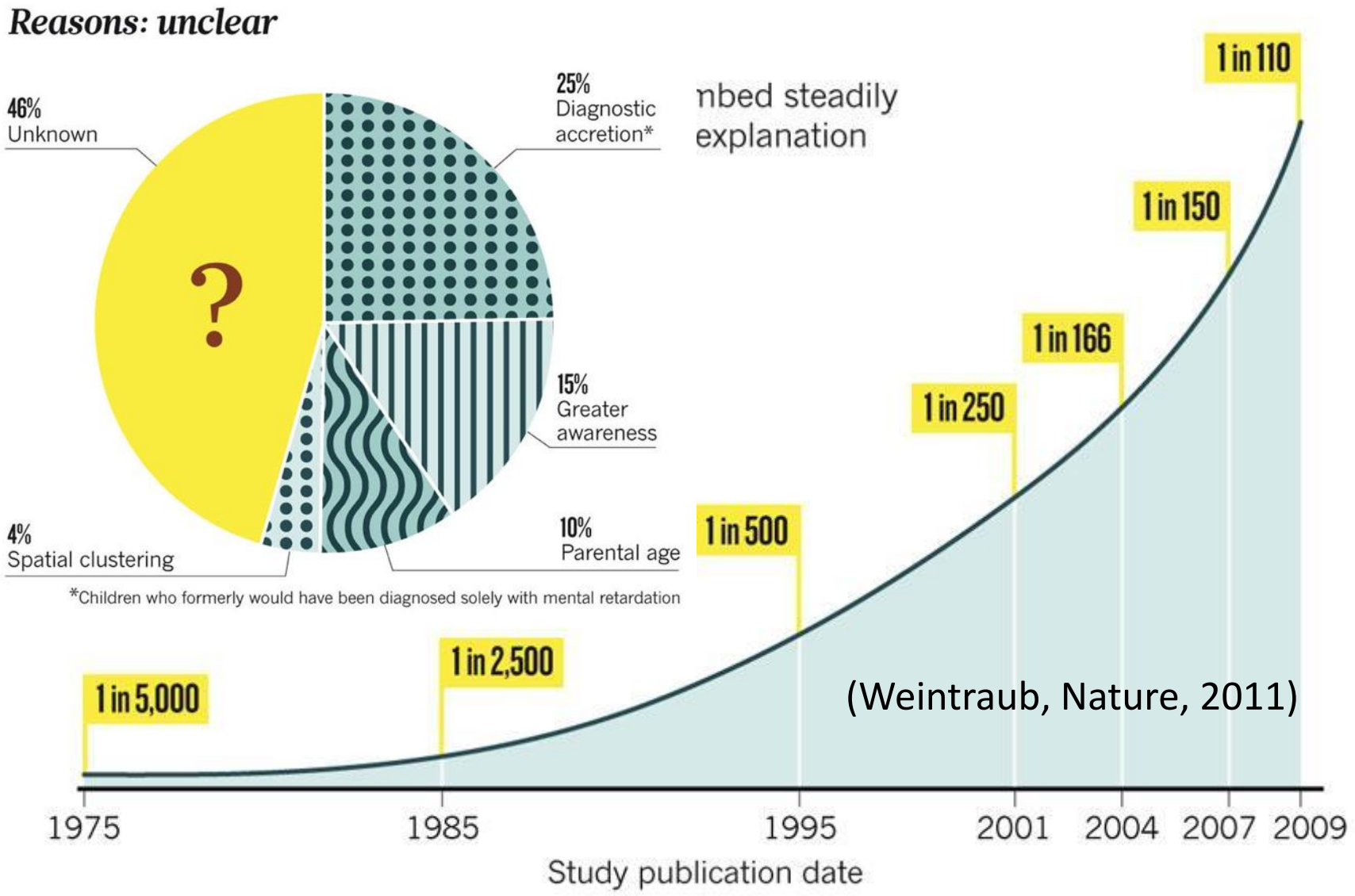
Increased 4.6% annually from 1999-2010 in youth <16 y

Driven by ***7% increasing incidence annually*** in children <6y

Trends in Epidemiology of Pediatric Inflammatory Bowel Disease in Canada: Distributed Network Analysis of Multiple Population-Based Provincial Health Administrative Databases

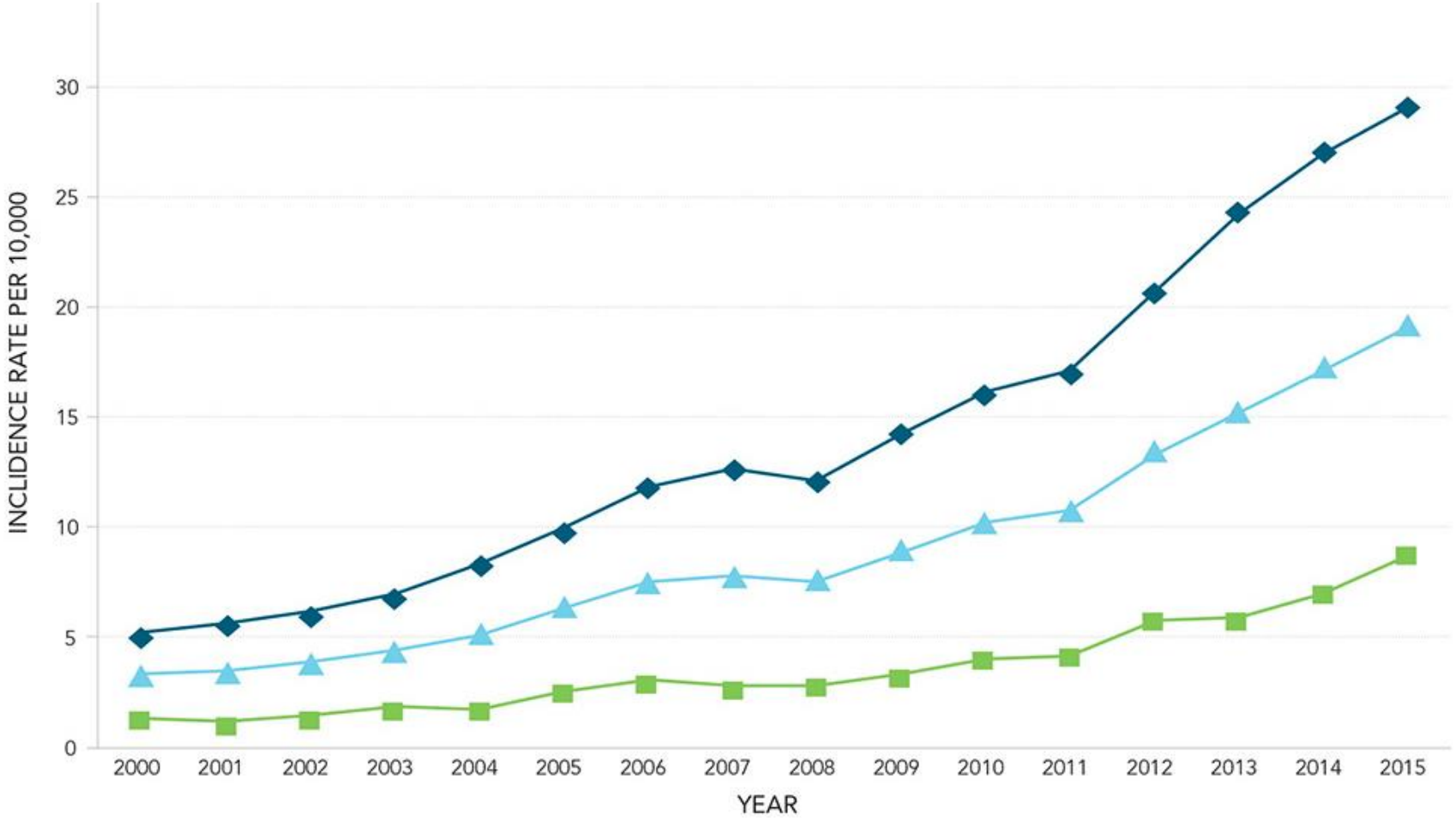
http://www.nature.com/ajg/journal/v112/n7/full/ajg201797a.html

AUTISM COUNTS



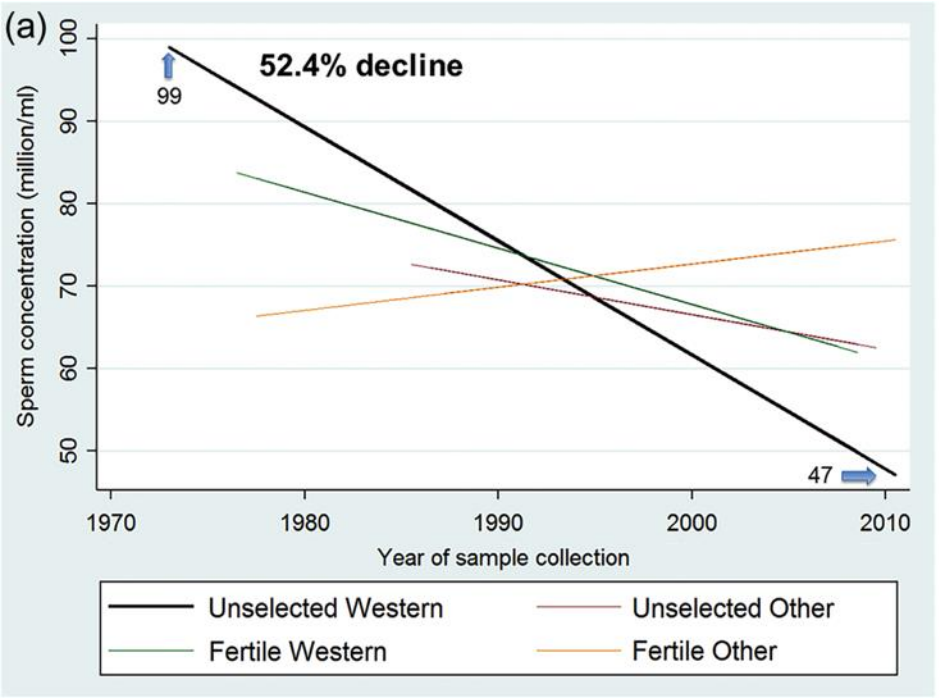
(Weintraub, Nature, 2011)

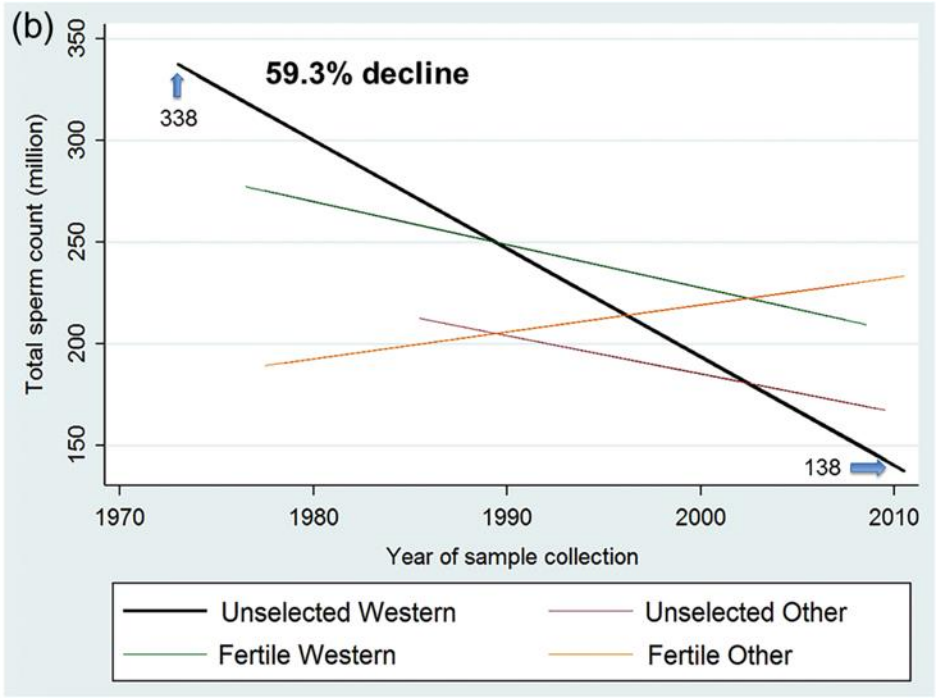
AUTISM SPECTRUM DISORDER (ASD) INCIDENCE RATE PER 10,000 BY SEX IN QUEBEC, 2000-2015 (PHAC, 2018)



https://www.canada.ca/en/public-health/services/publications/diseases-conditions/autism-spectrum-disorder-children-youth-canada-2018.html

IN WESTERN MEN, HUMAN SPERM COUNTS AND CONCENTRATIONS HALVED 1981 – 2013 ~ *NO EVIDENCE OF LEVELLING OFF*





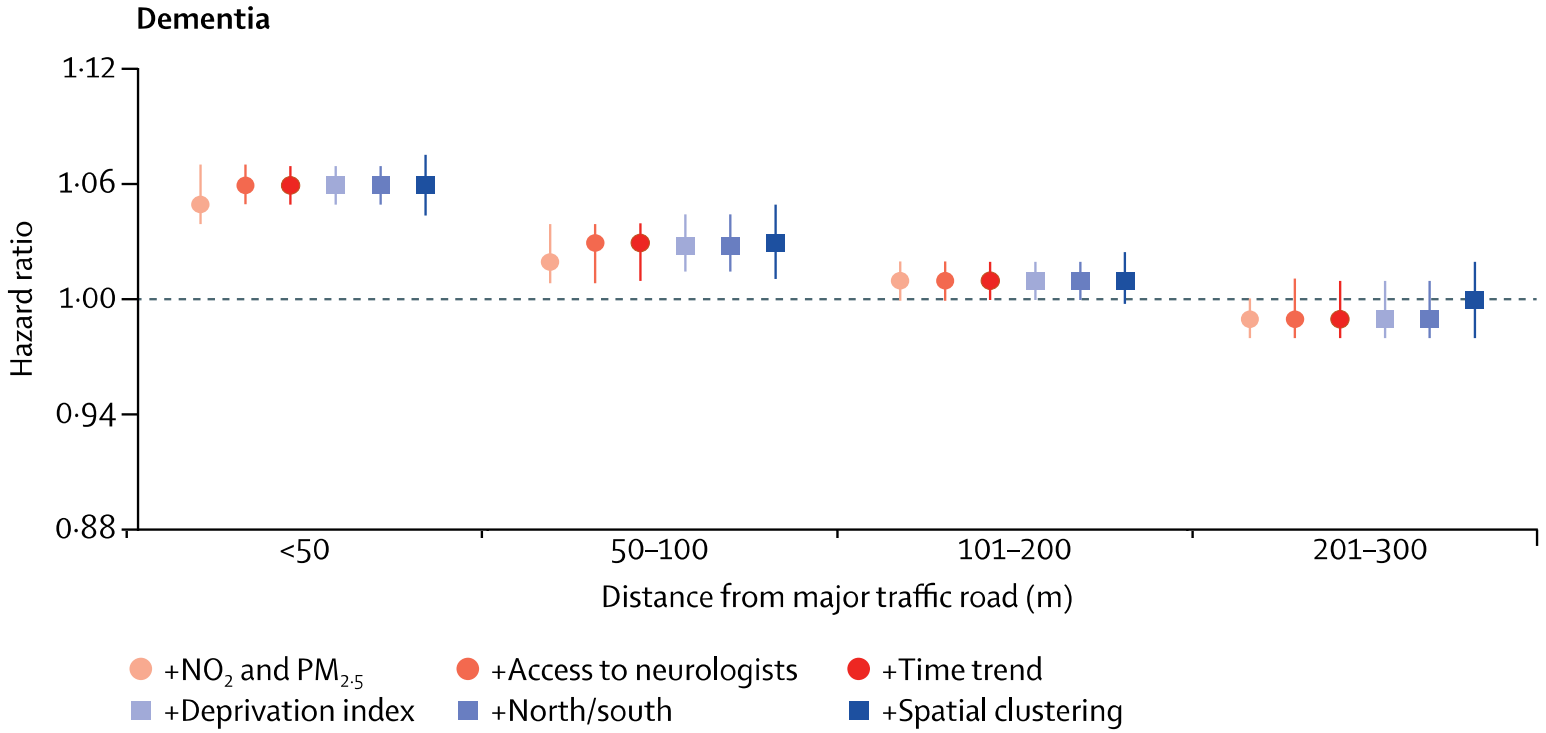
Temporal trends in sperm count:
a systematic review and meta-regression analysis

Levine et al, 2017, Hum Reprod. Update

ENVIRONMENTAL CLUES: CLUSTERING OF EXPOSURES AND BIOMARKERS MAY REVEAL LINKS TO ILL HEALTH

- Dementia (and air pollution)
- Birth defects (in agricultural areas)
- Hypothyroidism (and contaminated water + fish)
- Diabetes (in northern populations)

LIVING NEAR MAJOR ONTARIO ROADS (1996) INCREASES RISK OF DEMENTIA (2011-2012)



Particulates, ozone, metals, nitrogen oxides and poly-aromatic hydrocarbons

OUTSTANDING QUESTION: What about lead from plumbing?

Chen et all, 2017. Lancet

AIR POLLUTION AND MULTIPLE MORBIDITIES

The World Health Organization recognizes air pollution as major cause of illness and pre-mature death.

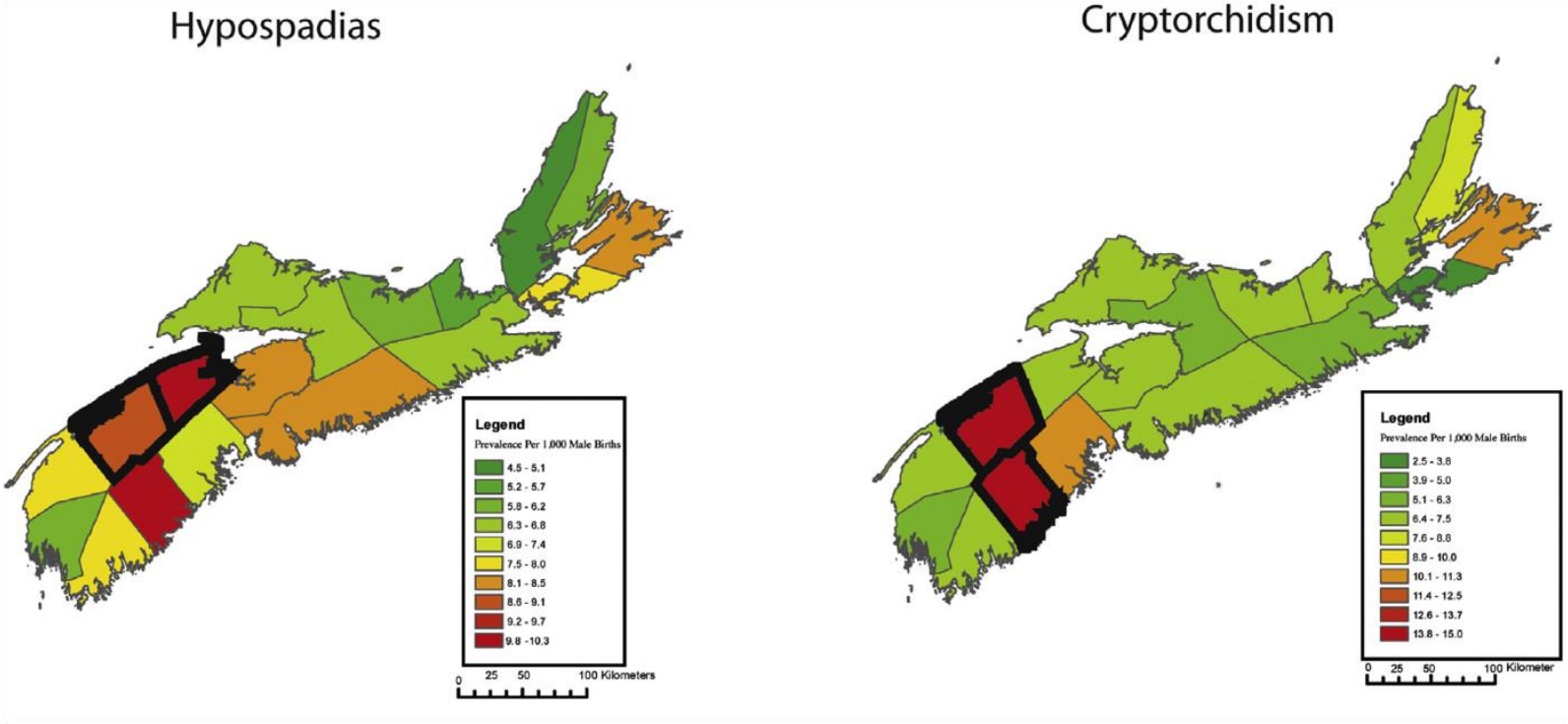
- Cancer
- Obesity and diabetes
- Autoimmune disease
- Asthma
- Reproductive harms (small, early births, stillbirths, poor development…)

What else causes harm?

BIRTH DEFECTS – HYPOSPADIAS AND UNDESCENDED TESTICLES

- Higher rates in Canada than US, internationally
- Geospatial clustering in NS high agriculture areas

(Lane et al., 2017, J Pediatr Urology)



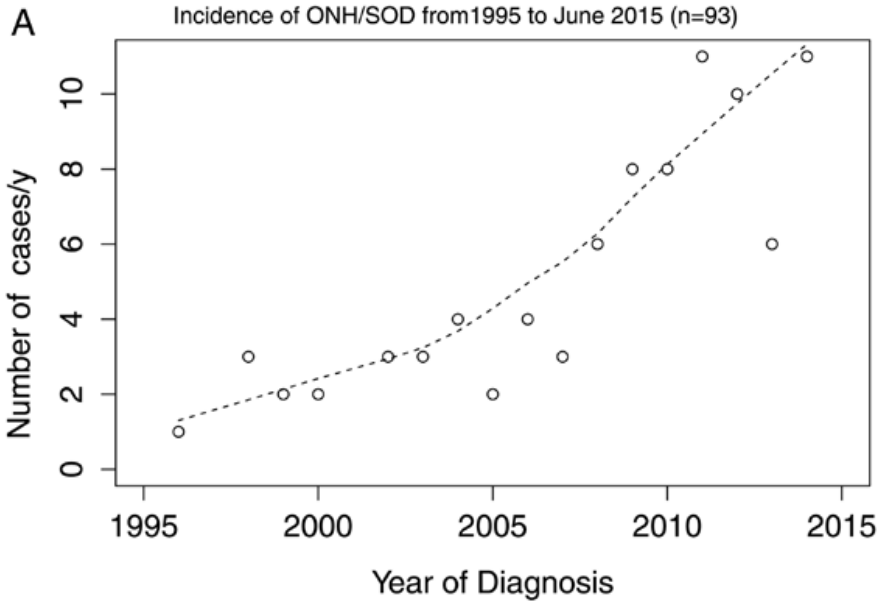
Paediatrics & Child Health, 2017, 1–9
doi: 10.1093/pch/pxx118
Original Article

OXFORD

Original Article

Increasing incidence of optic nerve hypoplasia/septo-optic dysplasia spectrum: Geographic clustering in Northern Canada

Tanya Khaper BSc MD[1], Martin Bunge MD[2], Ian Clark MB BCHir[3], Mubeen Fatima Rafay MBBS MSc[4], Aziz Mhanni MD[5], Nicole Kirouac RN BN[6], Atul Sharma MD MSc[7], Celia Rodd MD MSc[6,*], Brandy Wicklow MD MSc[6,*]



Incidence per 100,000 youth

Mostly in first-borne infants; mothers have had subsequent healthy children; potentially related to thyroid hormone.
NOTE: Toxins are released from mothers' tissues to the foetus and then breast milk, with the greatest quantities during the first pregnancy

HYPOTHYROIDISM IN NL CORRELATES WITH CHEMICALS IN FISH

Mean hypothyroidism rates on three coasts in Newfoundland, Canada

Coast	**Hypothyroidism rate**[a]	Average (std. dev.)
West		91.8 (36.73)
South		96.3 (51.96)
East		51.3 (20.25)

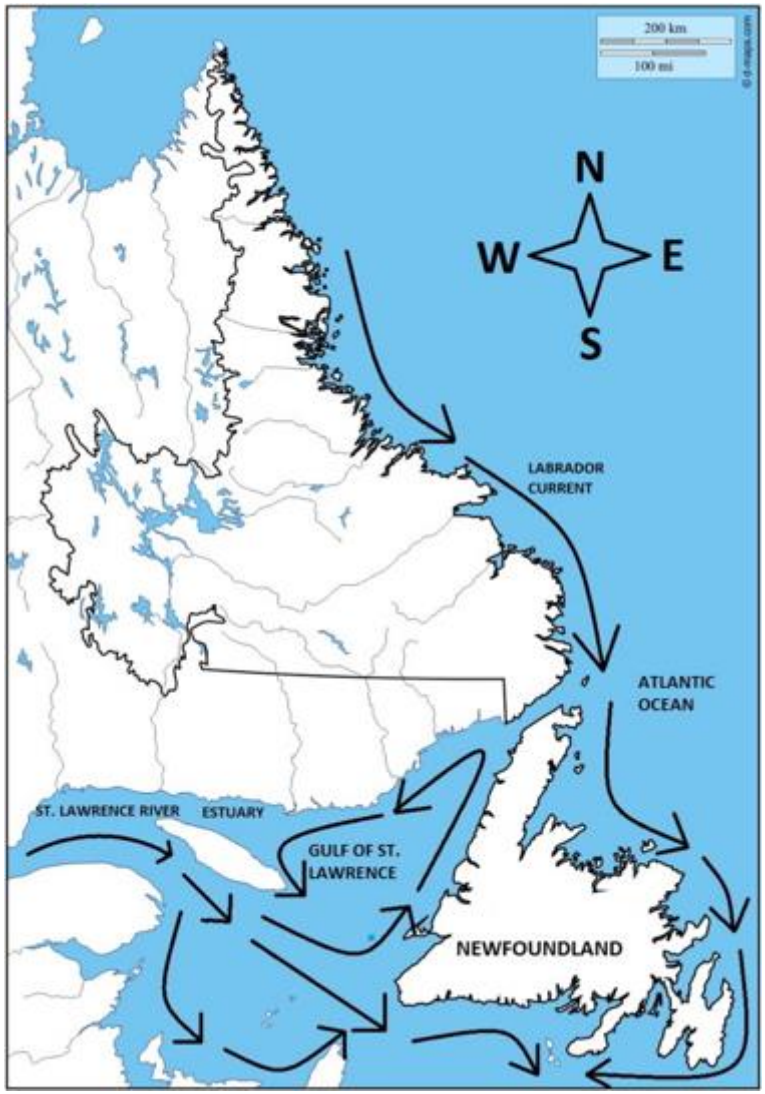
Comparison	*p*-Value
West vs. South	0.974
South vs. East	0.057
West vs. East	0.041

Calculated by averaging rates for communities within region.

[a]Number of people hospitalized with hypothyroidism diagnosis per 100,000 population per year.

Sarkar et al 2015. **Skewed distribution of hypothyroidism in the coastal communities of Newfoundland, Canada**

www.sciencedirect.com/science/article/pii/S0160412015001531



Contents lists available at ScienceDirect

Environment International

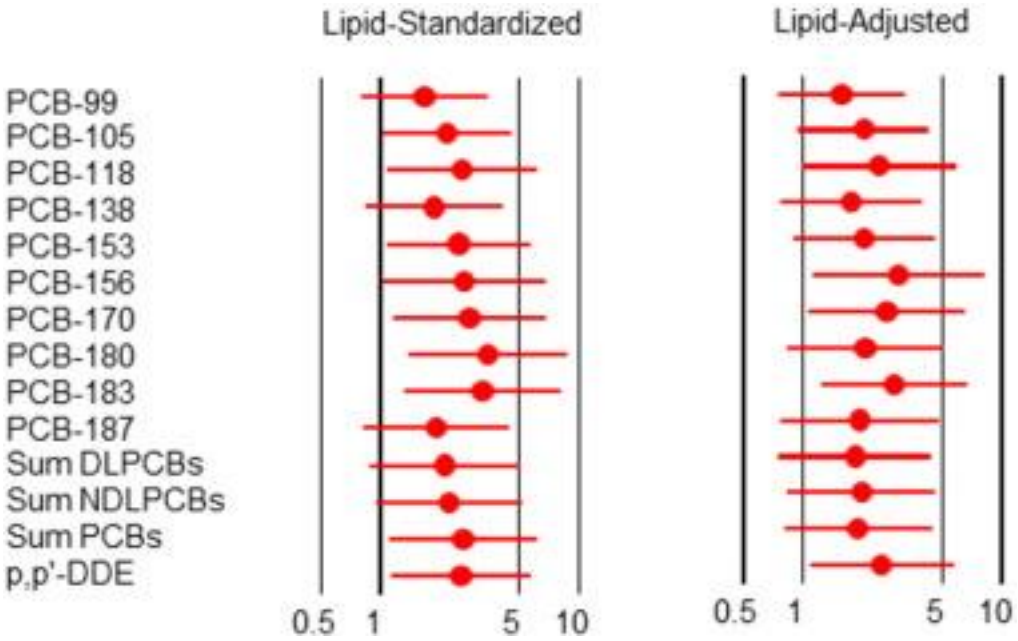
Volume 101, April 2017, Pages 183-189

journal homepage: www.elsevier.com/locate/envint

Persistent organic pollutants and diabetes among Inuit in the Canadian Arctic

Kavita Singh, Hing Man Chan *

Department of Biology, University of Ottawa, Ontario K1N 6N5, Canada



Blood PCB and p,p'-DDE levels were associated with increased risk of self-reported diabetes among Canadian Inuit.

Fasting glucose in the highest quartile of exposure was 3–7% higher compared with the lowest quartile of exposure.

Adjusted odd ratios and 95% CIs (Q4 vs. Q1) for self-reported diabetes

WHY THESE TRENDS AND EFFECTS?

Consider hormonally active or endocrine-disrupting chemicals (EDCs) in pesticides, plastics, household and personal products, cleaners, foods, long-standing pollution and toxic sites …

High dose research doesn't predict low dose effects, or vice versa

- Test at low and environmentally relevant doses
- New, rapid lab tests and computer models

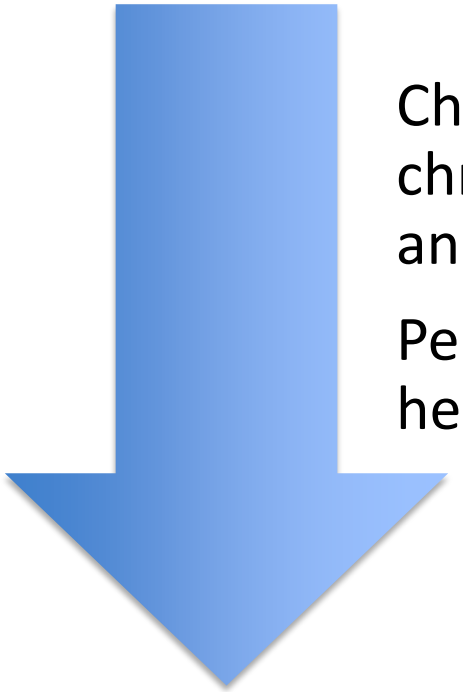
ENDOCRINE RELATED HAZARD PREDICTIONS

Early exposure to endocrine disrupting chemicals (EDCs) causes obesity, chronic diseases and cancers

- 100 ppb diethylstilbestrol (DES) or control on L
- 1 ppb DES - adult obesity, cancers

- Early life low dose BPA + chow on L
- Early life BPA + chow + nutrients on R
- Estrogenic (linked to cancer)
- Early exposure affects gene expression
- Causes adult obesity, diabetes

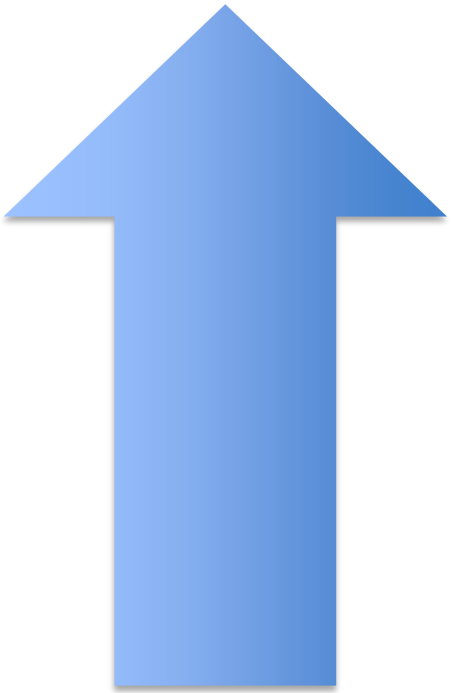
ENVIRONMENTAL HEALTH INFORMATION INFRASTRUCTURE



Child-onset and chronic disease, and early death

Personal and health care costs

Prompt responses to accelerating changes, with research, education and regulation

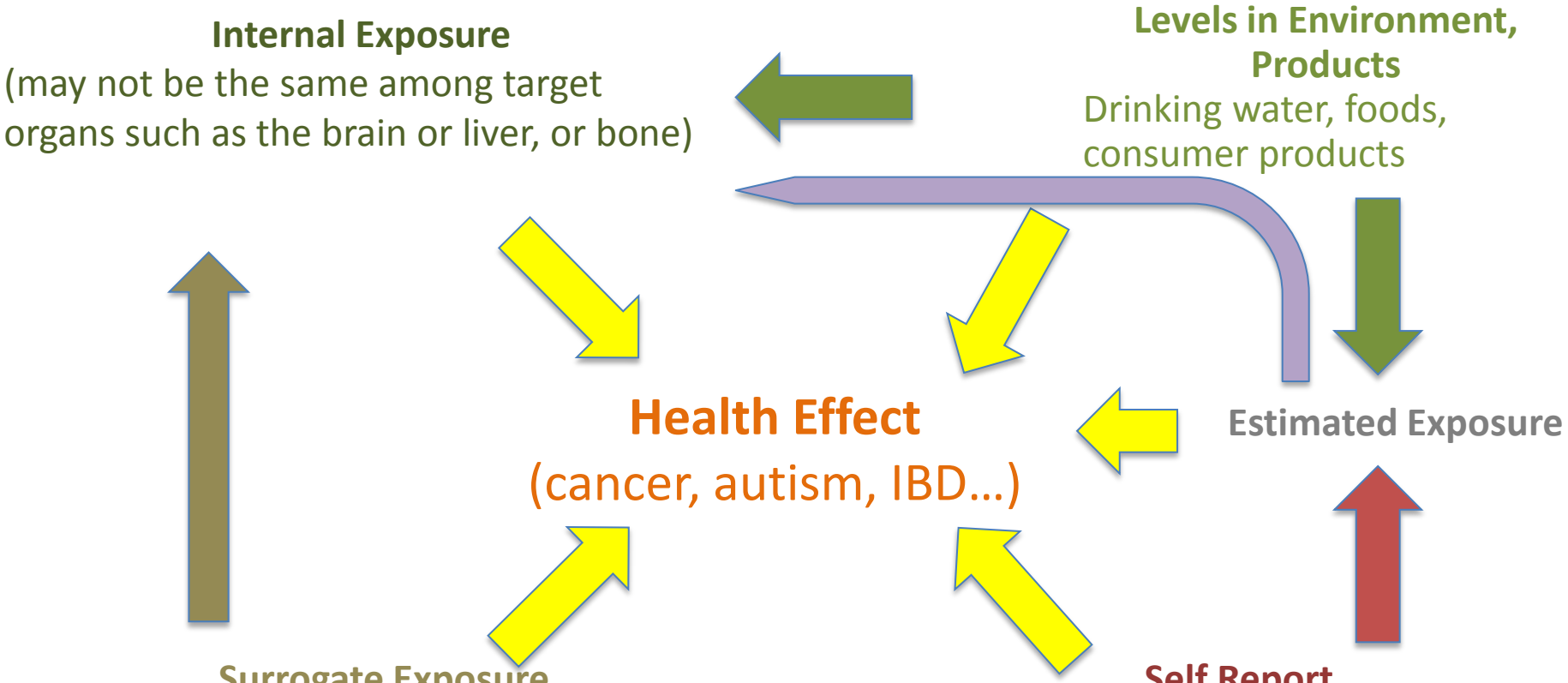


Map exposures (beneficial and adverse)

Map health outcomes (provincial and national data)

Link exposures to health outcomes

SURVEILLANCE OPPORTUNITIES IN ENVIRONMENTAL HEALTH



HOW MUCH EVIDENCE IS ENOUGH?

When action awaits proof of human harm, how much harm is done before:

1. Links are researched, then recognized?
2. Actions are taken?

Generations *of people are exposed and harmed before a human carcinogen is recognized; longer before it is acted upon.*

ETHICS

- PRECAUTION and PREVENTION require a shift to permitting only *least-toxic approaches / best practices*
- Individuals can make some personal choices, but education, opportunities and resources are challenging

ETHICAL, EFFECTIVE APPROACHES FOR ENVIRONMENTAL HEALTH

Nimble, pragmatic responses in a complex, rapidly changing world

Individuals can choose safer options, but cannot protect themselves or the environment against others' choices.

Research, educate, legislate, regulate for least-toxic, most sustainable choices.

Chemicals are often restricted once found to be harmful – how is this proven?

DATA

Beyond "preferable purchasing"

GROUP TOPIC SUGGESTIONS:

- Challenges in conducting surveillance in QC and in French-speaking populations across Canada
- New and emerging issues for surveillance
- Identification of and access to new/innovative data sources
- Linkage of multiple sources of data including SES data
- Knowledge Translation for broader communication on public health surveillance information
- Privacy and ethics in surveillance

CONTACT US

Meg Sears MEng, PhD
Sr. Clinical Research Associate
Ottawa Hospital Research Institute
Email: MSears@ohri.ca
Chair, Prevent Cancer Now
Email: Meg@PreventCancerNow.ca

Richard van der Jagt, MD, FRCP(C)
Assoc. Professor of Medicine (Hematology)
University of Ottawa
Email: RvanderJagt@toh.ca