Planetary Health and Pollution

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Image from https://stockphotos.com/pin/1484371005179650

Pollution defined…

'any material introduced into the environment as the result of human activity that endangers human health or harms living resources or ecosystems'

Global Commission on Pollution and Health

- Ambient air pollution: fine particulate ($PM_{2.5}$) pollution and tropospheric ozone pollution
- Household air pollution
- Water pollution: unsafe water sources and inadequate sanitation
- Occupational exposures to hazardous chemicals
- Soil pollution, e.g. contaminated industrial and mining sites
- Radiation, ultraviolet and ionising
- Heavy metals
- Plastics and microplastics
- Chemicals of emerging concern, e.g. endocrine disruptors

Global Commission on Pollution + Health

Major drivers of pollution

- Urbanization
- Increasing use of motor vehicles
- Globalization: relocation of industries to developing countries
- Increasing industrialization
- Increasing chemical production

Global chemical production

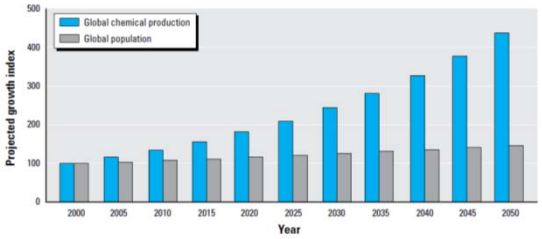


Figure 2. Global chemical production is projected to grow at a rate of 3% per year, rapidly outpacing the rate of global population growth, estimated at 0.77% per year. On this trajectory, chemical production will double by 2024, indexed to 2000 (American Chemistry Council 2003; OECD 2001; United Nations 2004).

Wilson and Schwarzman, 2009 • Environmental Health Perspectives

Planetary boundaries and chemical pollution: not yet quantified…

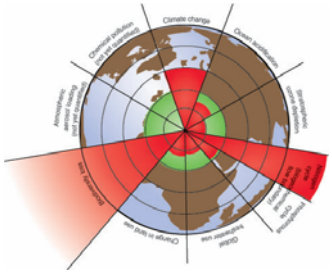
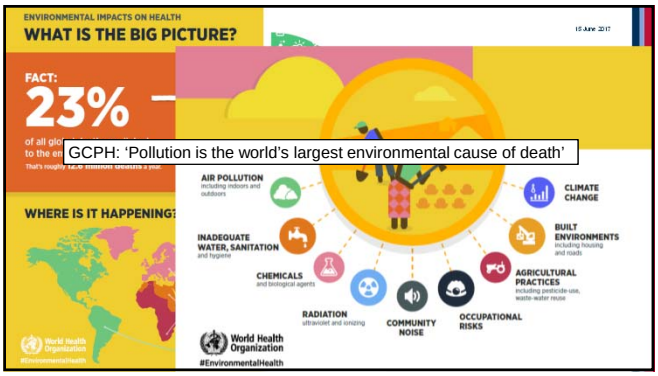
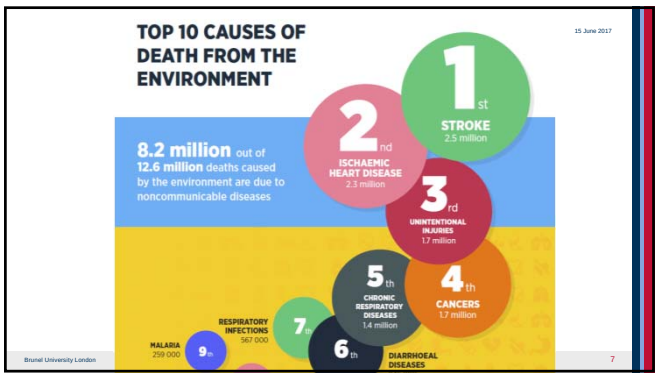
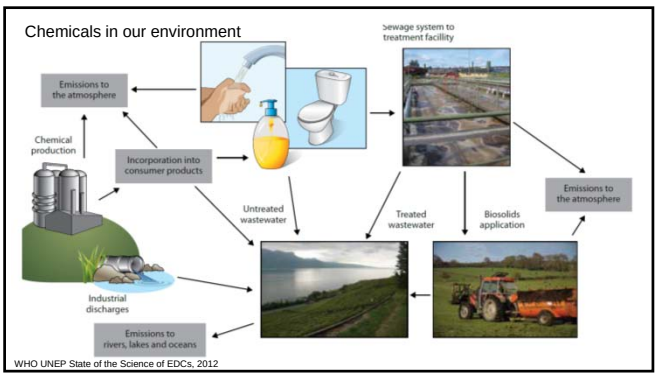


Image from The Stockholm Resilience Centre, Stockholm University, http://www.stockholmresilience.org/, Rockstrom et al, 2009, *Ecology and Society* **14**(2): 32

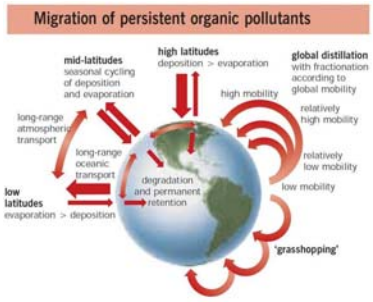


GCPH: 'Pollution is the world's largest environmental cause of death'





Chemicals reach every corner of the planet



Exposures during sensitive periods of life

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WHO UNEP State of the Science of EDCs, 2012

Chemicals of concern: endocrine disrupting chemicals

15 June 2017

"An endocrine disruptor is an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub)populations" (IPCS, 2002)

- Endocrine system controls:
  - Development and growth
  - Energy regulation and metabolism
  - Internal homeostasis
  - Reproduction (sex, pregnancy, lactation)
  - Physiology via **chemical signals (hormones)** from one part of the body to another

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Hormones produced by the endocrine system

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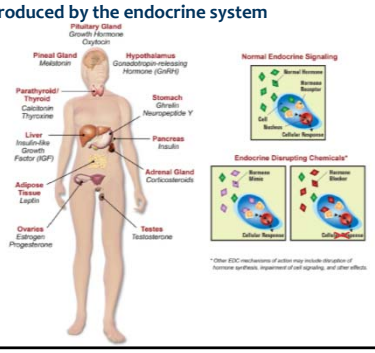

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Endocrine Disrupting Chemicals

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HERBICIDES
2,4,-D
2,4,5,-T
Alachlor
Amitro
Atrazine
Linuron
Metribuzin
Nitrofen
Trifluralin

FUNGICIDES
Benomyl
Ethylene thiourea
Fenarimol
Hexachlorobenzene
Mancozeb
Maneb
Metiram - complex
Tri-butyl-tin
Vinclozolin
Zineb

INSECTICIDES
Aldicarb
beta-HCH
Carbaryl
Chlordane
Chlordecone
DBCP
Dicofol
Dieldrin
DDT and metabolites
Endosulfan
Heptachlor / H-epoxide
Lindane (gamma-HCH)
Malathion
Methomyl
Methoxychlor
Oxychlordane
Parathion
Synthetic pyrethroids
Transnonachlor
Toxaphene

INDUSTRIAL CHEMICALS
Bisphenol - A
Polycarbonates
Butylhydroxyanisole
Cadmium
Chloro- & Bromo-diphenyl
Dioxins
Furans
Lead
Manganese
Methyl mercury
Nonylphenol
Octylphenol
PBDEs
PCBs
Pentachlorophenol
Penta- to Nonylphenols
Perchlorate
PFOA
p-tert-Pentylphenol
Phthalates
Styrene

METALS

Testosterone synthesis inhibitor
Thyroid hormone disruptor
Estrogen receptor agonist
Androgen receptor antagonist

EU priority list:
over 560 suspected endocrine disruptors

Effects of endocrine disruptors in wildlife - examples

15 June 2017

- egg shell thinning and feminisation of males in **birds** by DDT and other pesticides (North America, Europe)
- impairment of reproduction and immune function in **seals** by PCB/DDT metabolites, dioxins (Baltic and North Sea)
- masculinization of female marine **snails** by TBT from antifoulings (world-wide)
- feminisation of male **fish** by natural estrogens and xeno-estrogens (world-wide)

The Queen's Anniversary Prizes 2011

Professor John Sumpter, O.B.E., July 2016

EDCs and humans: associations with endocrine-related and other diseases

- **Reproductive/endocrine**
  - Breast/prostate cancer
  - Endometriosis
  - Infertility
  - Diabetes/metabolic syndrome
  - Early puberty
  - Obesity
- **Immune/autoimmune**
  - Susceptibility to infections
  - Autoimmune disease
- **Cardiopulmonary**
  - Asthma
  - Heart disease/hypertension
  - Stroke
- **Brain/nervous system**
  - Alzheimer disease
  - Parkinson disease
  - ADHD/learning disabilities

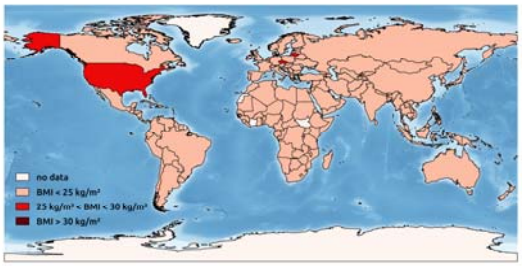
Obesity, planetary health, and pollution

15 June 2017

Image from The Economist, 2014, Special issue on Planetary Health, http://www.visionariesunbound.com/static/pdf/

Overweight and obesity in males: 1975

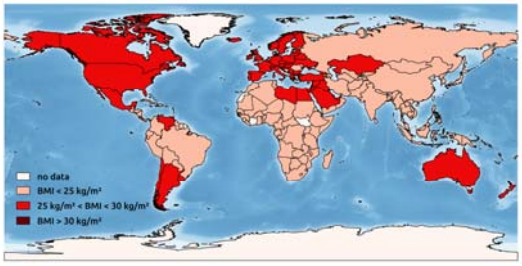
15 June 2017



Maps by Marta Plaza Hernandez, data from WHO/The Lancet

Overweight and obesity in males: 1995

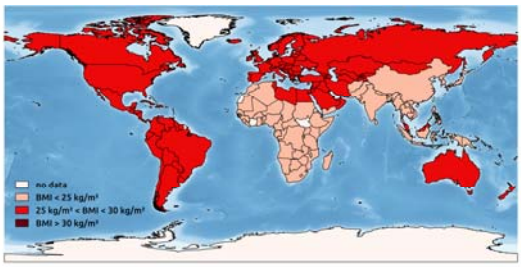
15 June 2017



Maps by Marta Plaza Hernandez, data from WHO/The Lancet

Overweight and obesity in males: 2014

15 June 2017

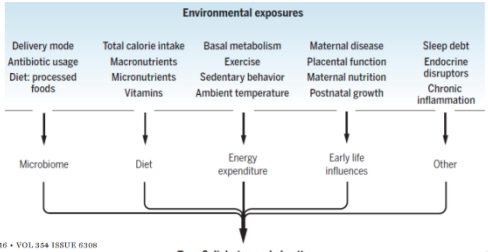


Maps by Marta Plaza Hernandez, data from WHO/The Lancet

Exposing the exposures responsible for type 2 diabetes and obesity

Science

Paul W. Franks[1,2,3] and Mark I. McCarthy[4,5,*]



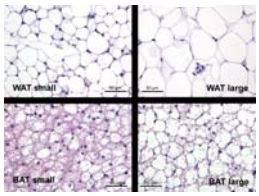
7 OCTOBER 2016 • VOL 354 ISSUE 6308

A role for chemical exposures in obesity?

15 June 2017

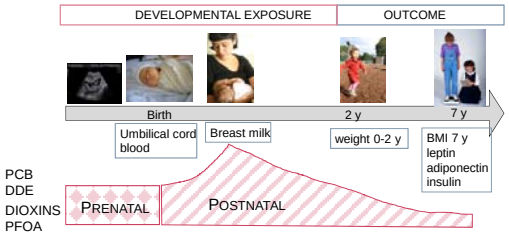
Developmental exposure to synthetic estrogen (diethylstilbestrol - DES) (Newbold et al., 2007, *Repro.Tox*)

control BPA



Developmental exposure to chemical in plastics packaging (Bisphenol A - BPA) (van Esterik et al, 2014, *Toxicology*)

Human studies



Contents lists available at ScienceDirect
Environment International
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15 June 2017

Perinatal exposure to dioxins and dioxin-like compounds and infant growth and body mass index at seven years: A pooled analysis of three European birth cohorts

Nina Iszatt [a], Hein Stigum [a], Eva Govarts [b], Lubica Palkovicova Murinova [c], Greet Schoeters [b,d,e], Tomas Trnovec [c], Juliette Legler [f,1], Cathrine Thomsen [g], Gudrun Koppen [b], Merete Eggesbø [a,*]

VOLUME 123 | NUMBER 7 | July 2015 • Environmental Health Perspectives

Prenatal and Postnatal Exposure to Persistent Organic Pollutants and Infant Growth: A Pooled Analysis of Seven European Birth Cohorts

Nina Iszatt,[1] Hein Stigum,[1] Marc-André Verner,[2,3] Richard A. White,[1] Eva Govarts,[4] Lubica Palkovicova Murinova,[5] Greet Schoeters,[4,6,7] Tomas Trnovec,[5] Juliette Legler,[8] Fabienne Pelé,[9,10] Jérémie Botton,[11,12] Cécile Chevrier,[9] Jürgen Wittsiepe,[13] Ulrich Ranft,[14] Stéphanie Vandentorren,[15] Monika Kasper-Sonnenberg,[13] Claudia Klümper,[14] Nynke Weisglas-Kuperus,[16] Anuschka Polder,[17] Merete Eggesbø,[1] and OBELIX

Int. J. Environ. Res. Public Health **2014**, *11*, 7001-7021; doi:10.3390/ijerph110707001

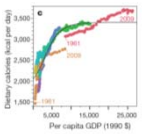
First Year Growth in Relation to Prenatal Exposure to Endocrine Disruptors — A Dutch Prospective Cohort Study

Marijke de Cock [1,*], Michiel R. de Boer [2], Marja Lamoree [3], Juliette Legler [3] and Margot van de Bor [1]

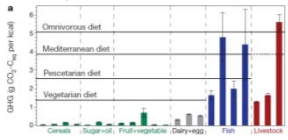
Planetary health and obesity: "the diet-environment-health trilemma"

15 June 2017

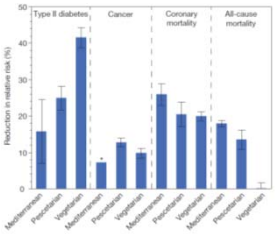
Calories



Greenhouse gases



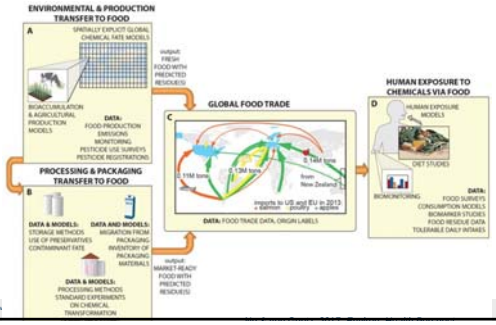
Reduction in relative disease risk



Tilman & Clark, 2014, *Nature*

The global food system as a transport system for chemicals

15 June 2017



H2020 Research Proposal 'HEROES'
Healthy EnviRonments to prevent childhood ObESity

15 June 2017

Complementary approaches to childhood obesity prevention

Changing the gradient …

… will make it easier to maintain a healthy weight

Planetary boundaries and chemical pollution: not yet quantified…

But not too late to push it back!

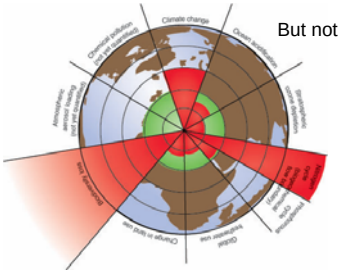


Image from The Stockholm Resilience Centre, Stockholm University, http://www.stockholmresilience.org/, Rockstrom et al, 2009, *Ecology and Society* **14**(2): 32

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Environment and Health Theme

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