Environmental toxic substances: exposed individuals and exposed populations

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www.imim.es
Sick individuals and sick populations

Geoffrey Rone

Rose G (Department of Epidemiology, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK). Sick individuals and sick populations. *International Journal of Epidemiology* 1985:14:32–38.

Aetiology confronts two distinct issues: the determinants of individual cases, and the causes of disease within a population. Therefore, the search for determinants of individual cases and the causes of disease within a population are distinct. The first approach aims to identify the cause of the disease in individual cases. The second approach aims to identify the causes of disease within a population. The two approaches are not usually in competition, but the prior concern should always be to discover and control the causes of disease.

Based on a lecture to the 4th Scientific Meeting of the International Epidemiological Association, 27 August 1984, Vancouver, Canada.


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**Exposed individuals and exposed populations**

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**PTS levels in farm-raised and in wild salmon**

**Fig. 1.** Concentrations (in ng/g wet weight, except dioxins) of 14 contaminants found in farm-raised (red bars) and wild (green bars) salmon. The vertical lines represent the 10th, 50th, and 90th percentiles, and the boxes represent the 25th to 75th percentiles. Dioxins are in pg of World Health Organization toxic equivalents (WHO-TEQs) per g of wet weight and include polychlorinated dibenzo-p-dioxins; and dibenzo-p-dioxins and dibenzofurans and dioxin-like PCBs. Typically, 75% of the total TEQs are due to the dioxin-like PCDDs. Other abbreviations are as follows: DOT, the p,p' and o,p' isomers of DOT, DDE, and DDD; DDE: DDE, nonachlor; Chlor: dichloro-; Hep Epox: heptachlor epoxide.

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**Exposed individuals and exposed populations**

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**Concentrations of CBs in commercial fish feed purchased at facilities in various countries at various times of the year. Each bar represents the analysis of one sample of fish feed, and the country indicated by red, and fish feed purchased in North or South America is indicated by gray.**

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**Fig. 3.** Concentrations of (A) PCBs in ng/g wet weight

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**Pp-DDE and Hg (ppb)**

**3rd. NRHEEC 2001-2002**

**Median and 75th percentile.**

**www.cdc.gov/exposurereport**
Physiologically Based Pharmacokinetic Modeling of Persistent Organic Pollutants for Lifetime Exposure Assessment: A New Tool in Breast Cancer Epidemiologic Studies

M. A. Varoumen, M. Charbonneau, L. L. Lopes-Carnota, and S. Haddad

Exposure individuals and exposed populations

Could low-level background exposure to persistent organic pollutants contribute to the social burden of type 2 diabetes?

Duk-Hee Lee, David R. Jacobs Jr., Miquel Porta

Persistent organic pollutants may contribute to cause diabetes

J Epidemiol Community Health 2006;60:1006-1008

Arsenic Exposure and Prevalence of Type 2 Diabetes in US Adults

Ana Navas-Acien, MD, PhD
Ellen K. Silbergeld, PhD
Robert Pastor-Barron, PhD
Elissa Gadour, MD, DrPH

Design, Setting, and Participants Cross-sectional study in 788 adults aged 20 years or older who participated in the 2003-2004 National Health and Nutrition Examination Survey (NHANES) and had urine arsenic determinations.

Results After adjustment for diabetes risk factors and markers of seafood intake, participants with type 2 diabetes had a 26% higher level of total arsenic (95% confidence interval [CI], 2.0%-56.0%) than participants without type 2 diabetes. After similar adjustment, the odds ratios for type 2 diabetes comparing participants at the 80th vs the 20th percentiles were 3.58 for the level of total arsenic (95% CI, 1.18-10.83).

A Strong Dose-Response Relation Between Serum Concentrations of Persistent Organic Pollutants and Diabetes

Results from the National Health and Examination Survey 1999–2002

Duk-Hee Lee, MD, PhD
David R. Jacobs, Jr., PhD

OBJECTIVE — Low-level exposure to some persistent organic pollutants (POPs) has recently become a focus because of their possible link with the risk of diabetes.

RESULTS — Compared with subjects with serum concentrations below the limit of detection, after adjustment for age, sex, race and ethnicity, poverty income ratio, BMI, and waist circumference, diabetes prevalence was strongly positively associated with lipid-adjusted serum concentrations of all six POPs. When the participants were classified according to the sum of category numbers of the six POPs, adjusted odds ratios were 1.0, 1.4, 1.9, 3.8, 3.4, and 3.7 (p for trend < 0.001). The association was consistent in stratified analyses and stronger in younger participants, Mexican Americans, and obese individuals.

Response to Porta DIABETES CARE, November 2006
**THE LANCET**

**Vol 368** August 12, 2006

*Miquel Porta*

**Persistent organic pollutants and the burden of diabetes**

Studies from the USA have drawn attention to the possibility that persistent organic pollutants might contribute to cause diabetes. Because they contaminate virtually all people, even if they confer only a low individual risk of diabetes, these pollutants might have a substantial overall population effect.

Results At birth and 4 years of age, all children had detectable levels of DDE (median 1 ng/ml and 0.4 ng/ml, respectively). From birth to age 4, the mean DDE level among children with artificial feeding decreased by 7%, while among breastfed children it increased by 53%. Diagnosed asthma and persistent wheezing were associated with DDE at birth (odds ratio [OR] for an increase in 1 ng/ml = 1.18, 95% confidence interval [CI] = 1.01–1.33 and OR = 1.11, 95% CI = 0.98–1.30, respectively), but not with DDE at 4 years. Neither breastfeeding nor stunting modified these associations (P > 0.3). Breastfeeding protected against diagnosed asthma (OR = 0.33, 95% CI = 0.06–0.87) and wheezing (OR = 0.51, 95% CI = 0.34–0.82) in children with low and high DDE levels at birth.

Conclusion In a community without known dichlorodiphenyltrichloroethane environmental releases, this study strengthens the evidence for an effect of DDE on asthma by measuring the disease at age 6 and does not support the hypothesis that DDE modifies the protective effect of breastfeeding on asthma.
Exposed individuals and exposed populations

The contamination of the general healthy population by organochlorine compounds, other PTS, and other Environmental Chemical Agents is a fact of relevance for public health.

It also has important consequences for environmental, food, industrial and economic policies.

• Most countries lack population indicators on the effects that environmental agents have on human health.
• Several government levels have a role in the monitoring of biological levels of PTS among humans in order to assess the risks of adverse health effects.
• Surveillance of contamination of the general population by PTS is necessary to fulfil the governments' mission to protect the public health.
PTS are present at 'low doses' in many fatty foods.

PTS are commonly detected in human beings...

... at concentrations that at mid- and long-term, and in combination with other factors may contribute to cause effects clinically and –particularly– socially relevant.

PTS accumulate in the biological sense...

PTS travel great distances: through the atmosphere as well as through the international trade channels for human food, animal feed, fat...

PTS also accumulate in the cultural environment of our societies: PTS are deeply rooted in our lifestyles.

"Knowing is not enough; we must apply. Willing is not enough; we must do." —Goethe

"Conocer no basta; debemos aplicar. Querer no basta; debemos hacer." —Goethe
Exposed individuals and exposed populations

El libro de los desórdenes. Reservor books / Mondadori, 2004. p 81
Exposed individuals and exposed populations

**Blood Concentrations Women, NORWAY (1973 - 1990)**

**p,p'-DDE**

**p,p'-DDT**

**PCBs**

**public & private policies**

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**Figure 1.** Box & Whisker diagram of p,p'-DDE concentrations (ng/g) in full-term German neonates from the mid-1980s to 2002.
Exposed individuals and exposed populations

Curves for each PTS, for different social groups, geographic areas.

Figure 1. Box & Whisker-diagram of \( p,p'-\text{DDE} \) concentrations (\( \text{mg/L} \)) in full-term German neonates from the mid-1980s to 2002.

- Exposed individuals and exposed populations

Other papers of Prof. G. Rose:
- Rose G, Day S. The population mean predicts the number of deviant individuals. BMJ 1990.
- Porta M. PTS: Exposed individuals and exposed populations. JECH 2004.
Exposed individuals and exposed populations

On the lintel of his classic *The strategy of preventive medicine*, Geoffrey Rose (1926–1993) inscribed these words of Fyodor Dostoevsky (1821–1881): “We are all responsible for all.” The idea that as citizens and societies we have shared, common responsibilities in front of threats to health is central to epidemiology, public health, even to clinical medicine...and to virtually all other professions and scientific disciplines. Why should it not also be relevant to urbanism, pedagogy, biology, or chemistry? It is of course also central to literature and most other forms of artistic expression.

While these findings should not leave us indifferent, they are not particularly alarming. Mainly, because similar results would be obtained in most of us. But, would it not be more coherent to say that similar results would be obtained “in our populations”,22 should we have the appropriate surveillance systems in place? Do we not know that there’s no effective individual escape from PTS? Then the path to follow is not to perform individual measurements of PTS, but population surveillance and control of PTS. Indeed, “Geoffrey Rose’s big idea”23 (changing the population distribution of a risk factor prevents more burden of disease than targeting people at high risk) is perfectly relevant to PTS—perhaps even more than to classic risk factors for chronic diseases.44 The only way forward is to shift the population distribution of PTS.

The dominance of deaths (coronary heart disease) in those with average levels of a risk factor


Geoffrey Rose’s big idea... is even more relevant for environmental exposures as PTS because there is very little or nothing an individual may do...
Changes in LDL cholesterol, 1995-2005

Exposed individuals and exposed populations

XVIII IEA World Congress of Epidemiology
Miquel Porta - 21 Sept. 2008 - Porto Alegre
Exposed individuals and exposed populations

Changes in LDL cholesterol, 1995-2005
Population of Girona 35-74 years.

Median GerES: 3,3 μg/dl
Median USA: 1,6 μg/dl

90 Percentil GerES: 6,2 μg/dl
90 Percentil USA: 3,8 μg/dl

Blood LEAD, Germany and USA

Blood LEAD, Germany and USA

Distribución poblacional de p,p'-DDE

Catalunya 2002 (mediana: 2,64 ng/ml)
Alemania 1998 (mediana: 1,52 ng/ml)

Distribución poblacional de PCB 138

Catalunya 2002 (mediana: 0,45 ng/ml)
Alemania 1998 (mediana: 0,72 ng/ml)
Exposed individuals and exposed populations

Distribución poblacional de HCB

Catalunya 2002
(mediana: 1,19 ng/ml)
Alemania 1998
(mediana: 0,43 ng/ml)

Distribución poblacional de β-HCH

Catalunya 2002
(mediana: 0,67 ng/ml) (detección: 98%)
Alemania 1998
(mediana: <0,1 ng/ml) (detección: <50%)

En busca de la química limpia
El nuevo reglamento europeo obliga a las empresas a registrar las sustancias que utilicen en sus procesos

Quien incumpla las normas puede ver prohibida la venta de sus productos

www.cdc.gov/exposurerreport
Science of the Total Environment 139 (2005) 49-62

Canary I.

Median Canary I.: 118
Median USA: 226 ng/g

α,β-DDE lipid-corrected (ng/g)
Exposed individuals and exposed populations

Blood levels of DDE

- Canarias: 118
- USA: 226

Median Canarias: 118
Median USA: 226

Differences within country: >500 and even >1000-fold.

Blood levels of DDE

- West Germany: 1.3 μg/l
- East Germany: 3.4 μg/l (1990-1992)

Median West: 1.3 μg/l
Median East: 3.4 μg/l (1990-1992)

Differences within country: >500 and even >1000-fold.
Exposed individuals and exposed populations

Serum concentrations of p,p'-DDE (lipid-corrected, in ng/g) in the US general population

<table>
<thead>
<tr>
<th>Geometric mean (95% confidence interval)</th>
<th>Selected percentile (95% confidence interval)</th>
<th>Sample size</th>
</tr>
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Dostoievski: 
"We are all responsible for all."

Geoffrey Rose (1926 - 1993) 
*La estrategia de la medicina preventiva.* 

Exposed individuals and exposed populations

"We all go down on the same boat."

The values of the majority?
Risk privatization? As individuals there's little we can do to “defend ourselves” from certain environmental risks. “We are all on the same boat.”

Exposed individuals and exposed populations

Should we know what are the concentrations of PTS in the population?

*Sociol Health & Soc Med 2003;55:165-178*

Persistent toxic substances: exposed individuals and exposed populations

Should we analyze our blood concentrations of PTS?

News Focus

Biomonitoring is charting the public's exposure to many chemicals.

After the World Trade Center towers collapsed on 11 September 2001, the world was gripped by the search for survivors. Researchers at the Centers for Disease Control and Prevention (CDC) raced to address an additional concern: the exposure of rescuers to potentially toxic smoke from the rubble. They took blood and urine samples from 370 firefighters, including those digging through the rubble at Ground Zero and those putting out nearby blazes. After examining the samples for dioxins, cyanide, and 100 other chemicals associated with burning buildings, they determined that the rescuers had not been exposed to dangerous levels. Although the team couldn’t rule out all possible health effects, James Pickle, deputy director for science at CDC’s Environmental Health Laboratory, says the tests were “a huge help,” eliminating the need for a lot of further studies.

What made the rapid findings possible were tremendous advances in methods of sampling human tissue for chemicals, called biomonitoring. Over the past decade, analytical techniques have improved so much that researchers can detect ever smaller concentrations of chemicals in a single blood sample. The largest effort is CDC’s National Report on Human Exposure to Environmental Chemicals, an ongoing $6.5 million survey that is now measuring about 145 chemicals in some 2500 people across the United States every 2 years. “It’s critically important early intelligence about compounds that are getting into people,” says Philip Lundrigan of Mount Sinai School of Medicine in New York City.
Biomonitoring is hot. With lab costs down, environmental groups are commissioning their own analyses of chemical exposures. Last year, the Environmental Working Group (EWG) in Washington, D.C., released a report entitled *Body Burden: The Pollution in People* that examined the levels of 210 chemicals in nine people. In April, the World Wildlife Federation tested 101 compounds in 39 members of the European Parliament. The impetus is clear: Such studies can generate headlines and political leverage. As a result of biomonitoring data, “we’ll see sweeping changes in our system of public health safeguards,” predicts Jane Houlihan, EWG’s vice president of research.

But although biomonitoring can provide reams of statistics about the chemicals people are exposed to, it can’t necessarily indicate whether such exposures are likely to make them sick. So while environmentalists herald biomonitoring as a valuable tool for precautionary action, chemical manufacturers worry that it will spark unjustified alarm and costly regulations that may not provide much real benefit to public health. “Industry sees a movement toward collecting a lot of biomonitoring data prematurely, before we know what to do with it,” says Nancy Doerrer, scientific program manager at ILSI Health and Environmental Sciences Institute, an industry-funded group in Washington, D.C. What’s
For EPA, the problem is that the pace of biomonitoring has eclipsed that of the basic epidemiology and toxicology needed to reveal whether a chemical causes harm.

What's normal?  
What does it mean?

NO to indifference, NO to fear.  
NO to paternalism, NO to opacity.  
YES to measures of collective protection.  
YES to research, YES to innovation.  
YES to society of knowledge: apply it.  
YES to information, YES to awareness.  
YES to active citizens.  
YES to law enforcement.  
YES to ecologic agriculture... and more...

YES to ecologic agriculture...

YES to active citizens.

YES to law enforcement.

YES to ecologic agriculture... and more...
Exposed individuals and exposed populations

What triggers childhood type 1 diabetes?

"birds... vs. human beings"
Exposed individuals and exposed populations

XVIII IEA World Congress of Epidemiology
Miquel Porta - 21 Sept. 2008 - Porto Alegre
Exposed individuals and exposed populations

David Michaels is a scientist and former government regulator. During the Clinton Administration, he served as Assistant Secretary of Energy for Environment, Safety and Health, responsible for protecting the health and safety of the workers, neighboring communities, and the environment surrounding the nation’s nuclear weapons factories. He currently directs the Project on Scientific Knowledge and Public Policy at The George Washington University School of Public Health and Health Services. In 2006, he received the American Association for the Advancement of Science’s Scientific Freedom and Responsibility Award for his work on behalf of nuclear weapons workers and for advocacy for scientific integrity.
THANK YOU FOR YOUR ATTENTION