



# Chemical Safety Seminar

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# Children's Environmental Health Research



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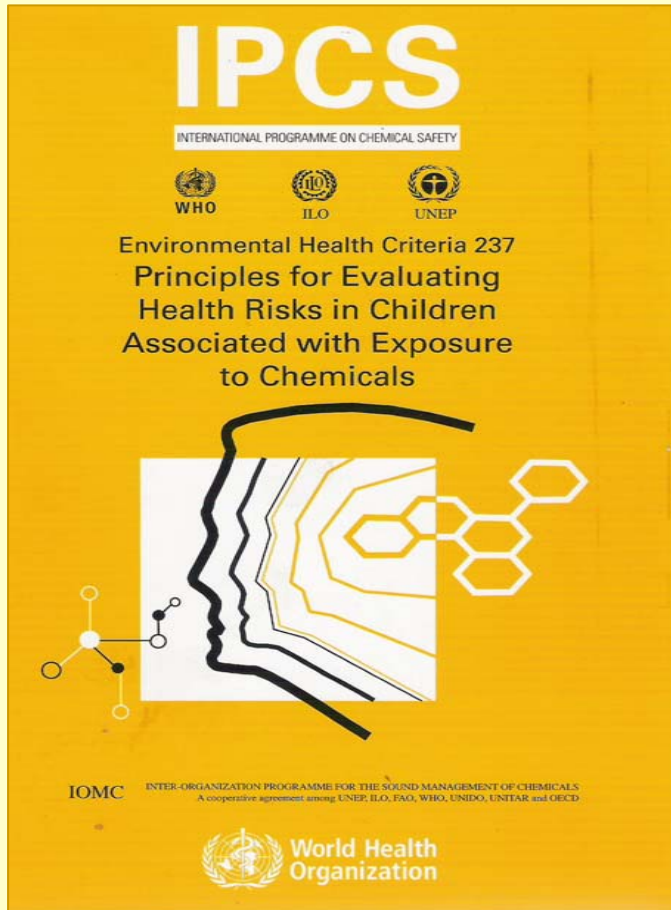


# Children's Environmental Health Research

***This presentation will include information on:***

- burden of disease caused by chemicals,***
- bio-monitoring as a tool for research, and***
- research to support policy development***

# Children's Environmental Health Research

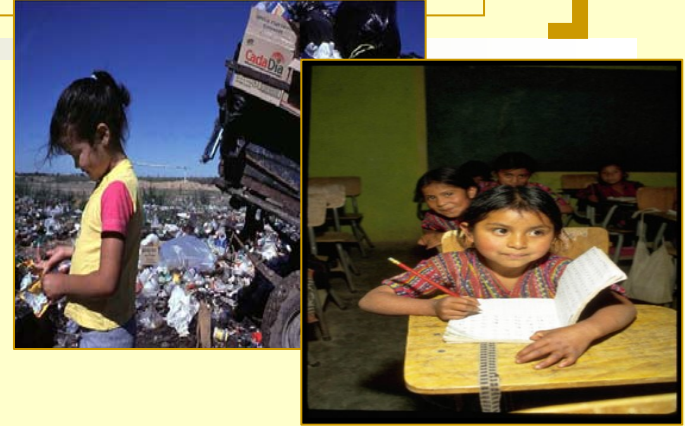


This presentation is based on the information published in

## Environmental Health Criteria 237

- PRINCIPLES FOR EVALUATING HEALTH RISKS IN CHILDREN ASSOCIATED WITH EXPOSURE TO CHEMICALS
- First drafts prepared by Dr. Germaine Buck Louis, Bethesda, USA; Dr. Terri Damstra, Research Triangle Park, and al.
- Published by the World health organization under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals.

# Children environmental health



- Health is determined by a variety of factors.
- In addition to the physical environment, genetics, and biology, social, economic, and cultural factors play major roles.

# Children environmental health

Although it is critical to understand the various driving forces during childhood that shape health and behavior throughout life, the emphasis of this presentation is specifically on **exposure to environmental chemicals**.

The central focus is on the developmental stage when the exposure to chemicals occurs rather than on a specific environmental chemical or a specific disease or outcome.

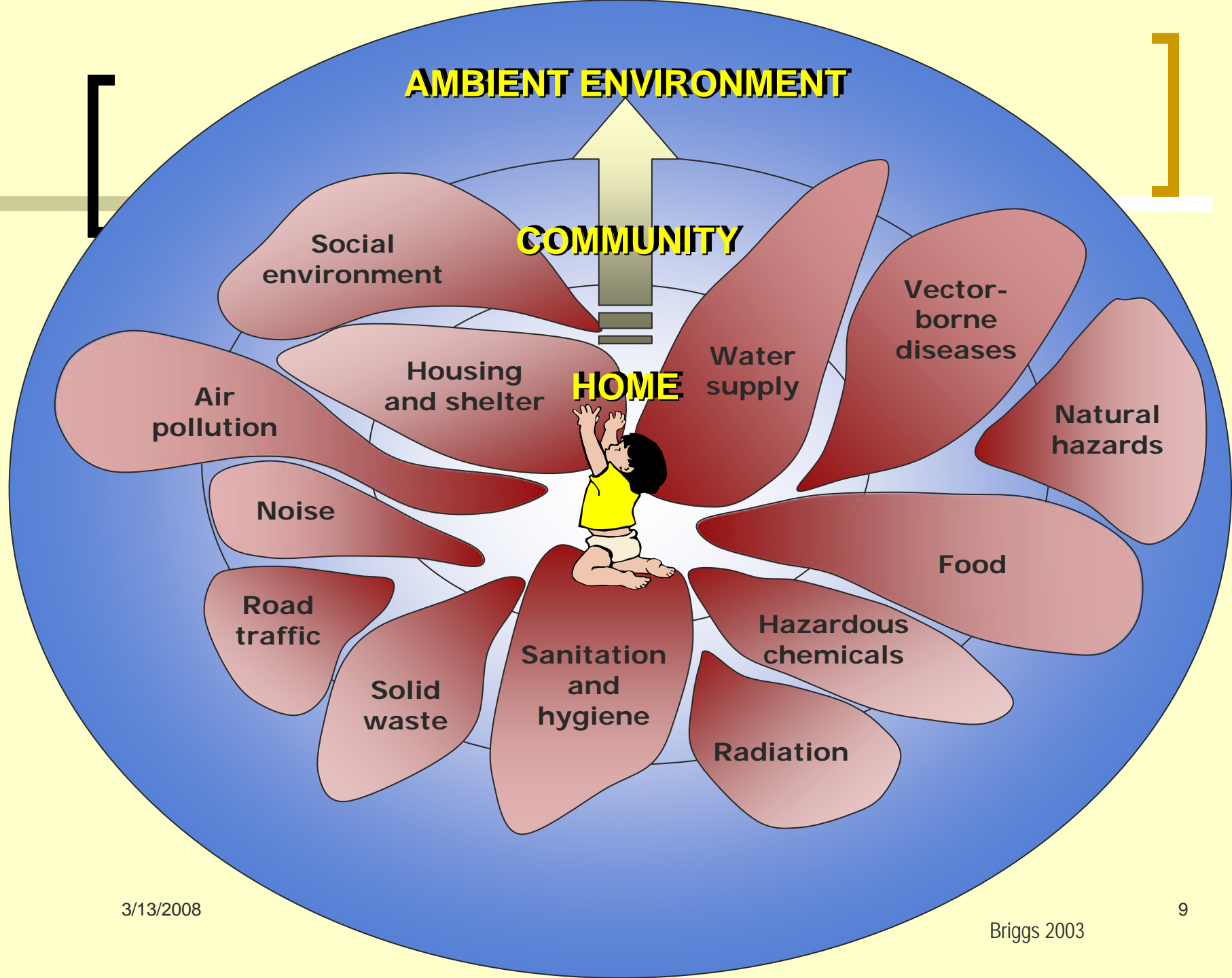
# Children environmental health

- The central focus in children's\* environmental health research is now on the **child including developing embryo, fetus, infant and adolescent.**
- And on the need to have a good understanding of the **interactions between exposure, biological susceptibility, and socioeconomic and nutritional factors at each stage of a child's development.**

\* The terms "children" and "child" as used in this document include the stages of development from conception through adolescence.

# Children environmental health

- **The stage in children development when exposure occurs may be just as important as the magnitude of the exposure.**
- Evaluating environmental health risks in children will help the health sector, researchers and policy makers to protect children of all ages through improved risk assessments, appropriate interventions and focused research to become healthy adults.



# Why children?



# [ Why children? ]

## **Environmentally-related paediatric illnesses have high social and economic costs**

- **Increased medical expenses**
- **Sickness, disability and death**
- **Sick days away from school**
- **Productivity lost by parents away from work**
- **Personal agony to families and communities**
- **Reduced long-term productivity of the country**

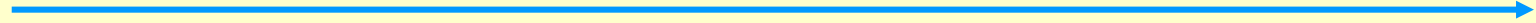
# Children vulnerability



- Children have more years of future life and thus more time to develop chronic diseases that take decades to appear and that may be triggered by early environmental exposures.

# Lifetime exposure

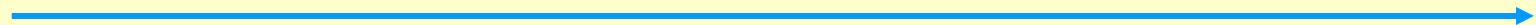
Air



Drinking water



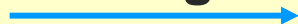
Domestic environments



Soil: dermal



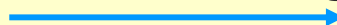
Soil: ingestion



“Normal” food



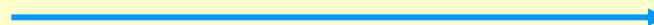
Breastfeeding



Intrauterine



Occupational exposure



Birth

6 m

1 yr

5 yr

16 yr

45 yr

65 yr

# Children are not just small adults



- **Children are especially vulnerable to environmental risks**
  - Higher exposures compared to body weight
  - More vulnerable to the effects of exposure
  - Unique exposure patterns due to behaviours
  - Less aware of risk
  - Less able to control their environment
  - "Windows of susceptibility"
  - Ignored or poorly served by policy

# New research findings suggest:



- ❖ Children and developing foetuses have special vulnerability to certain toxicants
- ❖ Effects depend upon: toxicity, dose, and **timing** of exposure
- ❖ Effects of exposure are exacerbated by:
  - poverty
  - malnutrition
  - urbanization
  - degraded environments
  - stressful circumstances

# Emerging scientific evidence

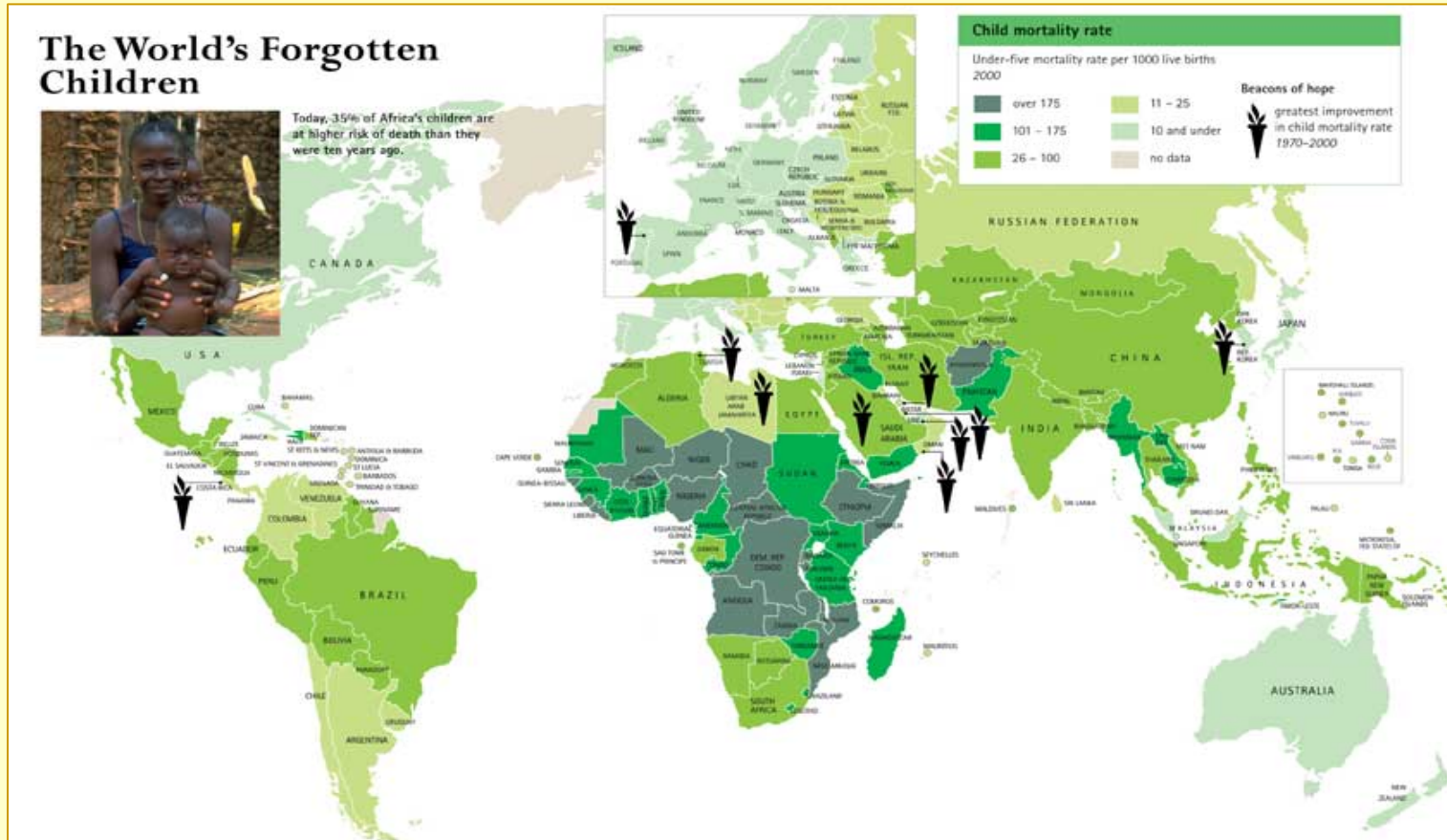
- Some examples of health effects resulting from developmental exposures:
- **pre-natally and at birth** include miscarriage, still birth, low birth weight and birth defects;
- **in young children**, infant mortality, asthma, neuro-behavioural and immune impairment; and
- **in adolescents**, precocious or delayed puberty.
  
- **Adults:**

Emerging evidence suggests that an increased risk of certain diseases in **adults** such as asthma, cancer, diabetes and heart disease can result in part from exposures to certain environmental chemicals during **childhood**.

# Environmental burden of disease



Over 10 million children under five die every year, 98% of them in developing countries



# Environmental burden of disease

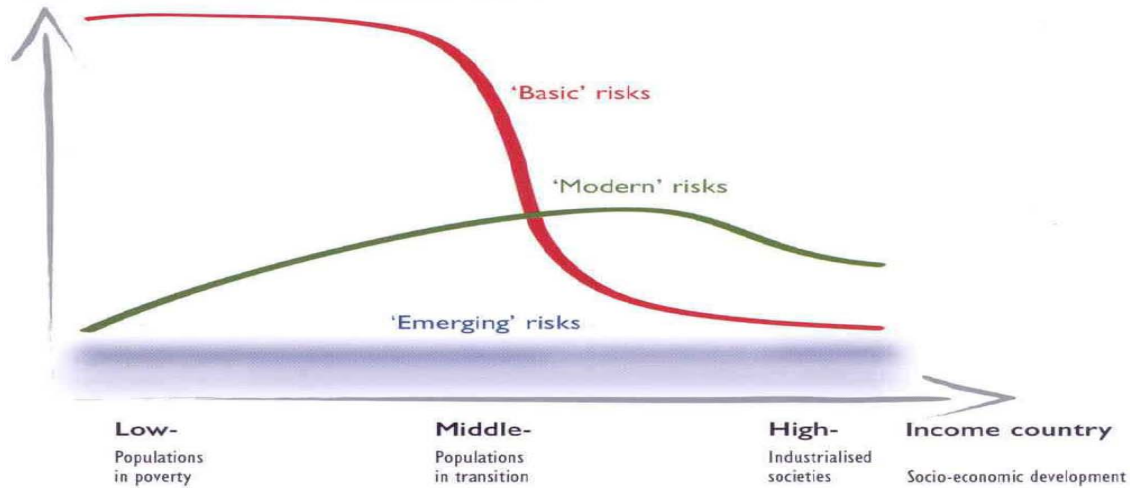
- Over 30% of the global burden of disease can be attributed to environmental factors.
- 40% of this burden falls on children under five years of age, who account for only 10% of the world's population.
- At least three million children under five years of age die annually due to environment-related illnesses.
- One in five children in the poorest parts of the world will not live longer than their fifth birthday, mainly because of environment-related diseases.

# Major environmental threats to children

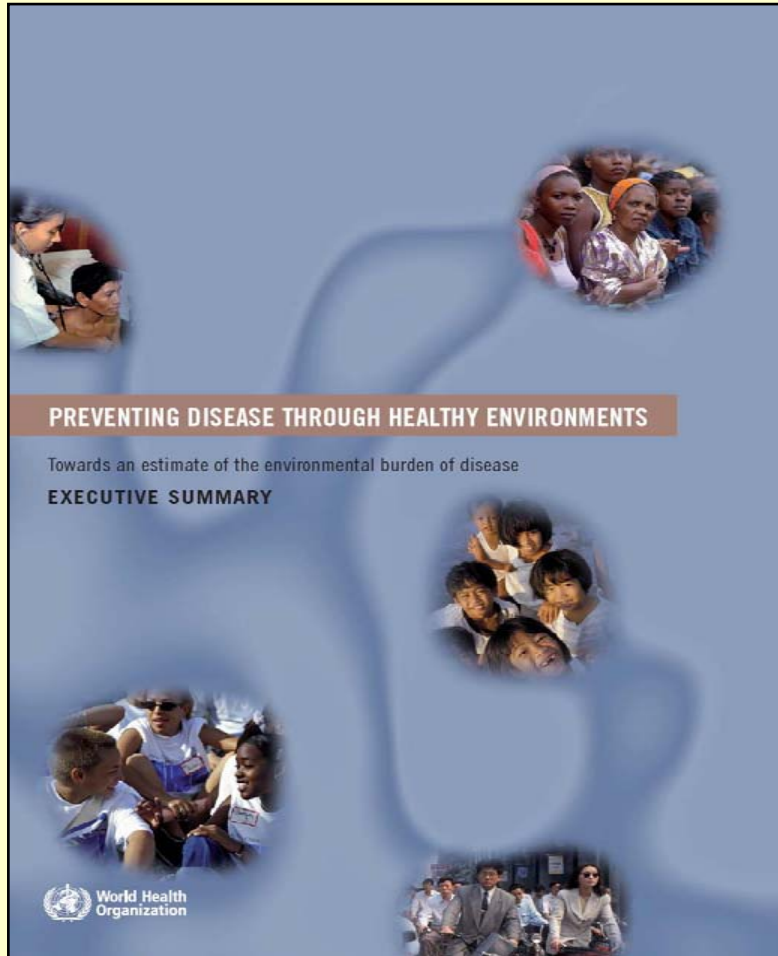
## OVERLAP OF ENVIRONMENTAL RISKS

Children in developing countries face risks from many sources of pollution. Children from all socio-economic backgrounds may also be vulnerable to 'emerging' risks.

The importance of environmental risks



# Environmental burden of disease

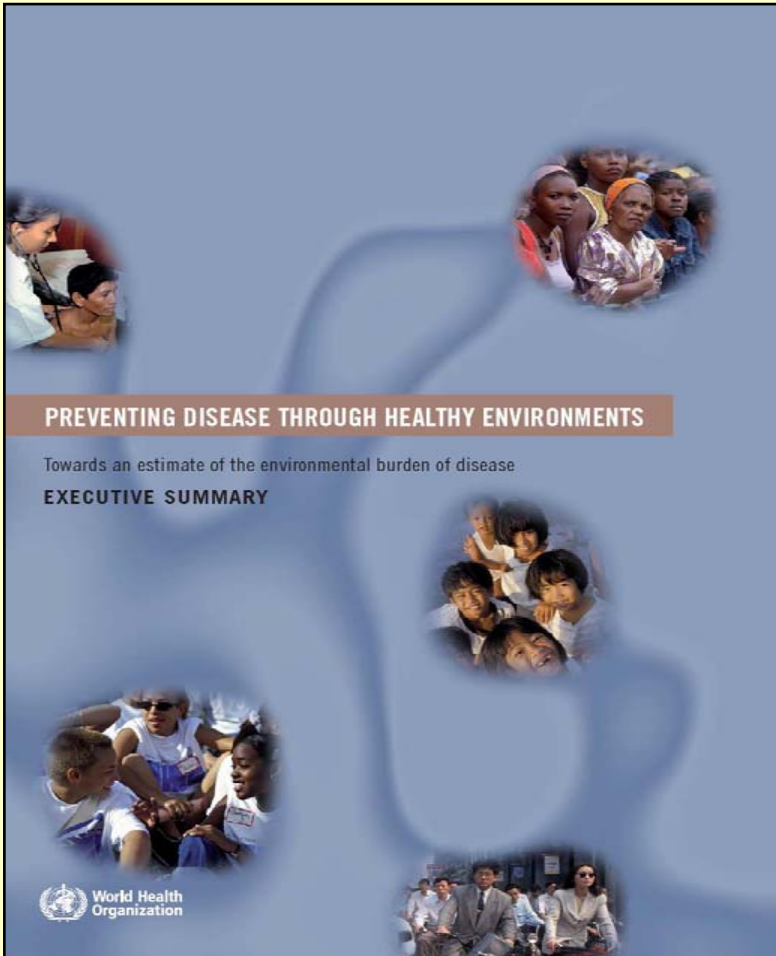


*“Preventing disease through healthy environments: Towards an estimate of environmental burden of disease”*

\* How are specific diseases and injuries related to environmental risk factor

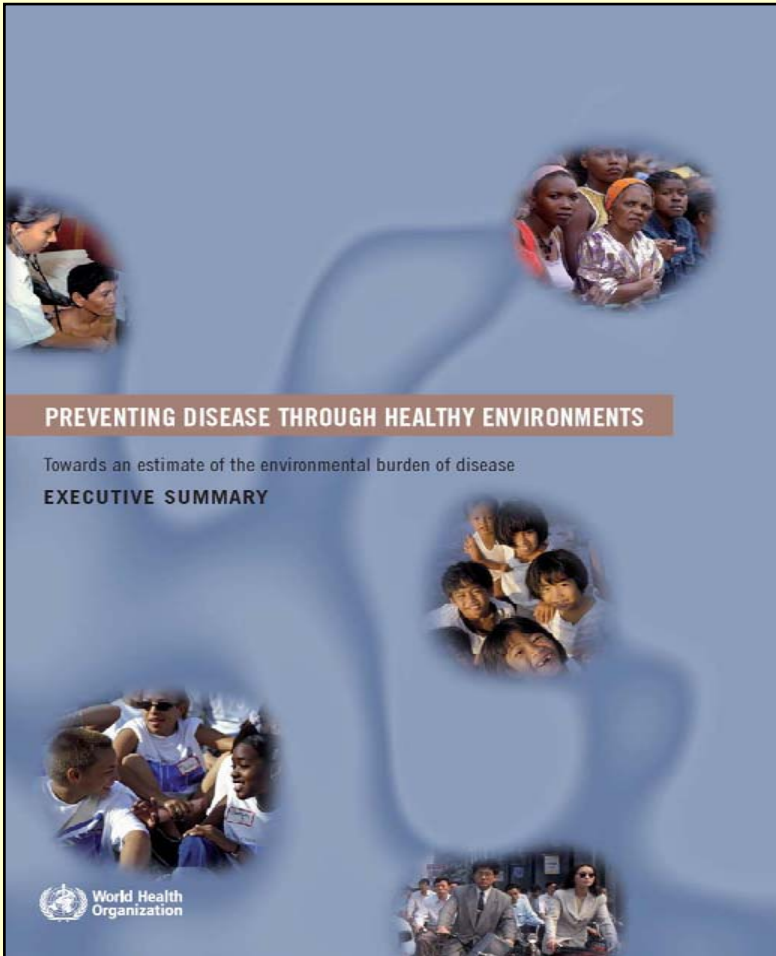
\* Which regions and populations are the most vulnerable

# Environmental burden of disease



Environmental factors contribute to 85 of the 102 major diseases of the World Health Report, 2004.

# Environmental burden of disease



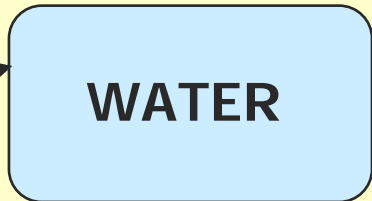
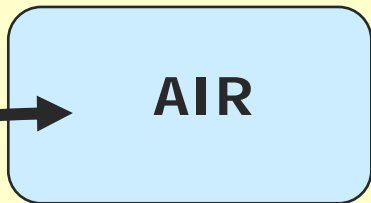
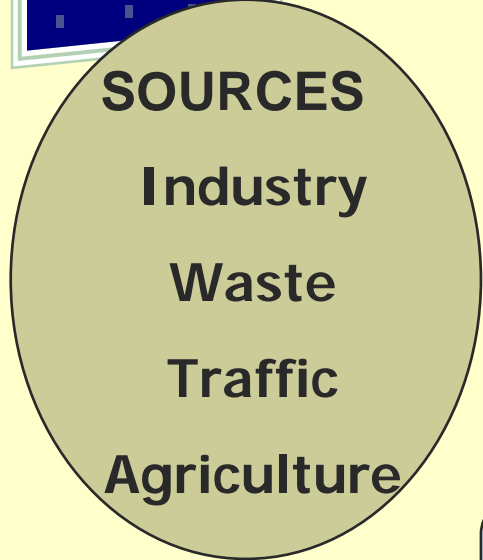
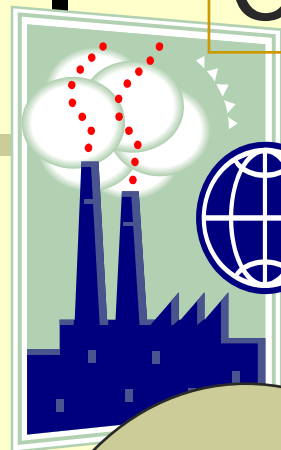
Attributable to environmental factors:

- 24% of global disease burden  
*(healthy life years lost)*
- 23% of all death  
*(premature mortality)*
- *25% in developing countries*
- *17% in developed regions*
- *36% in children 0-14 years*

# Chemical hazards



# Chemical hazards



- Air-water
- Rain
- Snow
- Particles



# Chemical burden of disease

- An estimated 50 000 children die annually as a result of accidental or intentional ingestion of toxic substances.
- The global burden of disease in children attributed to environmental chemical exposures is largely unknown and has only recently begun to be investigated

# Chemical burden of disease

A wide range of chemicals can affect children's health, but a few chemical classes are of particular concern.

These include heavy metals, POPs, pesticides, and air pollutants.

Heavy metals and lipophilic POPs cross the placenta, transfer into breast milk, and are known to interfere with the normal growth and development of children.

# Persistent Organic Pollutants POPs

## PESTICIDES

Aldrin  
Dieldrin  
Chlordane  
DDT  
Endrin  
Heptachlor  
Mirex  
Toxaphene

## INDUSTRIAL CHEMICALS

PCBs and HCB

## UNINTENDED BY- PRODUCTS

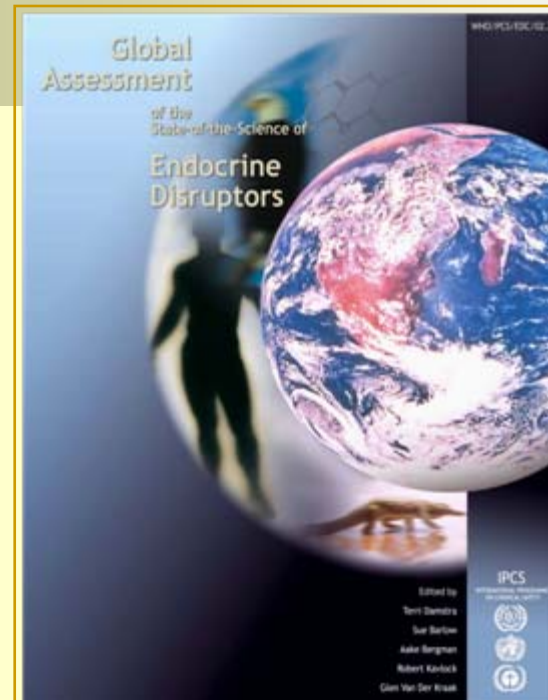
Dioxins and furans

**Stockholm Convention: a global treaty ratified by the international community lead by UNEP – calls for the elimination and/or phasing out of 12 POPs**

# High concern about Endocrine Disruptors

- ❖ Reproductive/developmental effects observed in *wildlife*
- ❖ Effects demonstrated experimentally, in *animals*
- ❖ Increasing *trends of hormone-related cancers*
- ❖ Neurobehavioural *deficits in children*

# New risk assessment approach



# New risk assessment approach

- “Critical windows”
- Children’s different susceptibility
- Children’s pathways and exposure



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3/13/2008



# **New risk assessment approach**

**Most of the chemicals in the environment have not been assessed for potential toxicity to children, nor have the most vulnerable sub-populations of children been identified.**

# New risk assessment approach

- **New** risk assessment approaches may be necessary in order to adequately protect children.
  - The full spectrum of effects from childhood exposures cannot be predicted from adult data.

# New risk assessment approach

- Risk assessment approaches for exposures in children must be linked to life stages.

# New risk assessment approach

- Establishing causal links between specific environmental exposures and complex, multi-factorial health outcomes is difficult and challenging, particularly in children.

# New risk assessment approach

- Investigators have focused on exposure to a particular environmental chemical and a particular organ system or end-point.
- Noticeably absent are prospective longitudinal studies.
  - Virtually no studies have captured peri-conceptual exposures.

# Risk assessment methods



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The risk assessor should understand the type of methods and models used to determine exposure, by example:

- direct
- biomarkers

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# Conclusions and recommendations



# Summary and conclusions

Considerable progress has been made in developing risk assessment approaches that address the special developmental stage–specific vulnerabilities of children.

There is an increased understanding of normal and abnormal development and the influence of age-specific conditions on a child’s vulnerability.

Nevertheless, life stage–specific risk assessments are only beginning to be incorporated into the overall risk assessment process, and many gaps in knowledge and in the appropriate application of data into child-protective risk assessment policies need to be addressed.

# Recommendations

In order to gain a better understanding, further research is needed in the following areas:

- Design and implement **prospective cohort studies of pregnant women, infants, and children with longitudinal capture of exposures** at critical windows and sensitive health end-points along the continuum of human development.

# Recommendations

- **Continue to develop and enhance population-based surveillance systems for the real-time capture of sentinel health end-points.**
- **Strengthen exposure monitoring efforts in children** during different developmental stages, including efforts to assess aggregate and cumulative exposures.

# Recommendations

- **Strengthen exposure monitoring efforts in developing countries.**
- **Identify subpopulations with the highest exposure levels.**
- **Develop validated, sensitive, and cost-effective biomarkers of exposure, susceptibility, and effects, particularly during early developmental stages.**

# Recommendations

- **Improve characterization of the differences in toxicokinetic and toxicodynamic properties of xenobiotics at different developmental stages.**
- **Develop end-points that can be used to assess organ system functions in both humans and animal species**

# Recommendations

- **Improve characterization of the windows of susceptibility** of different organ systems in relation to structural and functional end-points.
- **Develop and validate biological models and animal testing guidelines** that can address health outcomes at different developmental stages.
- **Determine which exposure reductions will have the greatest overall impact on children's health.**

# Public health preventive strategies on chemical safety

The development of risk assessment strategies that address the developmental life stages through which all future generations must pass is essential to any public health strategy.

Protection of children is at the core of the sustainability of the human species.

It should be a priority of all countries and international and national organizations to provide safe environments for all children and reduce exposure to environmental hazards through promotion of healthy behaviours, education, and awareness raising at all levels, including the community, family, and child.

# Public health preventive strategies on chemical safety

In order to better accomplish this, research on the effectiveness of risk reduction and intervention practices, including the most effective means to educate and communicate the need for child-protective public health policies, legislation, and safety standards, is needed.

The active participation of all sectors of society plays an important role in promoting safe and healthy environments for all.

**The special vulnerability of children should form the basis for development of child-protective policies and risk assessment approaches.**

**A lack of full proof for causal associations should not prevent efforts to reduce exposures or implement intervention and prevention strategies.**

