The Environmental Burden of Disease

Briefing

Environmental pollution has a variety of effects on human health. Illnesses such as allergies, asthma, cancers, neuro-developmental disorders, and even cardiovascular disease have already been linked to environmental factors such as exposure to environmental pollutants. These diseases are on the rise and so are the costs for treatment and the impact on labour productivity. Assessing the full extent of the environmental burden of disease (EBD), or the impact of the environment on health, can help in understanding the actual causes of illnesses and provides opportunities for relevant policy interventions.

An Old and New Paradigm of Scientific Evidence

The environmental burden of disease was addressed by the EU Commission's Environmental Health Strategy (SCALE) in 2003, and a report of the European Environment Agency (EEA) and the European Commission Joint Research Centre (JRC), explained that the environment and health connection is characterized by multi-causality and complexities.[1] This concept can be understood by an example given by David Gee, Coordinator for Emerging Issues and Scientific Liaison of the EEA:

X% of cancer is caused by smoking, y% by diet, z% by alcohol, etc. When the percentages are added up, only a small percentage is left for occupational or environmental causes. But this is fallacious because it is based on the naive view that every case of cancer has a single cause and that two causes cannot contribute to the same case of cancer. Thus, simply adding up to 100% suggests that every cancer has one cause, meanwhile there are in fact multiple factors.[2]

The links between exposures and their health consequences depend on the specific environmental pollutants and diseases considered, but health consequences are also influenced by factors such as genetic constitution, age, lifestyle, and socio-economic aspects (e.g. poverty, level of education). As such simple genetic determinism (e.g. being prone to a disease because of heredity), becomes one factor in a case of complex system dynamics. The multi-causality approach was also noted in the European Commission follow up to SCALE, the Environment and Health Action Plan 2004-2010.[3]
When considering exposure and risk assessment we must take into account some main attributes of multi-causality, namely:

- **Combined exposures from multiple sources (e.g. food, air, water).**
- **The so called "cocktail-effect" (i.e. the effects of combinations of chemicals).**
- **The timing of exposure (consider exposure in the womb versus exposure as an adult).**
- **The amount or dose of exposure.**
- **The duration of exposure.**

These diverse elements make directly targeted assessments complicated, but simultaneously highlight that traditional scientific analysis, based on a single-causality approach, cannot tell the whole story. In addition, epidemiological studies, which have pioneered much of what we know about environmental effects on public health, are severely limited in assessing the environment-health relationship under such diverse conditions and variables.
In a statement by Prof. Dr. Nic van Larebeke of Ghent University (Radiotherapy, Nuclear Medicine and Cancer Specialist)[4], epidemiological limitations include:

- **No low sensitivity; relative risks lower than 1.5-2 cannot be detected.**
- **Confounders, or outside factors that are corrected for might actually be co-causal factors.**[5]
- **Follow-up time is too short compared to the latency time of, e.g. cancer in humans.**
- **Dose-response relation; inaccuracies in assessing exposure lead to underestimation of risk increase.**

New research clearly shows a need to shift away from traditional, uni-causal risk assessment methods towards a multi-causal perspective. But, as noted by Prof. McGlade, Executive Director of the EEA, multi-causality itself is complex. In the multi-causality setting the timing of the dose can make the poison: early exposure (i.e. in the womb) is far more important than exposure later in life.[6] Also, the "consistency" of scientific results can be unusual; different outcomes do not necessarily mean that studies point in different directions. Further, "small"environmental causes can be very important as links in an interdependent causal chain, or as "triggers" of diseases (e.g. asthma is thought to be triggered by air pollution).
The increase in allergies, asthma, cancers, neurodevelopmental disorders, and even cardiovascular disease over the last few years has been linked to exposure to environmental pollutants. According to a growing group of scientists the size and strength of this link has been underestimated. Such findings have tremendous policy implications, yet there is still some debate about new research results. "Uncertainty," an inevitability in any scientific work, is a primary cause for political inaction. However, we must also be aware of "manufactured' uncertainty – doubts put forth by special interests that mask scientific findings.[7] In addition, we should keep in mind the precautionary principle, because "absence of evidence of harm is not evidence of absence of harm." [8]

Environmental Factors of Disease – Some of the findings

The following section gives a glimpse of the diverse environmental-related causes that can influence health. It should be understood that there is a vast array of research available, and in development, on the environmental-health link.
The following is based primarily on the 2005 EEA/JRC report, *Health and Environment*, except where noted.

Chemicals: In a recent and salient test by the WWF (2004), human bio-monitoring (e.g., blood testing) revealed that every European citizen has man-made chemicals in his/her body. 55 different chemicals were found in the blood of the subjects, many of which are persistent, bio-accumulative and capable of disrupting hormone systems in wildlife and people. Some chemicals found included those used in fire-resistant sofas, non-stick pans, flexible PVC, fragrances, and pesticides.
According to the EEA/JRC Report, approximately 500 chemicals are identified as carcinogenic and banned from reaching the consumer, but may enter the environment through diffuse sources or accidents. Arsenic and cadmium are environmental contaminants of special concern because of their increasing presence in the environment (i.e. drinking water) and potential carcinogenic effects. Mercury and lead at levels observed in the environment are known to cause *neuro-developmental, or brain disorders*.

Endocrine disruptors are substances that interfere with *hormone development functions* in the body like embryonic development, sperm production, control of the menstrual cycle, the onset of puberty, and can cause cancers in hormone-dependent tissue. Breast and testicular cancers are increasing in Europe (breast cancers at 1-2% yearly according to a European Parliament report (2002/2279(INI)). The results of a study observing cancer incidence in a cohort of identical twins indicated that the environment one lives in, rather than genetics, is a better indicator of cancer.[9] This is echoed in the Breast Cancer Fund annual report, which claims almost half of all breast cancer cases are linked to the environment (their report is based on results from 350 scientific studies).[10]
The incidence of cancer in children in Europe is increasing 1% a year and it is a second cause of mortality.[11] Furthermore, we find a 1% yearly decrease in sperm count in areas polluted by chemicals and note there has been a decline in semen quality observed worldwide over the past 50 years.[12]

Air Quality: It is well established that asthmatic persons and particularly children, are sensitive to air quality. According to the WHO, *respiratory infections* worldwide account for 20% of mortality in children under five; *asthma* is the leading cause for child hospitalisation and the main reason for missing school. OECD member countries are reporting asthma epidemics related to air pollution and there has been a drastic increase in the incidence of asthma and allergies over the past 15-20 years in Europe.[13] The EEA/JRC report has estimated the societal cost of asthma in Europe to be approximately 3 billion Euros per year.

Climate Change: Links between health and climate change are increasingly identified including increase in *heat-induced deaths* (especially for children and the elderly) and the spread of *vector-borne pathogens*, e.g. malaria. 35,000 heat-induced deaths in Europe were registered during the 2003 heat wave and the EU has created a stakeholder group on climate change to look specifically at the health impacts and adaptation strategies required.

Noise: According to the EEA/JRC report, this is an environmental factor that affects a substantial amount of Europeans (although the extent that people are affected is not yet fully understood). Transport (road, rail, and air traffic) are the most important sources of community noise, and due to increasing transport demands, there is an increase in peoples duration of exposure.[14] The main associated health risks of noise include *annoyance, interference* with social behaviour and speech communication, and *sleep disturbance* which has multiple consequences, including *stress*, which can have *cardiovascular effects, hormonal fluxes,* and *poor performances at school or work*.

Nanoparticles: There is also rising concern with nanoparticles, materials at the scale of atoms, used in diverse personal care products (e.g. cosmetics, toothpastes, deodorants, shampoos), and medicines. Nanoparticles are able to pass through the blood and brain membranes because they are so small. There has been a lack of regulation and independent safety assessments on these particles despite a growing concern about their harm to consumers.[15]

Radiation: There are also health effects associated with exposure to radiation, both ionising (e.g. radio-active) and non-ionising (e.g. electromagnetic waves). This will be discussed in a separate WECF fact sheet.

Assessing the Economic Impact of the Environmental Burden of Disease

According to the WHO, investments in health lead to gains in economic productivity as well as savings in health-care costs and healthy life years lost.[16] Furthermore, children with better health can be expected to attain higher education levels and thus be more productive in the future.[17] This is an important outcome for economic aims and a knowledge-based society.

The estimated average cost of just one case of cancer, per person, per year can range from 1 million to 2 million Euros.[18] These costs include medical treatment and the value of lost output (productivity). If we consider there are almost 3 million new cancer cases yearly in Europe alone,[19] this can add up to 6 trillion Euros. These figures are staggering if we consider them in relation to the EU GDP. Concerning air pollution, the WHO estimated that the EU could save up to 161 billion Euros per year if they could reduce air-pollution deaths,[20] a figure comparable to the annual GDP of the Republic of Ireland.[21] Clearly, when trying to understand the environmental burden of disease the economic implications become important.
But how do we measure the state of health of a population? The most widely used method was developed by the WHO and is referred to as DALY, or Disability-Adjusted Life Years. It quantifies the amount of years of life lost due to premature mortality or disability.[22] If used with the concept of cost-effectiveness it can be a tool to judge which interventions to

improve health deserve priority. 1 DALY represents the loss of one year of equivalent full health, e.g. with 5 DALY someone who would otherwise live a healthy life to 65 would only live healthy to 60 given a certain factor.[23] DALY offers a single index which permits the comparison of the disease burden due to various environmental risk factors,[24] which makes environmental health problems generally comparable, their costs more visible, and provides a basis for targeted policy.
However, the WHO notes that their findings are based on the tradition of focusing on a single stressor at a time. This is not sufficient to give a complete view of the negative effects of environmental pollution on human health (remember, multi-causal aspects).
Still, a number of studies have been published in recent years estimating the economic impact of the EBD for some countries and the economic impact is significant.
The JRC and EEA plan to produce an extensive publication on the matter in 2007.

The Impact on Children, Our Future

Children suffer a disproportionate share of the environmental burden of disease. According to the WHO, globally the number of healthy life years lost due to environmental risk factors is approximately 5 times greater in children under five years than in the total population.[25] It should also be noted that women also are particularly affected by the disease burden. They usually take the role of caretaker when there is illness in the family and also have a unique vulnerability of their reproductive organs.

Based on an assessment by the Health and Environment Alliance (HEAL), the special vulnerability of (unborn) children, particularly males in the womb, to environmental degradation stems primarily from three factors:[26]

- Per unit of body weight, children are more heavily exposed to environmental hazards; they drink more water, eat more food, breathe more air, and absorb more toxins than adults. Young children often crawl and frequently put their hands and other objects into their mouths.
- Children are open to longer term risks because of early exposure, particularly before birth, or continual exposure. They may develop chronic diseases that take decades to appear.
- Children are more susceptible to long term and inter-generational effects of bio accumulation. Toxics are stored up in the mother and passed to children via the placenta and breast feeding (it should be noted that approximately 350 chemicals have been identified in breast milk, making this essential nutrition for babies the most chemically contaminated food on the planet[27]).

Based on a WHO bulletin, "Investing in Children's Health: What are the Economic Benefits," we know that poor health during children's early years is likely to permanently impair them over the course of their life.[28] When considering a child's brain development, elaborate studies on a small number on industrial chemicals (i.e. lead, methyl-mercury, polychlorinated biphenyls, arsenic, and toluene) have shown that exposure to such substances during the prenatal phase can cause neuro-developmental disorders, at levels much lower than those affecting adults.[29] In this recent study, Professors Grandjean and Landrigan have identified more than 200 chemicals with neuron-toxic properties. Neuro-developmental disorders, such as mental retardation, attention deficit disorder, cerebral palsy, and autism are common, costly and can cause lifelong disability. Clearly, it is not only the health of our children we should worry about, but their future health as adults. The Standing Committee of European Doctors adopted a policy stating that "chemical pollution poses a serious threat to children and the human race."[30] Though seen as an excessive conclusion by some, globally declining sperm counts and shifts in girl/boy birth ratios give rise for concern; research shows endocrine disrupting chemicals can cause such effects. Beyond this present danger is a future one as well. Research published in Sept. 2006 from a group at Washington State University suggests that environmental pollution can permanently reprogram genetic traits in a family line.[31] After exposing rats to certain environmental toxins it was observed that the effects were seen for generations, even when the affected rats were paired with healthy ones. According to the leading scientist,
A human analogy would be if your grandmother was exposed to an environmental toxicant during mid-gestation, you may develop a disease state even though you never had direct exposure, and you may pass it on to your great-grandchildren.

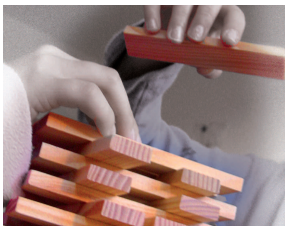
WECF Point of View

A new scientific paradigm is evolving in the field of environmental health. Research developments demand that a multi-causality approach be used to better understand the reality of the environmental health link, and the results from recent studies are alarming. A surge in scientific and political conferences around these issues indicates a stirring awareness.

According to the European Voice EU-wide Citizen Survey (May 2006), the environment was the top desired priority for the EU, and 88% of Europeans said the environment should be taken into consideration when making decisions in areas such as economic policy (Eurobarometer 217, 2005). That same Eurobarometer said the main environmental concern of EU citizens for which they feel they lack information is the impact on health of chemicals in everyday products. Recent scientific findings show that citizens have good reason to be concerned.

In times of economic stagnation the political focus is understandably on economic growth. However, Lisbon Agenda proponents and various European Union documents clearly reinforce the notion that a healthy population boosts a healthy economy. We also know that investments in health, especially for children, can give even better long term financial returns than investments in education (although the latter is also important).[32]

In light of new findings about the impact of the environment on our health, we can no longer neglect to address these matters, for ethical, social and economic reasons.




WECF provides the following recommendations:

- There is more than sufficient evidence suggesting a substantial link between our environment and our health, and this link has been underestimated. Based on the seriousness of the recent scientific findings we cannot afford to wait with policy measures; action must be taken on the basis of the **precautionary principle**, a principle grounded in the European Treaty. Clear and convincing examples of when the precautionary principle could have been applied are described in the EEA Report, "Late Lessons and Early Warnings: the Precautionary Principle 1896-2000." The first warnings of asbestos came in 1898, and CFCs in 1974, yet it was decades before real preventative action was taken. To date there have been no real cases of false positives and the costs of remedial action always exceed preventative ones. [33]

- Policy interventions must have a **synergistic and multi-sectoral approach**, originating from the environment and health domain, but also spanning the energy, transport, urban planning and education sectors. Health should be integrated into all policies.

- There is an urgent need for policy intervention aimed specifically at reducing **exposure of (unborn) children** to environmental pollutants.

- In order to guide policymaking, governments and public agencies need solid estimates of the costs and benefits associated with the EBD and **further research** into the environment-health link as a whole. Proper **finances** must be appropriated for this, but continuing research must not be an impediment to action now (the precautionary principle must lead).

WECF believes a healthy environment is a prerequisite for the healthy development of every human being, and that a healthy society is a productive one. Tackling the environmental effects on health has the opportunity to create a win-win-win situation, benefiting the environment, society, and the economy.

1 *EEA/JRC Report (2005), "Environment and Health" no. 10/2005.*
2 *Gee, D. referencing Rothman, K (2002), "Epidemiology: an introduction," p. 13.*
3 *COM (2004) 416, see also QA on European Health and Environment Action Plan 2004-2010 (memo 04/143) (2004).*
4 *Statement made during Expert Workshop on the Environmental Burden of Disease (2006), Brussels.*
5 *Confounders are hidden variables in research that (potentially) distort the data in question (e.g. Dioxin causes in-utero growth delays, but a confounder is smoking, which has the same effect, and thus must be accounted, or corrected for. With multiple exposures, e.g. chemicals, a chemical may be noted as a confounder when it is actually a co-causal factor.*
6 *See also WHO/IPCS (2002), "State of the Science of Endocrine Disruptors."*
7 *Agood example of this is the case of air quality and the question of acceptable particulate matter (PM). There were attacks on the scientific integrity of the findings and a slogan emerged – the PM panic machine – that obscured findings on air pollution and health. Fortunately the cost/benefit ratio of reducing particulate air pollution was large, making a good economic case for action.*
8 *See, amongst others, Gee, D. (2006), "Children's health, multi-causality, and the precautionary principle."*
9 *Lichtenstein et al, (2000), "Environmental and Heritable Factors in the Causation of Cancer." See also Czene, et al (2002).*
10 *Breast Cancer Fund US (2006), "State of the Evidence."*
11 *International Association for Cancer Research (IARC). Steliarova-Foucher, et al (2004), The Lancet (364).*
12 *Carlsen E., et al (1992), British Medical Journal 305. See also van Waeleghem, K., et al (1996), Human Reproduction 112.*
13 *EEA/WHO Regional Office for Europe. Tamburlini, G. et al, (2002). "Children's health and environment: a Review of evidence." pp. 44–47.*
14 *RIVM Report. Knol, AB., Staatsen, BAM. (2005), "Trends in the environmental burden of disease in the Netherlands: 1980-2020."*
15 *See, amongst others, Friends of the Earth (2006), "Small Chemicals, Big Risks."*
16 *WHO Bulletin. Belli, et al (2005), "Investing in Children's health: what are the economic benefits?"*
17 *DG Health and Consumer Protection (2005), "The contribution of health to the economy in the European Union," pg. 12.*
18 *European Trade Union Confederation-ETUC (2006), based on a report by Risk & Policy Analysts- RPA (2003), "Assessment of the impact of the new chemicals policy on occupational health." (report prepared for European Commission DG Environment).*
19 *International Agency for Research on Cancer-IARC (2005), Press Release, n. 159.*
20 *WHO Press Release (2005), EURO/08/05.*
21 *European Lung foundation, <http://www.european-lung-foundation.org/index.php?id=16>*
22 *In DALY calculations, the number of people with a certain disease is multiplied by the duration of the disease (or loss of life expectancy in cases of morality) and the severity of the disorder (0 for perfect health to 1 for death).*
23 *Environmental risk factors identified by WHO include unsafe drinking water, sanitation and hygiene, urban air pollution, indoor smoke from solid fuels, lead, climate change, the housing environment, traffic and transport incidents. There are also selected occupational risks which include pesticides, heavy metals and carcinogens.*
24 *WHO (2006), "Quantifying environmental health impacts."*
25 *WHO (2006), "Preventing Disease through Healthy Environments: Towards an estimate of the environmental disease burden."*
26 *HEAL (formerly EEN) Policy Paper (2004), "Children's special health vulnerability to environmental hazards and REACH."*
27 *WWF (1999), "Chemical Trespass: A Toxic Legacy." See also Noreen, K., Mieronyte, D. (1998).*
28 *WHO Bulletin. Belli, et al (2005), "Investing in Children's health: what are the economic benefits?"*
29 *Grandjean, P., Landrigan PJ. (2006), "Developmental neurotoxicity of industrial chemicals" The Lancet (368).*
30 *<http://cpme.dyndns.org:591/adopted/CPME_AD_Brd_030905_100_EN.pdf>. See also the UNESCO Paris Appeal.*
31 *Skinner, et al (2006), "Transgenerational epigenetic imprinting of the male germ-line by endocrine disruptor exposure during gonadal sex determination." Endocrinology (147).*
32 *WHO Bulletin. Belli, et al (2005), "Investing in Children's health: what are the economic benefits?" See also, DG Health and Consumer Protection (2005), "The contribution of health to the economy in the European Union."*
33 *EEA (2002), "Late lessons and early warnings: the precautionary principle 1896-2000."*

WECF Women in Europe for a Common Future

is a Network of 78 Organisations in 31 Western and Eastern European countries, the Caucasus and Central Asia, working on sustainable development, health and environment, and poverty reduction.

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