



Environment and Health

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Environment and health matters for Europe

A significant number of health problems can be attributed to environmental factors, which range from chemicals and food, to housing quality and noise. For example, a major 2004 WHO study reported that one third of disease children and adolescents in the European Region stems from just five environmental risk factors.

High quality research is needed to underpin policies designed to influence the environmental factors that affect our health. This issue reports on some of the latest research which points the way to robust health and environment policies and helps evaluate their impact.

The impacts of climate change are far-reaching, and scientific information about its possible health effects is emerging. The article 'Link between climate change and child health: call for more research' highlights the sensitivity of children to the environment, while 'Managing infectious disease under climate change' discusses how to protect Europe's health in a changing planet.

Research into the effects of air pollution on health remains critical. Often overlooked are the health impacts of indoor air pollution; these are investigated in 'Levels of several air pollutants are higher indoors than outdoors', 'New compilation of research on indoor industrial air pollutants' and 'Air pollution policy must be based on indoor and outdoor sources'.

We must also take care not to overlook air pollutants other than particulate matter (PM). Problems associated with some of these, such as persistent organic pollutants (POPs), are discussed in 'Unregulated pollutants may cause health risks in Western Balkans'.

Resistance to antimicrobials, such as antibiotics and disinfectants, is a major cause for concern – both for our health and the environment. This issue is explored in 'Are bacteria becoming more resistant after biocide exposure?' and 'Reducing environmental pollution by antibiotics to curb drug resistance'.

To assess and manage environmental health risks, such as those explored in this issue, human biomonitoring can be hugely valuable. Work on a European human biomonitoring programme is underway, and much can be learned from experiences and expertise in individual countries. Germany has the most extensive experience of human biomonitoring in Europe and some of its latest work is reported in 'Changes in background exposure to pollutants for German children'. Biomonitoring also brings ethical and communication challenges. 'Human biomonitoring: involve participants in communication strategy' highlights some new approaches in this field.

The European Commission recognises the complexity of environment and health issues. In 2003, the European Commission adopted a European Strategy on Environment and Health, followed by the European Environment and Health Action Plan 2004-2010 in 2004, which proposes an integrated information system on environment and health as well as a coordinated approach to human biomonitoring in Member States. Further driving the environment and health agenda in Europe is the upcoming WHO/Europe Fifth Ministerial Conference on Environment and Health, which puts children at the centre of concern.

Ludwine Casteleyn, MD

Katholieke Universiteit Leuven (University of Leuven), Belgium

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A selection of recent articles from the *Science for Environment Policy News Alert*.





Link between climate change and child health: call for more research

Contact: yoko_akachi@post.harvard.edu
Theme(s): Climate change and energy, Environment and health

“Research indicated that children are more likely to die during floods and suffer from pneumonia and diarrhoea during droughts.”

UN researchers highlight the need to develop better ways to measure the impacts of climate change on children’s health. They suggest more attention be given to impact analysis of different social groups and ages, as well as nutrition.

There is existing evidence that children are particularly vulnerable to climate change, especially in developing countries. Little research, however, has been done to measure the specific impacts on children’s health, particularly in developing countries where children are disproportionately prone to health problems, including those caused by the impacts of climate change.

The new review of literature published up until 2009 summarises what is currently understood about global climate change and its link to child health.

Between 1990 and 2000, 66.5 million children were affected each year by natural disasters such as floods, droughts and extreme heat and cold. Research indicated that children are more likely to die during floods and suffer from pneumonia and diarrhoea during droughts. Safe water and sanitation is associated with physical growth and learning ability, while unsafe water and poor sanitation has been associated with increased infection.

Climate change may increase pollutants such as nitrogen dioxide, ozone and particulate matter (PM), which have been linked to increases in allergic diseases and asthma, especially among children. Children’s lungs are particularly vulnerable as they are not fully developed and children tend to spend more time outside. Fatal diseases, such as malaria and dengue fever, are sensitive to climate and children are more susceptible to these because of lower immunity. The World Health Organisation (WHO) indicated that 75 per cent of malaria deaths occur in children under 5 years.

One of the major consequences of climate change will be lack of food. The relationship between disease and malnutrition goes both ways: disease has an impact on nutrition and under-nutrition increases the risk of disease. Furthermore, unsafe water, disease and malnutrition will be exacerbated by migration caused by climate change.

The review highlighted several gaps in our knowledge of this area. Indicators of children’s environmental health (CEH) need to be developed to measure the impacts of climate change on health and develop policy. Five categories have been identified: physical injuries, food and water-borne diseases (diarrhoea), respiratory diseases, vector-borne diseases (vectors are typically arthropods, such as mosquitoes and ticks) and perinatal diseases (conditions which affect babies around the time of birth).

The study calls for the additional inclusion of malnutrition as a CEH indicator. It suggests governments assess existing health information, identify gaps and use effective CEH indicators once they have been tested. The study also proposes that CEH indicators be integrated into school and education.

Source: UNICEF Innocenti Discussion Paper IDP No. 2009-03. (2009). Global Climate Change and Child Health: A review of pathways, impacts and measures to improve the evidence base. Available to download from: www.unicef-irc.org/cgi-bin/unicef/Lunga.sql?ProductID=560



Managing infectious disease under climate change

Contact: jan.semenza@ecdc.europa.eu
Theme(s): Climate change and energy, Environment and health

“It is envisaged that the European Environmental and Epidemiology (E³) Network will act as a central hub for information, surveillance and technical support.”

Health experts have called for a proactive, joined-up approach to public health in Europe under a changing climate. A recent study has examined the evidence for the influence of the climate on infectious disease and proposes a new integrated network for environmental and health data. .

The impacts of climate change on health in Europe could be considerable, and include deaths and injuries resulting from heat waves, blizzards and floods. It could also lead to changes in the incidence and spread of infectious diseases through impacts on the agents or pathways which transmit disease, such as arthropod vectors (for example, mosquitoes and ticks), rodents, food, water and air.

Although the researchers conclude that there is still much uncertainty, by assessing what is currently understood about the climate's effects on a wide range of infectious disease, they provide information to help guide adaptation and public health strategies.

For instance, it is understood that some arthropod vectors are shifting their geographical range in line with rising temperatures. This introduces illnesses to new areas, such as Lyme disease, carried by ticks which have progressively moved into more northern parts of Sweden and more mountainous areas of the Czech Republic. This illustrates the importance of integrated meteorological, ecological and health surveillance.

Pest control could become more important. Rodent populations grow rapidly under increasingly common, warm, wet winters and springs, and heat waves can drive rodents indoors creating greater risk of human contact. This in turn increases the risk of transmission of diseases, such as hantavirus, which can cause kidney failure. Plague, spread by rats, could even return under a new favourable climate in central Asia, posing a threat to eastern Europe.

Water managers also need to play a greater public health role. For example, extreme weather can damage ageing water treatment and distribution systems, encouraging the spread of diseases, including campylobacter, through drinking water. Warmer conditions may also favour cholera, which can spread through flooding. Improvements in infrastructure and environmental protection can avoid these negative health consequences of climate change.

Food poisoning caused by temperature-sensitive bacteria, such as *Campylobacter* spp and *Salmonella* spp, could also become more prevalent. However, this could be limited by appropriate food handling and storage. Effective food safety campaigns and regulations will therefore be important.

On the basis of the evidence cited in this analysis and expert consultation, a new infrastructure has been proposed by the EU's European Centre for Disease Prevention and Control¹ to address the multidisciplinary and complex nature of managing the impacts of climate change on disease. Called the European Environmental and Epidemiology (E³) Network², it is envisaged that it will bring together data from a variety of sources and act as a central hub for information, surveillance and technical support.

Source: Semenza, J.C., Menne, B. (2009). Climate change and infectious diseases in Europe. *The Lancet Infectious Diseases*. 9(6):365-375.

1. See: <http://ecdc.europa.eu>

2. See: http://ecdc.europa.eu/en/healthtopics/Pages/Climate_Change.aspx



Levels of several air pollutants are higher indoors than outdoors

Contact: dimitrios.kotzias@jrc.it
Theme(s): Air pollution, Environment and health

“In all locations studied the concentrations for aldehydes were up to 7-8 times higher inside buildings than outside. Formaldehyde has recently been declared a human carcinogen.”

New European research finds that the levels of several harmful air pollutants are greater indoors than outdoors, and even greater when measured on the person themselves. The measured levels of benzene are especially concerning and often indicate higher exposure than what is normally associated with the annual EU limit value set for ambient air quality.

The European Environment and Health Strategy¹ recognises the importance of indoor air pollution. As part of several EU-funded research projects, the European Indoor Air Monitoring and Exposure Assessment Project (AIRMEX), has identified the main culprits and mapped their geographical distribution.

The AIRMEX study monitored indoor, outdoor and individual exposure to selected chemical compounds (aromatics, carbonyls, terpenes and other Volatile Organic Compounds (VOCs)) across Europe. A total of 991 samples were taken from public buildings, schools/kindergartens, individual volunteers and the homes of those volunteers.

Generally, the total VOC concentrations inside public buildings were higher than outdoor concentrations. The levels of VOCs showed a seasonal variation and were higher in colder months. The same trend was seen in kindergartens and schools and in most cases average levels of VOCs were twice as high indoors as outdoors. The exposure of individual volunteers was higher than average exposure to indoor concentrations and associated with smoking.

Benzene was of particular interest and concern as it is known to have cancer-causing effects. For this pollutant, 18 per cent of outdoor concentrations, 23 per cent of indoor concentrations and 30 per cent of concentrations measured on people exceeded the ambient air limit (5 microgrammes per cubic metre-annual mean) established in the European Union (Directive 2000/69/EC)².

In all locations the concentrations for aldehydes were up to 7-8 times higher inside buildings than outside. This is particularly relevant for formaldehyde which has recently been declared a human carcinogen. Indoor levels of aldehydes increased in warmer months, particularly formaldehyde.

To identify the source of indoor pollution the study examined the ratio of indoor to outdoor pollution of VOCs. This indicated that although benzene had important indoor sources, such as cigarette smoke, it mainly originated from sources outdoors. However, other VOCs and carbonyls had additional sources within homes, such as flooring and furniture.

The researchers examined the impact of two mixtures of chemicals on human lung cells. The mixtures comprised different fractions of benzene, toluene, ethylbenzene and xylenes. Results indicated that the presence of toluene in air containing VOCs enhances immune system responses, such as inflammation. This suggests that chemical compounds interact and effects may change depending on the other chemicals present.

Source: Kotzias, D., Geiss, O., Tirendi, S. *et al.* (2009). Exposure to multiple air contaminants in public buildings, schools and kindergartens – the European indoor air monitoring and exposure assessment (AIRMEX) study. *Fresenius Environmental Bulletin*. 18(5a): 670-681.

1. See http://ec.europa.eu/environment/health/action_plan.htm
2. Directive 2000/69/EC of the European Parliament and of the Council of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air. See: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0069:EN:HTML>



New compilation of research on indoor industrial air pollutants

Contact: Carmen.garcia.jares@usc.es
Theme(s): Air pollution, Environment and health

A recent analysis of indoor industrial air pollutants could be useful for implementing REACH (Registration, Evaluation and Authorisation of Chemicals)¹. Implementation of REACH should be based on sound analytical methods and targeting of priority chemicals, according to the researchers.

“People in developed countries spend up to 90 per cent of their time indoors where they come into contact with many airborne pollutants.”

Indoor air can be contaminated by a wide range of industrial air pollutants, from volatile organic compounds (VOCs) to endocrine disrupting chemicals. People in developed countries spend up to 90 per cent of their time indoors where they come into contact with many of these airborne pollutants. To add to the problem, the concentration of indoor pollutants could be increasing due to improved insulation and reduced ventilation.

The study examined the methods used to establish the levels of chemicals found in indoor air that are known to pose a risk to health. It also summarised the current knowledge of these levels. This could prove useful to those involved in evaluating substances and managing their risk for REACH. The chemicals include:

- Volatile organic compounds (VOCs) are emitted from products such as paints, cleaning supplies and building materials. They cause symptoms such as headaches and eye irritation and some are suspected of causing cancer. Their levels have been measured in a range of indoor environments and their concentration tends to increase in winter.
- Carbonyls found indoors are mainly aldehydes emitted from building materials and furniture. They are suspected of causing cancer and genetic mutations and have been detected in residential homes and workplaces.
- Polycyclic aromatic hydrocarbons (PAHs) are among the most concerning pollutants. Major sources are industrial processes, vehicle exhausts and waste incineration. They are carcinogens and mutagens, highly persistent in the environment and have been found in residential homes.
- Polychlorinated biphenyls (PCBs) are probable carcinogens and are long-lasting in the environment. Recent findings suggest that indoor air – possibly through fluorescent lighting and plasticizers – is a major source of PCBs.

Recently a number of additional industrial substances have emerged as indoor pollutants. Phthalate esters are used as softeners in production of PVC and are present in building materials. Brominated flame retardants are also present in many common products, as well as organophosphate esters. Synthetic musk fragrances are added to toiletries and household products. All these chemicals have been found in a range of indoor environments. In addition, there is increasing attention to the presence of pesticides indoors.

Lastly the study summarised research on the analysis of pollutants in indoor dust and suspended particulate matter (PM). Inhalation, skin contact and ingestion of dust have been recognised as sources of exposure, especially for crawling children. Research indicated that the majority of air pollutants considered are present in indoor dust.

Source: Barro, R., Regueiro, J., Llompart, M. and Garcia-Jares, C. (2009). Analysis of industrial contaminants in indoor air: Part 1. Volatile organic compounds, carbonyl compounds, polycyclic aromatic hydrocarbons and polychlorinated biphenyls. *Journal of Chromatography A*. 1216:540-566.

And:

Garcia-Jares, C., Regueiro, J., Barro, R., Dagnac, T. & Llompart, M. (2009). Analysis of industrial contaminants in indoor air. Part 2. Emergent contaminants and pesticides. *Journal of Chromatography A*. 1216:567-597.

1. See: http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm



Air pollution policy must be based on indoor and outdoor sources

Contact: brody@silentspring.org

Themes: Air pollution, Environment and health

“The research results have supported community efforts to block permits for a nearby oil refinery.”

New research reveals that indoor air pollution is an important indicator of the impact of emissions from an oil refinery on nearby communities. It suggests policies based on outdoor monitoring alone are not sufficient to safeguard health, especially with regards to breast cancer.

The EU Environment and Health Action Plan¹ has identified indoor air pollution as one of its 13 actions. It aims to understand better the link between indoor air quality and health and establish how exposure to pollutants influences various health conditions.

The research was designed on the basis of community health concerns and aimed to inform policy. It studied levels of exposure to a wide range of pollutants, particularly those that are thought to contribute to breast cancer. Dust and air samples were taken from inside and outside 40 homes in an American community that was neighbouring an oil-refinery (fence-line community or FLC). The samples were compared with those taken from 10 homes in a non-industrial community (NIC).

80 compounds were detected outdoors in the FLC and 60 in the NIC. Concentrations in the FLC were generally higher and, compared with previous figures, the levels of nickel and vanadium were among the highest in the state (California). These are known to come from heavy oil combustion and are some of most harmful components of PM_{2.5} (particulate matter less than 2.5 micrometres in diameter).

The study analysed the relationship between indoor and outdoor air pollution. The level of pollutants indoors was much higher than outdoors, indicating that environmental assessments based on outdoor air pollution may be inadequate. Although the air quality standard is not intended to be applied indoors, nearly half of the FLC homes exceeded California's regulations for PM_{2.5}.

Further analysis on the relationship between outdoor and indoor levels indicates that pollutants are penetrating indoors. Examples are sulphates, vanadium and selenium. However, the source of indoor endocrine disrupting compounds (EDCs), particularly di-n-butyl phthalate, is more likely to be from consumer products. Previous research has associated EDCs with breast cancer.

The study is limited by its small sample size and that it sampled each home only once. However, the results suggest that monitoring of both indoor and outdoor air is important and that greater consideration should be given to the impact of local pollution sources on communities. The research was community-based and involved participants in the design. Its results have supported community efforts to block permits for a nearby oil refinery.

Source: Green Brody, J., Morello-Frosch, R., Zota, A. *et al.* (2009). Linking Exposure Assessment Science with Policy Objectives for Environmental Justice and Breast Cancer Advocacy: The Northern California Household Exposure Study. *American Journal of Public Health*. 99(S3): 600-609.

1 See http://ec.europa.eu/environment/health/action_plan.htm



Unregulated pollutants may cause health risks in Western Balkans

Contact: cupr@recetox.muni.cz

Themes: Air pollution, Environment and health

“Most contamination was in Bosnia and Herzegovina and it is suggested that it could be caused by non-regulated burning of waste, wood and other fuels.”

Several pollutants that are not covered by UN regulations could be harmful to humans, according to new research in the Balkans. By sampling air at various urban sites, the research showed that polycyclic aromatic compounds (PAHs) have the potential to be a major health risk.

The UNEP Stockholm Convention¹ regulates emissions of Persistent Organic Pollutants (POPs). These are carbon-based chemicals, such as polychlorinated biphenyls (PCBs), that remain in the environment and accumulate in the fatty tissue of humans and wildlife. However, the Convention does not include a number of other potentially harmful organic substances, especially PAHs which are produced by incomplete burning of fuels and can cause cancer, developmental and reproductive problems.

The former Yugoslavia has limited information on air pollution, despite possible contamination from damaged industrial sites during the Balkan war conflicts in the late 1990s. A new EU-supported study, conducted under the APOPSBAL project², assessed the contribution of several classes of toxic compounds to human health risks: PCBs, PAHs and organochloride pesticides (OCPs). Researchers collected 127 samples and the assessment of health risk was based on exposure levels and carcinogenic effects of pollutants.

Results indicated that Croatia had the lowest overall health risks and Bosnia and Herzegovina the highest. With just one exception, all locations in Bosnia and Herzegovina reached or exceeded a significant risk level. PCBs posed a risk, particularly when bound to particles. Particulate PCBs are thought to be released from contaminated soils and buildings. PCB levels were significantly higher in the Serbian town of Kragujevac where a car factory is based.

However, the majority of human health risk in urban areas was associated with PAHs, predominantly when bound to particles. Between 83 and 94 per cent of total health risk was accounted for by pollutants bound to particles and PAHs were responsible for 99 per cent of this risk. Most contamination was in Bosnia and Herzegovina and it is suggested that it could be caused by non-regulated burning of waste, wood and other fuels. In comparison to the other two classes, OCPs do not represent a significant risk to human health in the western Balkans.

Data were collected between May and June, which is the season with lowest emissions from combustion sources. Using a different sampling technique, contributions to health risks were estimated for the winter months. This indicated that PAH related human health risks increased by several orders of magnitude between summer and winter months.

The researchers highlighted several uncertainties in their results. For example, the sampling procedure at different times over 24 hours may not ensure typical samples. Nevertheless it indicates that the health risks posed by PCBs may be underestimated in the Western Balkans.

Source: Bartoš, T., Čupr, P., Klánová, J. & Holoubek, I. (2009). Which compounds contribute most to elevated airborne exposure and corresponding health risks in the Western Balkans? *Environment International*. 35:1066-1071.

1. See <http://chm.pops.int/>

2. APOPSBAL was supported by the European Commission under the Fifth Framework Programme. See www.recetox.muni.cz/projekty/apopsbal/index.php



Are bacteria becoming more resistant after biocide exposure?

Contact: maillard@cardiff.ac.uk

Themes: Chemicals, Environment and health

“Standard risk assessment methods are urgently needed for the use of biocides in real-life situations, according to the scientists.”

Researchers have raised concerns that an increase in the use of biocides could reduce their effectiveness and, in some cases, may lead to the development of antibiotic resistant bacteria. Standard risk assessment methods are urgently needed for the use of biocides in real-life situations, according to the scientists.

Biocides are chemical agents used to kill or control the growth of living organisms, including bacteria. Biocide products are used as surface disinfectants to clean bathrooms and kitchens, for water treatment, as antiseptics on skin and as preservatives in cosmetics, canned food or on wood, for example. They are found in personal care products, such as shampoos and soaps, in domestic and healthcare settings, industry and in animal care. When applied correctly, biocides are effective in controlling contamination, spoilage and infection.

In the EU, the Biocide Directive¹ is concerned with the placing of biocidal products on the market. The Directive contains a list of active substances, which have been tested for use in authorised products in the Member States. Although the use of biocides is widespread and increasing, there is little information on the total amounts of biocides used in the EU.

Of major concern is the emergence of resistance to biocides and the possibility that disease-causing bacteria will develop resistance to antibiotics following exposure to biocides. Laboratory experiments have identified some of the different mechanisms bacterial cells use to develop resistance; many of these mechanisms depend on reducing the amount of biocide reaching the target areas of the bacterial cells, for example, by pumping out the biocide from the bacteria.

In addition, bacteria frequently occur as part of complex microbial communities, or ‘biofilms’, attached to surfaces. These biofilms have their own resistance characteristics, making them more difficult to eradicate by biocides or antibiotics, creating further opportunities for bacteria to develop resistance.

Although laboratory experiments have demonstrated mechanisms by which bacteria exposed to biocides develop resistance, there are comparatively few studies on emerging resistance in medical or environmental settings. For example, early studies report the development of bacterial resistance to wound dressings containing silver compounds, which have antimicrobial properties.

Unfortunately, there is no general consensus in the methodologies used to determine resistance to biocides, whereby the minimum amount of a biocide needed to stop bacteria growing is often determined, whereas in practice, much higher concentrations are often used.

Therefore, to more accurately assess how the widespread use of biocide products could reduce the effectiveness of biocides and alter the susceptibility of disease-causing bacteria to antibiotics, the researchers call for risk assessment protocols to be established that are based on the conditions under which biocide products are used and on the likelihood of bacterial exposure.

Source: Maillard, J-Y., Denyer, S.P. (2009). Emerging bacterial resistance following biocide exposure: should we be concerned? *Chimica Oggi/Chemistry Today*. 27 (3): 26-28.

1. See: <http://ec.europa.eu/environment/biocides/revision.htm>



Reducing environmental pollution by antibiotics to curb drug resistance.

Contact: jlmtnez@cnb.csic.es
Themes: Environment and health

“There is a risk that bacteria found naturally in the environment will develop resistance to antibiotics commonly used to treat human diseases.”

Widespread use of antibiotics to prevent and treat infections in people and animals as well as for promoting growth in livestock is causing environmental contamination. A new study highlights the need for extra measures to reduce environmental pollution from antibiotics. Such pollution can increase the risk of diseases caused by bacteria that become resistant to antibiotics.

Over recent decades large amounts of antibiotics have been released into the environment, but little is known about the effects of these antibiotics on microbes living in natural habitats. The antibiotics are released into the environment when they are excreted along with body wastes and pass into water systems, the soil and sewage treatment plants.

Since bacteria can develop resistance to antibiotics and this resistance can be passed on to other bacteria, there is a risk that bacteria found naturally in the environment will develop resistance to antibiotics commonly used to treat human diseases. This resistance can in turn be passed on to bacteria that cause diseases in humans and animals, making it more difficult to control bacterial infections.

In addition to developing new resistance in natural microbial populations, antibiotics released into soil and water can change the composition and activity of local microbial communities. For example, antibiotics can reduce the numbers of naturally susceptible bacteria thus favouring the growth of resistant strains of bacteria.

Antibiotics break down at different rates in the environment. Over time, the concentration of antibiotic pollution in natural ecosystems diminishes, unless further contamination occurs. Some environments are repeatedly polluted, for instance, by hospital or farm discharges. Continued exposure to antibiotics is of particular concern in these environments as repeated exposure to low levels of antibiotics could promote resistance.

Although environmental bacteria can develop resistance to antibiotics under selective pressure, the same antibiotic resistance genes, already present in human bacterial pathogens, have been found in bacteria in environments where no pollution by antibiotics has occurred. This may occur because resistance genes can be maintained and spread in natural bacterial populations through gene transfer when bacteria reproduce and migrate to different ecosystems. This indicates that it may be difficult to eliminate pollution by antibiotic resistance.

A lack of reliable information in some countries makes it difficult to estimate the global extent of antibiotic use in veterinary medicine. This issue needs to be addressed as antimicrobial use in livestock and, increasingly, in fish farming is an important source of antibiotic contamination. In the EU, antibiotics used to treat human infections cannot be used to promote growth in livestock. However there has been an increase of the use of antibiotics for therapeutic purposes in animals.

It is suggested that water, sewage and other wastes polluted with antibiotics should be specifically treated for antibiotics before being released to the environment or used as fertiliser in agriculture.

Source: Martinez, J.M. (2009). Environmental pollution by antibiotics and by antibiotic resistance determinants. *Environmental Pollution*. 157: 2893–2902..



Changes in background exposure to pollutants for German children

Contact: christine.schulz-ch@uba.de and marike.kolossa@uba.de

Themes: Environment and health

Children are thought to be at greater risk from exposure to environmental pollutants than adults because their bodies are still developing and their lower body weight means that relative exposure is higher. A new study reports background exposure levels in German children aged 3-14.

“Compared with previous data, the measured concentrations of cadmium, lead and mercury in blood and urine had decreased and the reference values were adjusted to reflect this.”

Exposure to environmental pollutants can be measured by monitoring pollutants in the human body, known as ‘biomonitoring’. Germany has a long history of biomonitoring and its Human Biomonitoring Commission¹ has established reference values to assess exposure. A reference value indicates the upper level of background exposure (or exposure naturally present in the environment) of a certain pollutant for a certain population at a certain time. Due to changing environmental conditions, reference values need to be regularly updated.

Results from the German Environmental Survey on Children 2003-2006 (GerES IV)² on pollutant levels in blood and urine were used to update the reference values in Germany. The sample consisted of 1790 children living in 150 different locations in Germany.

Compared with previous data, the measured concentrations of cadmium, lead and mercury in blood and urine had decreased and the reference values were adjusted to reflect this change. The lower levels of these pollutants may be due to the control of industrial emissions, replacement of lead water pipes and limited use of amalgam fillings in children. Arsenic’s reference value remained the same and, for the first time, reference values were derived for antimony, nickel, thallium and uranium.

First-time reference values were also set for several compounds associated with the toxic effects of polycyclic aromatic hydrocarbons (PAHs). PAHs are produced by burning carbon-containing fuels and are carcinogenic. The data indicated there was a higher level of PAH exposure in eastern Germany probably due to higher air pollution from fuel and industry.

Three first-time reference values were established for compounds associated with the toxic effects of pesticides. In addition the reference values for two other pesticide-related compounds (DMP & DMTP) were lowered and reference values of three others (cis- Cl₂CA, trans-Cl₂CA & 3-PBA) were confirmed.

The research stressed that reference values are based on statistics and do not represent exposure limits above which the pollutants become toxic. They can be used to assess exposure of individuals or groups and classify them as “elevated” or “not elevated” compared with a general background exposure.

Work on a coherent approach for a harmonised HBM in Europe³ is progressing. The COPHES network⁴ to further implement HBM on the European scale commenced in December 2009.

Source: Schulz, C., Angerer, J. Ewers, U. *et al.* (2009). Revised and new reference values for environmental pollutants in urine or blood of children in Germany derived from the German Environmental Survey on Children 2003-2006 (GerES IV). *International Journal of Hygiene and Environmental Health*. Doi: 10.1016/j.ijheh.2009.05.003.

1. See www.umweltbundesamt.de/gesundheit-e/monitor/index.htm

2. See www.eu-humanbiomonitoring.org/

3. See www.umweltbundesamt.de/gesundheit-e/survey/us03/uprog.htm

4. COPHES is supported by the European Commission under the Seventh Framework Programme. See: www.eu-humanbiomonitoring.org/sub/news.htm



Human biomonitoring: involve participants in communication strategy

Monitoring the effects of chemicals in the human body provides useful data for assessing and managing environmental risks to health, but it also raises ethical questions about how the results of such studies should be reported to participants. New research suggests that changes are needed to the research process to allow study participants to play a greater role in interpreting, disseminating and using the results.

Contact: rmf@berkeley.edu
Themes: Environment and health, Environmental information services

“Participants may misinterpret general population exposure levels and averages as safety benchmarks, leading to distress if individual levels are above these thresholds.”

Assessing exposure to pollutants has shifted from monitoring pollutants in air, soil and water to human biomonitoring. Human biomonitoring involves measuring exposure in the human body by analysing blood, urine or breast milk, for example. However, there is little guidance for researchers on how to communicate exposure data to the study participants and some concerns have been raised about releasing data to participants.

The researchers interviewed 26 individuals involved in human biomonitoring studies in the US, including academics, scientists from environmental advocacy organisations and individuals who took part in research. The interviews suggested that there are currently three frameworks in which the results of human biomonitoring studies are reported to participants; these have been termed ‘clinical ethics’, ‘community-based participatory research’ and ‘citizen-science data judo’.

Researchers using a clinical ethics model assume that the decision about sharing research results with study participants should rest with the researchers. In contrast, community-based participatory research is based on the assumption that information should be shared equally between researchers and study participants; sharing results is seen to empower the study participants to make use of the data.

Citizen-Science Data Judo is used by advocacy groups to encourage study participants to pursue policy change as well as reduce individual exposure chemicals; study design and communication of results are shaped by the intended policy goals of the researchers.

Reporting data to study participants raises a number of issues. For example, some researchers may be prohibited from sharing data as a requirement of their funding. Another important issue is that participants may misinterpret general population exposure levels and averages as safety benchmarks, leading to distress if individual levels are above these thresholds.

The research also reported the importance of communication methods. A positive example is a pesticide study that, alongside the results, provided information on preventing pesticides from entering homes. Other communication efforts should address potential conflicts with existing public health practice. For example, some researchers worry that the dissemination of results from studies of polybrominated diphenylethers (PBDEs) in breast milk could cause mothers to wean earlier than intended despite the benefits of breastfeeding, although this issue has not yet been extensively studied.

The study highlights the need for guidance on how best to communicate results from human biomonitoring studies and suggests that study participants themselves need to be involved in the creation of these guidelines.

Source: Morello-Frosch, R., Green Brody, J., Brown, P. *et al.* (2009). Toxic ignorance and right-to-know in biomonitoring results communication: a survey of scientists and study participants. *Environmental Health*. 8:6 doi: 10.1186/1476-069X-8-6. This study is free to view at www.ehjournal.net/content/8/1/6



A selection of articles on Environment and Health from the *Science for Environment Policy News Alert*

Safety of sunscreen pigments comes under scrutiny (21/1/10)

A new study shows how titanium dioxide nanoparticles used in sunscreens may cause cancer in mice. Although there is no proof that the nanoparticles can cause cancer in humans, the researchers say the study raises concerns about the safety of workers exposed to high concentrations of the nanoparticles in factory settings.

Mapping human health risk in urban environments (26/11/09)

A new study demonstrates how mapping software can be used to analyse data on heavy metal soil pollution in an urban environment. The researchers incorporated land use information to gain realistic estimates of potential risks to human health that could help inform land use planning.

Congestion tax in Stockholm improved air quality and health (5/11/09)

An evaluation of the effects of a congestion tax trial in Stockholm, designed to reduce traffic levels, reveals that there was a decrease of 8.5 per cent in nitrogen oxide (NOx) emissions and of 13 per cent in coarse particle (PM10) emissions in the congestion zone. Improvements of this level could avoid 27 premature deaths due to road traffic emissions a year for Stockholm.

Living close to major roads may increase risk of rheumatoid arthritis (15/10/09)

People who live close to major roads with high levels of traffic pollution may have a greater risk of developing rheumatoid arthritis, according to a recent study. This has possible implications for town planners.

Does noise pollution weaken the immune system? (3/9/09)

Excess noise is a common cause of stress and its impact on health is a concern for environmental policy makers. An analysis of current research in this area raises the question of whether noise-induced stress could increase the likelihood of illness by weakening the immune system.

How can we manage the health impacts of climate change? (23/7/09)

Climate change is the greatest health threat of the 21st century, according to a recent report. It stands to threaten the health of people across the globe, with the world's poorest suffering the severest consequences, even though they have contributed least to the problem.

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