Umwelt Bundes Amt
für Mensch und Umwelt

German Environmental Survey for Children (GerES IV)

Introduction

The German Environmental Surveys (GerES) conducted have provided representative data about the exposure of the adult population and are thus contributing to the environment related health surveillance system envisaged by the German National Environment and Health Action Programme (www.apug.de).

To date, there are no representative data on contaminant levels in children in Germany aged between 3 and 5 years and in the households they live in. For children aged 6 to 14 years such data have been collected in GerES II (1990/92). However, these data need to be updated.

Children must be considered as a risk group for adverse health effects caused by environmental factors. This is due to their specific exposure-relevant behaviour patterns (hand-to-mouth contact, crawling, playing on the floor, playing with soil, and uptake of dust outdoors) and the specific characteristics of their physiology (higher rates of ventilation and resorption). Therefore in many cases, children experience a higher exposure to pollutants than adults. Their health is particularly at risk as a result of their higher relative exposure if body weight is considered. Since the organism of a child is still developing it is thought to be especially sensitive in the different phases of its development (inter alia, neurotoxic substances in the prenatal phase, endocrine substances in puberty).

The study parameters in the present survey of children (GerES IV) comprise substances known or suspected to cause adverse health effects at higher levels: neurotoxins (Pb, Hg); carcinogenic/cocarcinogenic substances (PAHs, benzene, halogenated volatile organic compounds, As, Cd); substances that cause disorders or irritation of the respiratory tract, allergies and asthma (indoor air pollutants, such as excrements of dust mites, pet allergens, fungal spores, volatile organic compounds, formaldehyde and carbonyls); substances that have a possible effect on development with potentially long-term consequences (such as PCBs). In addition, damage to hearing and stress caused by noise is being studied.

Using standardized interview-based questionnaires, details on behaviour patterns that are relevant to exposure, on the situation in the home and the immediate surroundings of the home, and on the environmental health situation of the children will be recorded. In addition, there will be question-naires and data sheets for the documentation of field measurements and the samples taken.

GerES IV is being conducted in cooperation with and linked to the Health Survey for Children and Adolescents (KiGGS) which is conducted by the Robert Koch-Institute. The Ethics Commission and the data protection officers concerned have consented to the project.

1   Aims of GerES for Children

One of the main aims of GerES is to generate, update, and evaluate representative data to facilitate an environmental health related observation and reporting of information at the national level. These representative data are also useful:

- as a basis for establishing reference values with regard to the levels of noise and environmental pollutants to which children and teenagers are exposed;
- to indicate trends over time and regional differences in contaminant levels;
- to identify and quantify contamination routes;
- to evaluate influences on children's health;
- to design and evaluate preventive, interventive and control strategies within the framework of policy measures related to health and environment.

2   An overview of the investigation programme

The investigation programme comprises the following components:

Human biomonitoring:
- **Whole blood**
  During the blood sampling conducted for the Health Survey, an additional collection tube (Blaukopf vacutainer containing the anticoagulant sodium heparin) are filled, as follows:
  - for children aged between 3 and 6 years with 2 ml (for lead, cadmium, mercury);
  - for children aged 7 to 14 years with 6 ml (for lead, cadmium, mercury and organochlorine compounds such as PCBs, DDE, HCB, HCH);
  - for all children five fungi-specific IgE in addition to a panel test in 200 µl serum.
- **Sample of morning urine** (total volume of urine)
  If diapers are no longer worn at night samples are taken in 750 ml "toilet inserts" (for girls possibly until the age of 6 years, in consultation with their parents). From the age of 5 years 1 l wide-neck polyethylene flasks are used. The pollutants analysed are:
  - for all children: creatinine, arsenic, cadmium, mercury, nickel, nicotine, cotinine;
  - for children from the age of 8 years: cortisol, adrenalin and noradrenalin;
  - in 600 randomly selected samples from children of all ages: pentachlorophenol (PCP) and other chlorophenols, metabolites of pyrethroids, organic esters of phosphoric acid and PAHs.

Noise, hearing and stress in children aged 8 to 14 years:
- **Hearing test** (screening/audiometry as set out in DIN ISO 8253, point 9).
- **Measurement of traffic noise** outside the window of a child's bedroom (short-term mean assessment level using an integrated class 3 sound level gauge as prescribed by IEC 804/DIN EN 60604).
- **Morning urine** (see above) for cortisol, adrenalin and noradrenalin.

Monitoring of the domestic environment (children aged 3 to 14 years)
- **House dust** (**vacuum cleaner bag** as found in the home at the time of the visit). Analysis of 600 randomly selected sieved samples (63µm) for biocides such as methoxychlorine, chlorpyrifos, propoxur, polychlorinated sulfonamide-diphenyl ether and DDT, HCH, HCB, PCBs and PCP as well as flame proofing agents and plasticisers (organophosphate esters and phthalates).

- **Drinking water samples** from tap water used for drinking and cooking (½ l and 1 l polyethylene flasks) are tested for elements that can get into the water from pipe material: lead, cadmium, copper, nickel and uranium.

Monitoring of the domestic environment of sub-collectives
- **Chemical pollutants in indoor air**
  (using passive OVM-3500 (3M) collectors, Perkin Elmer type diffusion collectors (PE) and UMEX-100 type collectors for volatile organic compounds such as benzene, and carbonyl compounds such as formaldehyde). Size of sample N = 600 of all ages.
  - Measurement of indoor air: collection period of 7 days;
  - Questionnaires (parents).

- **Biological pollutants in indoor air**
  using active measurements of air and dust to detect mould spores, house dust mites and pet allergens. Size of sample N = 600 of all ages.
  - Indoor air: mould spores, particles;
  - Floor dust: mould spores and Fel d 1;
  - Mattress dust: Der p 1 and Der f 1;
  - Serum samples: specific IgE (see above);
  - Interview-based questionnaire (parents).

Interviews and data sheets
- Standardized basic interview (parents).
- Standardized basic interview (children aged 8 to 10 years).
- Standardized basic interview (children aged 11 to 14 years).
- Standardized data sheets for documenting the immediate environment around the home.
- Standardized data sheets for documenting the samples (morning urine, drinking water, dust from vacuum cleaner bags, measurement of traffic noise, hearing test).

3   Study population (sub-sample of the Health Survey)

GerES IV will be conducted on randomly selected children from the cross-sectional sample (N=18,000) of the Health Survey for Children and Adolescents (KiGGS) carried out by the Robert Koch Institute.

The target population of the Health Survey are children and adolescents in Germany aged zero to 17 years registered in registration offices. Excluded are children living in institutions such as hospitals or children's homes. The GerES IV sample is drawn from this population in a multistage random sampling procedure (due to limited funding, it is not possible to study the entire sample of the Health Survey). The sub-sample comprises at least 1,800 net cases aged 3 to 14 years. In each of 150 sampling locations 12 children (one child of each one-year age group) are invited to take part. If the child and the parents agree, he or she will be included in the survey. If the answer is negative another child will be chosen. Due to limited funding, some parts of the survey programme will be carried out on only 600 children. In these cases, one child from each of the four age groups 3 to 5 years, 6 to 8 years, 9 to 11 years, 12 to 14 years will be randomly selected.

Differences in exposure between different groups of children are to be confirmed at a 0.1 % level of significance. Based on the knowledge gained in previous GerESs and the pilot study, it can be estimated that for a sample size of 1,800 children differences between geometric means larger

than 8 % (pollutants with a low variance) and larger than 20 % (pollutants with a high variance) will be significant. These values increase to 14 % and 38 %, respectively, for the sub-sample of N=600. Although in this case the sample size is considerably smaller it will be possible to confirm differences between groups at the 0.1 % level. If a 1 % level of significance is assumed the lowest difference between the geometric means of the groups will be 5 % and 16 % for the sample size of 1,800 children and 11 % and 29 % for the sample size of 600 children.

4   Field Work

The field work, which is conducted in cooperation with the Health Survey for Children and Adolescents, started in 2003 and will be finished in 2006. At each of the 150 sample points one of the three field teams will operate for two weeks. The quality of the field work is being monitored by a consultant.

5   Chemical analyses and quality control

All chemical analyses are carried out by external laboratories. Contractors are required to meet high standards in terms of precision and accuracy. The laboratories of the Federal Environmental Agency, which did the analytical work in previous GerESs, are part of the quality control system.

6   Evaluation of data

Primary steps before analysing the data are: checking and revising data, matching different data files, weighting (data have to be weighted according to the population characteristics like age, gender, community size and region).

The distributions of the substances in the different media are depicted for groups stratified by sampling characteristics (age, sex, size of town, former West-Germany/East-Germany) and important substance-specific variables. To describe the distribution the following statistical parameters will be given: sample size, percentage of values below the limit of quantification, 10th, 50th, 90th, 95th, 98th percentile, maximum value, arithmetic mean, geometric mean and the 95 % confidence interval for the geometric or arithmetic mean. The 95% confidence intervals of the 95th percentiles are calculated for the different subgroups. These values are the basis to derive reference values for children from the age of 3 to 14 years in Germany.

Exposure routes, environmental conditions and individual patterns of behaviour will be evaluated by systematic hypothesis testing for selected relevant substances only.

Using data of both surveys (the Environmental and the Health Survey) it will be possible to evaluate relations between environmental conditions and the health of the children. The following issues will be examined using multivariate methods:

- Allergies of the respiratory system (asthma, hay fever) due to the occurrence of mould spores, house dust mites or pet allergens.
- Allergies due to nickel and chromium (from, e.g., costume, jewellery, piercing) and scents (e.g., terpenes in indoor air).
- Impact of noise on hearing loss, stress and sleeping disturbances.
- Irritation of the eyes and the respiratory system due to formaldehyde, aldehydes, or VOC in indoor air.

7   Information of study participants

Participants are notified of their results, along with an evaluation and, if applicable, recommendations on how to minimise any strikingly high levels of exposure. For additional support and possible follow up examinations the participants will be advised to turn to an outpatient clinic for environmental medicine.

8   Reporting and use of results

The exposure situation of children (3 to 14 years) in Germany will be described in a status report. This report will include an overview of human biomonitoring data, stratified by exposure relevant characteristics, a comparison with threshold values and data from international studies, and an evaluation of exposure trends over time. This report will provide nationwide data for the evaluation of other exposure studies. It is planned to make the data available as a public use file by the end of 2007 after completion of the field work.

The basis for the evaluation of the data on human biomonitoring are the reference and human-biomonitoring values established by the Human-Biomonitoring Commission of the Federal Environmental Agency (www.Umweltbundesamt.de/uba-info-daten-e/daten-e/monitor/index.htm).

Chemical pollutants in indoor air are evaluated on the basis of the guideline values of the Commission on Indoor Air Hygiene of the Federal Environmental Agency. The German Drinking Water Ordinance is used for the evaluation of the drinking water samples.

Measurement of chemical pollutants in house dust is first of all a screening tool to get an insight into the general exposure situation. An interpretation of the data in relation to health effects is not possible. Study participants will only receive their results in the case of very high values.

The results of the screening-audiometry are evaluated on the basis of the accident prevention regulation relating to noise issued by the Employers' Liability Insurance Association and the recommendations of the „Soziakusis" committee of the Federal Environmental Agency. They will be handed over to the participants or their parents directly after the measurements have been completed.