

## **10296- APHEIS: Monitoring the Effects of Air Pollution on Public Health in Europe**

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**Objectives:** The Apehis programme aims to provide European decision makers, environmental-health professionals and the general public with comprehensive, up-to-date and easy-to-use information on air pollution (AP) and public health (PH) so they can make informed decisions about the political, professional and personal issues they face in this area. For this purpose, Apehis will deliver standardised, periodic reports based on health impact assessments (HIAs) in 26 cities in 12 European countries. We describe here the findings of the HIA conducted for our first report. **Methods:** Apehis centres have been created in all cities participating in the programme. Apehis adopted WHO guidelines for environmental-health risk assessment, and we developed our own guidelines for gathering and analysing data on AP and its impact on PH. Apehis has analysed the acute effects of fine particles (PM10 and BS) on premature mortality and hospital admissions using the estimates newly developed by the Apeha2 study. We also studied the chronic effects of fine particles on premature mortality. We used the exposure-response function that we developed in the HIA in Austria, France and Switzerland and that was in turn based on two American cohort studies. We performed the present HIA for different scenarios on the health benefits of reducing PM10 and BS levels. **Findings:** The total population covered in this HIA includes nearly 39 million inhabitants of Western and Eastern Europe. PM10 measurements were provided by 19 cities. In most of the cities mean values fall in the range between 20 and 50  $\mu\text{g}/\text{m}^3$ ; Swedish cities are below 20  $\mu\text{g}/\text{m}^3$ . Black smoke (BS) measurements were provided by 14 cities. Athens shows the highest mean BS levels, while the lowest levels are seen in Lille, Le Havre, London and Rouen. The age-standardised mortality rates range from 456 per 100 000 in Toulouse to 1 127 per 100 000 in Bucharest. The attributable benefit of reducing PM10 levels by 5  $\mu\text{g}/\text{m}^3$  in cities that measure PM10 is a decrease in the number of long-term deaths by 5 000 per year, 800 of which are short-term deaths. A reduction of 5  $\mu\text{g}/\text{m}^3$  in BS levels would decrease short-term deaths by over 500 per year. **Conclusions:** Apehis has created an active public-health and environmental-information network on air-pollution-related diseases in Europe using a standardised methodology. Apehis will continue to keep the information we provide as up-to-date and accurate as possible.

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## **10328- The Evaluation of Specific Health Changes Due to Environmental Pollution Using Biological Markers**

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Identified exposure marker (toxicant) not always initiates adverse changes in organs and systems. It is connected with the difficulty to count all the variety of conditions determining sensibility to effects of study toxicants. So defining of effect biomarkers that are measures of health response and also exposure markers is important. We used content level of immunoglobulin E to low-molecular chemical compounds (LMCC) as a marker of allergic reactions. The methods were stated and the results were evaluated with the method developed in our laboratory (Patent for invention # 2152034 of 27.06.2000 "The method of quantitative evaluation of the allergen-specific immunoglobulins E in blood serum (plasma)". The study of specific sensibilization to formaldehyde helped to test this method. Formaldehyde was identified with 2,4-dinitrophenylhydrazine (method of highly effective chromatography). To test this method the clinical-laboratory and medical-chemical examination of 340 children undergoing the medical cure at our Institute, from 12 territories of Perm region with allergopathology, was carried out. Then the data of immuno-enzyme analysis and the indices of the chemical composition of blood and urine were compared. The testing of the assays of healthy children and children with the allergopathology allowed to reveal allergen-specific reagins to formaldehyde with the sensitiveness of 0.35 ME/ml in the determined range of concentrations 0.7-50 ME/ml with 89.3% of correlation to the results got while using the commercial set of Cypres Diagnostics, Belgium. The analysis of the regularities of the levels of general sensibilization and of specific to formaldehyde revealed their reliable ( $p < 0.05$ ) inverse correlation ( $r = -0.55$ ). This indicates the peculiarities of the mechanism of sensibilization with low-molecular allergens, which is accompanied by moderate general reagin level. In rural territories high general hyper-sensibility included about 5% of specific one for the IgE criterion, in urban territories (low general sensibilization) the part of specific to formaldehyde reached 15%. The lowest LMCC concentrations cause antibodies production adequate to content of hapten in blood (reliability  $p < 0.05$  with correlation of 0.78). Duration of influence of the lowest toxicant concentrations causes the accumulation of this toxicant and also its pathologic effects. To reveal the latter it is necessary to identify the toxicant in biological media and verify specific health response markers. Early identification of supposed adverse changes due to these markers helps to prevent them.

## 10361- ADVERSE HEALTH EFFECTS EXPERIMENTALLY-INDUCED BY CHEMICALS IN DRINKING WATER

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Extensive data indicate that the by-products of water chlorination cause toxicological effects that may critically affect the user's health. The goal of this toxicological study was to assess the risk arising from these by-products, and thus the hazards associated with the use of disinfectants in a given drinking water system. The study design was based on some new tenets in the environmental toxicology in the 1990s, by combination with other related fields, thus making possible the use of diagnostic tools for assessing some early, reversible changes. Another feature of our experimental study was that the doses used in the assessment were lower than those used in other similar studies, and were calculated based on the mean daily human consumption of drinking water. The methodological approach consisted in the following steps: (1) the selection of Delea water work in Vaslui town based on the results of previous studies carried out in Moldova; (2) twice a year sampling of large volumes of raw water (RW) (226 liters) and chlorinated water (CW) (282 liters); (3) assessment of the chemical and biological quality of water samples; (4) Solid-phase extraction of water samples for concentrating the non-volatile organic chemicals; (5) qualitative and quantitative (MX level) GC-MS analysis of water extracts; (6) experimentally-induced health effects: in vitro (Ames test) and in vivo effects in a sub-chronic experiment (90 days) on Wistar white rats and in acute and sub-acute experiments on aquatic organisms – daphnia, algae and fish. The results of water analysis showed a significant increase in organic matter levels up to 19.8mg/L in CW samples as to MAC. Some significant hematological changes were noticed, especially in the rats treated with CW extracts versus those treated with RW extracts and controls. Also, during the 90 days-experiment, the increase in rat body weight was significantly lower in the group treated with CW extract comparing to those treated with RW extracts and controls. Positive results were obtained for both RW- and CW-extracts-rat groups in three in vivo genetic tests (micronuclei, chromosomal aberrations and sperm-shape abnormalities) comparing to the control group. The toxic effects found in acute and sub-acute tests on aquatic organisms have gradually increased related to chemical concentrations in RW and CW. In fish, after the end of exposure to small concentrations of chemicals, the recovery was also proved. The results outlined the possible toxic risk arising from the chlorination by-products in drinking water for the population of Vaslui town and they are support for some subsequent local protective measures.

10435- ACUTE AND CHRONIC EFFECTS OF ENVIRONMENTAL EXPOSURE OF CHILDREN TO NITRITES/NITRATES – CRITERIA FOR DETERMINING THE AREAS AT RISK IN THE EASTERN PART OF ROMANIA

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Epidemiological studies carried out in the interval 1988 - 2000 in urban and rural areas were accounted for by the pollution of drinking water with nitrogenous substances, and the high incidence of infantile acute nitrates intoxication. The goals of these studies were: (a) to determine the frequency, distribution and trend of infantile acute nitrate intoxication in relation to the quality of drinking water during an accessible former period (descriptive studies); (b) to outline the areas at high risk; (c) to carry out in these areas epidemiological analytical studies which to substantiate the chronic effects of nitrite/nitrate exposure; (d) to establish criteria for ranking the areas at risk. The nine analytical studies (pilot study included) used the same methodology and were performed in seven territorial communities in 0-3 year children. The samples of children were calculated by the probabilistic technique, and were divided, based on the quality of drinking water at the time of this study, into exposed/unexposed to nitrite/nitrate levels above MAC. The collected data refer to exposure assessment, effects on health, and epidemiological analysis. The main aspects revealed by our results were: (1) in the 4827 well water samples collected from 137 villages in six East Romanian districts, the frequency of those with nitrates above MAC ranged between 44.6 and 95.97 %; (2) the incidence of acute nitrate intoxication in infants varied between 1.5 and 7.0 ‰, with a mean of 3.27 ‰, and showed a tendency to increase; (3) the nine analytical studies included 1488 children aged 0-3 years (884 of them exposed to high level nitrate drinking water) representing 7.5 – 42.4 % of the entire 0-3 year-old population in the study territory; (4) the mean levels of methemoglobin\_were significantly increased in the exposed versus the unexposed children, these levels decreasing with children age and increasing with the nitrate water concentration; (5) a higher frequency of pathological methemoglobin levels was found in the exposed group, and the urinary nitrate levels in children correlated with the intensity and duration of exposure; (6) changes in antioxidant defense biomarkers outlined the vulnerability of the exposed children. All these results confirm the study hypothesis. RR values ranged between 1.3 and 11.9, and RA% values between 23.1 – 91.6 % for the relationship between the differences in the frequency of pathological methemoglobin levels in the exposed/unexposed groups and water pollution by nitrogenous substances. All these aspects related to exposure and its effects represented criteria for ranking the areas at risk, areas where measures for lowering the risk were taken.

10438- The Influence of Population Heterogeneity on Air Pollution Risk Assessment: A Case Study of Power Plants Near Washington, DC

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**INTRODUCTION:** In assessing health risks from air pollution, both the magnitude and distribution of health benefits associated with reduced emissions should be considered. In addition to the geographical distribution of pollutants, the population distribution of age, race, gender, and socioeconomic status can affect health outcomes. Although these distributional issues are central in the interpretation of many proposed environmental policies, risk assessments and benefit-cost analyses have generally devoted only limited attention to factors that might lead to differential responses. To address this issue in a policy-relevant context, we constructed a model to estimate the magnitude and distribution of health benefits associated with improved emission controls at five older power plants located around the capital of the United States, Washington, DC. **METHODS:** We used the CALPUFF atmospheric dispersion model to determine the primary and secondary fine particulate matter (PM<sub>2.5</sub>) concentration reductions associated with the hypothetical application of Best Available Control Technology (BACT) to the selected power plants. We combined these concentration reductions with concentration-response functions for mortality and selected morbidity outcomes, using a conventional approach as well as a novel approach which models heterogeneity in concentration-response functions and baseline health status. **RESULTS:** In total, our central estimate of 230 fewer deaths per year (25% in individuals with less than high school education) is changed to 240 (51% in individuals with less than high school education) when we stratify both relative risk and baseline mortality risk by educational attainment. Although the central estimate is not greatly affected by incorporating population heterogeneity, the population distribution of health benefits resulting from the BACT application is changed. Cardiovascular hospital admissions in the elderly and asthma emergency room visits in children demonstrate similar patterns with the introduction of heterogeneity affecting the demographic and small-scale geographic distributions of benefits, but having limited influence on aggregate benefits or broad geographic trends. **CONCLUSIONS:** Although significant uncertainties are associated with our model assumptions, our analysis demonstrates that incorporation of information about population heterogeneity can enhance our understanding of individuals likely to benefit from emission controls.

## 10470- Using health impact assessment to estimate external costs of transport: the Impact Pathway Approach

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External costs of transport represent welfare losses to society leading to inefficiency and unfairness in the transport system. For the internalisation, these external costs need to be quantified. This contribution is dealing with a bottom-up methodology for the calculation of marginal external costs due to health effects of airborne pollution from road, rail, ship and air transport. The approach aims to reproduce the chain of causal relationships, starting with pollutant emissions, their dispersion and chemical conversion in the atmosphere and the exposure of the population, up to the quantification of health impacts. A Lagrangian trajectory model and a Gaussian dispersion model are used to calculate yearly average ambient concentrations on the regional and local scale respectively. Two scenarios, a reference scenario with emissions of all sectors and a scenario with additional emissions of the transport activity under assessment, are used. Adverse effects on human health are quantified by the application of exposure-response functions on the concentration changes between scenarios. 18 independent endpoints were identified, which are quantified using a large number of exposure-response functions for the pollutants: primary and secondary particles (PM<sub>2.5</sub>), SO<sub>2</sub>, CO, ozone, benzene, benzo-[a]-pyrene, 1,3-butadiene and formaldehyde. Mortality and morbidity effects are covered. The impacts are transferred into monetary terms following the approach of 'willingness-to-pay' as far as possible. Table 1 presents exemplarily results for an articulated train in an urban area. Mortality due to long-time exposure to small particles, which we value as a loss in life expectancy, shows to be the most important adverse health effect.

**Table 1 : External costs of an articulated train (>32t, emission standard EURO2, 1998 ) due to health effects in an urban area in the South of Germany.**

Category	Damaging pollutant	Endpoint	Reference	Euro / 1000 vkm
Morbidity	PM <sub>2.5</sub> <sup>(1)</sup>	9 endpoints <sup>(2)</sup>	several <sup>(3)</sup>	53
	SO <sub>2</sub>	Resp. hospital adm.	Ponce de Leon	0.02
	CO	Congestive heart failure	Schwartz/Morris	0.002
	Ozone	4 endpoints <sup>(4)</sup>	several <sup>(5)</sup>	-4.08
	Benzene	Leukaemia (non-fatal)	EPA (1990)	0.002
Mortality	PM <sub>2.5</sub>	Years of life loss (YOLL)	based on Pope et al. (1995)	122
	SO <sub>2</sub>	Acute mortality (YOLL)	Anderson/Touloumi (1996)	1.82
	Ozone	Acute mortality (YOLL)	Sunyer et al. (1996)	-2.76
	Benzene	Leukaemia (fatal)	EPA (1990)	0.02
<b>Total</b>				<b>170</b>

(1) PM<sub>2.5</sub>: primary and secondary particles; (2) Respiratory hospital admissions, congestive heart failure, cerebrovascular hosp. adm., bronchodilator usage, cough, lower resp. symptoms, chronic bronchitis, restricted activity days, chronic cough; (3) Dab et al. (1996), Schwartz/Morris (1995), Wordley et al. (1997), Roemer et al. (1993), Dusseldorp et al. (1995), Pope/Dockery (1992), Abbey (1995), Ostro (1987), Dockery et al. (1998); (4) Restricted activity days, asthma attacks, symptom days, resp. hosp. adm.; (5) Ostro and Rothschild (1989), Whittemore and Korn (1980), Krupnick et al. (1990), Ponce de Leon (1996);

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## **10478- Consideration of Qualified Medical Aid Provision in Determination of Priority Territories for Population Disease Incidence**

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Epidemiological evaluations of population disease incidence at population level are carried at present under State health statistics survey data. This survey does not show real incidence rate, but medical aid appeal frequency, which much depends on provision and capacity of treatment-and-prophylactic establishments (TPE): staff, laboratory resources, bed provision, etc. Thus, it is necessary to develop new approaches for determination of priority territories for population incidence criterion, accounting medical provision. The source of information about population incidence and medical aid provision was State statistics survey for a five-year period. Methods of correlative and regressive analysis, as well as rank estimates method were used to determine priority territories. Results of the analyses revealed significant territory differentiation in provision of TPE. E.g. number of medical positions for Perm region children population treatment varies from 6.9‰ to 1.1‰ in different establishments. At the same time children's incidence rate makes 2106.96‰ and 1274.7‰ correspondingly. Study of the relationship between children's incidence indices and rate of medical aid provision revealed reliable stability linear correlation that is adequately described with the following regression equation:  $y = 368x + 894.7$ . Linear correlation coefficient is  $r = 0.72$  at confidence level  $p < 0.05$ . Thus, it would be reasonable to compare single territories in relative indices characterizing disease level per occupied medical positions, but not disease incidence during the reported year. The former index for Perm region administrative and territorial units varies from 1544 cases/year per a doctor to 302 cases/year. This method allows estimate disease incidence level in territories introducing correction coefficient for medical aid provision. The coefficient is calculated as proportion of disease incidence level per a single medical position in the territory, to a background level. Average mean (per a single medical position in study territories) of three minimum incidence means is taken as background level. This coefficient characterizes exceed of standardized incidence level over the average minimum one. The coefficient of the example above varies from 1.03 to 5.29. Correction coefficients comparison by way of range estimates method allows account medical provision of TPE during determination of priority territories in population incidence. Thus, suggested method for standardization of disease incidence indices allows account different territory levels of qualified medical aid provision during determination of priority territories in population incidence.

## 10543- EVALUATION OF THE HEALTH IMPACT OF ENGLAND'S HOME ENERGY EFFICIENCY SCHEME

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**BACKGROUND.** A large, national programme of home energy efficiency improvements (known as Warm Front) is being carried out in England over the years to 2010. Its objective is to reduce fuel use and to improve indoor temperatures for low income families 'to ensure that the most vulnerable households need no longer risk ill-health due to a cold home'. We describe a major evaluation of the health impacts of this scheme. **METHODS.** Changes in physical conditions and health are being measured in households receiving new heating systems and/or other energy efficiency measures (insulation, draught-proofing). The study homes are located in geographical clusters in four regions: Bristol, Manchester, Newcastle-upon-Tyne and Southampton. The primary study groups are (a) households with children <16 years, and (b) households containing a family member over 60 years of age. Assessments are being made in 750 pre-improvement and 750 post-improvement dwellings in the winter of 2001-02 and in a similar number of pre- and post-improvement dwellings in the winter of 2002-03. The 750 dwellings that had pre-improvement assessments in the first winter will be re-assessed in the second winter to provide evidence of 'before-after' change. Physical conditions, fuel use and energy ratings are assessed by trained surveyors. Indoor temperatures and relative humidity are recorded every 30 minutes over a three week period using data loggers. Thermal comfort, mental well being and health-related quality of life are assessed using standard instruments (Short Form 12, General Health Questionnaire, EQ5D) and GP consultations by questionnaire. In-depth interviews are being used to gather information about changes in behaviours, and epidemiological modelling to estimate the impacts of the programme on mortality and hospital admissions. (Direct measurement of change in mortality and hospital admissions is not feasible in the short term because of the required sample size.) **RESULTS.** Results of the evaluation will not be available until late 2003. However, evidence from an initial pilot study suggests that the programme is having benefits to thermal comfort, quality of life and, by extrapolation, mortality. It also shows that changes in indoor temperatures are dependent on the type of energy improvement carried out: new heating systems achieve substantially greater temperature improvements than insulation which in turn achieves greater improvements than draught-proofing. Preliminary epidemiological modelling suggests that wide coverage of the scheme and effective targeting will be essential to maximize the public health benefits and to achieve significant reduction in the 18,000 deaths per year in England that are theoretically attributable to inadequate home heating. **CONCLUSIONS.** The evaluation of England's Warm Front programme will provide invaluable insights into the health impact of initiatives aimed at improving energy efficiency in the home.

10582- CANCER INCIDENCE IN MASSACHUSETTS PERSIAN GULF WAR VETERANS  
Clapp R, MacMillan A, Proctor SP.

Objectives: There is on-going interest in health effects from exposures to military personnel in the Persian Gulf War in 1991. U.S. Veterans have reported anecdotal evidence of cancer, and there have been suggestions of unusual patterns of cancer, including leukemia, in other veterans and Iraqi civilians. The present study examined the pattern of cancer incidence in Massachusetts veterans who were deployed to the Persian Gulf and other veterans who were mobilized at the same time but were not deployed to the Gulf.

Methods: A roster of New England Persian Gulf era veterans was provided by the Defense Manpower Data Center. There were 10,263 Gulf War deployed veterans and 70,672 Gulf War non-deployed veterans on the roster. After approval by the relevant Institutional Review Boards, this electronic file was linked to the Massachusetts Cancer Registry data files for the years 1992 to early 2001. Records were linked by Massachusetts Cancer Registry staff using social security number, name and date of birth. No patient contact was involved, and diagnostic and demographic information reported to the central cancer registry, without personal identifiers, was used for analysis.

Results: A total of 413 cancer cases diagnosed in Persian Gulf era veterans were identified in the linkage. Of these, 23 cases were in veterans deployed to the Persian Gulf theater and 390 cases were in veterans who were mobilized but not deployed to the Gulf. The most common types of cancer in those deployed to the Gulf were colo-rectal cancer, non-Hodgkin's lymphoma, and prostate cancer. In the veterans not deployed to the Gulf, the most common types of cancer were prostate cancer, colo-rectal cancer and melanoma of skin. Age-adjusted odds ratios for males and females, stratified by five-year time periods, will be presented for the major types of cancer.

Conclusions: The pattern of cancer incidence in Massachusetts Persian Gulf War veterans is of continuing interest to veterans and their families. The number of cases is small and the period of follow-up is too short to draw any definitive conclusions. Nevertheless, this initial record linkage process needs to be followed by periodic updates in the coming years to determine whether there are unusual occurrences of specific types of cancer in Gulf-deployed veterans.

## **10775- SOCIO-ECONOMIC AND DEMOGRAPHIC DETERMINANTS OF LIFE STYLE OF POPULATION IN OSTRAVA**

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### Introduction

In epidemiological studies the outcomes are often confounded by the socio-economic (SES) and demographic characteristics, especially in the specific population of the industrial city which inhabitants life-style is impacted by heavy and coal-mining industry.

### Objectives

The aim of the presented study was to identify the relationship between SES and demographic characteristics and the life-style.

### Methods

A structured questionnaire was elaborated, distributed to a random sample of some 3,000 of the population in Ostrava and collected by using the postal delivery. The data were double-entered, cleaned and analysed using the statistical software STATA. The SES and demographic factors being analysed were sex, age, education, marital status and economic situation of the family in the relationship with a wide range of information on life style. The method used was chi-square test and the analysis of variance ANOVA.

### Results

The total number of returned and completed questionnaires reached 634 (21.1% of the response rate). The sample was homogenous by sex in the age categories. The significant differences were found by sex in education (higher number of men in the category with apprenticeship and university education, higher number of women with the basic and secondary education), in marital status (more women living alone in the age over 51) and household income (more women in the lowest income category, men in the highest one). The underestimated response-rate was in the group with the basic education in spite of that this category is the most frequent in the city population.

Leisure time, weekend and holiday activities were significantly correlated with education – the higher education, the more active (sport, physical training, hiking, trips) people were unlike people with the lower education who prefer to stay at home cleaning the house. More than a half of respondents reported their diet as healthy, significantly more in women ( $p < 0.01$ ) and older people ( $p < 0.001$ ). The older people were, the significantly more they looked for information about healthy life-style, underwent the preventive medical care. Women spent nearly twice more time by taking care of children and keeping the house and had a half of free time. Women also significantly more searched for information about healthy life-style, applied the recommendations, unlike men who rather visit the preventive medical examination. Very busy were age groups between 41-60, which reported significantly higher importance of money as a value, less free time, less frequency of contacts with friends, less time for physical training. As for the values – health was given as a priority in 98% of respondents.

### Conclusions

Among the analysed factors education, followed by age and sex were the most significant determinants of the differences in life-style. The least effect was found between groups by marital status.

### Acknowledgement

This study was realised within the grant Nr. NJ/6139-3 funded by the Czech MoH: Subjective approach of inhabitants of Ostrava to their health in association with their life-style, socio-economic status and education.

## **10779- SOCIO-ECONOMIC AND DEMOGRAPHIC DETERMINANTS OF HEALTH OF POPULATION IN OSTRAVA**

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### Introduction

In epidemiological studies the outcomes are often confounded by the socio-economic (SES) and demographic characteristics, especially in the specific population of the industrial city which inhabitants' health and life style is impacted by heavy and coal-mining industry.

### Objectives

The aim of the presented study was to identify the relationship between socio-economic and demographic characteristics and health.

### Methods

A structured questionnaire was elaborated, distributed to a random sample of some 3,000 of the population in Ostrava and collected by using the postal delivery. The total number of returned and completed questionnaires reached 634 (21.1% of the response rate). The data were double-entered, cleaned and analysed using the statistical software STATA. The method used was chi-square test and the analysis of variance ANOVA.

### Results

Three thirds of respondents evaluated their health status as good, one third reported long time health disorders or disease. The self-reported health was correlated with education (the higher education people have got, the better subjective health), with age (the older people were, the worse subjective health), and the economical activity (non-active reported significantly worse subjective health) -  $p < 0,001$ . More than a half of the study sample suffered by the serious chronic disease, significantly more in men ( $p < 0,01$ ) and the prevalence increased with age ( $p < 0,001$ ).

The chronic diseases of the highest prevalence were: 28% disorders of locomotor system, 19% CDV and 9% respiratory disorders. About half of respondents regularly underwent the preventive medical examination at practitioner (significantly more men -  $p < 0,05$ , economically active people -  $p < 0,001$ , and married  $p < 0,01$ ), 48% at occupational physician, 76% at stomatologist and 70% of women at gynaecologist.

The satisfaction with the medical health care was reported by 83% respondents and the satisfaction increased with age ( $p < 0,05$ ), is higher in the group of health people than in people with declared illness. The majority of women (65%) and men (53%) took care about their body weight limit ( $p < 0,01$ ). Esthetical reasons significantly predominated in women, in people with higher education and in people economically active. Significantly more women (83%) than men (76%) were interested in information about the possibilities of improving health status ( $p < 0,01$ ). The main sources of this information are medical sources for people with diseases unlike the healthy people who prefer the popular sources.

### Conclusions

Women more frequently reported presence of chronic diseases, took care about their limit of weight, use more medicaments than men, they were more interested in protective health information. The self reported health was better in people with higher education. Economically active respondents better evaluated their health status, used less medicaments, reported higher frequency of preventive examinations, more took care about their limit of weight. Marital status affects health status the least of select factors.

### Acknowledgement

This study was realised within the grant Nr. NJ/6139-3 funded by the Czech MoH: Subjective approach of inhabitants of Ostrava to their health in association with their life-style, socio-economic status and education.

## 10792- Atmospheric Modeling Uncertainties in Estimation of Particulate Matter Intake Fractions from Power Plants

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The accuracy of air pollution health impact assessments depends on uncertainties in multiple subcomponents. While health uncertainties are frequently quantified, atmospheric modeling uncertainties are rarely systematically addressed in a framework relevant to risk calculations. To evaluate both within-model and between-model uncertainties and quantify exposures and health risks from power plants, we apply both CALPUFF and S-R matrix to a set of seven power plants in northern Georgia. We consider both direct emissions of fine particulate matter (PM<sub>2.5</sub>) and secondarily formed sulfate and nitrate particles, and we compare the model results in intake fraction terms (the fraction of a pollutant or its precursor emitted that is eventually inhaled). Over a domain within 500 km of Atlanta, we estimate emission-weighted average intake fractions of  $6 \times 10^{-7}$  for primary PM<sub>2.5</sub>,  $2 \times 10^{-7}$  for sulfates, and  $6 \times 10^{-8}$  for nitrates using CALPUFF. Estimates are similar using S-R matrix for primary PM<sub>2.5</sub> and sulfates but vary more substantially for nitrates. The relatively greater differences for nitrates can be related to the chemical transformation and partitioning assumptions in both models and the differences in model structure (modeling a single source in CALPUFF versus removing a source from a comprehensive emissions inventory in S-R matrix). When the domain is expanded across the US with S-R matrix, total intake fractions are approximately 40% higher for primary PM<sub>2.5</sub> and doubled for secondary particles. Our findings demonstrate that atmospheric modeling uncertainties may be small relative to other uncertainties in particulate matter risk assessment, although a comparative analysis is insufficient for model validation. We conclude that the intake fraction approach provides useful insight about the magnitude of relevant uncertainties, but that the emissions control context must be incorporated into the intake fraction definition for secondary pollutants.

## 10811- Health Impact Assessment as a Tool for Policy Development

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National government of the Netherlands plans to incorporate the development of a Health Impact Assessment tool in its NEHAP. Assessment criteria include magnitude of health effects, perception of health risk, possibilities of intervention, cost benefit analysis and many others. Ultimate goal is to increase the transparency and improve the acceptance of the government's environmental health policy.

The significance of this recently developed tool is the notion that consensus over the assessments results will be harder to realize than consensus over its criteria. An important outcome of the tool is therefore the discussion between various stakeholders (ministries, ngo's, scientific institutes). It is foreseen that this discussion will help elucidate the range of possible viewpoints and thus assist the government in making transparent and well founded decisions in the field of environmental health.

The presentation will outline the scope and current application in the Netherlands.

10932- Use of a population-based survey and exposure registry to assess acute health effects due to environmental contamination by O-nitroanisol after a chemical spill in Frankfurt/Main 1993  
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Objective: In 1993, a chemical accident at the Hoechst factory contaminated a residential area in Frankfurt/Main with 10 tons of the potentially carcinogenic O-nitroanisol and other chemicals. We investigated acute adverse health effects of the exposure in inhabitants of the residential area. Methods: An exposure registry was established to examine health effects of the exposure to potential carcinogens. For a representative sample of 15000 of the nearly 19000 potentially exposed inhabitants, information on exposure and on acute symptoms was collected via structured questionnaire. Exposure was assessed by asking for five types of direct contact with the chemicals (via mucous membranes, inhalation, skin, wearing or cleaning of contaminated clothes) and for seven types of indirect contact via cleaning of objects, car or the residential environment (e.g., walls or windows). The number of exposure days and presence in the most heavily contaminated center of the area was also considered. Multivariate logistic regression was used to examine the association of exposure with symptoms. Results: The response rate was 58% (N=7.484). Information on environmental contamination was available for more than 70% of the households in the residential area. Over 20% of the inhabitants had at least 4 types of contact with the "yellow rain". The relative risk (RR) for respiratory symptoms (RS), gastrointestinal symptoms (GIS), headache (HA), and psychological symptoms (PSYCH) (e.g., depression, restlessness, and sleeping difficulties) increased with the number of direct contacts, from 2.8 (95% confidence interval, CI, 2.0-3.8), 1.9 (1.2-2.9), 2.2 (1.6-3.1), and 1.6 (1.4-2.4) for one contact to 19.1 (13.2-27.7), 14.0 (8.8-22.1), 14.2 (9.8-20.7), and 10.1 (6.9-14.8) for five contacts, adjusted for indirect types of contact and number of exposure days. No association was observed for other unspecific symptoms such as fever. Conclusions: The strong association of acute symptoms with exposure is indicative of intake which may influence specific cancer rates in the exposed population.

## 10987- Alternative Reference Population Sensitivity Analysis for the Mortality Assessment of a Hexavalent Chromium Exposed Worker Cohort

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Cohort mortality analyses compare the number of deaths observed in the cohort with the corresponding number of expected deaths in a reference population, and the results depend critically on the choice of a reference population. In the mortality assessment of Gibb et al. (2000) of a Cr(VI)-exposed worker cohort, the researchers selected State of Maryland age, race and sex-adjusted reference rates. The authors report that 45% of the cohort died in the City of Baltimore, whereas only 16% died outside Baltimore (but in the State of Maryland), and 39% died in other states. This sensitivity analysis examines the potential effect of the choice of a reference population by comparing the number of expected deaths based on mortality rates for the City of Baltimore, the County of Baltimore, and the State of Maryland for all deaths, all cancers, lung and prostate cancer, and arteriosclerotic heart disease.

The original cohort vital status data are not readily available; however, the published study provides key characteristics of the cohort. Using this information, we generated a simulated cohort whose characteristics mimic closely those reported for the actual cohort. Although individual records from the simulated cohort may not correspond to any one member of the actual cohort, their collective characteristics are closely matched. Using the simulated cohort, we estimated the expected number of deaths for each comparison population. We used the age-, sex-, race- and calendar period mortality rates for each reference population from the Occupational Cohort Mortality Analysis Program. Using the simulated cohort, we estimated dates of birth, first employment, termination, and death, and calculated the years of follow-up, the age at follow-up, and the number of years worked.

The total number and cause-specific number of expected deaths calculated using the State of Maryland reference rates were nearly all lower than those calculated from the City or the County of Baltimore. The SMR for all deaths is 1.2 (1.2-1.3) when death rates from the State of Maryland are used. This SMR is reduced to 1.0 (0.97-1.1) and 0.9 (0.8-1.0) when computed using mortality rates from Baltimore County and City, respectively. Similarly, the SMRs for lung cancer for all workers are reduced from 1.6 (1.4-2.0), as calculated with Maryland mortality rates, to 1.2 (1.0- 1.5) and 1.4 (1.2-1.7) when using the City of and County of Baltimore mortality rates, respectively.

The present analysis clearly shows the sensitivity of the SMRs presented by Gibb et al. as a function of the reference population selected. Because we used the simulated cohort to evaluate potential bias and the simulated cohort data were applied to all three reference populations, discrepancies between the simulated and actual cohorts do not affect the

overall conclusions, namely that selecting different reference populations can result in important differences in SMRs.

## 11002- Economic evaluation of environmental health effects

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Cost-effectiveness becomes increasingly important in environmental policy decision making. Costs of policy measures are in general fairly easy quantifiable in contrary to the benefits of these measures. Monetary valuation of environmental health effects is not common practice.

We conducted a literature study on the applicability of monetary valuation for health effects associated with air pollution and noise. This study showed that data on health endpoints, risk estimates and estimations of the monetary value of health effects of environmental pollution are limited. Also there are methodological problems to overcome, such as the expression of mortality and morbidity in terms of money and benefit transfer. Estimations of the monetary value of health effects are limited. Due to assumptions in monetary valuations, as well as uncertainties in the underlying health risk assessments, the resulting estimates of health related costs and benefits vary substantially.

In addition to the literature study benefits of several noise policy measures for road, rail and air traffic for the year 2030 were assessed in the framework of the Netherlands Fourth National Environmental Policy Plan. Benefits are expressed as the willingness to pay for these measures and are calculated by both the Contingent Valuation (CV) and Hedonic Pricing (HP) method. Noise control measures for road traffic were found to yield the highest benefits whereas those for air traffic yielded the lowest benefits. When the willingness to pay was higher also the benefits for the different measures were higher. Sensitivity analysis showed that the chosen noise annoyance threshold value had large influence on the benefit estimations.

Health benefits can contribute substantially to the total benefits of measures and sometimes exceed the costs of the measure concerned. Health related costs and benefits could therefore add another dimension to discussions on setting of priorities for policy makers.