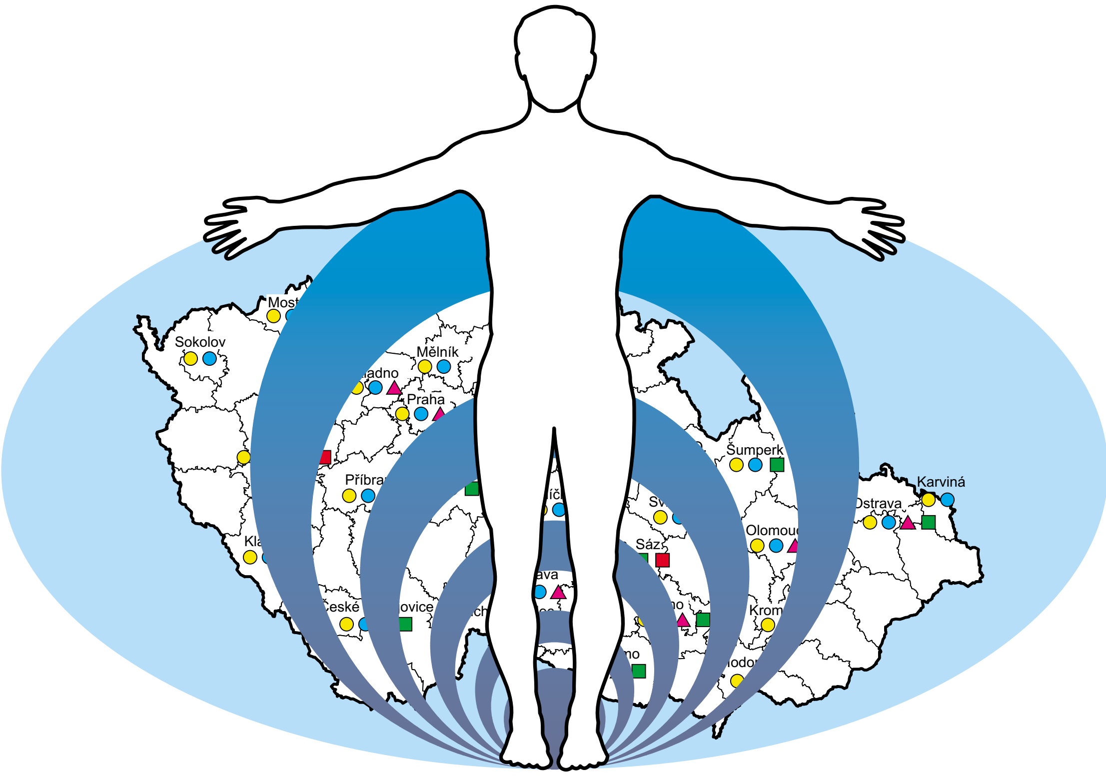
Environmental Health Monitoring System in the Czech Republic

Summary Report – 2006



National Institute of Public Health, Prague

Prague, October 2007

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Editor: Ms. Vladimíra Puklová

ISBN 80-7071-279-5

1st edition

This Report was compiled according to the Resolutions Nos. 369/1991 and 810/1998 of the Government of the Czech Republic.

Full text of this Summary Report is available on the NIPH website **http://www.szu.cz/chzpa/sumrep.htm.**

CONTENTS

1. INTRODUCTION

The Environmental Health Monitoring System (hereafter Monitoring System) is a comprehensive system of collection, processing and evaluation of data on environmental contaminants and their effects on population health in the Czech Republic. Its particular subsystems have been run routinely since 1994, so the year 2006 is the thirteenth year of the standard monitoring activities. The Monitoring System is an open system and has developed continuously in terms of both the range of factors and pollutants monitored and methods of data processing and presentation.

The Monitoring System has been operated as set out by Resolution No. 369/1991 of the Government of the Czech Republic. It is relied upon in the Act No. 258/2000 on public health protection, as amended, and is one of the priorities of the National Environmental Health Action Plan in the Czech Republic approved in Government Resolution No. 810/1998. The data obtained within this Monitoring System provide important background information for the long-term program focused on the improvement of population health in the Czech Republic, called "Health for All in the 21 Century", and approved by Resolution No. 1046/2002 of the Government of the Czech Republic. The data have also been used in the health impact assessment (HIA) and environmental impact assessment (EIA) of various activities, constructions and projects.

The Summary Report 2006 represents another component of the continuous series providing additional data on environmental health monitoring. It summarizes the results obtained within the individual subsystems in 2006 and compares them with those of the previous years. Aggregated results are presented as background information for the national authorities making decisions on environmental health, for the Public Health Service, co-operating sectors and institutions and for the interested public.

The results are provided in detail in the Technical Reports of the individual subsystems (in Czech) available through the Internet together with the Summary Report (in both Czech and English) and with other information on the Monitoring System at the web address of the National Institute of Public Health http://www.szu.cz/chzp/english/monitoring/index.htm.

Note: The terms and abbreviations used in the text, figures and tables are explained in Chapter 13.

2. OBJECTIVES AND FOCUS OF THE MONITORING SYSTEM

The aim of the Monitoring System is to provide high quality background data for decision making by the national and local authorities in the fields of health care policy, health risk management and control, and environmental protection. These data will be relied upon in the specification of legislative measures, establishment and adjustment of pollutant limits and informing the interested public.

The major objectives of the Monitoring System are to study and to assess time series of the selected environmental quality indicators and population health indicators, to determine levels of population exposure to environmental contaminants and to estimate subsequent health effects and risks. These comprehensive data are also an information source for other countries on health of the Czech population and risks from environmental pollution in the Czech Republic.

The results obtained for the monitored localities in individual periods are crucial in creating time series of data on health and environmental pollution. Systematic assessment of the resulting data series is relevant to the identification of long-term or seasonal trends as a background for possible recommendations and proposals of measures to be taken.

In 2006, the Monitoring System involved the following eight subsystems (projects):

- Health effects and risks related to air pollution (Subsystem I);
- Health effects and risks related to drinking water pollution (Subsystem II);
- Health effects of and annoyance from noise (Subsystem III);
- Health effects of and risks from dietary exposure to contaminants (Subsystem IV);
- Health effects of exposure to toxic environmental pollutants, human biomonitoring (Subsystem V);
- Health status and selected demographic and health statistics indicators (Subsystem VI);
- Health effects and risks related to the occupational environment (Subsystem VII);
- Health risks related to urban soil contamination (Subsystem VIII).

With the progressive development of the Monitoring System, specialized studies were designed in agreement with Resolution No. 369/1991 of the Government of the Czech Republic. These studies extend the existing monitoring results and deal with issues lying beyond the framework of the basic tasks of the Monitoring System, but whose solution is necessary for the monitoring activities to continue. The results are being published in the form of either monitoring reports or scientific papers.

3. ORGANIZATION OF THE MONITORING SYSTEM

3.1 Scope of the Monitoring System

The Monitoring System has been implemented in 30 cities including the capital Prague, regional capitals and selected former district cities. For economic and technical reasons not all subsystems of the Monitoring System have been in operation in all cities. On the other hand, additional cities have been included in some subsystems: stations operated by the Public Health Service in cities where the Monitoring System is not run to the full/initially planned extent were included in the air pollution monitoring within Subsystem I and surface soil contamination was also monitored within Subsystem VIII in more cities. Subsystems II and VII have been run at the nation-wide level. The cities participating in each of the monitoring subsystems are shown in Fig. 3.1 and Table 3.1 together with population numbers.

3.2 Monitored factors and indicators and their limits

The list of the factors (pollutants, contaminants, analytes and indicators) which have been monitored is based on the respective regulations and analyses carried out both prior to the actual start and during the routine operation of the Monitoring System. These factors together with the respective subsystems are listed in the Supplement. For evaluation of the results, several types of limits have been applied. On the one hand, these are limits given in Czech standards and regulations, and, on the other hand, these are values taken from documents of supranational institutions (e.g. the World Health Organization and US Environmental Protection Agency), which usually do not have the force of standards in the Czech Republic. This is true namely of the exposure limits such as the acceptable daily intake (ADI) or recommended daily allowance (RDA) applicable to contaminants or trace elements from foodstuffs or drinking water, or tolerable internal doses applicable to the content of toxic substances in biological material. These limits and values are being adjusted to keep up with the latest developments and the changes, if any, are indicated in the Technical Reports and the Summary Report.

3.3 Information system and data processing

The structure of the used databases and corresponding softwares enable the collection of results from the information system end users (measuring laboratories), their transport to the directors of the individual subsystems, and independent processing according to the requirements of the Monitoring System users. The directors archive all original data in databases for possible reprocessing according to other criteria, if needed. The databases are designed as standard products enabling data processing to the usual extent, are compatible with other database systems and allow additional data processing and evaluation, if required.

It should be noted that the calculation of individual statistical characteristics is limited by the number of values in the sample processed. For small numbers, only their mean value (arithmetic mean or median) is presented. Some data on a contaminant (analyte) concentration in an environmental medium or biological material may fall below the detection limit of the analytical methods used (so called “negative results” or “trace amounts”). If the concentration measured is below the detection limit, a value equalling one-half of the detection limit is used for the calculation of sample characteristics (based on the assumption of an even distribution of the values below the detection limit). This may lead to overestimated results; nevertheless, such an approach is safer than considering the values to be zero. Frequently, a greater number of the results can fall below the detection limit and their processing may be subject to error. If the number of the negative measurement results (i.e. falling below the detection limit) in the defined data set exceeds 50 %, the data on the given contaminant are usually described only verbally and their quantitative assessment is not routinely performed.

The trends in environmental quality and population health are established for the given time intervals in each of the subsystems; their evaluation reflecting both linear and non-linear development of concentrations or population exposure to environmental contaminants is being regularly presented within each of the subsystems.

3.4 QA/QC system

Quality assurance (QA) and quality control (QC) in the analytical laboratories participating in the Monitoring System have been included in the activities of the laboratories as well as their home institutions. These are analytical laboratories of the public health institutes, created after reorganization of the Public Health Service, private laboratories and laboratories of other institutions.

The QA system for analyses in the Monitoring System laboratories is based on the accreditation procedure steps focused on:

- using standard operation procedures in all phases of the process of data collection and submission;
- using reference or certified reference materials as internal controls, keeping regulatory diagrams;
- participation in external control programs with inter-laboratory comparison of sample analyses at both national and international levels;
- meeting the requirements for keeping documentation records.

Most collaborating Public Health Service laboratories use accredited methods according to CSN EN ISO/ICE 17025. As in previous years, the QA control for analyses included sampling reliability, compliance with good sampling practice and adequate data submission to the teams of different subsystems and NIPH Monitoring System Headquarters.

Tab. 3.1 Participant cities in the Environmental Health Monitoring System

Basic participants	Subsystem						City code	Number of inhabitants
	I	III	IV	V	VI	VIII		
Benešov	x		x		x	x	BN	16,245
Brno	x	x	x		x	x	BM	366,757
České Budějovice	x	x	x		x	x	CB	94,653
Děčín	x	x			x		DC	51,875
Havlíčkův Brod	x	x			x		HB	24,296
Hodonín	x						HO	26,226
Hradec Králové	x	x	x		x	x	HK	94,431
Jablonec nad Nisou	x	x	x		x	x	JN	44,748
Jihlava	x	x			x		JI	50,859
Jindřichův Hradec					x		JH	22,643
Karviná	x				x	x	KI	63,385
Kladno	x	x			x		KL	69,329
Klatovy	x				x	x	KT	22,898
Kolín	x	x			x		KO	30,175
Kroměříž	x			x	x	x	KM	29,024
Liberec	x	x		x	x	x	LB	97,950
Mělník	x				x	x	ME	19,124
Most	x				x		MO	67,805
Olomouc	x	x			x	x	OL	100,381
Ostrava	x	x	x	x	x	x	OS	310,078
Plzeň	x	x	x		x	x	PM	162,759
Prague	x	x	x	x	x		AB	1,181,610
Příbram	x	x			x	x	PB	34,884
Sokolov	x					x	SO	24,579
Svitavy	x				x		SY	17,248
Šumperk	x		x		x	x	SU	28,196
Ústí nad Labem	x	x	x		x	x	UL	94,298
Ústí nad Orlicí	x	x			x		UO	14,918
Znojmo		x	x		x		ZN	35,032
Žďár nad Sázavou	x	x	x		x	x	ZR	23,841
Other participants								
Karlovy Vary						x	KV	50,893
Litoměřice	x						LM	23,909
Litvínov	x						LT	27,056
Lovosice	x						LV	9,209
Meziboří	x						MZ	4,886
Tanvald	x						TN	6,966
Teplice	x						TP	51,010
Uherské Hradiště				x			UH	26,131
Rural background stations								
Košetice	x						P1	
Bílý Kříž	x						P2	

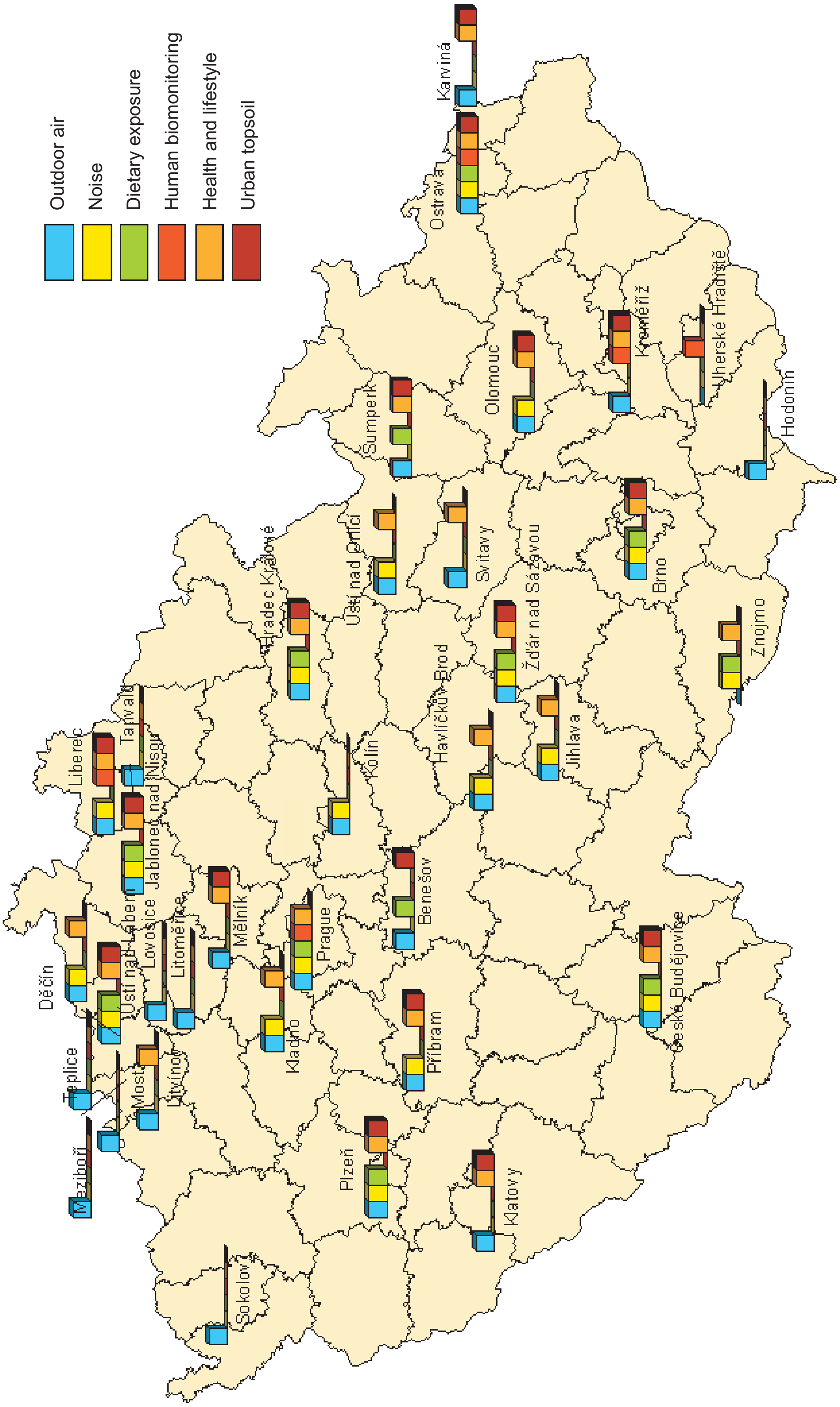
Note:

Subsystems II and VII are implemented nationwide.

Codes A1–A10 are used for Prague districts.

Number of inhabitants is updated on the date 1. 1. 2006 (Czech Statistical Office, www.czso.cz).

Fig. 3.1 Participant cities in the Environmental Health Monitoring System



Subsystems "Drinking water" and "Occupational environment" are nationwide.

4. HEALTH EFFECTS AND RISKS DUE TO AIR POLLUTION

4.1 Organization of monitoring activities

Subsystem I includes monitoring of selected indicators regarding the population health and the quality of outdoor and indoor air. Information on the population's state of health comes from general practitioners providing care for adults and paediatricians in outpatient healthcare facilities. Information on ambient air pollutant concentrations is obtained from the network of measuring stations operated by the public health institutes in the cities monitored as well as from selected measuring facilities administrated by the Czech Hydrometeorological Institute (CHMI), the location of which meets the requirements of the Monitoring System. Indoor air quality has been monitored within Subsystem I in cooperation with selected public health institutes.

4.2 Incidence of treated acute respiratory diseases

The source of information comprises records of the first treatment of a patient with an acute respiratory illness at a general practitioner. In 2006, 71 paediatricians and 38 general practitioners providing care for adults in 25 cities, who had a total of 163,837 patients in their care, were integrated into the collection of data. The numbers of new cases of acute respiratory diseases that were treated have not varied significantly in recent years. In 2006, monthly incidences also fluctuated from single-digit numbers to hundreds of cases per 1,000 people in a given age group depending on the season and the current epidemiological situation.

Fig. 4.1a presents the range of average annual incidences in the years 1995 to 2006 and the average values of incidences of acute respiratory diseases (excluding influenza) for the age group 1–5 years, where the sickness rate is traditionally higher. The development of acute respiratory diseases in children in the period 1995–2006 more or less stabilised after an initial marked drop in the values of incidences in the period 1995 to 2002. The sickness rate of children aged 6 to 14 years is distinguished by a higher variability (Fig. 4.1b).

Within the framework of monitoring, the group of diagnoses comprising diseases of the upper respiratory tract had the highest share in the overall sickness rate with an annual average of 79 % (from all localities and age groups). The second most numerically represented group of diagnoses was influenza with 10 %, followed by the group of diagnoses of acute bronchitis with 8 %. The other monitored diagnoses came in the following order: otitis media, nasosinusitis, mastoiditis (2 %), pneumonia (1 %) and asthma (0.6 %).

4.3 The prevalence of allergic diseases in children

A survey of the prevalence of allergic diseases in the population of 5, 9, 13 and 17-year-old children took place in 18 cities in the Czech Republic in 2006. The survey was a follow-up to similar studies from the years 1996 and 2001. The source of data comprised an excerpt from the documentation of children's doctors (61 paediatricians in total) and a questionnaire for parents. The data was obtained during compulsory preventive examinations in the course of 2006. The questionnaire included personal and medical history data as well as information on the environment in which the children live. In total, 7,075 children took part in the survey, of which 51 % were boys and 49 % were girls.

An allergic disease diagnosed by a paediatrician occurred in a total of 2,250 children from the monitored group of 7,075, which represents a prevalence of 32 %. The most frequent diseases were pollen-related allergic rhinitis, which affected 13 % of children, and atopic eczema (12 % of children). Both these diagnoses amount to more than 50 % of all diagnosed allergic diseases. The representation of individual diagnoses in the entire set is denoted by Table 4.3 and Fig. 4.2a, while the proportion of diagnoses in the set of children with allergy is given in Fig. 4.2b.

On the whole, a higher prevalence of allergic diseases was found in boys (32.7 %) in comparison with girls (30.8 %), not statistically significant. Boys suffered a higher occurrence of asthma (boys 9.2 % – girls 7.2 %; $p = 0.001$), recurring bronchitis (4.7 % versus 3.5 %; $p = 0.011$) and pollen-related allergic rhinitis (14.5 % versus 10.9 %; $p < 0.001$). There were no differences between boys and girls in terms of the prevalence of atopic eczema, non-pollen-related allergic rhinitis and other allergies (Fig. 4.2a).

Tab. 4.3 Distribution of allergy diagnoses in children, 2006

Single allergy diagnoses	N	%
Allergic pollen rhinitis (pollinosis)	907	12.8
Atopic eczema	872	12.3
Asthma	582	8.2
Relapsing obstructive bronchitis	263	3.7
All-season allergic rhinitis	231	3.3
Other allergies	450	6.4
Multiple allergy diagnoses		
Pollinosis + atopic eczema	245	3.4
Asthma pollinare	221	3.1
Dermorespiratory syndrome	196	2.8
Dermorespiratory syndrome + pollinosis	78	1.1

Four age groups (5, 9, 13 and 17-year-old children) were included in the survey. Thus it was possible to evaluate the prevalence of individual diseases at different ages and a type of allergic disease that affected individual age groups the most. For five-year-old children, there was a 28 % prevalence of allergic disease while this figure was 31 % for nine-year-old children. This difference was not significant. The prevalence of allergies was significantly higher among thirteen-year-olds (35 %) and seventeen-year-olds (34 %) in comparison with both five and nine-year-olds (Fig. 4.2c).

The highest prevalence of **asthma** was found in the thirteen-year-old group (10 %). This represents almost double the amount for that age group in comparison with five-year-old children (6 %; $p < 0.001$). The prevalence of asthma in seventeen-year-olds (8 %) did not differ compared with thirteen-year-olds. The diagnosis of **recurring bronchitis** was singled out separately as a more widely defined clinical case when an asthma diagnosis has still not been determined but the child is monitored and examined with the suspicion of asthma. This diagnosis was used for 263 children (3.7 %). The highest prevalence of **atopic eczema** was found among five-year-old children (14 %) while the lowest was found among seventeen-year-olds (10 %). There is a statistically significant difference between both groups ($p < 0.002$). The prevalence of **pollen-related allergic rhinitis (pollinosis)** increases with age, from 7 % among five-year-olds to 18 % among seventeen-year-olds. Nevertheless, the difference was no longer significant between thirteen-year-olds (16 %) and seventeen-year-olds. When it came to **perennial rhinitis**, there was a significant difference between the prevalence among five-year-old children (2 %) and older children. The highest prevalence was found among thirteen-year-olds (4 %). No age differences were found when it came to other seasonal forms of allergic rhinitis and other allergies. The prevalence of allergic diseases in the selected children's age groups is depicted in Fig. 4.2c.

4.4 Air pollution in cities

Data from 37 localities and a total of 81 measuring stations was processed in 2006. Cities where air quality is monitored are given in Table 3.1 and in Fig. 3.1. For comparison purposes, data on rural background levels from two EMEP stations was also included (EMEP = European Monitoring and Evaluation Program, a co-operative programme for the monitoring and evaluation of the long range transmission of air pollutants in Europe).

A definition of the types of urban localities was also provided. The criteria comprised the rate of traffic in the vicinity of the measuring station and the proportion of individual types of sources of heating or the burden caused by a significant industrial source. Data on air quality for 2006 was processed for selected pollutants (NO_2, PM_{10}, As, Cd, Ni, benzene and benzo[*a*]pyrene) for individual types of localities. Proceeding on the basis of the assumed similarities of concentration characteristics, seasonal behaviour and long-term trends in urban localities with similar topographical features, structure and dynamics of air-pollution sources, traffic burdens and purpose of use, it was possible to draw general conclusions with a certain degree of uncertainty from the outputs obtained.

4.4.1 Inorganic pollutants

4.4.1.1 Basic substances measured

The longstanding observed trends for most of the pollutants studied in the monitored localities continued in 2006. Higher measured values in conurbations are linked to traffic as the majority source being combined with other types of sources (heating plants, boiler plants, domestic heating and industry). This is confirmed by the annual concentration characteristics of nitrogen dioxide and of suspended particulate matter, PM_{10} and $PM_{2.5}$ fraction particles, which exceed the effective limits and the target values in most of the evaluated urban localities. Conversely, the measured values of **carbon monoxide and sulphur dioxide** exceeded the level of 10 % of the limits only in exceptional cases. The annual mean ozone values in monitored urban localities did not exceed 70 µg/m^3 in 2006 and the hourly values did not exceed the value that would give rise to a smog warning (180 µg/m^3) in any of the monitored localities. The annual arithmetic means of the amount of the sum of **nitrogen oxides** ranged between 10 to 60 µg/m^3 in 2006. In rural background stations, they did not exceed 10 µg/m^3. Air pollution caused by the sum of nitrogen oxides is of a stable nature in the long term without any substantial fluctuations or trends.

At least one of the criteria for exceeding the air quality limit for **suspended PM_{10} fraction particles** (an annual arithmetic mean above 40 µg/m^3 and/or more than 35 exceedances of the 24-hour limit of 50 µg/m^3 per calendar year) was fulfilled in 2006 by more than half (46) of the 81 measuring stations included in the data processing (Fig. 4.3a). Analyses of the individual types of urban localities indicate that – depending on the intensity of surrounding traffic – the annual mean value of the concentration of PM_{10} ranged from 28 µg/m^3 in localities not burdened with traffic to more than 35 µg/m^3 in areas with moderate traffic burden. An annual average of 45 µg/m^3 was found in areas with extreme exposure to traffic and of almost 50 µg/m^3 in localities heavily exposed to industry (Fig. 4.3c). A comparison of burden in individual types of residential urban localities (not burdened, burdened with various levels of traffic and industry) clearly proves that traffic is the main cause of air pollution in case of suspended particles in cities. A specific case is the Ostrava-Karviná conurbation, where the usual combination of sources (traffic and local sources) is supplemented by the influence of substantial industrial sources. The value of the annual arithmetic mean at the rural background station (Košetice) was 27 µg/m^3, which – together with 28 exceedances of the 24-hour limit – is fully comparable with the values measured in little burdened urban localities. The increased air pollution in the Czech Republic regarding suspended PM_{10} fraction particles can still be adjudged to be of a widespread nature. The measured values once again increased slightly in comparison with 2005 (Fig. 4.3b) and by estimation almost 80 % of the population in the monitored localities lives in places where the air quality limit is exceeded.

The measurement of **suspended $PM_{2.5}$ fraction particles** continued in 2006 at selected stations in Prague and in further 13 localities. Average annual concentrations in individual localities ranged from 13 to 44 µg/m^3. The value of the ceiling limit 25 µg/m^3 proposed by the EU within the framework of preparing a new general directive was exceeded in six cities. The proportion of suspended $PM_{2.5}$ fraction particles in a PM_{10} fraction ranged from 0.39 to 0.83 with an average of 0.7.

The annual arithmetic mean concentrations of **nitrogen dioxide** in 2006 are given in Fig. 4.4a. Annual mean values at rural background stations did not exceed 10 µg/m^3. Depending on the rate of surrounding traffic, in an urban environment they ranged from 20 µg/m^3 in localities less burdened with traffic to more than 30 µg/m^3 at stations with moderate traffic burdens and as much as 60 µg/m^3 in localities high burdened with traffic (Fig. 4.4b). At the traffic "hotspot", the value of the annual average reached 75 µg/m^3 (Fig. 4.4b). The number of localities with higher values of nitrogen dioxide air pollution is constantly rising.

4.4.1.2 Metals in suspended particles

The level of air pollution caused by heavy metals monitored in the period from 2000 to 2006 is more or less stable in most of the evaluated urban localities without any significant fluctuations. The good conformity between the annual arithmetic and geometric means shows evidence of the relative concentration stability and homogeneity without any major seasonal, climatic or other fluctuations.

The annual values of **arsenic** in cities comprise a relatively homogenous field within the range of 2 to 4 ng/m^3 of the arithmetic mean (30 to 60 % of the target value). These levels are roughly two to three times higher than the annual average of 1.3 ng/m^3 found at background stations. Despite the fact that the annual mean values of **cadmium** did not exceed 1 ng/m^3 (20 % of the target value) in the majority of localities, they were approximately twice the levels measured at background stations (0.2 to 0.3 ng/m^3). The field of annual mean values for **nickel** in cities, which is in the range of 2 to 4 ng/m^3 (10 to 20 % of the target value), can be considered to have increased slightly in comparison with the rural background value (0.6 ng/m^3). The concentration limit set for **lead** and the recommended WHO value were not exceeded in 2006 at even one measuring station. At the background-station level, annual mean values within the range of 5 to 15 ng/m^3 were found at more than half the urban stations. Annual average concentrations of **manganese** at urban stations amounted to 50 ng/m^3, of which more than half the stations were at the natural background level (up to 10 ng/m^3). Values of 112 to 188 ng/m^3 were found in localities influenced by heavy industry (in Ústí n. Labem and Ostrava).

4.4.2 Organic pollutants

Pollutants of an organic nature monitored in the air of selected localities included substances that seriously affect one's health. A number of these include mutagens or carcinogens. They can be bound to fine suspended particles or occur in vapour form.

4.4.2.1 Polycyclic aromatic hydrocarbons (PAHs)

In 2006, the target value for **benzo[*a*]pyrene** (BaP) was exceeded at all urban stations. While this limit was exceeded by double or triple the amount in the majority of urban stations, it was exceeded by five times or more at all stations in industrial areas (Ostrava and Karviná) – see Fig. 4.6a. Annual average concentrations of BaP in cities ranged from 1.0 to 2.8 ng/m^3 virtually independently of the traffic burden level (Fig. 4.6c). In the summertime, the 24-hour concentrations measured did not fall below 0.2 to 0.3 ng/m^3 in localities burdened with traffic. In areas with a higher proportion of emissions from household fireplaces burning solid fossil fuels, the 24-hour concentration exceeded 20 ng/m^3 in the wintertime. Localities burdened with industry had annual mean values that were up to several times higher (2.3 to 11.5 ng/m^3). In these places a 24-hour peak of over 60 ng/m^3 was measured in the wintertime (Fig. 4.6d).

The PAHs include several compounds varying in health significance; those considered as probable carcinogens differ in health effects as well. Based on comparison of carcinogenic effects of the concentrations measured for different PAHs with that of benzo[*a*]pyrene (BaP) as one of the most toxic and best studied carcinogenic polycyclic aromatic compounds, the carcinogenic potential of PAHs in air may be expressed using the **toxic equivalent of benzo[*a*]pyrene** (TEQ BaP). Toxic equivalent factors (TEFs) were used for the calculation of TEQ pursuant to the US EPA. Big differences were shown in the carcinogenic potential of the mix of polycyclic aromatic hydrocarbons expressed as a toxic equivalent of BaP depending on the type locality evaluated. The highest value of 15.9 ng/m^3 per year was found in Ostrava – Bartovice, which represents an area burdened with a substantial industrial source. The trend in the TEQ values in the period 1997 to 2006 is shown in Fig. 4.6b.

4.4.2.2 Volatile organic compounds

The mean concentration of benzene is depicted in Fig. 4.5a. The highest average concentration of 11.5 to 12.0 µg/m^3 was found in Ostrava, where the concentrations were more than double the limit value. While evaluating the measured concentrations of VOCs, the location of measuring stations in relation to the biggest sources of volatile organic compounds was taken into consideration, particularly with regard to benzene, i.e. traffic and heavy industry. In urban areas and localities variously burdened with traffic, concentrations ranged from 2 to 3 µg/m^3, and the concentration was 2.4 µg/m^3 in an extremely burdened "hotspot" in Prague. The annual mean concentrations of benzene are given in Fig. 4.5b. The difference between the effect of various types of sources is evident from the seasonal progress of monthly benzene values in urban stations and stations burdened by industry (Fig. 4.5c). For the most part, the average annual concentrations of other monitored volatile organic compounds had values of up to 10 % of the guideline concentration set by NIPH.

4.5 Evaluation of exposure

4.5.1 Air-quality index

The air-quality index represents a comprehensive evaluation of the state of the air based on limit values and target values set by the annexe to a Government Decree from 2006. The annual arithmetic means of nitrogen dioxide, suspended PM_{10} fraction particles, arsenic, cadmium, nickel, lead, benzene and benzo[*a*]pyrene were included in the calculation. The calculated values for individual types of urban localities indicate a gradual rise in the negative influence of the solid fuels burning in household fireplaces in peripheral urban areas not burdened by traffic. The level of pollution here borders on the second grade (suitable air) and the third grade (slightly polluted air) of air quality index. The gradual intensification of automobile transport has a rising influence in cities, where the values are growing continuously in individual types of urban localities, depending on the rate of traffic. Urban localities with a low to moderate traffic burden (2,000 to 10,000 vehicles per 24 hours) belong to the second grade of air quality index. Locations with a traffic burden of more than 10,000 vehicles per 24 hours and with limited air renewal (street canyons) are in the third grade of air quality. There is a significant contribution of large industrial sources, particularly in combination with the influences of traffic and emissions from small sources. Such example is the Ostrava-Karviná region, where the calculated mean index value is classified in the fourth grade, i.e. in the polluted air grade.

4.5.2 Exposure to air pollutants

The health effects of air pollution depend on the concentration of air pollutants and duration of human exposure. The exposure assessment is complicated by inter- and intra-individual variability. The actual exposure of an individual varies widely over the year and her/his lifetime, depending on job, lifestyle and outdoor/indoor pollutant concentrations. Pollutant concentrations change with the environment (outdoor vs. indoor), locality (city vs. countryside, low traffic vs. heavy traffic areas, industrial vs. non-industrial zones), time (seasonal trends, daily variability) and climatic conditions. Average long-term exposure to pollutants may be expressed as the potential exposure of the population to the average concentration level in a city – as a stratified "supply" at intervals of limit values, for example. The proportion of the population of monitored cities exposed to pollutants from outdoor air at intervals of limit values is shown in Fig. 4.8.

The number of inhabitants whose exposure to nitrogen dioxide is over the limit value is most affected by the Prague conurbation, where the limit value was exceeded at more than half the stations. In 2006, 41 % of the inhabitants of monitored cities were exposed to nitrogen dioxide concentrations of up to 27 $\mu g/m^3$, 18 % of the population lived within the range of 27 to 40 $\mu g/m^3$ and the limit value was exceeded for 35 % of the population.

The population's exposure to suspended PM_{10} fraction particles is still significant in health terms. The criteria for exceeding the annual limit value for PM_{10} fractions were fulfilled by 78 % of the inhabitants of the monitored cities. Exposure to suspended particles can be characterised as being widespread and long-term while mean values are gradually growing.

Of monitored cities 9 % of the inhabitants were exposed to concentrations of benzene in outdoor air that exceeded the limit value in 2006.

4.6 Health risk assessment

Theoretical increase in cancer risk from long-term exposure to outdoor air pollutants was calculated for arsenic, nickel, the sum of polyaromatic hydrocarbons and benzene. The estimate is based on the no-threshold theory concerning the action of carcinogenic substances and it considers the linear relationship between dosage and effect. Unit carcinogenic risk (UCR) values were used for the calculation. These express the size of the risk of an increase in the probability of contracting cancer during lifelong exposure to 1 $\mu g/m^3$ of a carcinogenic substance (Table 4.6a).

For inhabitants of the defined urban locality types, lifelong exposure to individual substances was taken into account at the level of the annual arithmetic means for 2006. The degree of individual risk was calculated. The results are summarised in Table 4.6b. The value of individual risk

Tab. 4.6a Unite cancer risk (UCR) values

Pollutant	UCR	Pollutant	UCR	Pollutant	UCR
Arsenic	1.5E-03	Benzo[*a*]anthracene	1.0E-04	Dibenz[*ah*]anthracene	1.0E-03
Nickel	3.8E-04	Benzo[*b*]fluoranthene	1.0E-04	Chrysene	1.0E-06
Benzene	6.0E-06	Benzo[*k*]fluoranthene	1.0E-05	Indeno[*1,2,3-cd*]pyrene	1.0E-04
Benzo[*a*]pyrene	8.7E-02	Benzo[*ghi*]perylene	1.0E-06		

Tab. 4.6b Individual risk assessment of exposure to carcinogenic pollutants in outdoor air

Pollutant	Rural background level	Urban minimum level	Urban mean level	Urban maximum level
Arsenic	1.88E-06	9.67E-07	4.14E-06	1.99E-05
Nickel	2.30E-07	1.90E-07	1.29E-06	4.40E-06
Benzene	–	7.17E-06	2.11E-05	7.25E-05
Carcinogenic PAHs	7.51E-05	7.00E-05	2.34E-04	1.01E-03

for the evaluated pollutants has been calculated on the basis of concentrations at rural background stations (Košetice and Bílý Kříž) as well as the minimum and maximum value of the health risk for inhabitants of the defined types of urban localities. The average value of individual risk was calculated on the basis of the concentrations of selected carcinogenic substances in all monitored locations.

A theoretical increase in the risk of contracting cancer as a result of exposure to carcinogenic substances from outdoor air is within the order of 10^{-7} to 10^{-3}. Exposure to carcinogenic polyaromatic hydrocarbons is the greatest contributory factor: in the most traffic-burdened urban localities a risk increase as much as one case per thousand inhabitants has been found.

4.7 Monitoring of indoor air quality

In the monitored areas, the quality of indoor air was measured in 25 primary schools. There were classrooms and gym-halls in focus. There have been identified 49 compounds. In almost all rooms ethanole, acetone, benzene, toluene, ethylbenzene, xylene, propane, propene, butane and isobutane have been found. The study’s detailed results will be processed in the report for 2007.

4.8 Partial conclusions

The development of acute respiratory diseases in children in the period 1995–2006 more or less stabilised after an initial marked drop in the incidence values in 1995 to 2002. A doctor-diagnosed allergic disease was found in a total of 32 % of children. The most frequent diseases are pollen-related allergic rhinitis and atopic eczema. The results indicate a growth in the number of allergies in all age groups in comparison with the previous survey in 2001.

The air quality in the monitored localities deteriorated slightly in 2006 in comparison with the previous year, particularly by those substances the emission of which is directly linked to a traffic, i.e. suspended particles, polycyclic aromatic hydrocarbons and nitrogen dioxide. The target value for benzo[*a*]pyrene is often significantly exceeded on a long-term basis at most measuring stations. According to an evaluation of the health risks from substances with a potential carcinogenic effect, the highest values of the individual risk of contracting cancer as a result of exposure to polyaromatic hydrocarbons were found. An increase is roughly of 2 cases per 10,000 inhabitants. The risk value was one order of magnitude lower for benzene (an increase of 2 cases per 100,000 inhabitants). Even though the slight increase compared with 2005 was caused by the inclusion of stations substantially exposed to industry, the values do warrant attention, particularly because the difference between normal urban localities and industry-burdened localities often does not exceed one order of magnitude.

Fig. 4.1a Treated cases of acute respiratory diseases (excluding influenza) in children 1–5 years of age, 2006

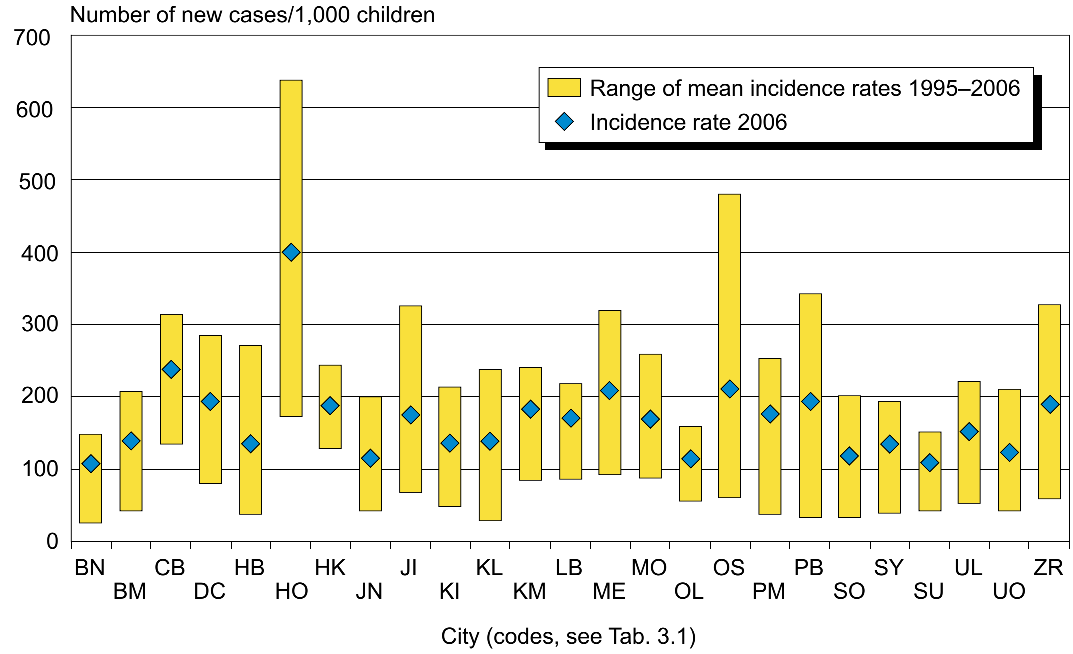


Fig. 4.1b Trend in treated cases of acute respiratory diseases in children, comparison with the mean year 1995–2006

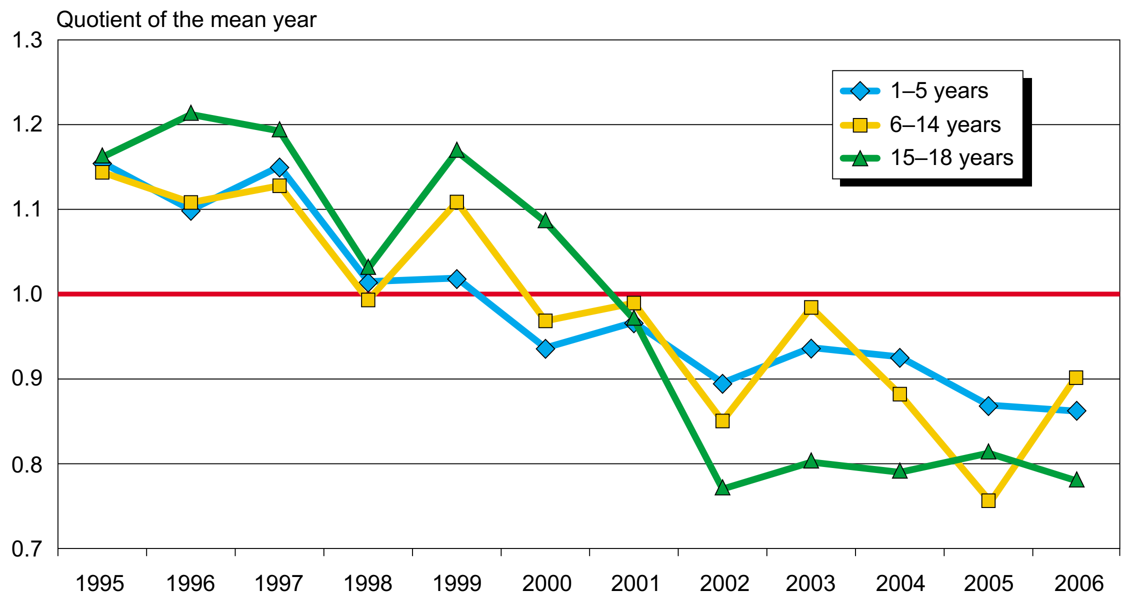


Fig. 4.2a The rate of children with allergy in the total study sample, 2006

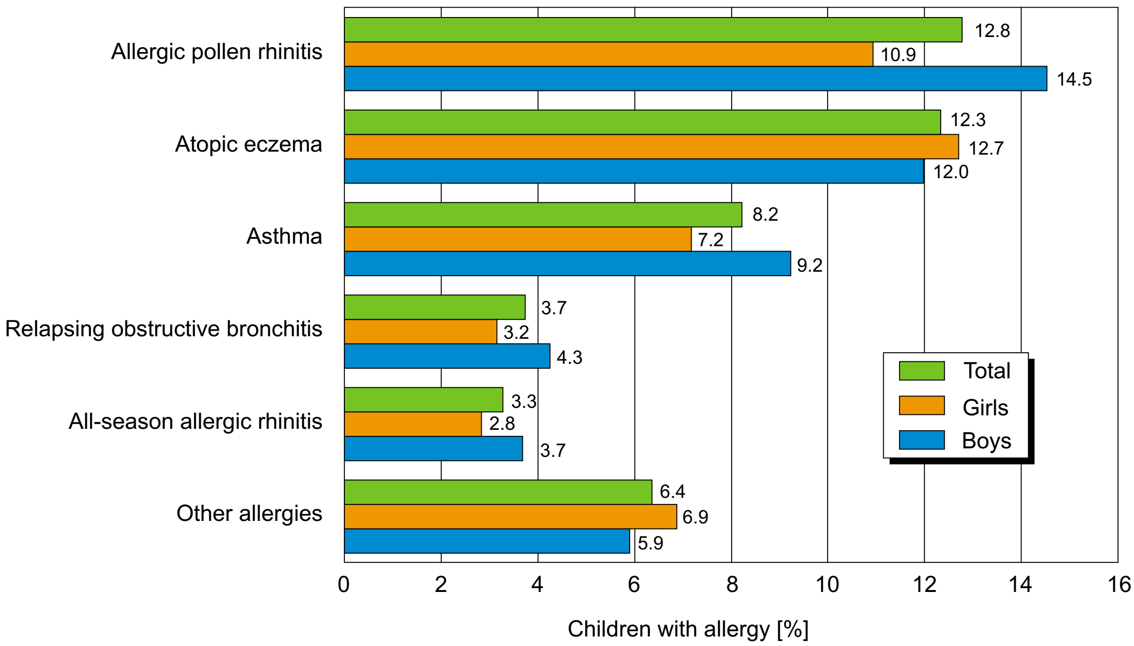


Fig. 4.2b Distribution of allergic diseases in the set of allergic children, 2006

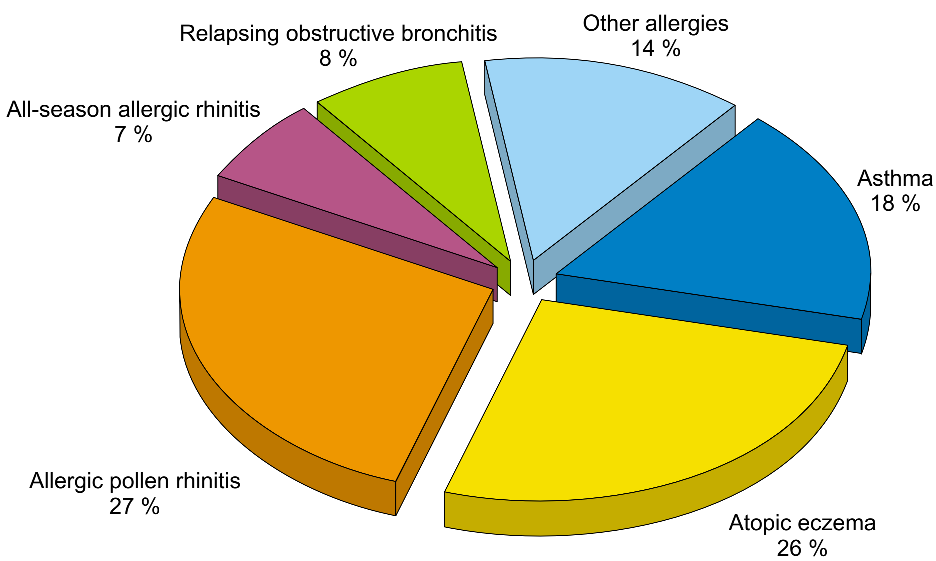


Fig. 4.2c Prevalence of allergic diseases in the different age groups, 2006

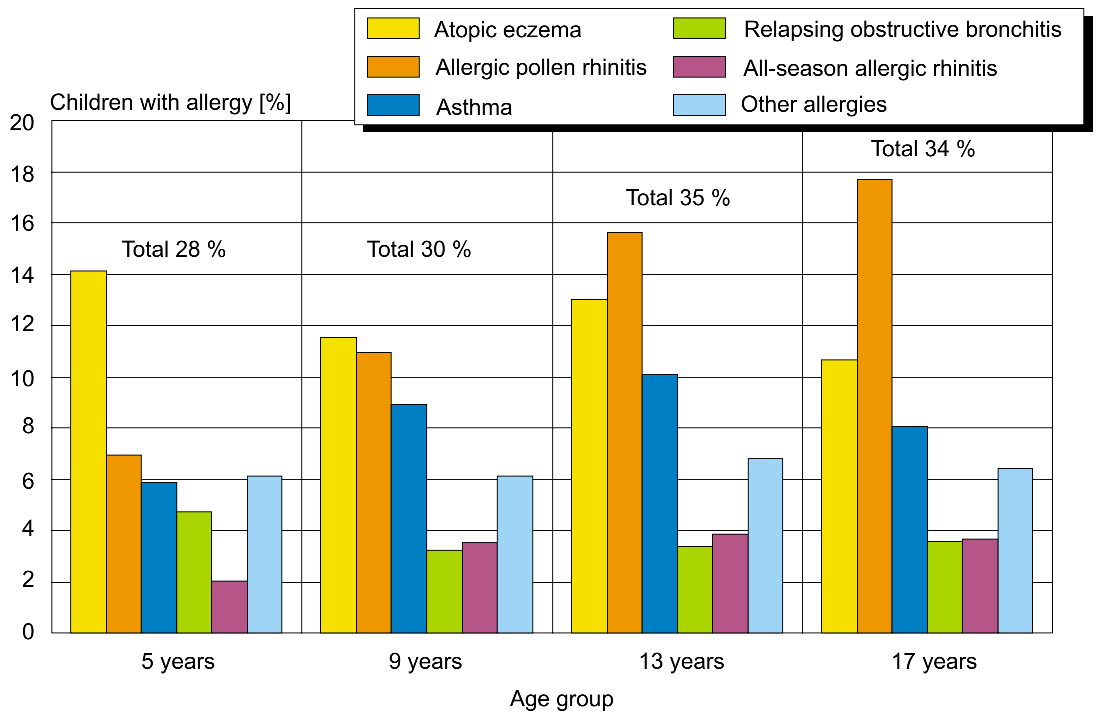


Fig. 4.2d Prevalence of allergic diseases in the cities

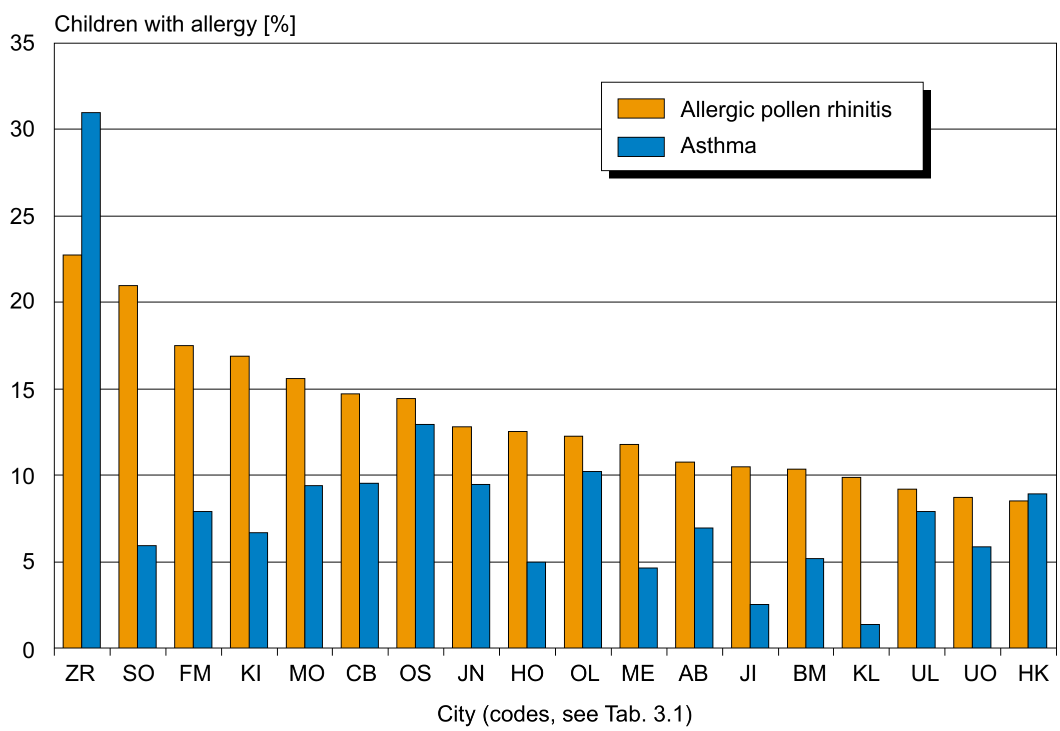


Fig. 4.3a Particulate matter PM_{10} in outdoor air, frequency of 24-h limit exceedances

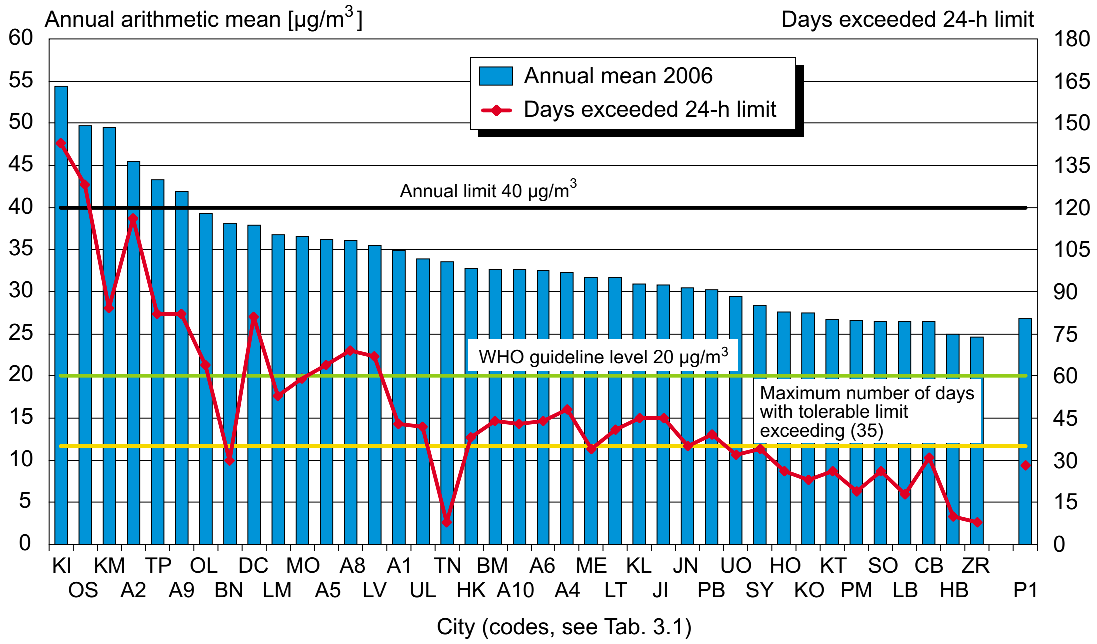
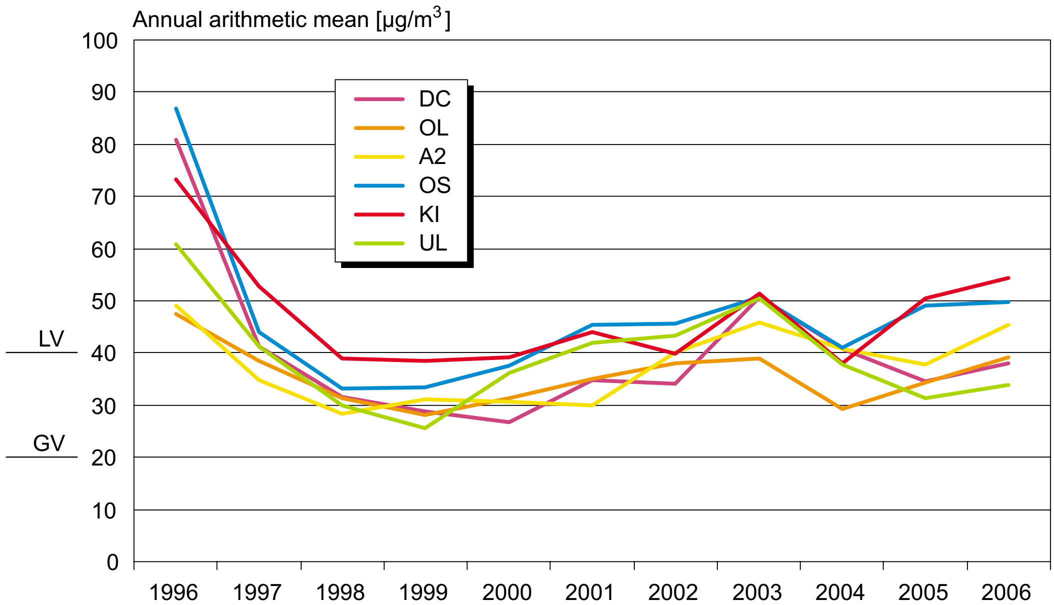


Fig. 4.3b Trend in PM_{10} air pollution in the most polluted cities



Note: A representative Prague district included
LV – limit value
GV – WHO guideline value

Fig. 4.3c Annual concentrations of particulate matter PM_{10} by type of the urban station, 2006

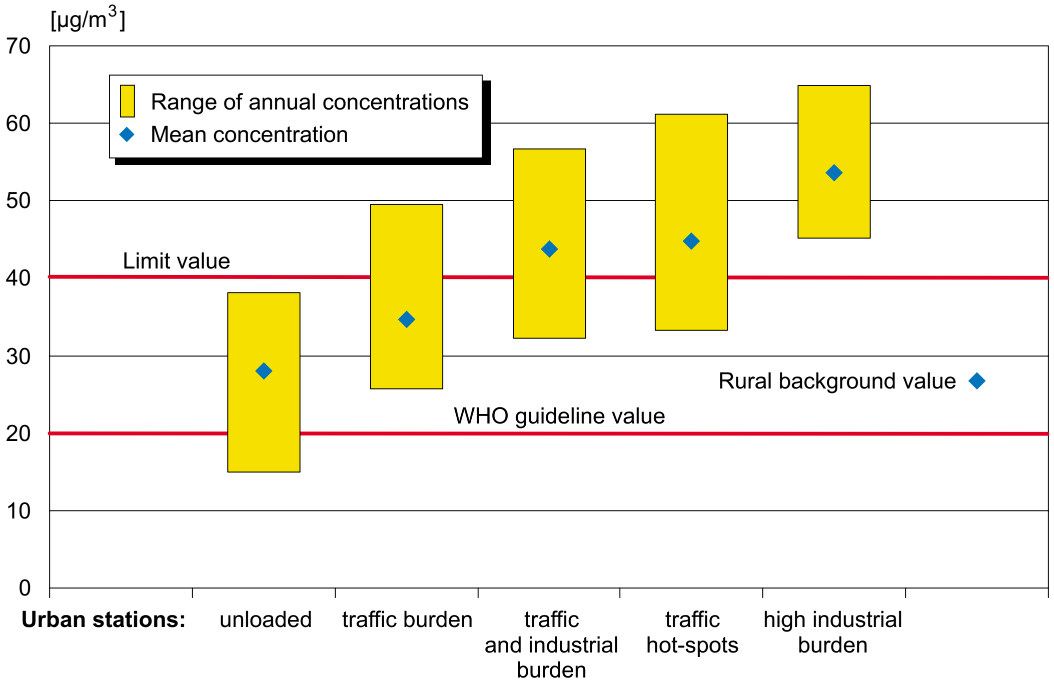


Fig. 4.4a Nitrogen dioxide in outdoor air, 1995–2006

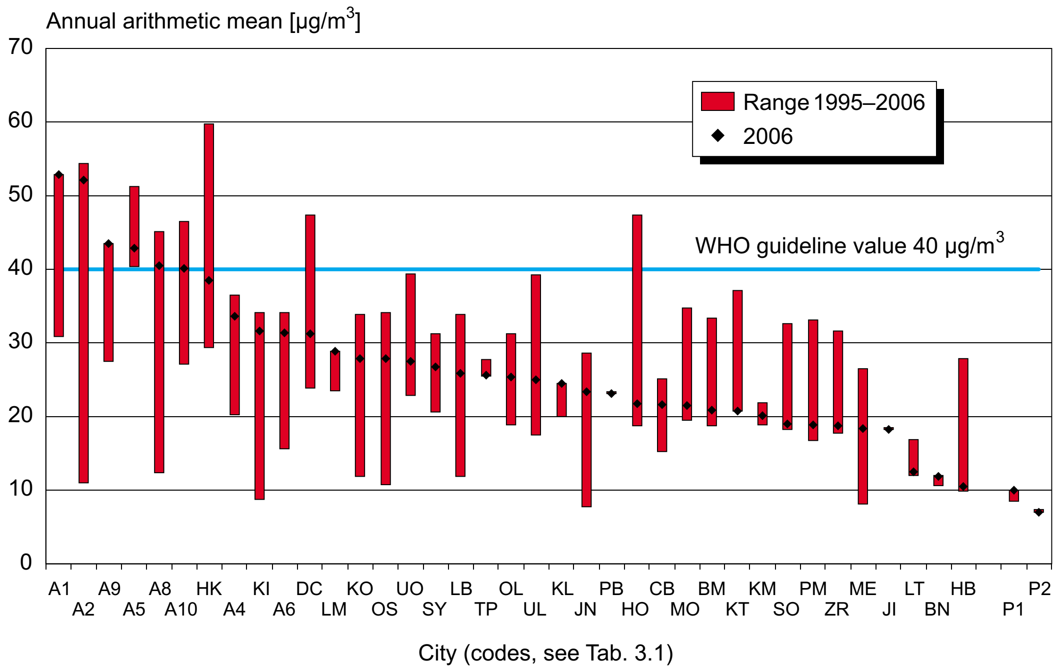


Fig. 4.4b Annual concentrations of nitrogen dioxide by type of the urban station, 2006

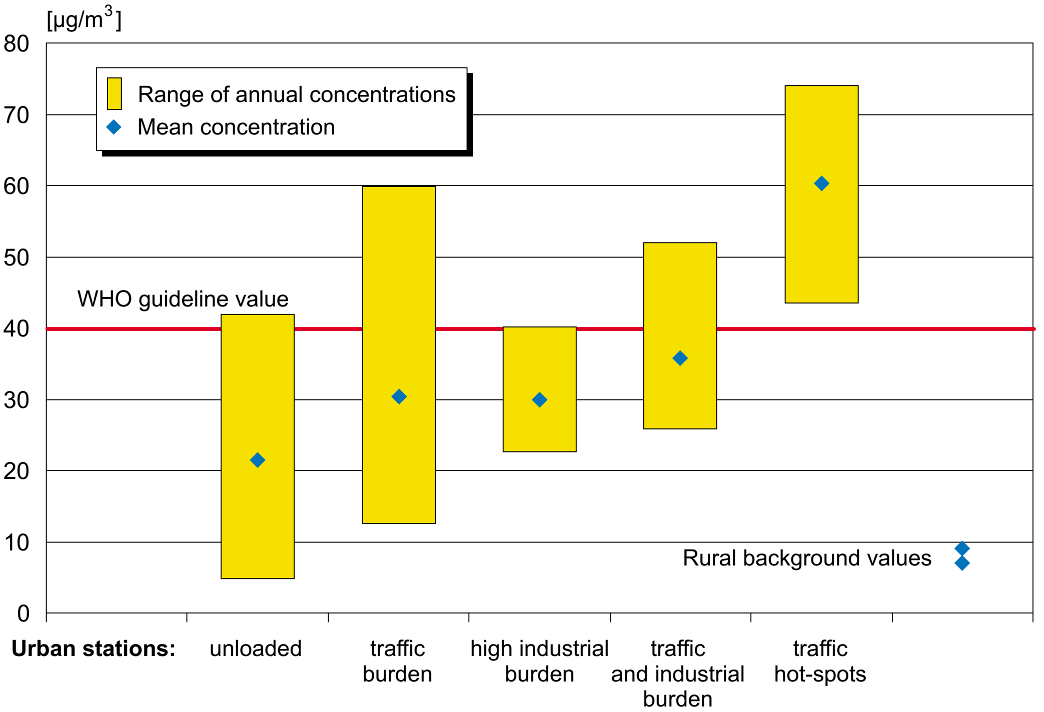


Fig. 4.5a Benzene in outdoor air, 2006

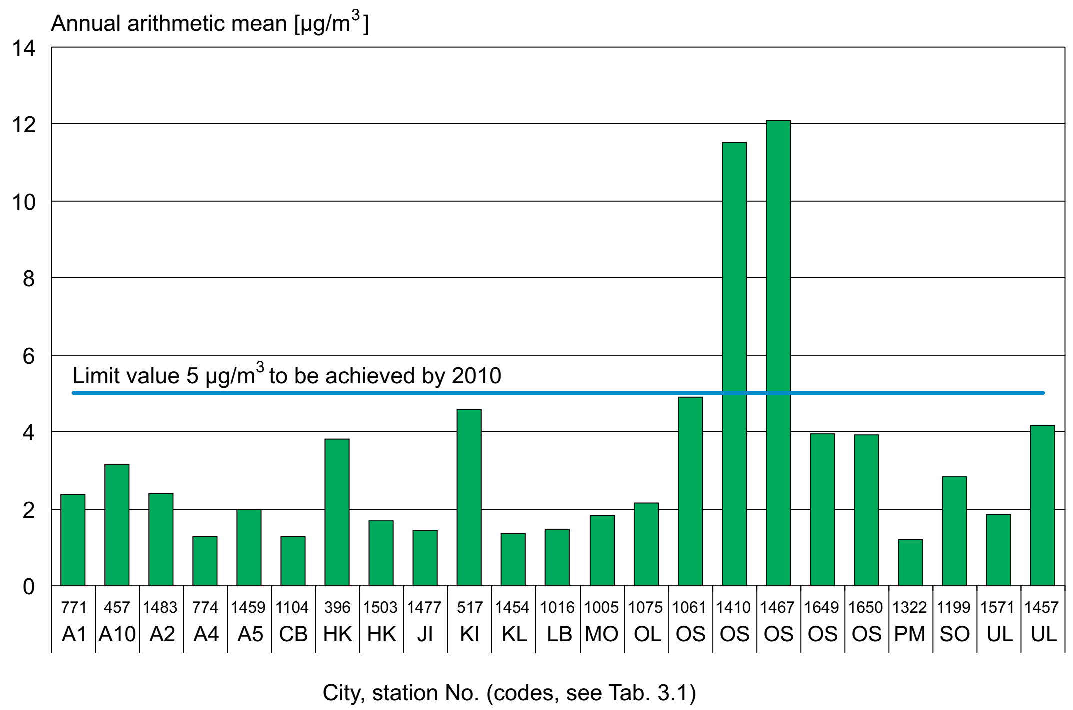


Fig. 4.5b Annual concentrations of benzene by type of the urban station, 2006

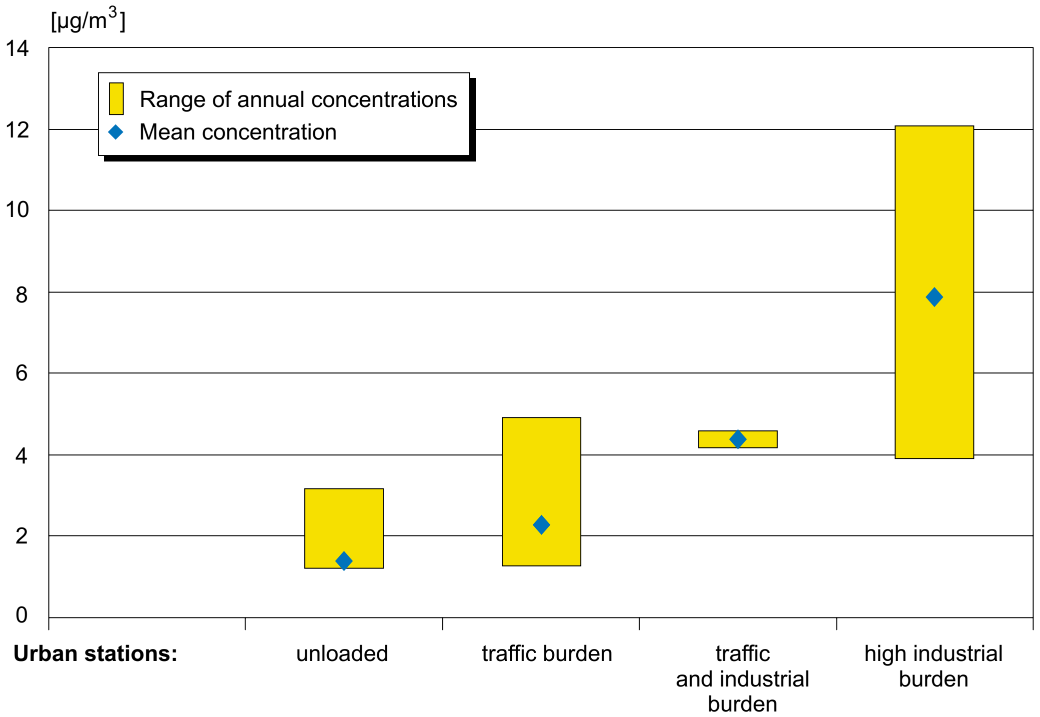


Fig. 4.5c Seasonal trend of benzene by type of the urban station, 2006

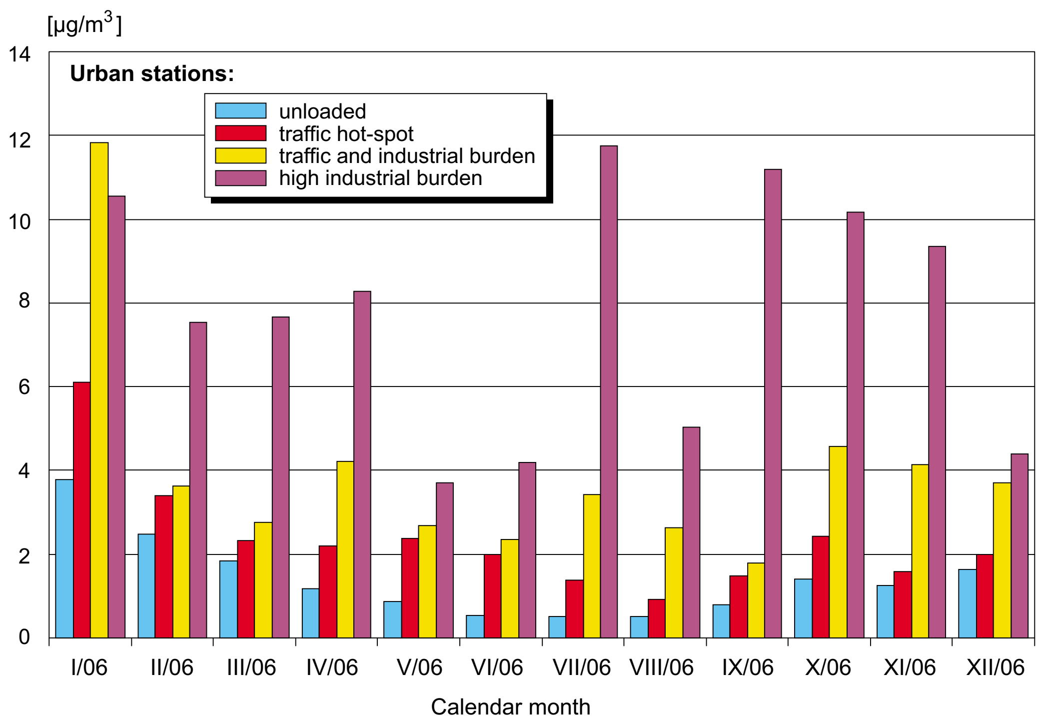


Fig. 4.6a Polycyclic aromatic hydrocarbons (PAHs), annual arithmetic mean 2006

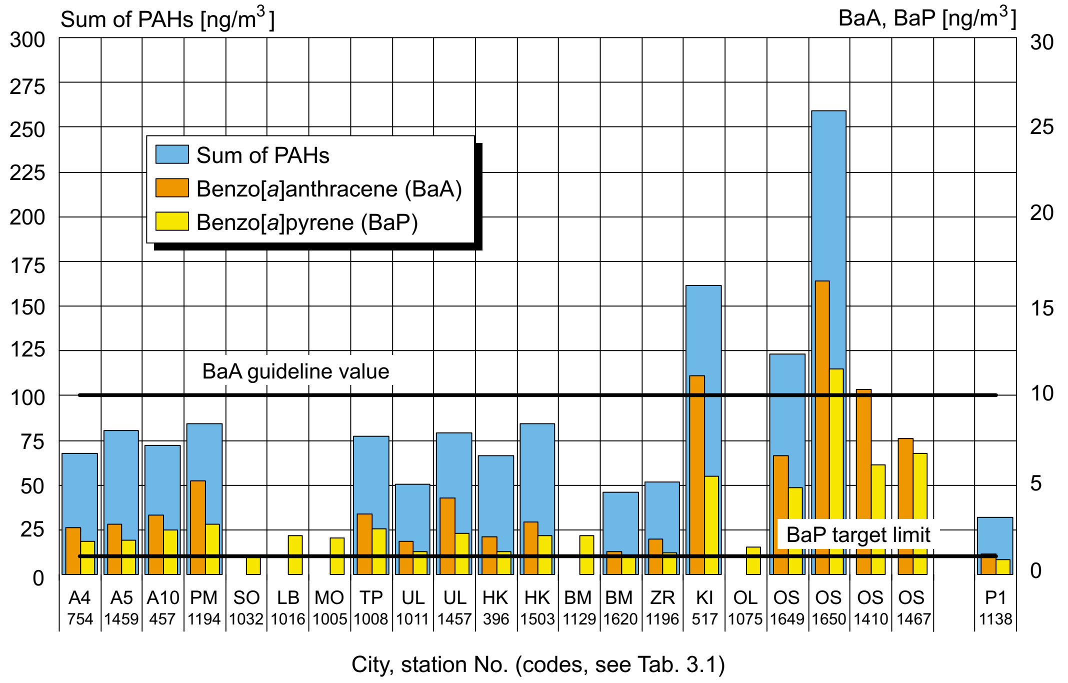


Fig. 4.6b Benzo[a]pyrene equivalent concentration of PAHs

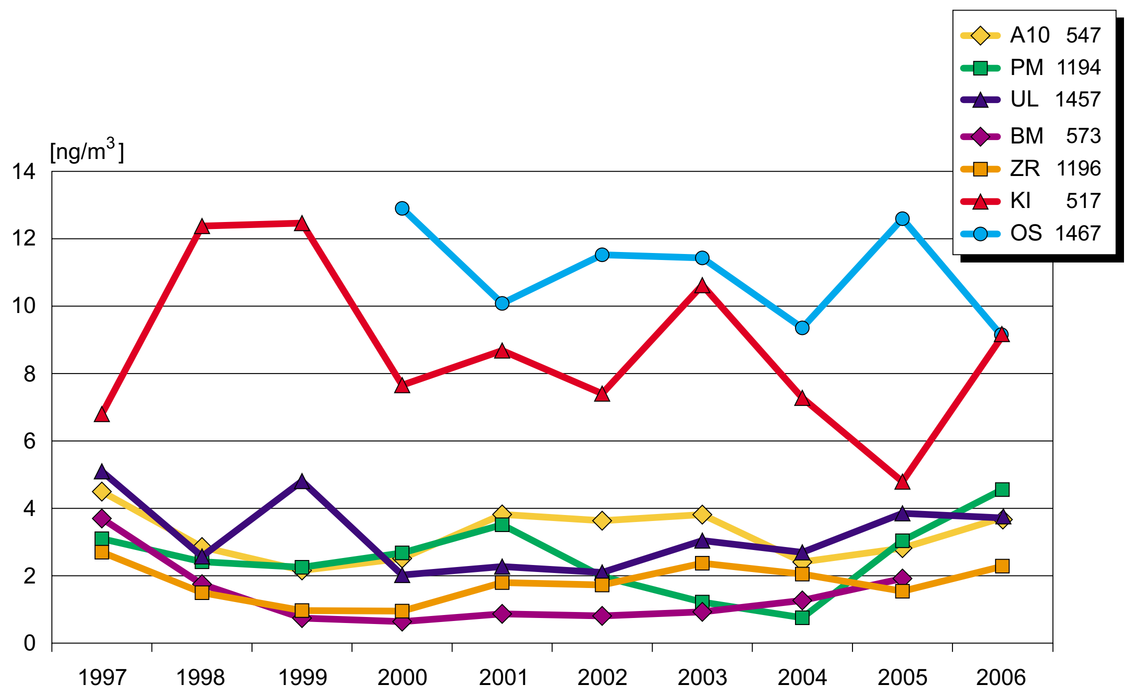


Fig. 4.6c Annual concentrations of benzo[*a*]pyrene by type of the urban station, 2006

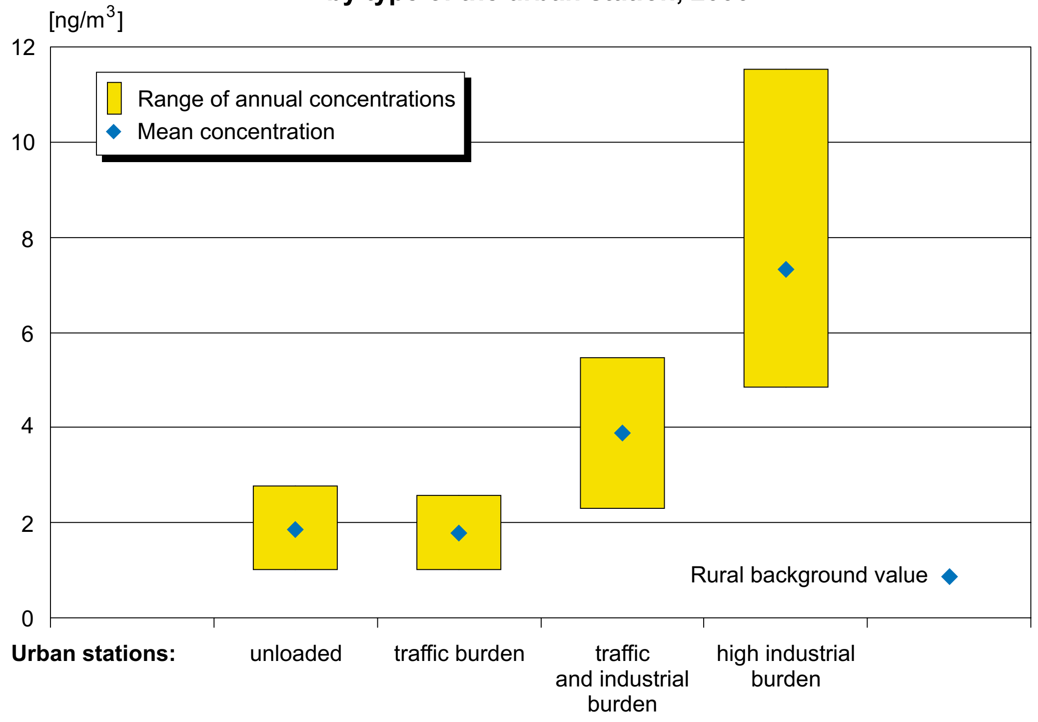


Fig. 4.6d Seasonal trend of benzo[*a*]pyrene by type of the urban station, 2006

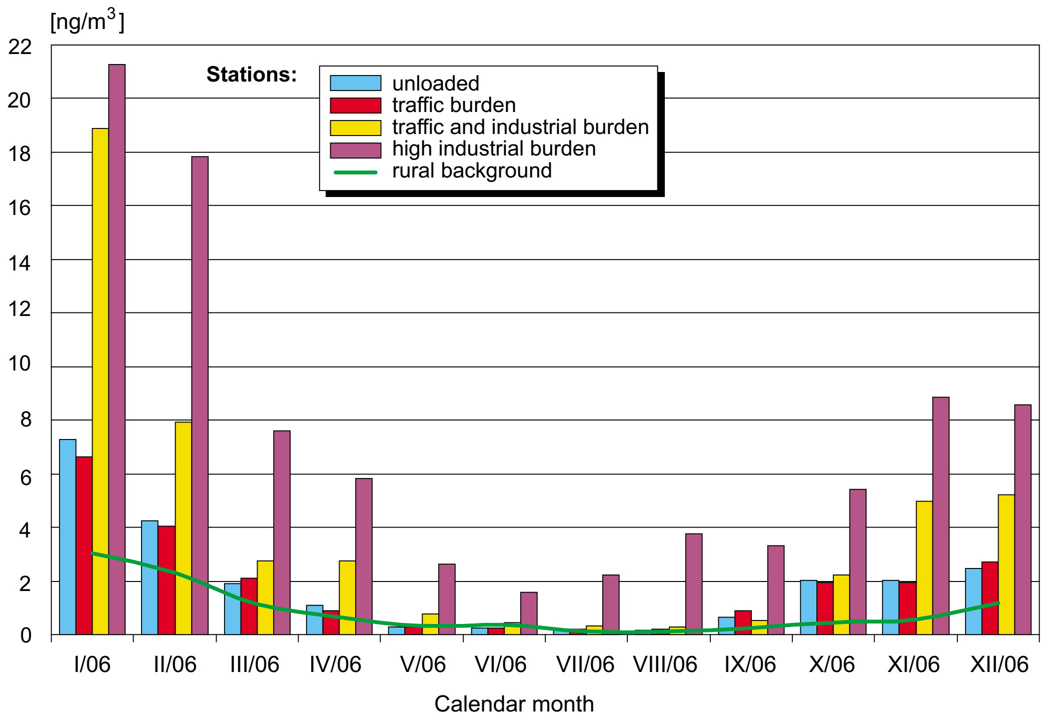


Fig. 4.7 Air Quality Index, 2006
(involved PM_{10}, NO_2, As, Cd, Pb, Ni, BaP, benzene)

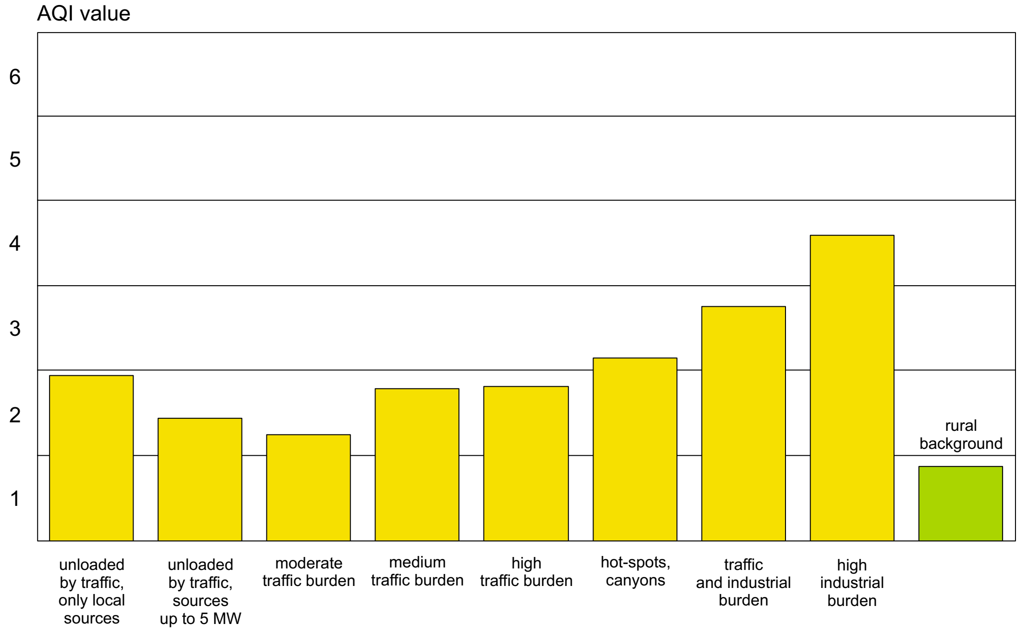
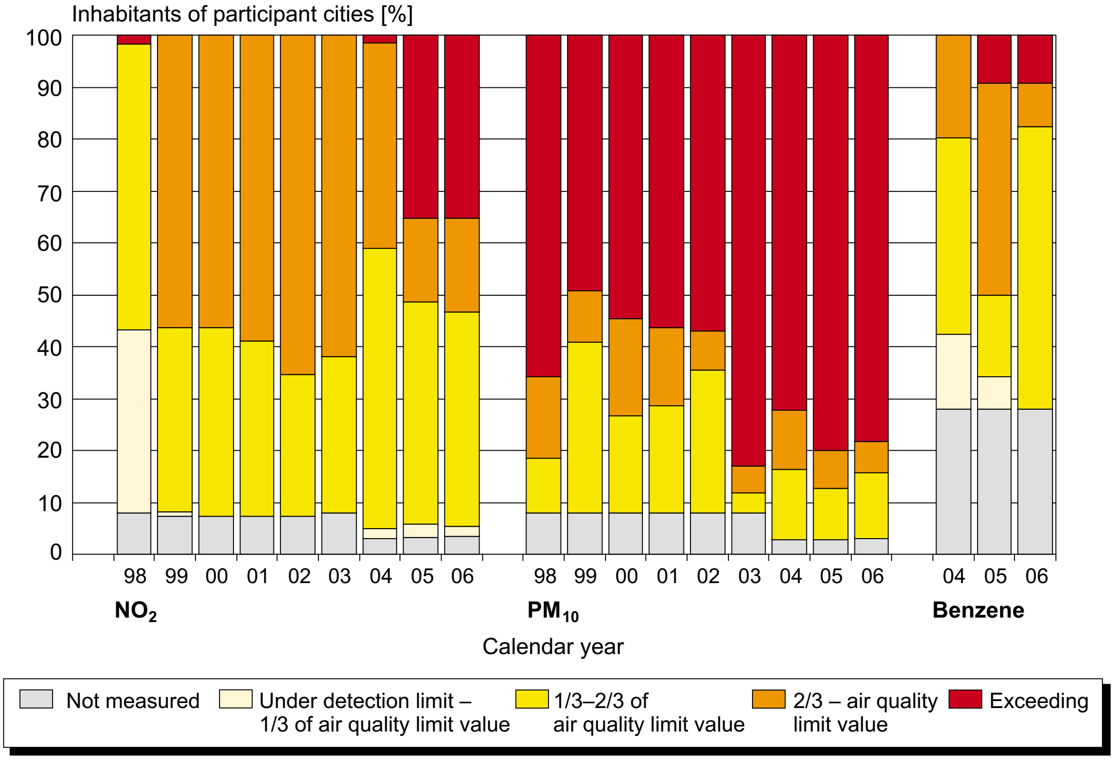


Fig. 4.8 Distribution of population in participant cities by potential exposure to air pollutants (at annual limit intervals)



5. HEALTH EFFECTS AND RISKS DUE TO DRINKING WATER POLLUTION

5.1 Organization of monitoring activities

Since 2004, data on the quality of drinking water has been obtained within the framework of monitoring the public supply of drinking water in the Czech Republic by means of an information system (IS PiVo) maintained by the Ministry of Health. The basic unit for assessing the quality of drinking water in public water mains is the supplied area. In 2006, a total of 4,077 supplied areas were monitored. The overwhelming majority of supplied areas (3,795) are so-called smaller areas, in which less than 5,000 inhabitants are supplied. Only 282 supplied areas belong to the so-called larger categories (supplying more than 5,000 inhabitants). Nevertheless, 80 % of the inhabitants of the Czech Republic who are supplied by public water mains are connected to these larger water-supply areas.

In 2006, 92.4 % of the inhabitants of the Czech Republic were supplied with drinking water from public water mains. Data on the quality of drinking water was obtained for 9.6 million inhabitants, i.e. data was obtained from the majority of public water mains in the Czech Republic. A more detailed breakdown of the total number of supplied inhabitants and the number of samplings in 2006 depending on the size of the water mains is given in Fig. 5.1.

Czech Ministry of Health Decree No. 252/2004 Coll., as amended, is the mandatory basis for evaluating the quality of drinking water. This decree is fully harmonised with Directive 98/83/EC on the quality of water intended for human consumption. The State Office for Nuclear Safety's Decree No. 307/2002 Coll., on radiation protection, as amended, is the basis for evaluating radiological indicators.

5.2 Water-borne diseases

According to data from the database of the EPIDAT information system for the mandatory reporting of the occurrence of infectious diseases, a total of 59,895 infectious diseases were reported in 2006 potentially transmissible by drinking water. This was proven in a total of 135 cases. These infections most frequently concerned gastroenteritis, campylobacteriosis, salmonellosis, leptospirosis and legionnaire's disease. Public water mains were not identified as the source of the infection in a single case.

Data on the number of epidemics of diseases that can be transmitted via water is important and often the only direct information on the impact of water quality on the population health. A prevalence survey on epidemics caused by water-born diseases was carried out in the years 1995–2005. In the given period, 27 epidemics were recorded with a total number of 1,489 reported cases of illness for which drinking water was identified as a transmission path. This concerns the following diseases: viral hepatitis A (263 cases of illness), bacillary dysentery (67 cases of illness), salmonellosis (18 cases of illness), bacterial infections caused by another microorganism (*Citrobacter, Klebsiella, E. coli, Campylobacter* – 105 cases of illness), tularaemia (48 cases of illness) and acute gastroenteritis (988 cases of illness). The results of the study probably represent an under-valuation of the real situation because, although it is not assumed that any serious waterborne epidemics have not been documented, some minor or less-serious epidemics end up not being recorded. On the other hand, the weight of evidence is different by reported epidemics, so that some epidemics are stated with certainty, others as probable or suspected.

5.3 Quality of drinking water

The complying with water quality limit values was evaluated separately for areas supplying up to 5,000 inhabitants (smaller areas) and areas supplying more than 5,000 inhabitants (larger areas). The limit value for the water quality indicators that are important to one's health is called the maximum limit value (MLV). The limit value of indicators that are rather for determining the organoleptic properties of water is called the limit value (LV).

In 2006, more than 36,000 drinking water samplings were carried out, during which more than

837,000 quality-indicator values were obtained. In the larger areas, 0.2 % of the total number of quality assessments exceeded the maximum limit value, 1.3 % exceeded the limit value. In the smaller areas, 1.2 % of the assessments exceeded the maximum limit value and 4 % exceeded the limit value. A more detailed distribution of areas according to the number of inhabitants supplied (see Fig. 5.2a) indicates that the failure to observe water quality limit values occurs more frequently as the number of supplied inhabitants declines. The trend in drinking-water quality supplied by public water mains in the last three years is illustrated in Fig. 5.2b.

In 2006, a total of 67 % of inhabitants were supplied with drinking water from distribution networks that were not found to have exceeded the limit for even one of the health-relevant indicators. On the other hand, more than 56,000 inhabitants (0.6 %) were supplied by water mains where at least one of the health-relevant indicators was found to have exceeded the limit value in all the quality assessments carried out.

In the Czech Republic, 43 % of inhabitants are supplied with drinking water produced from groundwater, 31 % are supplied from aboveground sources and 26 % are supplied from mixed sources (see Fig. 5.3). Generally, the maximum limit value is exceeded most frequently in drinking water produced from groundwater sources.

In larger areas, apart from a failure of compliance the recommended range of water hardness (calcium + magnesium) in more than half the assessments, the limit values for iron (7.3 %) and chloroform (4 %) were exceeded most frequently in 2006. In terms of microbiological indicators, the most frequently exceeded limit values were for the numbers of colonies at 36 °C (3.4 %) as well as the numbers of colonies at 22 °C (1.6 %) and the numbers of coliform bacteria (1.2 %). No limit value for health-relevant indicators (MLV) exceeded 1 % for any indicator.

In smaller areas, the recommended range of water hardness was not observed in 73 % of the assessments. The limit values for the following indicators were frequently found to have been exceeded: pH (15.4 %), iron (9.2 %) and manganese (7.0 %). The same also applies to the following microbiological indicators – coliform bacteria (8.5 %) and the numbers of colonies at 36 °C (6.6 %). The limit values for health-relevant indicators were most frequently exceeded in case of nitrates (6.0 %) and microbiological indicators enterococci (3.4 %) and *Escherichia coli* (2.6 %).

A comparison of the supplied areas indicates that traditionally the limit value for chloroform is more frequently exceeded in larger areas while the limit values for the other quality indicators for drinking water are more frequently exceeded in smaller areas. The frequency at which limit values are exceeded in all areas is depicted in Figs. 5.4a–c.

In terms of a health risk, nitrates and chloroform appear to be the most problematic. The content of nitrates in drinking water was monitored in practically every area. The limit value (50 mg/L) was found to have been exceeded in 4 % of cases. In 223 areas (2 of which were larger areas) supplying a total of 72,000 inhabitants, the calculated annual mean concentration attained or exceeded the limit value for the content of nitrates (with a range of 50–108 mg/L in the areas).

In the case of chloroform, the limit value (30 µg/L) was found to have been exceeded in 2 % of cases in 2006. In 37 areas (8 of which were larger areas) supplying a total of 143,000 inhabitants, the annual mean concentration exceeded the limit value.

At present, more and more information is being obtained on how important the optimum concentration of calcium and magnesium in drinking water is for one's health. From the monitoring it is apparent that only 6 % of inhabitants (Fig. 5.5) are being supplied with the recommended optimum concentration of magnesium (20–30 mg/L) and 20 % are being supplied with water containing the optimum amount of calcium (40–80 mg/L). Water with optimum hardness (2–3.5 mmol/L) is supplied to 27 % of the population. Softer water is distributed to 62 % of the population while harder water is distributed to 11 %.

The content of radionuclides in drinking water produces an effective dose at an average of roughly 0.05 mSv per year, a significant portion of which is as a result of the presence of radon (0.04 mSv per year). Average irradiation as a result of the presence of radon in drinking water is around one hundred times lower than that which ensues from radon penetrating buildings directly from the ground.

In 2006, there were 254 supplied areas recorded in the IS PiVo information system for which an exception approved by a public health protection authority applies. A more lenient hygiene limit than that stipulated by Decree No. 252/2004 Coll. was most frequently set for nitrates (in 126 areas supplying 60,000 population).

5.4 Exposure to selected chemicals

With selected pollutants (arsenic, chloroethene, nitrites, nitrates, aluminium, cadmium, manganese, copper, nickel, lead, mercury, selenium and chloroform) for which an exposure limit recommended by the WHO or the United States Environmental Protection Agency (US EPA) exists, the burden on the population from the intake of drinking water was evaluated. In evaluating the exposure, the average daily consumption of 1 litre of drinking water from the public water mains network was taken into account. This value was ascertained from the HELEN questionnaire survey. The extent of the exposure in each supplied area was obtained by means of the mean concentration (median) and of the ninety-percent quantile of the concentrations of the monitored pollutants in 2006. The average exposure for all areas was then weighted by the number of supplied inhabitants.

Exposure to nitrates clearly predominates in the intake of pollutants from drinking water in the Czech Republic, and it attains values of 6 % of the exposure limit for larger areas and 6.6 % for smaller areas. For a higher than median estimate of exposure (while using the ninety-percent quantile of concentrations), values of 8.2 % of the exposure limit for larger areas and for smaller areas were obtained. An intake of slightly more than 1 % of the relevant exposure limit was ascertained for chloroform in larger areas. Concentrations of the other evaluated pollutants in drinking water often do not exceed the determination limit of the analytical methods used. Therefore it is not possible to quantify exposure to these substances. It is possible to say with certainty, however, that it is less than 1 % of the exposure limit. The trend of drinking water's share in the total exposure of the population to nitrates and chloroform in the period 2002–2006 is depicted in Fig. 5.6.

A distribution of inhabitants according to the level of exposure to pollutants from drinking water in 2006 is given in Fig. 5.7. 25 % of inhabitants supplied with drinking water from public water mains draw more than 10 % of the exposure limit for nitrates while not more than 10 % of the exposure limit is drawn for the other pollutants. No acute damage to the health of the population by the monitored pollutants was found.

5.5 Health risk assessment

To calculate the prediction of a theoretical increase in the probability of contracting cancer as a result of chronic exposure to chemical substances ensuing from the intake of drinking water, a health risk evaluation method was used or, more precisely, the linear no-threshold model of the dose-effect relationship was applied. Of the quality indicators for drinking water given in Decree No. 252/2004 Coll., the following pollutants were selected for evaluation: 1,2-dichlorethane, benzene, benzo[*a*]pyrene, benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, bromodichloromethane, bromoform, chloroethene (vinyl chloride), dibromochloromethane, indeno-[*1,2,3-cd*]pyrene, tetrachloroethene and trichloroethene. Data on the carcinogenic capacity (slope factors) was taken from US EPA.

For the individual pollutants monitored, two values were calculated for an estimate of the contribution to an increase in the cancer risk: the minimum risk estimate (values below the determination limit were replaced by zero) and the maximum estimate (values below the determination limit were replaced by the value of the determination limit). The contribution to a theoretical increase in the probability of contracting cancer as a result of chronic exposure from the intake of drinking water did not exceed values in the order of 10^{-7} for any of the substances evaluated. Bromodichloromethane, vinyl chloride, dibromchloromethane, tetrachloroethane and trichloroethene had the greatest share in the size of the risk. The overall estimate of the increase the risk, which was calculated as the sum-total of the contributions of all the pollutants evaluated, indicates that the consumption of drinking water may theoretically contribute to an annual increase in the probability of contracting cancer which amounts to roughly two additional cancer cases per 10 million inhabitants.

The calculations of exposure and risk were carried out according to a standard procedure. Nevertheless, the factors used to determine exposure are always encumbered with a certain level of uncertainty such as the limited spectrum of health-relevant substances which were monitored, the individual extent of drinking water consumption, the various degrees of absorption of the monitored substances in the body, etc.

5.6 Water quality in public and commercial wells

Within the framework of the nationwide monitoring, data from public and commercial wells has also been collected in the PiVo information system. In 2006, 5,047 samples were taken (111,000 values of indicators) from 333 public wells and 1,934 commercial wells, which is roughly half of the wells on record.

Failures to comply with the limit values for all microbiological indicators of the quality of drinking water were found relatively frequently – *Clostridium perfringens* (2.6 %), enterococci (8.9 %), *E. coli* (5.9 %), coliform bacteria (18,3 %), the numbers of colonies at 22 °C (10.1 %) and the numbers of colonies at 36 °C (13.7 %). As regards other indicators, the limit values of the following indicators were most frequently not adhered to: pH (17.4 %), manganese content (16.1 %), iron (15.6 %), pesticide Desethylatrazine (13.7 %), nitrates (9.3 %) and the recommended water hardness value (79.5 %).

5.7 Partial conclusions

The data obtained within the framework of the nationwide monitoring of water quality in the years 2002 to 2006 indicates that no marked changes occurred in the quality of drinking water distributed by public water mains. The limit values for the content of health-relevant indicators were exceeded in 0.3 % of findings. The limit values of quality indicators primarily characterising the organoleptic properties of drinking water were not observed in 2 % of findings. The failure to comply with the limit values becomes less frequent with increasing the number of supplied inhabitants in an area (sizes of supplied areas).

Exposure to nitrates clearly predominates in the burden on the population of the Czech Republic from the consumption of drinking water. The intake of chloroform exceeded the value of 1 % of the exposure limit in larger supplied areas. No acute damage to the health of the population by the monitored pollutants was found.

According to a calculation of the theoretical increase in probability of contracting cancer as a result of chronic exposure to carcinogenic organic substances from the intake of drinking water, the consumption of drinking water from public water mains may theoretically contribute to an annual increase, which amounts to roughly two additional cases per 10 million inhabitants.

Fig. 5.1 Distribution of supplied population and drinking water samplings by size of supply area, 2006

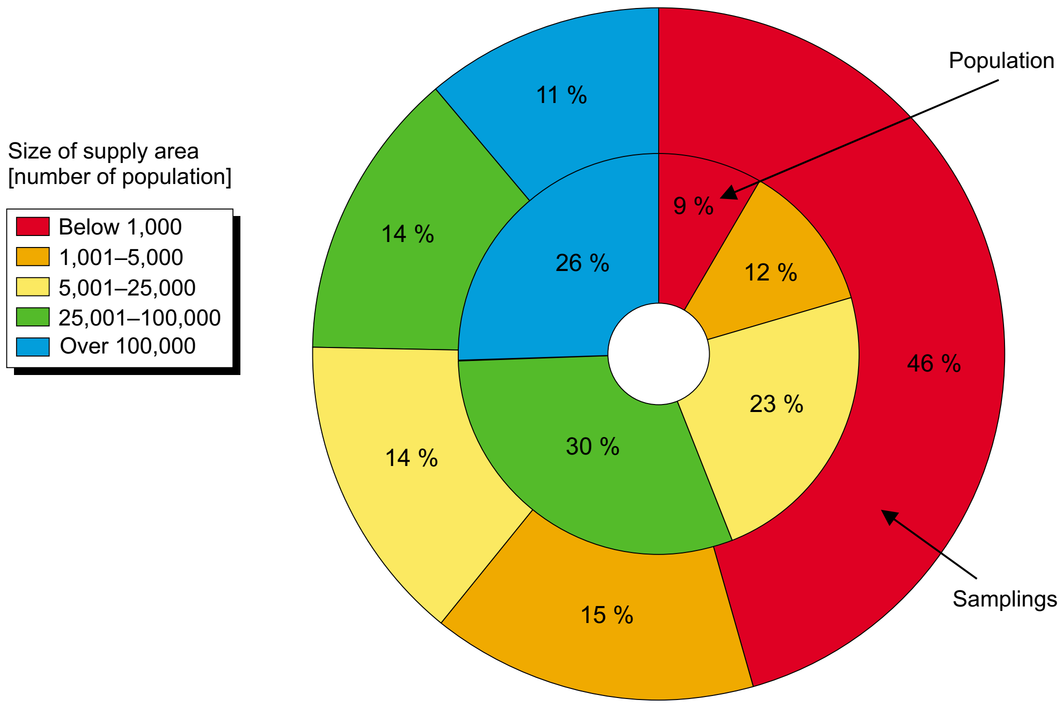


Fig. 5.2a Drinking water quality by the size of supply area – exceedances of the limits

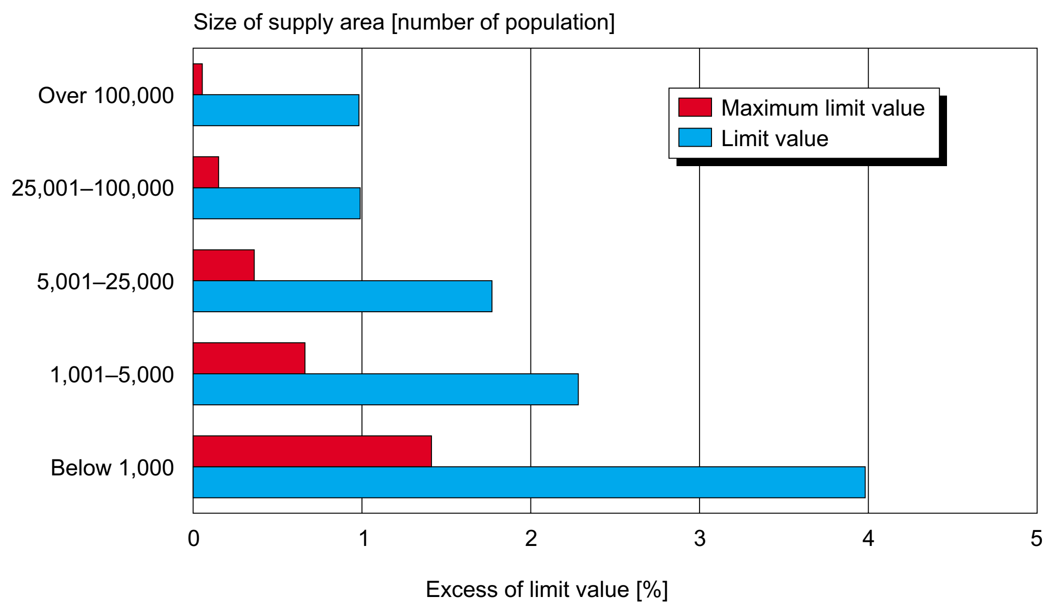
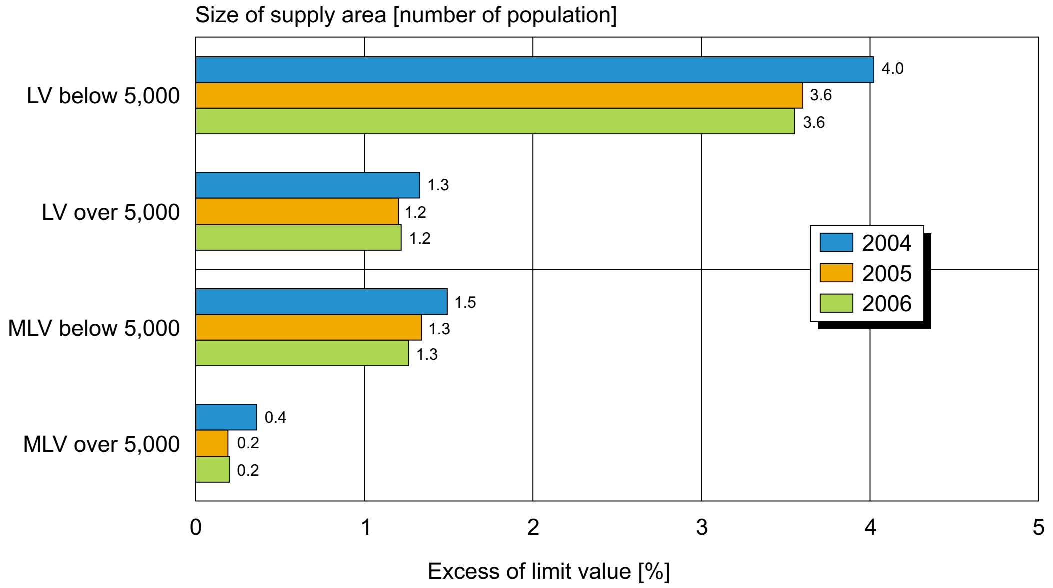


Fig. 5.2b Exceedances of the limits in supply areas (below 5,000 and over 5,000 population) in 2004–2006



Note: LV – limit value, MLV – maximum limit value

Fig. 5.3 Distribution of the population by type of crude water source, 2006

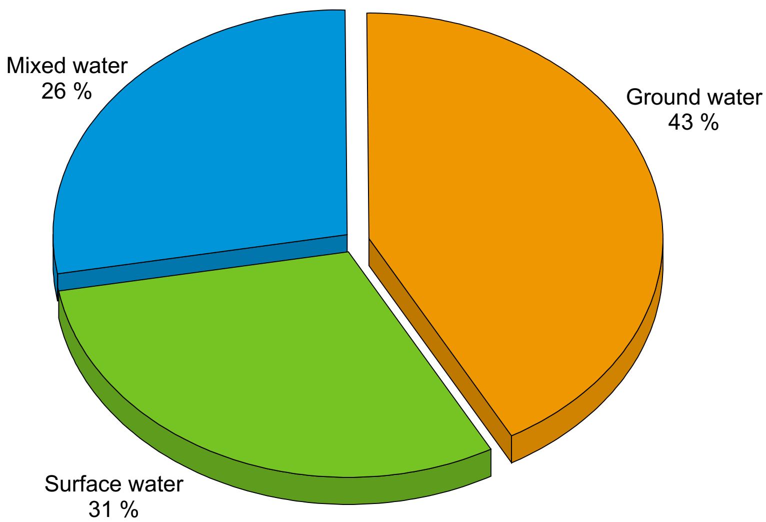


Fig. 5.4a Exceedances of the limits for microbiological and biological indicators

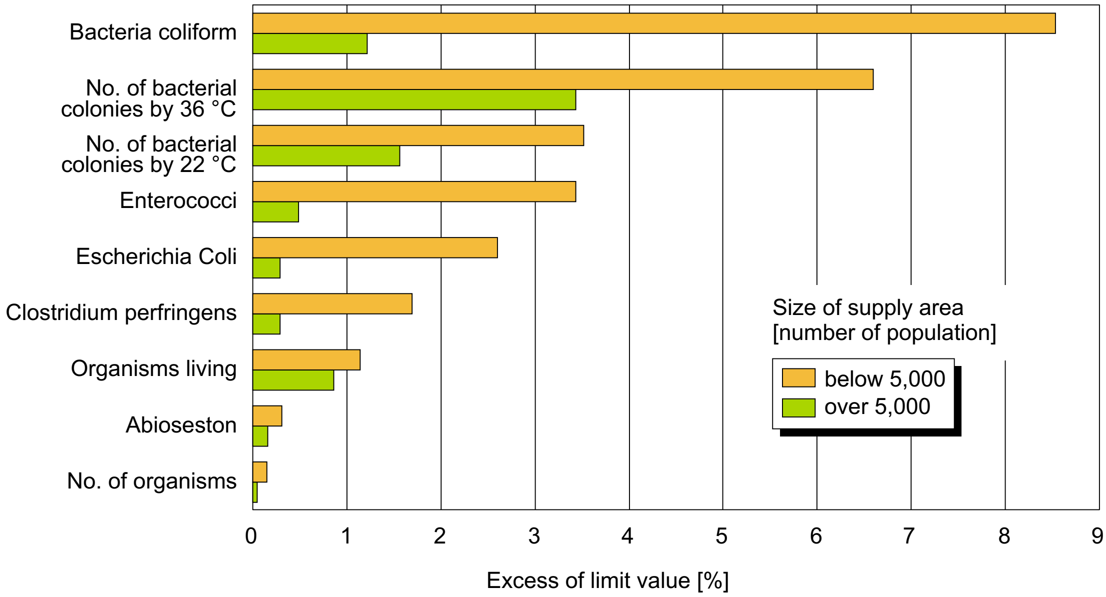
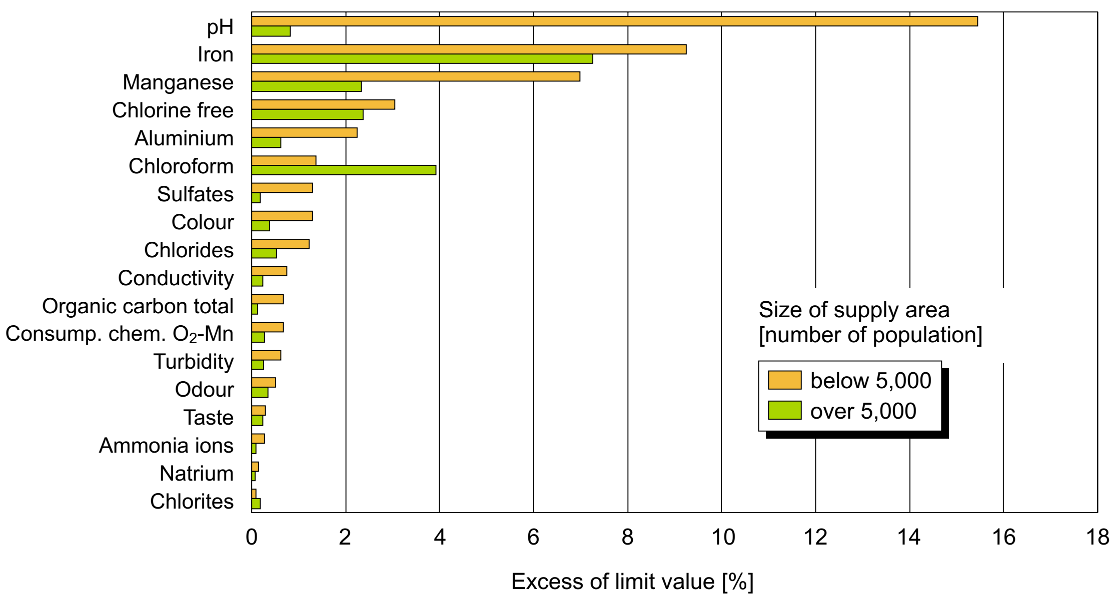
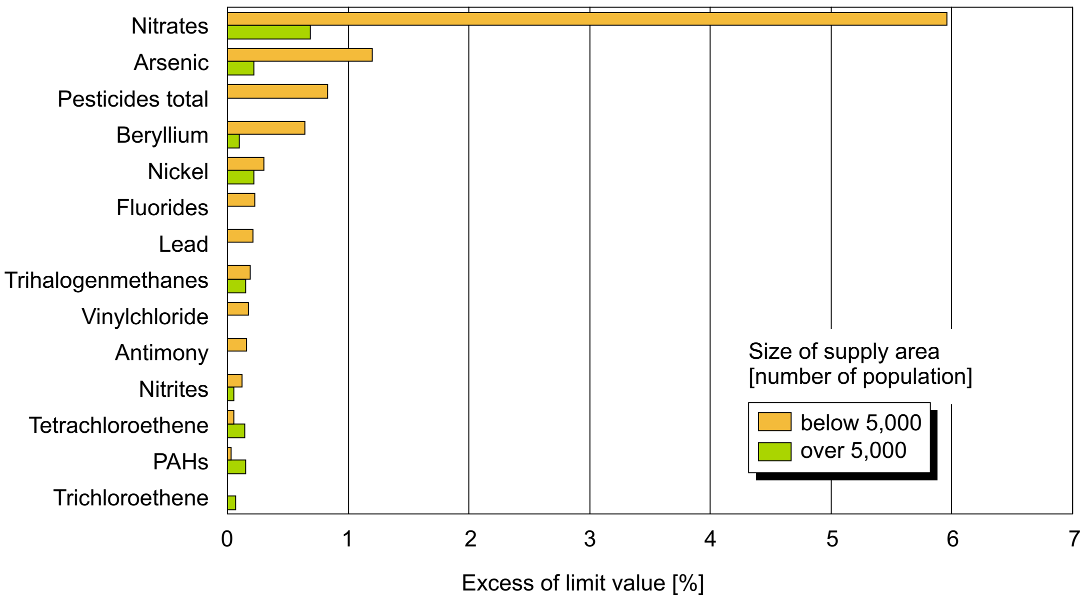


Fig. 5.4b Exceedances of the limits for chemical and physical indicators



No case of excessive values in both types of supply areas: ozone.

Fig. 5.4c Exceedances of the limits for health relevant indicators



No excessive values in both types of supply areas: 1,2-dichloroethane, boron, chromium, cadmium, cyanides, copper, microcystine-LR, silver. No excessive value in supply areas over 5,000 pop. and up to 0.1 % in supply areas below 5,000 pop.: benzene, benzo[a]pyrene, bromates, mercury, selenium.

Fig. 5.5 Distribution of the supplied population by Mg and Ca levels in drinking water

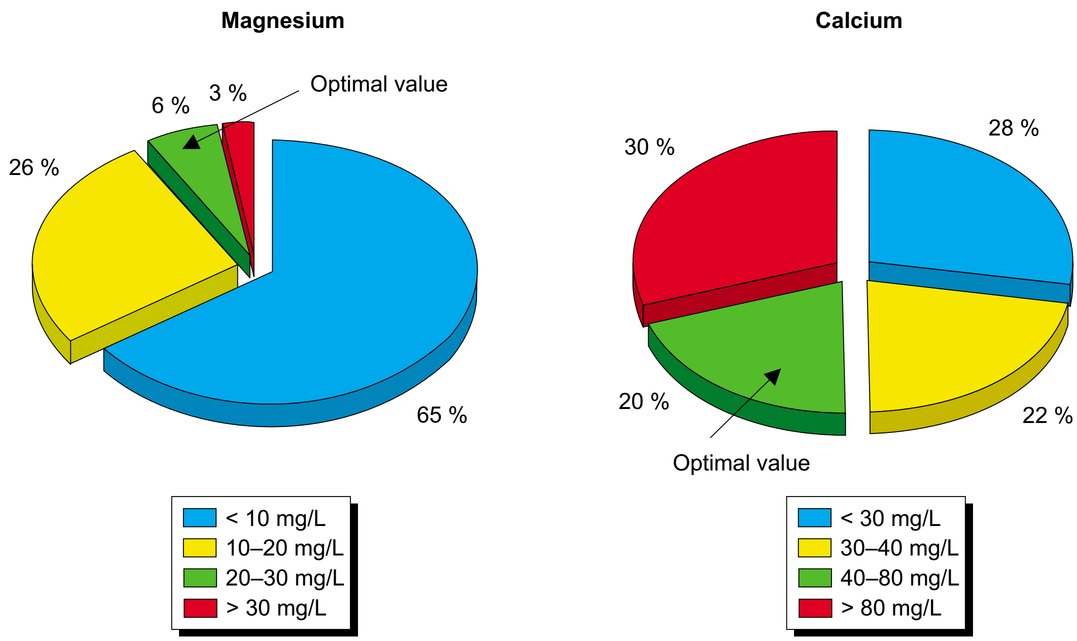


Fig. 5.6 Population exposure to selected contaminants from drinking water, 2002–2006

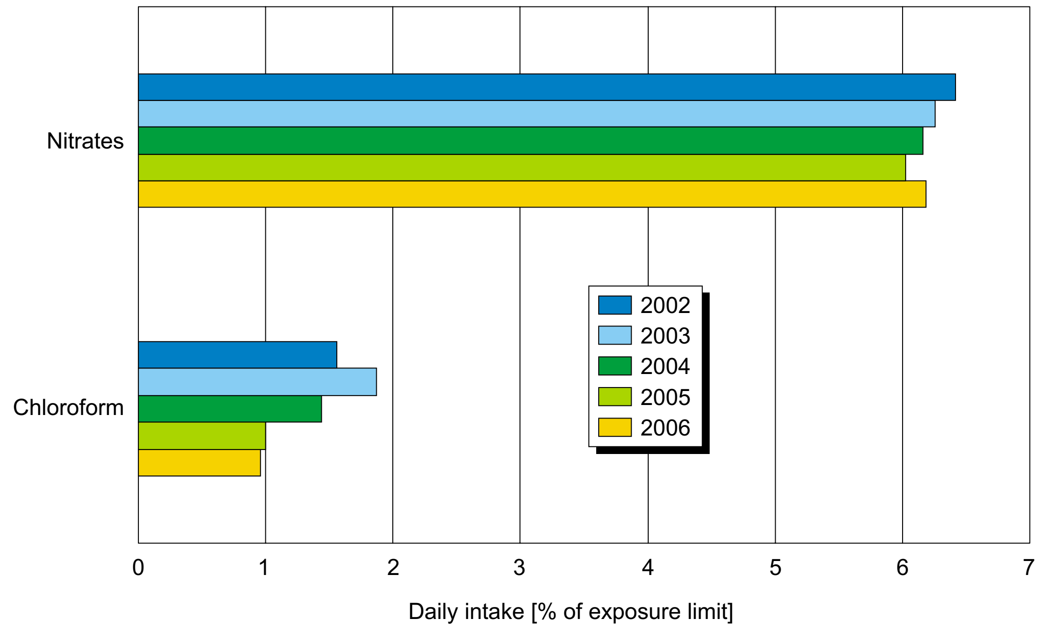
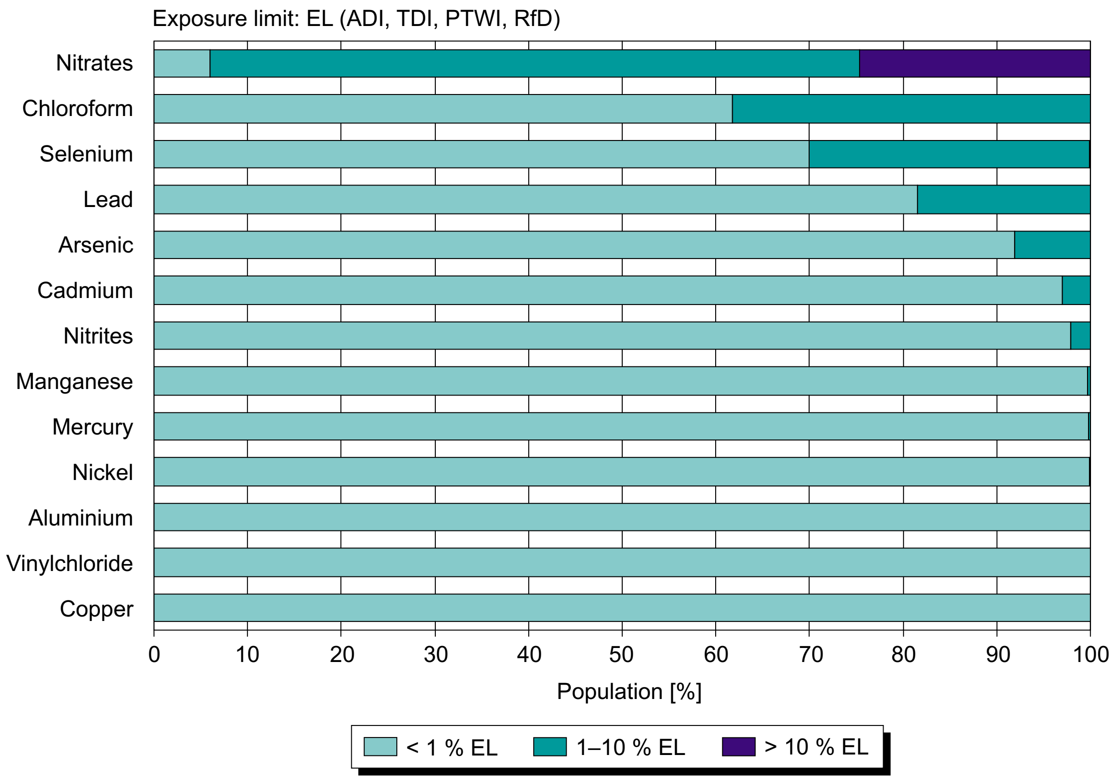


Fig. 5.7 Distribution of the population by the level of exposure to contaminants from the drinking water



Note: Calculated exposure based on ingestion of tap water 1 liter/day

6. NOISE ANNOYANCE AND HEALTH EFFECTS

6.1 Organization of monitoring activities

Subsystem III includes noise monitoring by way of periodically measurements in selected localities, and monitoring the population's state of health and its attitudes to noise pollution through questionnaire surveys. Measurements have been constantly carried out in the past 13 years in 19 cities (in two city districts in Prague). A total of three questionnaire surveys have been held (in the years 1995, 1997 and 2002). The next survey takes place in 2007.

Two basic localities have been chosen in each city – one noisy locality and one quiet one. The criteria for selecting a locality comprised the following:

- the number of inhabitants living in monitored localities – at least 300 people have to reside in the selected localities for the valid statistical evaluation of results;
- the absence of a significant burden caused by other negative factors, e.g. the frequent occurrence of atmospheric inversions or strong emissions;
- a basic similarity between the social, demographic and professional composition of the inhabitants to that of the ordinary population of the Czech Republic.

A measuring location was selected in each locality so that it would be possible by taking repeated measurements to monitor the level of noise in the entire area and the inhabitants' noise exposure ensuing from this. Monitoring is carried by measuring noise for a period of 24 hours. Measurements are always carried out once a month alternately in the noisy and the quiet locality, except for July and August. The required accuracy of the measurements is achieved by using the same measuring technology in all localities and by observing the uniform measurement methodology for subsystem III, which corresponds to methodology guidelines laid down by the chief public health officer in 2001.

6.2 Noise measurement

6.2.1 Noise indicators

Noise is any undesirable sound, which is disturbing or intrusive in nature or which has harmful effects on people's health. The physical essence of a sound is a change in acoustic air pressure which is discernible to the human ear. A noise that is variable in terms of time and which occurs in monitored localities is expressed through the equivalent level of acoustic sound pressure weighted by the filter A, i.e. L_{Aeq}. The equivalent level represents the calculated level of continuous background noise, which has an influence on the recipient using the same energy as the fluctuating level of an actual sound. The A filter is a corrective factor, which takes account of how the sound is perceived by the human ear.

Until the end of 2003, the L_{Aeq} indicator was also used for traffic noise. Subsequently, by way of Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise, it was recommended that new noise indicators should also be used to express traffic noise. These comprise a noise indicator for the daytime: L_{day} (6 am–6 pm), a noise indicator for the evening: $L_{evening}$ (6 pm–10 pm), a noise indicator for the nighttime: L_{night} (10 pm–6 am), and a noise indicator for the day-evening-night L_{den}. The main reason for the introduction of the indicators is that it enables to compare the noise situation in EU member states.

The $L_{day,}$ $L_{evening}$ and L_{night} indicators are calculated as the long-term L_{Aeq} average for all daytime or evening and nighttime periods in one year. In the calculated sample of the L_{den} level, the heightened importance of noise in the evening and nighttime hours is taken into account and 5 or 10 dB respectively are added to the values measured during these times. In this way, the L_{den} indicator harmonises the recommended limits for evening and nighttime hours with the daytime values.

6.2.2 Noise levels

In 2006, the noise levels (levels of acoustic sound pressure) comprised a continuous progression in individual localities. Annual noise levels expressed by the noise indicators $L_{day,}$ $L_{evening}$ and L_{night}

amounted to 74.3 dB in the daytime, 72.9 dB in the evening and 68.3 dB at night in the most noisy localities.

As in previous years, the highest noise levels were found in noisy localities of Pilsen, Olomouc and Prague. The least noisy area was a repeatedly quiet locality in the Kolín area followed by quiet locality in Jablonec n. Nisou and Jihlava. The noise levels ascertained in individual localities in the daytime, evening and nighttime, as expressed by the L_{day}, $L_{evening}$ and L_{night} indicators, are depicted in Figs. 6.1a, 6.1b and 6.1c. A comparison of noise levels in individual localities in the daytime, evening and nighttime is given in Figs. 6.3a and 6.3b.

In expressing the noise in localities using the L_{den} day-evening-night noise indicator, the values found ranged from 50.8 dB to 75.9 dB. The highest noise level was found in a noisy locality of Olomouc, followed by a noisy locality in Pilsen. Conversely, the lowest noise level was found in a quiet locality in Kolín. The second-lowest noise level was found in the quiet Jablonec n. Nisou locality. The noise levels expressed using the L_{den} indicator and the rankings of the monitored localities are shown in Fig. 6.2.

Limit values for the L_{den} and L_{night} indicators are stipulated in Decree No. 523/2006 Coll. dated 21 November 2006 (the decree on mapping noise). For road traffic, which is the most frequent source of noise in the monitored localities, the L_{den} limit value is 70 dB and L_{night} limit value is 60 dB. In 2006, these L_{den} and L_{night} limit values were exceeded by a total of 10 noisy localities. They were not exceeded by any quiet locality.

6.3 Health effects of noise

Recently, noise is one of the most widespread pollutants in both the working and living environments. As with other environmental factors, the human perception of sound is subjective. The auditory analyser serves as an alarm-raising organ. A person receives the overwhelming majority of warning stimuli through his or her hearing. The human organism has no possibility of physiologically switching off its sense of hearing. Even when one is sleeping the central nervous system processes all auditory stimuli. The health effects of a long-term exposure to various noise levels have been monitored by regular questionnaire survey in the noisy and quiet monitoring localities. The past survey was conducted in 2002, the information from 12,000 respondents in 19 cities were obtained. By these surveys the significant relation between noise and the rate of annoyed respondents as well as of those with disturbed sleeping was repeatedly proved.

6.4 Partial conclusions

In individual localities, the ascertained noise levels expressed by the noise indicators L_{day}, $L_{evening}$ and L_{night} ranged between 49.3 and 74.3 dB in the daytime, 44.8 and 72.9 dB in the evening and 42.2 and 68.3 dB at night. In expressing the noise level using the L_{den} indicator, noise levels ranged between 50.8 dB and 75.9 dB. The highest level of noise in the monitored localities has been ascertained over a long period of time in noisy localities of Pilsen, Olomouc and Prague. The limit value for road-traffic noise (L_{den} =70 dB, L_{night} = 60 dB) was exceeded in 10 out of 19 noisy localities.

Fig. 6.1a Noise descriptor – daytime L_d (6.00 am–6.00 pm)

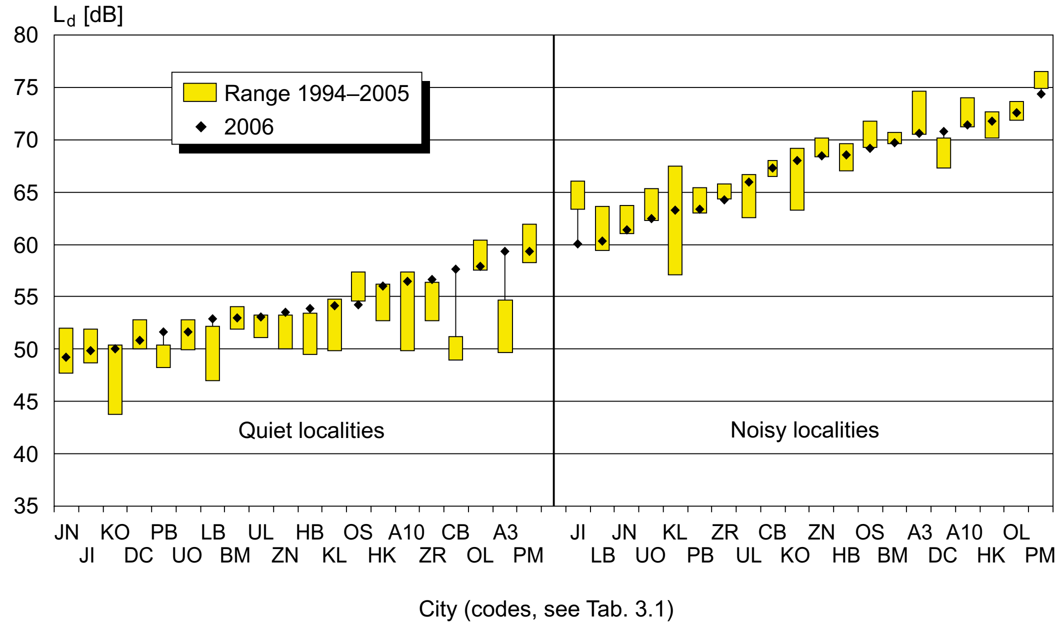


Fig. 6.1b Noise descriptor – evening L_e (6.00 pm–10.00 pm)

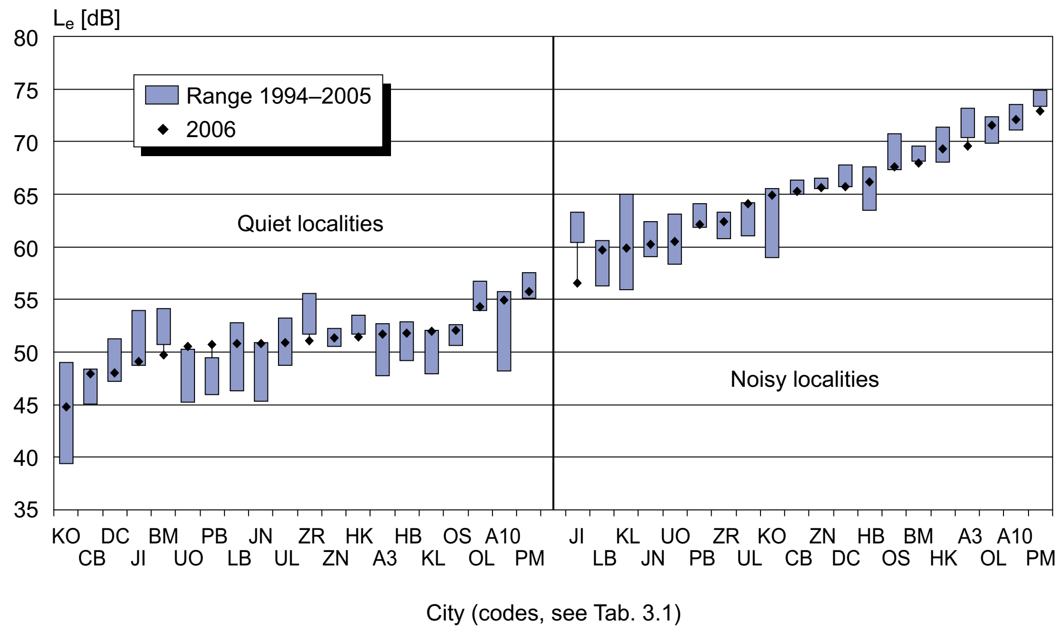


Fig. 6.1c Noise descriptor – night-time L_n (10.00 pm–6.00 am)

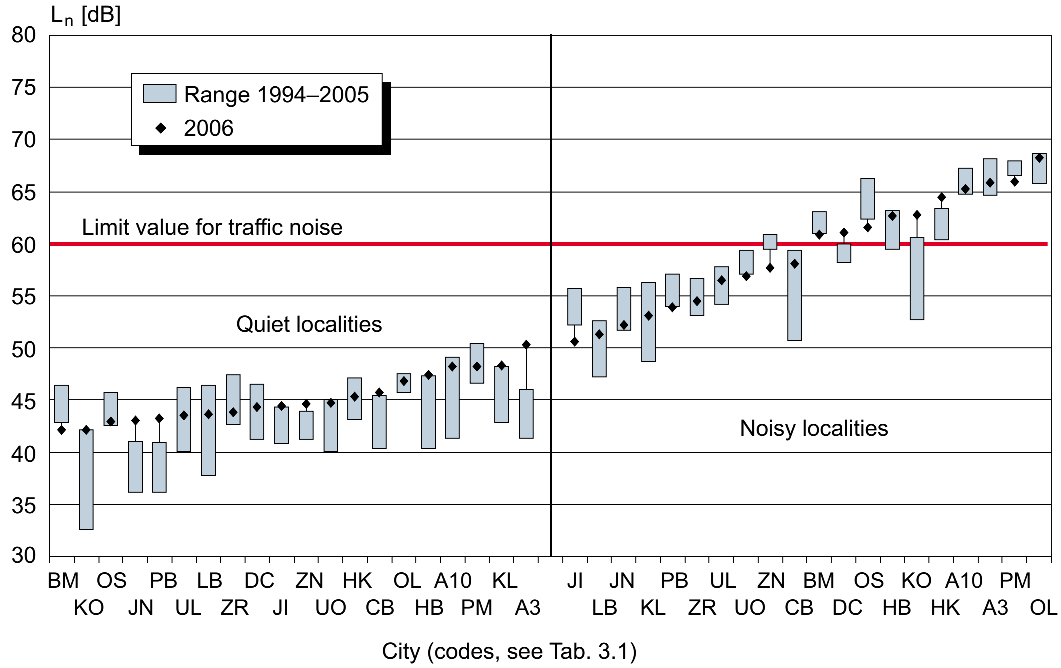


Fig. 6.2 Noise descriptor – day – evening – night period L_{den} (24 hours)

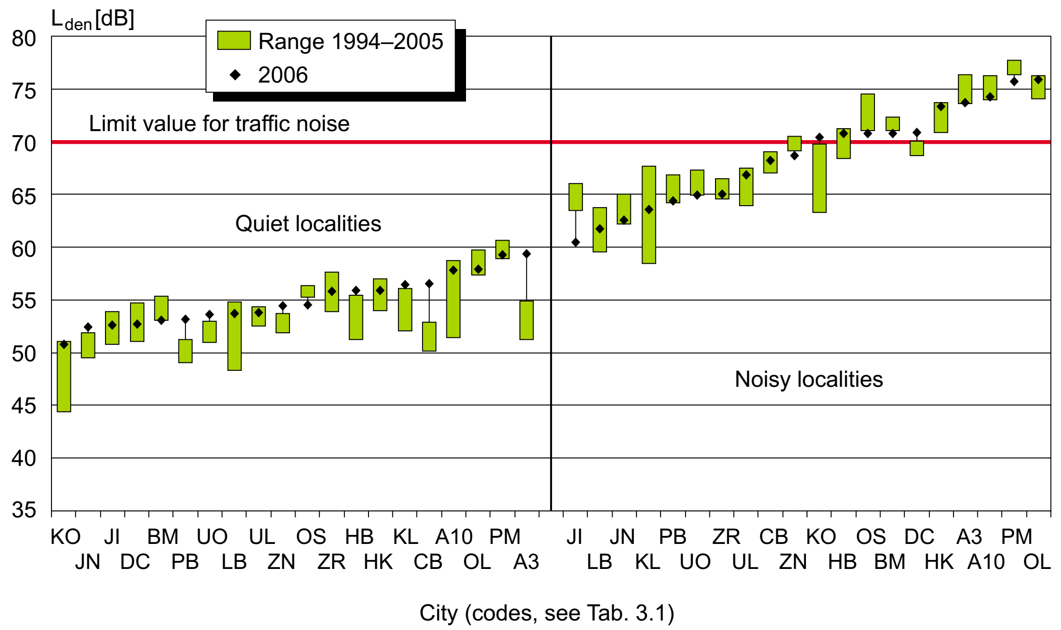


Fig. 6.3a Noise descriptor – daytime L_d, evening L_e and night-time L_n noisy localities

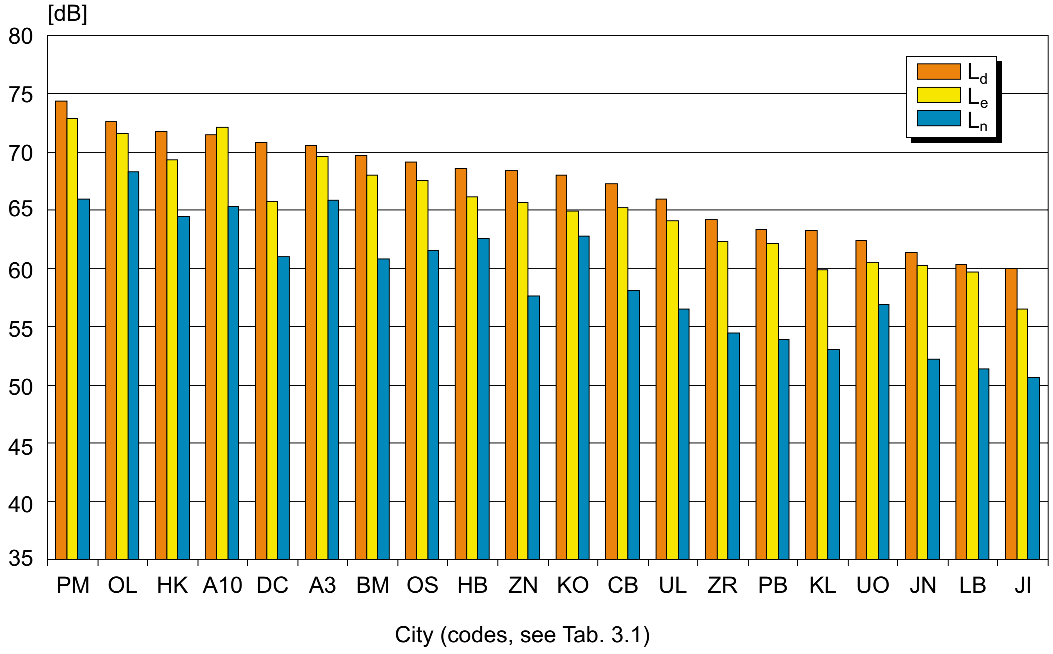
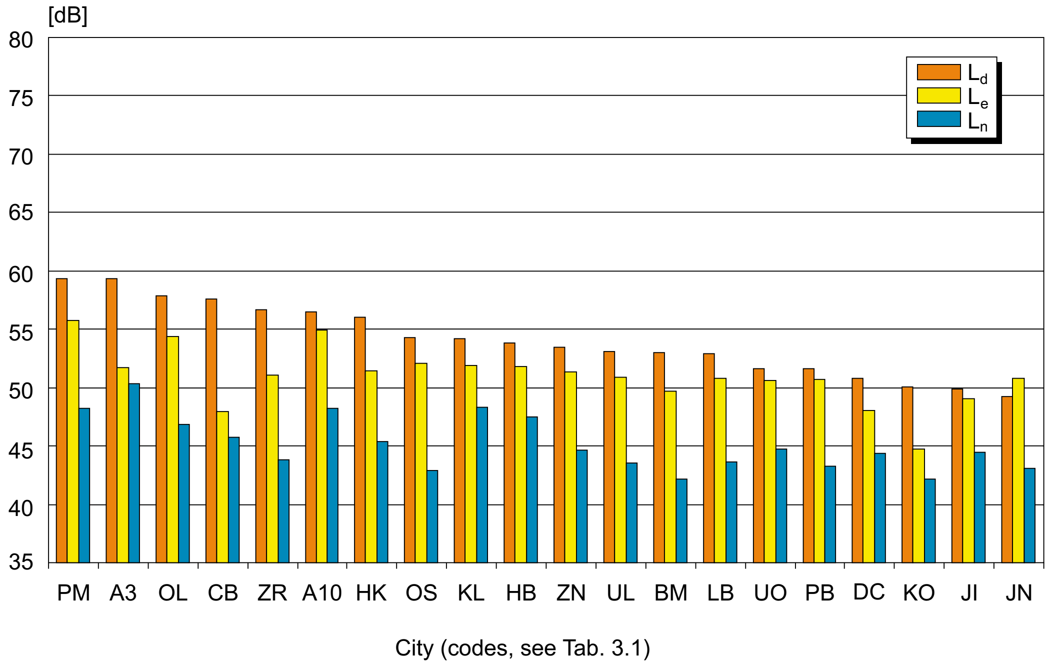


Fig. 6.3b Noise descriptor – daytime L_d, evening L_e and night-time L_n quiet localities



7. BODY BURDEN OF CONTAMINANTS FROM FOOD CHAINS, DIETARY EXPOSURE

7.1 Organization of monitoring activities

The Subsystem IV consists of four project parts.

- MIKROMON – monitoring the presence of selected pathogenic bacteria in sampled foodstuffs. In all monitored agents excluding campylobacter both qualitative and quantitative examination was performed. The isolates underwent phenotype typification including resistance to antimicrobial agents.

- MYKOMON – monitoring the incidence of toxic micromycetes (fungi) in sampled foodstuffs. Micromycete isolates were classified by genus and species and their toxicity (particularly the production of mycotoxins aflatoxins and ochratoxins) was studied.

- GENOMON – monitoring the presence of foodstuffs based on genetically modified organisms (GM) on the Czech market. Inclusion of this part was a response to public demands for information about the situation in the Czech Republic and to information required by the EU and other international organizations, not from the point of view of anticipated health risks. The presence of GM soya, maize and tomatoes was monitored; for 2006 also monitoring of papaya was added.

- CHEMON – monitoring the population's dietary exposure to selected chemical substances. The monitoring of dietary exposure was performed in 12 cities of the Czech Republic. The number of locations was selected so as to provide a homogenous representation of all regions and with regards to the environment burden at the beginning of the monitoring program. The food samples were gathered in one location where they underwent a standard culinary preparation and then they were subsequently analyzed for the content of selected chemical substances. The results serve to estimate exposure doses and to characterize health risks associated with eating habits of the Czech population. Since the beginning of year 2004, this part has been performed in two-year intervals. This part of the project will be terminated and evaluated for period 2006–2007 in 2008.

This chapter also contains a summary of alimentary infections and intoxications reported in 2006 and their development in the previous years as processed by the Centre of Epidemiology and Microbiology of NIPH.

7.2 Alimentary diseases in the Czech Republic

In 2006, the authorities of public health protection in the Czech Republic registered approximately 60,000 diseases of probable alimentary origin. The spectrum of etiology was rather wide and included bacterial infections, intoxications, viral and parasitic diseases, see Table 7.2.

In 2006 there has been an increase in the number of reported cases of listeriosis and viral gastrointestinal infections. A decrease in viral hepatitis A infections and in diseases diagnosed under code ICD A05 – other bacterial intoxications (Fig. 7.1a) was observed in comparison to the previous period.

The highest morbidity was again seen in salmonelloses and campylobacterioses where serotypes *Salmonella* Enteritidis and *Campylobacter jejuni* were predominant. In 2006, a certain decrease could be observed in long-term morbidity trend of both diseases (Fig. 7.1a, 7.2a) however, it is obvious from the further course in 2007 that it was just a temporary fluctuation. The reported incidence of salmonelloses in the regions of the Czech Republic is shown in Fig. 7.2b; it mainly reflects whether and in which region an epidemic of the disease occurred. The incidence of campylobacter infections in years 1984 through 2006 is shown in Fig. 7.2a. More than 99 % of campylobacterioses comprised of sporadic cases, eventually family incidence. No significant changes were found in seasonal or age distribution of both diseases in comparison to the previous years. These bacterial diseases have an evident summer seasonal character with evincible dependence on outer temperature unlike viral infections which tend to appear in winter

Tab. 7.2 Incidence of selected notified alimentary diseases in years 1997–2006 (number of cases per 100,000 inhabitants)

ICD	Diagnosis	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
A02	Salmonellosis	387.4	493.7	436.1	391.7	326.6	274.1	263.7	301.2	321.7	244.9
A04.5	Campylobacteriosis	35.2	53.8	95.7	164.7	210.5	227.5	196.7	249.9	295.8	221.6
A03	Shigellosis	6.0	5.0	5.1	5.3	3.4	2.8	3.7	3.2	2.7	2.8
B15	Viral hepatitis A	11.6	8.8	9.1	6.0	3.2	1.2	1.1	0.7	3.2	1.3
A04	E. coli enteritis	11.5	10.1	11.8	11.5	11.9	15.7	15.5	17.1	16.7	15.1
A05	Alimentary intoxications	3.2	4.8	5.1	10.6	6.7	2.6	0.6	1.9	0.4	0.5
A04.6	Yersiniosis	1.5	1.5	2.1	2.2	2.9	4.0	3.6	4.9	4.9	5.2
A08	Viral intenstinal infections	4.6	8.9	7.9	11.7	11.3	23.3	20.6	35.2	35.9	54.6
A32	Listeriosis	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.8

and often as contact infections. Both diseases were independently reported to the EU web Enter-Net (http://www.hpa.org.uk/hpa/inter/enter-net_menu.htm). After examination of the history of tens of thousands of patients it is essential to alert to high risk of consumption of poultry and egg, domestic or imported, when not sufficiently heat-treated.

In 2006, an epidemic of listeriosis in the Czech Republic appeared after many years (Fig. 7.3a, 7.3b). 78 cases were reported, the epidemic regrettably continued until the beginning of year 2007, see Fig. 7.3a. In laboratory examination most of the examined strains of *Listeria monocytogenes* from the infected patients showed identical genetic features as listeria found in maturing cheese from the trade network. Total 15 patients died.

From the very beginning of the epidemic instructions were prepared for the population groups at risk in order to minimize the risk of infection; this information can be found on address http://www.mzcr.cz/data/c2323/lib/listerioza_info_pro_obcany.rtf. From the viewpoint of clinical severity the data from year 2006 demonstrate an unexceptional danger of listeria infection but these also confirm that any severe infection can be mortal or disabling.

In the Czech Republic there has been an exponential rise in viral intestinal infections mainly caused by Rotavirus and viruses from family Caliciviridae (Fig. 7.1b). However the quality of the surveillance must be taken into account mainly for international comparison. An international comparison of alimentary infections, mostly zoonoses, is being prepared recently (see European Food Safety Authority, EFSA, http://www.efsa.europa.eu/).

The viral hepatitis A morbidity stayed on a very low level as well as shigellosis. However, these must be considered risky in terms of imported diseases and in ethnic minorities. Hepatitis E which used to be rare in the past has already settled down in our region and also occasional cases of hemolytic-uremic syndrome must also be considered in some cases of infection caused by *E. coli*, mainly by O157 strains of *E. coli* producing Shiga toxin. An epidemic has not been reported.

Yersiniosis is one of the infections of alimentary tract and it belongs to common diseases in the Czech Republic (Table 7.2, Fig. 7.1b). In its annual report for year 2005 the European Food Safety Authority (EFSA) mentions this disease as the third most common bacterial infection (zoonosis) in the EU member countries. The most common agent is *Yersinia enterocolitica.* The tendency of the count of reported confirmed diseases is increasing however 536 reported cases represent a marginal problem in comparison to 25,000 salmonelloses or 23,000 campylobacterioses.

The trend of alimentary infection morbidity in the Czech republic can be weekly found on internet address of NIPH http://www.szu.cz/epidemie/tyden/index.php and main analyses are available in magazine Zprávy CEM (http://www.szu.cz/cem/). The basic competent views to the problem are put in practice by The Centre of Food Chains of NIPH in Brno (http://www.chpr.szu.cz/).

7.3 Bacteriological analysis of foodstuffs – MIKROMON

In the study focused on bacteriological analysis of foodstuffs the presence of selected pathogenic agents in foodstuffs from the market network was monitored. The selection of investigated commodities was performed following the so-called consumer basket and similarly to the previous years it was focused on the groups of foodstuffs that participated in the cause of alimentary diseases in the Czech Republic or abroad in the past.

The attention was focused on the demonstration of four etiological agents causing important alimentary diseases: *Salmonella* spp. *Campylobacter* spp. *Listeria monocytogenes*. and *S. aureus*. Except for salmonella these agents are monitored only exceptionally during the routine inspection of food health safety and therefore there is no information available about their incidence in the respective commodities in the Czech Republic.

A qualitative analysis was performed to the examined samples of foodstuffs and also evaluation of the number of bacteria was executed to ready-to-eat foodstuffs with positive finding of pathogens. All suspected colonies of followed agents were confirmed according to the respective standards, the serotype was identified for salmonellas and *L. monocytogenes.* For *S.* Enteritidis (SE) and *S.* Typhimurium (STM) a phage typification was performed. For *S. aureus* the ability to produce staphylococcal enterotoxins A – E (SEA – SEE) and the presence of genes coding staphylococcal enterotoxins A – J (sea – sej) were tested. Microbiological analysis was conducted according to the international standards of EN ISO series.

Total 636 samples of different kinds of food were tested for the presence of **salmonella.** The foodstuffs designed for heat treatment included poultry and rabbit meat, salt water and fresh water fish, poultry offal and porcine liver, eggs and frozen vegetable. Meat, diary products, pastry and delicatessen goods, fruit and vegetables were included in the group of ready-to-eat food. Total 12 salmonellas were isolated, 50 % of all salmonellas were obtained from chicken meat. In five cases salmonella was demonstrated in ready-to eat meat products; the registered numbers were lower than 5.10^1 $CFU.g^{-1}$ of the food. The most common serotype isolated from the food was *S.* Enteritidis (10 times), one case of serotype *S.* Typhimurium and *S.* Saintpaul was found.

The demonstration of the presence of **thermotolerant campylobacters** was performed in raw meat, vegetables and fruit. Total 156 food samples were examined. In 2 samples of poultry offal and two samples of poultry meat *Campylobacter* spp. was isolated. In one case of poultry offal the species could not be identified (it was a different species from *C. jejuni, C. coli* a *C. lari*). The isolate was classified only as *Campylobacter* spp. In one isolate from poultry meat both *C. jejuni* and *C. coli* were found at the same time.

Total 612 samples of foodstuffs were examined for the presence of ***Listeria monocytogenes***. Total 28 (4.6 %) isolates of L. monocytogenes were obtained. The presence of this pathogen is significant in ready-to-eat food. Almost 50 % of positive findings were acquired from this group, these included meat products (6 cases), blue cheese (5 cases) and one delicatessen product and one fish product. In these foodstuffs also quantitative examination was performed and in no tested sample the amount of 5.10^1 $CFU.g^{-1}$ of food was exceeded.

The most commonly isolated *L. monocytogenes* serotypes were of group 1/2 : 1/2a (57.1 %) and 1/2b (28.6 %). Three isolates were identified as serotype group 4 which is rarely found in the Czech Republic. This was one isolate from poultry meat (serotype 4b), hard fermented salami (serotype 4a) and one isolate from blood sausage (serotype 4ab). One isolate from porcine liver was not serologically identified (R form).

The presence of ***Staphylococcus aureus*** was monitored in 528 samples of foodstuffs, 91 % were represented by ready-to-eat food. In some strains of *S. aureus* the ability to produce staphylococcal enterotoxins in the food was proven. In ready-to-eat foodstuffs the counts of *S. aureus* did not exceed 10^2 $CFU.g^{-1}$ (ml^{-1}) of food, only in two samples – porkpie and poultry salami the count of *S. aureus* was estimated to $1.5x10^2$ $CFU.g^{-1}$ of food. In sea - fish a high incidence of *S. aureus* was found (66.7 %). 50 % of these were also proven to have genes coding staphylococcal enterotoxins.

7.4 Mycological analysis of foodstuffs – MYKOMON

In 2006 the monitoring of the incidence of toxinogenic micromycetes (fungi), producers of aflatoxins and ochratoxin A in the selected foodstuffs was in progress. As previously a specialized mycological examination was focused on description and risk characterization associated with the presence of toxinogenic micromycetes in foodstuffs. With regard to detailed mycological monitoring the amount of food samples previously collected over a one-year period of monitoring was divided into two years (2006–2007). In four collecting terms in 2006 13 kinds of commodities (lentil, peas, caraway, walnuts, sweet red pepper, pepper, rice, two kinds of hard fermented heat-treated salami, Eidam cheese, pasta) were sampled in 12 sampling localities in the Czech Republic, representing the total of 156 food samples.

Qualitative and quantitative frequency data were obtained about the incidence of toxinogenic micromycetes. The total micromycete count was determined in the selected foodstuffs (CFU/g of food) and their mycological profile was identified. The incidence of the monitored toxigenic micromycetes was characterized by contamination index (I_c) – i.e. the ratio of the potentially toxinogenic micromycetes to the overall micromycete count (CFU/g of food).

The presence of potentially toxinogenic micromycetes *Aspergillus flavus*, producers of aflatoxins and *Aspergillus* section *Nigri* (producers of ochratoxin A) was proven in the samples. The presence of Aspergillus *tamarii* (producers of aflatoxins) was not proven in the analysed foodstuffs. The obtained results of determination of toxinogenic micromycetes in the respective foodstuffs are shown in Table 7.4.1. The evaluation results of the identified mycotoxins (aflatoxin B1, ochratoxin A) are summarized in Table 7.4.2.

7.5 Incidence of GMOs on the market – GENOMON

Year 2006 was the fifth year of the GENOMON study. The monitoring of the occurrence of selected foodstuffs traded in the Czech Republic from the viewpoint of possibly being produced from GMO organism was continuing.

As in the previous years samples were taken from 5 kinds of foodstuffs – tomatoes, soya beans, soya products, maize flour and papaya during four collection dates in 12 locations of the Czech Republic market. Total 204 samples were taken. 48 samples of tomatoes, soya beans, soya products, maize flour and 12 samples of papaya were analysed.

To detect GMO and GMO-based food products a screening and identification method of polymerase chain reaction (PCR) was used as well as immunochemical methods (ELISA) and quantitative real-time PCR method (RT-PCR).

Tab. 7.4.1 Results of toxinogenic micromycetes determination in foodstuffs in 2006

Commodity	No. of samples	Positive findings (%)	Toxinogenic micromycetes	I_c
Sweet red pepper	12	1 (8)	*Aspergillus flavus*	0.05
Sweet red pepper	12	3 (25)	*Aspergillus* section *Nigri*	0.02–0.10
Pepper	12	2 (17)	*Aspergillus* section *Nigri*	0.01–0.04
Walnuts	12	3 (25)	*Penicillium crustosum*	*

** qualitative analysis only*

Tab. 7.4.2 Results of mycotoxins determination in foodstuffs in 2006

Mycotoxin	No. of samples	Positive findings (%)	Commodity	Concentration [μg/kg]	
				Average	Min–Max
Aflatoxin B_1	12	4 (33)	Sweet red pepper	0.7	0.35–2.10
Aflatoxin B_1	12	4 (33)	Pepper	1.0	0.35–7.10
Ochratoxin A	12	9 (75)	Sweet red pepper	3.0	1.00–10.00

The results of qualitative analysis of the samples are presented in Table 7.5.1. The overall number of 35 soya product samples and 1 sample of soya beans of Roundup Ready Soya (40-3-2) were evaluated as positive by the RT-PCR method. Also 1 positive sample of maize flour was identified. By the means of qualitative PCR method the presence of the maize line MON810 was proven. The food from RoundupReady soya and the transgenic maize of line MON810 are approved for introduction to the EU market.

The results of Roundup Ready Soya quantitative evaluation (RRS) in the foodstuffs by the method of Real-time PCR in 2006 are shown in Table 7.5.2. Following the EU regulations 1829/2003 and 1830/2003 foodstuffs containing more than 0.9 % GMO must be marked as such. The content of up to 0.9 % is considered to be a chance or technically unavoidable admixture of GMO. The discovered amount of RRS present in soya beans and soya products was lower than 0.9 % in all cases. The proportion of positive results was higher in comparison to the previous years, however because the limit of 0.9 % was not exceeded, the products did not have to be marked as GMO containing.

In the course of year 2006 no novel scientific data of topical interest indicating any potential health risks due to the use of food based on GMOs were published. The GENOMON study will be performed also in 2007. Based on the negative results obtained so far about the presence of transgenes in tomatoes and papaya samples no further sampling and analysis will be performed to these items. Rice sampling and analysis will be added to the study as a reaction to the unchartered appearance of LLRICE601 rice and Chinese rice Bt63 in the EU market in 2006.

7.6 Dietary exposure

In 2006 the sampling of foodstuffs and its analysis was in progress according to the previously approved plan. The two-year period of monitoring (2006–2007) will be evaluated in 2008.

7.7 Partial conclusions

The results of microbiological analysis show the frequency of the occurrence of pathogenic agents in the selected commodities of the market network and help to obtain a more precise idea about any potential means of spread of alimentary infections. In comparison to the previous years a higher number of meat products contaminated by salmonellas and a higher number of dairy products contaminated by *L. monocytogenes* were found. Therefore in the next period the attention will be focused on analysis of ready-to-eat foodstuffs and to detailed phenotype and genotype characteristics of isolated pathogens.

The results of the monitoring of toxigenic micromycetes in foodstuffs again confirmed the assumption of the actual occurrence of dangerous mycotoxins in certain types of foodstuffs (e.g. aflatoxins in sweet red pepper and in ground pepper). Based

Tab. 7.5.1 Results of foodstuff sample analysis for GMO detection in 2006

Material	No. of samples	Positive findings (%)	Negative findings (%)
Tomatoes	48	0	48
Soya beans	48	1 (2)	47
Soya products	48	35 (73)	13
Maize flour	48	1 (2)	47
Papaya	12	0	12
Total	204	37 (18)	167 (82)

Tab. 7.5.2 Quantitative analysis of Roundup Ready Soya (RRS) in 2006

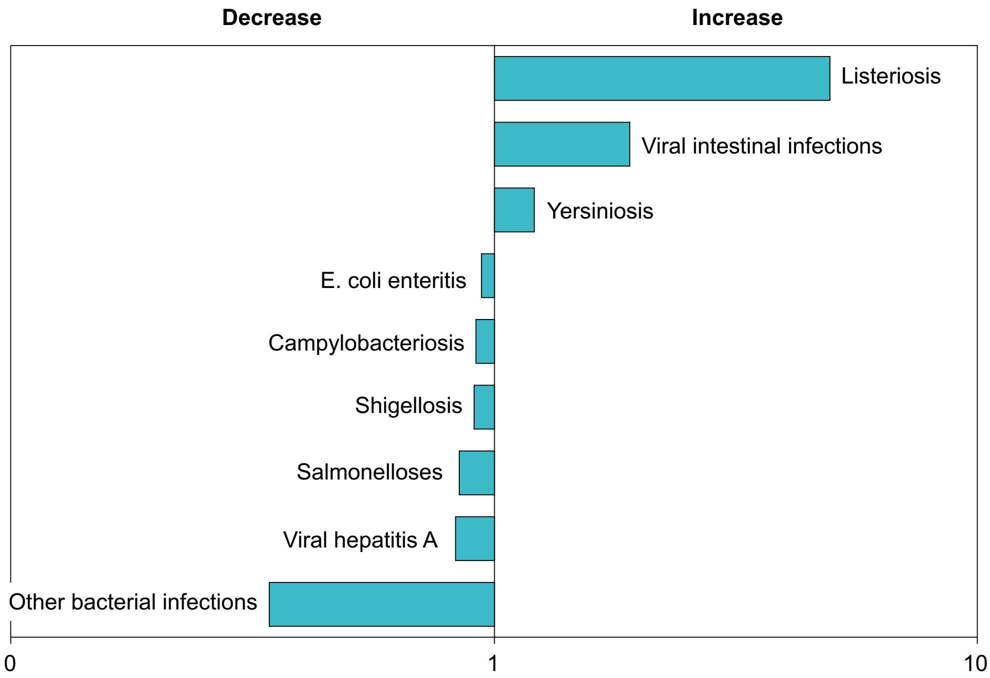
Material	Positive findings (up to 0.9 %)	Positive findings (over 0.9 %)
Soya beans	1	0
Soya products	35	0
Total	36	0

on the information from foreign research about an increased occurrence of ochratoxin A in sweet red pepper and its ascertained mycological profile also the analysis of sweet red pepper for ochratoxin A was recently included in the MYKOMON study and its presence was confirmed. Together with results of authority control the presented results served as a national background for a conference of the work group for agricultural contaminants of the European committee in Bruxelles where a discussion is going on about a proposal of the novel of Regulation (ES) No. 1881/2006 and the determination of a hygienic limit for ochratoxin A in sweet red pepper. In 2007 the two-year sampling cycle will be concluded and the results will be evaluated in summary.

From the GMOs in foodstuffs monitoring it is evident that also in 2006 the foodstuffs produced from both Roundup Ready Soya (40-3-2) and transgenic maize of line MON810 appeared on the market in the Czech Republic, both of these are approved in the EU for introduction to the market. The number of positive samples was higher in comparison to the previous years; however the limit of 0.9 % which conditions the declaration on the label ('Produced from GMO') was not exceeded.

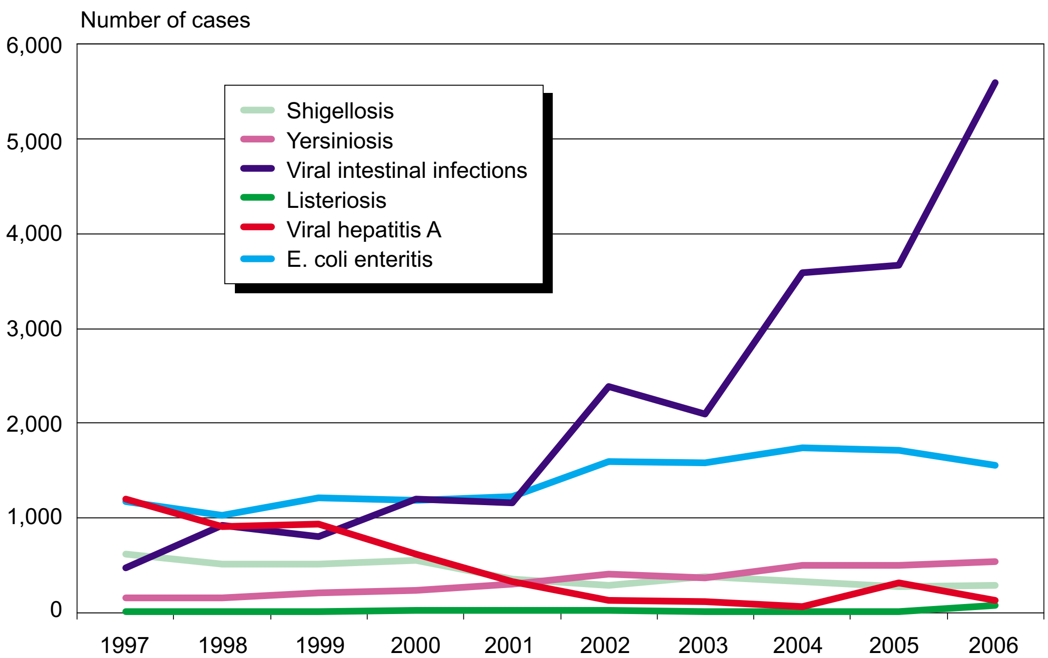
The monitoring of dietary exposure to chemical substances is being performed in two-year period. The period of 2006–2007 will be terminated and analysed in 2008.

Fig. 7.1a Comparison of the notified alimentary diseases in 2006 with the mean annual level (period of 2001–2005)



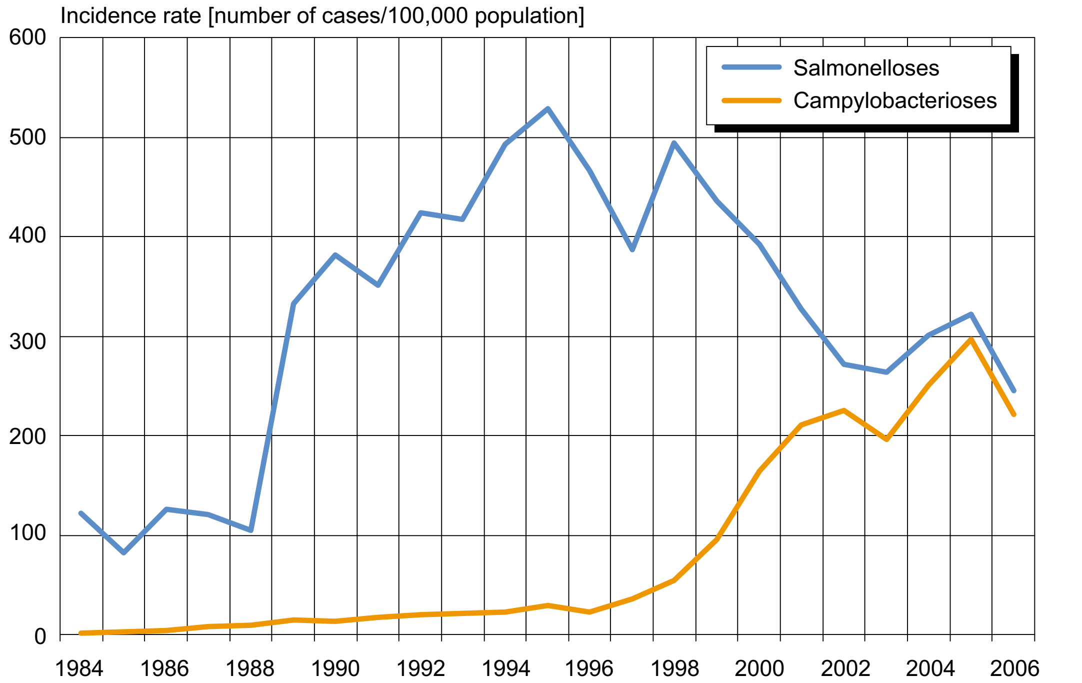
Source: EPIDAT

Fig. 7.1b Trends in the notified alimentary diseases, 1997–2006



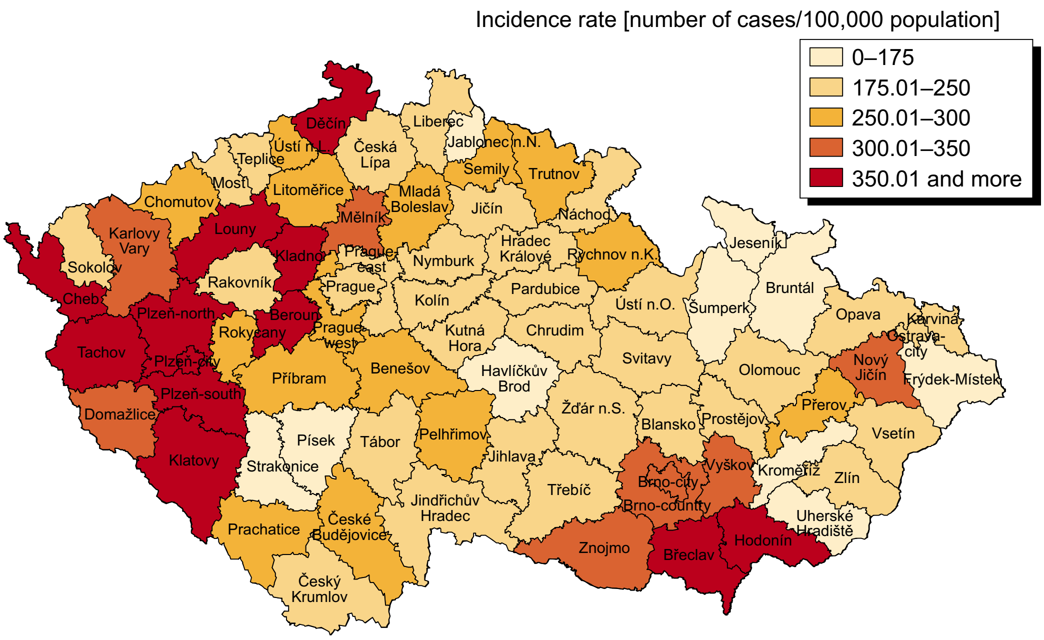
Source: EPIDAT

Fig. 7.2a Incidence rate of salmonelloses and campylobacterioses in 1984–2006



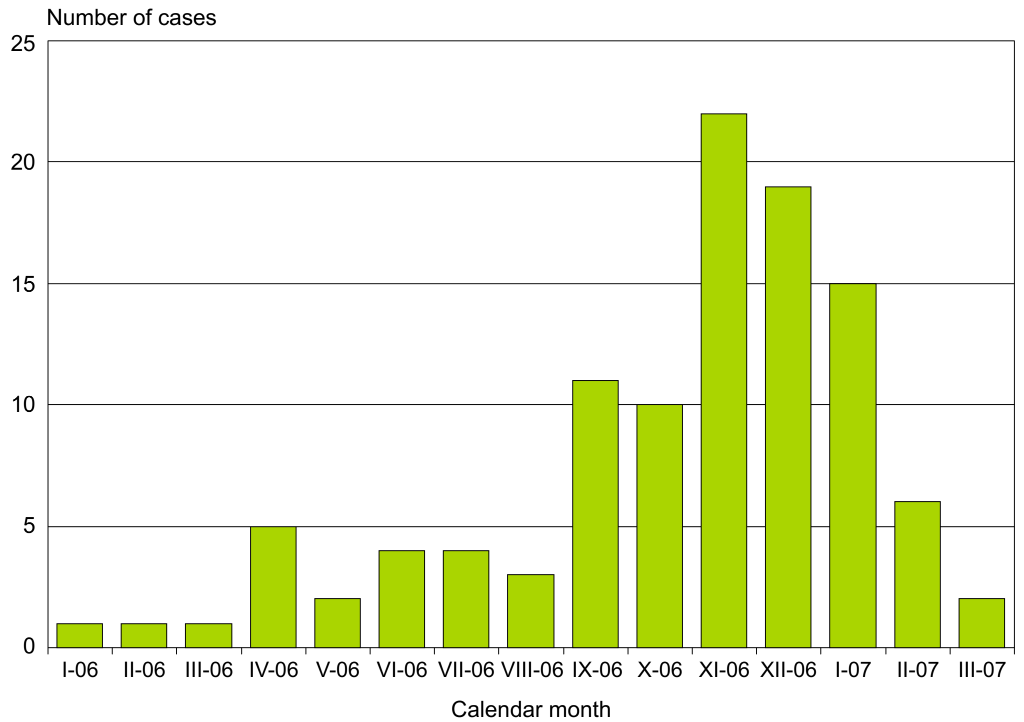
Source: EPIDAT

Fig. 7.2b Salmonellosis incidence rate in the CZ districts, 2006



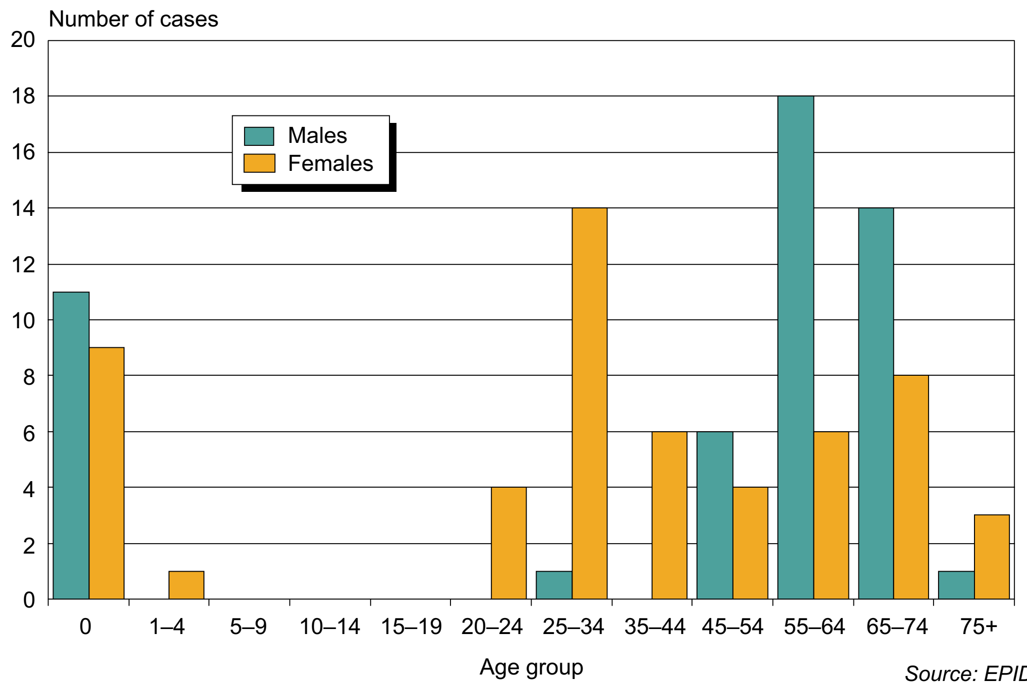
Source: EPIDAT

Fig. 7.3a Incidence of listeriosis in CZ during the period January 2006–March 2007



Source: EPIDAT

Fig. 7.3b Notified cases of listeriosis in CZ by age and gender (period January 2006–March 2007)



Source: EPIDAT

Fig. 7.4a Positive findings of Listeria monocytogenes in foodstuffs intended for the direct consumption, 1999–2006

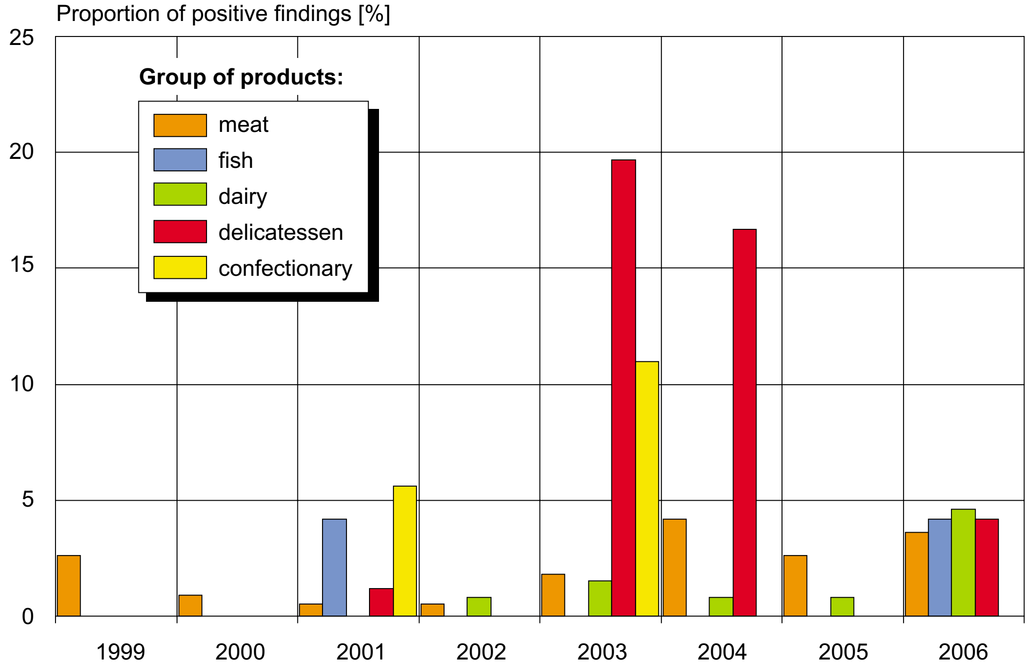
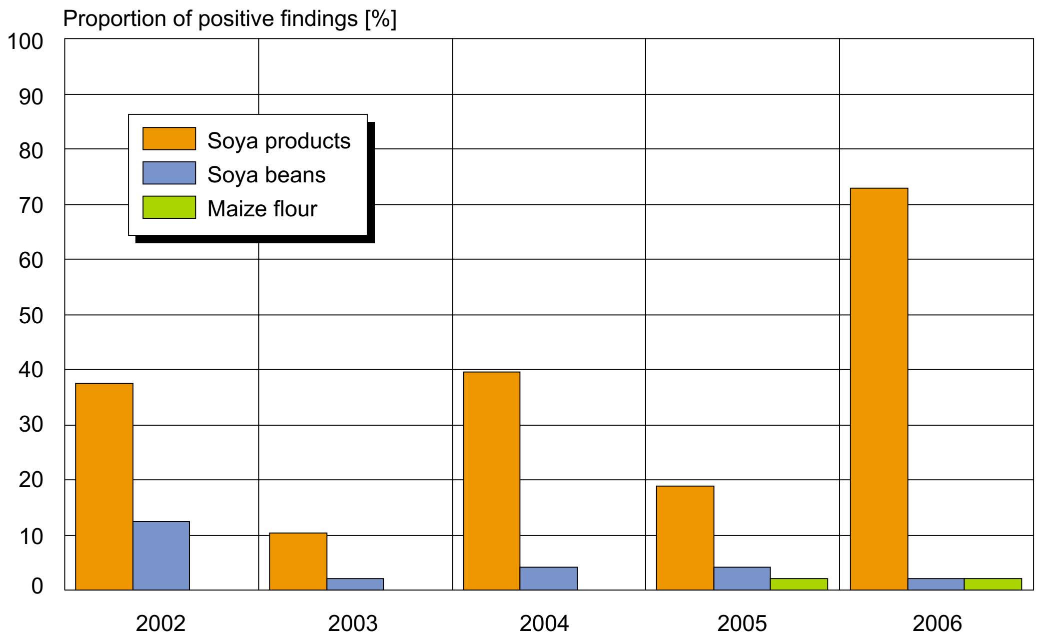


Fig. 7.4b Positive findings of GMOs in foodstuffs, 2002–2006



Note: There have been analysed 48 samples of relevant commodity annually
"Practical" limit of quantification = 0.1 %

8. HUMAN BIOMONITORING

8.1 Organization of monitoring activities

Over the period 1994–2003 the subsystem was executed in four selected regions – Benešov, Žďár nad Sázavou, Plzeň and Ústí nad Labem. Since year 2005, human biomonitoring has been performed in other Czech cities – Ostrava, Prague, Liberec and Zlín (Kroměříž and Uherské Hradiště).

In 2006 the monitoring activities were focused on child population between 8 and 10 years of age. Selected toxic substances (cadmium, lead, mercury) were analysed in blood, urine and hair and also essential elements (copper, selenium, zinc) were monitored. As a marker of biological effect the cytogenetic analysis of peripheral lymphocytes was used. In each region approximately 100 children from the followed population group (per 50 children in Kroměříž and Uherské Hradiště) were included in the study. Basic demographic data and information about their life style which were basic for estimating the exposure to the monitored toxic substances were obtained by means of a brief questionnaire.

Indicator congeners of polychlorinated biphenyls (PCB) and selected chlorinated pesticides were followed in breast milk of nursing mothers (minimum 50 samples in each region).

Participating analytical laboratories were subjected to constant quality control of the data produced. Inter-laboratory differences were minimized by defining the analyses according to matrix or analyte respectively. All involved laboratories acquired the ČIA accreditation.

8.2 Monitored factors

8.2.1 Toxic metals and trace elements

The concentration of **cadmium** in blood is a biomarker of current population exposure and its level is significantly increased in smokers. This habit can not be presumed in the target group of children between 8 and 10 years of age; however passive smoking can play a certain role. Approx. 25 % of the monitored children are living in a household together with at least one adult smoker; however no significant difference was found between the level of cadmium in blood of children exposed and not exposed to tobacco smoke. The cadmium concentration in blood of children in the followed regions varied between 0.1 and 0.4 µg/L (Table 8.1), urine level between 0.15 and 0.33 µg/g of creatinine (Table 8.2) and hair content from 0.02 to 0.06 µg/g (Table 8.3). The values are close to the detection limit of the method used and do not differ from the results obtained during the previous monitoring period.

From the viewpoint of the environmental exposure to **lead** and its consequences for health mainly neurobehavioral and developmental changes in small children are emphasized which can appear from the doses which correspond to lead blood level of 100 µg/L. The significant value for health (tolerable limit) of blood lead which was established to 100 µg/L for children and women of reproductive age was not exceeded in any of the followed children. Blood lead levels (medians) varied from 23 to 34 µg/L in the followed regions, higher levels were observed in boys compared to girls (Fig. 8.1a). In comparison to the results from the previous years a downward trend was observed. As in 1996 only 64 % of the children had blood lead level lower than 40 µg/L, in 2006 it was 87 %; three quarters of the children had blood lead level between 20–40 µg/L (for details see Fig. 8.1b). Lead levels in urine and in hair are shown in Tables 8.2 and 8.3.

From the existing forms of **mercury** methylmercury has the most serious health effects for its neurotoxic effects. The identified levels of mercury in blood do not indicate a higher load on the Czech population with this element. In children the levels are lower than in adults. The mean blood mercury level (median) in children ranged between 0.42 and 0.50 µg/L in single regions (Table 8.1, Fig. 8.1c). Urine levels varied between 0.19 and 0.31 µg/g of creatinine (Table 8.2). In most of the children (respectively for 95th percentile of values) the amount did not exceed the health significant (tolerable) level which was established to 5 µg/L of blood or 5 µg/g of creatinine in urine (Fig. 8.1d).

The values of mercury in children hair do not reach the limit value recommended by U.S. EPA 1 μg/g (Table 8.3).

Copper represents a component of a number of enzymes with antioxidant functions, it is essential for haematopoiesis and lipid metabolism. The effects of copper are determined by its ratio to zinc and iron in body. The mean values of copper concentration in blood of children (medians) ranged from 1,015 to 1,130 μg/L in the selected regions (Fig. 8.2a). The copper values in urine and hair are presented in Tables 8.2 and 8.3. Higher concentrations of copper are found in females and adolescent girls; no sex difference is expressed in child population.

Zinc is an essential element as a part of several enzymes, it is important for the function of immune system and as a part of antioxidant processes. The mean values of blood zinc level in children (Fig. 8.2b) are equal in the monitored cities from 5,170 to 5,410 μg/L with lower levels in Kroměříž (4,955 μg/L). Unlike copper lower zinc levels can be seen in women and adolescent girls than those in men and boys, no difference was yet demonstrated in the target age group. Zinc values in urine and hair of children are shown in Tables 8.2 and 8.3.

Selenium belongs to the trace elements with prominent positive effects on cardiovascular, oncological and endocrine diseases. Its antioxidant features are important for defence mechanisms against oxidation stress. The level of selenium in serum, plasma or blood is a marker of saturation of the organism with this element. In children the blood selenium levels are lower than in adults. The observed mean blood selenium levels in children varied between 104–115 μg/L in single cities (Fig. 8.2c). Kroměříž region as well as Uherské Hradiště has a limited predictive value for low number of the analysed samples. The optimum level of selenium concentration is considered to be 125–175 μg/L of blood. The content of selenium found in children blood in currently monitored cities of the biomonitoring second phase is higher than the values found during the first phase. If this trend is confirmed in the next period, it will signify a positive trend of gradual increase of the selenium saturation level which recently has been found in adult population. Children urine and hair selenium levels are shown in Tables 8.2 and 8.3.

8.2.2 Toxic substances of organic origin

Systematic monitoring is being performed to polychlorinated biphenyl (PCB) indicator congeners and selected chlorinated pesticides in breast milk. The results confirm the predominance of PCB congeners 138, 153 and 180. According to the results of the previous monitoring period the content of PCB in milk increases with age and is not dependent on the succession of childbirth. A decreasing tendency proven during years 1994 through 2001 transformed into a stable value during years 2002–2004.

The results of year 2006 presented by the means of one of the indicator congeners PCB 153 levels in the regions of the second biomonitoring phase suggest an increase in comparison to year 2005 and confirm higher values in the area of Uherské Hradiště (Fig. 8.3a).

DDT concentrations presented as total DDT with a predominant share of DDE show a decreasing tendency following a gradual decreasing burden documented both during the 80's and in the previous phase of biomonitoring in years 1994–2003. DDT median concentration was 321 μg/kg of fat (Fig. 8.3b).

Concentrations of hexachlorobenzene (HCB) in breast milk demonstrated a long-term gradual decreasing trend which has been continuing in the regions during the second phase (see Fig. 8.3c). In 2006 the HCB median concentration reached 52 μg/kg of fat.

8.3 Cytogenetic analysis of peripheral lymphocytes

Cytogenetic analysis of peripheral lymphocytes used for human biomonitoring of the population groups enables to detect the presence of active genotoxic substances in the environment and to indicate the degree of individual tolerance and compensation capacity through defence mechanisms in the monitored files. The values of chromosomal aberrations that are significantly higher than the reference values for each monitored population group may thus reveal a significantly increased exposure to genotoxic substances from the environment.

The values of chromosomal aberrations in child population generally occupy lower levels than those in adults. Individual values of spontaneous level of chromosomal aberrations (CH.A) in child population vary between 0 and 4 % of aberrant cells (AB.C.). In the previous period of biomonitoring in years 1994–1996 the average values showed, similarly to adults, a declining tendency. In the subsequent years of monitoring – 1999 and 2001 these values were stable. In 2006 blood samples were taken in four recently monitored regions from total 339 children. The average value of chromosomal aberrations was 1.49 % of aberrant cells in child population and thus it returned back to the level of year 1994 approximately. The results of cytogenetic analysis are shown in Fig. 8.4a and 8.4b.

8.4 Partial conclusions

The results of human biomonitoring in the recently monitored regions are mostly in accordance with the data obtained in the previous monitoring period as well as with the results from other European countries. A decreasing tendency is being observed in blood lead levels. There is a suggested increasing tendency of blood selenium levels. The concentrations of other monitored elements in blood, urine and hair are stable.

The results of analysis of indicator PCBs in breast milk indicate a rather surprising increase in comparison to the previous monitoring year. On the contrary, a slightly decreasing trend is continuing for chlorinated pesticides.

The results of cytogenetic analysis in children suggest a moderate elevation of numbers of aberrant cells in comparison to the data previously found out.

Tab. 8.1 Metal and metalloid levels in blood – children [µg/L]

	Cadmium	Lead boys	Lead girls	Mercury	Copper	Zinc	Selenium
Total							
N	373	168	204	382	373	372	277
Median	0.2	30	27	0.4	1,040	5,205	108
95th perc.	0.5	52	42	1.4	1,294	6,320	149
Prague							
N	99	45	54	104	99	99	78
Median	0.2	31	28	0.4	1,060	5,190	108
95th perc.	0.3	41	40	1.2	1,270	6,228	143
Liberec							
N	87	36	50	87	87	87	82
Median	0.1	26	23	0.4	1,020	5,170	106
95th perc.	0.3	56	33	1.5	1,191	6,123	148
Ostrava							
N	90	44	46	91	90	89	82
Median	0.3	28	26	0.5	1,015	5,250	115
95th perc.	0.5	42	46	1.3	1,230	6,398	155
Kroměříž							
N	44	21	23	49	44	44	13
Median	0.2	33	29	0.5	1,025	4,955	90
95th perc.	0.5	50	44	2.5	1,327	6,102	115
Uherské Hradiště							
N	53	22	31	51	53	53	22
Median	0.4	38	32	0.5	1,130	5,410	104
95th perc.	0.6	56	43	1.7	1,356	7,328	131

Tab. 8.2 Metal and metalloid levels in urine – children [µg/g creatinine], range of creatinine content in urine 300–2,800 mg/L

	Cadmium	Lead	Mercury	Copper	Zinc	Selenium
Total						
N	373	373	364	372	370	372
Median	0.21	7.10	0.30	27.80	450	11.90
95th perc.	0.99	20.80	2.20	64.00	991	22.70
Prague						
N	101	101	101	101	101	101
Median	0.33	9.40	0.30	22.20	486	12.20
95th perc.	1.32	22.70	1.40	55.00	1,064	24.00
Liberec						
N	91	91	91	91	91	91
Median	0.15	4.20	0.20	22.30	527	10.70
95th perc.	0.55	12.20	2.20	47.00	890	20.00
Ostrava						
N	82	82	82	82	79	82
Median	0.26	7.30	0.20	37.50	387	13.70
95th perc.	0.82	21.20	2.00	99.00	999	23.70
Kroměříž						
N	46	46	37	45	46	46
Median	0.16	8.80	0.30	25.60	426	12.30
95th perc.	0.70	21.20	4.70	45.00	732	20.40
Uherské Hradiště						
N	53	53	53	53	53	52
Median	0.21	5.80	0.20	33.80	341	8.60
95th perc.	0.78	16.70	2.00	67.80	759	22.90

Tab. 8.3 Metal and metalloid levels in hair – children [µg/g]

	Cadmium	Lead	Mercury	Copper	Zinc	Selenium
Total						
N	375	374	372	375	375	375
Median	0.04	0.90	0.13	13.90	150	0.29
95th perc.	0.17	3.20	0.28	77.00	210	0.39
Prague						
N	105	104	107	106	106	106
Median	0.02	0.90	0.15	14.80	151	0.28
95th perc.	0.06	2.30	0.36	86.00	198	0.38
Liberec						
N	82	82	75	82	82	82
Median	0.06	1.20	0.12	14.90	159	0.32
95th perc.	0.26	4.40	0.31	61.00	208	0.43
Ostrava						
N	90	90	91	89	89	89
Median	0.03	0.70	0.13	15.60	149	0.29
95th perc.	0.09	2.60	0.26	95.00	221	0.39
Kroměříž						
N	50	50	50	50	50	50
Median	0.06	1.10	0.15	10.20	148	0.28
95th perc.	0.30	2.90	0.23	30.00	259	0.33
Uherské Hradiště						
N	48	48	49	48	48	48
Median	0.04	1.00	0.13	10.90	135	0.27
95th perc.	0.13	4.20	0.27	42.00	176	0.34

Fig. 8.1a Blood lead levels in children, 2006

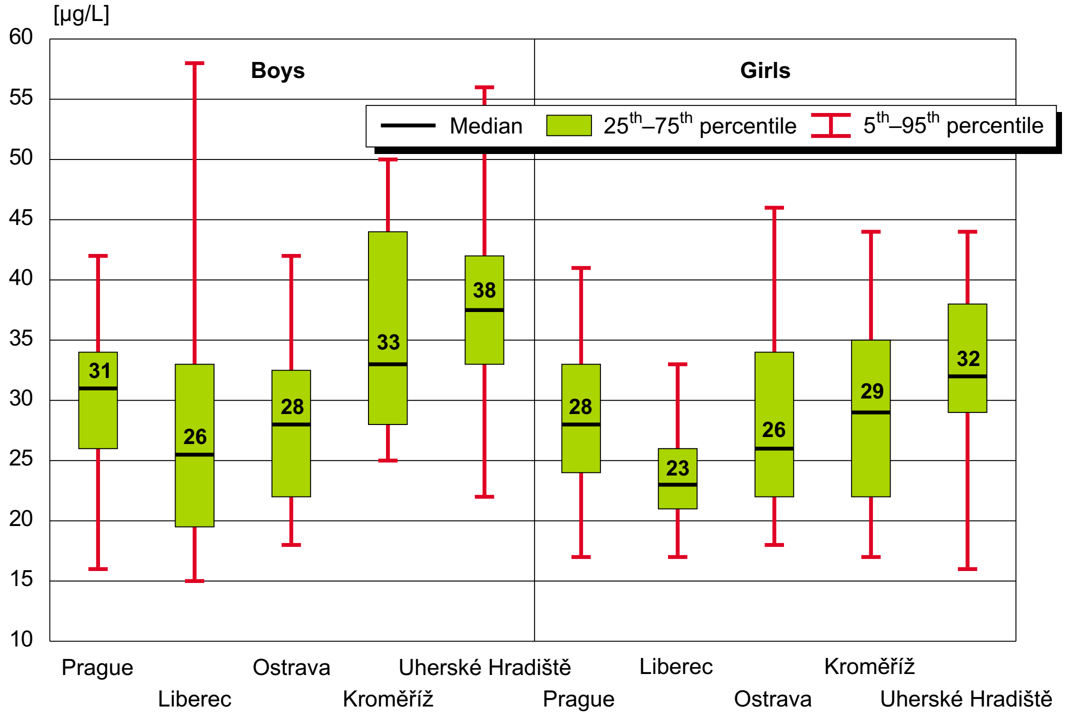
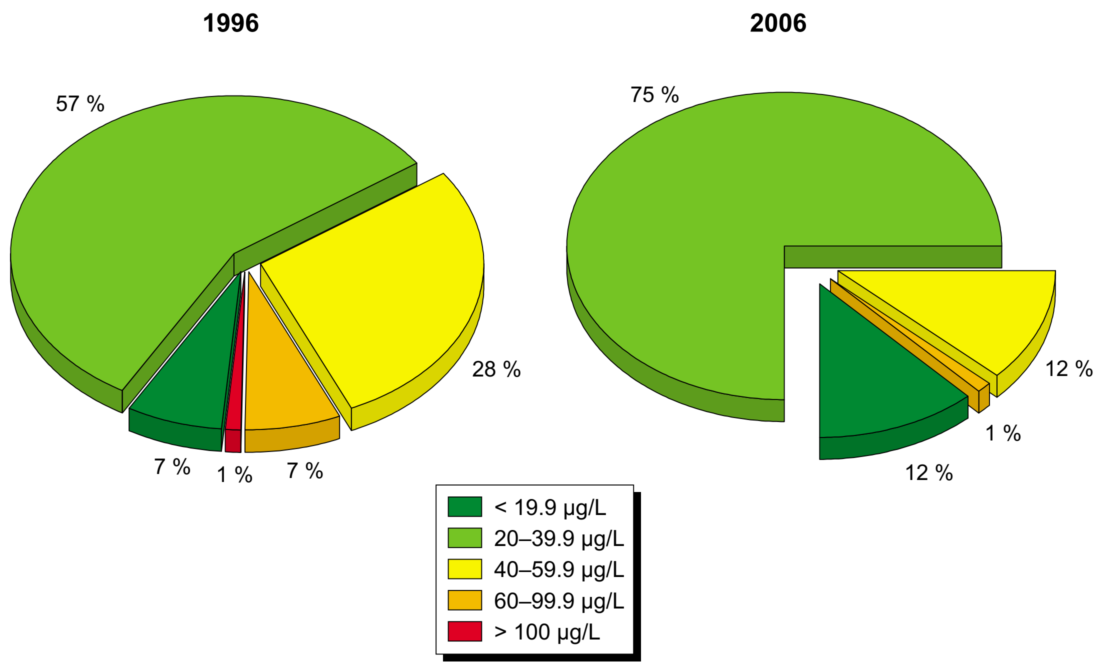


Fig. 8.1b Distribution of children by the blood lead levels, 1996 and 2001



Note: Tolerable lead level in blood 100 µg/L

Fig. 8.1c Blood mercury levels in children, 2006

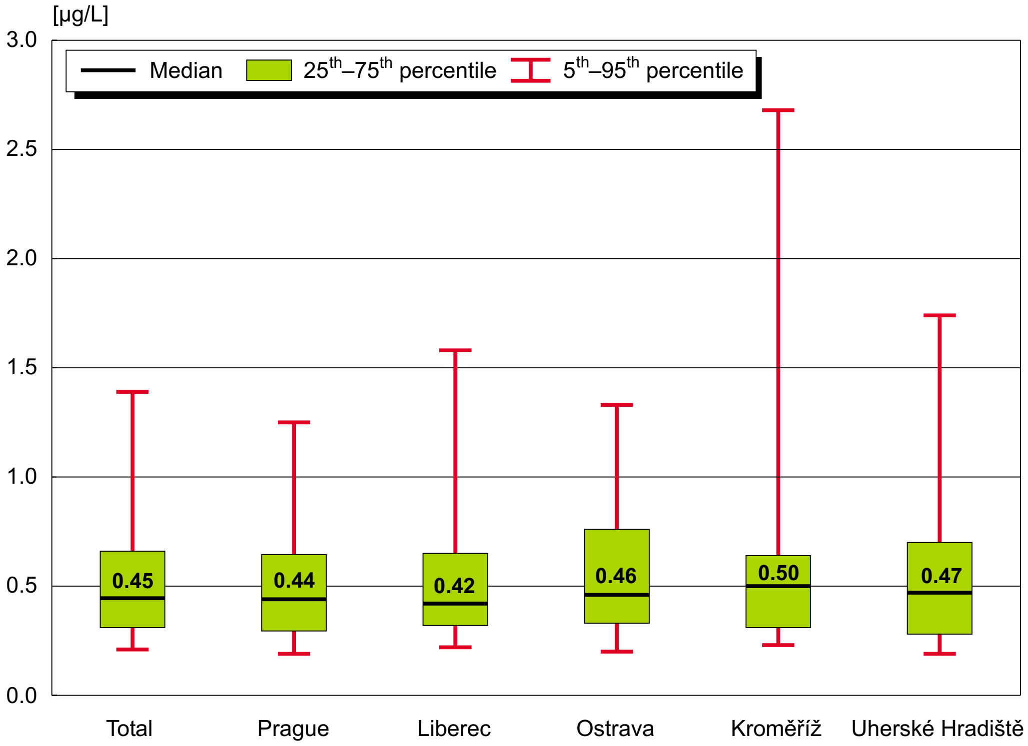


Fig. 8.1d Urine mercury levels in children, 2006

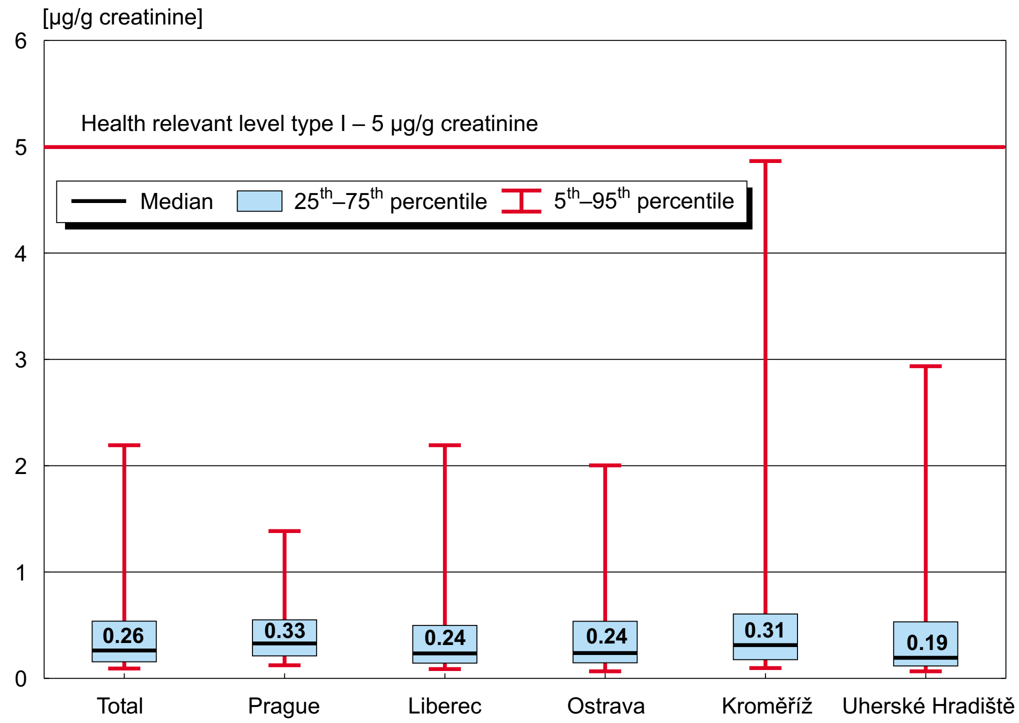


Fig. 8.2a Blood copper levels in children, 2006

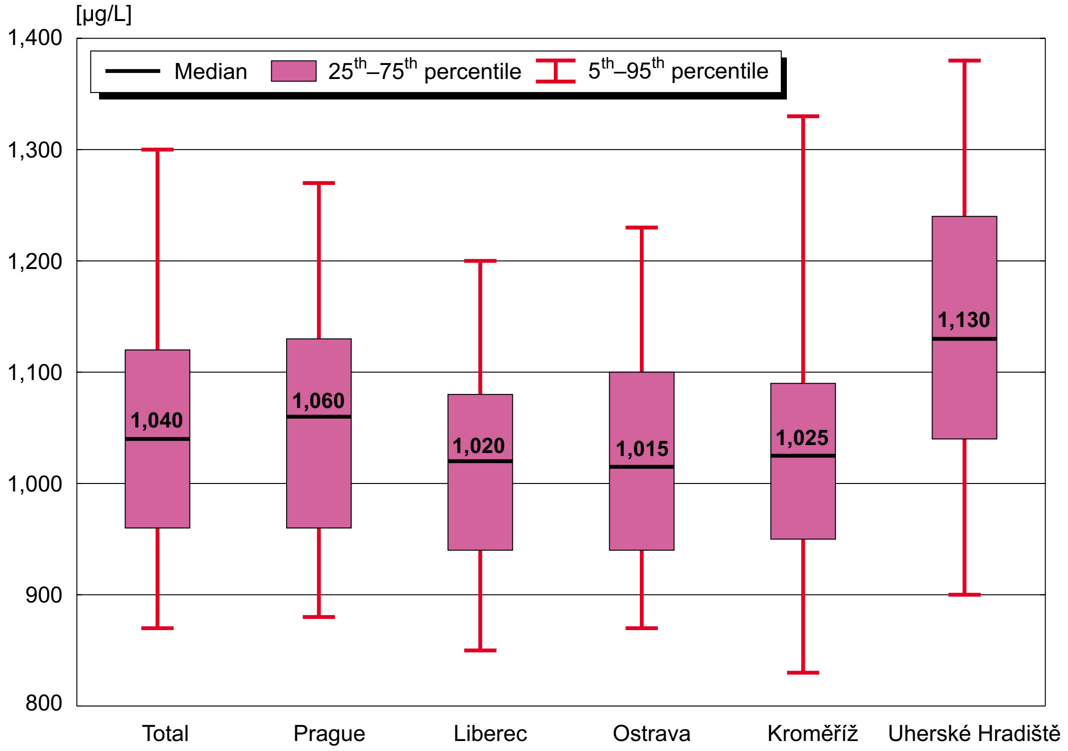


Fig. 8.2b Blood zinc levels in children, 2006

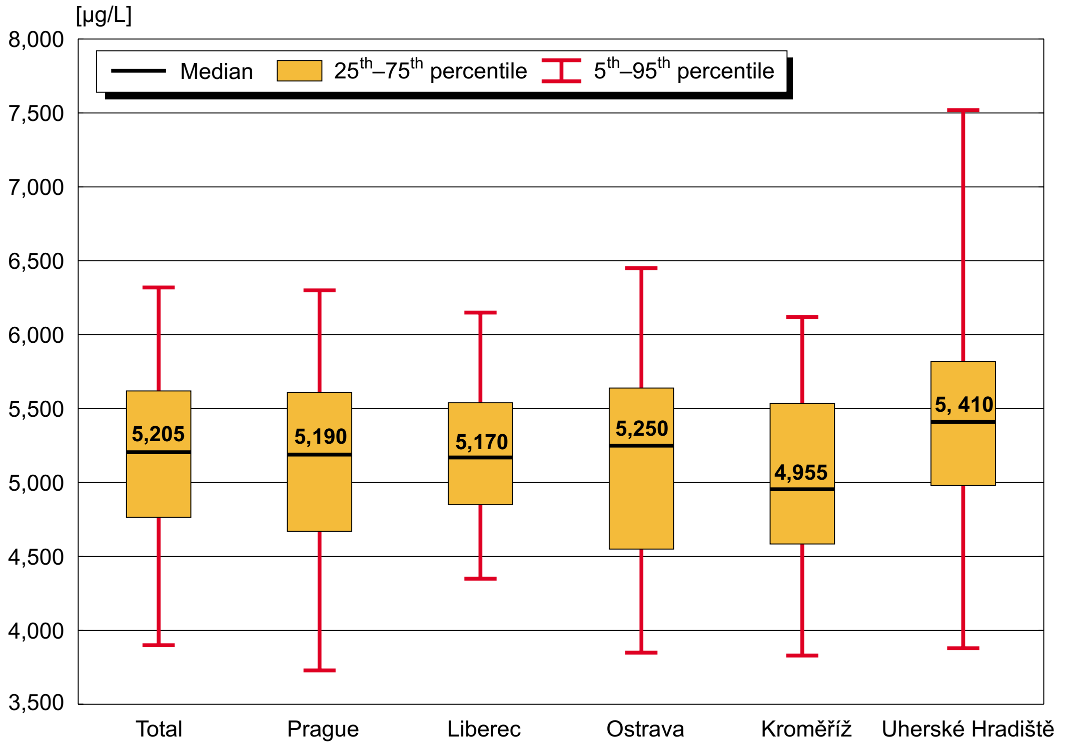


Fig. 8.2c Blood selenium levels in children, 2006

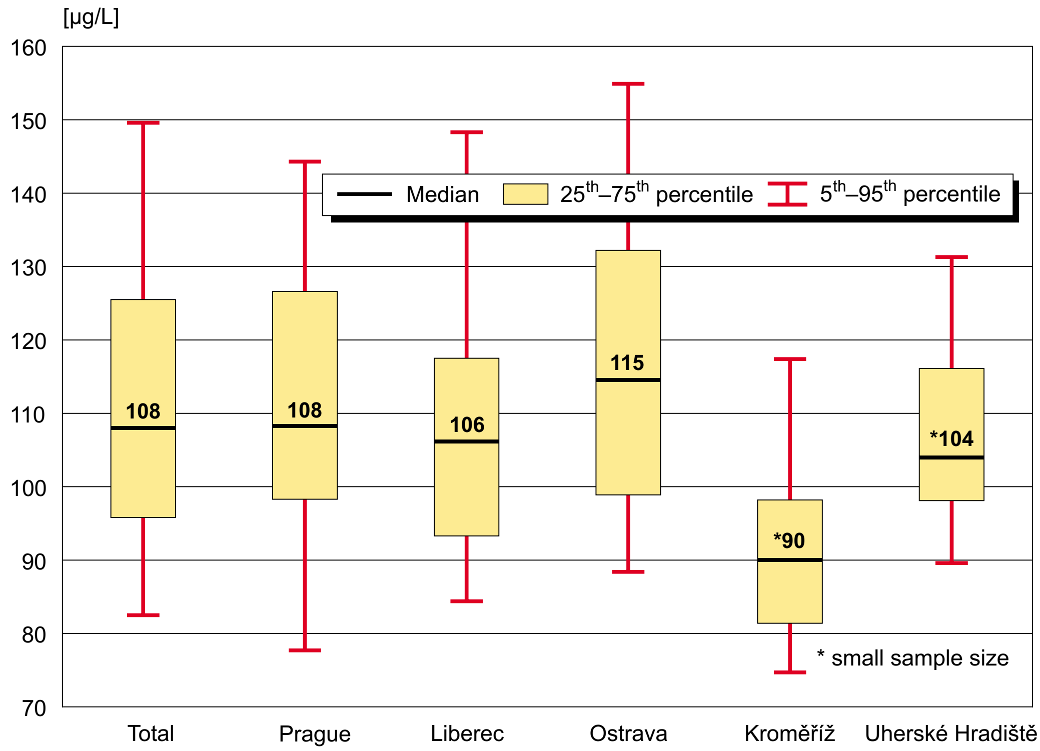


Fig. 8.3a Polychlorinated biphenyls in breast milk, 2005–2006
PCB 153 indicator congener

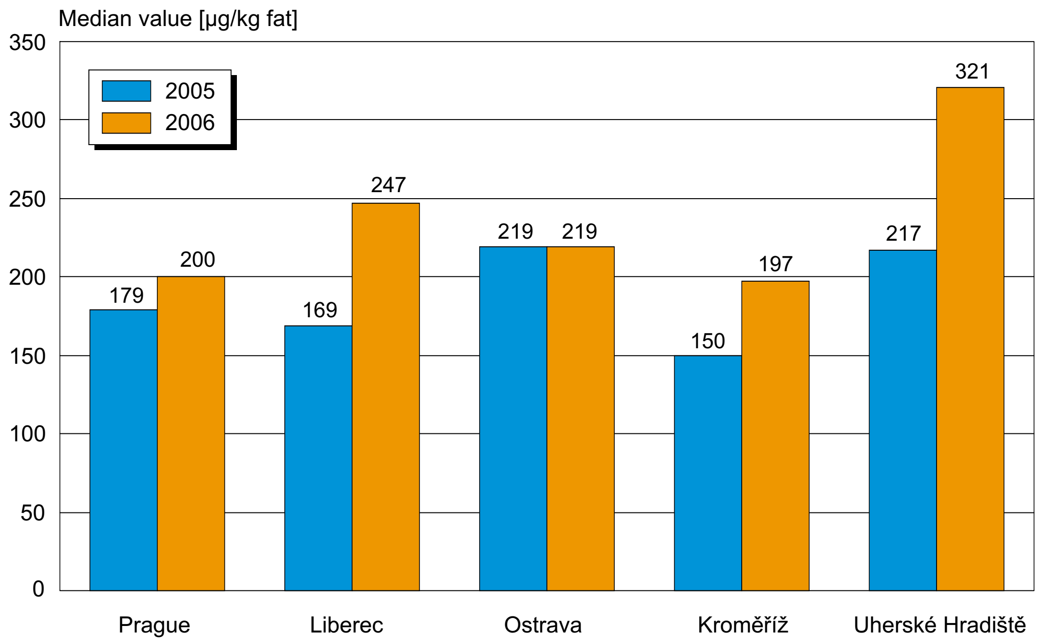


Fig. 8.3b Chlorinated pesticides in breast milk, 2005–2006
sum of DDTs

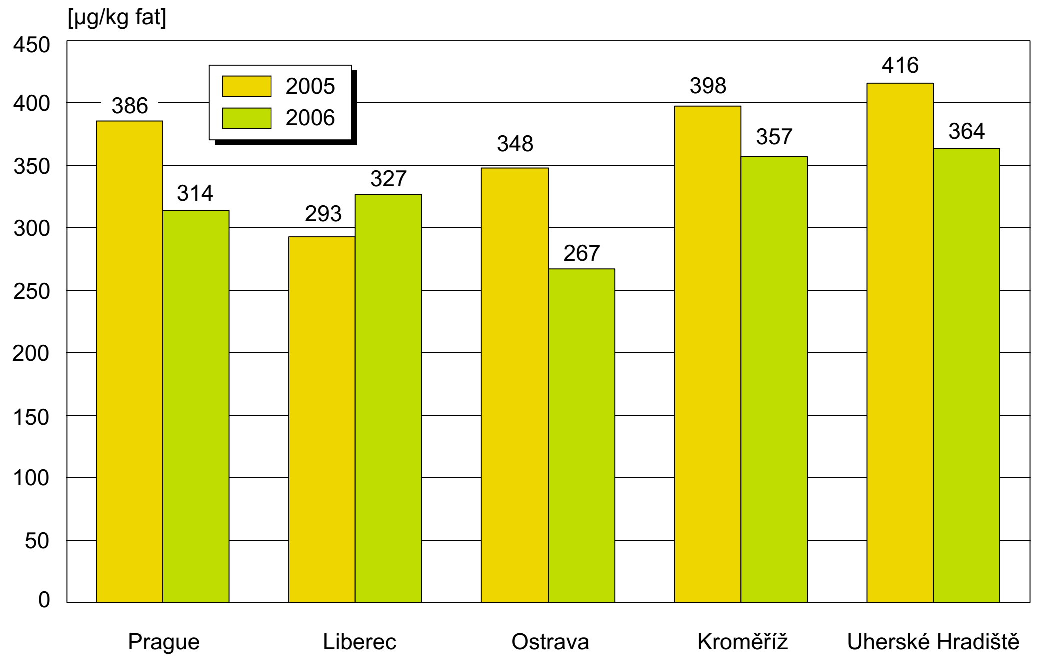


Fig. 8.3c Chlorinated pesticides in breast milk, 2005–2006
hexachlorobenzene

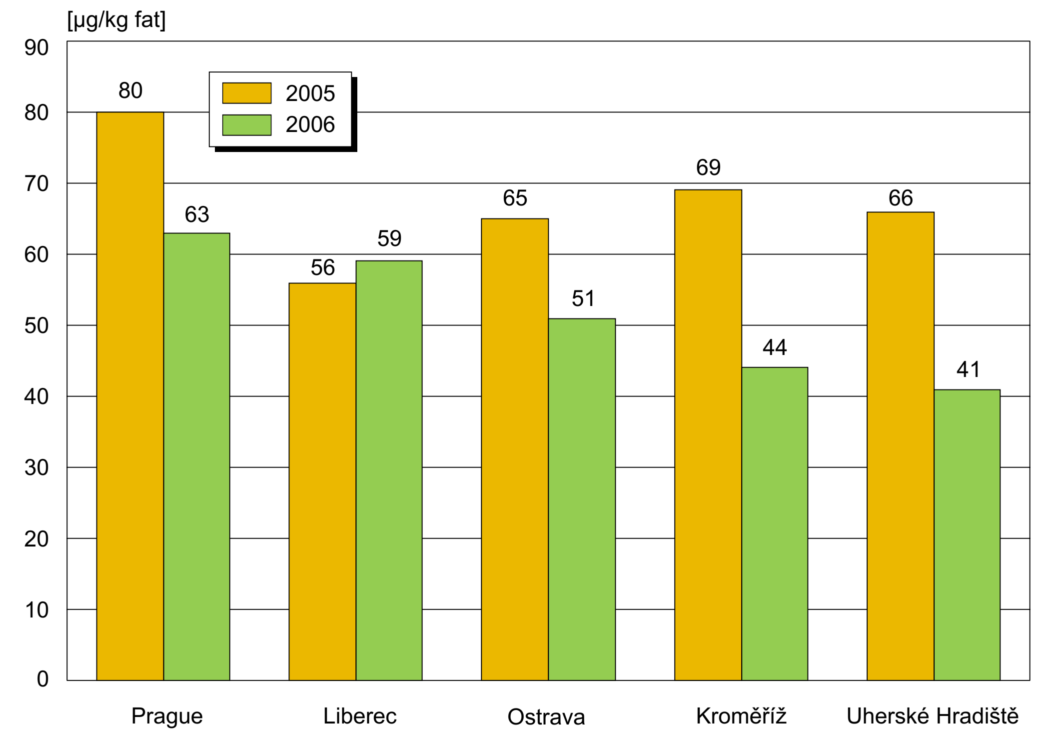


Fig. 8.4a Frequency of chromosomal aberrations in children (N = 339), 2006

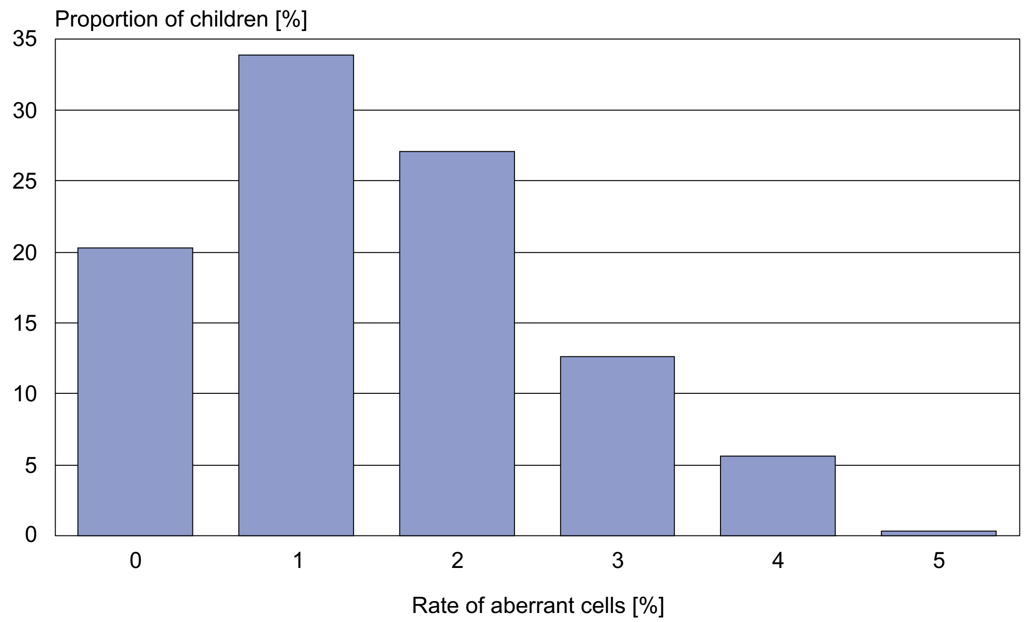
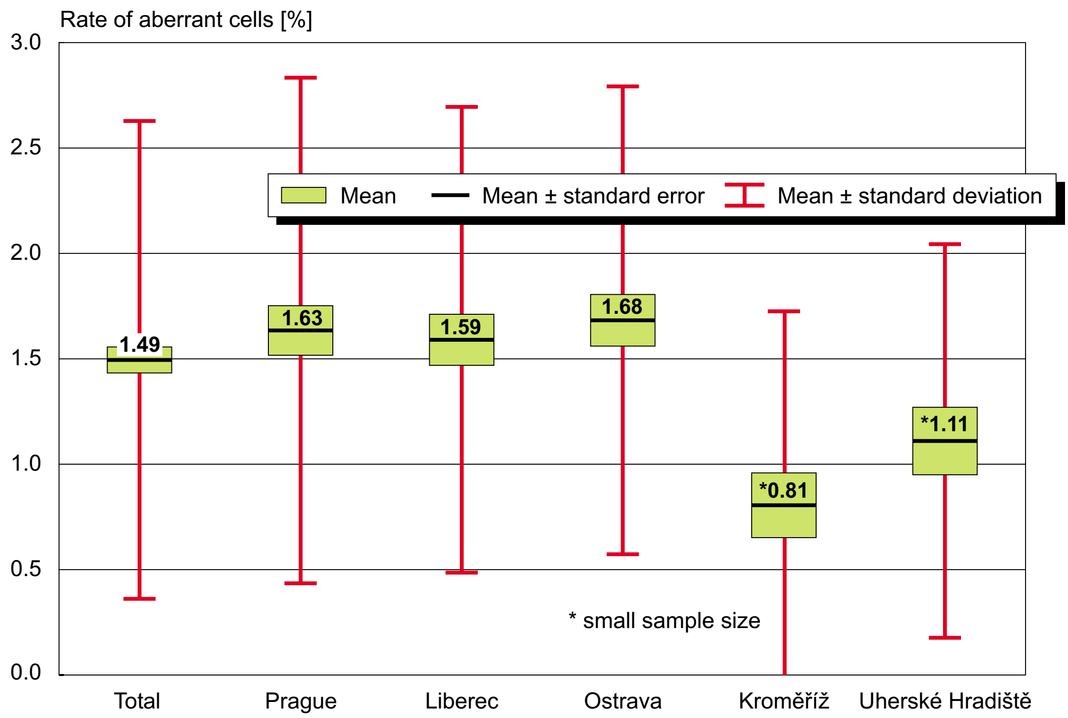


Fig. 8.4b Chromosomal aberrations in children in the cities, 2006



9. HEALTH STATUS AND SELECTED PARAMETERS OF DEMOGRAPHIC AND HEALTH STATISTICS

9.1 Organization of monitoring activities

The monitoring of population's health status is based on a questionnaire survey titled the HELEN Study (*Health, Life Style and Environment)*.

The aim of the study is to obtain basic data of the health status of inhabitants in the urban areas involved in the System of monitoring. Besides health factors (overall markers of health state and the prevalence of selected non-infectious diseases) also other factors which influence health state (socio-economic and psychosocial characteristics, indicators of lifestyle, family history) are evaluated. In addition opinions of the inhabitants of the participating localities regarding the environment quality in the neighbourhood are evaluated as well as their attitudes to the problem of lifestyle and health.

The first phase of the HELEN study was performed during years 1998 to 2002 in total 27 cities; the second phase applied the same methodology and took place in the same cities in years 2004 and 2005 (25 cities). The results of the second phase of the HELEN study are presented in this report and a comparison is given of the first and the second phase.

Through a systematic random selection ensuring a representative sample 800 subjects were selected in each city (400 males and 400 females) between 45 and 54 years of age. The population register of the Ministry of Interior of the Czech Republic served as the basis of selection. Interviewers mainly employees of a hygiene service were responsible for the delivery and the collection of questionnaires. Each respondent filled in the questionnaire independently.

The results of the survey were described by means of relative counts. A hypothesis of conformity of the percentage proportion of the evaluated categories in a contingency table was tested by χ^2 independency test, the tests were performed on the level of statistical significance $p = 0.05$. The statistical significance of the differences between the first and the second phase of study was established on background of regressive analyses where the influence of basic socio-economic characteristics of the compared groups was taken into account. These analyses were performed on the level of statistical significance $p = 0.01$.

9.1.1 Selected results of the second phase of the HELEN study, 2004–2005

The questionnaire was completed by total 9,230 respondents; the overall respondency rate was 50 % (in single cities it ranged from 29 % in Klatovy to 67 % in Karviná).

Health state

- 49 % of respondents assessed their overall health state as good or very good, 39 % rated it as moderate and 12 % as poor or very poor. In the subjective evaluation of health state no statistically significant difference was found between males and females ($p = 0.662$). The difference between cities that is statistically significant ($p < 0.001$) is shown in Fig. 9.1.

- 55 % of persons complained of long-term health problems (53 % of males and 57 % of females, $p = 0.001$). The most common cause of these problems was a locomotive system disorder which was reported by 36 % of respondents. On second place there were diseases of heart and vessels (12 % of persons). The frequency of the causes of long-term health problems is presented in Fig. 9.2a.

- 62 % (56 % of males and 67 % of females, $p < 0.001$) of persons were taking drugs for long time (more than 14 days in the previous year). Females were taking drugs significantly more often than males (even with exclusion of contraceptive drugs). The most common purpose for taking drugs was back and joint pain (25 % of persons) and hypertension (21 %).

- The evaluation of the prevalence of selected diseases was based on the answer to question if any respondent's diseases were found by a physician. The summary of the whole-life prevalence of selected diseases of males and females is presented in Fig. 9.2b. The most frequent diseases were diseases of spine and joints (32 % of persons), hypertension (30 %). 68 % of respondents with hypertension were using blood pressure lowering drugs.

- 27 % of respondents reported an allergic disease in their personal history, significantly predominating females over males (33 % vs. 19 %; $p < 0.001$). The diagnosis of allergy was confirmed by a physician in 76 % of the respondents with allergy, hence 19 % of all respondents. The average age when the first signs of an allergic disease demonstrated was 31 years. The most common allergen was pollen (43 % of persons with allergy), dust (32 %) and drugs (25 %).

Comparison of the results of I. and II. study phase:

In the second phase of the HELEN study there was no significant change of the overall parameters of health state and in the occurrence of the most of evaluated types of problems and monitored diagnoses. Only in male population there has been an increase in locomotive system problems (of 2 percentage points) and an increased prevalence of hypertension (of 4 percentage points); at the same time the number of males treated for hypertension raised (of 8 percentage points). An increase of prevalence was observed mainly in the group of males with lower education. No change was found in the prevalence and the treatment of hypertension in females.

Risk factors of chronic non-infectious diseases

The occurrence of monitored risk factors in urban population (separately for males and females) from 45 to 54 years of age for single cities is presented in Table 9.1 and in summary in Fig. 9.3a.

- Obesity (BMI $\geq$ 30.0) was found in 18 % of respondents; 43 % of respondents (54 % males and 34 % females; $p < 0.001$) were overweight (BMI 25.0–29.9).

- In 33 % of persons increased cholesterol level was found by a physician. Total 16 % of persons responded that they had not been tested for cholesterol level. 23 % of respondents were taking drugs reducing cholesterol level (from the group with proven increased cholesterol level), 32 % of respondents are on a diet and 44 % are not treated. Males were taking drugs more frequently than females; females reported diet more frequently.

- In the monitored population there were total 32 % of regular smokers, more males (35 %) than females (28 %), 3 % of occasional smokers, 25 % of ex-smokers (29 % of males and 21 % females) and 41 % of non-smokers (33 % males and 48 % females; p-value for the difference between male and female smoking habits: $p < 0.001$). Males – regular smokers smoke 17 cigarettes a day in average, females 11 cigarettes. Ex-smokers (males and females) stopped smoking approximately 13.5 years ago, 77 % of male ex-smokers and 73 % of female ex-smokers have not smoked for more than 5 years. In the overall summary 25 % of the households were smoking where average 13 cigarettes a day were smoked. The proportion of smokers in single cities is shown in Fig. 9.3b.

- 23 % of persons were exposed to passive smoking (a stay of a non-smoker in a smoky room for more than 1 hour a day). Females were spending shorter time in a smoky environment than males (females 1.4 hour/day, males 1.9 hour/day, $p < 0.001$; both smokers and non-smokers, the non-smokers were spending less than an hour in a smoky room on average day).

- Structured physical activity (physical exercise, sport or tourism) was executed by 70 % of all respondents, for average 3.7 hours in a typical week. One half of respondents reported 2 hours or less, no physical activity was reported by 28 % of all respondents. A low level of physical activity (less than 3 hours a week) was found in 62 % of all respondents. An insufficient physical activity was found in significantly more females in comparison to males, in persons with lower education level and in people with long-term health problems.

Comparison of results of I. and II. study phase:

In the second phase there was a significant increase in the number of respondents with increased cholesterol level (males of 5 percentage points, females of 3 percentage points). However the percentage of respondents who had not been tested for cholesterol level has not changed significantly. In the second phase also a major change was found in the treatment of increased cholesterol level. A number of respondents on diet declined (males of 5.9 percentage points and females of 5.3 percentage points) and a number of those taking drugs increased (males of 5.7 percentage points and females of 3.2 percentage points).

The comparison of smoking habits of males and females in both phases is shown in Fig. 9.3c. In both phases there were significantly more male regular smokers than female ones; however this difference was reduced in the second phase. In the second phase of study thus a more prominent reduction of the number of regular smokers – males in comparison to females. In the proportion of passive smokers no change was observed during the second phase.

Nutrition and dietary habits

- The evaluation of eating habits of respondents was based on the answers to a set of questions. The frequency of consumption of eight kinds of food (dairy products, poultry meat, fish, vegetables, fruit, wholegrain bread, roasted and deep fried food, cakes and other sweets) and the preference of low-fat dairy products and unsweetened drinks was investigated. Females were eating fruit and vegetables, wholegrain bread and dairy products more often than males and they also were consuming roasted and deep fried products less frequently. Males preferred fish more frequently than females and consumed cakes and other sweets less frequently. Low-fat dairy products and unsweetened drinks were preferred by females more than by males. From the answers to a whole set of questions a score was calculated which reflects the overall approach of respondents to healthy diet. 10 % of respondents were keeping conditions of healthy diet well whereas 21 % of persons observed these rules in a very limited amount. The recommended daily consumption of at least 500 grams of fruit or vegetables was fulfilled by 24 % of persons (18 % males and 29 % females, $p < 0.001$).

- The average daily intake of fluids was 2.5 litres in males and 2.0 litres in females ($p < 0.001$). An insufficient daily fluid intake (less than 2 litres of fluids a day) was seen in 11 % of males and 24 % of females ($p < 0.001$). Drinking water from the public water tap is used by 86 % of persons, 5 % of people use well water and 52 % of persons are buying bottled water.

- An excessive alcohol consumption was discovered in 26 % of males and 8 % of females ($p < 0.001$). In average males drink 3.6 litres of beer, 2.4 dl of wine and 0.6 dl of spirits per person per week, females 0.5 litres of beer, 2.0 dl of wine and 0.2 dl of spirits per person per week.

- Vitamin supplements or supplements containing trace elements were regularly used (i.e. minimum 3 times a week) by 20 % of respondents (15 % of males and 24 % of females), 44 % of persons (54 % of males and 35 % of females) did not use any vitamins and trace elements. Females were using these supplements more frequently than males ($p < 0.001$).

Psychosocial factors and health and environment opinion

- 53 % of persons were satisfied with their lives, 41 % held neutral opinion and 6 % of persons were dissatisfied, the difference between males and females was on the border of statistical significance ($p = 0.047$).

- 61 % of respondents felt shared responsibility for their own health, 35 % held neutral opinion and 5 % felt very little ability to affect their health.

- More males (55 %) than females (50 %, $p < 0.001$) agreed with the statement “my health depends on me”. The respondents’ opinions of the statement “I can reduce the risk of heart attack/cancer by myself” are shown in Fig. 9.6.

- The respondents considered permanent stress to be the main health-affecting factor (76 % of all respondents), followed by smoking (74 %) and obesity (72 %). Females attached more importance to the monitored factors than males, only from the viewpoint of lack of physical activity there was no difference between males and females. The level of importance attached to single factors in shown in Fig. 9.4a.

- 38 % respondents were satisfied with the environment in the neighbourhood, 11 % of respondents were dissatisfied. The subjective evaluation of urban environment is shown in Fig. 9.5a. In most of the cities the main annoying factor was traffic. Total 30 % of respondents were complaining about it. The second most inconveniencing factor was pollution of public places which bothered 22 % of respondents. Day noise represented a problem for 17 % of respondents, night noise annoyed 12 % of the people asked. The level of annoyance by traffic and noise in the cities can be seen in Fig. 9.5b. 15 % of respondents complained of air pollution as well as dust in the neighbourhood and 9 % complained of water pollution.

Comparison of results of I. and II. study phase:

In the second phase of study there was an increase in the number of respondents who were satisfied with their life (of 5 percentage points). The increase of satisfied respondents was at the expense of respondents with neutral opinion, the proportion of discontented persons changed only slightly.

The feeling of shared responsibility for their own health including the attitude to the possibility of influencing the risk of myocardial infarction and cancer had not changed in respondents of the second phase of the HELEN study.

In the second phase of study there was a significant increase in a number of respondents attributing a prominent influence on health state to obesity and eating habits. On the contrary the significance attributed to the factors of environment decreased (Fig. 9.4b).

In the second phase of study the proportion of persons who were satisfied with the environment in the area of residency significantly increased.

Tab. 9.1 Risk factors occurrence in city inhabitants 45–54 years of age [%]

City	Obesity BMI ≥ 30		High blood pressure		High cholesterol level		Passive smoking		Active smoking		Low physical activity		Poor dietary habits	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Brno	15.9	16.0	39.7	23.6	36.5	31.4	26.8	12.9	33.3	23.4	59.8	63.4	28.0	11.0
Č. Budějovice	18.6	17.2	29.5	23.2	36.8	30.3	38.9	23.7	29.2	32.2	59.3	62.4	33.7	13.1
Děčín	27.0	22.9	33.6	35.4	39.4	39.6	32.0	12.8	40.2	27.1	60.3	66.2	38.0	8.3
Havlíč. Brod	19.4	14.2	26.4	31.0	17.2	22.2	23.4	14.9	34.4	16.7	73.5	78.2	32.7	12.2
Hr. Králové	19.2	13.6	33.7	22.6	41.5	33.9	29.5	15.2	27.9	28.6	62.4	61.3	23.8	8.5
Jihlava	20.5	14.4	33.7	30.3	23.8	25.4	33.0	14.2	34.3	24.3	62.1	67.9	36.1	18.7
Jablonec n. N.	17.1	13.1	31.9	23.7	36.2	29.2	25.0	14.3	26.5	27.2	48.2	43.5	26.1	8.3
Karviná	23.0	22.4	35.2	34.2	32.6	34.2	34.8	20.5	40.9	41.6	63.0	75.1	23.5	14.6
Kladno	14.9	17.7	29.1	25.3	38.1	32.8	47.3	25.5	46.0	38.5	53.2	59.2	33.9	11.4
Kroměříž	16.0	13.8	41.5	32.4	27.9	25.8	27.3	13.1	33.7	18.9	56.1	58.8	29.9	8.2
Klatovy	21.0	15.9	35.7	26.6	40.0	36.6	44.1	34.9	29.0	18.9	63.2	62.1	28.3	9.4
Liberec	15.8	14.3	30.1	24.0	35.3	25.1	35.6	12.3	29.7	27.2	53.6	59.8	25.9	8.8
Mělník	17.4	9.5	34.5	27.0	30.6	31.4	31.5	19.1	31.6	24.4	64.3	63.1	33.5	13.9
Most	27.3	20.0	32.2	20.1	36.3	30.4	36.4	23.4	46.5	37.6	64.1	72.4	36.1	15.5
Olomouc	14.2	14.4	32.0	27.4	37.2	32.2	24.7	8.7	33.7	27.7	55.6	65.4	31.5	12.6
Ostrava	22.1	21.7	43.9	35.1	43.6	38.9	35.0	25.4	40.3	32.0	64.5	70.5	26.3	12.3
Prague 10	23.1	12.7	39.1	20.4	44.6	31.0	25.0	27.5	21.3	28.2	63.4	62.2	27.7	10.4
Příbram	20.2	13.0	31.5	24.7	44.0	31.8	40.0	18.4	34.9	29.9	63.4	56.5	33.3	9.9
Plzeň	20.0	11.6	36.4	14.3	43.8	33.6	35.8	22.4	34.7	35.4	56.6	62.1	29.1	12.1
Šumperk	13.7	12.0	29.3	20.3	34.6	23.5	24.8	9.7	34.1	22.7	54.8	53.8	31.2	6.4
Svitavy	20.9	20.0	37.3	26.6	36.2	34.7	33.0	12.7	35.7	28.4	65.5	65.9	30.5	13.5
Ústí n. L.	19.3	19.0	34.1	37.4	38.8	41.1	33.8	17.5	43.3	34.6	57.1	72.5	37.1	6.9
Ústí n. O.	17.9	15.3	29.7	29.4	36.9	37.6	30.9	10.1	32.2	27.5	48.8	56.8	40.8	11.7
Znojmo	19.6	19.2	43.1	27.1	29.1	23.7	22.7	19.9	38.9	29.8	61.5	65.0	31.8	14.2
Žďár n. S.	14.0	19.3	32.1	22.9	41.3	37.5	27.1	13.8	34.2	24.7	53.8	67.7	30.3	13.8
Total	19.0	16.3	34.0	26.9	35.3	31.5	31.6	17.1	35.2	28.4	59.9	64.2	31.3	11.7

The percentage of persons who considered the environmental factors very bothering decreased – pollution of public places, air pollution (both factors of 4 percentage points) and noise at night (of 2 percentage points). No statistically significant change was observed for other evaluated factors.

9.2 Age structure and demographic aging

The age and sex structure of population belongs to the basic characteristics of the monitored population and in the developed countries its changes have greater significance than trends in total number of population itself. The age structure of the population of a certain region reflects long-term population development, and in connection to that reproduction behaviour and population movement (migration) in the last approximately 100 years. At the same time current population structure by age and sex markedly affects its future development.

In these days mainly questions linked to the process of **population aging** or **demographic aging** are discussed when speaking about age structure. It is one of the most significant demographic process which is characterized by changing age structure of the population and proceeds in absolute majority of countries in the world, partly as an outcome of decreasing mortality and resulting prolongation of human life and partly as a consequence of decreased birth rate level. It isn't modern process only in recent days there has been an acceleration due to significant changes in demographic reproduction. The difference in age structure of population between year 1965 and estimated situation in year 2050 is shown in Fig. 9.7b.

Demographic aging is often measured by proportions of specific age groups in overall population, also based on indexes (aging index, support ratios) and by means of average age or median age. The most common feature is the proportion of persons over 65 years of age in the population. Approximately 7 % population aged 65 and more (2005) live in the world, in the developed countries the proportion is even greater. The oldest population from the viewpoint of this marker is in Italy and Germany with 19 % of persons of this age, followed by Greece with 18 %. Within Europe Czechia belongs to relatively younger states, 14 % of population is aged 65 and more (for details see Fig. 9.9). The elderly support ratio or the number of persons over 65 years of age per 100 persons from 15 to 64 years of age in the European countries is presented in Fig. 9.10.

Despite the fact that permanent discussion about this problem concentrates mainly on associated problems[1], it is essential to see aging of population as a success of human society and its development including increasing living standards.

9.2.1 Current situation and future development in the Czech Republic

The population pyramid representing age structure and structure by marital status in the Czech population in year 2005 is very irregular (Fig. 9.7a) and it has lost its characteristic shape. This is given by termination of the process of demographic revolution in the 30's of the previous century and also by the onset of demographic aging. The base of the age pyramid gets narrow as a result of low fertility level and with prolongation of human life the top of the pyramid is spreading. This general regularity is also influenced by specific fluctuations in fertility rate. Deep notches, i.e. lower numbers of persons born, appeared for example as a result of the World War I and II, the economic crisis of the 30's of the past century and also in the end of the past century reflecting a steep decrease of fertility to one of the lowest levels in the world. On the contrary the generations born after the wars and over the natality wave in the 70's are more numerous.

The sex ratio in the population is approx. 95 males to 100 females. In the age distribution however there are noticeable disproportions in the sex ratio. Most of the older population is represented by females despite the fact that during the birth in most of the populations there are 106 boys to 100 girls. For higher mortality of males in all age groups there are balanced numbers of males and females during the middle age (in our country in age of 47). With advanced age the proportion of

[1] *Social security, health state in advanced age, seniors' rights, insufficient offer of services, seniors' living, increased number of seniors living without a partner, loneliness etc.*

females in each generation increases, in year 2005 in age group 65–69 years there were 125 females to 100 males, in age group 85–89 years even 250 females to 100 males (Fig. 9.2). 70 % of the group over 80 years are formed by females.

In Czechia the population aging has had a tranquil course so far, mainly it represented the aging of population from the bottom, the number of children in the population was reduced whereas the number of people in postproductive age increased slightly. Regarding the age structure a prominent aging of our population can be expected in the following years mainly because strong war-time and after war age groups (age groups 2011–2017) will reach age of retirement (65 years).

The Table 9.3 demonstrates that during the last 25 years the proportion of children (0–14 years of age) in the population was gradually decreasing as a result of reduced birth rate. The proportion of working-age population (15–64 years) is slightly increasing in these days, in year 2005 this group formed 71 % of population. According to the long-term prognoses of the expected development of the population age structure this proportion will drop to 56 % in year 2050 while the proportion of persons aged 65 and more will increase to 31 %. In future also the distribution of the older population will change, the proportion of so called “oldest old” i.e. persons aged 80 and more will increase. Nowadays this group forms 24 % of the population over 65 years of age in the developed world. In the Czech Republic its proportion is approx. 21 %, in year 2050 it is supposed to occupy 9 % of the population and it will represent approx. 30 % of persons over 65 years of age (see Fig. 9.8). These significant changes of the age structure will also reflect in other parameters; the mean age might be approximately 49 years and the number of people aged 65 and more would exceed the number of children (0–14 years of age) approx. by 2.5 times, i.e. the value of aging index approx. 250.

9.3 Partial conclusions

The most common health problems of the monitored middle-aged population were represented by diseases of locomotive system and diseases of heart and vessels. In one third of respondents a physician found diseases of spine and joints and the same percentage of persons had been found to have hypertension. Approximately one third of respondents reported an allergic disease. Despite the fact that one half of respondents reported to have long-term health problems, only 10 % of respondents considered their health state as bad or very bad. In the vast majority of the monitored health parameters no significant change was found in comparison to the first phase of study, only in males there has been an increase in the prevalence of hypertension and an increase in the diseases of locomotive system was suggested. The most common risk factor in the monitored population was insufficient physical activity. The results of the study prove that the prevalence of the risk factors of serious diseases was common in the monitored population, an unfavourable trend of some parameters such as increased cholesterol level and hypertension was observed. From the viewpoint of preventive medicine the results of the HELEN study confirm the need of effective preventive programs to improve the lifestyle of population.

The population aging process is a result of changes of reproductive behaviour in the last two centuries and it will be a crucial feature of the population trend during the next decades not only in the Czech Republic. This process must be seen as a success of our civilization in overcoming mortal crises, in significant reduction of premature deaths and in constant increase of living standards. However with increasing number and proportion of old persons in the population the society will have to face many questions/problems.

Literature to chapter 9.2:

- *Kretschmerová, T., Šimek, M. (2004): Projection of the population in the Czech Republic by the year 2050, Demografie, 2004, 46, 2, pp. 91–99.*
- *Projection of the Czech population by the year 2050, Czech Statistical Office Prague, 2003.*
- *Kinsella, K., Philips, D. R. (2005): Global Aging: The Challenge of Success, Population Bulletin PRB, 60, 1, 44 pp.*
- *Health 21 – Health for all in the 21st century: Long-term programme of improving the health status of the Czech population, MoH CZ, Prague, 2003.*

Tab. 9.2 Sex ratio – number of women per 100 men, Czech Republic, 2005

Age	0	1–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49
Ratio	94.7	94.4	94.8	94.8	95.5	95.4	96.0	95.8	95.9	96.7	99.2
Age	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95+	
Ratio	102.6	106.5	113.4	124.7	141.1	168.5	212.0	251.2	317.3	397.7	

Source: Czech Statistical Office

Tab. 9.3 Population age distribution, Czech Republic

Indicator	1980	1985	1990	1995	2000	2005	2050[1)]
Total number of population (in ths.)							
Total	10,327	10,337	10,363	10,331	10,273	10,234	9,438
0–14	2,412	2,417	2,223	1,921	1,685	1,514	1,173
15–64	6,525	6,697	6,843	7,044	7,165	7,275	5,309
65+	1,390	1,222	1,296	1,366	1,422	1,445	2,956
80+	196	220	254	282	244	315	905
Distribution [%]							
0–14	23.4	23.4	21.5	18.6	16.4	14.8	12.4
15–64	63.2	64.8	66.0	68.2	69.8	71.1	56.3
65+	13.5	11.8	12.5	13.2	13.8	14.1	31.3
80+	1.9	2.1	2.5	2.7	2.4	3.1	9.6
Age distribution characteristics							
Mean age	35.4	35.7	36.5	37.3	38.8	40.0	48.8
Median age	33.1	34.2	35.6	36.4	37.6	38.9	x
Aging index	57.7	50.6	58.3	71.1	84.4	95.5	252.0
Support ratios							
Youth support ratio	37.0	36.1	32.5	27.3	23.5	20.8	22.1
Elderly support ratio	21.3	18.3	18.9	19.4	19.8	19.9	55.7
Total support ratio	58.3	54.3	51.4	46.7	43.4	40.7	77.8

Note:

[1)] According to the projection of the Czech Statistical Office, 2003, middle scenario

Aging index – the number of people over the age of 65 per 100 children aged 0–14 years
Youth support ratio – the number of children 0–14 per 100 people in working age (i.e. 15–64)
Elderly support ratio – the number of people over the age of 65 per 100 people in working age (i.e. 15–64)
Total support ratio – the number of children 0–14 and the number of people over the age of 65 per 100 people in working age (i.e. 15–64)

Source: Czech Statistical Office

Fig. 9.1 Subjectively perceived health status in the last six months

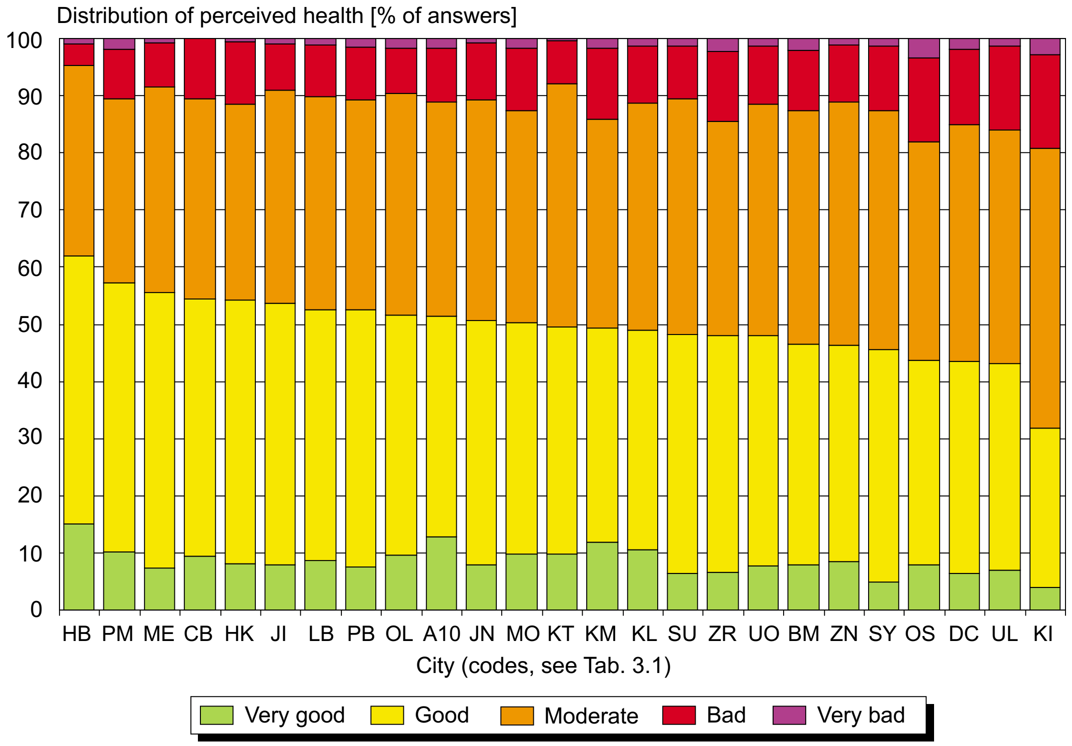
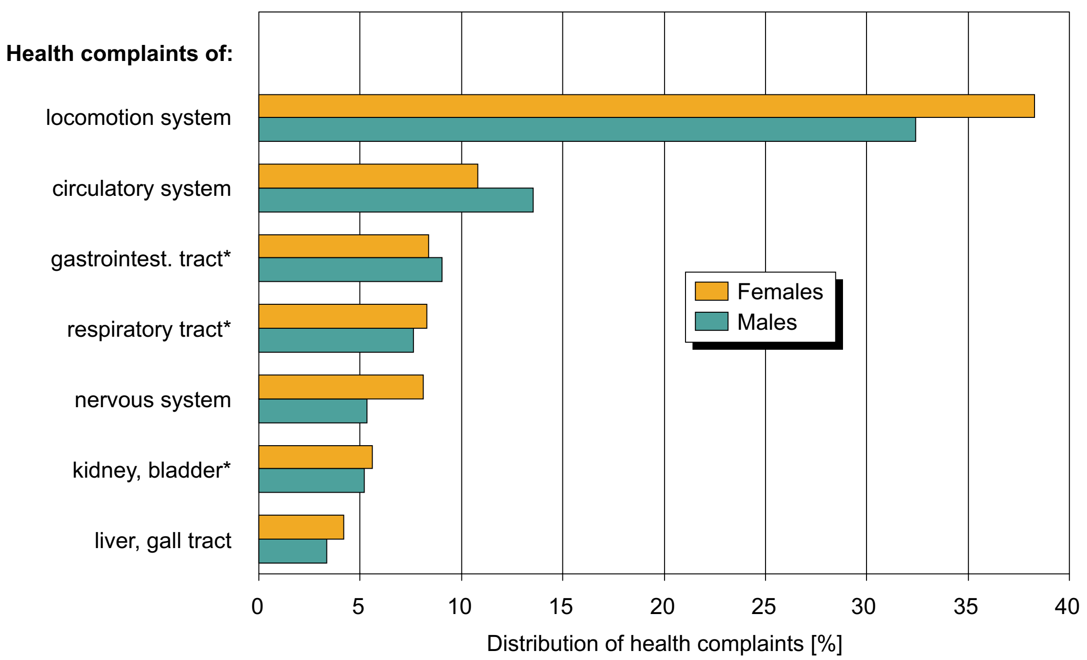
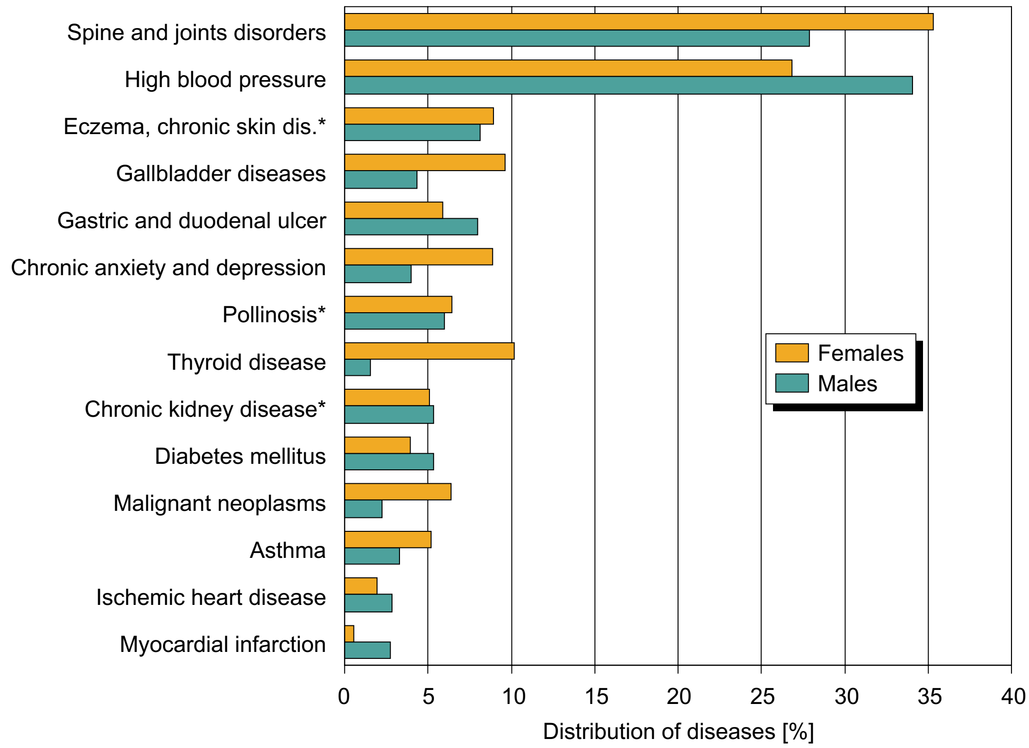


Fig. 9.2a Long-term health complaints, personal medical history



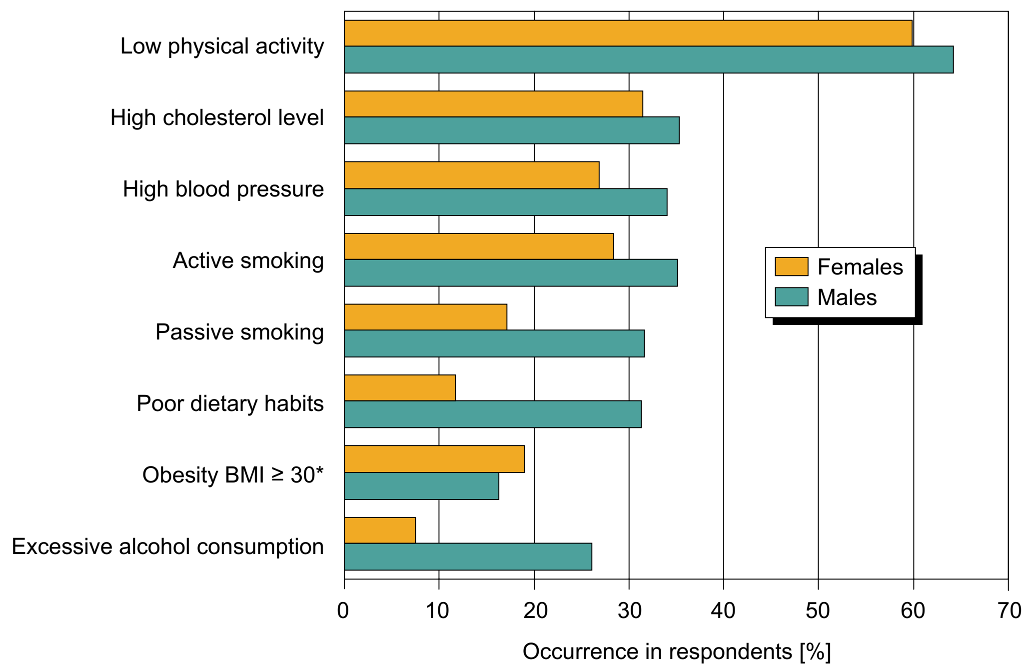
** no statistically significant difference between females and males*

Fig. 9.2b Diseases notified by physician, personal medical history



** no statistically significant difference between females and males*

Fig. 9.3a Risk factors of chronic non-infectious diseases



** no statistically significant difference between females and males*

Fig. 9.3b Prevalence of regular smoking

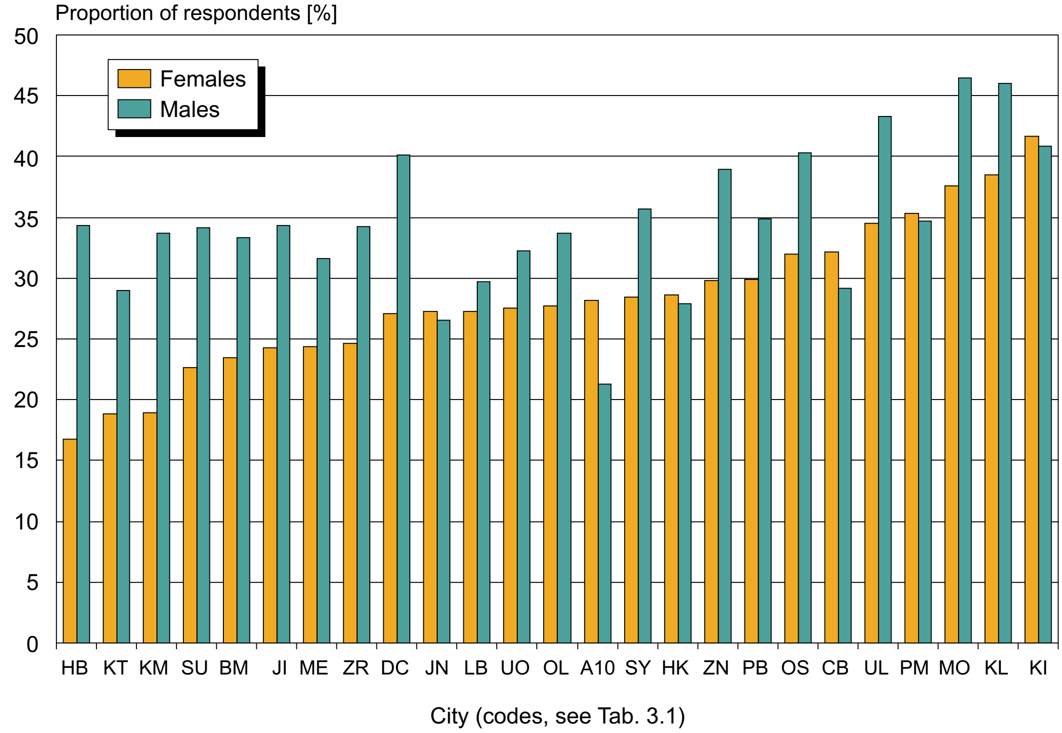


Fig. 9.3c Smoking habit – a comparison between I. (1998–2002) and II. (2004–2005) study period

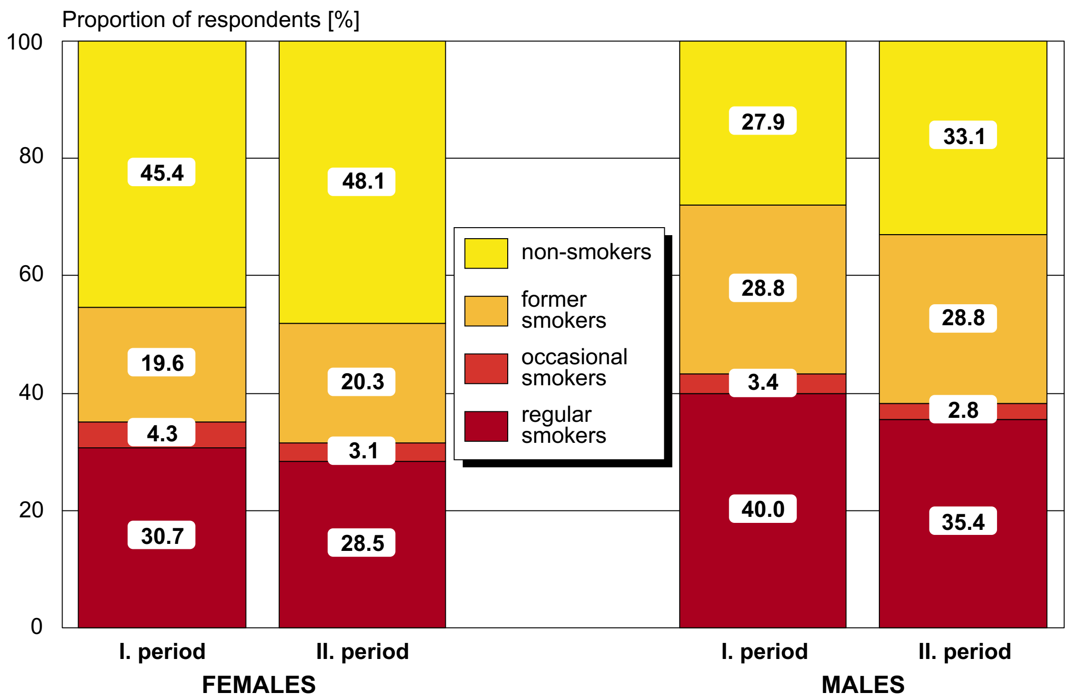


Fig. 9.4a The health relevance of selected factors – subjective assessment

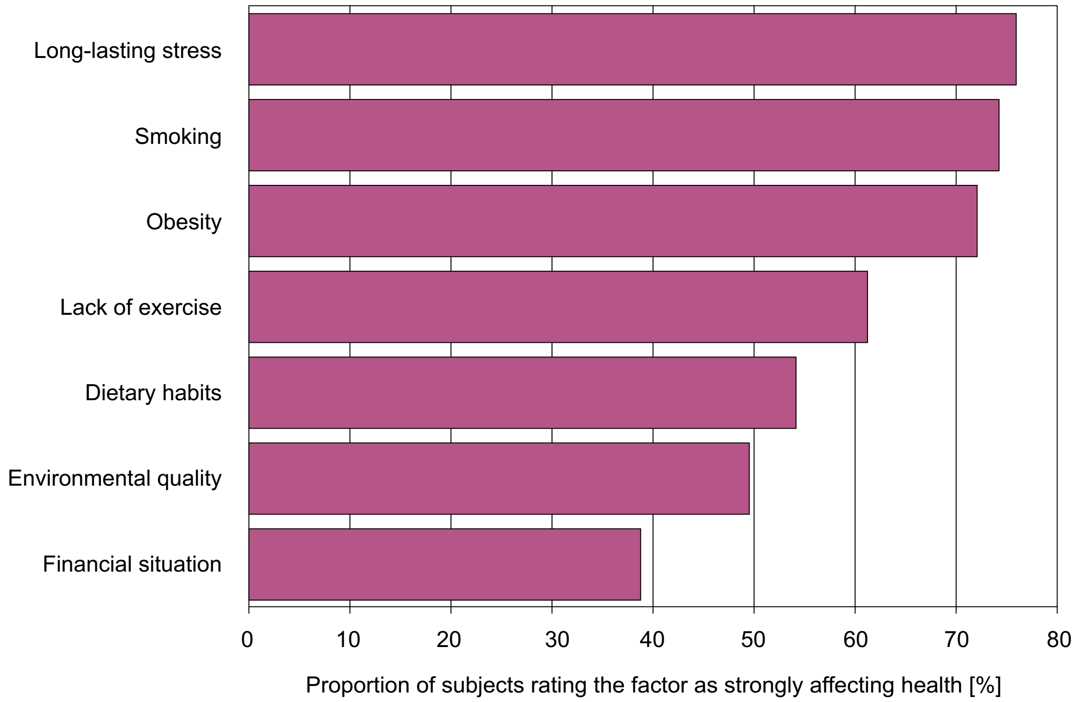
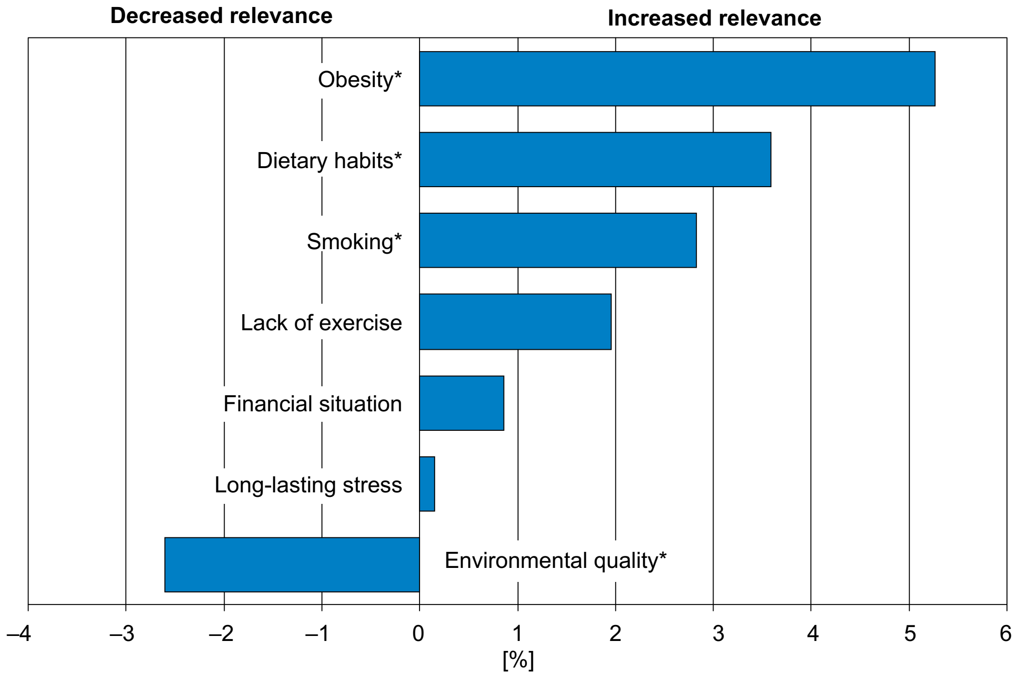


Fig. 9.4b Comparison of the health relevance assessment between I. (1998–2002) and II. (2004–2005) study period

Difference in number of respondents rating the factor as strongly affecting health



** statistically significant difference between I. and II. study period*

Fig. 9.5a Subjective evaluation of environmental quality in the neighbourhood

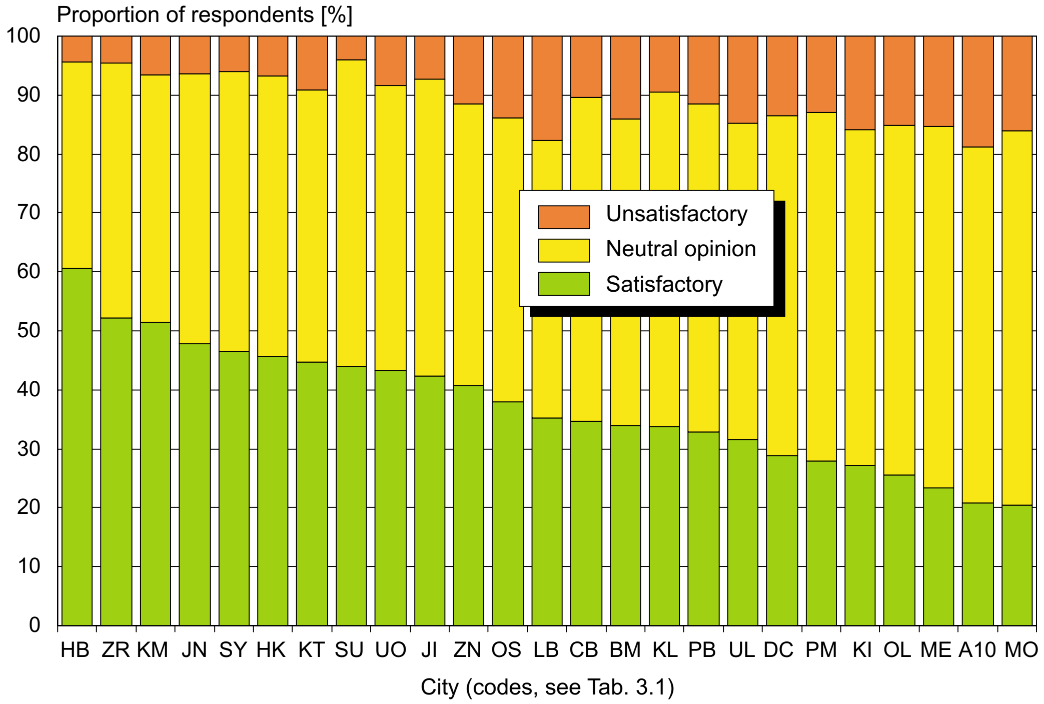


Fig. 9.5b Traffic noise and automobile transport – annoying factors in the cities

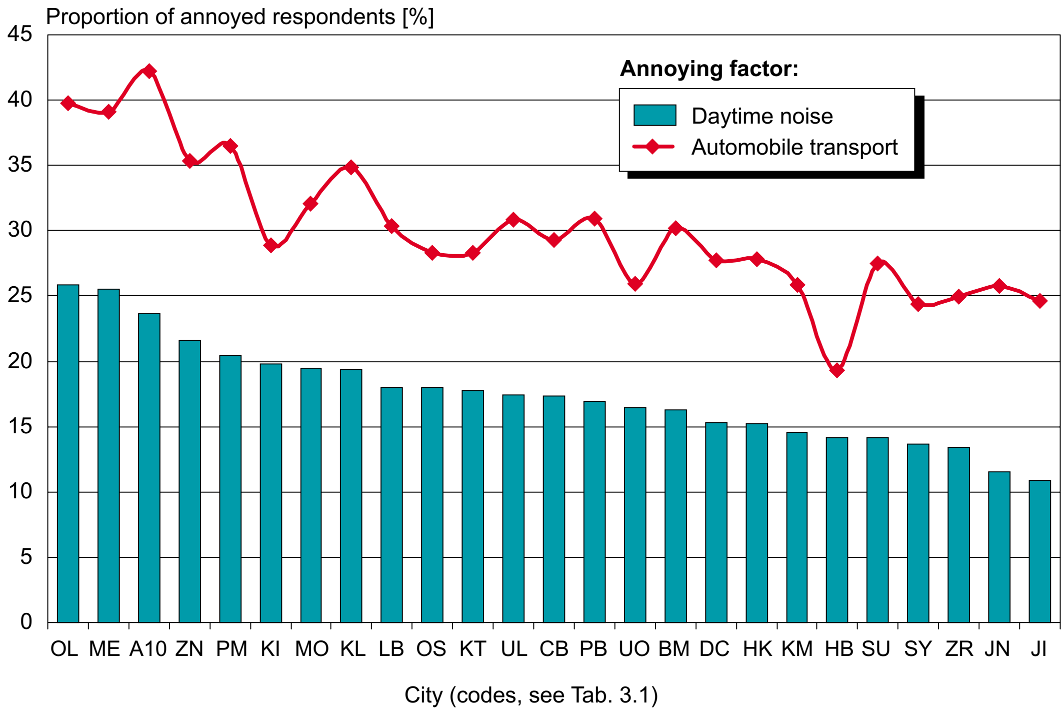


Fig. 9.6 Attitude towards behavior reducing one's own health risk

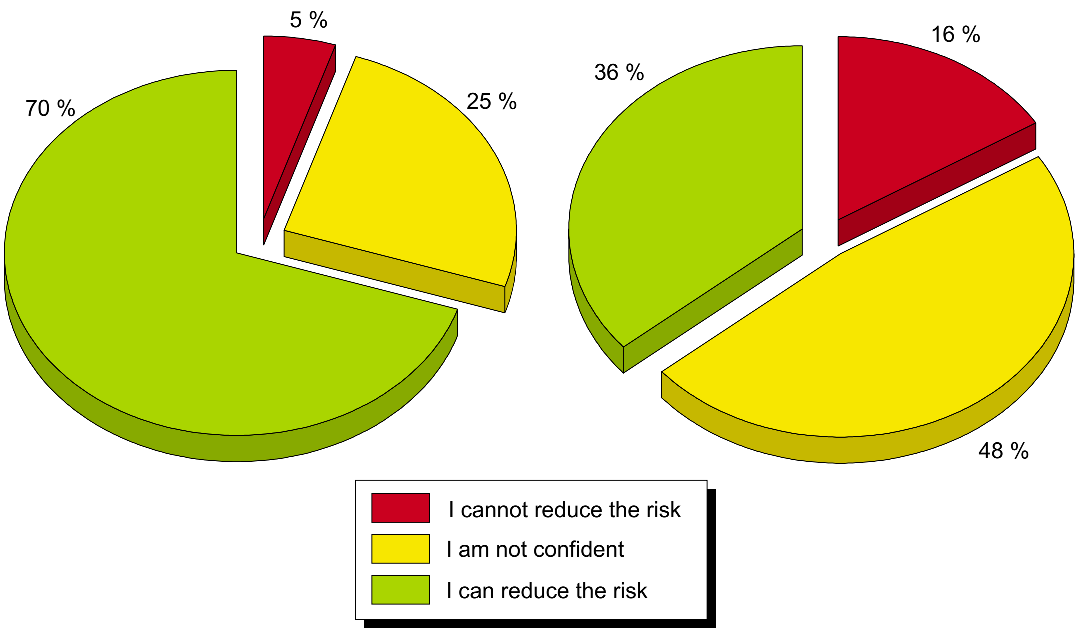
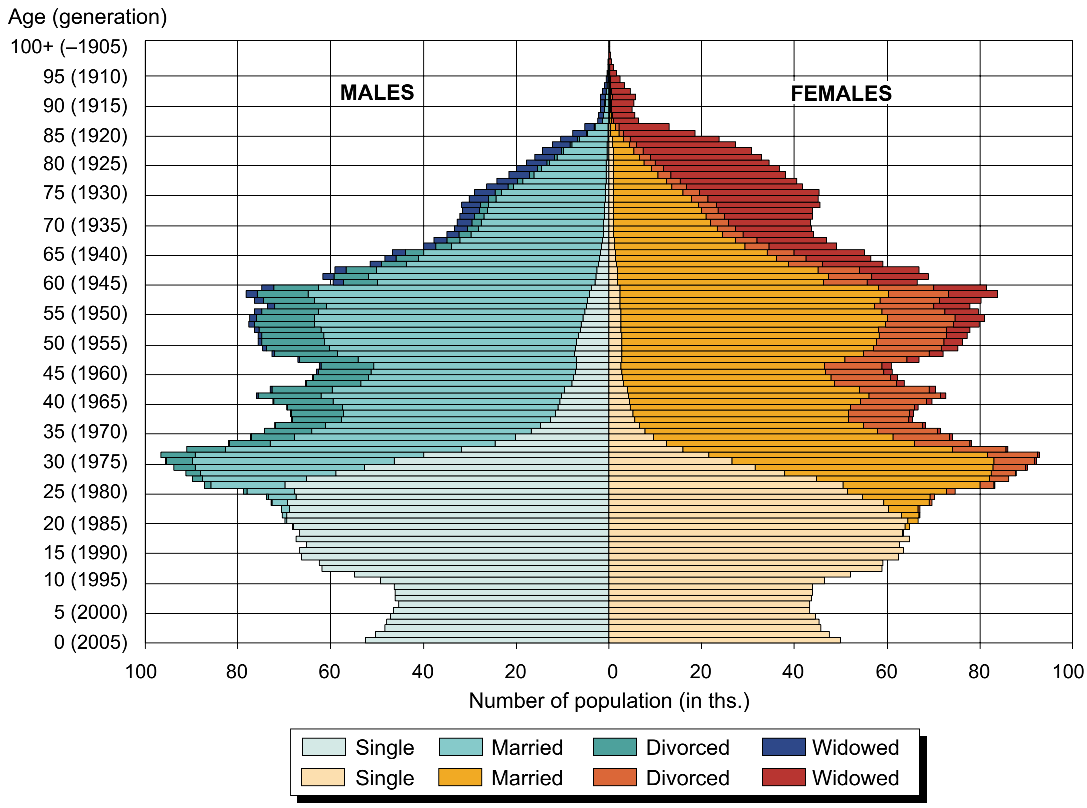
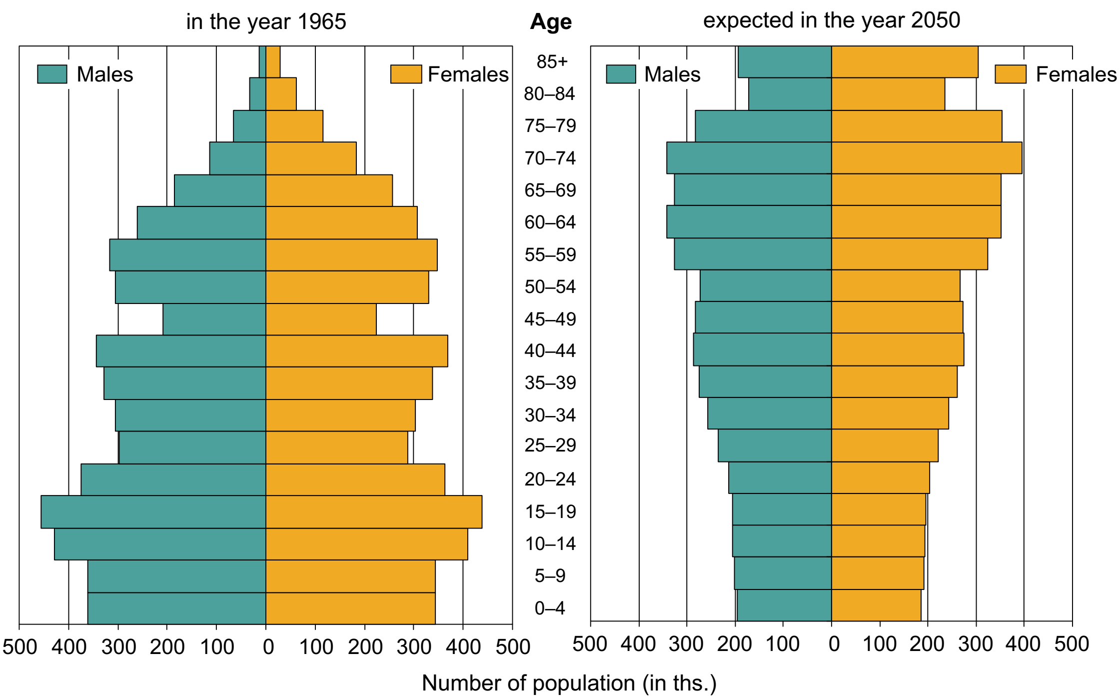


Fig. 9.7a Population age distribution by marital status (Czech Republic, 2005)



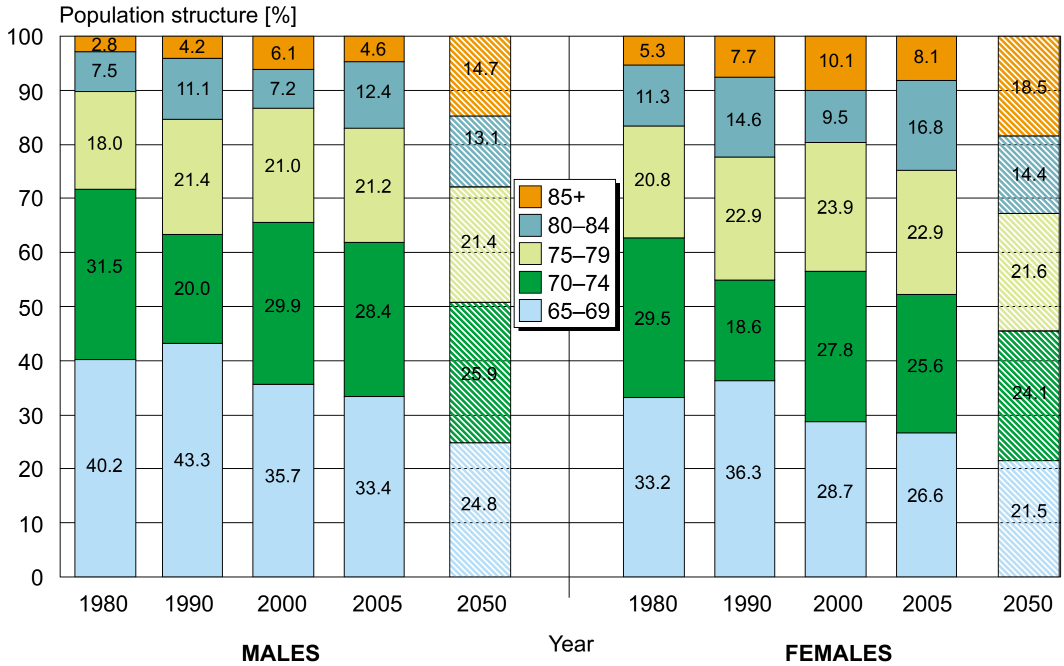
Source: Czech Statistical Office

Fig. 9.7b Population age distribution, Czech Republic



Source: Czech Statistical Office

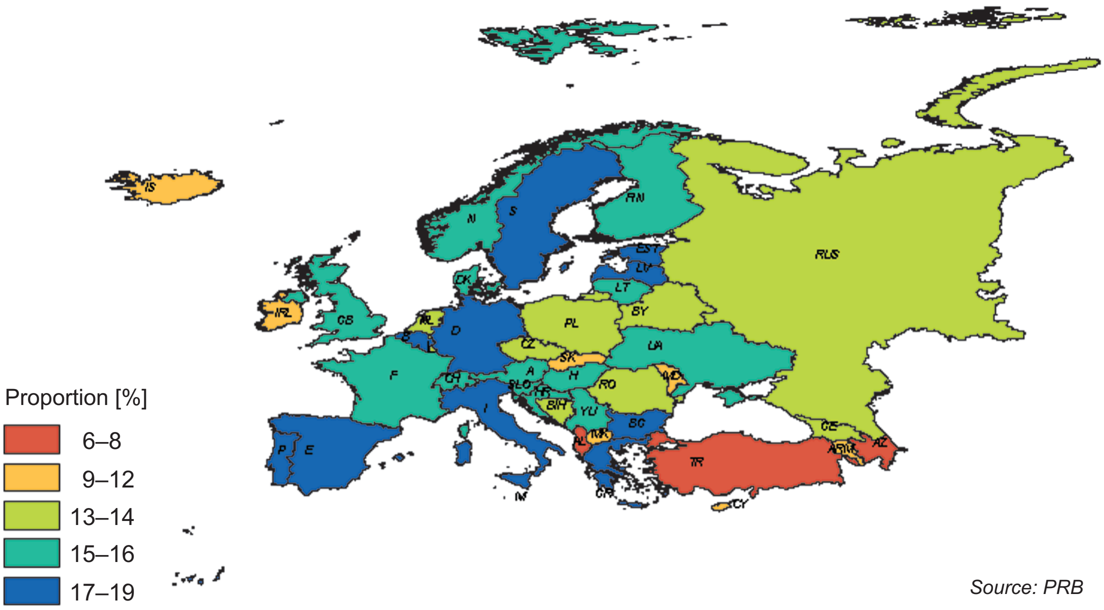
Fig. 9.8 Age structure of population over the age of 65, period 1980–2005 & estimation for the year 2050



Note: Situation in 2050 – according to the projection of the Czech Statistical Office, 2003

Source: Czech Statistical Office

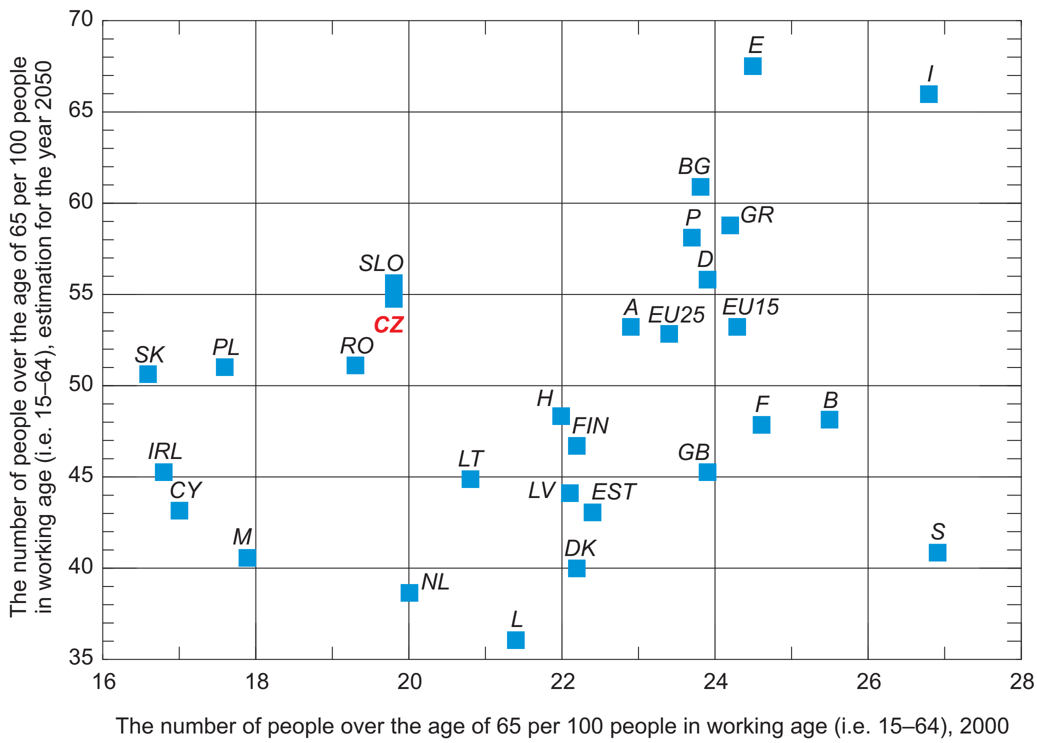
Fig. 9.9 Proportion of older people (65+) in the population, Europe, 2005



Source: PRB

Note: A – Austria, AL – Albania, ARM – Armenia, AZ – Azerbaijan, B – Belgium, BG – Bulgaria, BIH – Bosnia and Herzegovina, BY – Belarus, CY – Cyprus, CZ – The Czech Republic, D – Germany, DK – Denmark, E – Spain, EST – Estonia, F – France, FIN – Finland, GB – The United Kingdom, GE – Georgia, GR – Greece, H – Hungary, HR – Croatia, CH – Switzerland, I – Italy, IRL – Ireland, IS – Iceland, L – Luxembourg, LT – Lithuania, LV – Latvia, M – Malta, MD – Republic of Moldova, MK – The former Yugoslav Republic of Macedonia, N – Norway, NL – The Netherlands, P – Portugal, PL – Poland, RO – Romania, RUS – The Russian Federation, S – Sweden, SK – Slovakia, SLO – Slovenia, TR – Turkey, UA – Ukraine, YU – Serbia and Monte Negro.

Fig. 9.10 Elderly support ratio, Europe



Source: EUROSTAT

10. OCCUPATIONAL HEALTH HAZARDS AND THEIR CONSEQUENCES

10.1 Organization of monitoring activities

The subsystem includes tracking of working condition and working environment factors which are significant from the viewpoint of health effects and subsequent health impairment. The monitoring proceeds on nationwide level.

10.2 Monitoring of exposure to risk factors

The system of work categorization serves to monitor the exposure to hazardous work and working condition factors. Within this system each employer is obliged to evaluate the risk and categorize the works which are performed in his workplace to one of 4 categories due to the presence of risk factors and their severity. The data in the Information system of work categorization show that on 24th April 2007 (see Table 10.2a) total 1,799,023 persons were involved in all working categories (2, 2R, 3, 4), i.e. 37.8 % of total 4,764,600 employees (Statistical Yearbook of the Czech Republic 2006) which is 19,342/100,000 employees. 420,343 persons were involved in job at risk categories (2R, 3, 4), i.e. 8.8 % of all employees (4,519/100,000 employees). In the Czech Republic 17,611 persons (289/100,000 employees), including 1,570 women were involved in category 4 which represents high-risk workplaces.

Up-to-date numbers of employees involved in particular categories of work in the regions are shown in Table 10.2a and in Fig. 10.1a. The numbers per 100,000 employees do not exceed the nationwide average of 4,560 employees in only three regions, see Fig. 10.1b. Within the jobs at risk categories (2R, 3, 4) the greatest number of registered employees is under risk factor Noise – 250,162, Particulate matter – 67,260 and Physical load – 65,092, see Table 10.2b and Fig. 10.1c. During work employees can be exposed to more than one factor. The number of exposed persons according to the number of risk factors is shown in Table 10.2c. The data demonstrate that 66 % of employees are exposed to more than one factor; 10 % of employees are exposed to more than four factors.

Tab. 10.2a Number of employees in work categories by regions, on April 2007

Region	Category 2 + 2R + 3 + 4		Category 2		Category 2R		Category 3		Category 4	
	Total	Females	Total	Females	Total	Females	Total	Females	Total	Females
Capital City Prague	195,406	88,448	161,787	77,311	1,721	606	31,203	10,236	695	295
Central Bohemian	190,929	71,771	146,791	59,342	7,579	2,483	35,416	9,799	1,143	147
South Bohemian	110,562	45,816	84,634	37,610	510	342	24,432	7,801	986	63
Plzeň	104,909	42,923	82,520	36,917	756	239	20,542	5,665	1,091	102
Karlovy Vary	63,643	29,291	54,454	26,505	354	57	8,703	2,726	132	3
Ústí n. Labem	166,853	69,743	126,827	56,868	5,221	1,587	34,016	11,181	789	107
Liberec	86,207	36,883	68,517	30,618	1,006	466	15,984	5,710	700	89
Hradec Králové	101,586	42,764	78,800	35,422	3,034	1,104	18,835	6,150	917	88
Pardubice	85,527	33,695	63,772	27,676	4,124	930	16,884	4,917	747	172
Highlands	102,094	34,134	77,120	27,457	5,568	2,030	18,573	4,549	833	98
South Moravian	176,745	72,247	144,173	62,541	2,473	1,070	29,258	8,553	841	83
Olomouc	99,380	39,707	73,043	32,319	3,711	1,332	21,857	5,937	769	119
Zlín	96,876	43,208	75,102	34,634	1,989	1,206	19,294	7,314	491	54
Moravian-Silesian	218,306	78,011	141,140	62,613	5,506	2,233	64,183	13,015	7,477	150
Total	1,799,023	728,641	1,378,680	607,833	43,552	15,685	359,180	103,553	17,611	1,570

Note: *category 2 – not hazardous work, category 2R – potentially hazardous work, category 3 and 4 – hazardous work*

Tab. 10.2b Number of employees exposed to risk factors in potentially hazardous and hazardous work (2R, 3, 4), on April 2007

Factor	Females	Males	Total
Noise	43,510	206,652	250,162
Dust	9,735	57,525	67,260
Physical load	30,445	34,647	65,092
Vibrations	2,074	51,889	53,963
Biological agents	31,457	10,537	41,994
Psychic load	14,472	25,734	40,206
Chemical substances	9,312	21,260	30,572
Working position	5,234	14,369	19,603
Heat load	2,663	12,673	15,366
Non-ionizing radiation and electromagnetic field	1,905	11,435	13,340
Visual load	3,136	6,199	9,355
Selected jobs	3,014	3,392	6,406
Cold load	205	1,431	1,636
Ionizing radiation	98	356	454
Increased air pressure	5	6	11

The presented numbers should be considered as being preliminary as the registration has not been finalized yet. During the following period the workplaces will appear and disappear, protective precautions will be applied to reduce risk and so re-classification of works will be performed.

Tab. 10.2c Number of employees with concurrently acting risk factors

No. of risk factors	No. of exposed employees
1	603,923
2	496,805
3	319,907
4	195,204
More	182,074

10.3 Monitoring of health effects

Based on data from the National Register of Occupational Diseases, in 2006 1,216 profession-linked diseases were reported in 1,122 employees in the Czech Republic (708 man and 508 women), whereas total 1,150 were occupational diseases and 66 were occupational disease threats. Compared to year 2005 the total number of diagnosed profession-linked diseases decreased of 184, i.e. of 15.1 % cases and also the incidence of profession-linked diseases declined from 31.5 to 27.5 to 100,000 employees (Table 10.3a). The development of counts of the cases of profession-linked diseases is demonstrated in Fig. 10.2a.

The majority of profession-linked diseases was reported from the Moravian-Silesian and Central Bohemian Regions (253 and 152 i.e. 20.8 % and 12.5 % of all cases), see Table 10.3b and Fig. 10.2b. The largest category was represented by diseases caused by physical factors (166 cases). Those were mainly diseases of peripheral nerves due to long-term unilateral extremities overload and diseases of peripheral nerves due to vibrations (30 and 48 cases). In the Central Bohemian Region the main proportion was represented by the occupational diseases affecting respiratory system, lungs, pleura and peritoneum (64 cases). Mainly diseases arising as an effect of free crystalline silicon dioxide containing dust (35 cases) were reported, also diseases caused by asbestos (17 cases) and lung carcinoma caused by radioactive substances (9 cases).

In year 2006 total 534 cases of profession-linked diseases (44 %) were caused by physical factors. In descending order followed by affections of skin (246 cases), respiratory system and lung diseases (239 cases), infectious and parasitic diseases (164 cases), diseases caused by chemical agents (32 cases), diseases caused by other factors and agents (1 case). The distribution of

Tab. 10.3a Reported occupational diseases 1996–2006

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Number of patients	2,483	2,326	2,801	1,863	1,713	1,661	1,567	1,506	1,316	1,317	1,122
Occupational diseases total	2,541	2,376	2,111	1,886	1,751	1,677	1,600	1,558	1,388	1,400	1,216
– occupational diseases	2,517	2,350	2,054	1,845	1,691	1,627	1,531	1,486	1,329	1,340	1,150
– occupational diseases threat	24	26	57	41	60	50	69	72	59	60	66
Occupational diseases – males	1,563	1,551	1,261	1,192	1,104	1,034	977	972	826	817	708
Occupational diseases – females	978	825	850	694	647	643	623	586	562	583	508
Incidence rate per 100,000 employees	55.2	49.1	44.1	41.1	38.7	37.4	35.8	35.1	31.6	31.5	27.5

Tab. 10.3b Distribution of occupational diseases by region and the List of occupational diseases

Region	Chapter						Total
	I	II	III	IV	V	VI	
Capital City Prague	2	15	3	7	9		36
South Bohemian		47	10	21	25		103
South Moravian	3	12	36	20	21		92
Karlovy Vary	7	4	6	5			22
Hradec Králové	3	18	18	32	16		87
Liberec		15	2	3	3		23
Moravian-Silesian	4	166	55	23	5		253
Olomouc		41	8	23	6		78
Pardubice	4	27	7	28	9		75
Plzeň	4	50	6	16	8		84
Central Bohemian	1	60	64	16	11		152
Ústí n. Labem		23	6	34	23	1	87
Highlands	2	20	6	9	13		50
Zlín	2	25	11	8	1		47
Not differenciated		11	1	1			13
Work abroad					14		14
Total	32	534	239	246	164	1	1,216

Chapters in the List of occupational diseases:

I – Occupational diseases caused by chemical substances
II – Occupational diseases caused by physical factors
III – Occupational diseases of the respiratory tract, lungs, pleura and peritoneum
IV – Occupational diseases of the skin
V – Infectious and parasitary occupational diseases
VI – Occupational diseases caused by other factors and agents

the occupational diseases in year 2006 is shown in Fig. 10.2c.

Among the occupational diseases the most common diagnoses were profession-linked dermatoses (246, i.e. 21 % cases), diseases of peripheral nerves due to extremities overload and due to vibrations (179 and 119, i.e. 15 % and 10 % of cases). In the occupational disease threats affections of peripheral nerves of extremities due to long-term unilateral overload (22, i.e. 33 % cases) and hearing disorders caused by noise (10, i.e. 15 % of cases) were the most commonly reported.

10.4 Register of professional exposure to carcinogens

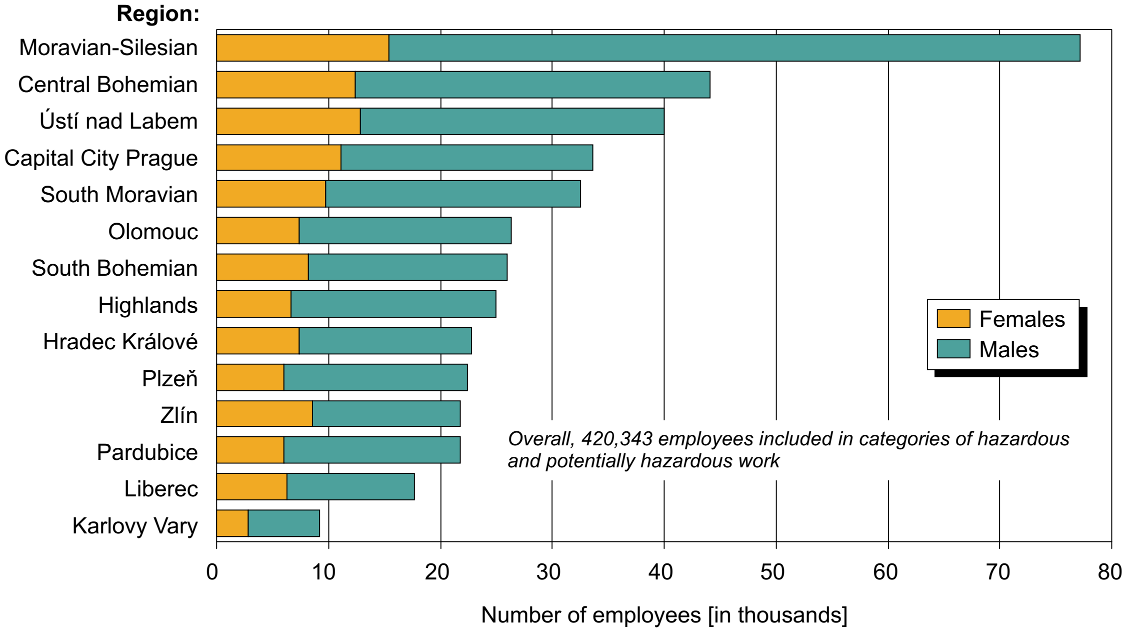
The number of exposed persons registered in the central register REGEX reaches 7,333 persons during the evaluated period (in the previous year 5,499 persons) with 14,353 records (in the previous year 10,395 records). The difference between the number of registered persons and the number of records stands for persons where updated hence repeated records were performed. Quality control of the entered data was performed in the regions. The connection to one central data file was executed, its descriptive analysis and subsequent further epidemiology analysis of morbidity and mortality of tumours is being prepared. The first one was described in the Summary report 2005. The analysis proved its unquestionable usefulness of the system for the intended purpose of the evaluation of health condition of the population professionally exposed to carcinogens. In the next step the targeted focus to the most frequent professional expositions is presumed.

10.5 Partial conclusions

During year 2006 new proposals to the categorization of jobs and workplaces suggested by the employers were proceeding and resolutions of public healthcare authorities which authorized these proposals were issued. These proposals resulted from the currently starting works and also from the newly classified works due to the change of legislation. In the Information system of work categorization 38 % of all employees were registered in April 2007. During year 2006 also an increment of the number of persons in particular workplaces was observed, however it was not as high as in the previous years. This gives an evidence of stabilization of the classification system and of gradual involvement of increasing proportion of actually existing works. Compared to the previous year there was a decrease of the number of employees in high-risk works. If this trend is confirmed during the following period, it will be a highly significant information evincing that the recovering precautions are being put in practice.

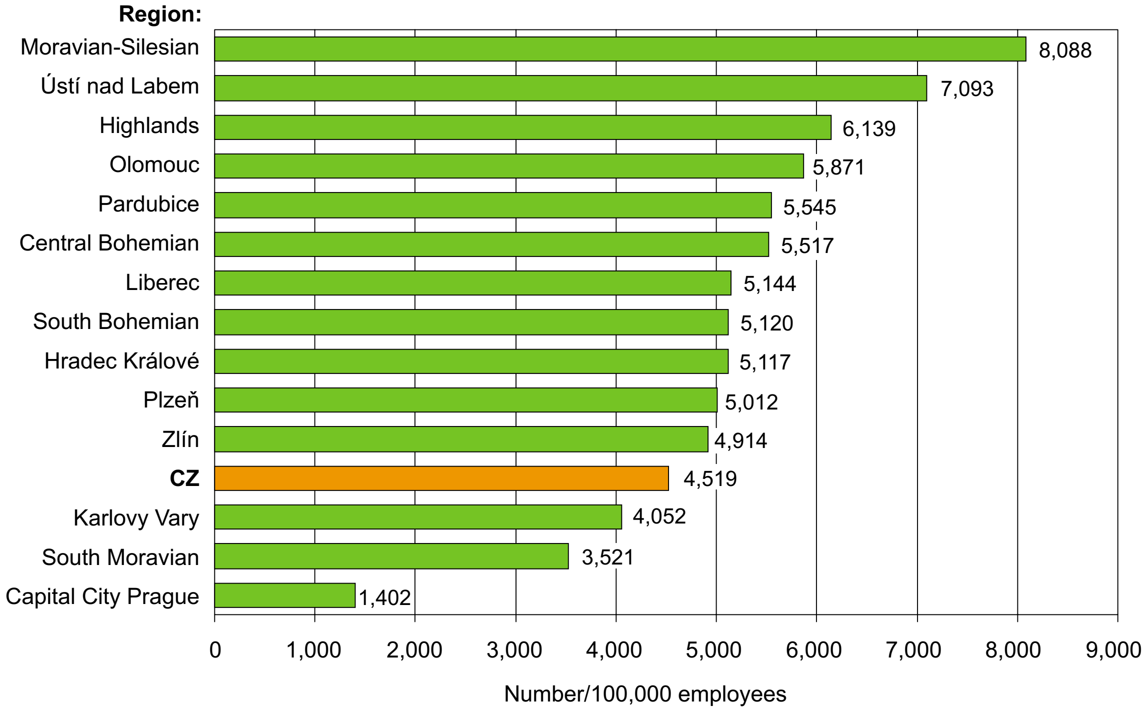
Compared to the previous year also the overall number of diagnosed profession-linked diseases and their incidence decreased. The majority of cases of profession-linked diseases were caused by physical factors. The most common occupational diseases were professional dermatoses and diseases of peripheral nerves due to extremities overload and vibrations.

Fig. 10.1a Number of employees in categories of potentially hazardous and hazardous work in regions, on April 2007



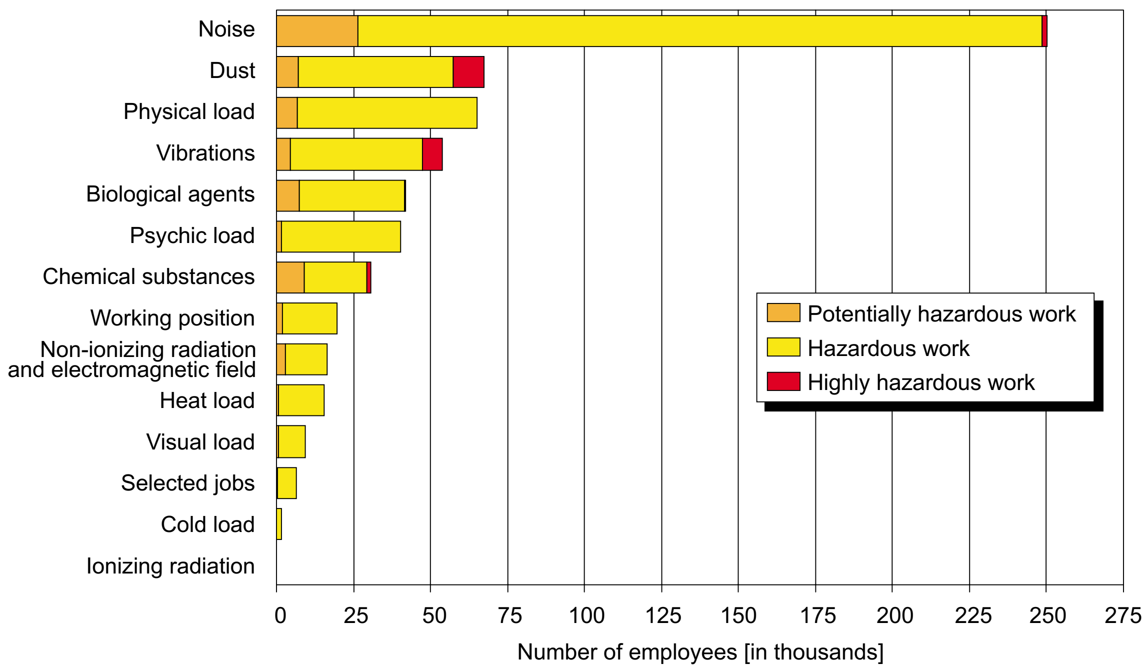
Source: Information system of work categorization

Fig. 10.1b Number of employees in categories of potentially hazardous and hazardous work per 100,000 employees, on April 2007



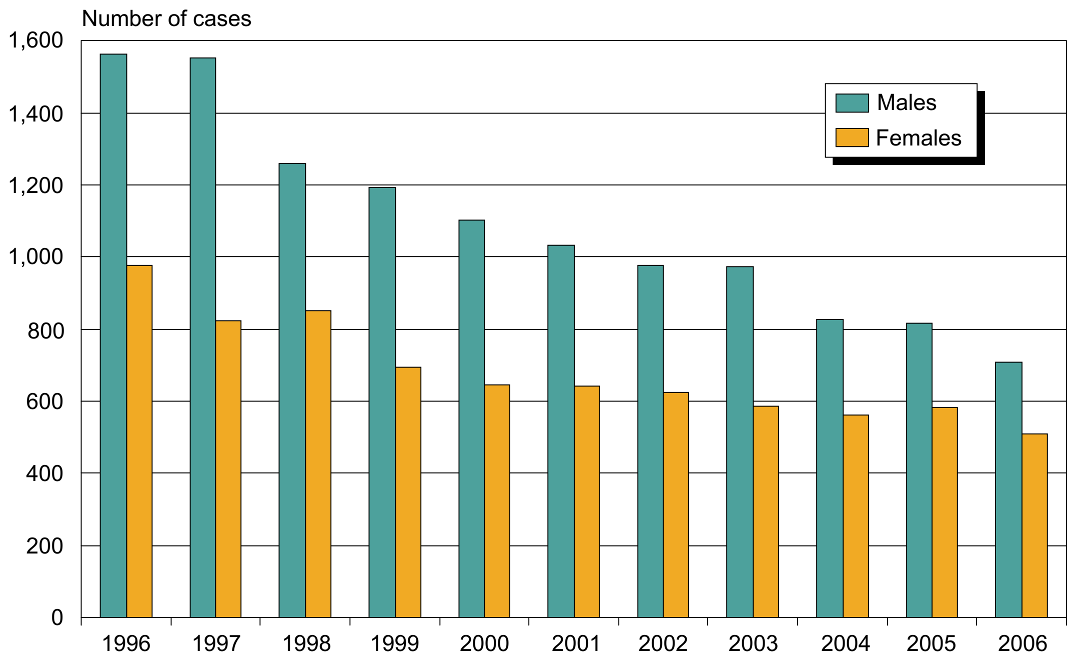
Source: Information system of work categorization

Fig. 10.1c Number of employees exposed to risk factors in the categories of hazardous work, on April 2007



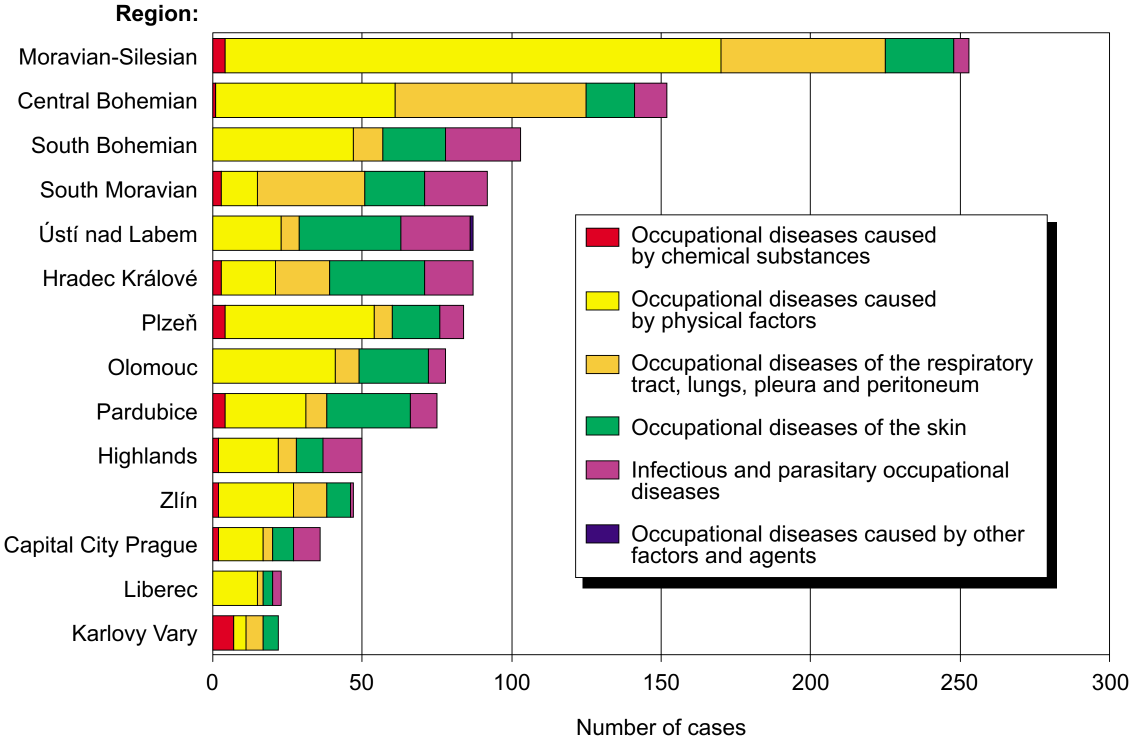
Source: Information system of work categorization

Fig. 10.2a Occupational diseases in the Czech Republic, 1996–2006



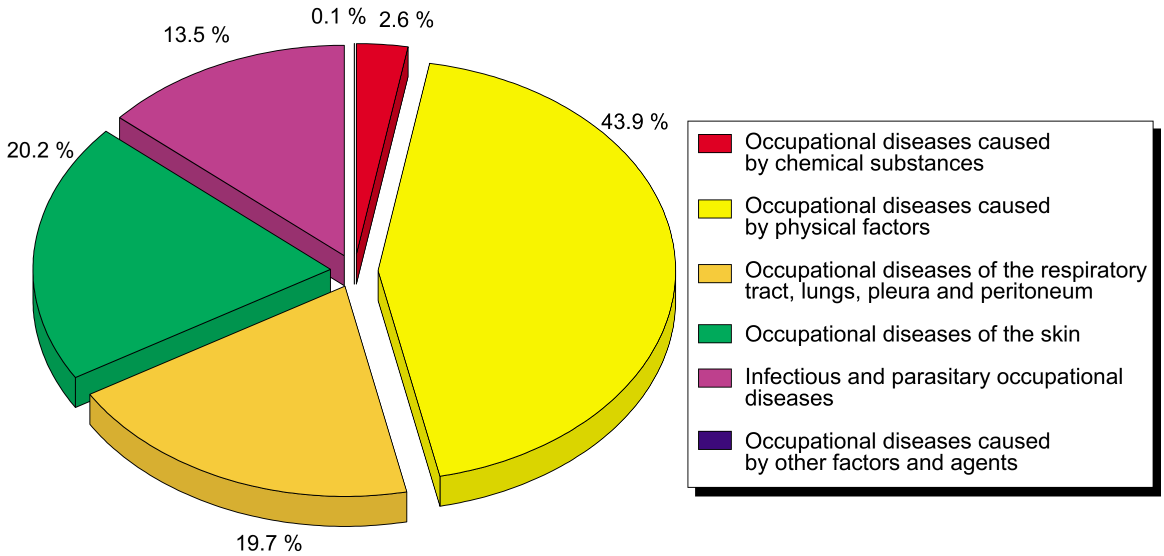
Source: National Register of Occupational Diseases

Fig. 10.2b Occupational diseases in regions, 2006



Source: National Register of Occupational Diseases

Fig. 10.2c Distribution of occupational diseases following the List of occupational diseases



Source: National Register of Occupational Diseases

11. HEALTH RISKS FROM CONTAMINATED SOIL IN URBAN AGGLOMERATIONS

11.1 Organization of monitoring activities

The subsystem contains the monitoring of urban topsoil contamination in order to assess the degree of health risk resulting from the exposure to toxic substances from unintentional soil and soil dust consumption. Regarding the fact that the greatest risk of increased exposure is in the population of preschool children, the project was focused on kindergarten playgrounds.

Over the monitoring period of 2002–2005, sampling in total 329 kindergartens in 20 towns was performed; in year 2006 sampling and evaluation of soil contamination was performed in total 84 kindergartens; 50 in Brno, 7 in Karlovy Vary and in 1 to 3 kindergartens in towns of the Karlovy Vary region.

The method of soil sampling was identical to the previous years: sampling at 10 cm depth from five sampling points from the area of kindergarten that were indentified as the places most frequently visited by children. After homogenization of the samples from the sampling points an analysis of composite samples was performed for the selected contaminants. Each kindergarten was thus represented by one composite topsoil sample.

11.2 Monitored factors

The following chemicals were monitored in the topsoil samples from the kindergarten playgrounds:

- metals – lead, chromium, arsenic, cadmium, beryllium, vanadium, mercury and copper;
- polycyclic aromatic hydrocarbons;
  - naphthalene, acenaphthalene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene (not classified as carcinogens according to US EPA – in group D);
  - chrysene, benzo[*a*]anthracene, benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, benzo[*a*]pyrene, indeno[*1,2,3-c,d*]pyrene, di-benzo[*a,h*]anthracene and benzo[*ghi*] perylene (classified by US EPA as carcinogens – in groups A–C).

The samples of topsoil were taken and processed according to the Standard Operating Procedures for sampling, storage and transport of soil and for analytical determination of selected metals and polycyclic aromatic hydrocarbons in soil. The soil samples for chemical analysis were taken over the period from May to September 2006.

11.3 Urban topsoil contamination

11.3.1 Toxic metals and trace elements

The concentration of monitored metals in the top layer of urban soil ranged within a wide spectrum of values. Basic statistical parameters of the reported content of monitored metals and metalloids in the kindergarten playgrounds of the cities monitored in year 2006 are presented in Tables 11.1 and 11.2. Also recommended limits for playgrounds following the Ministry of Health Decree No. 135/2004 are presented here.

The highest mean concentration of lead in the soil of monitored kindergartens was found in the Karlovy Vary region where these values ranged from 20 to 296 mg/kg. In Karlovy Vary city itself the amount of lead in the soil can be considered average. Even more favourable situation was found in kindergartens in Brno; concentration significantly exceeding the recommended limit was found in only one case there. The content of arsenic in topsoil exceeded the limit in all locations in the Karlovy Vary region including Karlovy Vary city itself. On the contrary a favourable situation is in Brno where low concentrations of arsenic were found. Moderately increased level in comparison to the recommended value was revealed for cadmium; this was found in approx. half of kindergartens of the Karlovy Vary region, in most of the kindergartens in Karlovy Vary and in Brno as well. Higher concentrations of a significant value were however found only in sporadic cases. The recommended chromium level in uncontaminated soil was only exceptionally exceeded in the topsoil of kindergartens but not significantly. So it was for the content of mercury: significantly increased concentrations were found only in two kindergartens. On the contrary beryllium and vanadium concentrations were found increased, exceeding recommended limits for soil in most of the kindergartens in the Karlovy Vary region and in several cases this excess was more prominent. In Brno low concentrations of both elements were found.

11.3.2 Polycyclic aromatic hydrocarbons

The analysis results of polycyclic aromatic hydrocarbons in the topsoil of kindergartens are shown in Table 11.2 which includes basic statistical parameters for polycyclic aromatic hydrocarbons which are classified by US EPA as carcinogenic.

The concentrations of **benzo[*a*]pyrene** in the topsoil samples from kindergartens were below the detection limit up to the maximum value of 2.1 mg/kg (in Brno). The monitored kindergartens in Brno and in the Karlovy Vary region belong to these of less polluted by benzo[*a*]pyrene from all followed locations up to date. Regarding a lower health risk of **benzo[*a*]anthracene** (higher recommended limit concentration in comparison to benzo[*a*]pyrene) the situation concerning the contamination with this PAH representative looks even more favourable. Higher concentrations than the recommended limit concentrations were found only in sporadic cases. **Chrysene** has a low-established recommended limit, the comparison therefore looks unfavourable. In comparison to the recommended hygienic limit of the most hazardous PAHs representative benzo[*a*]pyrene, a question of re-evaluation of the suggested limit value for chrysene arises. For the other carcinogenic representatives of polyaromatic hydrocarbons a public health limit has not been set; the concentration characteristics are presented in Table 11.2.

11.4 Partial conclusions

Increased concentrations of arsenic, beryllium and vanadium were found in the topsoil of kindergartens in Karlovy Vary and another 16 locations within the Karlovy Vary region. The potential arsenic burden there is the highest from all monitored locations up to date and it is probably related to being burdened by the emissions from power plants as well as to the character of geographical subsoil. Moderate or average burden of the topsoil by followed substances was found in the monitored locations in Brno.

Within the screening program of topsoil from kindergarten playgrounds the results of the Subsystem VIII serve as a base to evaluate a potential health risk from unintentional soil consumption. In the locations with relatively higher contaminant concentrations and identified possible higher burden technical and organizational precautions are recommended to the authorities of public administration and to founders of kindergartens.

Tab. 11.1 Concentration of elements in the topsoil of kindergartens

	Concentration of elements [mg/kg]							
	Lead	Arsenic	Cadmium	Chromium	Mercury	Beryllium	Vanadium	Copper
Recommended limits for non-contaminated soil in CZ	50	10	0.3	85	0.3	1.5	80	45
Brno N = 50								
Median	28.4	9.1	0.51	67.3	0.09	0.52	69.5	25.8
Arithmetic mean	37.6	9.3	0.50	69.5	0.14	0.51	69.7	31.6
X_{max}	166.0	15.7	1.34	172.0	0.78	0.81	118.0	127.0
X_{min}	11.7	4.9	0.30	50.8	0.02	0.31	49.2	13.9
Standard deviation	24.3	2.1	0.18	16.1	0.14	0.09	11.5	19.2
Karlovy Vary N = 7								
Median	55.5	60.5	0.41	58.5	0.31	4.86	119.0	68.6
Arithmetic mean	60.0	101.5	0.55	80.0	0.27	8.30	132.4	66.6
X_{max}	99.4	414.0	0.84	189.0	0.43	24.28	240.0	90.3
X_{min}	38.0	23.6	0.30	48.0	0.11	1.64	68.6	42.5
Standard deviation	18.3	128.4	0.20	46.4	0.11	7.52	50.9	16.2
Karlovy Vary region – 16 municipalities N = 27								
Median	56.1	34.1	0.42	66.0	0.19	1.71	105.0	51.9
Arithmetic mean	76.3	46.0	0.59	67.1	0.24	3.59	116.9	66.7
X_{max}	296.0	154.0	3.16	144.0	0.98	18.76	304.0	396.0
X_{min}	19.8	6.6	0.30	28.1	0.04	0.30	27.6	9.8
Standard deviation	60.2	35.8	0.57	24.6	0.18	4.85	64.2	71.0

N – number of kindergartens
X_{max} – the highest concentration of all kindergartens
X_{min} – the lowest concentration of all kindergartens

Tab. 11.2 Concentration of PAHs in the topsoil of kindergartens

	Concentration of PAHs [mg/kg]						
	Benzo[*a*]-anthracene	Benzo[*b*]-fluoranthene	Benzo[*k*]-fluoranthene	Benzo[*a*]-pyrene	Indeno-[*1,2,3-c,d*]-pyrene	Di-benz[*a,h*]-anthracene	Chrysene
Recommended limits for non-contaminated soil in CZ	1	–	–	0.1	–	–	0.01
Brno N = 50							
Median	0.15	0.22	0.09	0.18	0.08	0.00	0.152
Arithmetic mean	0.30	0.34	0.16	0.31	0.16	0.01	0.299
X_{max}	2.56	2.04	0.95	2.13	1.45	0.12	1.890
X_{min}	0.01	0.01	0.01	0.01	0.01	0.00	0.006
Standard deviation	0.45	0.43	0.20	0.42	0.25	0.02	0.425
Karlovy Vary N = 7							
Median	0.22	0.10	0.08	0.15	0.20	–	0.151
Arithmetic mean	0.28	0.12	0.09	0.19	0.22	–	0.154
X_{max}	0.54	0.18	0.14	0.29	0.32	–	0.259
X_{min}	0.15	0.06	0.04	0.08	0.09	–	0.067
Standard deviation	0.13	0.04	0.03	0.07	0.08	–	0.059
Karlovy Vary region – 16 municipalities N = 27							
Median	0.09	0.08	0.07	0.12	0.16	–	0.145
Arithmetic mean	0.19	0.12	0.10	0.20	0.24	–	0.151
X_{max}	1.32	0.57	0.48	0.96	1.01	–	0.658
X_{min}	0.01	0.01	0.01	0.01	0.02	–	0.008
Standard deviation	0.27	0.12	0.11	0.22	0.24	–	0.127

N – number of kindergartens
X_{max} – the highest concentration of all kindergartens
X_{min} – the lowest concentration of all kindergartens

Fig. 11.1a Mean concentration of arsenic in the topsoil of kindergartens

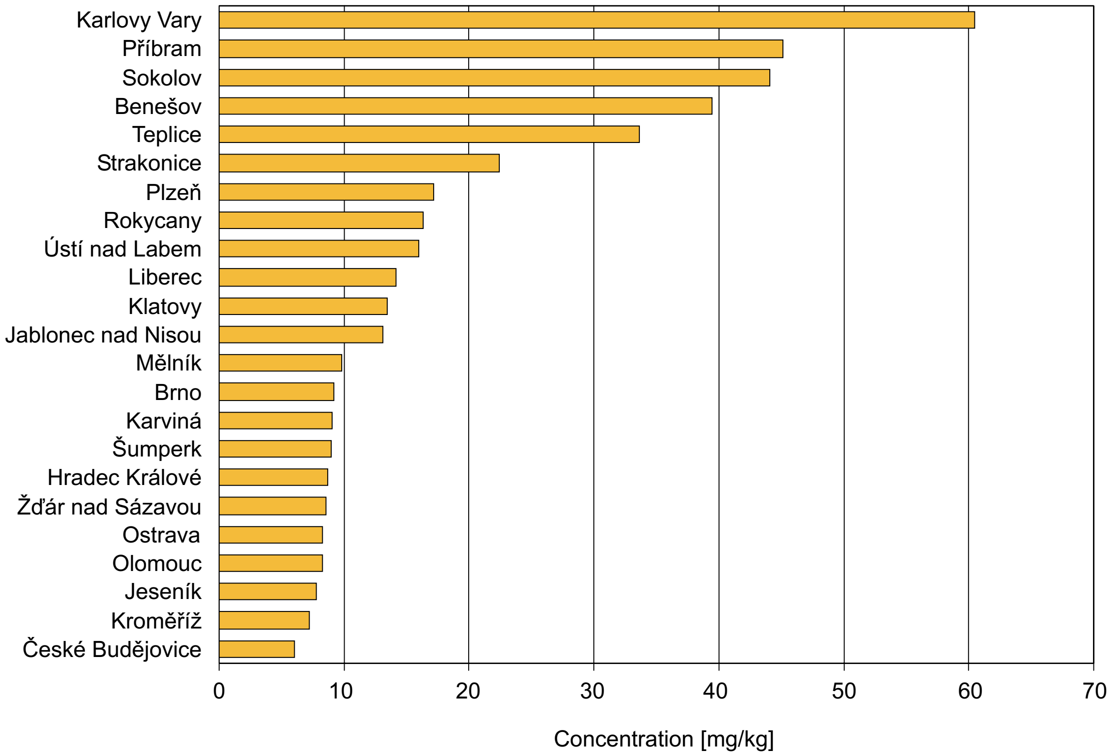
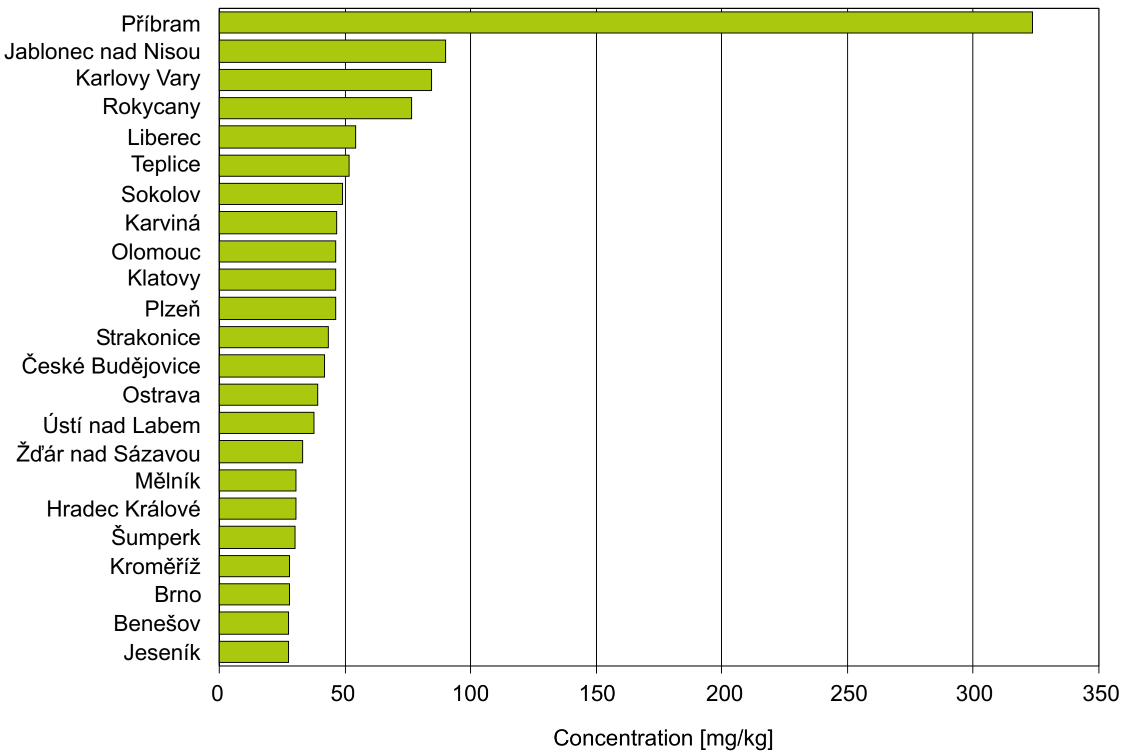


Fig. 11.1b Mean concentration of lead in the topsoil of kindergartens



12. CONCLUSIONS

The results of the Environmental Health Monitoring System for year 2006 form a standard comprehensive data series that has been obtained during the thirteenth year of monitoring activities. These data document the environmental pollution levels and resulting health risks in the Czech Republic. They provide important background information to both the national authorities involved in the health risk control and management as well as to general public facilitating active health protection. The data serves for the monitoring the progress in performance of the tasks resulting from the policies and action planes, such as NEHAP, Health 21 programme or CEHAP. For its complexity they also represent a data source for the Environmental Health Information System in Europe.

The most significant health burden from urban air pollution is related to traffic emissions; a significant local contribution is made by industry mainly in the region of Ostrava-Karviná. This is represented by suspended particles, polycyclic carbohydrates and nitrogen dioxide. In the regions with the highest burden an increased risk of tumours has been found of 1 case per 1,000 inhabitants due to the exposure to carcinogenic PAHs.

The quality of drinking water from public water systems remained without significant changes in the period 2002–2006. The limit concentration of water quality indicators with health significance was exceeded in 0.3 % of findings. Almost 70 % of inhabitants were supplied by drinking water from public water systems where none limit exceedings for health-relevant indicators occurred. Nitrates and chloroform are the most meaningful contaminants of drinking water. Total 72,000 inhabitants are exposed to drinking water with above-limit level of nitrates, 143,000 with exceeded limit of chloroform. The drinking water consumption may theoretically has contributed to the cancer risk in the Czech Republic by only two incremental cancer cases.

Food is the primary source of exposure to the most of chemical substances. The monitoring of dietary exposure is performed in two-year period, the results from years 2006–2007 will be analysed in year 2008. From the previous phase results it is obvious that the exposure to the monitored chemicals did not reach the exposure limits, and the situation for an average person can be considered positive from the point of view of non-carcinogenic effects.

It is not possible to determine any safe concentration or exposure limit for mutagenic and carcinogenic substances considering their no-threshold effects; only socially allowable health risk level could be established. Although justly suspected, negative health effects have not been either known or proven for a number of chemicals. Therefore, it is crucial to reduce the population exposure to these chemicals or to keep it as low as reasonably achievable. To apply the strategy of reducing environmental pollution where most needed, a systematic monitoring of the environmental pollutants have to be performed together with the monitoring of their health effects supplemented with the assessment of probable health risks. The environmental and health monitoring thus might advance the life sustainability.

13. LIST OF TERMS AND ABBREVIATIONS

ADI – acceptable daily intake comparable with the term tolerable daily intake (TDI). Exposure limit presented in µg of contaminants per day and per 1 kg of body weight.

AIM – Automated Immission Monitoring.

AQI – Air Quality Index. The concentrations of contaminants measured are compared with corresponding limit values and transformed into a dimensionless parameter which describes the state of ambient air quality at six levels. For AQI of 0–1 it is clean atmosphere, 1–2 acceptable, 2–3 moderately polluted, 3–4 polluted, 4–5 highly polluted, 5–6 harmful to health.

ARD – acute respiratory disease.

ASR – Age-standardized rate – an adjustment of a rate designed to minimize the effects of differences in age composition when comparing rates (i.e. of incidence or mortality) for different populations; method of direct standardization. Age specified rates are weighted by proportional number of persons in standard population. The most often the European or World Standard are used, it is a fictive population similar to real one.

Basal population minimum – minimal requirement for the continuous intake of substance ***E*** (nutrient, micronutrient) in the population which is essential for the prevention of pathologically relevant and clinically diagnosable functions that are the consequence of the lack of substance ***E*** (WHO, 1996).

Biomarker – whatever measurable characteristic in a biological system which reflects the interaction of the organism and environmental factors (biomarkers of exposure, effect and sensitivity) (see e.g. Environment Health Criteria 155, 1993).

BMI – body mass index = body weight/(body height)^2 [kg/m^2].

Bound of determination – lowest concentration of a substance that can be determined with an acceptable degree of accuracy and precision. It is usually the lowest point in a calibration curve under exclusion of a blind experiment.

Carency – disorder of nourishment owing to want of some necessary substance in foodstuffs and/or in water.

CFU – microorganism capable to create a colony.

CI – confidence interval – conveys information on what interval with reliability of 1 – p (p is significance level) shall contain at least a P quotient of distribution of a random quantity. E.g. an interval that shall contain 90 % of values with a 95% probability. There are defined a unilateral and a bilateral interval around the arithmetical mean.

Clastogenic effect – ability of a substance or mixture to induce chromosomal breaks.

Congener – a member of a class, group or other category, in this case isomer. Isomers are chemical substances of identical empirical (proportional) composition and molecular weight, differing in certain physical or chemical characteristics due to another arrangement of atoms in the molecule.

Correlation – information on the statistic relation between certain characteristics in a sample A. A hypothesis that the characteristics under study is not statistically correlated (there are randomly distributed) and can be tested at a selected level of significance.

Critical value – in this text a value describing the attainment of a limit concentration, exposure limit and exposure dose, respectively, signaling any risk of possible health harm in population scale.

ČHMÚ – Czech Hydrometeorological Institute.

ČIA – Czech Institute for Accreditation.

ČSÚ – Czech Statistical Office.

Direct standardization – see ASR.

Dose – measure of the amount received by the subject under follow-up, either human or animal.

EPIDAT – database of epidemiological information dealing with infectious diseases in the Czech Republic.

EU – countries of European Union.

Evaluation of living conditions quality – overall evaluation of areas (districts) according to the environmental health level, social conditions and mortality rate. Scale: relatively high level – A, above average – B, mostly below average – C, extremely disrupted – D.

Evaluation of environment quality – worked out for sites according to the environmental health level and of well-being from the point of view of landscape and urban parameters. Scale: high level – I, satisfactory – II, disrupted – III, very disrupted – IV, extremely disrupted – V.

Exposure – to be accessible to the influence of a physical, chemical or biological factor or action.

Exposure limits – are defined by the commission of JECFA FAO/WHO as ADI, PTWI, and PMTDI or by US EPA as RfD. In some cases an internationally recognized exposure limit has not been set. Then TDI is temporarily used in national or international levels. The construction of limits is based on an effort to establish an exposure, which probably will not have harmful effects, even not by lifetime exposure.

FAO – Food and Agriculture Organization under the WHO.

Fatality rate – the quality of being able to cause death; number of dead persons from specific disease over a specified period of time per 1,000 or 100,000 diseased persons.

Food poisoning – it takes place by transmission through foodstuffs contaminated with toxins of bacteria found in the gastrointestinal tract of healthy animals or in suppurative affections of man. Here belongs botulism, intoxications due to *Staphylococcus* aureus, enterotoxin, *Clostridium* perfringens type A and *Bacillus* cereus.

Genotoxic substance – a substance with the ability to induce various types of damage to the genome of a cell that may lead to an alteration of a genetic information transfer.

Glycemia – level of sugar in blood.

Human alimentary diseases – alimentary infections and intoxications the transmission of which takes place through fecal-oral transfer, hands contaminated by the stool or urine. Here belong e.g. typhoid and paratyphoid fevers, bacillary dysentery, acute diarrhoeal affections, type-A virus hepatitis.

ICD – International Statistical Classification of Diseases and Related Health Problems, 10^{th} Revision.

IISE – Integrated Information System of the Environment.

Index of indirect standardization – an index that compares the actual and the expected number of cases of a disease in the exposed population. It is usually expressed in percentages and indicates what per cent the actual incidence is either higher or lower than the incidence in the standard population (100 %).

Incidence rate – number of newly occurring affections, e.g. per 1,000 or 100,000 individuals within a defined time period.

Interquartile range – range described by 75% and 25% quantile, it contains 50 % of values from sample under follow-up.

IRIS – Integrated Risk Information System under the US EPA.

JECFA – Joint Expert Committee on Food Additives.

L_{Aeq} – permanently continuous sound level of acoustic pressure (A weighed) expressed in dB (decibel).

L_{90} – 90% quantile of a sound level of acoustic pressure (A weighed) of the total period of measuring expressed in dB (decibel).

Limit – the largest or the lowest quantity or amount allowed.

Limit of detection – lowest concentration of a substance that can still be identified and presented with a 99% probability. It is determined by analysis in a blind experiment and it is such a concentration of the substance the response of which is equivalent to an average response of a blind experiment plus a three-fold standard deviation estimate.

LSPP – on-duty medical first aid.

LV – limit value is an indicator of water quality, mostly the upper limit of the range of admissible values by the exceeding of which water loses its satisfactory quality as regards the indicator the value of which has been exceeded.

LVRR – limit value of reference risk is the value of quality indicator, usually of delayed toxic effects (carcinogen, mutagen) derived on the principle of non-threshold effect which induces one lethal case more in a population of 100,000 average consumers upon life-long consumption.

Malnutrition – incorrect, unbalanced nutrition lacking in certain essential components.

Median – the value of a set of values for which the cumulative frequency function is equal 0.5. Median = 50% quantile.

Metabolite – a product of metabolic reaction, as a part of the chemical processes that occur in living organism.

Metalloid – a non-metallic element, such as arsenic or silicon, that has some of the properties of a metal.

MLV – maximal limit value is the value of a quality indicator the exceeding of which excludes the use of the water as drinking water.

MVRR – maximal value of reference risk, exceeding of indicator with such limit excludes the use of the water as drinking water.

Mortality rate – number of deceased persons per defined number of individuals:
- **infant:** number of deceased children under 1 year of age per 1,000 live-born children.
- **neonatal:** number of deceased children under 28 days of age per 1,000 live-born children.
- **postneonatal:** number of deceased children between 28 days and 1 year of age per 1,000 live-born children. It is equal a difference between infant and neonatal mortality.
- **perinatal:** number of death-born children and deceased children under 7 days of age per 1,000 childbirth's.

NIPH – National Institute of Public Health.

Normative population minimum – a requirement for the continuous intake of substance ***E*** in the population which is essential for the retainment of tissue and/or other reserve of substance ***E*** (WHO, 1996).

Nutrient – substance serving as or providing nourishment, in this case namely chemical elements the presence of which in foodstuffs is important for ensuring a balanced diet.

Odds ratio (questionnaire on health status) – city with minimal incidence rate of evaluated phenomenon is defined as a reference level. Similarly, male population is a reference level for evaluation of genders.

OKEČ – Industrial Classification of Economic Activities.

Organoleptic quality – method of sensory assessment of drinking water, foodstuffs, etc. on a professional basis.

PAHs – polycyclic aromatic hydrocarbons.

Photochemical reaction – type of reaction concerned with the chemical effects of light and other electromagnetic radiation.

PMTDI – provisional maximal tolerable daily intake. Exposure limit presented in micrograms of contaminant per day and per 1 kg of body weight.

PM_{10} – a fraction of particulate matter with mean value of size distribution equals 10 μm.

Prevalence – number of registrated cases, e.g. per 100,000 inhabitants to a defined date.

PTWI – provisional tolerable weekly intake. Exposure limit presented in micrograms of contaminant per week and per 1 kg of body weight.

Quantile (p – percent, percentile) – is that value of a set of values for which the cumulative frequency function equals p % (50% quantile = median).

RDA – recommended daily allowance. Recommended long-term average daily intake covering individual variability in requirements of the majority of normal subjects living in the USA under the usual environmental burden.

RDI – recommended daily intake. Average required intake that takes into consideration individual variability. RDI is considered to be sufficient for maintaining health in the majority of the population.

Revertant – bacteria, that through a back mutation have returned to a former genetic trait, e.g. histidine independence.

RfD – reference dose for chronic oral exposure. Exposure limit defined by US EPA as a daily exposure to the human population (including sensitive subgroups) expressed in micrograms of contaminant per unit of body weight. Meaning: daily exposure (estimated within the range of one order) which on lifelong exposure shall most likely cause no damage to health. It is defined by the share of the maximum dose (NOAEL) at which there is observed at a statistically significant level no unfavorable response in comparison with a control group and by the product of a modifying factor (MF) and factor of uncertainty (UF): RfD = NOAEL/(UF*MF).

Risk – the probability of injury, disease, or death under specific circumstances. In quantitative terms, risk is expressed in values ranging from zero (representing the certainty that harm will not occur) to one (representing the certainty that harm will occur). **Individual risk** is the probability that an individual person will experience an adverse effect. This is identical to **population risk** unless specified. The numeric values are identical in both cases, but as a fictitious level of "safety" we consider the value of probability equals 1.0E-04 for individual and 1.0E-06 for population.

Screening – procedure of the active search of sources of infection, early stages of disease, etc.

SOP – Standard operation procedure in QA/QC system.

System QA/QC – all the planned and systematic activities realized within the framework of the system of quality and applied according to need, necessary to gain adequate confidence that the requirement for quality shall be met. Operation methods and activities used to fill the requirement for quality.

TCDD – 2,3,7,8 - tetrachlorodibenzo(p)dioxine, substance with maximal known toxic effect, used as the standard of toxicity (toxic equivalent) for PCB, dioxines and dibenzofurans.

TDI – tolerable daily intake. It is presented in micrograms of contaminant per day and per 1 kg of body weight.

TOCs – Total organic compounds.

Toxic equivalent (I-TEQ) – method facilitating a mutual comparison of substances belonging to the same chemical group eliciting various toxic effects and to present them at a comparable level in relation to the most toxic one of the group (e.g. benzo[*a*]pyrene and TCDD, respective).

TSP – total suspended particles in air.

US EPA – United States Environmental Protection Agency.

ÚZIS – Institute of Health Information and Statistics.

VOCs – Volatile organic compounds.

WHO – World Health Organization.

Xenobiotics – extraneous substances for organism. They are not inevitable for its metabolism and they are not customary component of foodstuffs, e.g. drugs, industrial chemicals and poisons.

Contaminants and factors in the EH Monitoring System

Supplement

Contaminant factor	Realization in subsystem					CasNo	Classification of carcinogenity (group)		Exposure limits	
									ADI, PMTDI+, PTWI*	RfD
	I	II	IV	V	VIII		EPA	IARC	[μg/kg/d, * week]	[μg/kg/d]
Acrylamide		x	x			79-06-1	B2	2A		0.2
Activity concentration sum, alpha		x								
Activity concentration sum, beta		x								
Activity concentration, Rn 222		x								
Aldrin			x			309-00-2		3	0.1	0.03
Aluminium (and compounds)		x	x			7429-90-5			7,000*	
Antimony		x				7440-36-0				0.4
Anthracene	x					120-12-7	D	3		300
Arsenic (and compounds)	x	x	x	x	x	7440-38-2	A	1	15*	0.3
Aspergillus spp.			x							
Bacteria colif. [CFU/100 ml]		x								
Bacteria psychrofillic [CFU/100 ml]		x								
Barium (and compounds)		x				7440-39-3			51	200
Benzene	x	x				71-43-2	A	1		
Benzo[*a*]anthracene	x				x	56-55-3	B2	2A		
Benzo[*a*]pyrene-3,4	x	x			x	50-32-8	B2	2A		
Benzo[*b*]fluoranthene	x				x	205-99-2	B2	2B		
Benzo[*g,h,i*]perylene	x				x	191-24-2	D	3		
Benzo[*k*]fluoranthene	x				x	207-08-9	B2	2B		
Beryllium (and compounds)		x			x	7440-41-7	B1	1		2
Boron		x				7440-42-8				90
Bromates		x				15541-45-4	B2			4
Bromodichloromethane		x				75-27-4				
Bromoform		x				75-25-2		3		
Cadmium (and compounds)	x	x	x	x	x	7440-43-9	B1	1	7*	0.5 water, 1.0 diet
Calcium (and compounds)		x	x			7440-70-2				
Calcium and Magnesium (and com.)		x								
Carbon monoxide	x									
Clostridium perfringens [CFU/100 ml]		x								
Colour of drinking water		x								
Conductivity [mS/m]		x								

Contaminant factor	Realization in subsystem					CasNo	Classification of carcinogenity (group)		Exposure limits	
									ADI, PMTDI+, PTWI*	RfD
	I	II	IV	V	VIII		EPA	IARC	[µg/kg/d, * week]	[µg/kg/d]
Copper (and compounds)		x	x	x	x	7440-50-8	D		500+	
Cyanides		x				57-12-5	D		12	20
DDD-o,p			x			53-19-0				
DDD-p,p			x	x		72-54-8				
DDE-o,p			x			3424-82-6				
DDE-p,p			x	x		72-55-9				
DDT-o,p		x	x			789-02-6				
DDT-p,p		x	x	x		50-29-3				0.5
DDTs – sum			x	x				2B	20	
Di-benzo[*a,h*]anthracene	x				x	53-70-3	B2	2A		
Dibromchloromethane		x				124-48-1		3		
Dieldrin			x			60-57-1	B2	3	0.1	0.05
Dichlorbenzenes – sum	x									
Dichloroethane-1,2		x				107-06-2	B2	2B		30
Dichloromethane	x					75-09-2	B2	2B		60
Endosulphane			x			115-29-7			6	6
Endrin			x			72-20-8	D	3	0.2	0.3
Enterococci [CFU/100 ml]		x								
Epichlorohydrine		x				106-89-8	B2	2A		1
Escherichia coli [CFU/100 ml]		x								
Ethylbenzene	x					100-41-4	D	2B	97	100
Flavour of drinking water [grade]		x								
Fluoranthene	x					206-44-0	D	3		40
Fluorine (and compounds)		x		x		7782-41-4				60
Formaldehyde	x					50-00-0	1	2A	150	200
Freon 11	x									
Freon 113	x									
Freon 12	x									
Heptachloroepoxide			x			1024-57-3	B2		0.1[a]	0.013
Hexachlorobenzene			x	x		118-74-1	B2	2B	0.17	0.8
Hexachlorocyklohexane – HCH, sum				x				2B		

Contaminant factor	Realization in subsystem					CasNo	Classification of carcinogenity (group)		Exposure limits	
									ADI, PMTDI+, PTWI*	RfD
	I	II	IV	V	VIII		EPA	IARC	[µg/kg/d, * week]	[µg/kg/d]
HCH alpha			x	x		319-84-6	B2			
HCH beta			x	x		319-85-7	C			
HCH delta			x			319-86-8	D			
HCH gamma (lindane)			x	x		58-89-9	B2		8	0.3
Chlorides		x								
Chlorine free		x				7782-50-5			150	100
Chlorites		x								
Chlorobenzene	x					108-90-7	D			20
Chloroethene		x							0.33	
Chloroform	x	x				67-66-3	B2	2B	15	10
Chromium (and compounds)	x	x	x		x	7440-47-3	A inh, D oral	1		3[c]
Chrysene	x				x	218-01-9	B2	3		
Indeno[*1,2,3-c,d*]pyren	x				x	193-39-5	B2	2B		
Iodine (and compounds)			x			7553-56-2			17+	
Iron (and compounds)		x	x			7439-89-6			800+	
Lead (and compounds)	x	x	x	x	x	7439-92-1	B2	2B	25*	
Magnesium (and compounds)		x	x			7439-95-4				
Manganese (and compounds)	x	x	x			7439-96-5	D			140
Mercury (and compounds)		x	x	x	x	7439-97-6	D	3	5*	0.1
Methoxychlorine			x			72-43-5	D	3	100	5
Methyl chloride	x					74-87-3	D	3		
Natrium (and compounds)			x			7440-23-5				
Nickel (and compounds)	x	x	x			7440-02-0	A	2B		20
Nitrates		x	x	x		14797-55-8			3,700	7,000
Nitrites		x	x			14797-65-0			60	330
Nitrogen dioxide	x									
Nitrogen monoxide	x									
Nitrogen oxides – sum	x					10102-44-0				
Number of aberant cells				x						
Number of revertant				x						
Odour of drinking water [grade]		x								

Contaminant factor	Realization in subsystem					CasNo	Classification of carcinogenity (group)		Exposure limits	
									ADI, PMTDI+, PTWI*	RfD
	I	II	IV	V	VIII		EPA	IARC	[µg/kg/d, * week]	[µg/kg/d]
Ochratoxin A			x	x				2B		
Organic carbon total		x								
Organisms living [number/ml]		x								
Oxidability MnO_4^-		x								
Ozone	x	x								
Particulate matter – PM_{10}	x									
Particulate matter – PM_{10}	x									
Particulate matter – TSP	x									
PCB 028			x	x						
PCB 052			x	x						
PCB 101			x	x						
PCB 118			x	x						
PCB 138			x	x						
PCB 153			x	x						
PCB 180			x	x						
PCBs – sum of congeners				x		1336-36-3	B2	2A	0.4+	
PCDDs – sum of congeners			x	x						
PCDFs – sum of congeners			x	x				3		
Penicillium crustosum			x							
Pesticides total		x								
pH		x								
Phenanthrene	x					85-01-8	D	3		
Polyaromatic hydrocarbons – sum	x	x	x		x					
Potassium (and compounds)			x			7440-09-7				
Pyrene	x				x	129-00-0	D	3		30
Selenium (and compounds)		x	x	x		7782-49-2	D	3		5
Silver (and compounds)		x				7440-22-4				5
Styrene	x					100-42-5		2B	7.7	200
Sulphates		x								
Sulphur dioxide	x							3		
Temperature [°C]	x									

Contaminant factor	Realization in subsystem					CasNo	Classification of carcinogenity (group)		Exposure limits	
									ADI, PMTDI+, PTWI*	RfD
	I	II	IV	V	VIII		EPA	IARC	[µg/kg/d, * week]	[µg/kg/d]
Tetrachloroethene-1,1,2,2,	x	x				127-18-4		2A		10
Tetrachloromethane	x					56-23-5			0.71	0.7
Toluene	x					108-88-3	D	3		200
Tribromomethane		x				75-25-2		3		
Trihalogenmethanes THM[b]		x								
Trichloroethane-1,1,1	x					71-55-6	D	3		
Trichloroethene 1,1,2	x	x				79-01-6		2A		4
Trimethylbenzenes – sum	x									
Turbidity of drinking water [NTU]		x								
Volatile org. comp. (US EPA TO14)	x									
Xylenes	x					1330-20-7	D	3	180	2,000
Zinc (and compounds)			x	x		7440-66-6	D		1,000+	300

Notes:

Subsystems: I – air pollution, II – drinking water, IV – dietary exposure, V – human biomonitoring, VIII – soil contamination

[a] *– sum of heptachlorine a heptachlor epoxide*

[b] *– sum of chloroform, bromdichloromethane, dibromchloromethane and bromoform*

[c] *– for* Cr^{VI}

[x] *– for subsystem I – phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyren, dibenz[a,h]antracen, benzo[g,h,i]perylen, indeno[c,d]pyren*
for subsystem II – benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, indeno[c,d]pyrene

Exposure limits:

ADI – acceptable daily intake

PMTDI, TDI, PTWI – provisional maximum tolerable daily or tolerable daily (weekly) intake

RfD – reference dose for chronic oral exposure (US EPA)

Environmental Health Monitoring System in the Czech Republic

Summary Report – 2006

Layout and setting: EnviTypo®

1st edition, 100 pages

150 copies

ISBN 80-7071-279-5