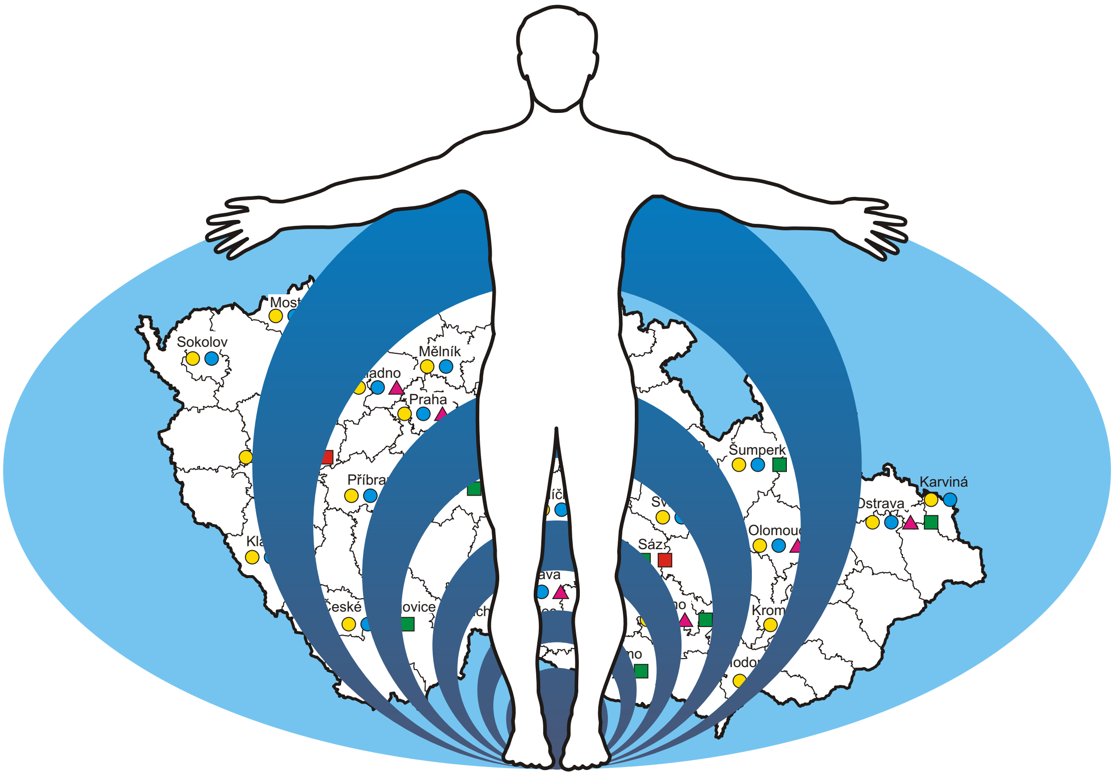
Environmental Health Monitoring System in the Czech Republic

Summary Report – 2007



National Institute of Public Health, Prague

Prague, September 2008

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CONTENTS

1. INTRODUCTION

The Environmental Health Monitoring System (hereafter Monitoring System) is a comprehensive system of collection, processing and evaluation of data on environmental pollution and effects on population health in the Czech Republic. Its particular subsystems have been run routinely since 1994, so the year 2007 is the fourteenth year of the standard monitoring activities.

The Monitoring System was set out by the Government Resolution from 1991; it is incorporated in the Act on public health protection. The System represents one of the priorities of the National Environmental Health Action Plan in the Czech Republic approved in the Government Resolution from 1998. The data obtained within this Monitoring System provide important background information for a long-term program focused on the improvement of population health in the Czech Republic, called "Health for All in the 21 Century", which was approved by the Government Resolution from 2002. The data have also been used in the process of health impact assessment (HIA) and environmental impact assessment (EIA) of various activities, programmes and projects.

The Summary Report 2007 represents another component of the continuous series providing data on environmental health monitoring. It summarizes the results obtained within the individual subsystems in 2007 and compares them with those of the previous years. Aggregated results are presented as background information for the national and regional authorities making decisions on environment and public health, for the Public Health Service, co-operating sectors and institutions, and for the interested public.

The detailed results have been provided 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/topics/environmental-health/environmental-health-monitoring**.

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 in the fields of public health protection, health risk management and control, and environmental protection. The data have been used in the specification of legislative measures as well as establishment and adjustment of pollutant limits. 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 represent also an information source for other countries on risks from environmental pollution in the Czech Republic and a health status of the Czech population.

The results obtained for the monitored localities in individual periods are crucial in creating time series of data on environmental pollution and its effects on health. Systematic assessment 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 2007, the Monitoring System involved eight subsystems (projects) as follows:

- Health effects and risks from **Air** pollution (Subsystem I);
- Health effects and risks from **Drinking water** pollution (Subsystem II);
- Health effects and annoyance of **Noise** (Subsystem III);
- **Dietary exposure** (Subsystem IV);
- **Human biomonitoring** (Subsystem V);
- **Health status** and health statistics indicators (Subsystem VI);
- Health effects and risks from **Occupational environment** (Subsystem VII);
- Health risks from **Urban soil** pollution (Subsystem VIII).

Within the Monitoring System, specialized studies were designed that extend the existing monitoring activities. They deal with issues lying beyond the framework of the basic tasks of the Monitoring System, but are needed to be investigated and checked as a potential threat for public health. The results have been published in the form of either monitoring reports or scientific papers. In 2006–2007, a study of halogenoacetic acids content in drinking water was performed.

3. ORGANIZATION OF THE MONITORING SYSTEM

3.1 Scope of the Monitoring System

The Monitoring System has been basically implemented in the core set of 30 cities including the capital city of 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 into some subsystems. Monitoring of drinking water quality and occupational environment have been realized at the nationwide level. The participating cities are shown in Fig. 3.1 and Table 3.1 together with population numbers.

3.2 Monitored factors

The list of the factors which have been monitored is based on the respective regulations and analyses carried out both prior to the actual start as well as during the operation of the Monitoring System. These factors together with the respective subsystems are listed in the Supplement of this report.

For evaluation of the results, several types of concentration and exposure limits have been applied. The limits are given in Czech standards and regulations, the recommended values are taken from supranational institutions (e.g. the World Health Organization or US Environmental Protection Agency). These usually do not have the force of standards in the Czech Republic. It regards namely the exposure limits such as the acceptable daily intake (ADI) or reference doses (RfD) 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.

3.3 Information system and data processing

The structure of the used databases and corresponding software enable the collection of results from the information system end users (measuring laboratories), their transport to the heads of the individual subsystems, and independent processing according to the requirements of the Monitoring System users. The heads 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 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.

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. 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; on using reference or certified reference materials as internal controls, on keeping regulatory diagrams; on participation in external control programs with inter-laboratory comparison of sample analyses at both national and international levels and on meeting the requirements for keeping documentation records. Most of collaborating Public Health Service laboratories use accredited methods according to CSN EN ISO/ICE 17025.

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	16,247
Brno	x		x		x	x	BM	366,680
České Budějovice	x	x	x		x	x	CB	94,747
Děčín	x				x		DC	52,165
Havlíčkův Brod	x	x			x		HB	24,265
Hodonín	x				x		HO	26,110
Hradec Králové	x	x	x		x	x	HK	94,255
Jablonec nad Nisou	x	x	x		x	x	JN	44,822
Jihlava	x				x		JI	50,916
Jindřichův Hradec					x		JH	22,464
Karviná	x				x	x	KI	63,045
Kladno	x	x			x		KL	69,276
Klatovy	x				x	x	KT	22,898
Kolín	x				x		KO	30,158
Kroměříž	x			x	x	x	KM	29,038
Liberec	x			x	x	x	LB	98,781
Mělník	x				x	x	ME	19,003
Most	x				x		MO	67,691
Olomouc	x	x			x	x	OL	100,168
Ostrava	x	x	x	x	x	x	OS	309,098
Plzeň	x	x	x		x	x	PM	163,392
Prague	x	x	x	x	x		AB	1,188,126
Příbram	x				x	x	PB	34,660
Sokolov	x				x	x	SO	24,456
Svitavy	x				x		SY	17,226
Šumperk	x		x		x	x	SU	28,069
Ústí nad Labem	x	x	x		x	x	UL	94,565
Ústí nad Orlicí	x	x			x		UO	14,864
Znojmo		x	x		x		ZN	34,902
Žďár nad Sázavou	x		x		x	x	ZR	23,688
Other participants								
Frýdek-Místek					x		FM	59,416
Karlovy Vary						x	KV	50,691
Litoměřice	x						LM	23,091
Litvínov	x						LT	27,079
Lovosice	x						LV	8,905
Meziboří	x						MZ	4,874
Tanvald	x						TN	6,980
Teplice	x						TP	51,046
Uherské Hradiště				x			UH	26,007
Rural background stations								
Košetice	x						P1	
Bílý Kříž	x						P2	

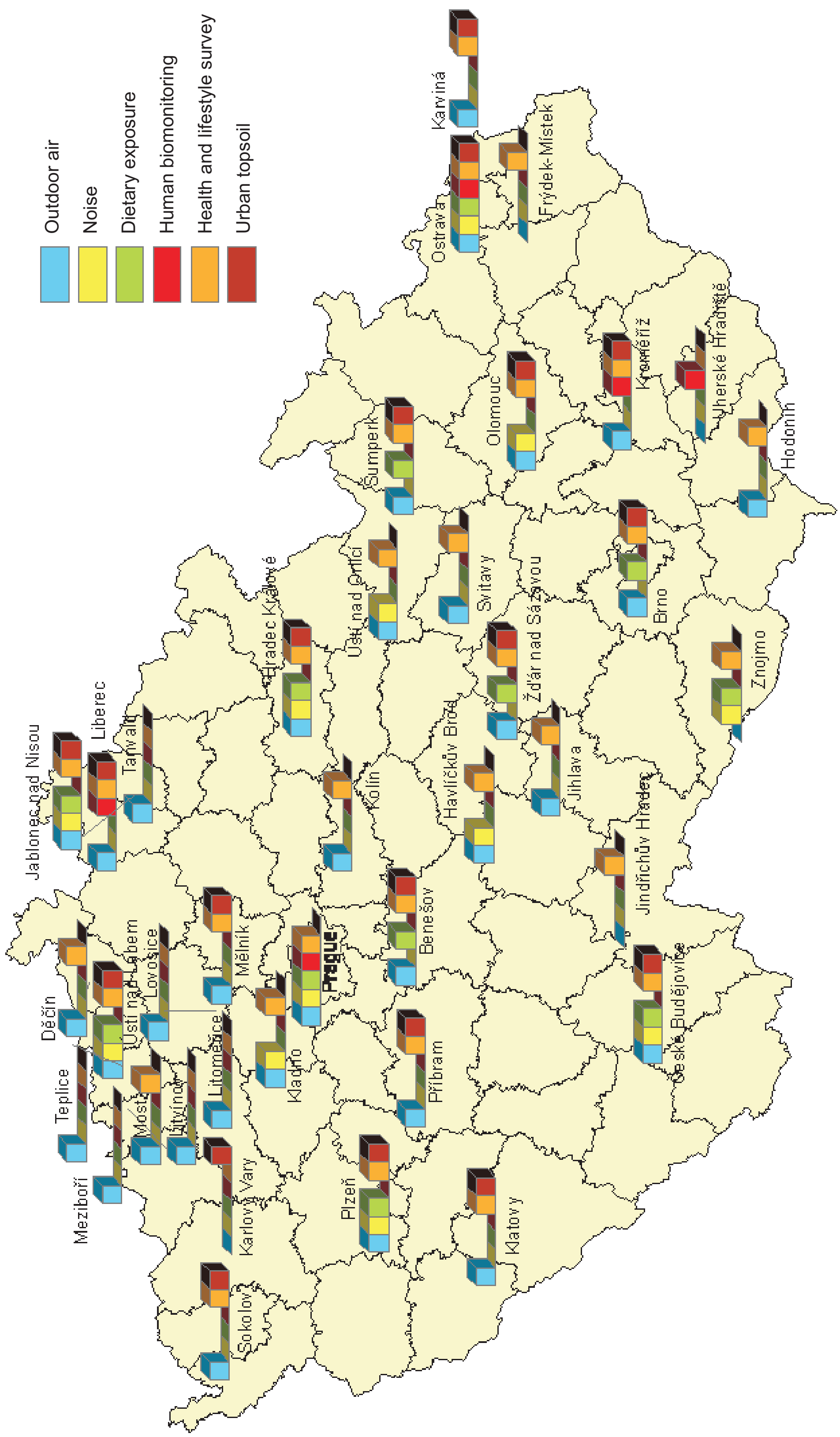
Note:

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. 2007 (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 FROM AIR POLLUTION

4.1 Organization of monitoring

Subsystem I focuses on selected indicators of population health and indoor/outdoor air quality. Information on population health is obtained from general practitioners and paediatricians in out-patient facilities. Information on ambient air pollutant concentrations is obtained from the network of measuring stations operated by the public health institutes in the monitored cities as well as from selected measuring facilities administrated by the Czech Hydrometeorological Institute.

4.2 Incidence of treated acute respiratory diseases

Acute respiratory diseases (ARD) account for a significant percentage of the overall morbidity and are the most frequently reported diagnosis in childhood. When considering the incidence data, it should be taken into account that the treated cases are only included, with the patient's decision and physician's subjective evaluation playing a major role. The information source are medical records on the first treatment given to patients presenting with acute respiratory disease. The basic output is the age distribution of diagnoses. In 2007, 73 paediatricians and 38 general practitioners providing care to a total of 163,794 patients in 25 cities took part in the ARD data collection. The data were processed on a monthly basis and only those from physicians providing service for not less than 10 days of the given month were taken into account.

The data 2007 do not markedly differ from those from previous years with the monthly incidence rates ranging from tens to hundreds of cases per 1,000 population of a given age group, depending on season and epidemiological situation. Fig. 4.1a presents the range of the mean annual ARD incidence rates in 1995 to 2007. The incidence of treated ARD in children has become more or less stable over the last years after a clear downward trend in 1995–2002 (Fig. 4.1b).

Upper respiratory tract diseases accounted for the highest percentage, i.e. 77 %, of the overall annual ARD incidence as calculated for all localities and age categories. The second most frequent diagnosis was influenza with 11 % (in comparison with 9.8 in 2006), followed by acute bronchitis with 9 %. The order of the remaining diagnoses by frequency was the following: otitis media – sinusitis – mastoiditis (2.0 %), pneumonia (1.0 %) and asthma (0.7 %).

4.3 Urban air pollution

In large cities and conurbations, the traffic and related processes (primary emissions, resuspension, abrasion, corrosion, etc.) are considered to be the major source of air pollution with nitrogen oxides, carbon monoxide, PM_{10}, $PM_{2.5}$, $PM_{1.0}$, submicrometric particles, chrome, nickel, volatile organic compounds (VOCs) (ignition engines) and polycyclic aromatic hydrocarbons (compression ignition engines). Other relevant air pollutants are ozone formed from emitted precursors, volatile organic compounds, and the sum of greenhouse gases, carbon monoxide and carbon dioxide (ca 10^2 to 10^3 g CO_2/1 km/vehicle). The actual level of air pollution with a given pollutant or group of pollutants in a given locality is always the sum of its natural background level and the contribution from traffic and local sources.

In 2007, air pollutant concentration data from 37 localities measured at 81 stations were processed (Tab. 3.1, Fig. 3.1). For comparison, data on rural background levels obtained within the respective measuring programmes at two EMEP (European Monitoring and Evaluation Programme) stations in Košetice and Bílý Kříž (Co-operative programme for the monitoring and evaluation of the long range transmission of air pollutants in Europe) and at traffic hot spots in Prague were also evaluated.

4.3.1 Major pollutants monitored

The long-term trends in most monitored air pollutants continued in 2007. Favourable climatic conditions (warm winter) caused a more important contribution of traffic pollution as the major source of urban air pollution compared to other types of sources (heating plants, household heating and industry). It is confirmed by the annual characteristics for nitrogen dioxide and suspended particulate matter (PM_{10} and $PM_{2.5}$), exceeding the established and target air pollution limits. The levels of carbon monoxide and sulfur dioxide measured at the urban stations only exceptionally exceeded 10 % of the established short-term limits, while higher concentrations of sulfur dioxide can be observed in the Ústí nad Labem region (Fig. 4.3). The impact of large industrial sources is reflected by the long-term elevated levels in the Ostrava-Karviná area of the Moravian-Silesian region.

The annual arithmetic means of **nitrogen dioxide** (NO_2) at rural background stations did not exceed 10 μg/m^3 (Fig. 4.4a). The mean annual nitrogen dioxide level in urban localities depending on traffic burden ranged from 19 μg/m^3 in localities with less traffic to 63 μg/m^3 at heavy traffic hot spots (Fig. 4.4b). Apart from the Prague conurbation where half of the monitoring stations reported values above the annual limit, this limit was not exceeded.

At least one of the criteria of exceedance of the annual limit for **suspended PM_{10}** (annual arithmetic mean over 40 μg/m^3 and/or more than 35 exceedances of the 24-hour limit of 50 μg/m^3/calendar year) was met in 2007 at 27 of 81 monitoring stations. A decrease by 5–10 μg/m^3 in annual means at urban monitoring stations compared to 2006 was attributed to the extraordinary climatic conditions in 2007. The annual mean level ranged, depending on traffic intensity, between 23 μg/m^3 in localities with less traffic to 38 μg/m^3 in heavy traffic localities (Fig. 4.2c). The annual arithmetic mean at the background Košetice station was 18 μg/m^3, but 27 exceedances of the 24-hour concentration of 50 μg/m^3 are comparable with the results obtained in urban localities with less traffic.

The concentration of suspended $PM_{2.5}$ continued to be monitored in 2007 at selected stations in Prague and 13 other localities. The annual mean $PM_{2.5}$ concentrations varied from 14 to 33 μg/m^3. The target annual mean $PM_{2.5}$ concentration of 25 μg/m^3 proposed by the new draft framework EU directive was exceeded at two stations in the heavily industrialized area of Ostrava. The proportion of $PM_{2.5}$ in PM_{10} varied between 0.43 and 0.80, with the mean of 0.66 for all stations.

4.3.2 Metals in suspended PM_{10}

The levels of air pollution with heavy metals in 2000 to 2007 were rather stable in most monitored urban localities. Good concordance of annual arithmetic and geometric means in most localities indicates long-term stability and homogeneity of the monitored pollution levels without any significant seasonal, climatic or other oscillations.

The annual arithmetic mean **arsenic** levels ranged between 0.4 and 5.4 ng/m^3 at urban stations of less industrialized areas. At rural background stations, the arsenic levels ranged between 0.8 and 1 ng/m^3/year. These levels are indicative of the increasing contribution of the burning fossil fuels and traffic related processes. At the stations in highly industrialized areas, the annual mean levels exceeded the target limit of 5 ng/m^3/year. The mean annual **cadmium** levels were comparable with those at background stations (0.2 to 0.3 ng/m^3/year) at half of urban stations and did not exceed

1 ng/m^3/year (i.e. 20 % of the target limit) in most remaining stations. The higher levels at several monitoring stations were attributable to the local or industrial sources (Tanvald, Ostrava). The annual arithmetic mean **chromium** levels ranged between 1 and 5 ng/m^3. At three monitoring stations, they exceeded 10 ng/m^3, which was probably caused by emissions from the nearby industrial sources. The annual mean **nickel** levels in urban areas (1 to 4 ng/m^3) are slightly elevated in comparison with the natural background level (0.5 ng/m^3 or below). Higher pollution levels exceeding 50 % of the target limit were recorded in Ostrava (11.6 ng/m^3), Most, Plzeň and Prague (over 10 ng/m^3). The limit and WHO maximum level recommended for **lead** were not exceeded at any of the monitoring stations in 2007. Annual mean levels corresponding to the EMEP background range (5 to 12 ng/m^3) were recorded at more than half of the urban monitoring stations. The annual mean levels higher than 20 µg/m^3 were local in nature. The annual mean **manganese** levels in urban areas did not exceed 35 ng/m^3 and at more than half of the monitoring stations, they were comparable with the natural background level (10 ng/m^3 or below). The impact of heavy industry (metallurgy) in Ostrava is reflected in annual mean levels of 102 and 182 ng/m^3.

4.3.3 Polycyclic aromatic hydrocarbons

In 2007, the monitoring of polycyclic aromatic hydrocarbons (PAHs) was conducted at 21 stations in 15 cities. At 16 stations, twelve polycyclic aromatic hydrocarbons were monitored according to US EPA TO – 13. Other five included stations only monitored a limited range of particulate bound higher molecular weight compounds collected on silica filters. The ambient air sampling was performed every sixth day.

From the comparison of pollution characteristics at the stations located in different types of urban areas it follows that local heating and traffic are two major sources of PAHs. A specific situation is in the Ostrava-Karviná conurbation where two other sources play a major role: previous burden and large industrial complexes.

In 2007, the target limit for **benzo[*a*]pyrene** was exceeded at 15 of 21 monitoring stations. The target limit was exceeded 4 or more times at all stations in the highly industrialized cities Ostrava and Karviná. The lowest urban level (0.6 ng/m^3/year at Žďár nad Sázavou) is twice as high as that obtained at the background station in Košetice (0.3 ng/m^3/year) (Fig. 4.6a). The urban annual mean levels ranged between 0.7 and 1.8 ng/m^3 regardless of traffic burden. The mean 24-hour concentrations in the heavy traffic areas ranged from less than 0.1 to 0.4 ng/m^3 in summer and did not exceed 4 ng/m^3 in winter. In the areas polluted mainly by local heating with fossil fuels, the mean 24-hour concentrations were lower than 0.1 ng/m^3 in summer but higher than 5 ng/m^3 in winter. The highly industrialized localities compared to other types of localities showed even several times higher annual mean levels (1.3 to 8.9 ng/m^3/year) depending on type of industry (chemical, metallurgy, etc.) (Fig. 4.6c). In winter, the 24-hour maximum levels were in the order of tens of ng/m^3 (Fig. 4.6d).

The contribution of emissions from industrial sources is evident from the levels of **phenanthrene** (PHEN) and **benzo[*a*]anthracene** (BaA). The annual mean PHEN levels in urban areas varied from 11 to 27 ng/m^3, i.e. were slightly higher than the background level of 4.4 ng/m^3 in Košetice. In highly industrialized areas, the annual mean levels were almost 3 times as high, ranging from 40 to 84 ng/m^3. The annual mean BaA levels varied widely from 0.3 ng/m^3 to 15.3 ng/m^3. In the areas other than the Ostrava-Karviná basin, the annual mean levels ranged from 0.4 to 1.9 ng/m^3. In heavy traffic areas, the annual mean levels were in the range of 0.6 to 1.8 ng/m^3. The annual reference concentration was exceeded only in the highly industrialized zone of Ostrava.

The carcinogenic potential of the mixture of PAHs in air expressed as the **toxic equivalent of benzo[*a*]pyrene (TEQ BaP)** varied widely with type of locality. It was the highest, i.e. 13.1 ng/m^3/year, in the area polluted by an important industrial source in Ostrava. At other four monitoring stations of the highly industrialized area of Ostrava and Karviná, the TEQ BaP levels were several times higher than in the other areas where the annual mean levels ranged between 1.0 and 2.4 ng/m^3 regardless of traffic pollution. The trend in the TEQ BaP levels in 1997–2007 is shown in Fig. 4.6b.

4.3.4 Volatile organic compounds

In 2007, volatile organic compounds (VOCs) in outdoor air were monitored at 23 stations. At selected stations, forty-two organic compounds were monitored (according to US EPA TO – 14); nevertheless, only twenty-three of these were taken into account since the remaining ones were mostly present at concentrations below the respective detection limits. Winter sampling was carried out on every sixth day, while from April to September, outdoor air samples were collected on every twelfth day. Some stations used automated analyzers to monitor benzene, toluene, ethylbenzene and xylenes.

An annual limit of 5.0 µg/m^3 has been established for benzene by Decree No. 597/2006 of the government of the Czech Republic, Annexe 1. Among other important VOCs, for which reference concentrations have been set, are aromatic hydrocarbons (toluene, sum of xylenes, styrene, sum of trimethylbenzenes) and chlorinated aliphatic and aromatic hydrocarbons (trichloromethane, tetrachloromethane, trichloroethene, tetrachloroethene, chlorobenzene, and sum of dichlorobenzenes).

The annual mean **benzene** level in urban air varied with the traffic level between 1 and 3 µg/m^3 (Fig. 4.5a) and a comparable annual mean level of 1.6 µg/m^3 was also obtained in a heavy traffic hot spot in Prague. The highest annual mean level, i.e. 8.0 µg/m^3, was recorded in Ostrava where the pollution limit was exceeded. Differences in the impact of various types of benzene sources in urban and highly industrialized areas (Fig. 4.5c) are evident from the seasonal trend in the monthly benzene levels.

The impact of different sources of VOCs is reflected in the ranges of annual benzene levels at the urban monitoring stations (Fig. 4.5b). The annual mean levels of other monitored VOCs did not generally exceed 10 % of the set reference concentrations.

4.3.5 Air Quality Index

The air quality index (AQI) based on the limit concentrations (L – limit, TL – target limit) of the pollutants was used in processing air quality data for 2007. The annual arithmetic mean levels of nitrogen dioxide, PM_{10}, arsenic, cadmium, nickel, lead, benzene and benzo[*a*]pyrene were included in the calculation of AQI.

From the AQI values calculated for different types of urban areas (Fig. 4.7) it follows that:

- due to the mild and warm winter 2007, annual AQI values were lower. In border urban areas they decreased from 1.94 in 2006 to 1.09 in 2007 which confirmed the negative impact of local solid fuel heating;
- mean AQI levels calculated for different types of urban areas increased depending on traffic from 0.94 to 1.26 and all types were classified into air quality class 2;
- the favourable climate in 2007 did not influence the high annual AQI levels in highly industrialized areas of the Ostrava-Karviná region classified into air quality class 4, characterized by polluted air.

4.3.6 Exposure to outdoor air pollutants

The mean long-term exposure to outdoor air pollutants can be expressed as potential exposure of the population of a given locality to the mean pollutant concentration level for a stratified supply, e.g. at limit concentration intervals. The estimated population distribution by air pollution (NO_2, PM_{10} and benzene) level is shown in Fig. 4.8.

Levels of exposure to nitrogen dioxide remain significant despite a slight reduction in 2007. The population distribution by nitrogen dioxide exposure level is most influenced by the Prague conurbation where the limit was exceeded at half of the monitoring stations but the mean annual level was within the limit. The estimated outdoor nitrogen dioxide exposure in 2007 was in the range of 27 to 40 $\mu g/m^3$ for 42 % of the monitored urban population.

In 2007, the estimated outdoor benzene exposure exceeded the limit for 9 % of the population.

The population distribution by PM_{10} exposure level is most influenced by the Prague conurbation where the limit was exceeded at more than half of the monitoring stations, i.e. at 17 of 20 monitoring stations, but the annual mean level was within the limit of 40 $\mu g/m^3$. The annual PM_{10} limit was exceeded for 16 % of the monitored urban population.

4.4 Indoor air quality monitoring

In 2007, based on the results from Phase 1 of the Project, indoor air quality monitoring in elementary schools continued. The objectives of Phase 2 are to test the obtained results for representativeness and to provide additional data on the space-time variability of the parameters previously identified as problematic. The monitored parameters were microclimatic factors (temperature, humidity), ventilation rate (based on air exchange and CO_2 level) and PM_{10}, $PM_{2.5}$ and PM_1 levels. The measurements were made in heating season 2007/2008 (from January to April 2008) in all 14 administrative regions of the Czech Republic. In each region, one elementary school was selected and in each school the selected parameters were measured in ten classrooms located at different floors, with the windows facing different directions. More detailed information will be available in the next summary report.

4.5 Health effects of air pollution

Air pollution with carbon monoxide and sulfur dioxide does not pose a significant health risk in the monitored localities; nevertheless, for the 24-hour sulfur dioxide concentration the threshold of harmful effect has not been determined yet. Ozone pollution does not reach such levels to cause acute health effects, with the exception of warm summers when, under certain circumstances, the so-called summer smog episodes can occur. Of the heavy metals monitored in aerosol samples, lead has become unimportant after the widespread introduction of lead-free petrol, similarly as have manganese and cadmium.

Among the most important air pollutants with health significance are primarily aerosol and nitrogen dioxide in heavy traffic areas.

The effect of nitrogen dioxide is difficult to separate from that of other pollutants, mainly of aerosol. The highest nitrogen dioxide exposure is observed in heavy traffic areas. From the determined annual mean levels it follows that mainly in the Prague conurbation, reduced lung function, higher incidence of respiratory diseases and more frequent complaints from asthma and allergic patients can be expected in both children and adults.

Short-term increase in daytime PM_{10} levels contributes to higher morbidity and mortality, in particular from cardiovascular diseases, increased number of persons hospitalized for respiratory tract diseases, higher infant mortality, higher incidence of cough and difficult breathing mainly in asthma patients, and changed lung function on spirometry. Long-term increase in concentrations can result in reduced lung function in both children and adults, higher morbidity from respiratory diseases, higher incidence of chronic bronchitis and reduced life expectancy due to higher mortality from cardiovascular diseases, particularly in the elderly and polymorbid patients, and probably also from lung cancer. These effects are reported even for the annual mean concentrations lower than 30 μg/m^3. Reduced life expectancy due to chronic $PM_{2.5}$ exposure has been reported starting from the annual mean concentration of 10 μg/m^3.

Any safe threshold concentration has not been set for suspended PM. According to the World Health Organization, at annual mean PM_{10} levels of 20 μg/m^3 and lower the overall mortality does not increase with 95% reliability rate. Nevertheless, even such a level does not imply the safety of the general population from the negative effects of PM.

The range of PM_{10} concentrations characteristic of pollution in the monitored areas is presented in Tab. 4.5.1. From the 2007 data it follows that only a part of the background monitoring stations and low traffic urban areas are not exposed to PM_{10} levels that pose a substantial health risk.

Tab. 4.5.1 Ranges of annual mean levels of NO_2 and PM_{10} in outdoor air (in μg/m^3)

Pollutant	Rural background	Urban area		
		Minimum level	Mean level	Maximum level
Nitrogen dioxide	8.0	7.2	25.6	85.3
Suspended PM_{10}	18.3	11.0	28.0	61.5

To estimate the impact of long-term exposure to particulate matter, the American Cancer Society data and the revised European Air Quality Directive were used. It was concluded that an increase in the annual PM_{10} concentration by 10 μg/m^3 elevates the overall mortality rate of the exposed population by 3 %.

Based on the annual mean concentration of suspended PM_{10} from 2007, it can be estimated that in urban areas this air pollutant was responsible for 2.4 % increase in the overall mortality. In view of the wide variation of the annual mean PM_{10} concentrations between various types of localities, the proportion of premature deaths varied from inappreciable in extremely low traffic areas to 12.5 % of the overall mortality in highly industrialized and/or heavy traffic areas. For a total of 104.4 thousand deaths in the Czech Republic in 2007 the estimated number of premature deaths caused by exposure to suspended PM_{10} varies between 2,450 and 11,620 (with the upper figure calculated for a general pollution level which would be as high as that in the Ostrava-Karviná region).

4.6 Health risk assessment

Theoretical increase in cancer risk from long-term exposure to outdoor air pollutants was calculated for arsenic, nickel, sum of PAHs and benzene. The estimate was based on a linear no-threshold dose-effect model. Unit cancer risk (UCR) values expressing incremental cancer risk from lifetime exposure to a given air pollutant at a concentration of 1 μg/m^3 were used for the calculation.

The UCR values for the major carcinogens were taken from the WHO guidelines (e.g. Air quality guidelines for Europe and Air quality guidelines. Global update 2005, Particulate matter, ozone, nitrogen dioxide and sulfur dioxide) and other sources (US EPA, HEAST).

Tab. 4.6.1 Unit cancer risk values for the monitored carcinogens

Pollutant	Arsenic	Nickel	Benzene	Benzo[*a*]pyrene
Unit cancer risk	1.5E-03	3.8E-04	6.0E-6	8.7E-02
Pollutant	Benzo[*a*]anthracene	Benzo[*b*]fluoranthene	Benzo[*k*]fluoranthene	Benzo[*ghi*]perylene
Unit cancer risk	1.0E-04	1.0E-04	1.0E-05	1.0E-06
Pollutant	Dibenzo[*ah*]anthracene	Chrysene	Indeno[*1,2,3-cd*]pyrene	
Unit cancer risk	1.0E-03	1.0E-06	1.0E-04	

Lifetime exposure to particular pollutants was considered; based on the annual arithmetic mean levels for 2007 the individual risk estimates were calculated for the population in each type of the monitored urban areas. The results are summarized in Tab. 4.6.2 giving individual risks based on the data from the rural background stations (Košetice and Bílý Kříž), the minimum cancer risk level for the least polluted urban areas and maximum cancer risk for the most polluted urban areas. The mean individual cancer risk was calculated from the concentrations of carcinogens in all monitored localities.

Tab. 4.6.2 Individual risk from exposure to air carcinogens

Pollutant	Rural background	Urban area		
		Minimum level	Mean level	Maximum level
Arsenic	1.44E-06	6.44E-07	4.24E-06	1.67E-05
Nickel	1.68E-07	1.68E-07	1.13E-06	3.99E-06
Benzene	–	4.63E-06	1.43E-05	4.81E-05
Carcinogenic PAHs	2.80E-05	2.80E-05	1.74E-04	7.84E-04

Incremental cancer risk for particular air pollutants ranges between the orders of magnitude of 10^{-7} and 10^{-4} (one incremental cancer case per 10 million to 10 thousand population) with the highest contribution of PAHs: in the most polluted types of urban areas (highly industrialized areas) the risk was almost one incremental cancer case per 1,000 population.

4.7 Partial conclusions

In 2007, the results related to the incidence of treated acute respiratory diseases were similar as in previous years. The highest morbidity rate is traditionally found in the age group 1–5 years. The incidence rates of treated acute respiratory diseases in children in 1995–2007 showed a plateau after a clear downward trend in 1995–2002.

The air quality in the monitored localities improved slightly in 2007 compared to 2006. This fact is explained by a very mild and warm winter associated with a lower contribution of pollutants from local heating. Air pollution with particulate matter, nitrogen dioxide and PAHs as a result of heavy traffic remained significant. In 2007, the annual limit for PM_{10} was exceeded for 16 % of the population in 7 monitored localities. Air pollution with $PM_{2.5}$ is also relevant; the target annual limit of the EU Framework Directive (25 µg/m^3) was exceeded at the monitoring stations in Ostrava. Air pollution with nitrogen dioxide showed comparable characteristics as in 2006 in most monitored localities, with the limit exceeded in heavy traffic areas and in large conurbations.

The target limit set for benzo[*a*]pyrene is frequently significantly exceeded on a long-term basis at most monitoring stations despite a certain decrease in its levels caused by the mild winter 2007. Significantly higher BaP levels were recorded in highly industrialized areas in the Ostrava-Karviná conurbation.

Based on the mean PM_{10} concentration found in urban areas in 2007, it can be estimated that this air pollutant is responsible for an increased mortality of ca 2.4 %. The highest incremental cancer risk associated with exposure to polluted air was estimated for carcinogenic PAHs and corresponded to 2 incremental cancer cases per 10 thousand population. The respective incremental cancer risk for benzene was 1.5 cases per 100 thousand population.

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

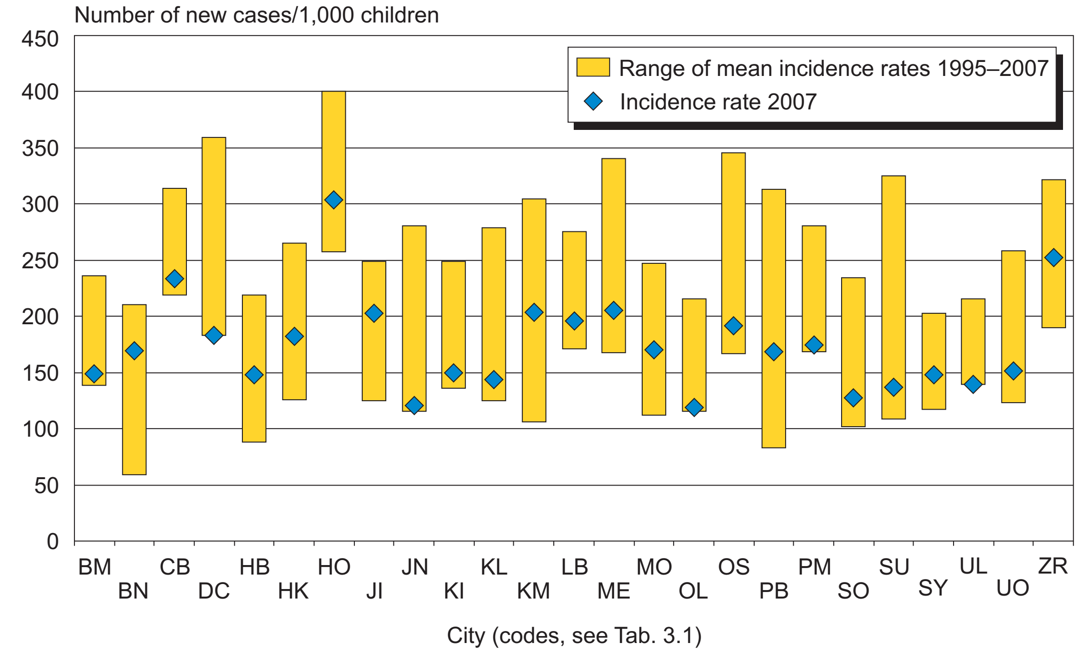


Fig. 4.1b Trend of acute respiratory diseases in children, comparison with the mean year 1995–2007

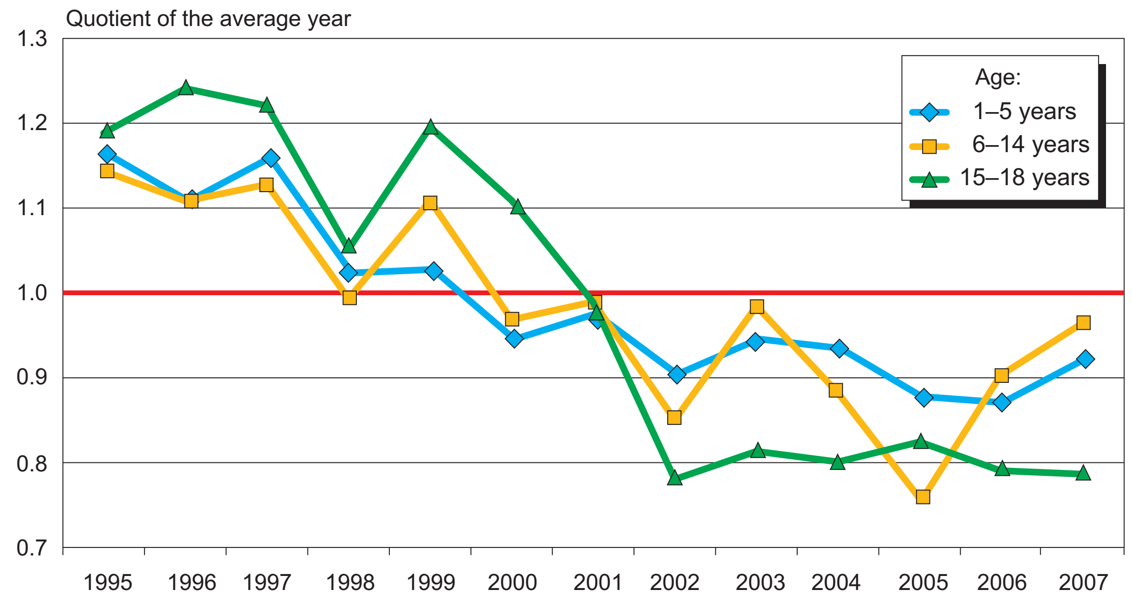


Fig. 4.2a Particulate matter (PM_{10}) levels in urban air, frequency of days with PM_{10} concentration exceeding the 24-h limit

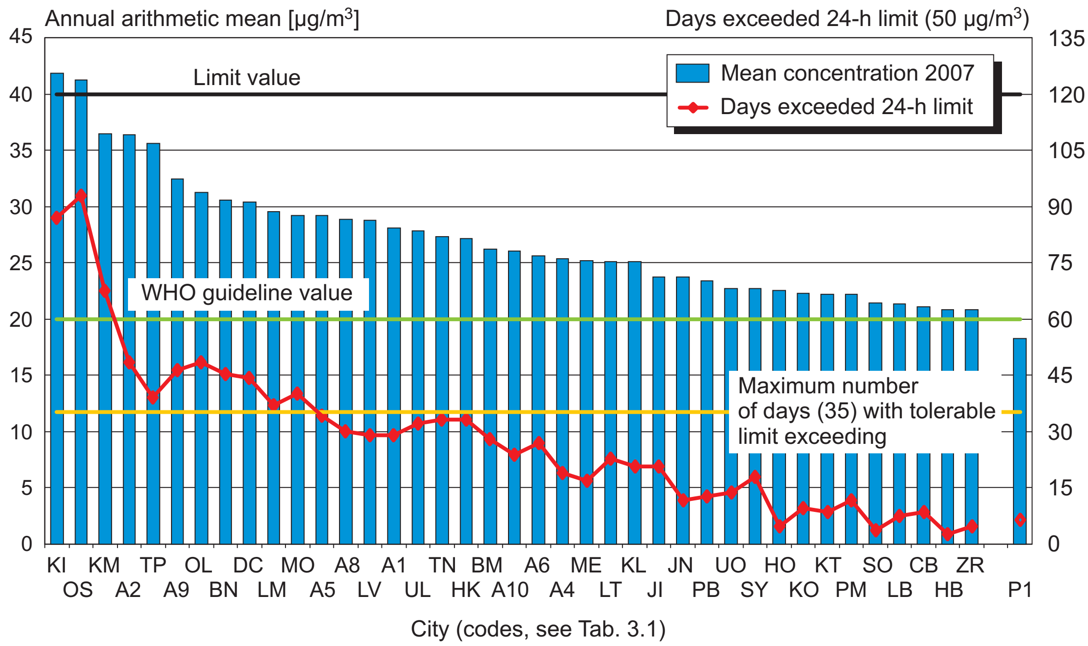
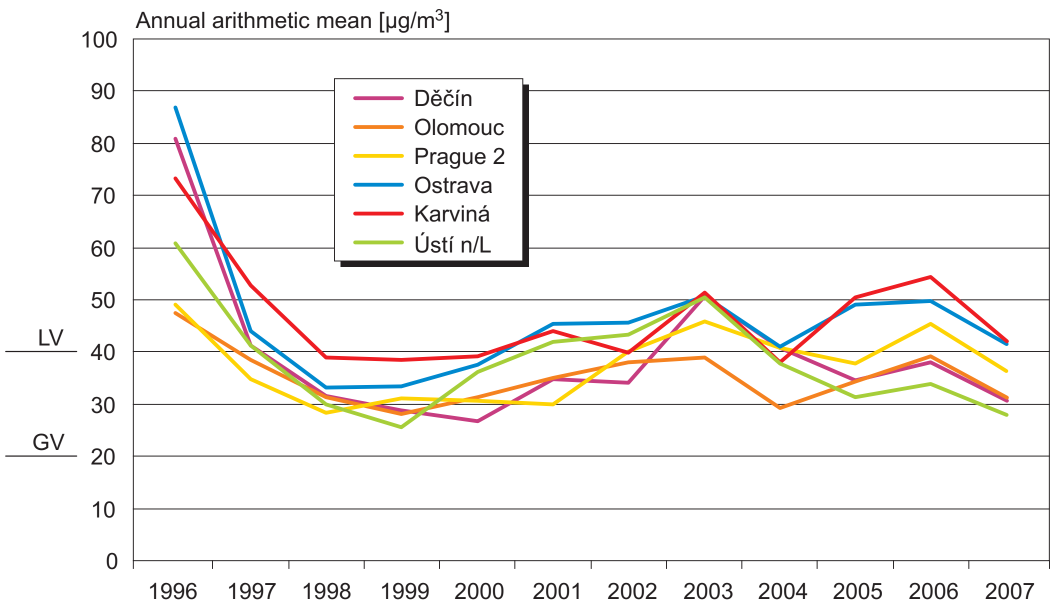


Fig. 4.2b Trends in PM_{10} levels in the most polluted cities



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

Fig. 4.2c Particulate matter (PM_{10}) levels by type of the urban station, 2007

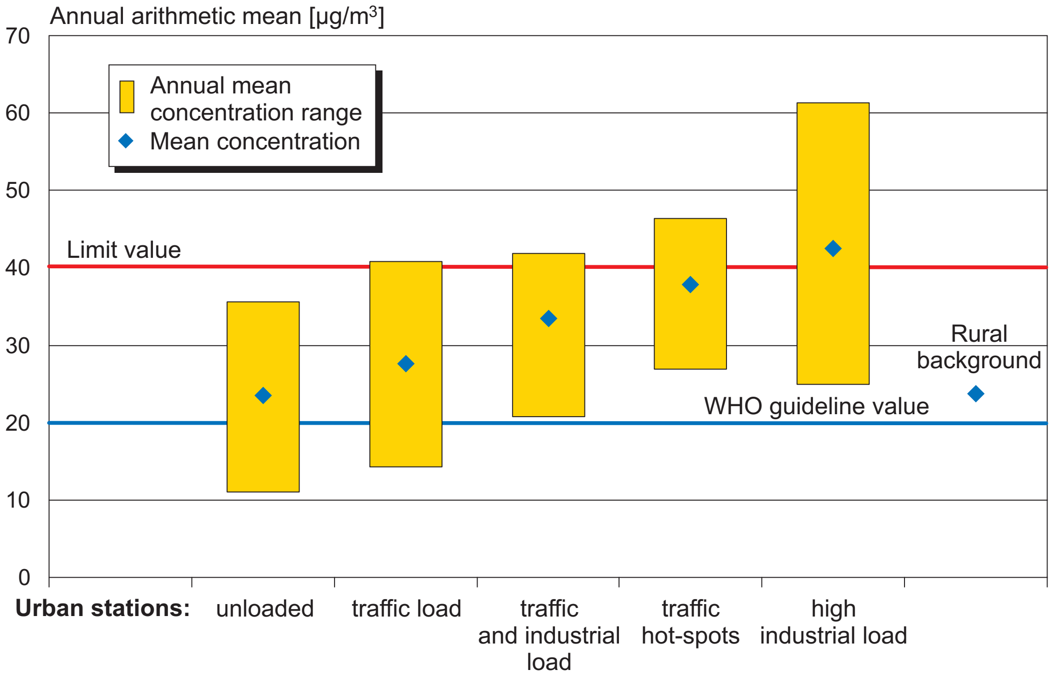


Fig. 4.3 Sulphur dioxide levels in the monitored locations by the regions, 2007

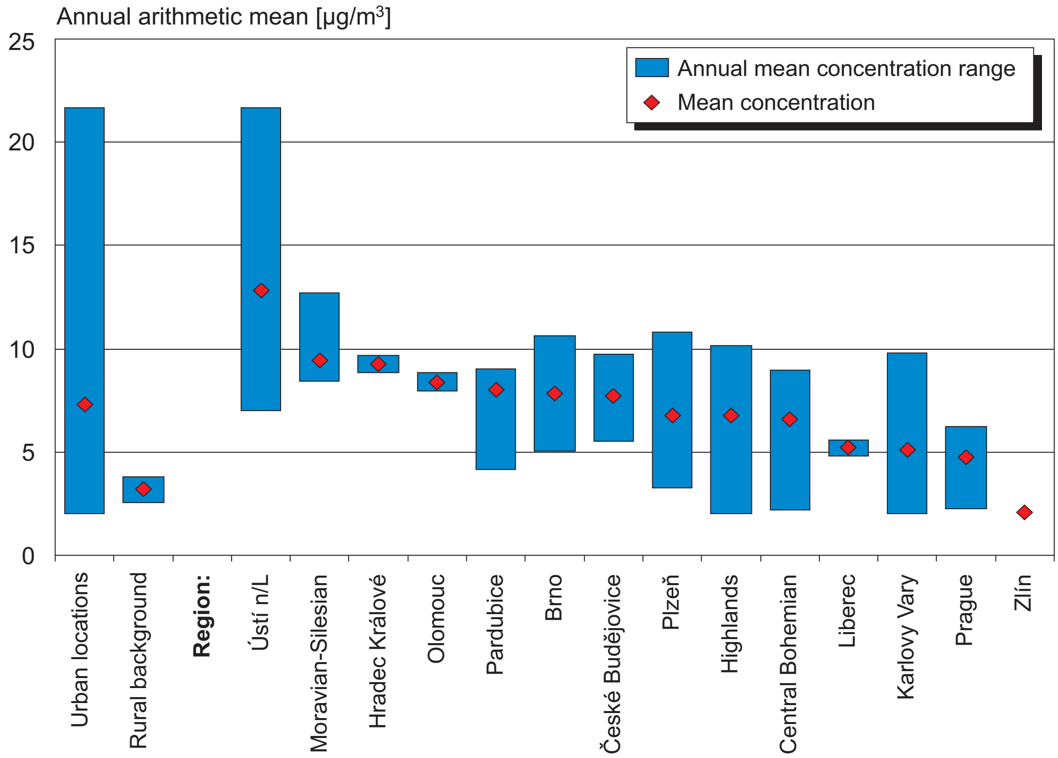


Fig. 4.4a Nitrogen dioxide levels in urban air, 1995–2007

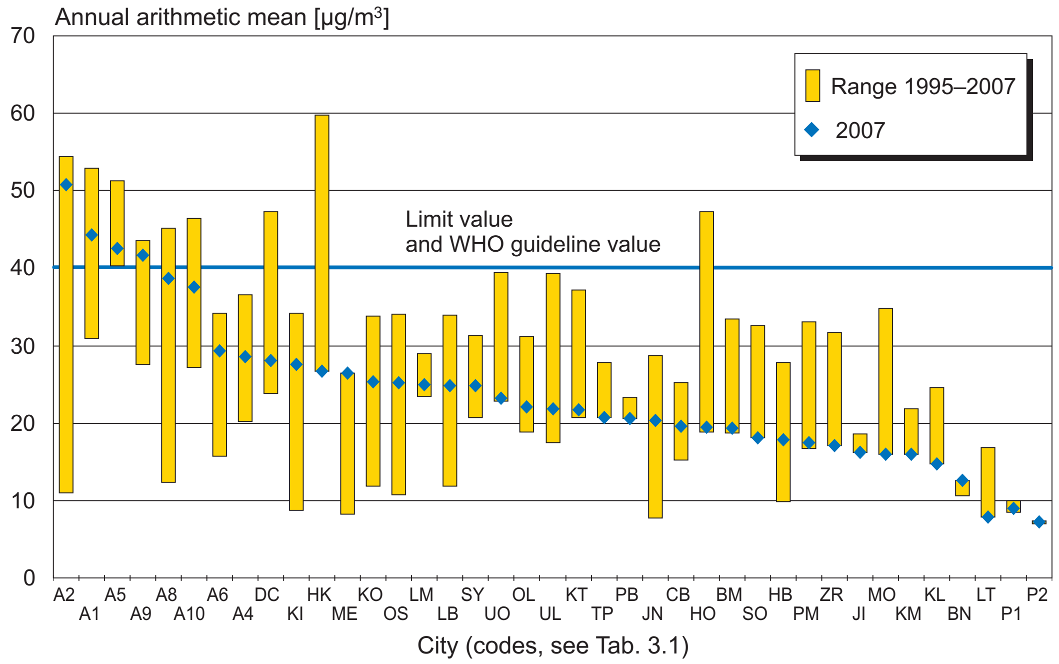


Fig. 4.4b Nitrogen dioxide levels by type of the urban station, 2007

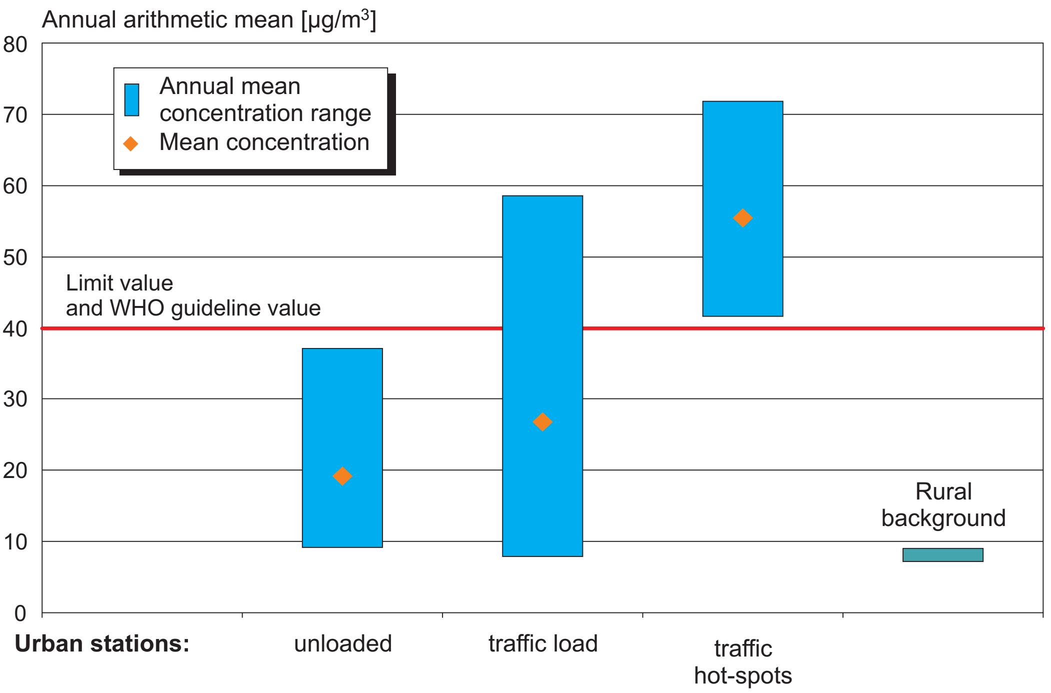


Fig. 4.5a VOC levels in urban air, 2007

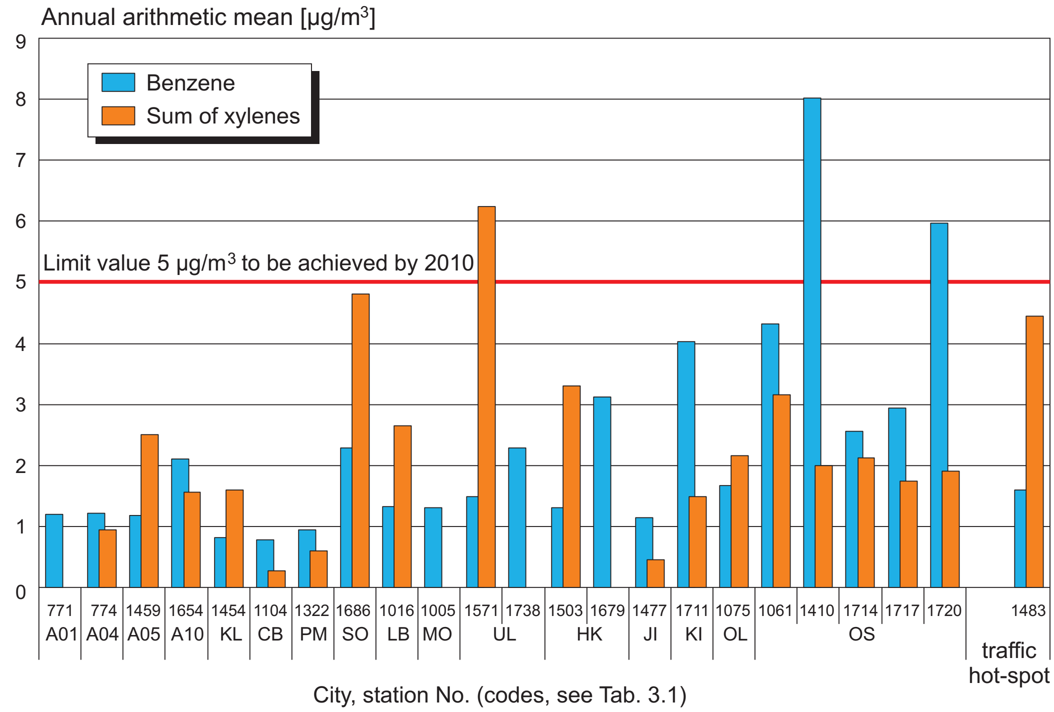


Fig. 4.5b Benzene levels by type of the urban station, 2007

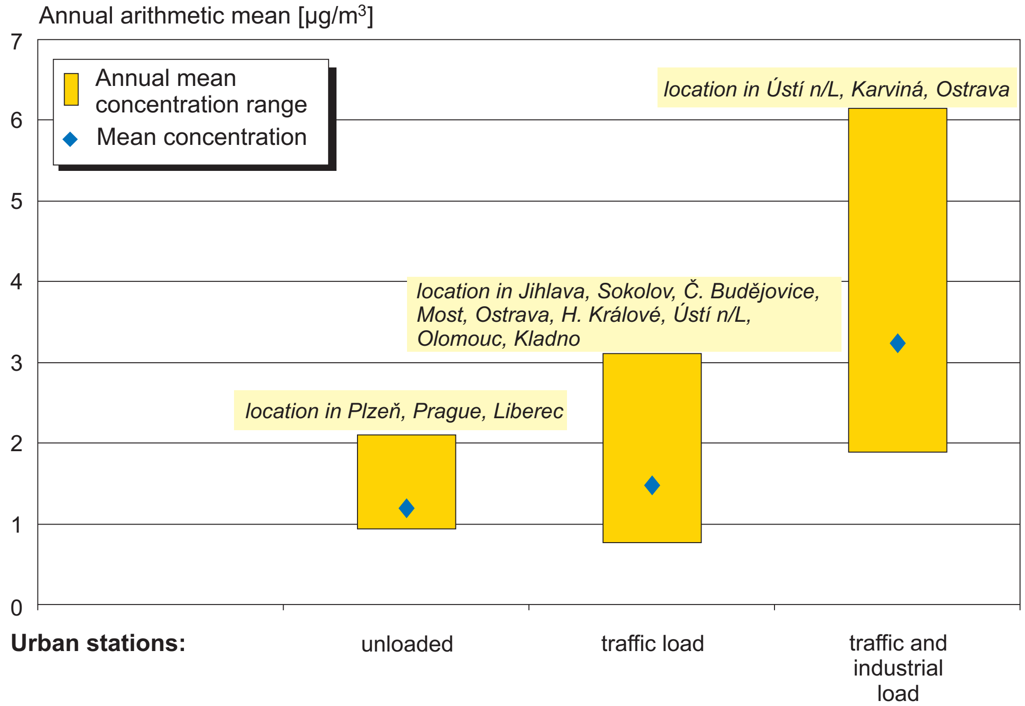


Fig. 4.5c Seasonal trends in benzene levels by type of the urban station, 2007

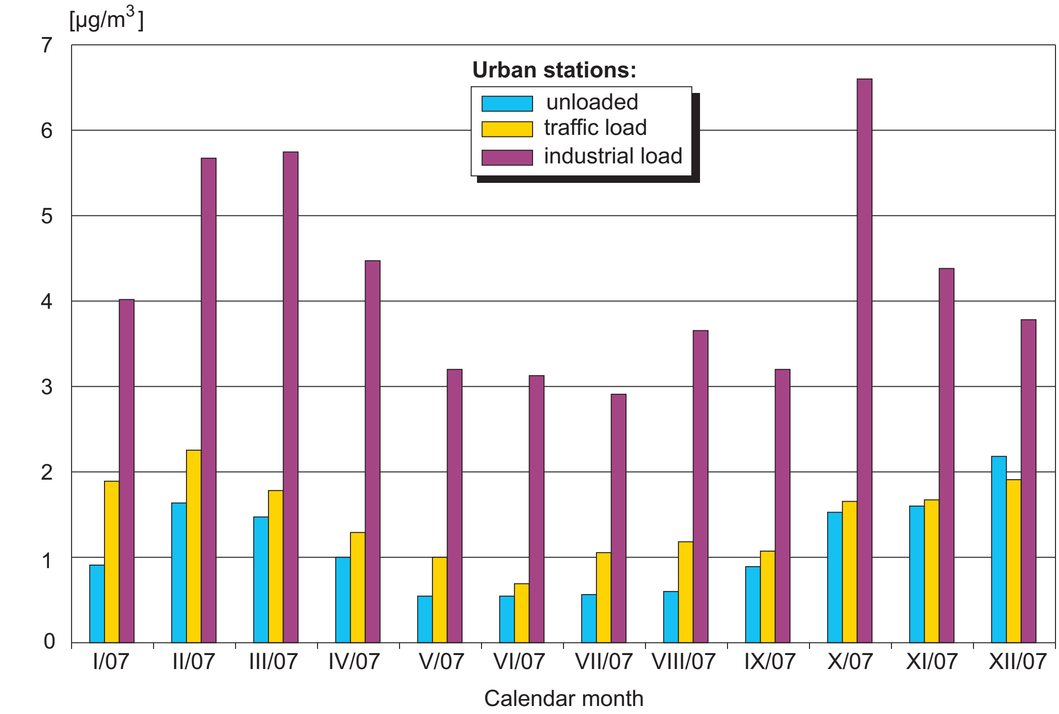


Fig. 4.6a Polycyclic aromatic hydrocarbons (PAHs), annual arithmetic mean, 2007

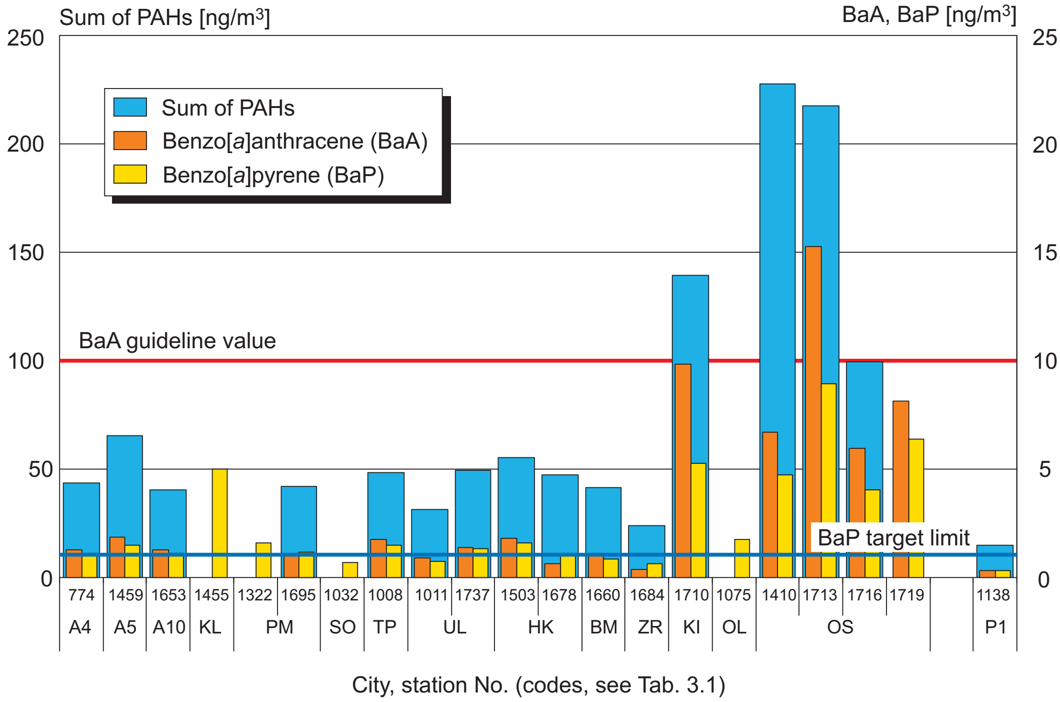


Fig. 4.6b Benzo[*a*]pyrene toxic equivalent (TEQ), 1997–2007

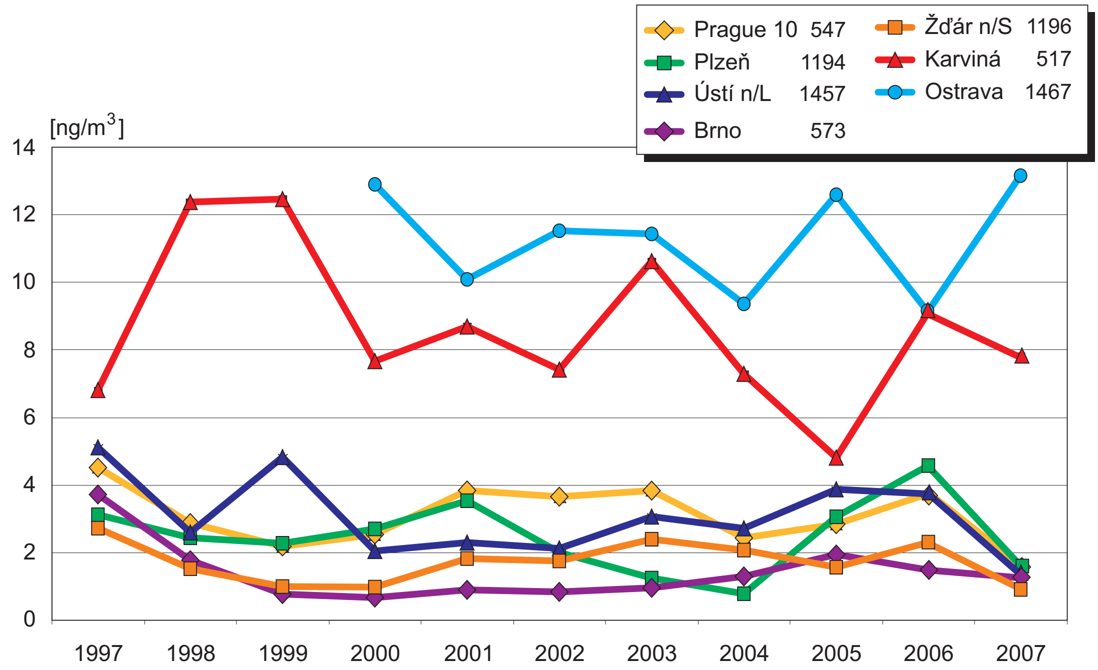


Fig. 4.6c Benzo[*a*]pyrene levels by type of the urban station, 2007

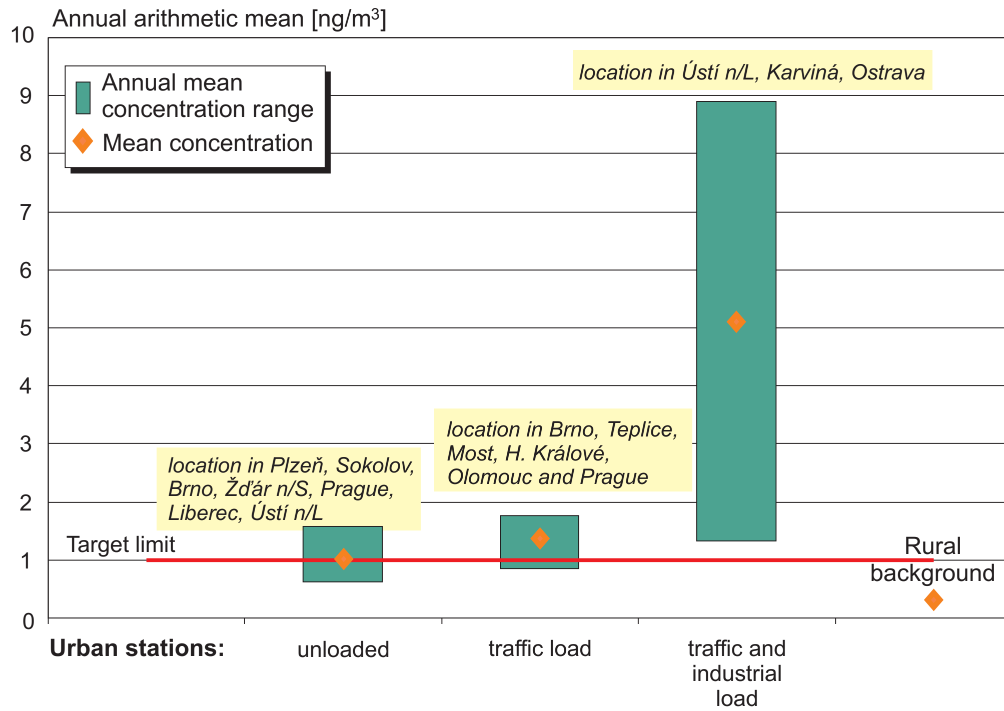


Fig. 4.6d Seasonal trends in benzo[*a*]pyrene levels by type of the urban station, 2007

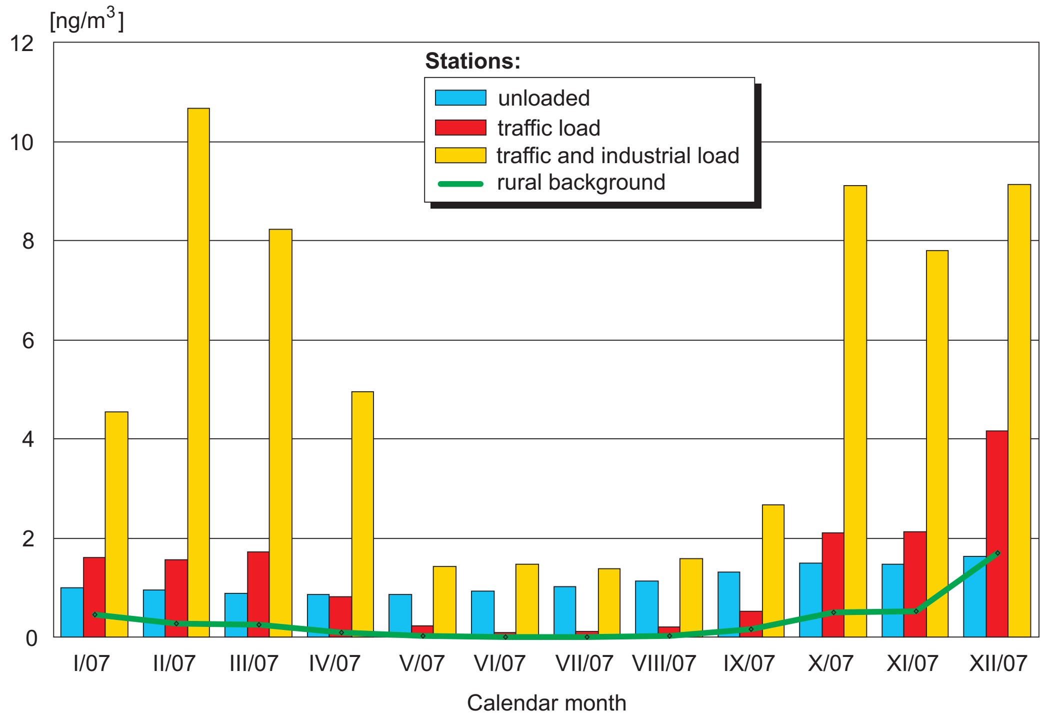


Fig. 4.7 Air Quality Index, 2007
(based on concentrations of PM_{10}, NO_2, As, Cd, Pb, Ni, BaP, benzene)

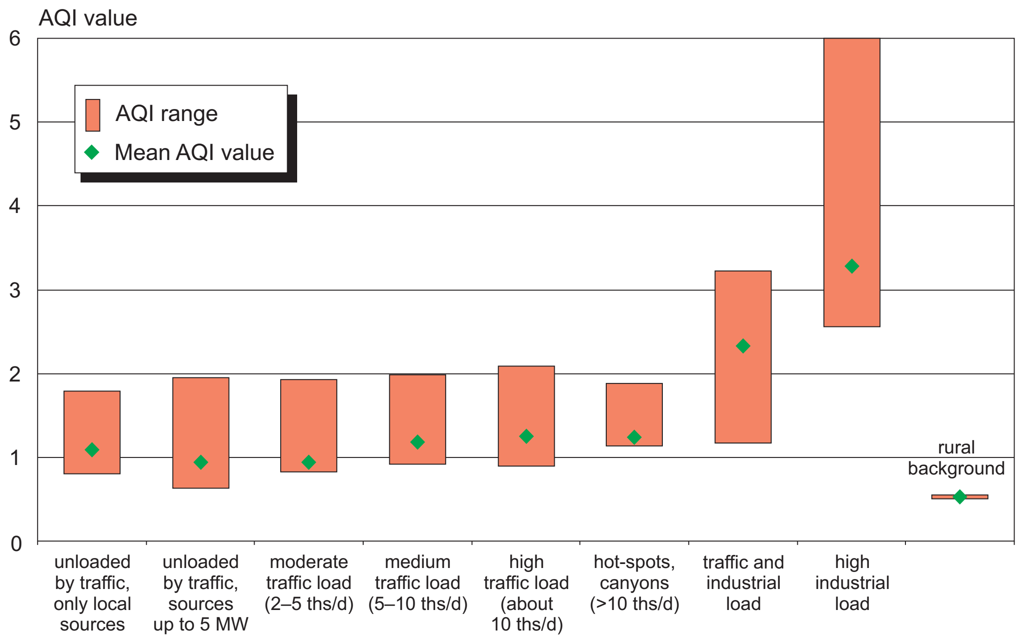


Fig. 4.8 Distribution of the population by air pollution levels (at intervals of the limit values)

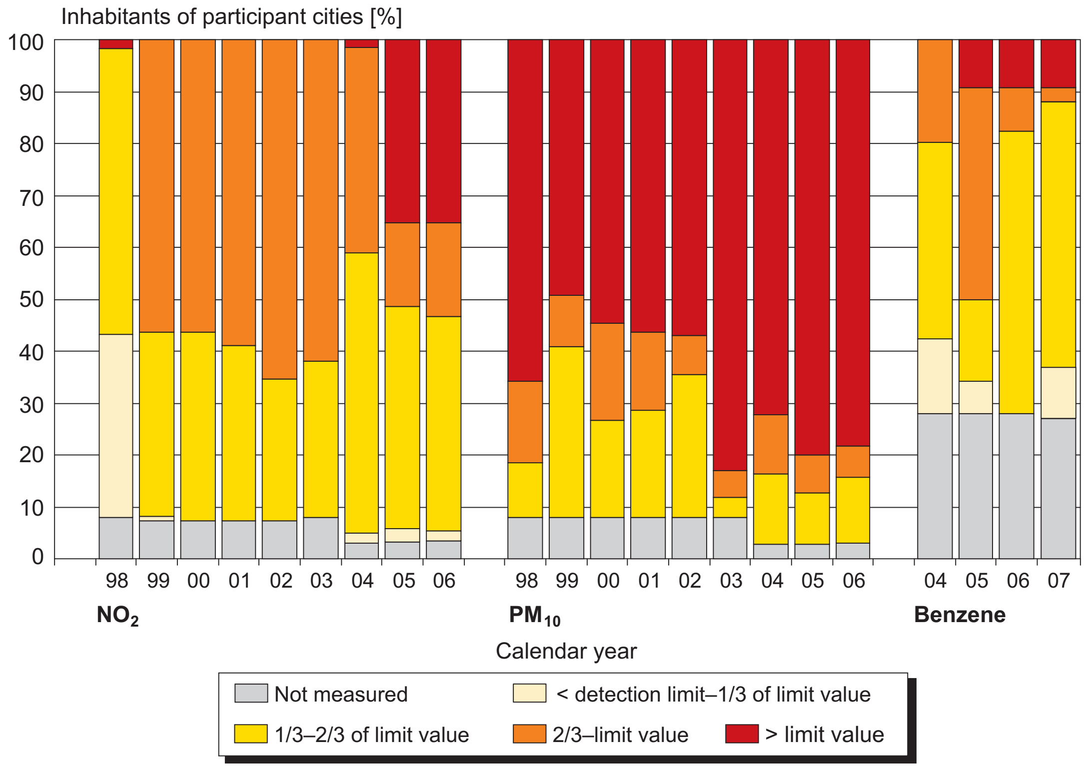
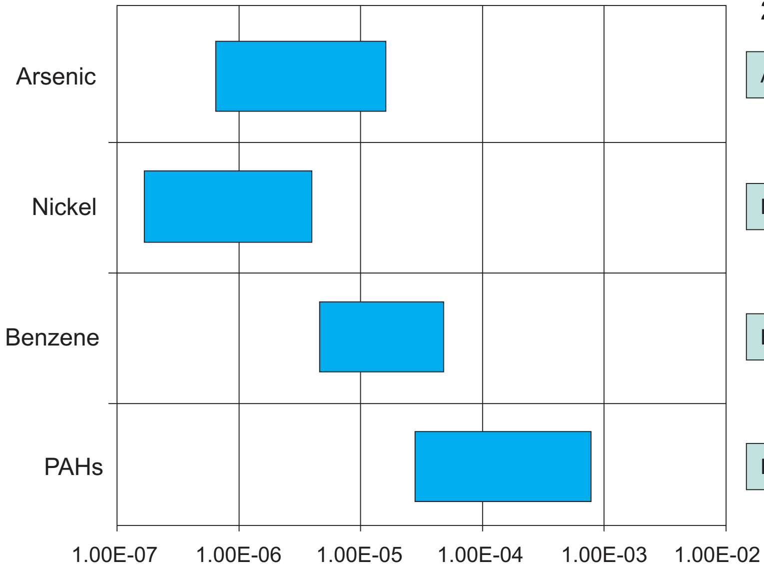


Fig. 4.9 Cancer risk assessment for exposure to carcinogens in urban air, 2007



2007	Mean value in monitoring cities	Rural background
Arsenic	4.24E-06	1.44E-06
Nickel	1.13E-06	1.84E-07
Benzene	1.43E-05	–
PAHs	1.74E-04	2.83E-05

5. HEALTH EFFECTS AND RISKS FROM DRINKING WATER POLLUTION

5.1 Organization of monitoring

In the Czech Republic, over 90 % of the population is connected to a public water supply network. In 2006 it was 92.4 %. Since 2004, data on the drinking water quality has been obtained within the framework of monitoring the public supply of drinking water in the Czech Republic by means of an information system 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 2007, a total of 4,034 water mains (supplied areas) were monitored. The overwhelming majority of them (3,753) are so-called smaller areas, in which less than 5,000 inhabitants are supplied. Only 281 supplied areas belong to the so-called larger category (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. A more detailed breakdown of the total number of supplied inhabitants and the number of samplings depending on the size of the water mains is given in Fig. 5.1.

The Decree No. 252/2004 Coll. as amended, of the Czech Ministry of Health, is the mandatory basis for evaluating the quality of drinking water. This decree is fully harmonized 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 Drinking water quality

Compliance with water quality limit values was evaluated separately for water mains supplying up to 5,000 inhabitants (smaller ones) and for those supplying more than 5,000 inhabitants (larger ones). A limit value for the health-relevant quality indicators is called the maximum limit value (MLV). A limit value for indicators that are rather for determining the organoleptic properties of water is called the limit value (LV).

In 2007, more than 35,700 drinking water samplings were carried out, during which more than 821 thousand quality-indicator values were obtained. In the larger water mains, 0.1 % of the total number of quality assessments exceeded the maximum limit value and 1.1 % exceeded the limit value. In the smaller ones, 1.2 % of the assessments exceeded the maximum limit value and 3.4 % 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 comply with water quality standards occurs more frequently as the size of the water mains decreases. The trend in quality of drinking water supplied by public water mains in the last several years is illustrated in Fig. 5.2b.

In larger water mains, apart from a failure with the compliance of the recommended range of water hardness (calcium + magnesium) in more than half the assessments, the limit values for iron (6 %) and chloroform (2 %) were exceeded most frequently in 2007. In terms of microbiological indicators, the most frequently exceeded limit values were for the numbers of colonies at 36 °C (4.2 %) as well as the numbers of colonies at 22 °C (2.1 %). No health-relevant indicator exceeded the limit (MLV) in more than 1 % of cases.

In smaller water mains, 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 %), iron (8.7 %) and manganese (7.4 %). The same also applies to the following microbiological indicators – coliform bacteria (6.5 %) and the numbers of colonies at 36 °C (6.2 %).

The limit values for health-relevant indicators were most frequently non-complied in case of nitrates (6.2 %) and microbiological indicator *Escherichia coli* (2.4 %).

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

In 2007, a total of 78 % of inhabitants (7.4 mil.) 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, about 0.5 % of inhabitants (43,000) were supplied by water mains where at least one of the health-relevant indicators was found to have exceeded the limit value in all analyses.

As regards a health risk, nitrates and chloroform appear to be the most problematic. The content of nitrates in drinking water was monitored in practically every water main. The limit value (50 mg/l) was found to have been exceeded in 4 % of cases. In 179 water mains (2 of which were larger ones) supplying a total of 58,500 inhabitants, the calculated annual mean concentration attained or exceeded the limit value for the content of nitrates (with a range of 50–131 mg/l).

In the case of chloroform, the limit value (30 μg/l) was found to have been exceeded in 3 % of cases in 2007. In 19 water mains (8 of which were larger ones) supplying a total of 143,000 inhabitants, the annual mean concentration exceeded the limit value.

The distribution of the inhabitants according to the sources of drinking water is presented in Fig. 5.3. Generally, the maximum limit value is exceeded most frequently in drinking water produced from groundwater sources.

Currently, there is more information available on the importance of an optimal concentration of calcium and magnesium in drinking water for one's health. Based on monitoring data only 5 % of inhabitants 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) (Fig. 5.5). Water with optimum hardness (2–3.5 mmol/l) is supplied to 28 % of the population. Softer water is distributed to 63 % of the population while harder water is distributed to 9 %.

In 2006–2007, a screening study on a content of halogenoacetic acids in drinking water was performed. A group of five acids was investigated: chloroacetic, dichloroacetic, trichloroacetic, bromoacetic and dibromoacetic; all of them belong to the disinfection byproducts. Together 197 samples were analyzed from 94 water mains. In about one third of samplings negative results were obtained. In other cases, the content of particular acids varied up to 10 μg/l, and the content of the whole halogenoacetic acid group was about 13 μg/l. These results seem relatively favorable compared to the US EPA limit 60 μg/l. There was estimated no health risk from such exposure. A theoretical risk of contracting cancer as a consequence of exposure to dichloroacetic acid does not exceed the acceptable value; it amounts to a few cases per million of exposed inhabitants. Nevertheless, it is clear that by maintaining the microbiological safety of drinking water, the content of disinfection byproducts should be minimalized.

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 2007, there were 205 supplied areas (water mains) recorded in the 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 163 areas supplying a population of 53,500).

5.3 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 US EPA exists, an evaluation was conducted of the burden of the population from drinking water intake. In evaluating the exposure, the average daily consumption of 1 litre of drinking water from the public water mains network was taken into account. The extent of the exposure in each supplied area was obtained by means of the mean concentration (median) and of the 90% quantile of the concentrations of the monitored pollutants in the year 2007. The average exposure for all areas was weighted by the number of supplied inhabitants.

Exposure to nitrates clearly predominates in the intake of pollutants from drinking water in the Czech Republic. It amounts to 5.8 % of the exposure limit for larger supplied areas and 6.6 % for smaller ones. For a higher than median estimate of exposure (while using the ninety-percent quantile of concentrations), values of 7.5 % of the exposure limit for larger areas and 8 % for smaller ones were found. An intake of slightly more than 1 % of the relevant exposure limit was found 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. However, it can be stated 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 2002–2007 is shown in Fig. 5.6.

A distribution of inhabitants according to the level of exposure to pollutants from drinking water in 2007 is given in Fig. 5.7. A total of 25 % of inhabitants supplied with drinking water from public water mains draw more than 10 % of the exposure limit for nitrates.

No acute health damage caused by the monitored pollutants was found. As well, no case of infection, intoxication or other health impairment provable connected with drinking water intake from public water mains was recorded in 2007.

5.4 Health risk assessment

To calculate 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 pollutants were selected for evaluation as follows: 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 increased 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 by 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 monitored health-relevant substances, the individual extent of drinking water consumption, the various absorption degrees of the substances, etc.

5.5 Water quality in public and commercial wells

Within the framework of the nationwide monitoring, data from public and commercial wells has been collected in the information system. In 2007, 5,658 samples were taken from 348 public wells and 2,143 commercial ones. About 5 % of samplings did not comply with the water quality standards.

Failures to comply with the limit values for all microbiological indicators of the quality of drinking water were found relatively frequently – *Clostridium perfringens* (3.4 %), enterococci (9 %), *E. coli* (5.3 %), coliform bacteria (16.4 %), the numbers of colonies at 22 °C (10.1 %) and the numbers of colonies at 36 °C (13.6 %). As regards other indicators, the limit values of the following indicators were most frequently not adhered to: pH (18 %), manganese content (15 %), iron (15 %), nitrates (7.3 %), and the recommended water hardness value (80 %).

5.6 Partial conclusions

The data obtained within the framework of the nationwide monitoring of water quality in the years 2002 to 2007 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 characterizing the organoleptic properties of drinking water in 2 % of findings. The failure to comply with the limit values becomes less frequent with the increasing size of water main (number of supplied inhabitants in an area).

Exposure to nitrates clearly predominates in the burden on the population of the Czech Republic from the consumption of drinking water; the average intake represents 6 % of the acceptable daily intake for nitrates. The intake of chloroform exceeded the value of 1 % of the exposure limit in larger supplied areas. No acute health damage by the monitored pollutants or due to microbial contamination was reported.

According to a calculation of the theoretical increase in probability of contracting cancer as a result of chronic exposure to monitored 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 amounting to roughly two additional cases per 10 million inhabitants.

Fig. 5.1 Number of the supplied population and drinking water samplings by size of the supply area, 2007

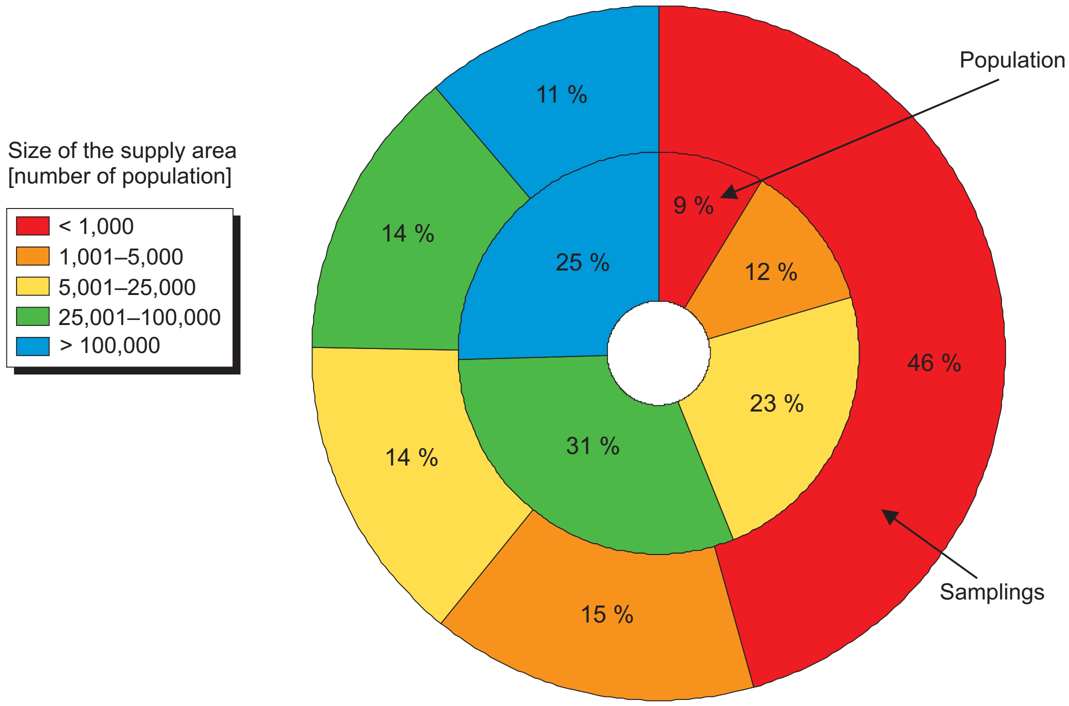


Fig. 5.2a Drinking water quality by size of the supply area – exceedance of the limit values

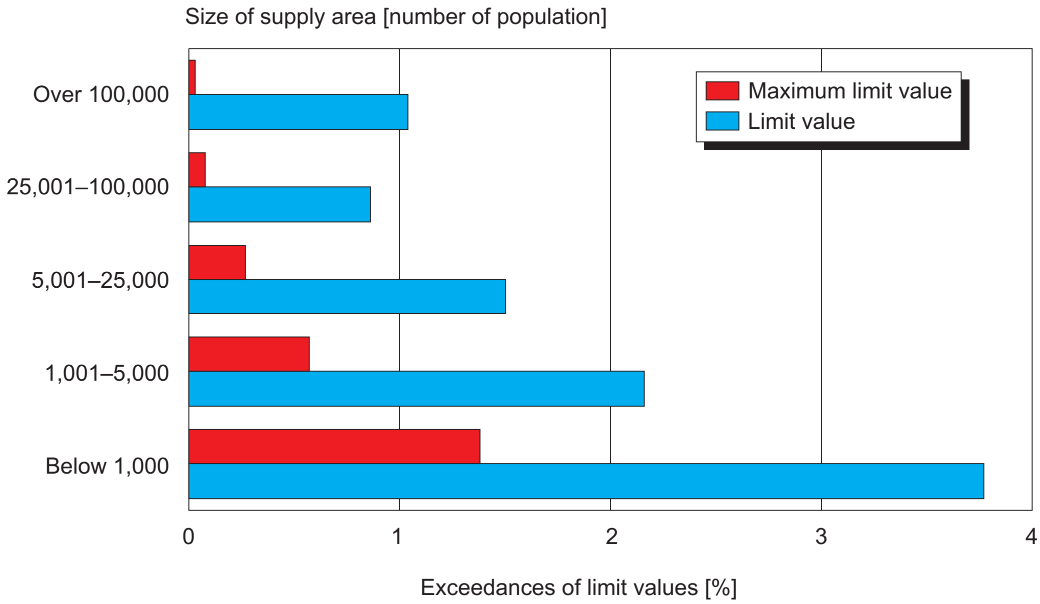
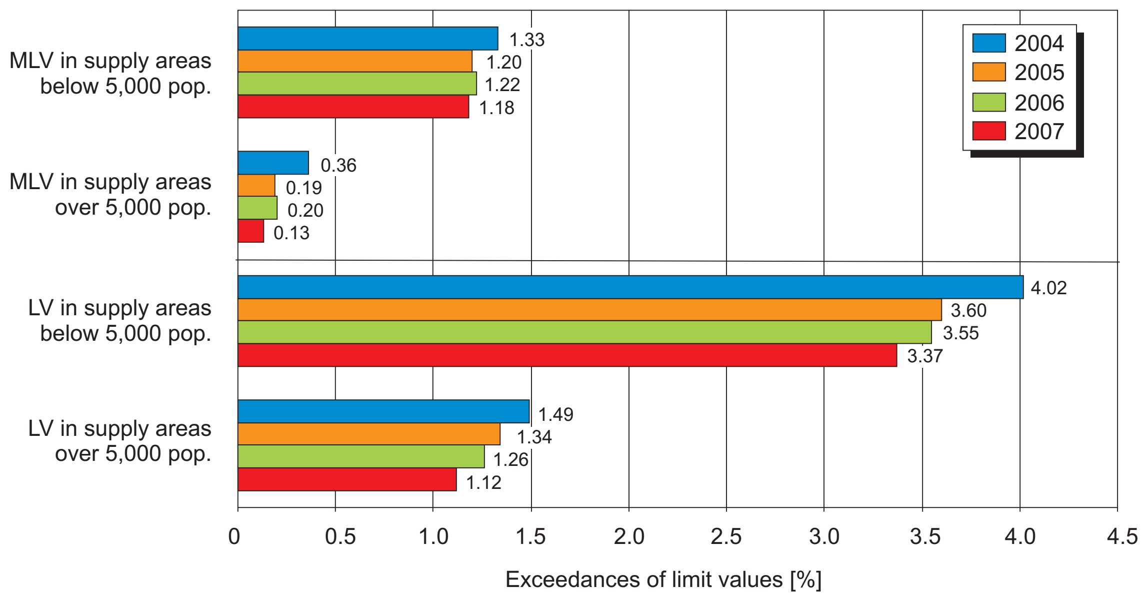


Fig. 5.2b Exceedance of the DW quality limit values, 2004–2007



Note: MLV – maximum limit value (for health relevant indicators)
LV – limit value (for organoleptic property indicators)

Fig. 5.3 Distribution of the population by type of crude water source, 2007

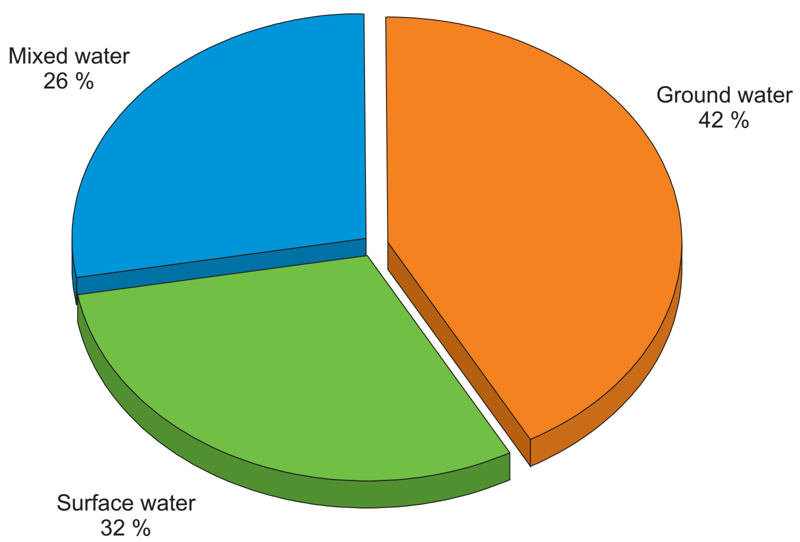


Fig. 5.4a Exceedance of the limit values for microbiological and biological indicators, 2007

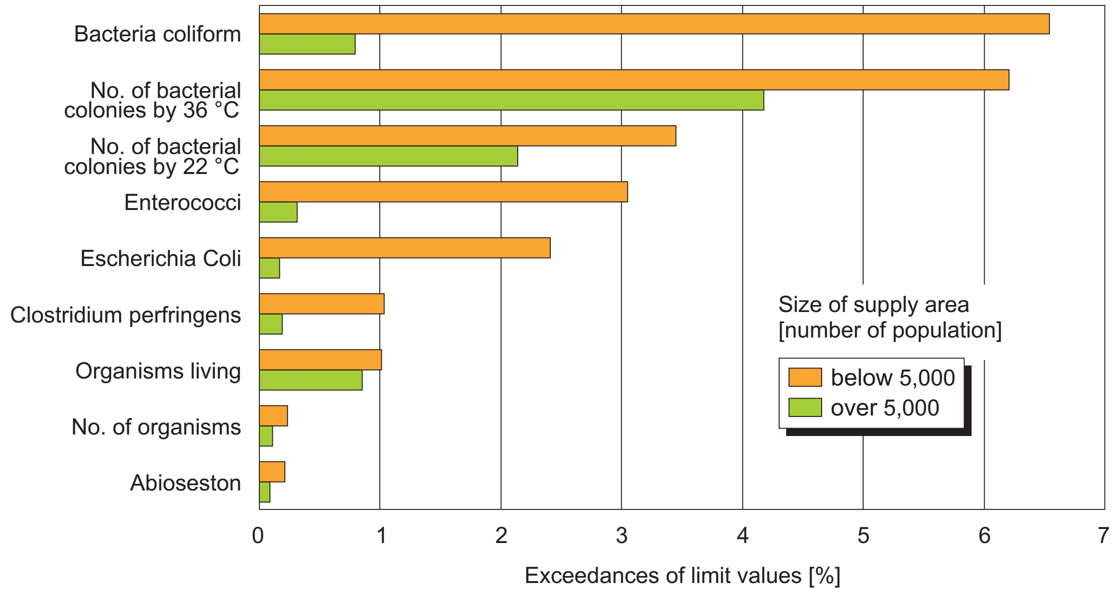
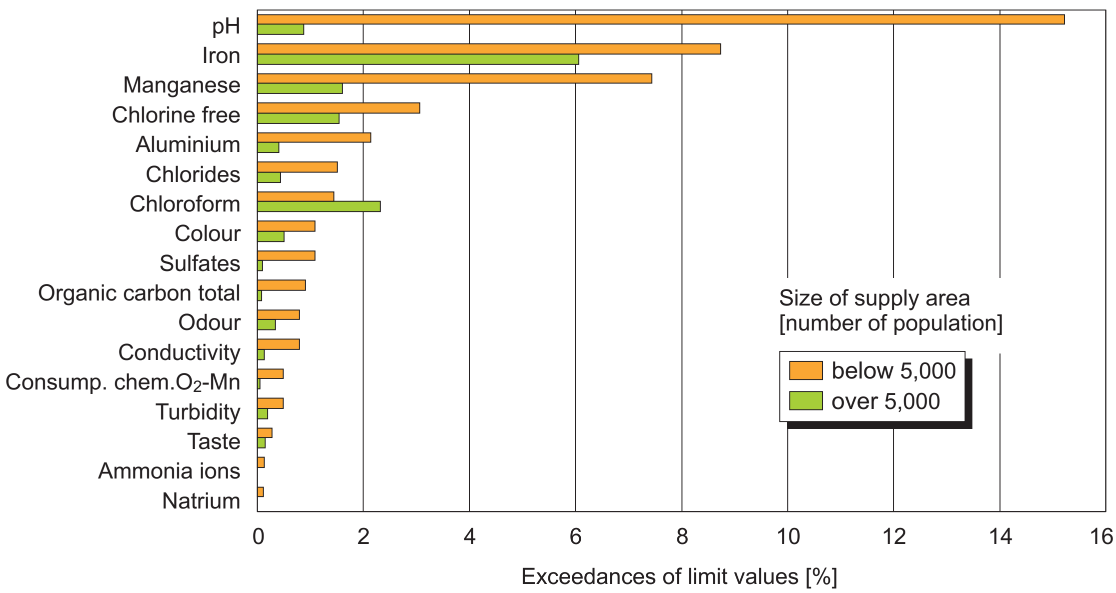
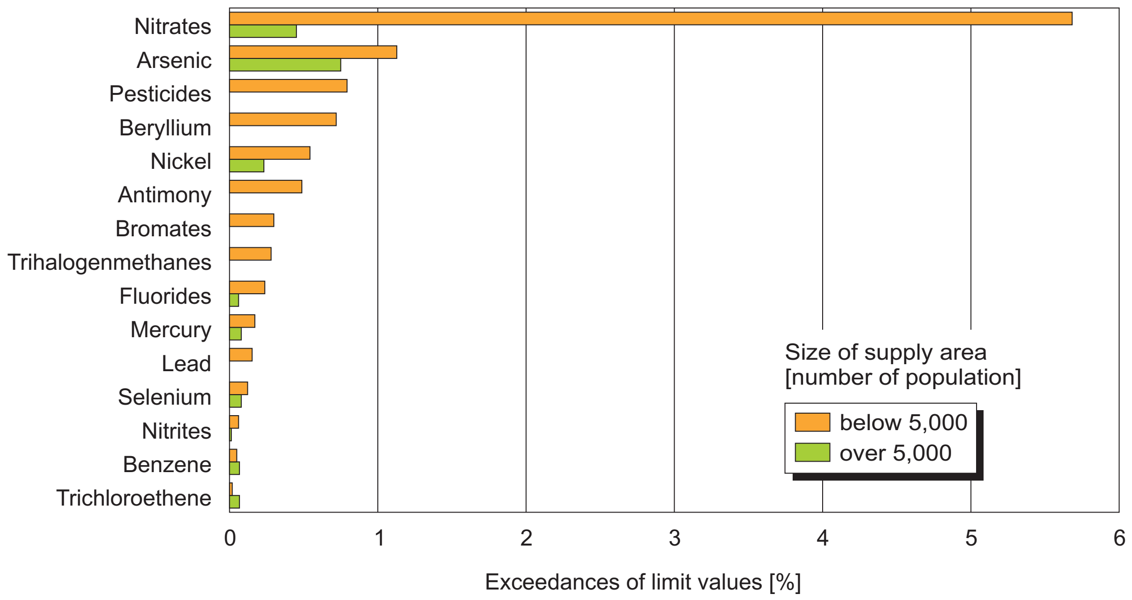


Fig. 5.4b Exceedance of the limit values for chemical and physical indicators, 2007



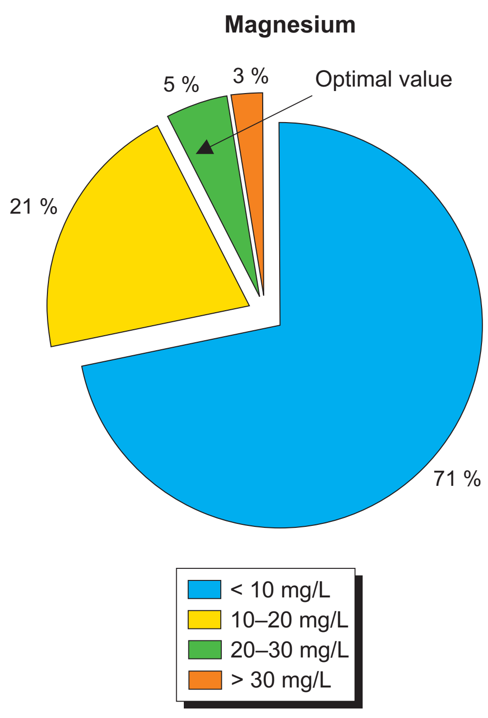
No case of excessive values in both types of supply area: ozone, chlorites.

Fig. 5.4c Exceedance of the limit values for health relevant indicators



No excessive values in both types of supply area: 1,2- dichloroethane, chloroethene, tetrachloroethene, 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.: boron, benzo[a]pyrene, chromium, cadmium, cyanides, PAHs.

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



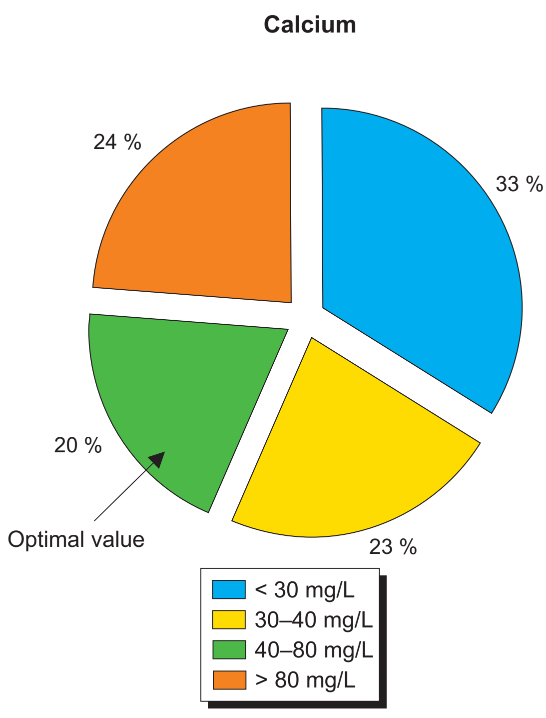


Fig. 5.6 Population exposure to nitrates and chloroform in drinking water, 2002–2007

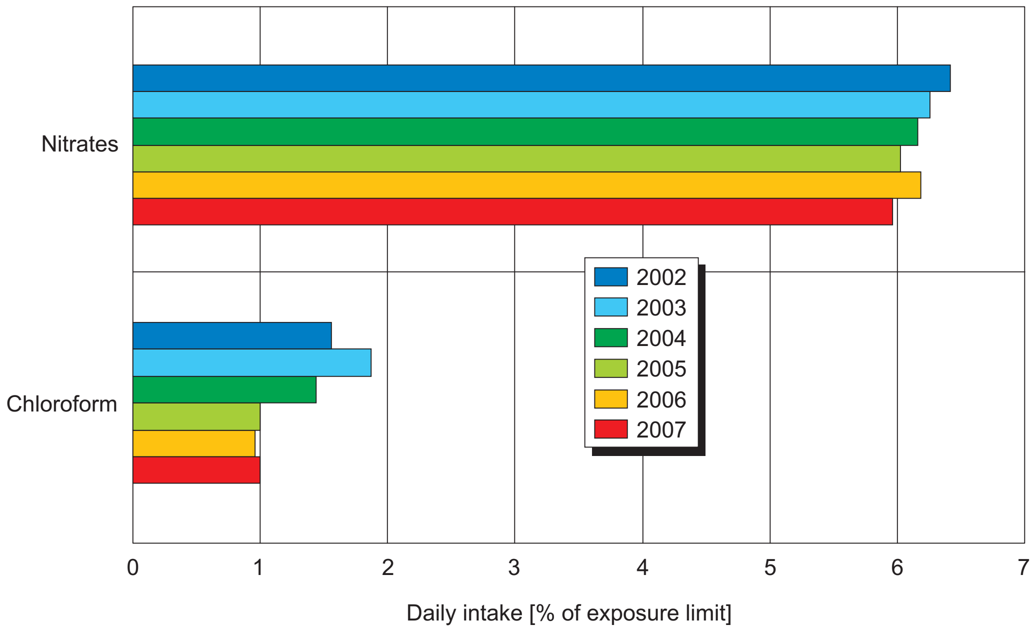
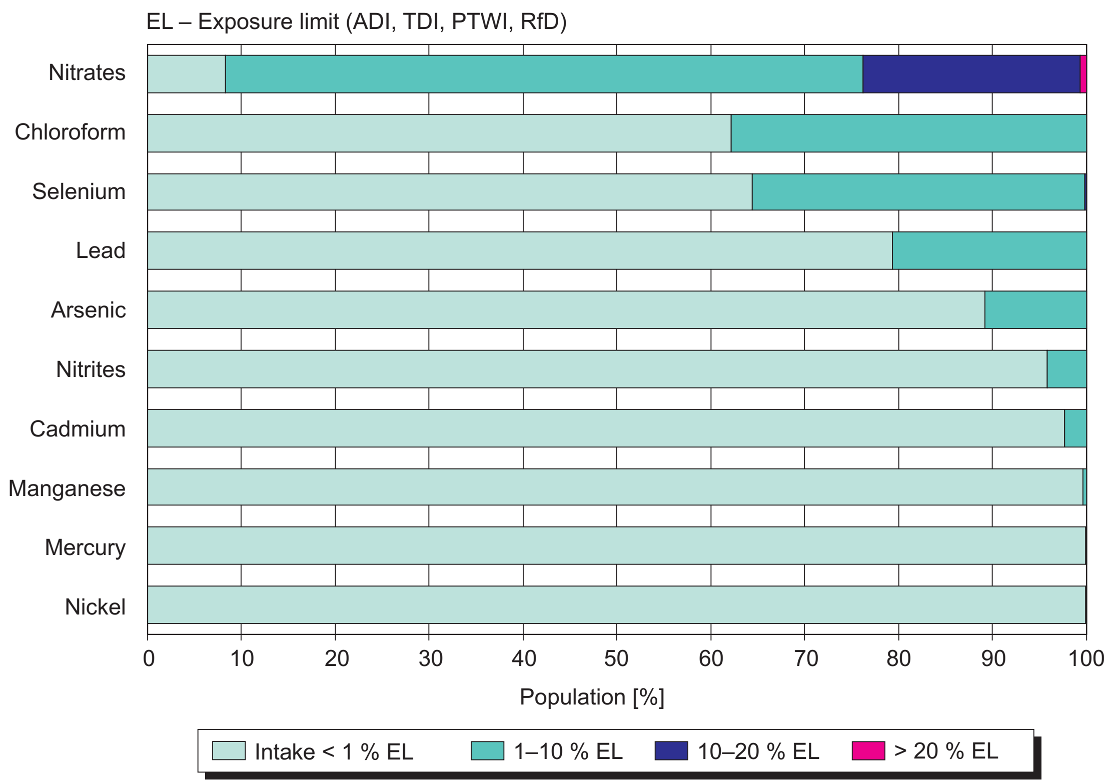


Fig. 5.7 Distribution of the population by the level of exposure to contaminants from drinking water, 2007



Note: Exposure estimate based on ingestion of 1 liter tap water/day.

6. NOISE ANNOYANCE AND HEALTH EFFECTS

6.1 Organization of monitoring

Subsystem III comprise 24-hour monitoring of noise in selected sites and monitoring of population health state and attitudes to noise by way of questionnaire research. Noise monitoring has been carried out annually since 1994–2006 in 19 cities (of this in two locations in Prague).

In 2007, annual measurements were replaced with periodic monitoring with a 2–3 year interval. The number of monitored cities was reduced to 12, with 2 sites in each city (a total of 24 localities). Whilst in 2007 no measurements were performed, the next series is projected for 2009. Previous questionnaire surveys took place in 1995, 1997, 2002 and 2007.

6.2 Method of questionnaire survey

The "Health and Noise" questionnaire survey in 2007 took place in the following cities: Havlíčkův Brod, Hradec Králové, Jablonec nad Nisou, Kladno, Olomouc, Ostrava, Prague 3, Ústí nad Labem, Ústí nad Orlicí and Znojmo. These cities were selected with a view to covering a variety of noise levels and cities with differing population counts. Research in each city was performed in two questionnaire/measurement sites with differing noise levels. The number of participants was determined approximately per 10,000 population (rounded down for complete homes). All inhabitants aged 30–75 years in domiciles belonging to a selected locality were addressed.

The questionnaire surveys were conducted by teams from public health institutes from each city and coordinated by the National Institute of Public Health, Prague. The questionnaires were distributed by post, were filled out in privacy and subsequently collected in person by members of the questionnaire teams. A total of 4,987 questionnaires were collected, with a response-rate of 51 %. Response-rates for individual cities are presented in Tab. 6.2.1. Missing questionnaires were due to either refusal to participate or unavailability of certain respondents.

Tab. 6.2.1 Survey response rates, 2007

City	Response rate [%]	Refusal [%]
Havlíčkův Brod	51	26
Hradec Králové	36	27
Jablonec nad Nisou	51	47
Kladno	49	26
Olomouc	40	40
Ostrava	70	6
Prague 3	43	29
Ústí nad Labem	48	21
Ústí nad Orlicí	56	28
Znojmo	71	18
Total	51	27

Questionnaire surveys took place in two localities in each city, representing varying noise-levels. All of these monitored localities show a smooth progression. All localities were divided into 3 categories: noisy, medium and quiet. Classification of localities into these groups was based on noise-levels measured at measurement sites over the period of the previous year (2006). Classified localities are presented in Tab. 6.2.2.

'Noisy' localities were defined as those in which the day-evening-night descriptor (L_{dvn}) exceeded 70 dB [1]. 'Quiet' localities were defined as those with a day noise descriptor (L_d) under 55 dB. This specific limit is also the public-health limit for noise in a protected outdoor building-site and protected outdoor area (50 dB + 5 dB adjustment for overground traffic noise [2]). This limit value was determined for the purposes of result evaluation and not for registration of limit transgressions. All other localities were classified as 'medium'.

Tab. 6.2.2 Noise levels in the monitored localities in 2006 (in dB)

Monitored localities (city, street)	Noise descriptors	
	L_d (day 6–18 h)	L_{den} (day-evening-night)
Noisy localities		
Olomouc - Foerstrova	72.6	75.9
Hradec Králové - Gočárova	71.8	73.3
Prague 3 - Koněvova	70.6	73.7
Ostrava - 17. Listopadu	69.2	70.8
Havlíčkův Brod - Pražská	68.5	70.7
Medium localities		
Znojmo - Roosveltova	68.4	68.7
Ústí nad Labem - Kosmonautů	65.9	66.8
Kladno - Vodárenská	63.3	63.6
Ústí nad Orlicí - Jilemnického	62.4	64.9
Jablonec nad Nisou - Boženy Němcové	61.4	62.6
Prague 3 - Pod Lipami	59.3	59.4
Olomouc - I. P. Pavlova	57.9	57.9
Hradec Králové - Labská Kotlina	56.1	55.9
Quiet localities		
Ostrava - Havlíčkovo Náměstí	54.3	54.5
Kladno - Vítězslava Nezvala	54.2	56.4
Havlíčkův Brod - Žižkov	53.9	55.9
Znojmo - U Brány	53.5	54.5
Ústí nad Labem - Zvonková	53.1	53.8
Ústí nad Orlicí - Popradská	51.7	53.6
Jablonec - Mšenská	49.3	52.4

All respondents of pertinent age in the measured localities were included in the final evaluation, regardless of the window positions in their domiciles vis-a-vis the source of noise. In cases of annoyance and sleep-disturbance we eliminated persons' resident in a given locality for less than one year or those resident more than 6 months per year (45 persons).

The results gained have undergone preliminary analysis; a detailed evaluation of the relationship between noise-levels and health effects, including noise-annoyance, will be presented in the 2009 report. Basic questionnaire-survey data were processed both as a whole and individually in terms of locality and gender. Category variables are presented as relative values and as arithmetic means in the case of joint-variables. A hypothesis of the percentile association of individual categories was tested by Chi-quadrate test. All tests were conducted at $p = 0.05$ significance level. For joint-variables the above-mentioned hypothesis was adjudged by comparison of 95% confidence intervals.

6.3 Questionnaire survey results

6.3.1 Demographic and socio-economic characteristics

The questionnaire survey paid attention to demographic and socio-economic indicators which have proven association with health and other consequences such as the degree of annoyance and sleep-disruption experienced. Literature sources cite an increased degree of noise annoyance experienced by more educated persons with matching employment and a more marked level of sleep-disturbance in women and the aged [3].

The set monitored in this study was evaluated by gender, age, education and economic activity. The set comprised 42 % women and 58 % men; 43 % of respondents had elementary education or had no trade, 41 % were grammar-school educated and 16 % had high-school education. No difference was detected between inhabitants of noisy, medium or quiet localities in terms of gender and education. Conversely, there was a considerable difference in terms of age and economic activity. The age of respondents in quiet localities is significantly lower (50.7 years) than in the set as a whole (52.5 years). In quiet localities there is a higher ratio of employed respondents (66 %) in comparison with the whole set (62 %). Evaluation of the relationship between these markers and noise-associated annoyance and sleep-disturbance will be the subject of further analyses.

6.3.2 Noise annoyance

Noise annoyance is considered the most frequent effect of noise on the population. Our survey evaluated annoyance of the respondent by all noise during the day, regardless of the source. The results, therefore, cannot be compared to annoyance quoted in literature as [%A] (percentage of persons annoyed) [4] which is specific for road, rail or air-traffic. Noise disturbance from these sources will be the subject of further planned surveys in Subsystem III.

Respondents expressed the degree of annoyance on a six-point scale ranging from ‘not at all’ to ‘very high’. Noise annoyance was registered at the upper end of this scale (the 3 higher points). In the whole set, a total of 48 % of respondents were afflicted by noise; in the noisiest localities it was 80 % of respondents. The degree of noise annoyance in individual localities is presented in Fig. 6.1. The most frequent cause of disturbance was automobile traffic which disturbs 59 % of all respondents on a daily basis. In noisy and medium localities the causes are motorcycles and commercial traffic whilst in quiet localities the secondary and tertiary causes comprise domestic technical sources and noise from neighbours.

6.3.3 Noise sensitivity

The degree of noise disturbance is for each individual dependent, amongst other factors, on individual noise sensitivity. It has been postulated that 10–20 % of the population are highly sensitive to noise, whilst the same proportion is highly tolerant. For the remaining 60–80 % the relationship of noise and annoyance is based on a dose – effect basis [3].

Respondents evaluated subjective sensitivity to noise on a six-point scale. 26 % of respondents regard their noise-sensitivity as low, 44 % as medium and 29 % as high. Women and persons aged over 60 years reported markedly higher sensitivity than men or younger persons. In noisy localities respondents reported markedly higher noise sensitivity than those in localities classified as quiet. The possibility exists that respondents’ confused noise sensitivity with noise annoyance, and in consequence the higher noise sensitivity in noisy localities in fact reflects a higher degree of annoyance.

6.3.4 Noise-associated sleep disturbance

Sleep-disturbance is a significant mechanism of noise-associated effects on the population which have both physiological and psychological consequences. Deterioration of sleep quality manifests in worsened mood, declined efficiency, headache and fatigue [5]. Sleep disturbance may also lead to increased intake of sleeping-pills, and associated side-effects, and may also result in the risk of hypertension.

The gravity of noise-influenced sleep disturbance was expressed by respondents on a six-point scale, with the top three points being considered as manifest sleep disturbance. These comprise sleep disturbance by any noise irrespective of the source, as in the case of noise annoyance. Noise-associated sleep disturbance was reported by 37 % of respondents in total. In the noisiest localities, 66 % of respondents reported sleep disturbance (Fig. 6.1). Awakening from sleep was a more frequent mechanism of sleep disturbance than problems with actually going to sleep. The causes of sleep disturbance were the same as those of noise-based annoyance. The most frequent causes of everyday sleep disturbance are automobile traffic (59 % of all respondents), followed by motorcycles and commercial traffic. The exception was in quiet localities where major causes comprised domestic technical noise and noise from neighbours.

A consequence of noise-associated sleep disturbance is the use of sleeping-pills (Fig. 6.2). A total of 23 % of respondents in the whole set uses such medication and noise is the causative agent of use in almost one third. In the noisiest localities, noise is the reason for use of sleeping-pills in over one half of their consumers, whilst use in quiet localities is primarily attributable to other reasons.

6.4 Partial conclusions

Noise-associated annoyance was revealed in 48 % of respondents, whilst 37 % reported sleep disturbance. In the group living in the noisiest localities (L_{dvn} exceeding 70 dB) 80 % and 66 % of respondents reported annoyance and sleep disturbance, respectively. On the contrary, in quiet localities (L_d under 55 dB) annoyance was reported by only 20 % of respondents and sleep disturbance by 15 %. The most frequent cause of annoyance and sleep disturbance is traffic noise. A result of sleep disturbance is increased use of sleep medication in noisy localities.

Literature:

1. *Decree on noise mapping, 523/2006 Coll., pp 7131–7138.*
2. *Resolution of the Government on health protection against adverse effects of noise and vibrations, 148/2006 Coll., pp 1842–1854.*
3. *Havránek J. et al.: Noise and Health, Avicenum 1990.*
4. *Position paper on dose response relationships between transportation noise and annoyance, European Commission working group, 2002.*
5. *Kubina J., Havel J.: Authorization guide for health risk assessment from noise exposure, NIPH 2006.*

Fig. 6.1 Noise annoyance and sleep disturbance by noise levels in the monitored localities

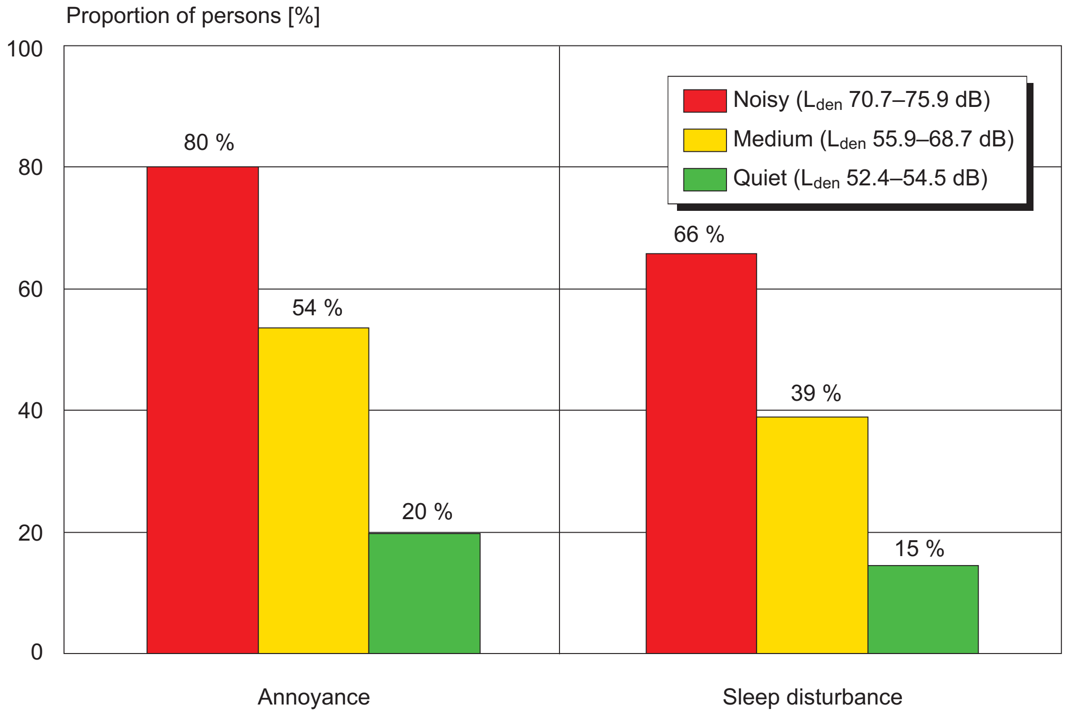
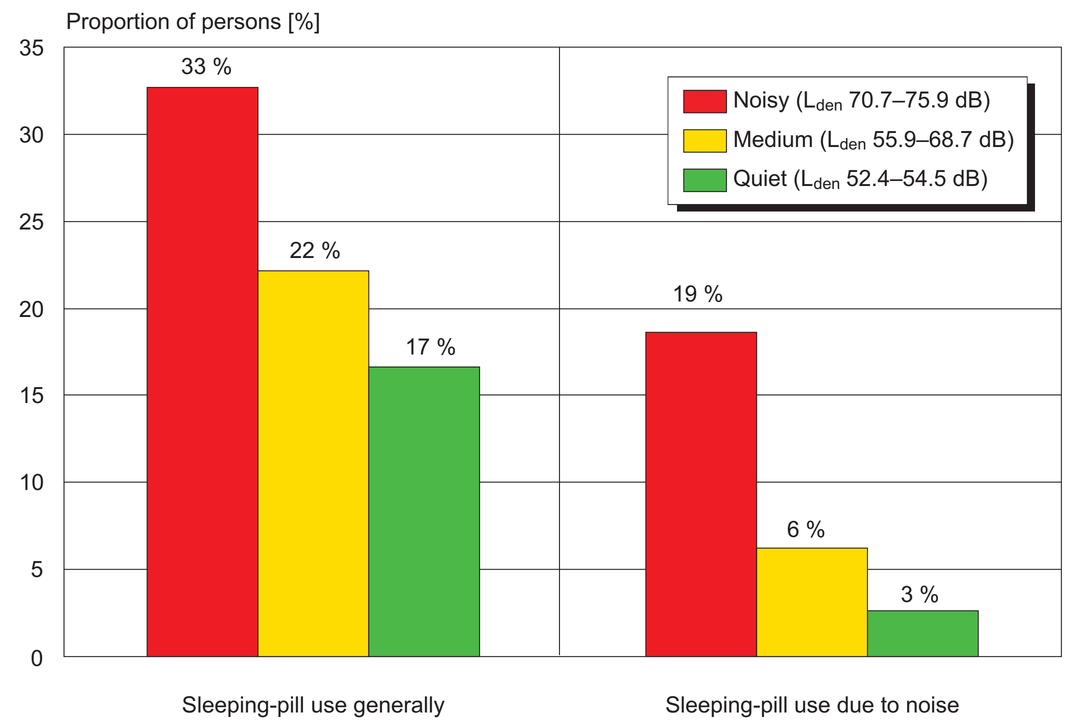


Fig. 6.2 Use of sleep medication by noise levels in the monitored localities
(share of persons using sleeping-pills regularly or occasionally)



7. HEALTH EFFECTS OF LOAD CAUSED BY CHEMICALS IN THE FOOD CHAIN, DIETARY EXPOSURE

7.1 Organization of monitoring

Since the monitoring period 2004/2005, Subsystem IV has comprised four parts:

- Monitoring the incidence of selected pathogenic bacteria in food samples. Bacterial strains isolated from foodstuffs are subjected to further qualitative study, including determination of bacterial resistance.
- Monitoring the incidence of toxinogenic micromycetes in food samples. Isolates are identified by strain and species and their toxinogenic properties are studied (particularly in terms of aflatoxin and ochratoxin production).
- Monitoring the incidence of genetically modified (GM) foods on the Czech market. This section was included mainly in response to public demand and requests for data by the EU and other international organizations, and not because any health risks were expected.
- Monitoring population dietary exposure by selected chemical substances. Food samples are centralized in one location in the Czech Republic where they undergo standard culinary treatment and subsequent analysis for chemical content. Results aid the estimation of exposure doses and characterization of health risk associated with population dietary habits in the CZ. The sampling system is representative of actual Czech population diet (selected food types represent over 95 % of the dietary bulk) and is representative nationwide by number of samples.

The subsystem is performed in 12 locations nationwide (Tab. 3.1, Fig. 3.1). The number of sites was chosen to provide equal representation of individual regions at the start of the monitoring programme in 1993.

This chapter includes a list of food-borne infections and poisoning reported in 2007, and their development over recent years, as compiled by the Centre of Epidemiology and Microbiology, NIPH.

7.2 Alimentary diseases in the CZ

In 2007, public health authorities in the CZ recorded around 55,000 cases of suspected alimentary disease. The etiological spectrum of these diseases was notably wide and included bacterial infections, poisoning, viral and parasitic infections (Tab. 7.2.1).

Highest reported morbidity was again associated with **salmonellosis** and **campylobacteriosis**. Of these, dominant serotypes were *Salmonella* Enteritidis and *Campylobacter jejuni.* The decline in cases of salmonella is continuing, but the hinted decrease of campylobacteriosis cases last year, otherwise part of a long-term rising trend, has stopped (Fig. 7.1a). Over 99 % cases of campylobacteriosis were sporadic or familial. Both diseases were reported to the EU Enter-Net. Seasonal and age distribution showed no significant changes. These bacteria have an apparent seasonal incidence in summer with confirmed dependence on outside air temperature, in contrast to viral infections which are clearly associated with winter and personal contact.

The CZ is witness to an exponential increase in the incidence of viral intestinal infections (enteritis, Fig. 7.1b), largely caused by rotaviruses and viruses from the Caliciviridae family. The routine reporting system does not, on its own, enable differentiation of causative factors for this. It appears, however, that (no)examination = (no)results. Particularly by international comparisons it is necessary to consider quality of surveillance systems. **Viral hepatitis A** has remained at very low levels, as has **shigellosis** (Fig. 7.1b). It is necessary to take these diseases into account as the risk of imported diseases and amongst ethnic minorities. The previously rare **hepatitis E** has become domesticate in our territories. There should be expected isolated cases of hemolytic-uremia syndrome in some cases of ***E. coli*** infection, particularly the toxin-producing *E. coli* strain O 157. However, an epidemic has not been detected so far. A slight increase occurred in the incidence of **yersiniosis**, a common disease in the CZ. The European Food Safety Authority (EFSA) has in its annual report in 2005 quoted this disease as the third most frequent bacterial infection (zoonosis) in EU member states. The increased incidence of yersiniosis has been observed in other EU member states. In the CZ the dominant agent is *Y. enterocolitica.*

Tab. 7.2.1 Selected reported alimentary diseases in 1997–2007 (number of cases per 100,000 inhabitants)

ICD	Diagnosis	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
A02	Salmonellosis	387.4	493.7	436.1	391.7	326.6	274.1	263.7	301.2	321.7	244.9	177.3
A04.5	Campylobacteriosis	35.2	53.8	95.7	164.7	210.5	227.5	196.7	249.9	295.8	221.6	236.3
A03	Shigellosis	6.0	5.0	5.1	5.3	3.4	2.8	3.7	3.2	2.7	2.8	3.4
B15	Viral hepatitis A	11.6	8.8	9.1	6.0	3.2	1.2	1.1	0.7	3.2	1.3	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	18.1
A05	Alimentary intoxication	3.2	4.8	5.1	10.6	6.7	2.6	0.6	1.9	0.4	0.5	0.7
A04.6	Yersiniosis	1.5	1.5	2.1	2.2	2.9	4.0	3.6	4.9	4.9	5.2	5.6
A08	Viral intestinal infections	4.6	8.9	7.9	11.7	11.3	23.3	20.6	35.2	35.9	54.6	58.8
A32	Listeriosis	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.8	0.5

7.3 Bacteriological analysis of foods

In the study aimed at bacteriological analysis of foods we monitored the incidence of selected pathogens in marketed foodstuffs. Selection of examined commodities was based on the consumer basket and targeted, as in previous years, at those food groups which had in the past played a role in alimentary diseases both in the CZ and abroad.

Attention was focused on determination of four etiological agents involved in significant alimentary diseases: *Salmonella* spp., *Campylobacter* spp., *Listeria monocytogenes* and *S. aureus.* Apart from salmonella, these agents are monitored only rarely as part of regular controls of foodstuff integrity. Therefore, data pertaining to incidence in various commodities and detailed phenotype and genotype characteristics are unavailable.

Examined food samples were subjected to detection only, whilst in foods intended for direct consumption that were positive for pathogens we also conducted microorganism counts. Microbiological analysis was conducted in line with international EN ISO norms.

Suspect colonies of monitored agents were confirmed. For salmonella and *Listeria monocytogenes* their serotypes were determined. For S. Enteritidis (SE) and S. Typhimurium (STM) we conducted phage typing. For salmonella, campylobacter and *S. aureus* resistance to antimicrobials was monitored by diffuse disk method. In *S. aureus* we tested the ability to produce staphylococcal enterotoxins A – E (SEA – SEE) and in *S. aureus* isolates we also monitored the presence of genes for coding staphylococcal enterotoxins A – J (*sea – sej).*

For presence of **salmonella**, 600 samples of various foods were examined, comprising both commodities intended for further culinary processing and those for direct consumption. A total of 4 samples were identified (0.7 %) as positive for salmonella: three from chicken and one from rabbit. The three isolates from chicken were identified as S. Enteritidis, phage types PT6, PT8 and PT13a. These strains were sensitive to all 17 tested antimicrobials. The rabbit meat isolate was identified as S. Typhimurium serotype, phage type DT104, resistant to 7 antimicrobials (ampicillin, chloramphenicol, streptomycin, sulphonamides, tetracycline, nalidixic acid, amoxicillin with Clavulin).

Determination of **thermoresistant campylobacteria** was conducted in raw meat, frozen vegetable and fresh fruit. A total of 156 foods were tested, of which 21 (13.5 %) were positive. These were: 9 samples of poultry, 11 samples of poultry offal and 1 sample of frozen spinach. The most frequent agent was *C. jejuni* (72 %), *C. coli* (14 %) and both *C. jejuni* and *C. coli* together (14 %). In campylobacters, resistance to 8 antimicrobials was detected (tetracycline, erythromycin, ampicillin, Clavulin, gentamycin, chloramphenicol, ciprofloxacin and cephotaxim). Resistance to chinolons and fluoridated chinolons was detected in meat products (58 %), whilst the *C. jejuni* isolate from spinach was multi-resistant (erythromycin, ampicillin, gentamycin, chloramphenicol and cephotaxim).

A total of 576 food samples were examined for presence of ***Listeria monocytogenes***, yielding 27 (4.7 %) isolates. The presence of this pathogen in foods intended for direct consumption was confirmed in meat products (5 cases) and blue cheese (3 cases). These foods were subjected to quantitative examination; none of the tested samples exceeded the acceptable limit of $1.0.10^2$ CFU/g. The most frequent serotypes of isolated *L. monocytogenes* were serotypes 1/2a (85 %) and 1/2b and 1/2c (both 7 %).

Presence of ***Staphylococcus aureus*** was monitored in a total of 504 food samples, and confirmed in 67 (13 %). Quantitative examination was performed in foods intended for direct consumption. In two samples of soft salami the count reached about 10^2 CFU/g; one sample of heat-processed hard salami yielded a count of $5.6.10^3$ CFU/g. In 51 (76 %) of *S. aureus* isolates, the presence of genes for coding staphylococcus enterotoxins was detected. The most frequent genes were *seg* and *sei* (27 isolates), followed by *seh* (15 isolates) and *sea* (14 isolates).

7.4 Mycological analysis of foods

This part of the subsystem continued in monitoring the incidence of toxinogenic fibrous microscopic fungi, producers of aflatoxin and ochratoxin A, in selected foods. Specialized mycological examination was also aimed at closer mycological monitoring of *Aspergillus* of the *Nigri* group, producers of ochratoxin A. A total of 16 types of commodity were collected on 4 occasions from 12 sites in the CZ, yielding 192 food samples.

Frequency data on qualitative and quantitative incidence of toxinogenic fungi, producers of aflatoxin and ochratoxin A in foods in the CZ were obtained. For selected food, the total count of fungi (CFU/g in food) was determined along with mycological profiles. The incidence of fungi was further characterized by a contamination index ($\mathbf{I}_K$) – the ratio of potentially toxinogenic fungi (CFU/g of food) to the total count of fungi present (CFU/g of food).

The presence of potentially toxinogenic *Aspergillus flavus*, producer of aflatoxin, was detected in 2 samples (17 %) of black tea and 1 sample (8 %) of infant cereal porridge. The presence of potentially toxinogenic *Aspergillus tamarii,* producer of aflatoxin, was detected in 3 samples (25 %) of black tea. Aflatoxin B_1 was not detected in the samples analyzed in this period.

Potentially toxinogenic *Aspergillus* group *Nigri*, producers of ochratoxin A, were detected in 11 samples (92 %) of black tea, 8 samples (67 %) of fruit tea, 1 sample (8 %) of flour, 1 sample (8 %) of infant wheat porridge and 12 samples (100 %) of raisins. On the basis of these findings ochratoxin A was detected in all those samples; 8 samples (67 %) of raisins was positive (arithmetic mean 3.3 µg/kg, maximum value 6.5 µg/kg).

7.5 Incidence of GM foods on the market

The year 2007 was the sixth year of the GM food monitoring. Monitoring of selected foodstuffs from the food distribution network continued, with the aim of identifying foods manufactured using genetically modified organisms (GMO). As in previous years, a total of 192 samples of foods (rice: 48, soya beans: 48, soya products: 48 and cornflour: 48) was taken in 12 locations and on four occasions. Methods for detection of GMO comprised polymerase chain reaction screening (PCR), immunochemical methodology (ELISA) and quantitative PCR in real-time (RT-PCR).

Results are presented in Tab. 7.5.1, showing overall numbers of positive results and ratio of foods with GM raw material content equal to or in excess of 0.9 %.

Tab. 7.5.1 Samples examined in 2007

Matrix	No. of samples	Positive findings (%)	Negative findings
Rice	48	1 (2.1)	47
Soya beans	48	2 (4.2)	46
Soya products	48	2 (4.2)	46
Cornflour	48	3 (6.3)	45
Total	192	8 (4.2)	184

In total, RT-PCR revealed 2 positive samples of soya beans and of soya products. The amount detected in Roundup Ready soya (RRS) beans and products was under 0.9 % in all cases. Cornflour samples were positive in 3 cases. PCR was positive for StarLink cornflour (1 case) and Bt176 (2 cases). In the case of Bt176 the amount was under 0.9 %. Results of quantitative determination by RT-PCR in 2007 are presented in Tab. 7.5.2.

Tab. 7.5.2 Quantitative determination for RRS and Bt176 in 2007

Matrix	Positive findings	
	under 0.9 %	over 0.9 %
Soya beans	2	0
Soya products	2	0
Cornflour (Bt176)	2	0
Total	6	0

According to EU legislation nos. 1829/2003 and 1830/2003 all foods in excess of 0.9 % GMO must be marked as such. A content of under 0.9 % is regarded as accidental or technically unavoidable. Foods manufactured from Roundup Ready soya and transgenic corn Bt176 are approved for sale in the EU. StarLink corn is not permitted for use as food. Aside from the planned scope of the project, the extent of infiltration by proscribed GM rice Bt63 was recorded. PCR uncovered the incidence of this rice in one case.

7.6 Human dietary exposure

The aim of this long-term monitoring programme is estimation of mean population exposure to selected chemicals (significant contaminants, nutrients, micro-nutrients) in the Czech Republic. The acquired data currently assist probability assessment of chronic exposure doses. This assessment is carried out in 4–6 year intervals in order to acquire sufficient numbers of results. The chemical content in foods may represent risk of oncological or other diseases or, in the case of nutrients and micronutrients, risk of insufficient intake.

Two values were employed during the 2006/2007 monitoring period for estimation of exposure doses: ‘actual consumption value’, acquired from the national epidemiological study of individual food consumption (SISP04 – provides values of mean food intake per capita in CZ during 2003/2004) and a model of recommended doses of foodstuffs (so-called food pyramid).

7.6.1 Selection of samples for analysis

The set of samples provided for chemical analysis comprised 205 individual types of food, collected from 4 regions (12 locations nationwide, region A = Plzeň-city, České Budějovice, Benešov – region B = Ústí nad Labem, Jablonec nad Nisou, Prague – region C = Hradec Králové, Šumperk, Ostrava – region D = Žďár nad Sázavou, Brno, Znojmo). The total amount of samples collected (some types of food are collected repeatedly under different trademarks) was 3,696 nationwide over a period of two years. Samples representing each region were prepared for consumption by standard methods and divided into 143 composite samples for each of the four regions, some repeatedly, so that the total count per region was 220 composite samples. For analysis of chemical content, a total of 880 nationwide samples were provided over the monitored period. For determination of certain chemical substances, composite samples from individual regions were mixed to provide a set of 143 mixed composite samples representative on nationwide level. Certain specific analyses (toxic PCB congeners, dibenzofurans and dioxins, nitrites, nitrates, etc.) require differentiated selection or combination of food samples.

A total of 151 chemical substances were quantified in the food samples. Detected concentrations of chemicals were used to estimate mean population exposure during 2006/2007. For long-term comparison of exposure (since 1994) a model of recommended food doses for the Czech Republic was used. This model is set for five different population groups (children, women, men, pregnant/ lactating women, the elderly) and provides standardization of results, enabling long-term monitoring of trends in chemical concentrations in foods – independent of changing consumption patterns.

7.6.2 Organic substances

The mean chronic population exposure dose to organic substances categorized as persistent organic pollutants and proscribed by the Stockholm Convention (polychlorinated biphenyls, aldrin, dieldrin, methoxychlor, endosulfan, heptachlor epoxide, hexachlor-benzene (HCB), alpha-, beta-, delta-, gamma- (lindane) hexachlorocyclohexane isomers, isomers of DDT, DDD, DDE, alpha-, gamma-, oxy- chlordane, mirex) did not reach levels associated with significant increase of the probability of non-carcinogenic health damage to consumers in the 2006/2007 period. The extent of exposure estimated according to actual food consumption (SISP04) was highest for PCBs. Exposure to the sum of seven PCB indicator congeners reached a mean level of about 3 % of the tolerable daily intake (TDI). This value is practically equivalent to the exposure values detected in the 2004/2005 period, but is lower than determined in previous years (prior to 2003). The difference is mainly caused by use of laboratory methods with lower determination limits which has in turn decreased the uncertainty of single exposure evaluation. The greatest amount of positive analytical results was observed for PCB congeners 138, 153 and 180 (66 %, 60 % and 66 %, respectively).

A high number of positives has traditionally been detected for the DDT metabolite – p,p´DDE (75 %). Greater amounts of positives were likewise detected for o,p´DDE, p,p´DDT and hexachlorobenzene (65 %, 52 % and 49 %, respectively). Fluctuations in numbers of positives in over the years are associated with low measured concentrations and resultant low exposure doses (for instance, 0.1 % PTDI for the sum of DDT and 1.5 % of the TDI for hexachlorobenzene). The results confirm continuing overall contamination by these persistent organic pollutants at very low concentrations with no serious consequences for consumer health.

Estimates of exposure to substances with so-called dioxin effect (the toxic equivalent of 2,3,7,8, tetra-chlorodibenzodioxin [TEQ 2,3,7,8-TCDD] for the sum of 29 toxic PCB congeners, dioxins and dibenzofurans) were about 4.2–5.3 pg WHO TEQ TCDD/kg b.w./week during 2006/2007. This is equivalent to 30–38 % of the tolerable limit TWI (EU). This relatively encouraging result should be taken with reserve due to the very small number of analyses (4 in each sampling period). Results are determined for the average person; for children it will be necessary to consider higher exposure dose values. PCBs contributed to so-called dioxin toxicity from 70–76 %, dibenzofurans 24–30 % and dioxins 0–1 %. The highest intakes were attributable to fish, fish products and butter (approx. 2/3 of the TWI).

Exposure doses estimated from models of recommended food doses reaches its highest levels among 4–6 year old children. Exposure to the sum of seven PCB indicator congeners was 10.2 % in children (Fig. 7.2a). Recorded exposure to PCBs is lower than in the past. One of the explanations is the use of laboratory methodology with lower limits of quantification (calculation of results smaller than the limit of quantification as 1/2 LoQ – decrease of determination uncertainty). More accurate evaluation may be provided by probability evaluation of exposure dose, although this would require more collected data.

In the 2006/2007 period, acrylamide was monitored in various food commodities and 22 selected composite samples. The estimate of acrylamide exposure dose was 0.29 µg/kg b.w./day.

7.6.3 Inorganic substances

The mean chronic population exposure dose of inorganic substances (nitrates, nitrites, cadmium, lead, mercury, arsenic, copper, zinc, manganese, selenium, magnesium, chromium, nickel, aluminium, iron, iodine) as based on actual food consumption (SISP04) did not exceed exposure limits for non-carcinogenic effects. Exposure to nitrates was 19 % of ADI and that for nitrites 14 %. Mean manganese intake was 40 % of the RfD. Cadmium load was slightly elevated to 17 % of PTWI. Lead load was slightly decreased at 5.0 % of PTWI. Total mercury load was a favourable 1.7 % of PTWI. Copper and zinc intake is, toxicologically speaking, continuously low (2.8 % PMTDI and 14 % PMTDI). Estimated exposure to ‘toxic arsenic’ (inorganic compounds) reached 4.0 % of PTWI. Selenium remained the same as in the previous period at 14 % RfD. Estimated nickel and chromium exposure is at fairly low levels with slight fluctuation (7 % and 16 % RfD). Estimated aluminium and iron exposure did not present a consumer health risk (3.4 % PTWI and 15 % PMTDI). During the 2006/2007 period, total tin was determined in 8 types of food (canned meat, pate, fish, sterilized vegetables, vegetable purees, fruit compotes, jam, marmalade and fruit-based infant foods) and detection of molybdenum was newly incepted. Tin exposure from selected foods reached 14 µg/kg b.w./day – or 0.7 % of PTWI. Estimated molybdenum exposure was 1.9 µg/kg b.w./day (38 % RfD).

Exposure doses estimated using models of recommended doses in food again reached highest values among 4–6 year old children. Estimated nitrate exposure was about 88 % of ADI (including intake from vegetables). Estimated exposure to total manganese was 156 % of the RfD (Fig. 7.2b). This result is difficult to interpret in terms of health effects since the chemical form of manganese is not defined.

Tab. 7.6.3.1 Estimation of exposure to chemicals in food (based on individual food consumption study), 2006/2007

	% of exposure limit	Type of exposure limit		% of exposure limit	Type of exposure limit
Arsenic (inorganic)	4.0	PTWI	Nickel	9.0	RfD
Tin total	0.7	PTWI	Aluminium	3.4	PTWI
Nitrates	19.0	ADI	Manganese	40.0	RfD
Nitrites	14.0	ADI	PCBs*	3.0	TDI
Cadmium	17.0	PTWI	DDT	0.1	PTDI
Lead	5.0	PTWI	Hexachlorobenzene	1.5	TDI
Mercury	1.7	PTWI	Dioxin-like compounds (TEQ 2,3,7,8 TCDD)	30–38	TWI

** Sum of 7 indicator PCB congeners*

7.6.4 Microelements

Overall evaluation of the intake of certain mineral substances (zinc, copper, selenium, chrome, nickel, manganese, molybdenum, calcium, sodium, kalium, iron) based on SISP04 revealed values of around 97 % of the population normative limit for zinc and under the population normative limit (67 %) for copper. The normative minimum was covered in the case of selenium at 120 %. Estimated recommended chromium intake was at 87 %, nickel at 241 %, molybdenum at 272 % and manganese at 113 %. The demand for magnesium was covered at 83 %, calcium at 86 % and phosphorous at 164 %. The upper limit for sodium intake was at 58 % and kalium requirements at 75 %. Iron intake reached only 55 % of the recommended population intake. Although iodine-enriched salt was not used during culinary preparation of samples, iodine requirements were surpassed at 120 %.

Estimated intake of trace elements based on models of recommended food doses is at lowest levels amongst persons aged 60 years or more. Food consumption in this age category does not supply recommended intake of certain minerals.

Tab. 7.6.4.1 Estimation of exposure to macro- and microelements in food (based on individual food consumption study), 2006/2007

	% of recommended intake [%]		% of recommended intake [%]
Kalium	75	Molybdenum	272
Phosphorus	164	Nickel	241
Magnesium	83	Selenium	120**
Chromium	87	Natrium	58*
Iodine	120	Calcium	86
Manganese	113	Zinc	97**
Copper	67**	Iron	55

** % of the upper intake limit*

*** % of normative minimum*

7.7 Partial conclusions

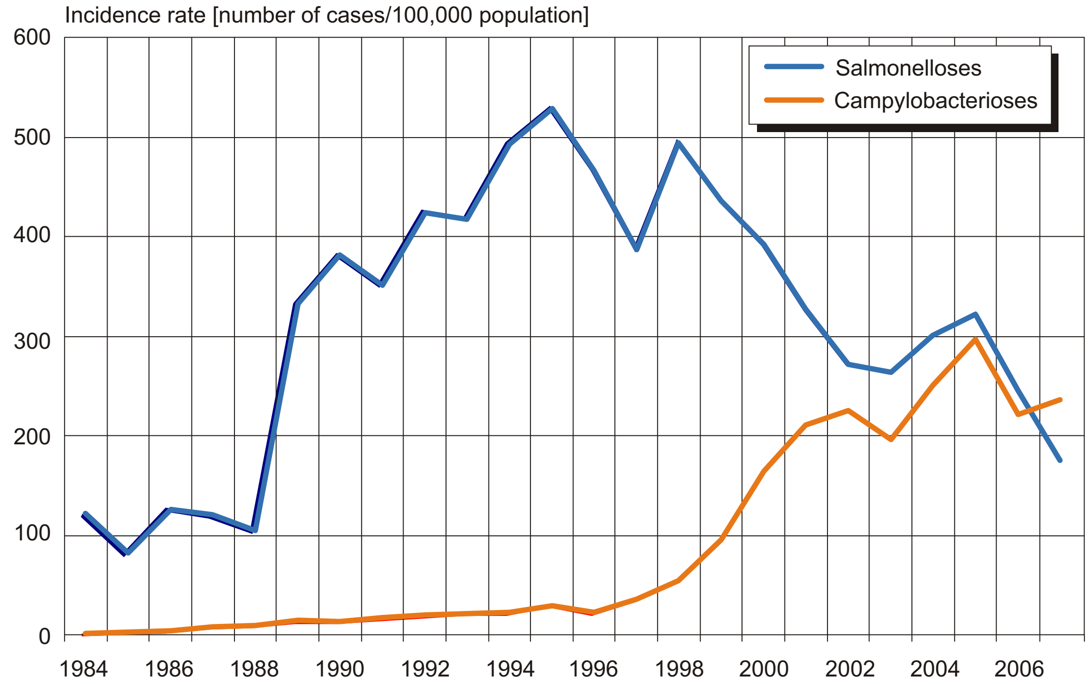
Microbiological analyses reveal the incidence of pathogens in selected marketed foods and assist in clarifying the possible vectors and routes of alimentary diseases in the commercial food network. Genetic characteristics of *L. monocytogenes* and *S. aureus* isolates lead us to the conclusion that certain outlets do not adhere to correct hygiene practice on staffed meat and delicatessen counters. This hypothesis is confirmed by detection of bacterial clones contaminating products from different manufacturers.

The results of monitoring toxinogenic micromycetes in foods have confirmed the possibility of incidence of dangerous mycotoxins (aflatoxins, ochratoxins) in certain types of foods. These results follow the trend of recent years.

Results of analyses for presence of GMO and their products show that the food market in the Czech Republic contains foods manufactured from Roundup Ready soya (40-3-2) and Bt176 corn which have been authorized for use on the Czech market. Recently, foods containing unauthorized GMO have also been detected (StarLink corn). In 2007, there were no new scientific publications dealing on the subject of health risks associated with use of GM foods.

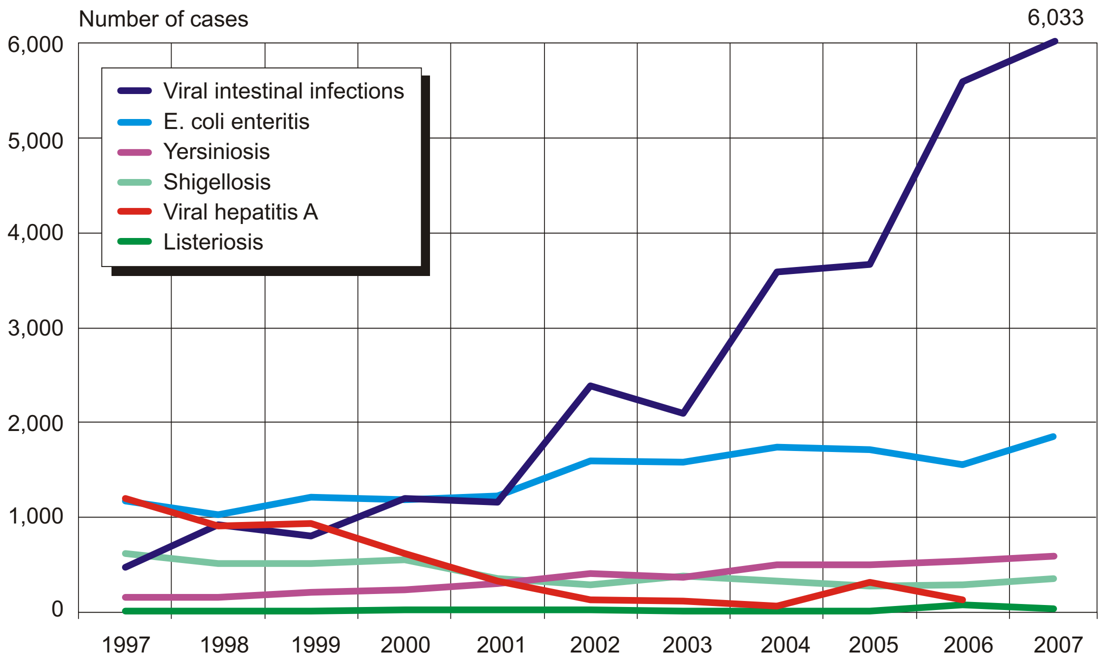
Results of monitoring exposure to certain dangerous chemical substances in foods in the Czech Republic have revealed slight fluctuation of exposure doses associated with concentration changes. Health risk characterization based on assessment rating is traditionally favourable for the average individual in the population. For a number of pollutants the exposure values are decreasing or remaining at low levels. Assessment based on models of recommended doses of foods, which take into account varying consumption by different population groups, confirms higher risk for children (greater exposure to pollutants or substances in fortified foods) and the aged (inadequate intake of certain minerals). More accurate assessment may be yielded by probability modeling of exposure doses, due to be performed following the third series of measurements in the 2008/2009 period.

Fig. 7.1a Incidence rate of salmonelloses and campylobacterioses in 1984–2007



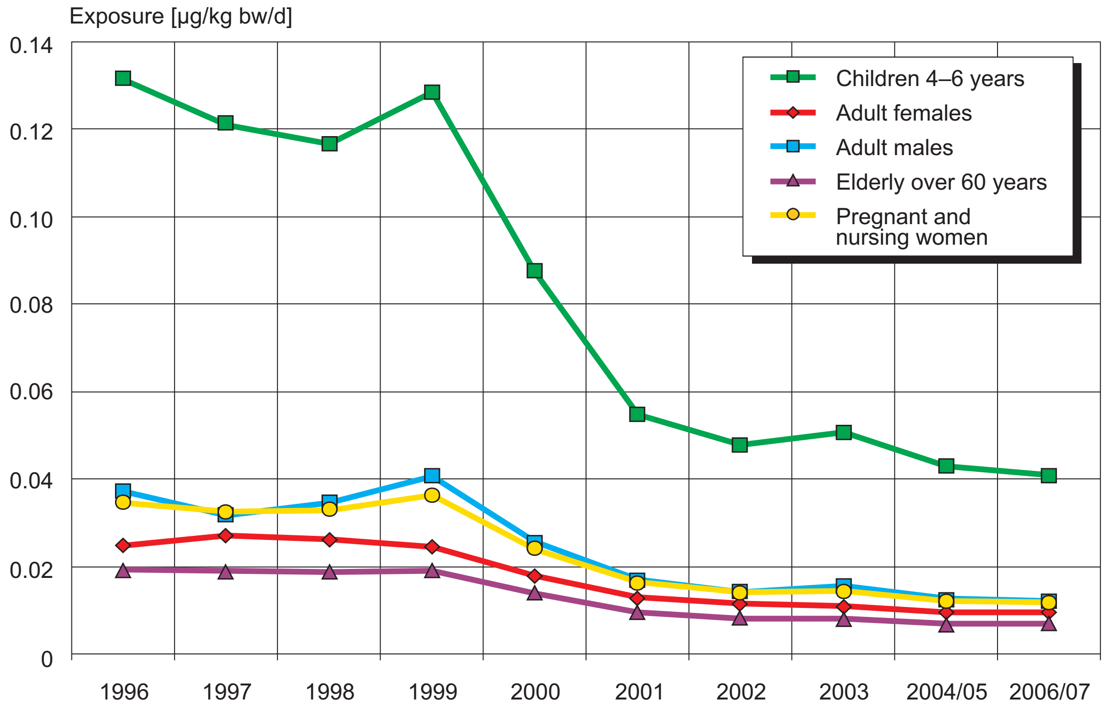
Source: EPIDAT

Fig. 7.1b Time trends in the number of notified alimentary diseases, 1997–2007



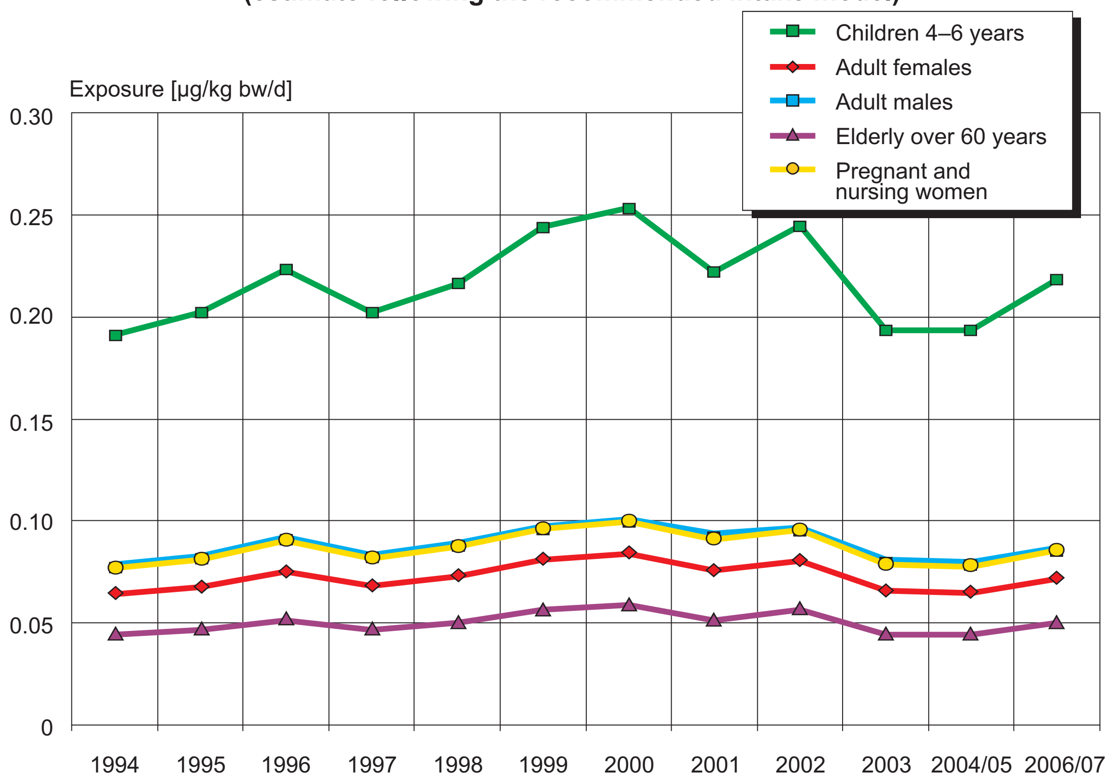
Source: EPIDAT

Fig. 7.2a Exposure to indicator PCB congeners from food, 1996–2006/07 (estimate following the recommended intake model)



Note: A sum of 7 indicator PCB congeners: 28, 52, 101, 118, 138. 153, 180.

Fig. 7.2b Exposure to manganese from food, 1994–2006/07 (estimate following the recommended intake model)



8. HUMAN BIOMONITORING

8.1 Organization of monitoring

In the period 1994–2003 a subsystem was established in four Czech cities: two smaller provincial cities – Benešov and Žďár nad Sázavou, and two industrially polluted cities – Plzeň and Ústí nad Labem. Since 2005, biological monitoring has been performed in other cities – the capital city of Prague, the industrial city Ostrava, Liberec city in North Bohemia and two smaller cities, Kroměříž and Uherské Hradiště. Activities are focused on the monitoring of toxic substances and their metabolites (biomarkers of internal dose) and selected biological mutations (biomarkers of biological effect) in blood and urine of adults (blood donors) and children, and in breast milk of nursing women.

Annually, about 100 subjects from a relevant population group have been included in each city. A brief questionnaire obtained basic demographic data and information on a life style necessary for exposure estimation.

Generally, there are no set biological exposure standards for the levels of chemicals in biological material in a non-professionally exposed population. For some significant chemicals there are available tolerable values, which if exceeded signals a risk of possible health damage in the population. The homogeneity of data produced, its inter-country comparability, together with multi-year continuity, enables its utilisation in establishing reference values which characterize the burden of a population in the relevant period. A certain rate of inter-individual variability can be caused by the differences in exposure as well as by the diverse individual sensitivity of humans to environmental pollutants.

8.2 Monitored factors

In 2007, basic monitored factors were toxic metals (cadmium, lead, mercury) and benefit elements (copper, zinc, selenium) in blood and urine of the adult population. Indicator congeners of polychlorinated biphenyls (PCB) and selected chlorinated pesticides were followed in breast milk of nursing mothers (minimum 50 samples in each region) and in blood serum of adult blood donors. A component part of monitoring activities was also cytogenetic analysis of peripheral lymphocytes.

8.2.1 Toxic metals and trace elements

The blood **cadmium** level is a biomarker of recent population exposure. It is significantly increased in smokers. The marked influence of tobacco smoking has been repeatedly confirmed also in the Czech adult population, the blood cadmium level in smokers being 2–3 times higher than in non-smokers (Fig. 8.1a, b). Cadmium levels in the blood of non-smokers in monitored cities did not differ from findings obtained in previous monitoring period (see Summary Report 2005, http://www.szu.cz/topics/environmental-health/environmental-health-monitoring).

The urine cadmium level (median 0.3 µg/g creatinine) does not differ from results obtained in the previous monitoring period (Tab. 8.1). A health relevant threshold value of the 1. degree for urine cadmium level recommended by German Human Biomonitoring Commission (www.umweltbundesamt.de/gesundheit-e/monitor/index.htm) 2 µg/g creatinine for adults over 25 years was exceeded in only 1.5 % of cases (4 persons). Nevertheless, the threshold value (2. degree), which would require a treatment, was not found in any of those cases. In persons under 25 years, the recommended threshold value for this population group (1 µg/g creatinine) wasn't exceeded at all.

From the viewpoint of the environmental exposure to **lead,** its consequences for health, mainly neurobehavioral and developmental changes in small children, have been emphasized. Blood lead levels in Czech adults showed a significant decreasing trend in the period 1994–2003 related to the lowering of lead emissions in the environment (Fig. 8.2a). The median value of blood lead levels amounted to 33 µg/l in men and 24 µg/l in women. The health relevant value (1. degree, 100 µg/l for women of reproductive age) wasn't exceeded in any case. The threshold value for other adult population (150 µg/l) was exceeded in only one case. Urine lead levels are presented in Tab. 8.1.

From the existing forms of **mercury,** methylmercury has been considered to have the most serious health effects, namely neurotoxic effects. The identified levels of mercury in blood do not indicate a high load on the Czech population with this element. The concentrations of mercury in the blood and urine of adults (Fig. 8.3a, b) are in conformity with previous monitoring data. The blood mercury threshold value for adults, 5 µg/l, was exceeded in 0.7 % of the cases (2 persons). Higher values have been demonstrated in women. For women of reproductive age a threshold value amounting to 3.4 µg/l was set (National Research Council – NRC, USA, 2000) in view of the possible risk of neurotoxicity for a fetus. This value was exceeded in 6 women. The significant difference in blood mercury levels between fish non-eaters and persons consuming fish regularly was found.

The urine mercury levels are shown in Tab. 8.1. Overall, in 7 % of the cases (21 persons) a health relevant threshold value exceeding 5 µg/g creatinine was found. Amalgam fillings which would influence the urine mercury levels have not been followed-up in the adult population. Mercury content in urine requiring an intervention (20 µg/g creatinine) was not found in any case.

Copper represents a component of a number of enzymes with antioxidant functions, and is essential for haematopoiesis and lipid metabolism. The effects of copper are determined by its ratio to zinc and iron in the body. The mean values of copper concentration in the blood of adults (medians) ranged from 810 to 1,020 µg/l in the selected cities (Fig. 8.4b). Higher concentrations of copper are found in females probably in connection with the use of birth control pills. The urine copper values are presented in Tab. 8.1.

Zinc is a component of several enzymes, it is important for the function of the immune system and for antioxidant processes. The mean value of blood zinc levels in adults doesn't differ from the previous monitoring year (Fig. 8.5a), and it equals 6,605 µg/l in 2007 (Fig. 8.5b). Zinc values in urine are shown in Tab. 8.1.

Selenium belongs to the trace elements with prominent positive effects in the prevention of cardio-vascular, 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. The observed mean blood selenium levels in adults varied between 101 µg/l and 119 µg/l in the cities (Fig. 8.6b). These values indicate a possible slight declining trend (Fig. 8.6a) which is necessary to be proved by continued monitoring; estimated selenium intake by food remains constant in the Czech population. The optimum level of selenium concentration is considered to be 125–175 µg/l of blood. In the last years, a number of persons with optimal blood selenium level have been decreasing; in 2007 only 14 % persons were optimal saturated, in other cases the levels were lower (Fig. 8.6a). Urine selenium levels are shown in Tab. 8.1.

8.2.2 Toxic substances of organic origin

Monitoring of polychlorinated biphenyl (PCB) indicator congeners and selected chlorinated pesticides in breast milk and in blood serum of adults (blood donors) has been performed. These health relevant chemicals belong to widespread organic compounds in the environment persisting there for decades. They accumulate in animal fatty tissues and they enter the human organism through the food chain. They can pass from mother to fetus through the placental barrier. Despite the fact these chemicals were banned several decades ago in the developed countries, they still persist in water sediments and in food of animal origin, and their presence has been detected in human body fluids and tissues containing fat.

The results confirm the predominance of **PCB congeners** 138, 153 and 180 which persist in the organism for long periods. Other PCB congener values have been over 50 % below the detection limit. The PCB's content in milk increases with the mother's age. A decreasing tendency in PCB levels proven during years 1994 through 2001 was transformed later into stable values. Since a certain increase apparent in the last monitoring years (2005–2007) has been bound to other monitoring localities, the time trend cannot be assessed yet (Fig. 8.7a). Higher values have been found in Uherské Hradiště as a result of a paint factory former operation (Fig. 8.7b).

PCB levels in blood serum confirmed the predominance of congeners 138, 153 and 180, and confirmed regional differences, with higher values in Uherské Hradiště (Tab. 8.2), similar as in the case of a breast milk. The decreasing tendency in comparison to the year 2005 needs to be proved by further monitoring.

DDT concentrations presented as the sum of DDT and DDE metabolites has a decreasing trend associated with gradual decline in burden, as documented since the end of the 1980s as well as in the previous phase of biomonitoring in 1994–2003. DDT median concentration amounted to 310 μg/kg of fat in 2007 (Fig. 8.8a). Slightly higher levels were apparent again in Uherské Hradiště (Fig. 8.8b). Concentrations of **hexachlorobenzene** (HCB) in breast milk (median value 66 μg/kg fat, Fig. 8.8c) demonstrated a long-term gradual decreasing trend which has been continuing in newly monitored localities.

Blood serum levels of DDT with predominance of the main metabolite DDE signalize a downward trend in comparison to the year 2005 (median value 341 μg/kg fat vs. 493 μg/kg fat). The situation is similar in the case of HCB (median value 63 μg/kg fat vs. 97 μg/kg fat), (Tab. 8.2).

8.3 Cytogenetic analysis of peripheral lymphocytes

Cytogenetic analysis of peripheral lymphocytes used for biological monitoring of the population groups enables detection of the presence of active genotoxic substances in the environment, and indicates the degree of individual tolerance and the compensation capacity through the defence mechanisms of the monitored groups. 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 frequency of aberrations significantly increases with age.

The frequency of 0–2 % aberrant cells is considered to be spontaneous frequency in the non-professionally exposed population. Fig. 8.9a shows the spontaneous frequency of aberrant cells in several population groups during the first monitoring period 1993–2003. The mean value of chromosomal aberrations found in adults in 2007 (mean value of aberrant cells 1.73 %) is consistent with the values from previous monitoring year. The value 1.73 % of aberrant cells is in agreement with a reference value 1.7 % which was derived for the non-professionally exposed Czech population in the period 2000–2006 (1,998 adults, 18–54 years of age). The frequency of aberrant cells found in adults in 2007 is shown in Fig. 8.9b. There is a clear shift towards higher values of chromosomal aberrations in smokers compared to non-smokers.

The chromosomal aberration frequency showed a decrease in the monitoring period 1993–1999. After a rise in the aberrant cells values in the following year 2000, the recent values are similar to the ones characteristic for the beginning of the 1990s (Fig. 8.9c). It is necessary to carefully evaluate the reason of that trend in relation to the size and burden of the environmental exposures on the one side and to the magnitude of protective substances intake on the other.

8.4 Genotoxic effects of ambient air

Monitoring of the mutagenic activity of airborne particulate matter (PM_{10}) in association with analyses of polycyclic aromatic hydrocarbons in Subsystem I has been carried out continually at 6-day intervals for 24-hour periods since 1997. In view of the significantly higher values demonstrated in winter months, sampling was limited to two periods: January–March and October–December. The results of the mutagenic activity of ambient air had a rising trend during the monitoring period 1998–2001, followed by a stabilization of the measured values.

After an interruption in 2004–2006, the sampling continued in the capital city of Prague and in the industrial city of Ostrava in 2007. So far, there are not any differences evident between the detected values in both cities; a more detailed evaluation of the mutagenic activity of airborne particulate matter with the aid of bacterial indicator strain *Salmonella Typhimurium* TA98 and YG1041 will be presented in the next Summary report in 2009.

8.5 Partial conclusions

The results of biological monitoring 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. The concentrations of other monitored elements in blood, urine and hair are relatively stable.

There is a declining trend for persistent chlorinated organic substances (PCBs, DDTs, hexachlorobenzene). Burden by these substances is firmly associated with age and variable locale or individual exposure in the past. The values of chromosomal aberrations are in agreement with those found in the previous monitoring period.

Tab. 8.1 Metal and metalloid levels in urine of adults, 2007 (in µg/g creatinine) (range of the creatinine content 500–2,800 mg/l)

	Cadmium	Lead	Mercury	Copper	Zinc	Selenium
Total						
N	275	276	279	273	278	278
Median	0.3	5.4	1.1	26.3	348.0	7.0
95th percentile	1.0	14.2	5.7	64.0	707.0	15.0
Prague						
N	62	61	62	61	62	62
Median	0.4	6.0	0.8	25.3	386.0	6.0
95th percentile	0.9	13.3	3.9	54.0	747.0	11.0
Liberec						
N	67	67	68	66	68	68
Median	0.2	6.1	1.5	21.1	375.0	7.0
95th percentile	0.5	16.2	7.0	55.0	730.0	12.0
Ostrava						
N	68	70	70	69	70	70
Median	0.4	4.7	0.9	29.7	269.0	9.0
95th percentile	1.7	13.6	4.5	103.0	570.0	15.0
Kroměříž						
N	41	41	42	40	41	41
Median	0.3	7.2	1.4	25.7	345.0	7.5
95th percentile	0.8	14.5	8.1	55.0	756.0	13.0
Uherské Hradiště						
N	37	37	37	37	37	37
Median	0.2	4.9	1.2	29.6	350.0	7.0
95th percentile	0.8	12.0	5.0	86.4	606.0	16.0

Tab. 8.2 Chlorinated organic compounds in blood serum of adults, 2007 (in µg/kg fat)

	Hexachloro-benzene	p,p´ DDE	p,p´ DDT	Congeners PCB		
				PCB138	PCB153	PCB180
Total						
N	410	410	410	410	410	410
Median	63.0	330.0	11.0	87.0	295.0	249.0
95th percentile	290.0	1,000.0	31.0	212.0	616.0	615.0
Prague						
N	100	100	100	100	100	100
Median	65.5	300.0	9.0	73.0	254.0	210.0
95th percentile	360.0	995.0	24.0	153.0	528.0	411.0
Liberec						
N	103	103	103	103	103	103
Median	65.0	280.0	11.0	72.0	263.0	214.0
95th percentile	208.0	820.0	25.0	146.0	535.0	456.0
Ostrava						
N	103	103	103	103	103	103
Median	52.0	290.0	11.0	113.0	310.0	280.0
95th percentile	269.0	996.0	30.0	245.0	608.0	632.0
Kroměříž						
N	52	52	52	52	52	52
Median	69.5	435.0	13.0	104.0	309.0	272.0
95th percentile	235.0	768.0	37.0	216.0	635.0	670.0
Uherské Hradiště						
N	52	52	52	52	52	52
Median	73.0	465.0	11.0	121.0	384.0	338.0
95th percentile	345.0	1,298.0	34.0	275.0	831.0	695.0

Fig. 8.1a Blood cadmium levels in adults, 1996–2007

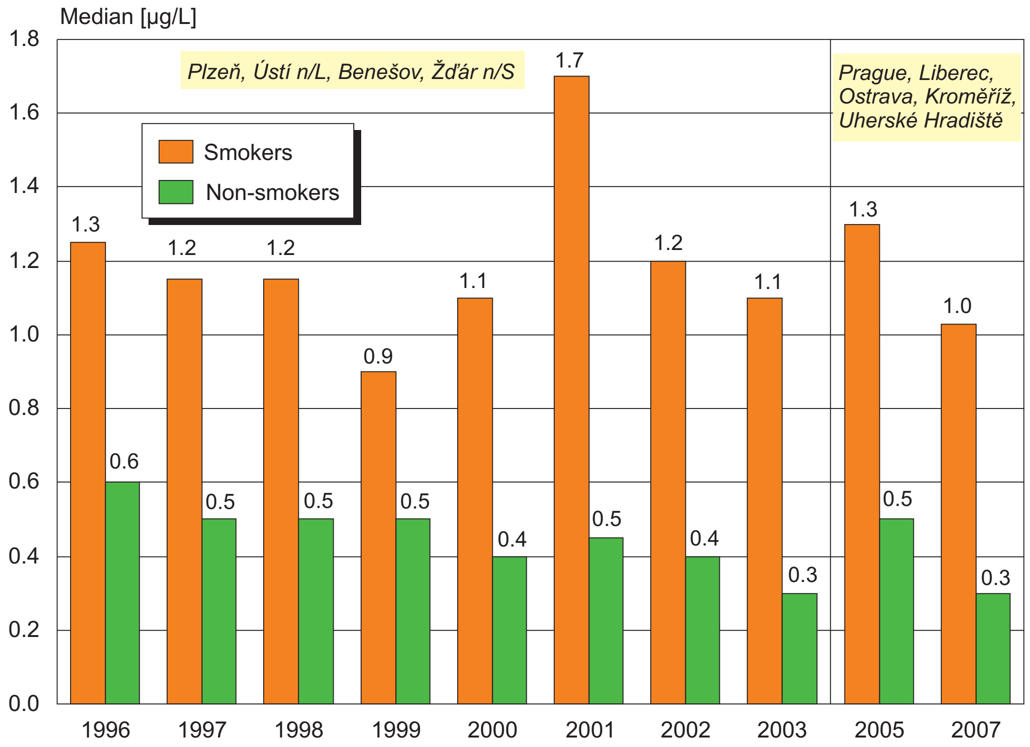


Fig. 8.1b Blood cadmium levels in adults, 2007

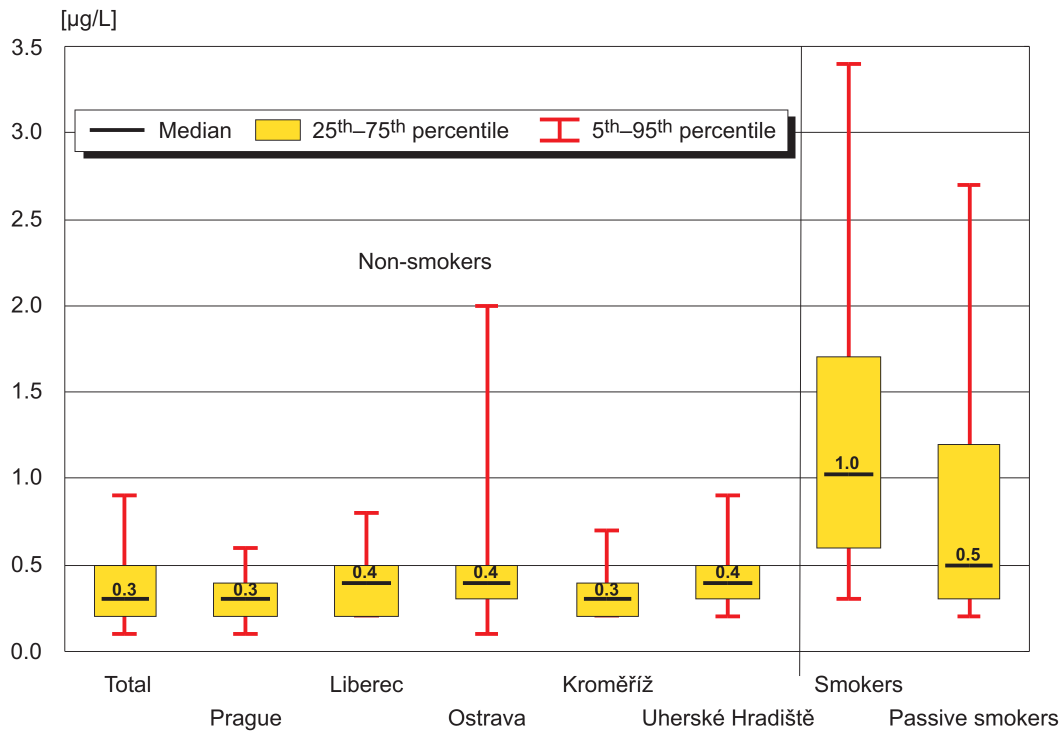
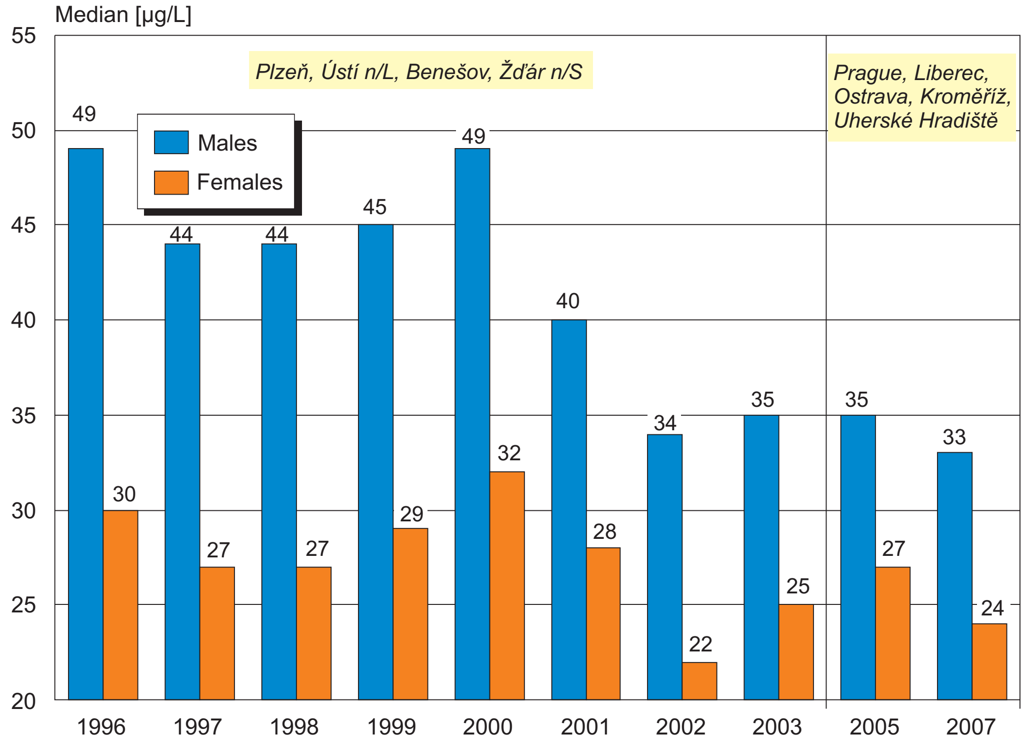


Fig. 8.2a Blood lead levels in adults, 1996–2007



Percentage of persons with blood lead level exceeding the Human Biomonitoring value (HBM-I) in 2007, according to the German Human Biomonitoring Commission:
– Females 18–35 years (100 µg/L): 0 % persons
– Females over 35 years (150 µg/L): 0 % persons
– Males (150 µg/L): 0.4 % persons (1 case)

Fig. 8.2b Blood lead levels in adults, 2007

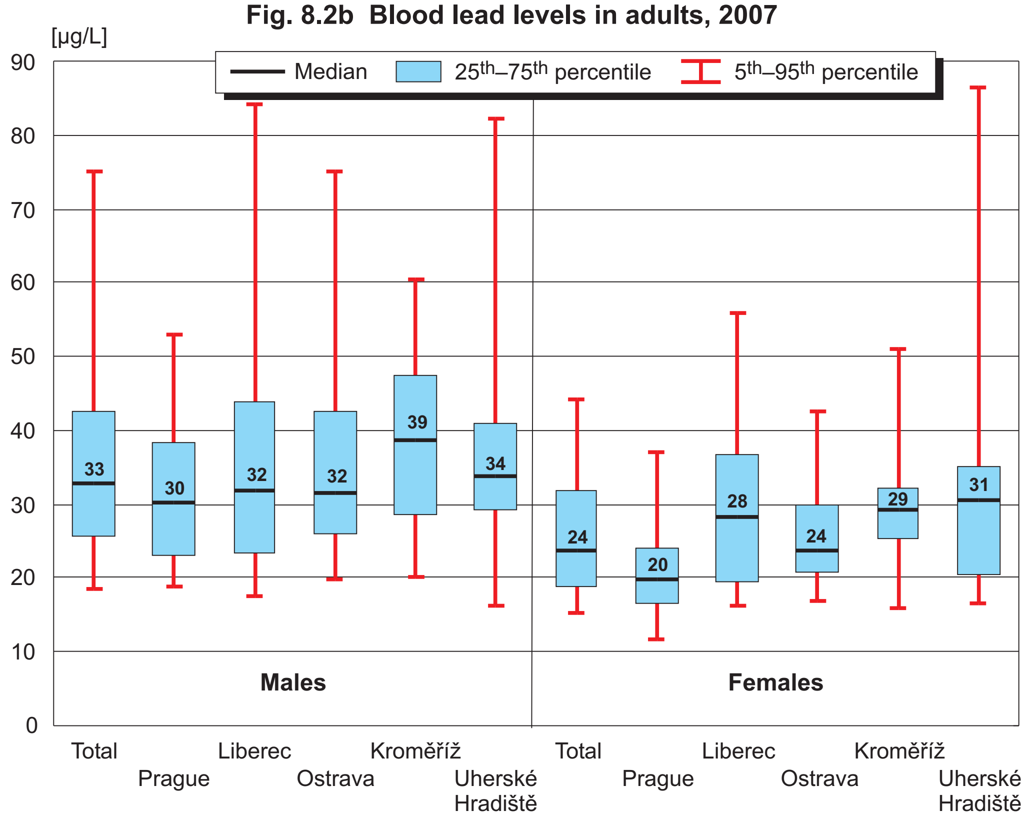


Fig. 8.3a Blood mercury levels in adults, 1996–2007

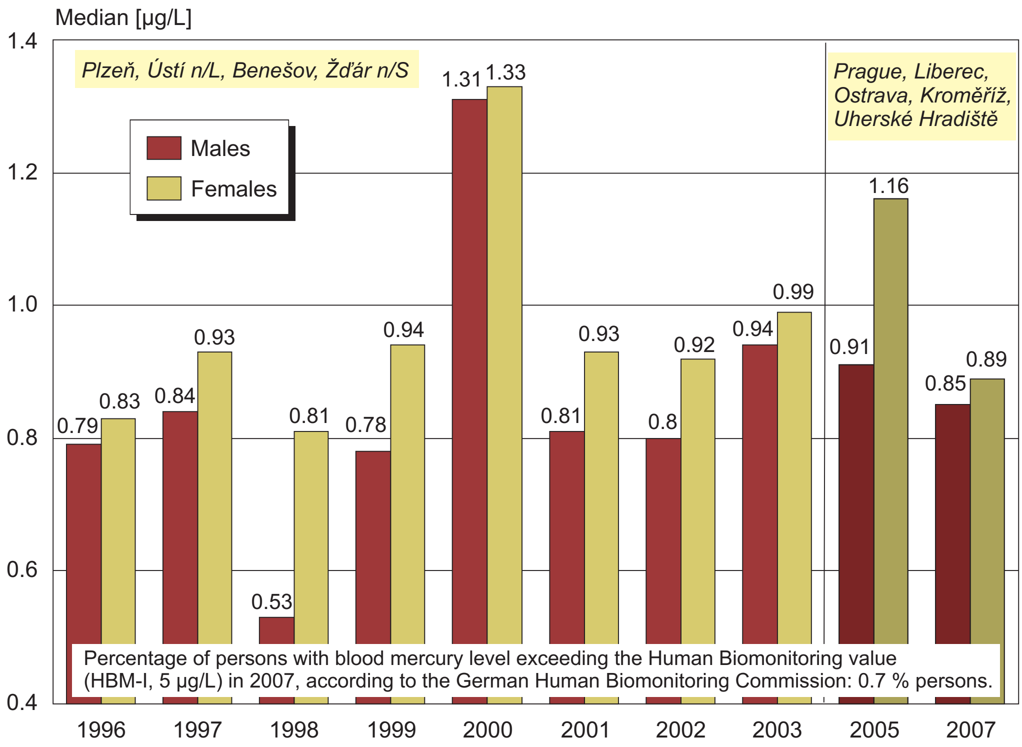


Fig. 8.3b Blood mercury levels in adults, 2007

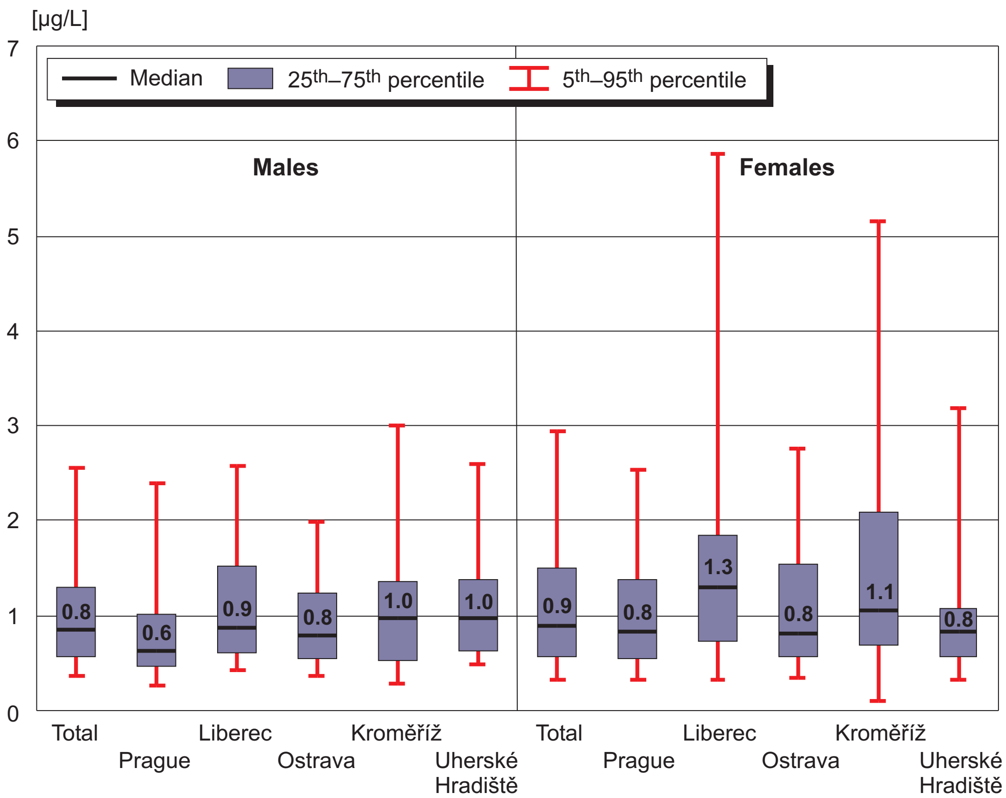


Fig. 8.4a Blood copper levels in adults, 1996–2007

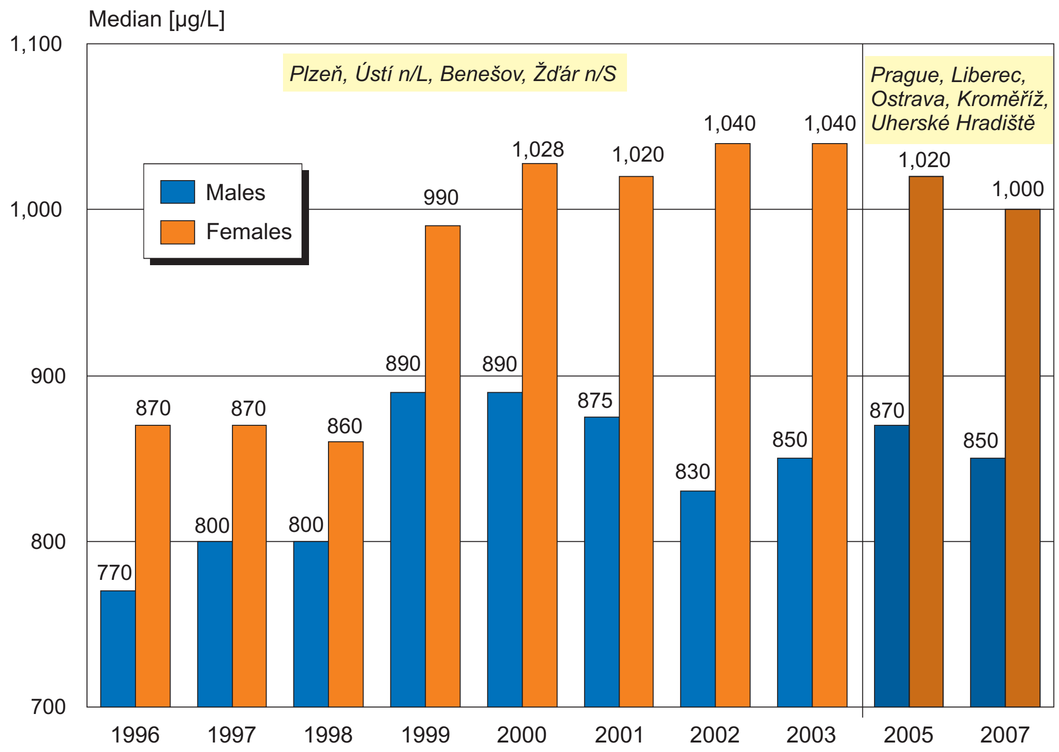


Fig. 8.4b Blood copper levels in adults, 2007

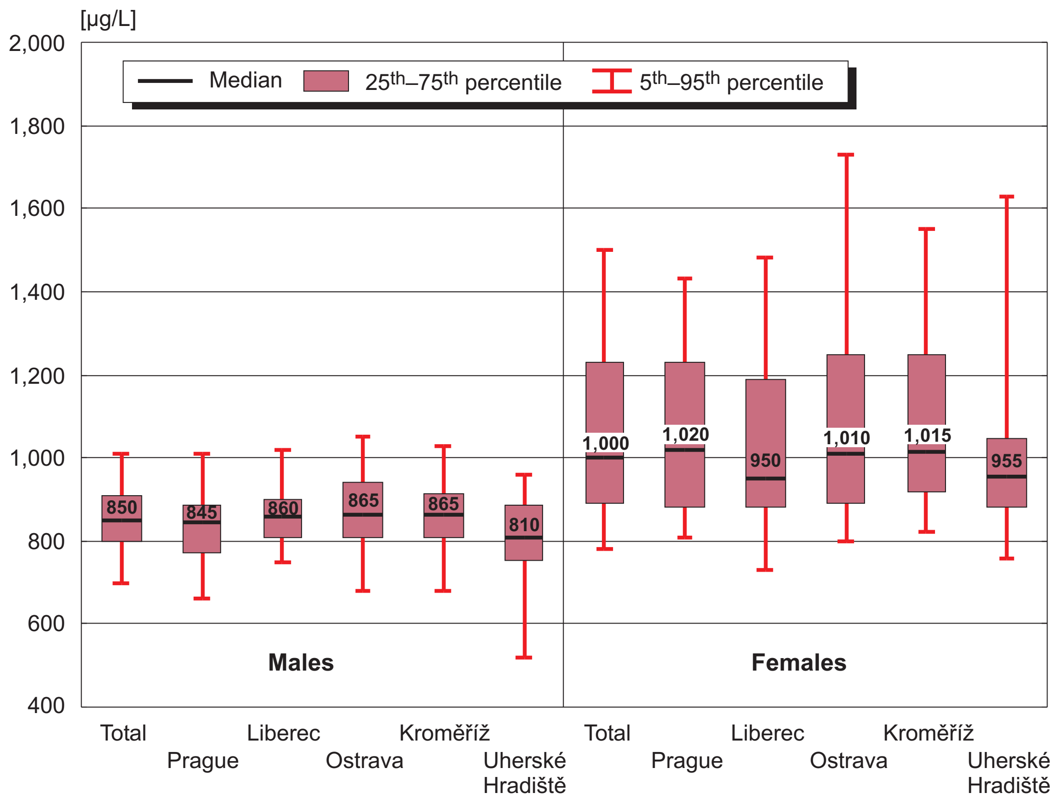


Fig. 8.5a Blood zinc levels in adults, 1996–2007

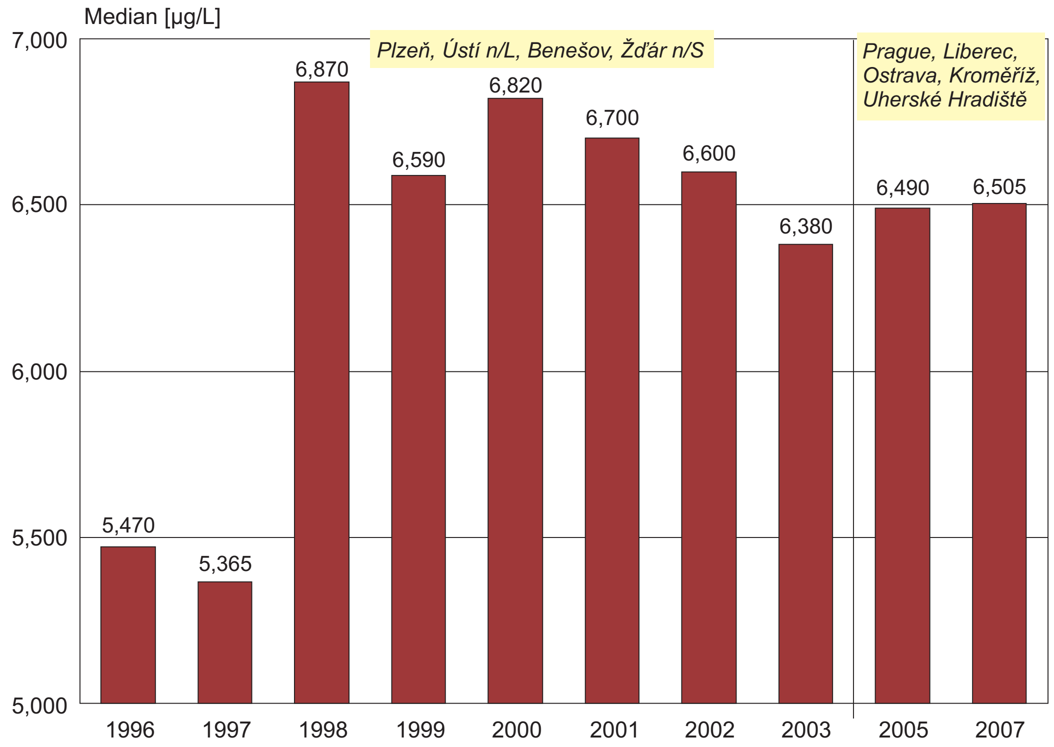


Fig. 8.5b Blood zinc levels in adults, 2007

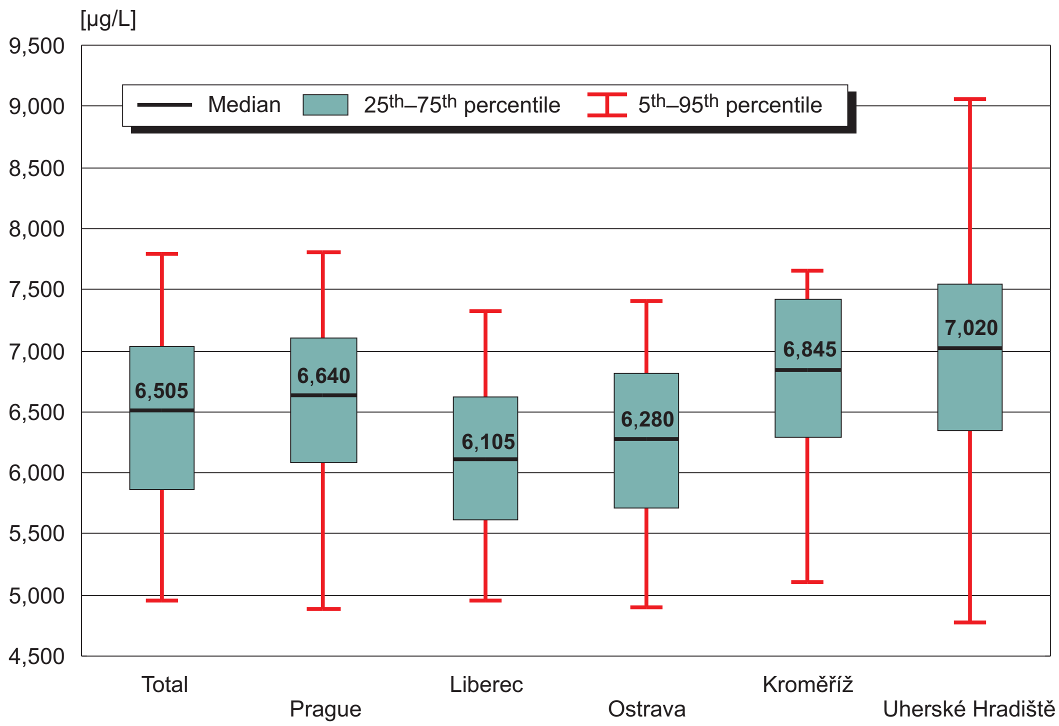


Fig. 8.6a Blood selenium levels in adults, 1996–2007

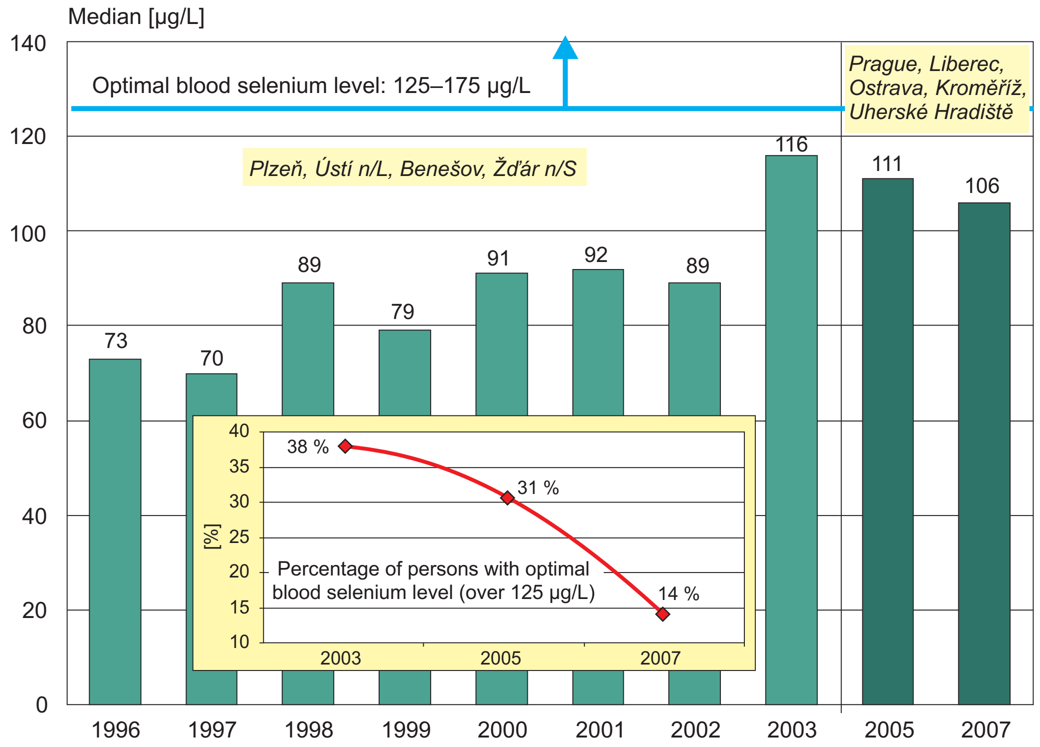


Fig. 8.6b Blood selenium levels in adults, 2007

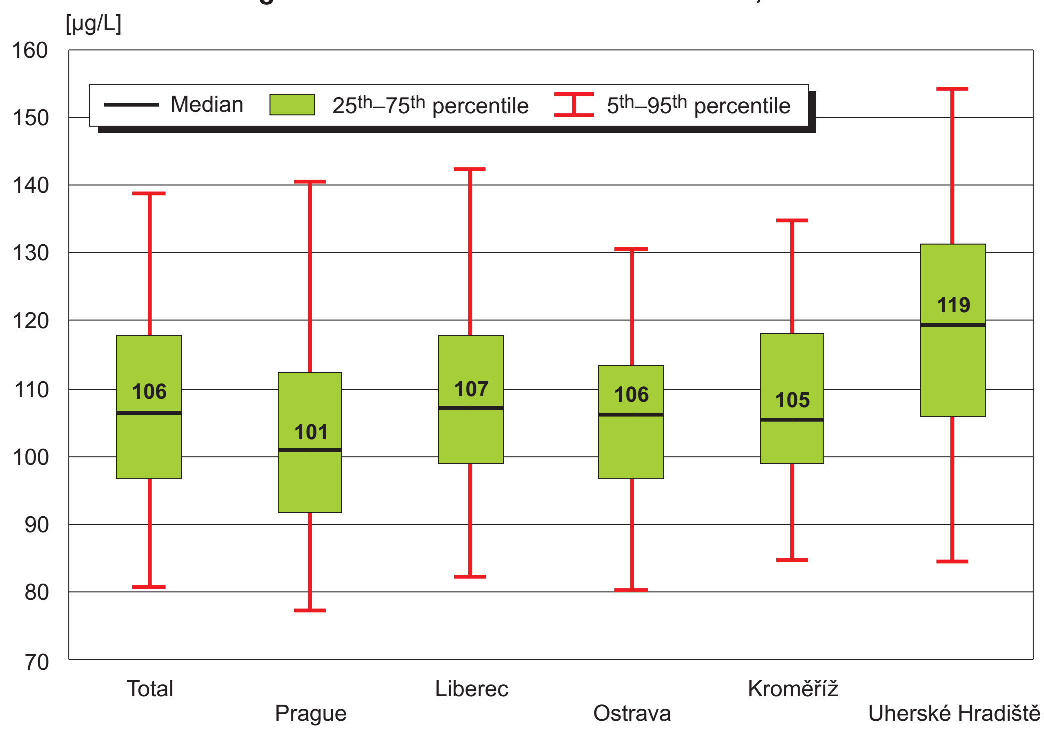


Fig. 8.7a Polychlorinated biphenyls in breast milk, 1994–2007 indicator congener PCB 153

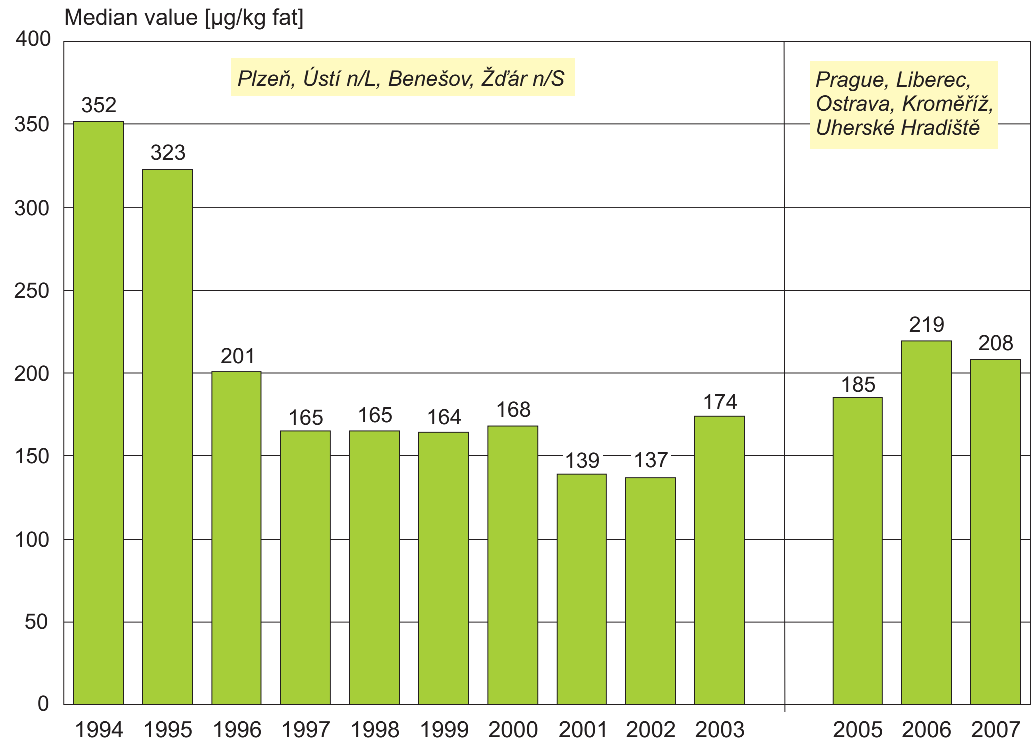


Fig. 8.7b Polychlorinated biphenyls in breast milk, 2007 indicator congener PCB 153

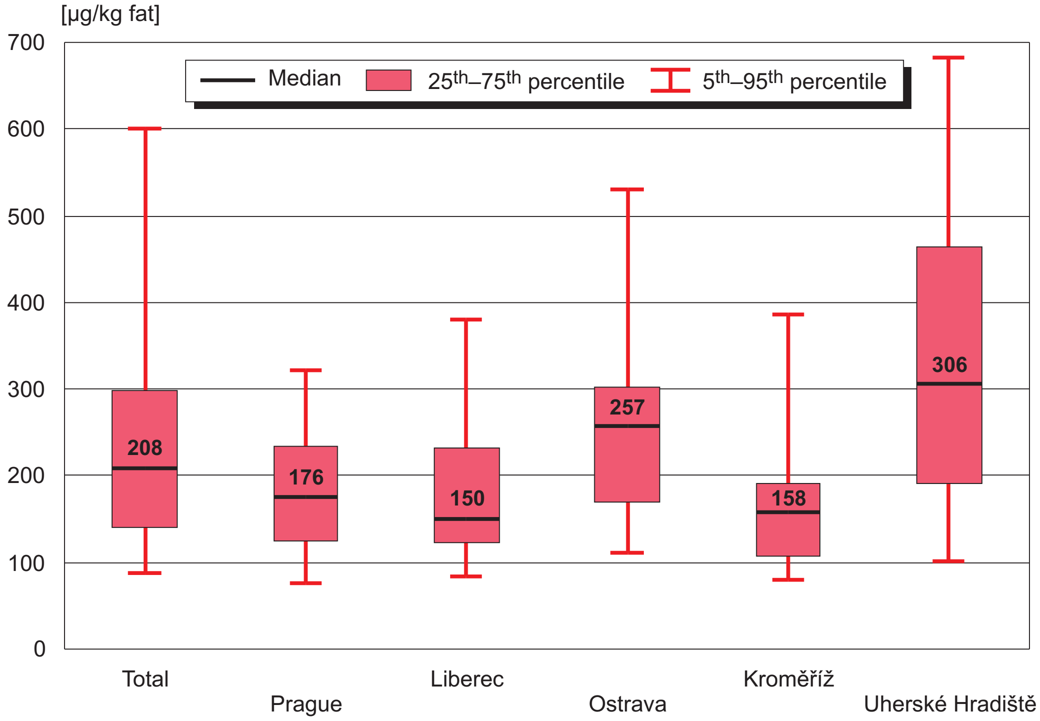


Fig. 8.8a Chlorinated organic compounds in breast milk, 1994–2007

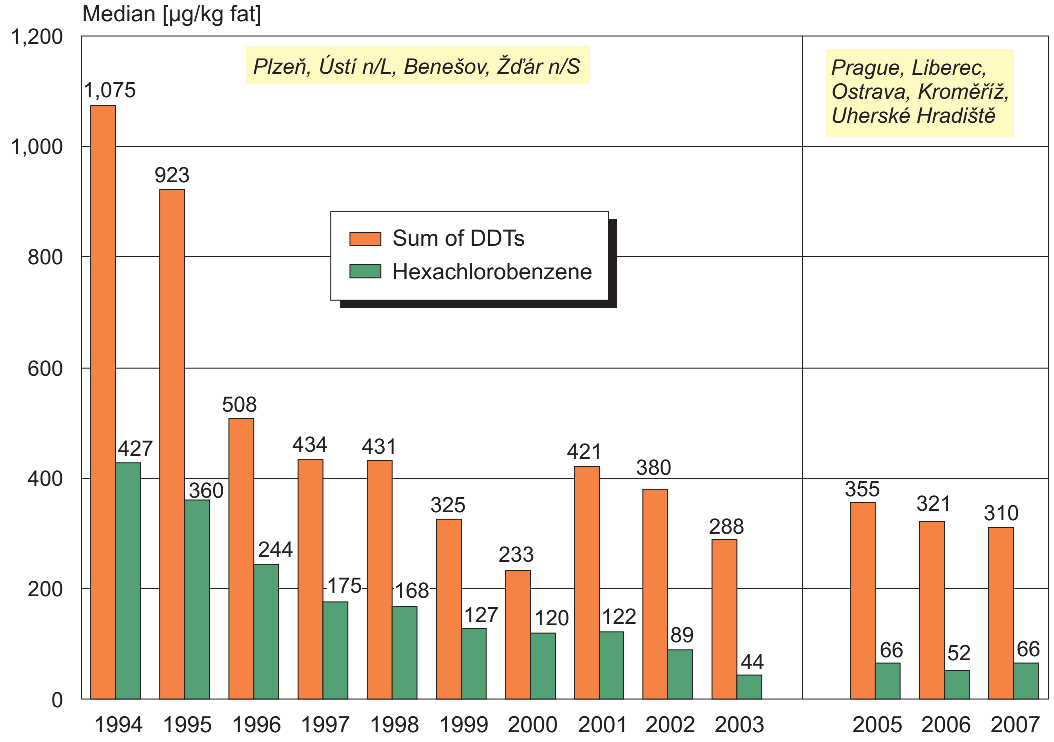


Fig. 8.8b Chlorinated pesticides in breast milk, 2007
Sum of DDTs

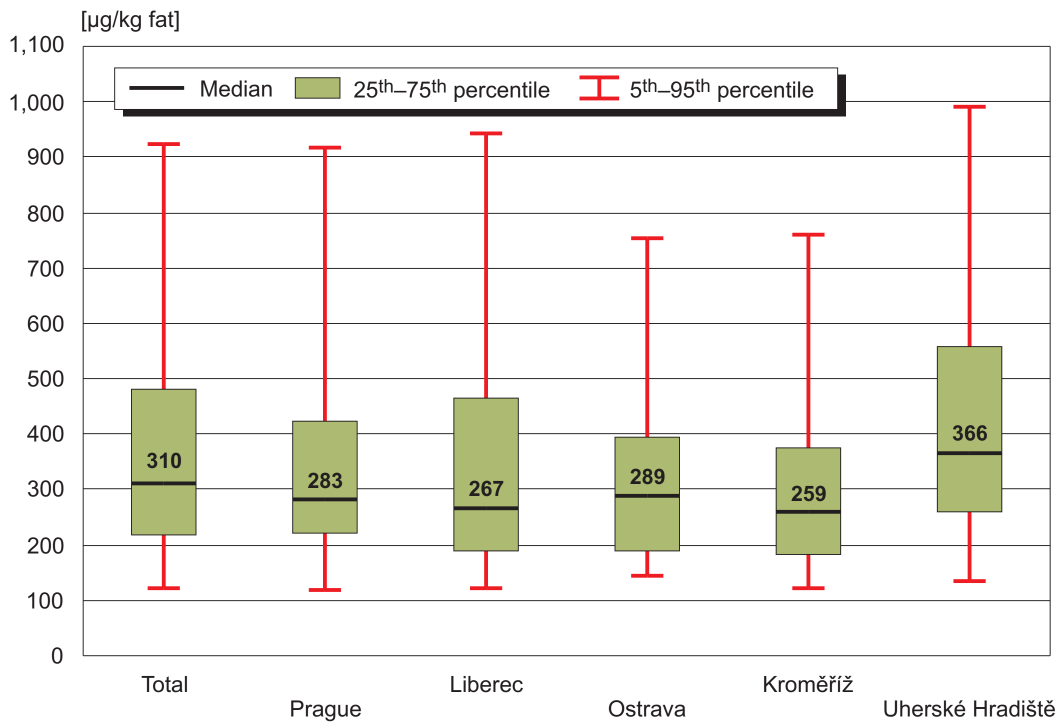


Fig. 8.8c Chlorinated pesticides in breast milk, 2007 Hexachlorobenzene

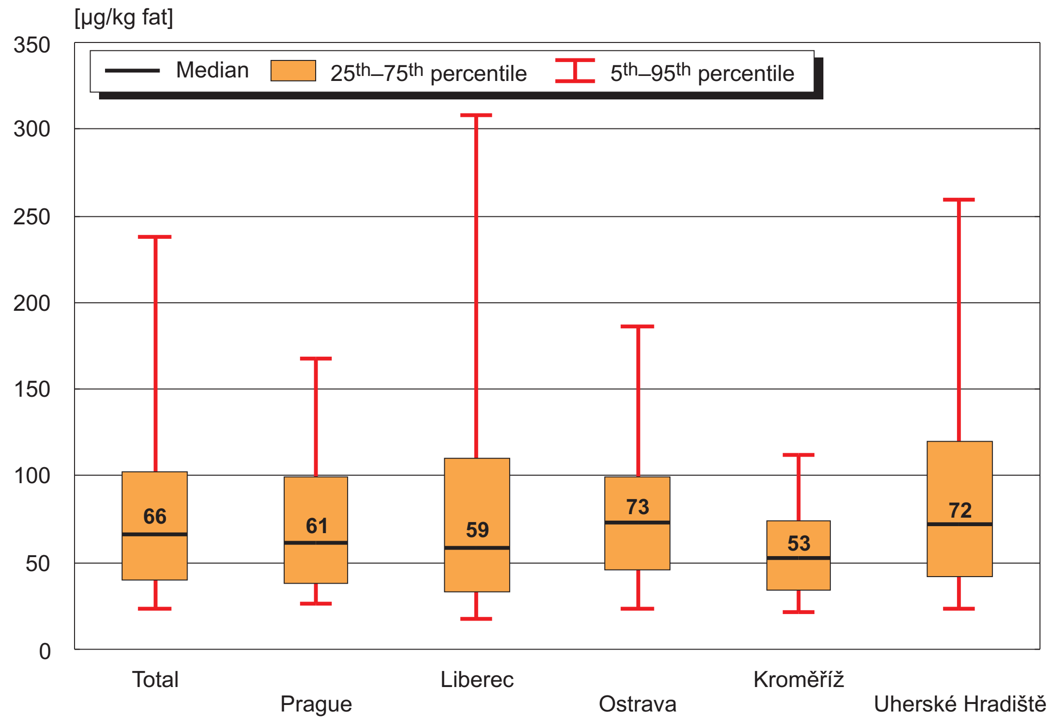


Fig. 8.9a Spontaneous frequency of chromosomal aberrations in various population groups

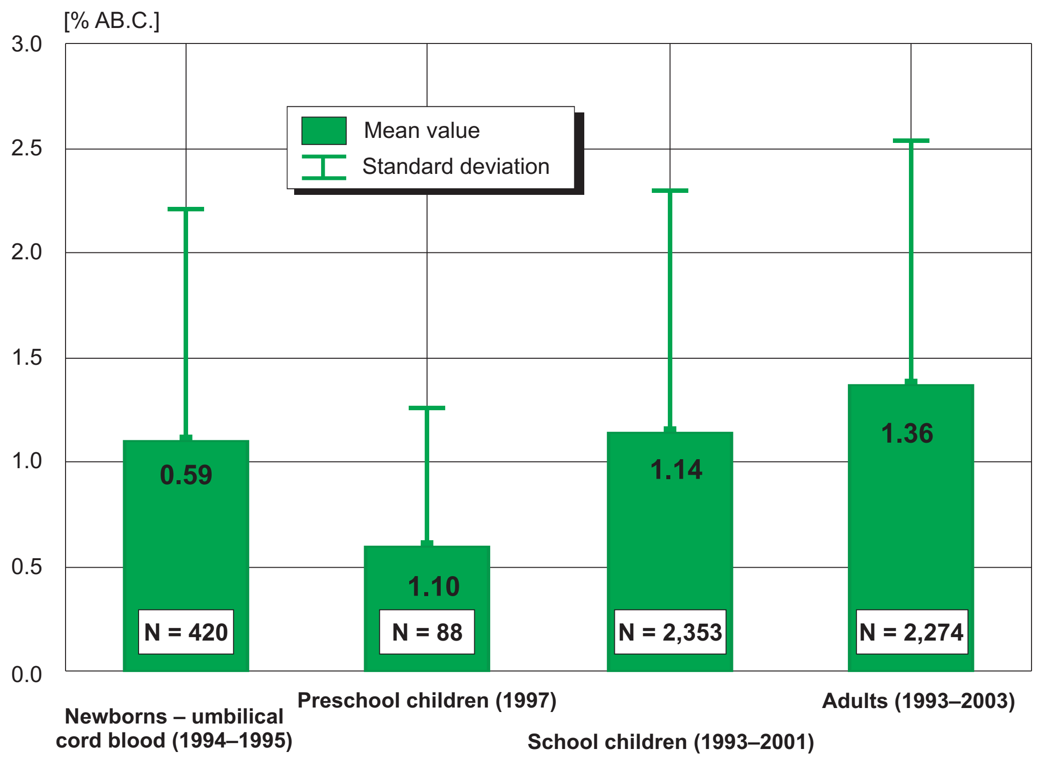


Fig. 8.9b Frequency of aberrant cells in peripheral lymphocytes in adults, 2007

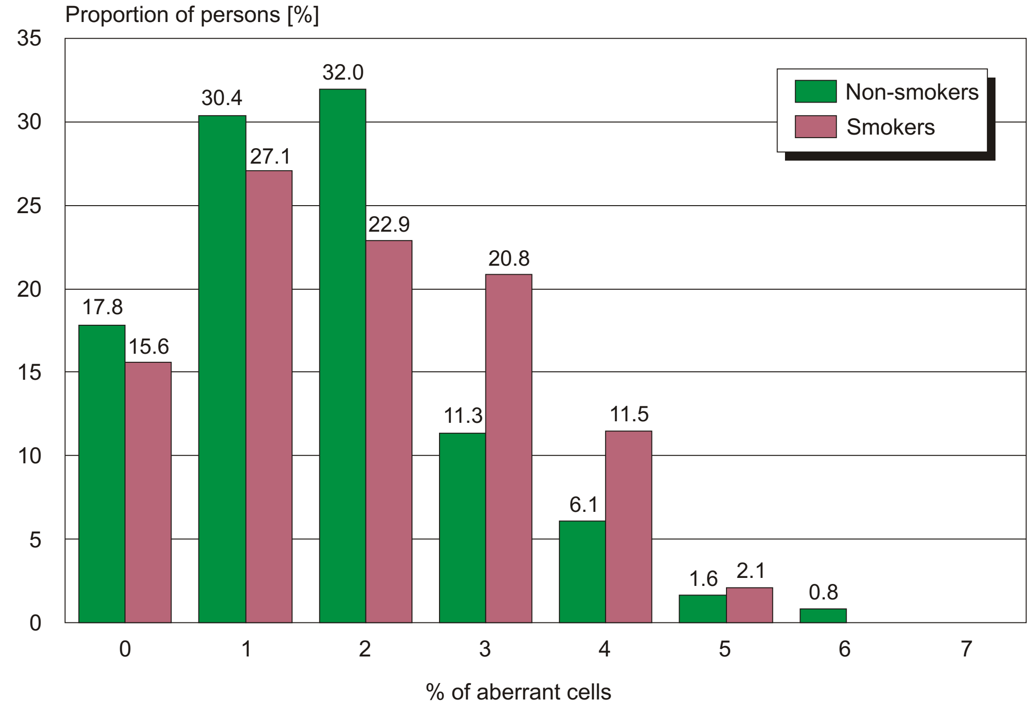
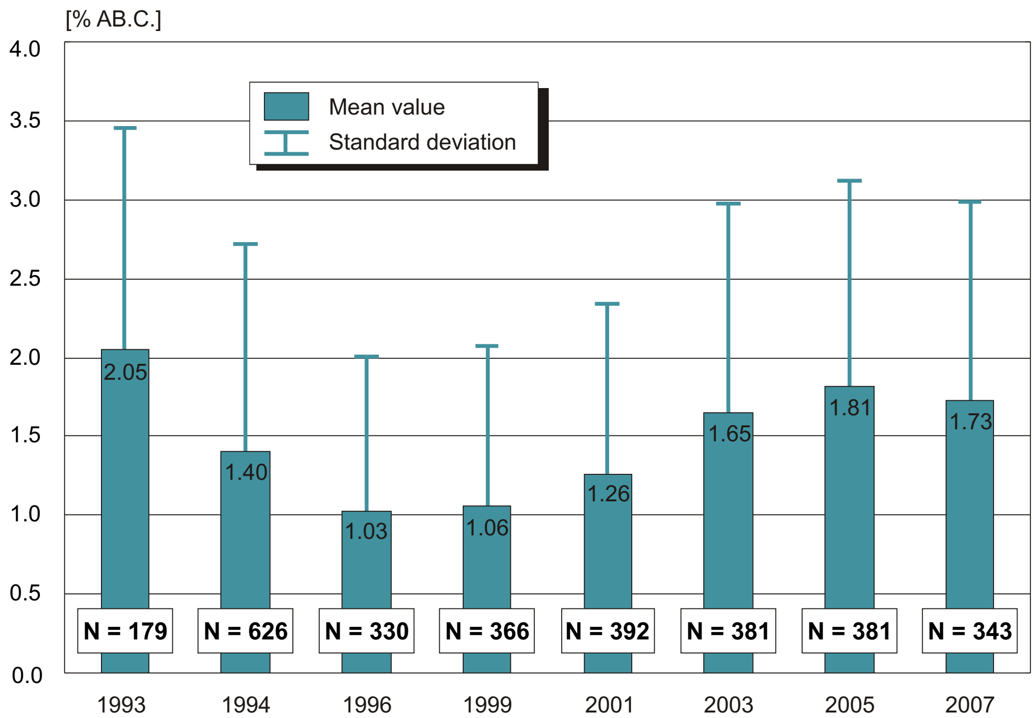


Fig. 8.9c Spontaneous frequency of chromosomal aberrations in adults, 1993–2007



9. POPULATION HEALT STATUS AND SELECTED DEMOGRAPHIC AND HEALTH STATISTICS INDICATORS

Within the population health monitoring system in the Czech Republic, results from the allergic disease study 2006, those from the adult population health survey and available reproductive health data were processed.

9.1 Incidence of allergic diseases in children

9.1.1 Study design and methods

In 2006, a survey of allergic diseases was performed in 18 cities of the Czech Republic in the population of 5-, 9-, 13- and 17-year-old children. The survey extended similar investigations carried out in 1996 and 2001. The survey major objective was to obtain data on the overall incidence of allergic diseases, incidence rates of different allergic diseases in children of the four age groups and to compare these data with previous results. The survey in 2006 included 7,075 children, 51 % of boys and 49 % of girls. The data sources were extracts from medical records (61 pediatricians participated in the survey) and a parental questionnaire administered at compulsory preventive check-ups in 2006. The questionnaire included data on personal and medical histories and living conditions. The obtained results were expressed as absolute and relative frequencies. The hypothesis of an even distribution of the evaluated categories in the contingency table was tested using the chi-square test for independence. Tests were performed at a significance level of 0.05.

9.1.2 Incidence of allergic diseases

Pediatrician diagnosed allergic disease was found in 32 % (2,250) of children included in the study. The rate is the cumulative or lifelong prevalence based on allergy diagnosis at any time during the child's life. Sixty-five percent of allergic children only reported allergic manifestations within the last year. Nevertheless, 70 % of allergic patients currently without allergy signs were on maintenance therapy, 17 % were on long-term therapy and 53 % were treated as needed. Seventy-five percent of children diagnosed by their general practitioners were also followed up by an allergologist, depending on disease severity (96 % of asthma patients, 86 % of patients with pollen rhinitis).

The reported 32 % is the national mean prevalence rate of allergic diseases for the studied age groups (Fig. 9.2a). Nevertheless, the prevalence rates varied widely with city, physician or even city district. The variation can be explained by differences in diagnostic approaches, physician's post-graduate specialization, etc. The physician characterizes allergic diseases in two ways, by indicating 1) type of disease and 2) classification code of disease according to the International Classification of Diseases (ICD).

9.1.3 Asthma

Asthma is one of the most common chronic non-communicable diseases. In the Czech Republic, about 800 thousand population suffer from asthma [1]. The allergy prevalence study in children in 2006 found the rate of asthmatics to be 8 %, with the highest rate (10 %) being recorded in 13-year-olds. Fifty-eight percent of asthmatics reported disease activity during the last year. Most asthma patients (91 %) with no signs of disease were on therapy, half of them on long-term therapy and the others were treated as needed. Most patients take asthma relieving drugs either to control symptoms of acute shortness of breath or in combination with anti-inflammatory therapy [2]. Either short-acting or long-acting drugs are prescribed (82 % of asthma patients take antihistamine drugs and 55 % are given beta-2-mimetics). The basic group of anti-inflammatory drugs are corticosteroids used by 62 % of asthma patients. Corticosteroids were used on average for 2.4 years in 5-year-old asthma patients, for 3 years in 9-year-olds and for 4 years in both 13-year-olds and 17-year-olds. Non-steroidal anti-asthma drugs such as antileukotrienes are given to 9 % of asthma patients. These drugs are indicated for use primarily in less severe forms of asthma and as adjuvant therapy in patients treated with corticosteroids. In moderately severe forms of asthma, a combination of inhaled corticosteroids with long-acting beta-2–mimetics relaxing bronchial spasms can be prescribed. Thirty-nine percent of asthma patients are on such combination therapy.

Asthma alone was diagnosed in 33 % of all asthma patients; the others have a combination of asthma with another allergy, most commonly with pollen allergic rhinitis (38 % of asthma patients). Spirometry was performed in 63 % of asthma patients over the last year.

Three percent (207) of children were examined and followed up when asthma was suspected but have not been diagnosed with asthma so far. All cases were reported as recurrent bronchitis – J40. Compared to 2001, the number of patients with this diagnosis remained unchanged. Although asthma diagnosis has improved considerably in the Czech Republic in the last years thanks to education activities of the Czech Initiative for Asthma, under-diagnosis of bronchial asthma still remains a great problem. The causes are wide variability of symptoms and differences in their prevalence. Tolerance to health problems such as cough and shortness of breath also shows great interindividual variability. Typical asthma symptoms are often identified in clinical interviews with patients who presented with allergic rhinitis. Asthma is also often revealed in patients with recurrent chronic irritating cough persisting after virosis [3]. An important asthma predictor is wheezing. This symptom was reported by parents in 14 % of children while having a cold (during the last year), and in about 4 % of children as either unrelated to a cold or as exercise induced (Fig. 9.3). Wheezing is considered as an important symptom in children with suspected asthma but not all children presenting with wheezing have asthma. It is true primarily of small children whose asthma diagnosis has to be based on clinical consideration and needs regular revising as the child is growing up.

Asthma control test

Since 2005, a useful tool for asthma patients has been available, allowing better monitoring of asthma control. It is the Asthma Control Test (ACT), an international standardized five-item self-administered written questionnaire for rapid evaluation of the level of asthma control which is the objective of the therapeutic and preventive programmes [3].

An overall score of 25 points corresponds to full asthma control, a score of 20–24 points is considered as good asthma control and a score of 19 points or less indicate uncontrolled asthma. The test is focused mainly on asthma symptoms; nevertheless, the objective parameters, in particular the spirometry data, i.e. lung function measurement data, have also to be taken into account to make the evaluation more accurate. Younger children filled out the ACT questionnaire in cooperation with their parents. Full asthma control was achieved in 44 % of the monitored asthma patients and partial asthma control or less severe stages of asthma as specified in a study [4] were observed in 35 % of these asthma patients. Uncontrolled asthma was reported in 20 % of asthma patients whose disease was characterized as moderate to severe persistent asthma (a score of 15 points or less was recorded in 8 % of asthma patients).

The study results showed differences in the asthma control level depending on age, Fig. 9.1. The number of asthma patients with full asthma control increases with increasing age while the incidence of uncontrolled asthma cases decreases. Differences between boys and girls were not found. Asthma control level correlated with maternal education: in families where the mother achieved a higher education level (secondary school or university graduate) uncontrolled asthma was significantly less common. More asthma patients with uncontrolled asthma were detected in smoker households and in families with indoor mould exposure. Differences from non-smoker families and from those without indoor mould exposure were not statistically significant which can be explained by small numbers of children in the evaluated categories.

9.1.4 Allergens

The action of allergens causes allergic sensitization in at-risk individuals. Physicians were addressed to find out association between disease and allergens. The most frequently detected allergens (in the skin prick test) were grass pollens (34 % of allergic patients), followed by other vegetal allergens (birch and weed pollens) and dust mites. The distribution of children with sensitivity to various allergens is represented in Fig. 9.5. In asthma patients, the most common detected allergens were grass pollens (50 %) and dust mites (46 %), most children with atopic eczema were sensitive to birch pollen and dust mites (19 %). Children with pollen rhinitis were most often allergic to grass, birch and weed pollen (63 %, 44 % and 41 %, respectively), followed by dust mites (30 %) and dust (18 %). The most common food allergens were nuts in asthma patients (3 %), milk in children with eczema (3 %) and milk/nuts in those with pollen rhinitis (2 %). Egg allergy ranged with diagnosis from 1 % to 1.4 % in asthma patients.

A pet was kept by 39 % of allergic children. Compared to the last survey in 2001, a lower number of households with children suffering from pollen rhinitis and atopic eczema have a pet. As for the asthma patients, no change was observed, with 36 % of these children having a pet.

The survey of 2006 found 20 % of non-allergic children and 15 % of allergic children to be exposed to tobacco smoke at home. The comparison of the data from 2001 and 2006 showed a significant reduction in the rates of smoking households, both in general and in families with allergic children, including asthma patients. While in 2001 22 % of the families with asthmatic children were smoker households, in 2006 their rate decreased to 13 %.

The rate of children with indoor mould exposure did not change in 2006 compared to 2001: exposure to moulds was reported to be 7.7 % in general, 8.2 % in families with allergic children and 10 % in families with an asthma patient. The incidence of allergies including asthma was higher in households with indoor mould exposure to those without indoor mould exposure, but the difference was not statistically significant.

The most often reported preventive measures were changing bedclothes (43 % of cases), adjusting bed (28 %) and removal of carpets (23 %). Limitated smoking at home was reported by 15 % of parents of allergic children and pet removal by 7 % of such parents.

The population comprises not only allergic individuals with clinical manifestations of allergy but also those at risk of developing allergy, i.e. individuals whose parents or siblings suffer from allergic diseases. In the monitored group, 25 % of children with a positive familial history have not developed allergy yet. These children have three times as high risk of developing allergic disease compared to children with no familial history of allergy.

9.1.5 Nonspecific signs of allergy as important disease predictors

In addition to the specific allergic diseases, non-specific signs of allergy such as wheezing, night cough, nasal obstruction, runny nose, watery or itchy eyes, were detected in children, primarily when unrelated to a cold. The parents were also asked to report the presence of these signs in their children during the last year.

Children show most often symptoms of rhinoconjunctivitis (runny nose, watery eyes) as potential predictors of allergic rhinitis. The incidence of these allergic symptoms (Fig. 9.3) was at least twice as high in allergic children compared to the general population of the same age. The monitored symptoms can be a reaction to exposure not only to allergens but also to various environmental pollutants irritating the upper respiratory tract. Exercise induced wheezing, wheezing unrelated to a cold and itchy rash were reported by parents of allergic children even three times as often as found for the whole study group. Wheezing and night cough are considered as the key indicators in asthma diagnosis and thus as highly relevant in at-risk individuals.

9.1.6 Comparison of the study results from 1996–2006

The existing allergy prevalence studies in children performed within the Environmental Health Monitoring System allow determining the trends in the prevalence of allergic diseases over the last decade. While in 1996 the overall prevalence rate of allergic diseases among the population of 5-, 9- and 13-year-olds was 17 %, in 2001, the respective rate was 25 % (in the study population extended to include 17-year-olds). In 2006, the allergy prevalence rate in children was as high as 32 %. The inclusion of 17-year-olds into the study in year 2 had no effect on the statistical significance of the increase in the prevalence of allergic diseases in 1996–2006; differences between years are statistically significant even when only the populations of 5 to 13-year olds are compared. Higher prevalence rates of allergic diseases were observed in all age groups for all monitored diagnoses (Figs. 9.2a and 9.2b).

The prevalence of allergies diagnosed at infant age is considerably increasing. In 1996, allergy was diagnosed in 5 % of 5-year-old allergic children at infant age while in 2006 the respective rate was 26 %. This trend toward allergy diagnosis at younger age can be explained not only by the availability of better diagnostic tools but also by the earlier onset of allergy. The shift of allergic symptoms toward younger age is shown in Fig. 9.4.

9.2 Monitoring adult population health

9.2.1 Study design and methods

In 2007, in cooperation with the Institute for the Study of Health and Life Style (INRES agency), three key questions were included into the nationwide representative questionnaire survey: **Opinion survey in citizens of the Czech Republic related to health and healthy life style issues**. The survey focused on health self-assessment and prevalence of hypertension and overweight as important risk factors for chronic non-communicable diseases. The survey was performed for a representative sample of the adult population aged 15 years or more and the results can be considered as representative for the whole adult population of the Czech Republic.

Standard interviewer-administered questionnaire was used for the survey. The respondents were recruited in a randomized manner, INRES professional interviewers addressed 1,802 citizens.

As many as 89.4 % (1,611) of the addressed subjects consented to the interview. Data from 1,606 respondents, 778 (48.4 %) males and 828 (51.6 %) females were included in the final processing.

The survey results are presented as absolute and relative rates. Hypothesis of the equal distribution of the evaluated categories was tested by the chi-square test of independence. To analyze relationships between selected indicators, the multiple logistic regression method was used, adjusted for gender and age. Analyses were performed at the 5 percent level of statistical significance.

9.2.2 Health self-assessment

More than half of respondents rated their health over the last six months as good and very good (59 %), one third as average (34 %) and only 7 % as poor or very poor (Fig. 9.6a). Females compared to males rated their health as poorer and the difference was statistically significant (8.5 % of females and 5.8 % of males rated their health as poor or very poor). The most significant factor influencing health self-assessment was expectedly the respondent's age: good health was reported by 80 % of respondents aged between 15 and 24 years compared to 25 % in the age group of 65 years or more. The distribution of health self-assessment by age is represented in Fig. 9.6b. Respondents with a higher education level rated their health as good significantly more often while those with a lower education level were about twice more likely to perceive their health as poor.

9.2.3 Hypertension

Physician-diagnosed hypertension was reported by 24 % of respondents and the difference between males and females was not statistically significant. The hypertension prevalence was significantly increasing with age: hypertension was reported by almost one quarter of respondents aged between 34–45 years in comparison with more than half of respondents in the age group of 65 years or more (Fig. 9.7). At younger age, hypertension is more common in males than in females, but the difference becomes less pronounced with increasing age and at the age over 55 years, hypertension is more common in females.

Antihypertensive therapy was used by 76 % of hypertensive respondents, significantly more often by females (83 %) than by males (68 %). Within the last twelve months hypertension was newly diagnosed in 34 % of respondents, with no difference between males and females. The highest prevalence of newly diagnosed hypertension was observed in the age group of 34–54 years.

9.2.4 Body weight assessment

In the questionnaire survey, respondents indicated their current weight and height and based on these data their Body Mass Index (BMI, in kg/m^2) was calculated. In accordance with the WHO classification a BMI range of 18.5–24.9 corresponds to normal weight, that of 25.0–29.9 to overweight and a BMI equal to 30.0 or higher indicates obesity.

In the survey group, 47 % of the subjects were normal weight, 37 % were overweight and 14 % were obese. Males compared to females are significantly more often overweight or obese (Fig. 9.8). The prevalence rates of overweight and obesity were significantly increasing in both males and females with age: obesity was reported in 4 % only of respondents aged between 15 and 34 years compared to 23 % of respondents in the age group of 55 years and more (Fig. 9.8). Obesity and overweight were more frequently observed in females with a lower education level (elementary school and apprenticeship graduates) than with a higher education level (secondary school and university graduates). No correlation was found between education level and body weight in males.

9.2.5 Correlation between health indicators

A significantly higher percentage (16 %) of respondents reporting a history of hypertension rated their health as poor or very poor compared to 4 % of non-hypertensive respondents. Average health was reported by 48 % of hypertensive respondents and by 30 % of non-hypertensive respondents. The number of respondents rating their health as poor owing to other health problems and hypertension prevalence are increasing with increasing age. Higher prevalence of hypertension complications, in particular of cardiovascular diseases, can be expected in older respondents. Based on logistic regression analysis, hypertensive respondents (even after adjusting for age) were 2.3 times more likely to rate their health as poor than those non-diagnosed with hypertension.

Body weight was also predictive of outcome of health self-assessment. Only 9 % of obese respondents rated their health as good compared with 55 % of normal weight respondents. As many as 33 % of obese respondents reported unsatisfactory health. Similarly to hypertension, correlation between body weight and health self-assessment is partly influenced by age and potential obesity complications.

The results confirmed significant correlation between body weight and hypertension. Hypertension was significantly more frequent among overweight and obese respondents: overweight respondents were twice more likely to be hypertensive and obese respondents were even 3.4 times more likely to be hypertensive than normal weight respondents.

9.3 Selected demographic and health statistics indicators: Reproductive health

Reproductive health is a state of full physical, mental, and social well-being in all matters relating to reproductive behaviour and the reproductive system. Reproductive health implies that both men and women are able to have a satisfying and safe sex life and have the following right: to be adequately informed and to have access to family planning methods and to appropriate reproduction related health care services (based on the definition approved at the 4th International Conference on Population and Development, Cairo, 1994). Reproductive health of populations in industrialized countries is at a high level and most people have access to family planning methods and appropriate reproduction related health care services. In these industrialized countries, HIV/AIDS as the only untreatable sexually transmitted disease remains the major risk. A lower level of reproductive health is of concern primarily in developing countries where sexual behaviour (more precisely unprotected sex) is the second major risk to population health, after malnutrition [1].

Reproductive health in the Czech Republic and in Europe

9.3.1 Family planning

Family planning can be characterized as a responsible approach to reproduction and sexual behaviour. The following questions should be asked within family planning: When to have a child, if ever? How many children to have? Which contraception method to use? Etc. In industrialized countries, a considerable proportion of women at fertile age use modern contraceptive methods. In many European countries it is possible to undergo abortion in case of unwanted pregnancy or fetal and/or maternal health problems. In 2006, almost 40,000 abortions were reported in the Czech Republic: 63 % were legally induced abortions, 33 % were spontaneous abortions and the remaining 4 % accounted for extrauterine pregnancies and other abortions.

Until the early 1990s, the Czech Republic as well as most countries of the former socialist block showed high rates of induced abortions. The countries of the former socialist block were the first to make legal abortions induced for other than health reasons[1]. Over the last 16 years the abortion indicator[2] decreased dramatically from 1.55 in 1990 to 0.34 in 2006 (Fig. 9.9a). The major reason for this reduction was the rapid spread of information related to reproductive health coupled with the availability of modern contraceptives since 1990[3]. The proportion of women aged between 15 and 49 years using modern, mostly hormonal, contraception increased to 54 % in 2006 (Fig. 9.10). The distribution of women undergoing induced abortion have also changed. While in the late 1980s most women undergoing induced abortion were married women with two children (nearly 75 %), the proportions of the married and single women undergoing abortion are currently almost equal (44 % and 42 %, respectively). At present, two groups of women undergo induced abortion most commonly, i.e. 1) married or divorced women with two children and 2) young single childless women [3]. As for the distribution of induced abortions by number of born children, the leading group are again women with two children who undergo 35 % of all induced abortions while the groups of childless women and of women with one child undergo each 27 % of induced abortions. International comparison is difficult in view of the differences in the national regulations and reporting systems[4]. With the exception of Poland, the countries of the former socialist block have highly liberal abortion legislation. The rates of induced abortions in these countries are higher than in other European countries. In addition to the liberal abortion legislation, other causal factors are lower self-responsibility for reproductive behaviour and lower use of modern contraception in comparison with the West European countries.

The number of children conceived by assisted reproductive technologies is ever increasing and 3 % of Czech children are currently conceived in this way. In industrialized countries, about 15 % of the reproductive age couples are diagnosed with fertility disorders. Only 3 % of infertility cases are intractable [4].

9.3.2 Mother and child health

Not only within the reproductive health assessment extra attention is paid to death in children under one year of age, i.e. to infant mortality. The most commonly used indicator is the infant mortality rate defined as the number of deaths of children under 1 year of age per 1,000 live born infants in the given year. This indicator is also used to compare the level of socio-economic and socio-cultural development between countries and regions. In the Czech Republic, this rate was 3.3 ‰ in 2006, i.e. one of the lowest worldwide, and in this respect, the Czech Republic ranks among the most developed countries in the world. Fig. 9.11 shows the infant mortality rates in the Czech Republic as well as in the EU27 countries. In 2004, the average EU27 rate was 5.22 ‰, ranging from 3.2 ‰ (Sweden) to 16.8 ‰ (Romania).

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[1] *In the Czech Republic, induced abortions for health reasons were legalized since 1950 and induced abortions for other than health reasons were legalized since 1958.*

[2] *Incidence of abortions per woman during the fertile life span.*

[3] *In the Czech Republic, until 1990 induced abortion was considered as an ex post contraceptive method. Until the late 1980, the abortion and fertility indicators were correlated in a mirror manner, i.e. while one indicator was decreasing, the other one was increasing. At present these demographic indicators are independent from each other [2].*

[4] *In many European countries, induced abortions done by the vacuum aspiration method before the end of pregnancy week 8 have not been reported.*

Another reproductive health indicator, widely used for the international and worldwide comparison, is maternal mortality. It indicates the proportion of mothers who died during the pregnancy, childbirth or puerperium (ICD-10: diagnosis O00-O99) per 100,000 live born infants. This indicator is not relevant for small populations such as that of the Czech Republic owing to small absolute numbers (e.g. in 2006, nine maternal deaths were reported in the Czech Republic) and is used primarily for the reproductive health assessment in developing countries.

In developed countries, the focus is rather on the incidence of spontaneous abortions, preterm labours[5] and subsequent low birth weight (less than 2,500 g). The number of spontaneous abortions depends on the number of conceived children or pregnancies. To study the trends in spontaneous abortions, it is more appropriate to use indicators such as the spontaneous abortion rate (number of spontaneous abortions per 100 born infants) or the cumulative rate of spontaneous abortions (number of events per one woman aged 15–49 years). In the Czech Republic, the spontaneous abortion rates ranged over the studied period between 10 and 14 abortions per 100 born children (Fig. 9.9b). A negligible increase since the mid-1990s is associated with the ever increasing mean age of pregnant women. The proportion of pregnant women aged more than 30 years or even more than 35 years is rapidly increasing, but the optimum maternal age for a healthy uncomplicated pregnancy is expected between 20 and 25 years of age. In addition, even very early spontaneous abortions have been detected and reported over the last years [5]. Preterm labour is observed in about 6 % of pregnant women in the Czech Republic [6]. The percentage of children with low birth weight has a slightly upward tendency over the last years and was the highest in 2006 (Fig. 9.12) when 7.3 % of the born children had a birth weight under 2,500 g. This trend is explained again by changes in the reproductive behaviour towards pregnancy at older age associated with a higher risk (see the mean maternal age at childbirth, Tab. 9.3.2.1).

Tab. 9.3.2.1 Mean maternal age at childbirth, Czech Republic

Year	1990	2000	2006
Mean maternal age at childbirth	24.8	27.2	28.9
Mean maternal age at first childbirth	22.5	24.9	26.9

Source: Czech Statistical Office

9.3.3 Sexually transmitted diseases

The reproductive health assessment also includes the prevalence and incidence surveys of sexually transmitted diseases (STD). Of reportable STDs (i.e. ICD-10, diagnoses A50-A57), only syphilis and gonococcal infection have been reported since 1994. The incidence rates do not significantly vary over the last years and in 2006, the incidence rates were 4.9 cases per 100,000 population for syphilis and 10.5 cases per 100,000 population for gonococcal infection [7].

The highest reproductive health risk in most developed European countries is posed by HIV/AIDS. In the Czech Republic the cumulative number of HIV-positive individuals by December 2006 was 920 cases in both Czech citizens and long-term foreign residents. Most (79 %) of HIV positives were males. In 2006, 93 new HIV cases were diagnosed and the HIV incidence rate of 0.9/100,000 population is among the lowest in Europe (Fig. 9.13).

In the European region the HIV/AIDS epidemics poses the greatest problem in the population of the former USSR where the first HIV/AIDS outbreak started in the early 1990s among injection drug

[5] *According to the WHO definition, preterm infants are those born before the end of pregnancy week 37.*

users. The highest proportion of HIV positives (1 % of HIV-positive females and 2 % of HIV-positive males) live in the Ukraine, but the highest number of persons with HIV/AIDS (estimated to be 700,000 population) live in Russia. The ineffective health care system in this region is not able to fight this threat. In the Central European countries HIV/AIDS seems to be spread among the specific population groups, e.g. in Poland, exclusively among the injection drug users. Nevertheless, the general population is at high risk of being infected owing to high migration of people from Eastern Europe and Central Asia. In Western Europe the most serious situation is in Spain, Italy, Portugal and Switzerland where HIV/AIDS is most widespread among homosexuals and bisexuals as well as injection drug users; the general population is also increasingly afflicted [8].

9.4 Partial conclusions

Although the lifelong prevalence of allergic diseases in children is as high as 32 % in the Czech Republic, not all allergic children suffer from allergic manifestations thanks to effective treatment. The asthma control test has shown full asthma control in as many as 44 % of asthmatic patients. Based on the results of the studies performed in 1996, 2001 and 2006, the prevalence of allergic diseases in children increased from 17 % to 32 % over the last decade. Allergic diseases are increasingly detected in younger children. Positive is the downward trend in the number of smoker households and pets in the families with allergic children.

More than half of the adult population in the Czech Republic rate their health as good and very good, one third of the adult population consider their health as average and 7 % of the adult population only perceive their health as poor or very poor. Females rate their health as poorer than males. Health self-assessment was negatively influenced by a history of hypertension and overweight/obesity. Hypertension has been diagnosed in almost a quarter of the Czech adult population. At younger age, hypertension is more common in males than females while at older age, hypertension is more common in females. One of possible explanations is that at older age women compared to men pay more attention to their health and thus are more often diagnosed with hypertension than men. In general, hypertension prevalence increases with increasing age: more than half of the population aged 65 years or more are hypertensive. Three quarters of hypertensive patients use antihypertensive drugs.

More than one third of the adult population in the Czech Republic are overweight and at least 14 % are obese. Owing to the use of the interviewer administered questionnaire, the obesity prevalence is likely to be underreported. A significantly higher proportion of hypertensive patients was found in the overweight/obesity group.

Often in developed countries, adequate attention has not been paid to reproductive health assessment as part of health assessment. Health care provided to mother and fetus/infant is at a high level but the current trends in reproductive behaviour (increasing maternal age at first childbirth) in developed countries bring about multiple problems such as the need for infertility therapy, higher incidence of spontaneous abortions, high-risk pregnancy and preterm labour and the need for providing care to preterm infants. Another serious health problem is the HIV spread. Reproductive health in the Czech Republic is comparable with that in the developed European countries, the only difference is the higher rate of induced abortions performed for other than health reasons in the Czech Republic.

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Fig. 9.1 Results of Asthma Control Test, 2006

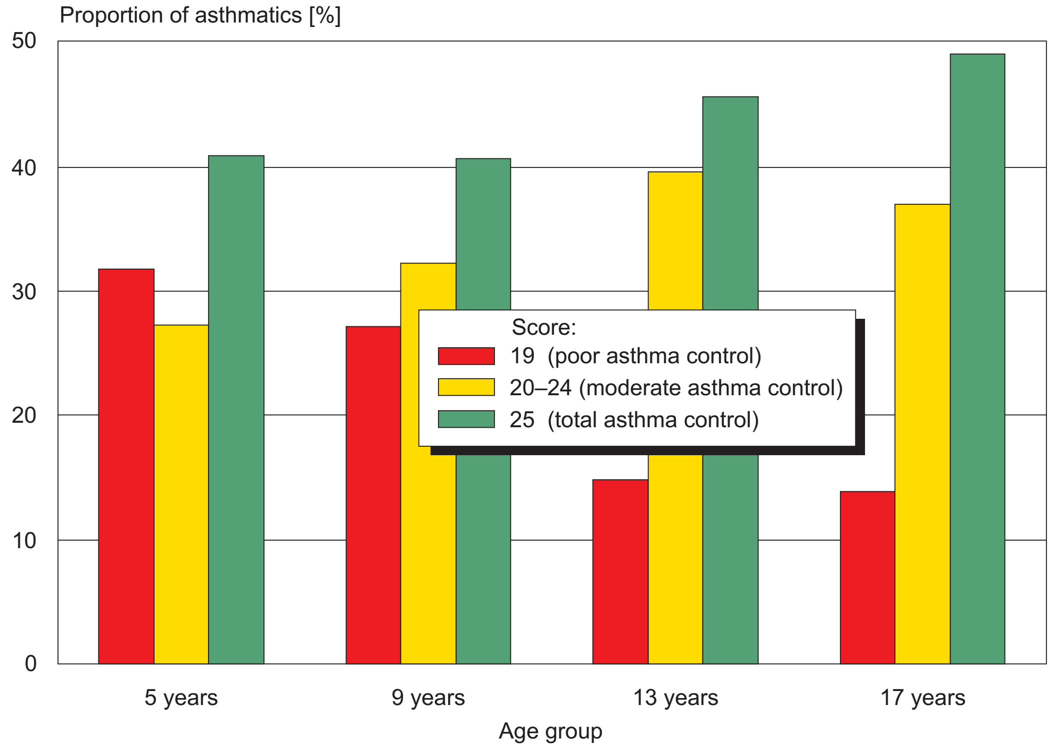


Fig. 9.2a Time trends in asthma prevalence, 1996–2006

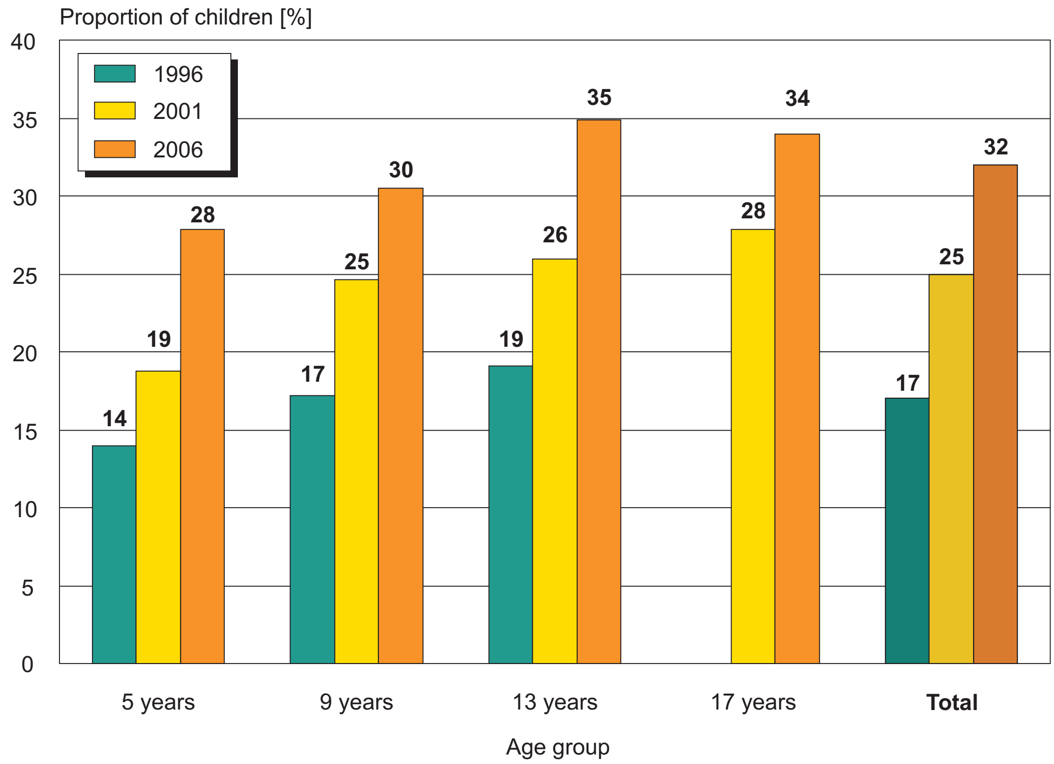


Fig. 9.2b Time trends in prevalence of allergic diseases in 5–13 years old children

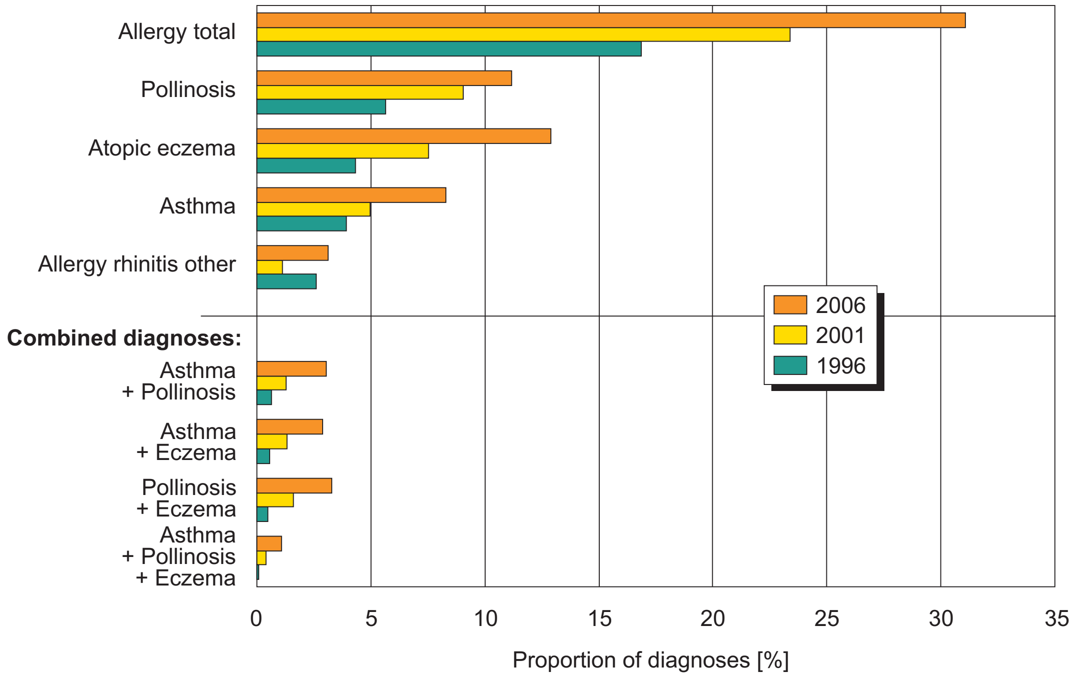


Fig. 9.3 Prevalence of non-specific symptoms in children (signs of potential allergic disease)

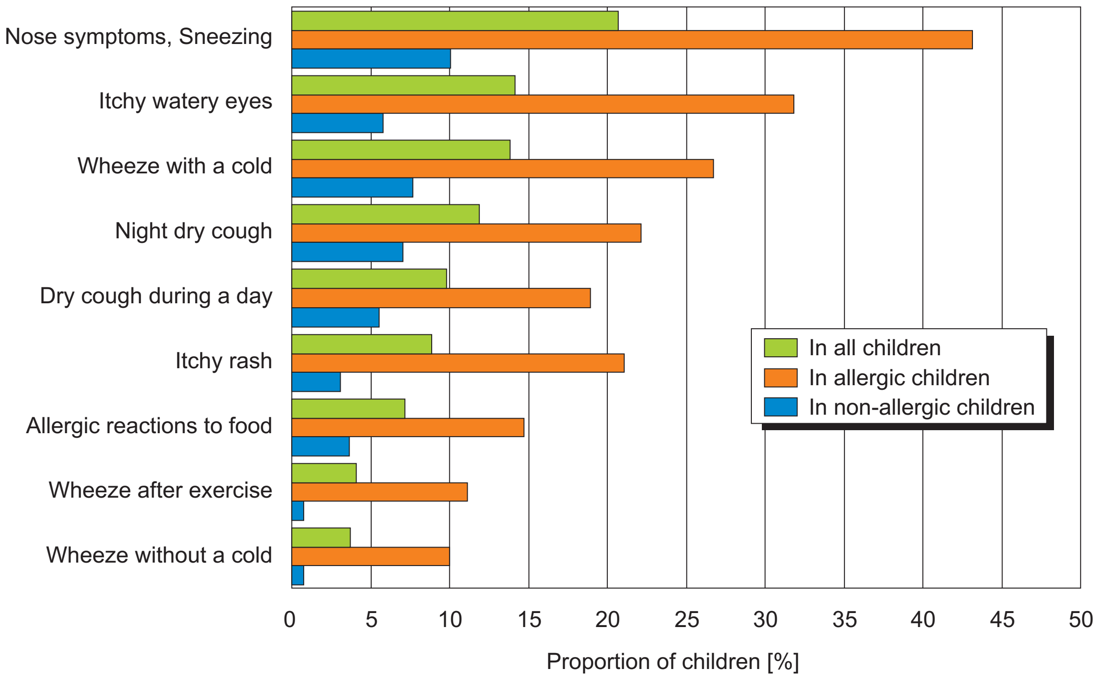


Fig. 9.4 Age of the 5-year-old children in which allergy was detected, 1996–2001–2006

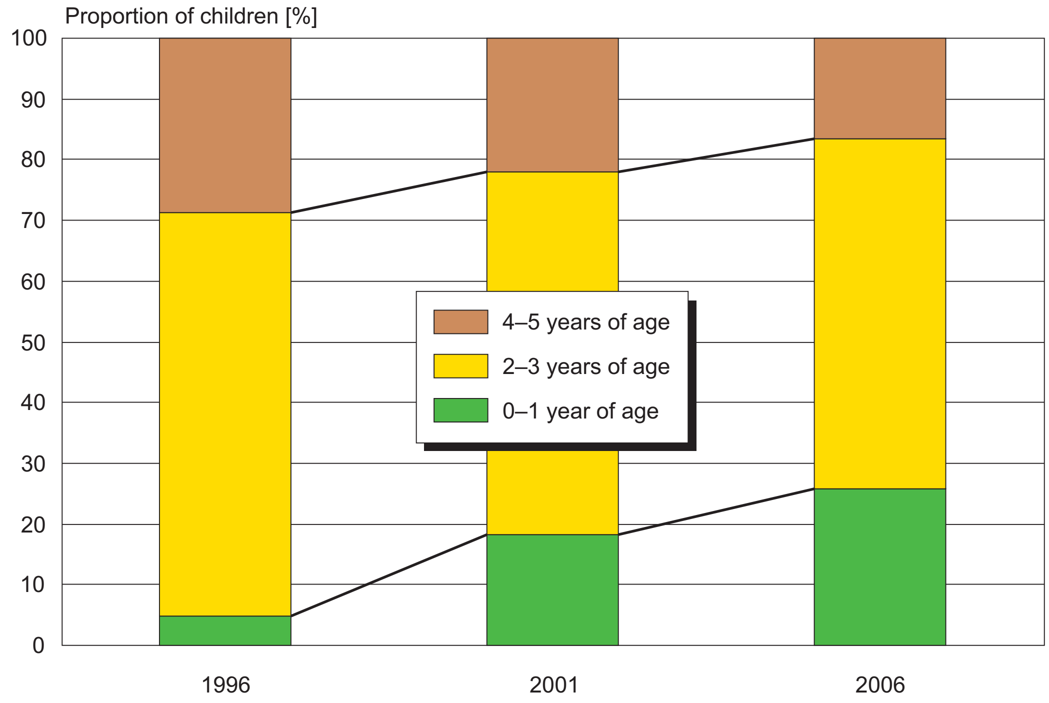


Fig. 9.5 Number of allergic children sensitive to allergens according to the skin prick test

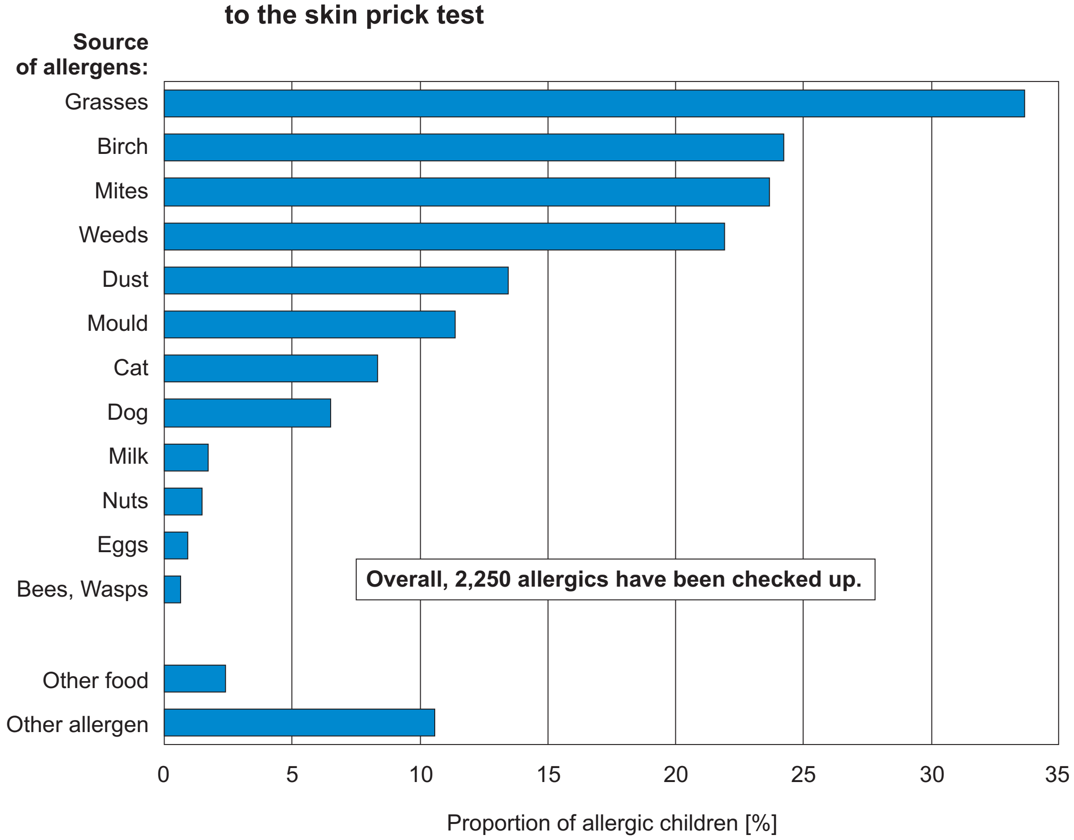


Fig. 9.6a Subjectively perceived health in Czech adult population

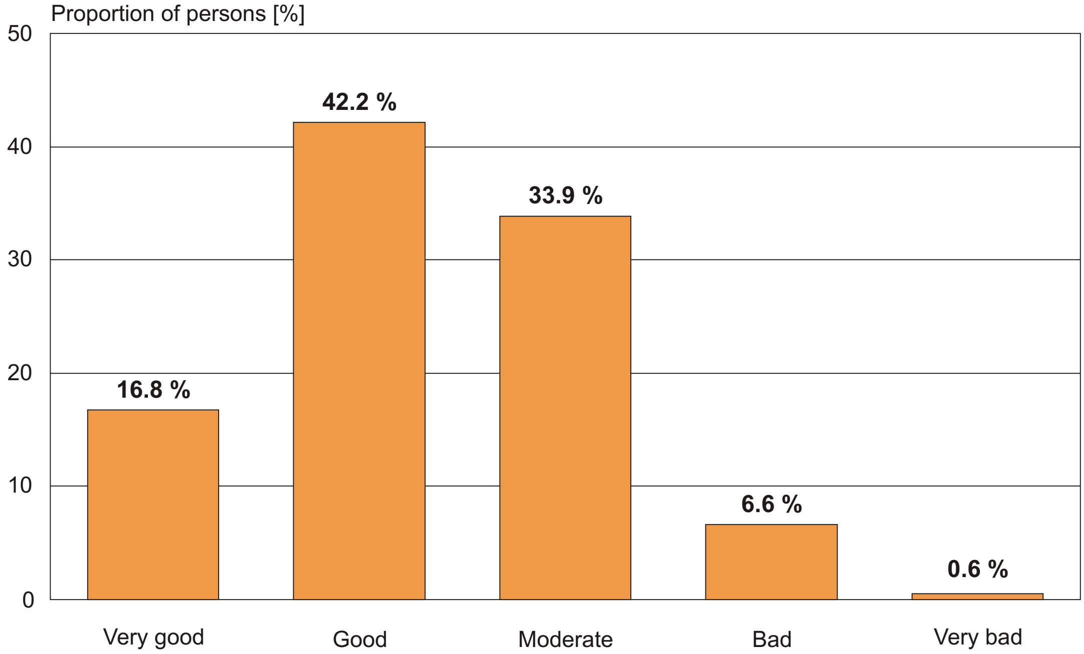


Fig. 9.6b Subjectively perceived health in relation to age

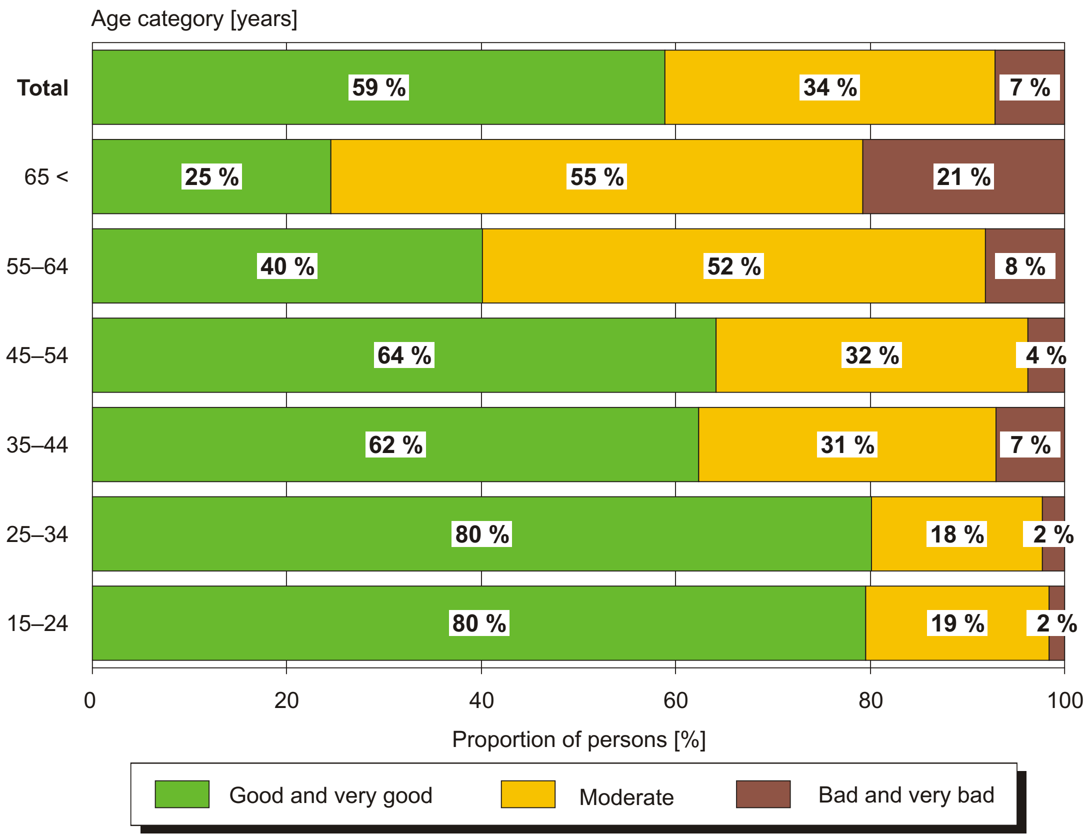


Fig. 9.7 Prevalence of high blood pressure in relation to age
(based on respondent's statement on a diagnosed hypertension)

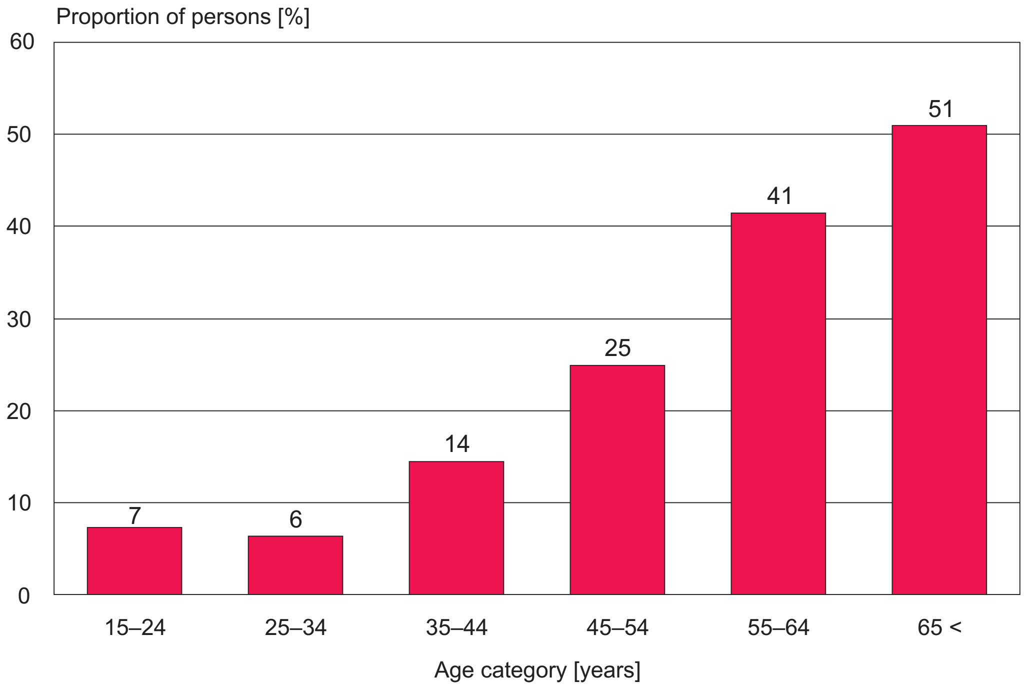


Fig. 9.8 Prevalence of overweight and obesity in relation to gender and age

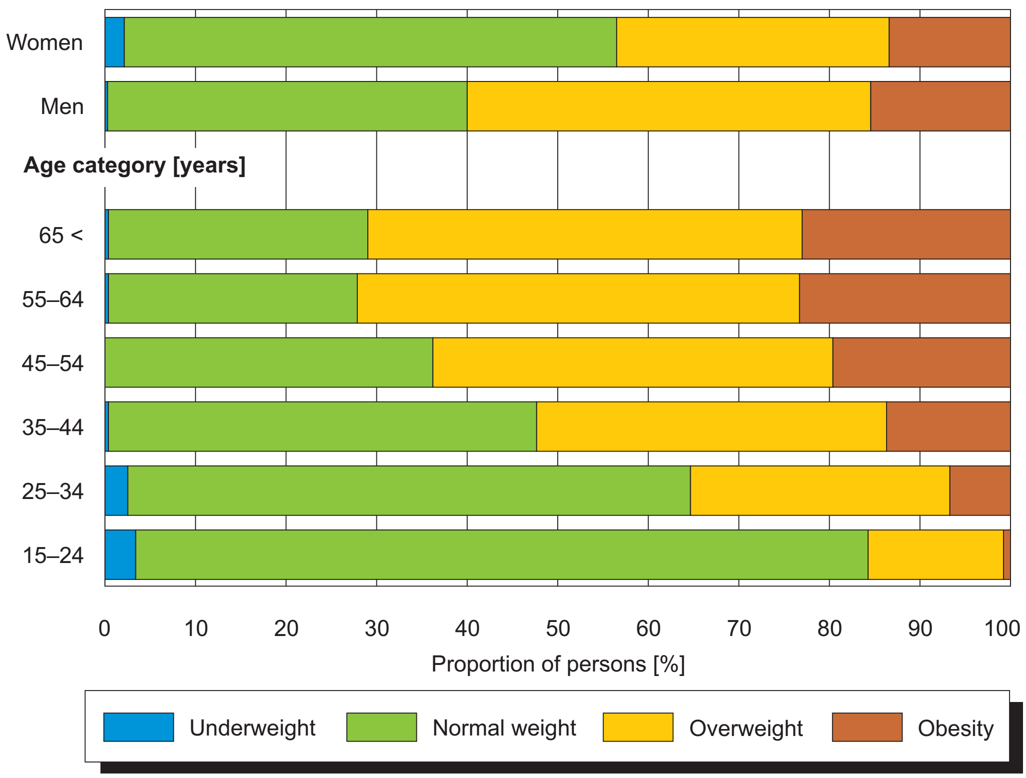
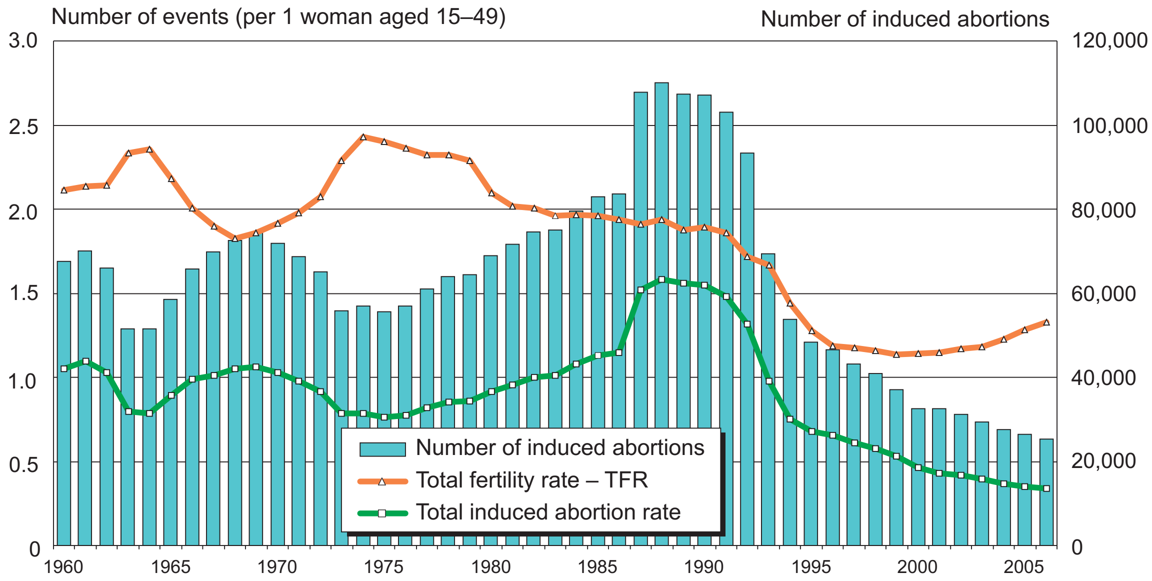
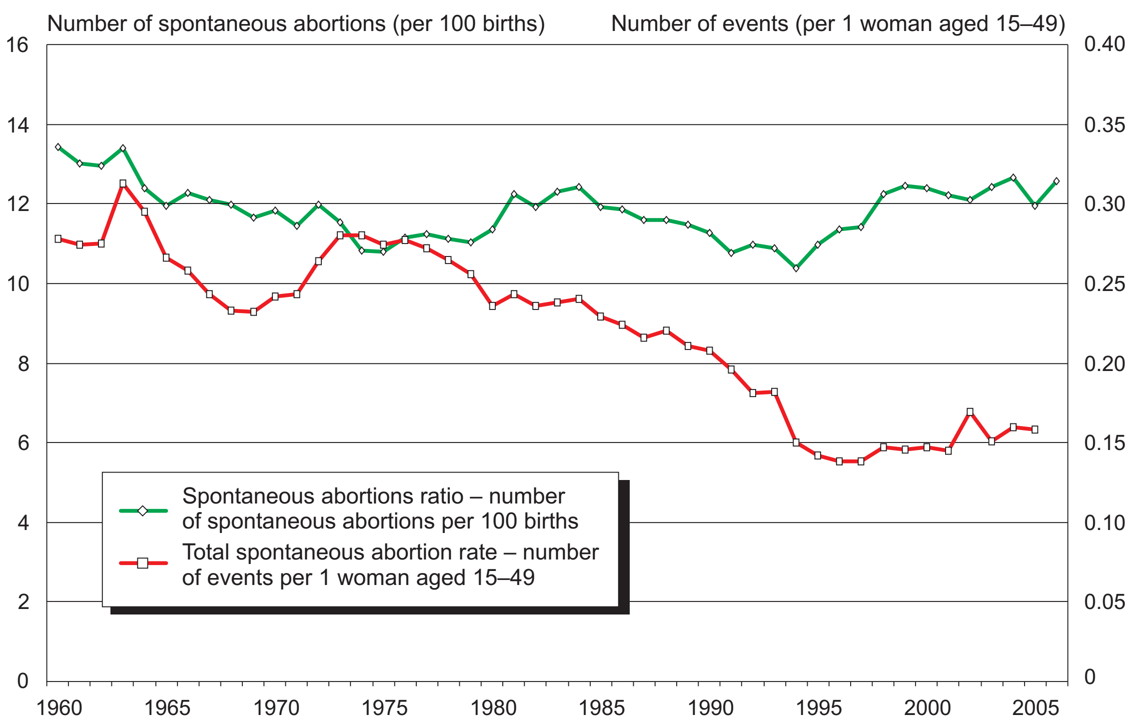


Fig. 9.9a Total fertility rate (TFR) and total induced abortion rate in the Czech Republic, 1960–2006



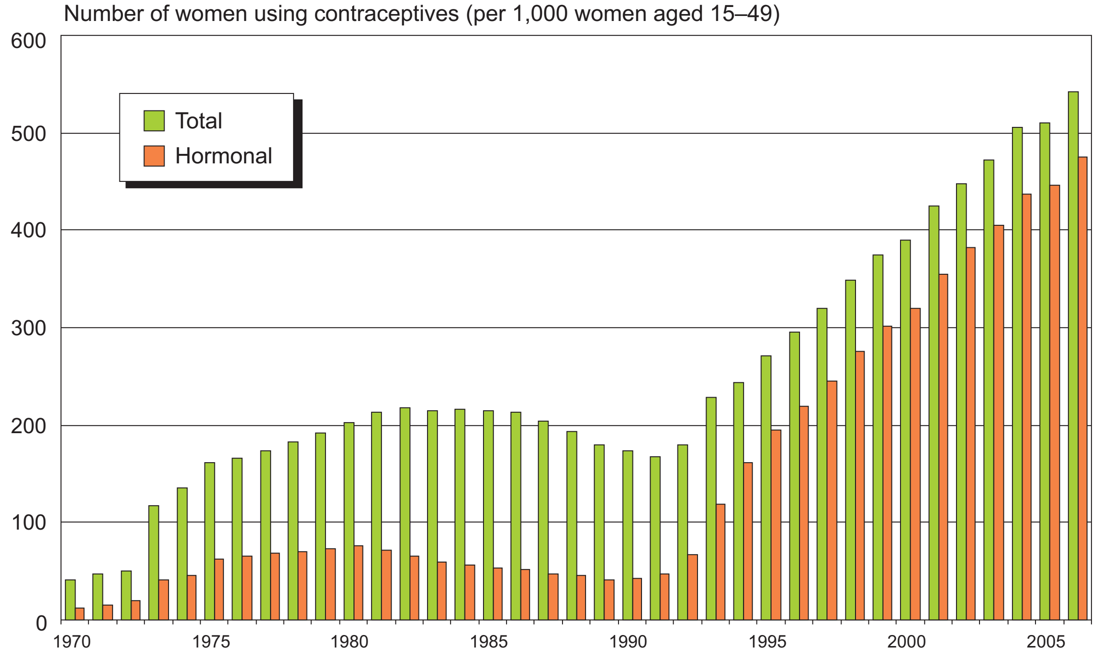
Source: Czech Statistical Office

Fig. 9.9b Trends in spontaneous abortions in the Czech Republic, 1960–2006



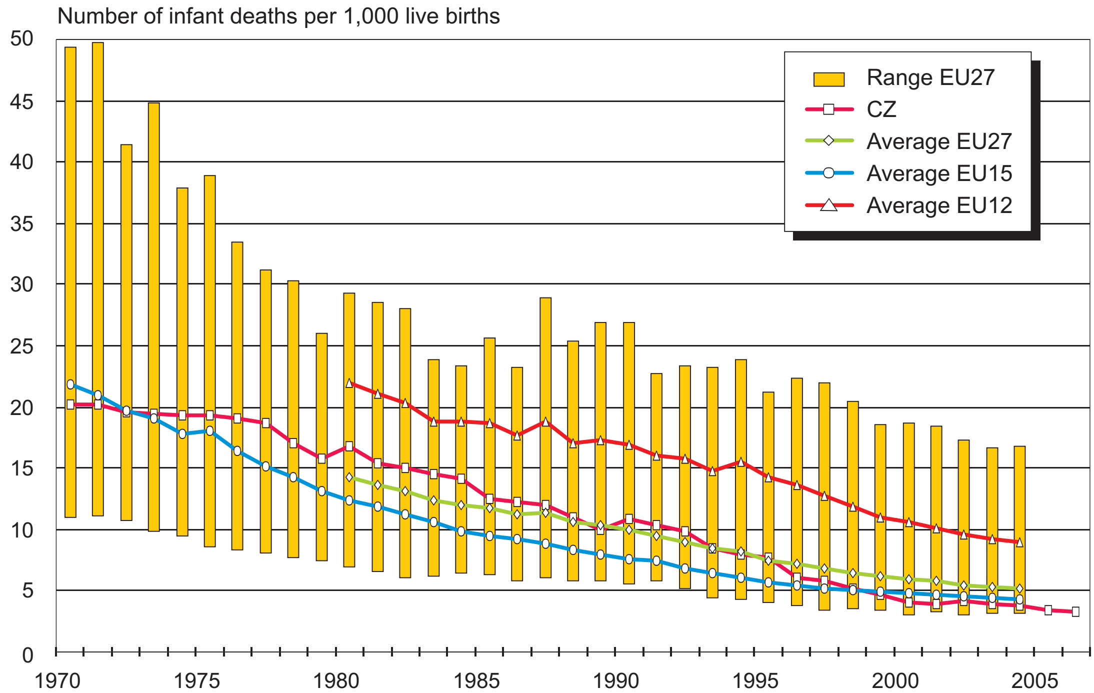
Source: Czech Statistical Office

Fig. 9.10 Trends in contraceptive use in the Czech Republic, 1970–2006



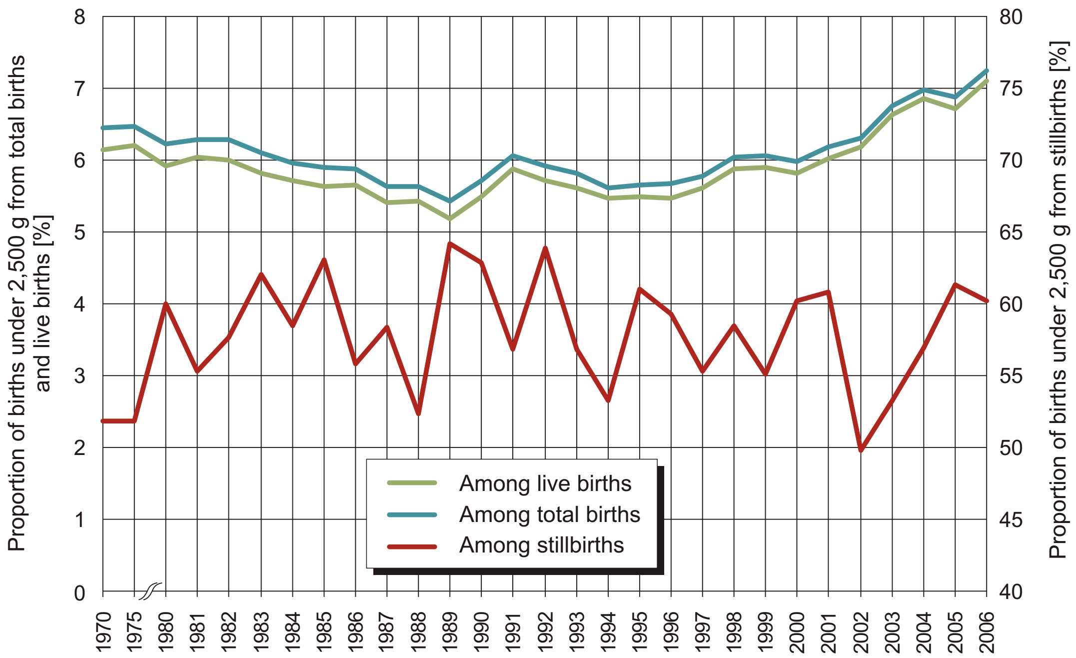
Source: Czech Statistical Office

Fig. 9.11 Trends in infant mortality rate in the Czech Republic and in Europe, 1970–2006



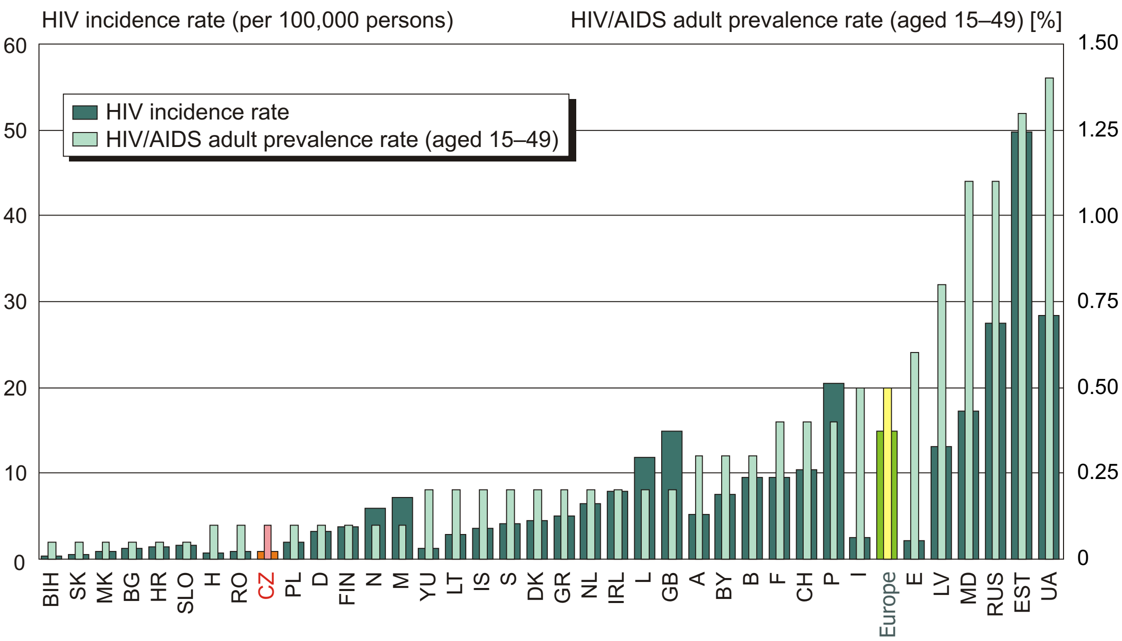
Source: Czech Statistical Office, WHO

Fig. 9.12 Proportion of births under 2,500 g in the Czech Republic, 1970–2006



Source: Czech Statistical Office

Fig. 9.13 HIV/AIDS prevalence and incidence rate in Europe, 2005–2006



Note: A – Austria, B – Belgium, BG – Bulgaria, BIH – Bosnia and Herzegovina, BY – Belarus, CZ – The Czech Republic, D – Germany, DK – Denmark, E – Spain, EST – Estonia, F – France, FIN – Finland, GB – The United Kingdom, GR – Greece, H – Hungary, HR – Croatia, CH – Switzerland, I – Italy, IRL – Ireland, IS – Iceland, L – Luxembourg, LT – Lithuania, LV – Latvia, 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, UA – Ukraine, YU – Serbia and Monte Negro

Source: WHO-HFA, PRB

10. OCCUPATIONAL HEALTH HAZARDS AND THEIR CONSEQUENCES

10.1 Organization of monitoring

Subsystem VII of the Environmental Health Monitoring System is concerned with monitoring the occupational environment and factors related to health damage caused by occupational exposure. The Subsystem is divided into three relatively independent sections:

- Exposure monitoring based on data from workplace categorisation as defined by existing legislation.
- Registry of workers occupationally exposed to chemical carcinogens (REGEX). The aim of this section comprises not only data collection, but also health impact evaluation based on the incidence of malignant carcinomas including both carcinoma-linked and overall mortality rates.
- Monitoring of occupational exposure health effects as related to occupational disease and risk of occupational disease – National Register of Occupational Diseases (NRNZP). This register is part of 13 national health registers formed by the National Health Information System.

10.2 Exposure monitoring based on data from workplace categorisation

Under workplace categorization, the responsibility of each employer is to evaluate occupational risk and categorize the relevant work performed under 1 of 4 categories – as related to incidence of occupational risk factors and their importance. Data from the Categorization Data System reveals that up to 15. 5. 2008, a total of 1,865,774 persons are included in all work categories (categories 2, 2R, 3, 4), i.e. 20,061 persons/100,000 employees. In the work under risk (categories 2R, 3, 4) 438,832 persons were registered, i.e. 4,718 persons/100,000 employees. In the highest risk level 18,479 persons (199/100,000 employees) were registered, of which 1,636 are females.

Tab. 10.2.1 Number of employees in work categories by regions, on May 2008

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 of Prague	198,048	88,477	161,712	76,542	1,704	609	33,714	11,028	918	298
Central Bohemian	199,561	72,316	156,444	60,611	7,179	2,027	34,737	9,527	1,201	151
South Bohemian	106,949	43,304	79,149	34,402	523	351	26,266	8,489	1,011	62
Plzeň	113,163	46,818	88,782	40,057	750	278	22,390	6,327	1,241	156
Karlovy Vary	65,580	30,042	56,108	26,962	303	53	9,041	3,024	128	3
Ústí nad Labem	169,297	69,860	128,600	56,709	5,263	1,628	34,502	11,392	932	131
Liberec	85,886	36,390	68,121	30,035	623	224	16,467	6,038	675	93
Hradec Králové	105,298	44,291	82,257	36,832	3,550	1,226	18,607	6,167	884	66
Pardubice	88,137	34,186	65,409	28,176	4,310	946	17,708	4,890	710	174
Highlands	109,694	36,762	83,670	30,054	5,450	1,829	19,734	4,797	840	82
South Moravian	180,810	72,992	146,892	63,325	2,571	1,087	30,416	8,495	931	85
Olomouc	106,357	42,685	79,103	35,061	3,457	1,492	22,989	6,005	808	127
Zlín	101,512	44,370	77,534	35,056	2,196	1,360	21,310	7,928	472	26
Moravian-Silesian	235,482	84,299	153,161	66,729	6,484	2,883	68,109	14,505	7,728	182
Total	1,865,774	746,792	1,426,942	620,551	44,363	15,993	375,990	108,612	18,479	1,636

Note: category 2 – non-hazardous work, category 2R – potentially hazardous work, category 3 and 4 – hazardous work.

The total sum of employees categorized by region is presented in Tab. 10.2.1. The greatest amount of exposed workers in the risk category (2R, 3, 4) is in the Moravian-Silesian region (82,321), Central Bohemia (43,117) and Ústí nad Labem (40,679) (Fig. 10.1a). The nationwide mean of 4,718 per 100,000 employees is not exceeded by the following regions: Prague (1,516), South Bohemia (3,666) and Karlovy Vary (4,177) (Fig. 10.1b).

The majority of employees in all work categories (2, 2R, 3, 4) is registered in the following categories: Physical load – 928,179 persons, Noise – 740,920 persons, Occupational posture – 733,009 persons, and Mental load – 698,820 persons. In the occupational risk category (2R, 3, 4) the majority of categorized employees is in the category Noise – 262,322 persons, Physical load – 71,666 and Dust – 70,793, see Tab. 10.2.2 and Fig. 10.1c.

Tab. 10.2.2 Number of employees exposed to risk factors, on May 2008

Factor	Work category of a factor				Totally in hazardous work categories (2R + 3 + 4)
	2	2R	3	4	
Noise	478,598	27,565	232,815	1,942	262,322
Mental load	856,513	6,364	64,967	335	71,666
Dust	205,350	7,222	53,447	10,124	70,793
Vibrations	114,581	5,076	45,986	7,264	58,326
Psychic load	655,626	1,683	41,511	0	43,194
Biological agents	112,964	8,606	32,929	479	42,014
Chemical substances	177,322	8,086	19,921	1,385	29,392
Occupational posture	713,348	1,342	18,319	0	19,661
Non-ionizing radiation and electromagnetic field	15,635	3,271	14,685	0	17,956
Heat load	66,912	666	14,616	52	15,334
Visual load	280,904	481	9,605	0	10,086
Selected jobs	42,170	272	5,407	98	5,777
Cold load	188,173	83	1,728	0	1,811
Ionizing radiation	671	348	31	0	379

Note: Selection criteria – works valid till 15. 5. 2008. Registered according to the final work category.

Occupational load may comprise more than one factor. Tab. 10.2.3 presents data on exposed persons related to the number of factors involved. This shows that 57 % of employees are exposed to more than one factor and 10.5 % are exposed to more than four factors.

Tab. 10.2.3 Number of employees with concurrently acting risk factors

No. of risk factors	No. of exposed employees
1	611,149
2	514,846
3	335,307
4	208,876
More	195,596
Total	1,865,774

The presented data of registered persons is not immutable; in the next phase, there will undoubtedly be changes as regards workplaces, protective measures for risk-reduction and associated changes in work categories. In time, we face legislative measures which comprise an updated understanding of the effects of pollutants on humans.

10.3 Register of occupational exposure to carcinogens: REGEX

The register currently contains 17,400 records on a total of 8,105 persons occupationally exposed to carcinogens; 3,785 persons have been added to this register during the period under study. New registrations have totalled 1,134. A number of updated records on already registered persons is 2,651.

All available and useable data were transferred to the Institute of Health Information and Statistics which was asked to produce follow-up data concerning overall mortality in the cohort, mortality from malignant carcinoma and incidence of malignant carcinoma. A detailed description of this cohort in relation to the incidence of malignancies will be the subject of a future report.

10.4 Monitoring of health effects – National Register of Occupational Diseases

In 2007, a total of 1,063 employees with 1,291 cases of occupational disease (753 in men, 538 in women) was reported to the National Register of Occupational Diseases; of this, 1,228 cases were deemed occupational disease and 63 cases as a threat of occupational disease. The incidence was 28.6 cases per 100,000 medically-insured employees. The development of occupational disease is presented in Tab. 10.4.1 and Fig. 10.2a.

Tab. 10.4.1 Reported cases of occupational diseases in 1997–2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of patients	2,326	2,801	1,863	1,713	1,661	1,567	1,506	1,316	1,317	1,122	1,062
Occupational diseases total	2,376	2,111	1,886	1,751	1,677	1,600	1,558	1,388	1,400	1,216	1,291
– occupational diseases	2,350	2,054	1,845	1,691	1,627	1,531	1,486	1,329	1,340	1,150	1,228
– occupational diseases threat	26	57	41	60	50	69	72	59	60	66	63
Occupational diseases – males	1,551	1,261	1,192	1,104	1,034	977	972	826	817	708	753
Occupational diseases – females	825	850	694	647	643	623	586	562	583	508	538
Incidence rate per 100,000 medically-insured employees	49.1	44.1	41.1	38.7	37.4	35.8	35.1	31.6	31.5	27.5	28.6

The majority of occupational diseases was reported from the Moravian-Silesian and South Bohemian regions (25.5 % and 11.3 % of all cases). The most frequent cause of occupational disease in the Moravian-Silesian region was disease caused by physical factors (228 cases), mainly comprising dysfunction caused by vibration or excessive load on the extremities. In the South Bohemian region the main causes were transmitted and parasitic diseases, in this case mainly scabies. Occupational diseases by region are presented in Tab. 10.4.2 and Fig. 10.2b.

The majority of reported occupational diseases occurred in 'manufacture of metal products and constructions' (167 cases, 12.9 %). Here the major complaints were diseases associated with vibration, excess load on extremities and the skin. The sectors of health, social and veterinary care' and 'coal-mining' were in second and third place. The most frequent disease in health-care workers in 2007 was scabies (78 cases) and pneumoconiosis in coal-miners (62 cases).

The majority of occupational diseases (53 %) in 2007 were caused by physical factors. The ratio of other diseases is presented in Fig. 10.2c.

The most common individual diagnosis of occupational disease was that of carpal tunnel syndrome, caused by vibration or excessive load on the extremities (355 cases). In second and third places were allergic dermatitis and scabies (143 and 81 cases). Endangered by carpal tunnel syndrome were 33 persons.

Tab. 10.4.2 Distribution of occupational diseases according to regions and chapters of the List of occupational diseases

Region	Chapter						Total
	I	II	III	IV	V	VI	
Capital City of Prague	1	17	5	8	6		37
South Bohemian	1	86	7	12	40		146
South Moravian	2	22	22	10	16		72
Karlovy Vary		7	4	7	1		19
Hradec Králové		33	10	18	4		65
Liberec		34	9	10	1		54
Moravian-Silesian	2	228	55	19	25		329
Olomouc		47	14	19	5		85
Pardubice	8	19	8	21	4		60
Plzeň	4	72	11	8	11		106
Central Bohemian	1	49	53	12	7		122
Ústí nad Labem	1	31	6	32	20		90
Highlands	1	15	2	10	7		35
Zlín	2	20	6	10	5		43
Not differentiated		3		1			4
Work abroad					24		24
Total	23	683	212	197	176	0	1,291

Chapters in the List of occupational diseases:

I – Occupational diseases caused by chemical agents
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

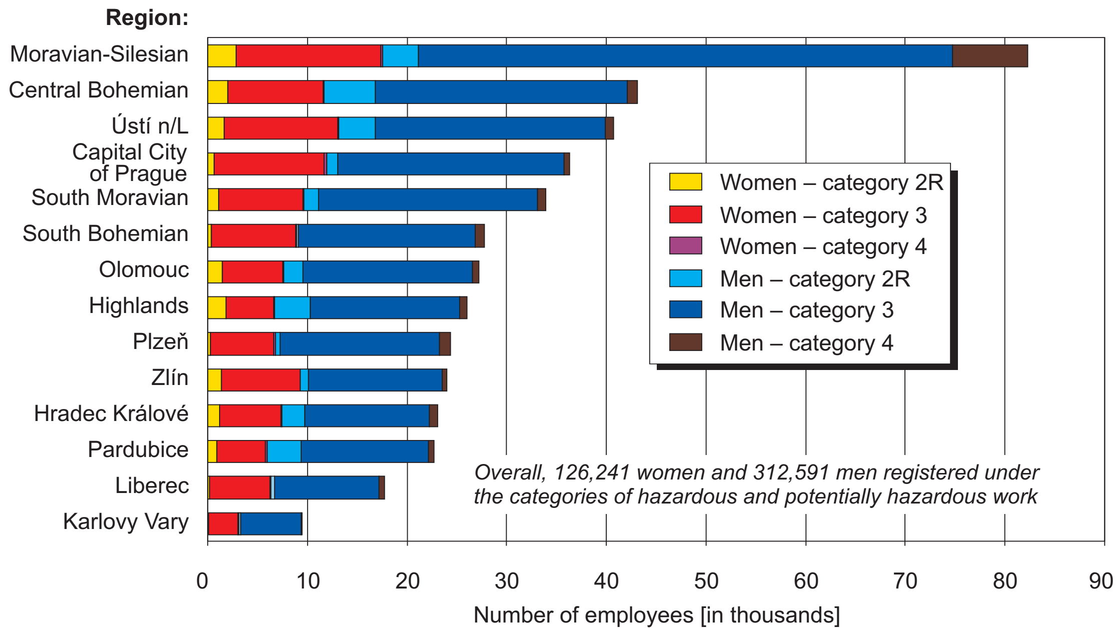
10.5 Partial conclusions

In 2007, exposure monitoring was carried out based on work categorization as stipulated by public health organs. Solutions were based on newly incepted work situations and newly categorized work, in line with updated regulations. By May 2008, 38 % of employees were registered in the information system. In the past year, there has been an increase in registered persons from separate workplaces, although not as great as in recent years; this will be due to the stabilization of the categorization system and the gradual inclusion of existing occupational branches.

The volume of data accumulated in REGEX is such that soon it will be possible to conduct effective analyses of the cohort's health condition as a whole, but also the same service for numerous occupational groups such as health-care providers. To ensure the full functioning of REGEX, continued efforts will be necessary to cover the entire territory of the Czech Republic and, if possible, all occupations involving exposure to carcinogens.

The monitoring results indicate that the number of reported cases of occupational disease dropped by 60 persons (5.3 %) in 2007 against the previous year. The total amount of reported cases of occupational disease increased by 75 in 2007 (6.2 %). This increase is caused by a change in the regulations for reporting motor apparatus disease to the NRNZP. An increase was noted in reported cases of vibration damage and excess load of the extremities. However, in comparison to 2006, fewer cases of skin disease, anthropomorphosis and allergic rhinitis were reported.

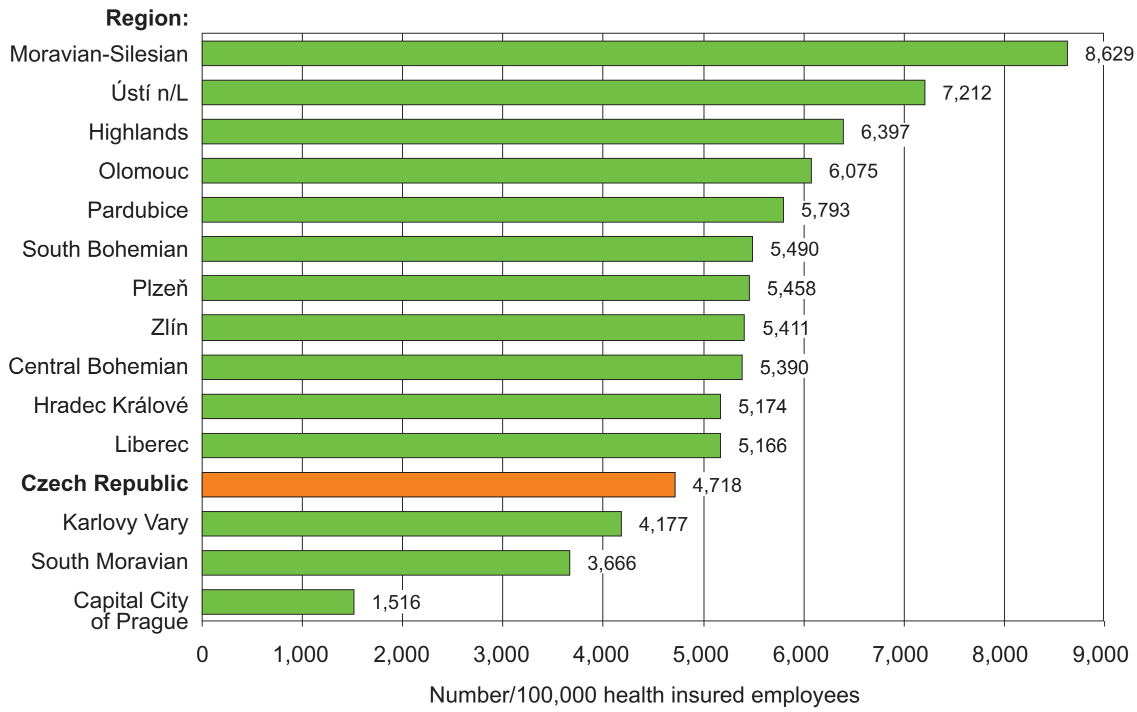
Fig. 10.1a Employees registered under the categories of potentially hazardous and hazardous work in regions, on May 15, 2008



Note: work category 2R – potentially hazardous work, category 3 and 4 – hazardous work

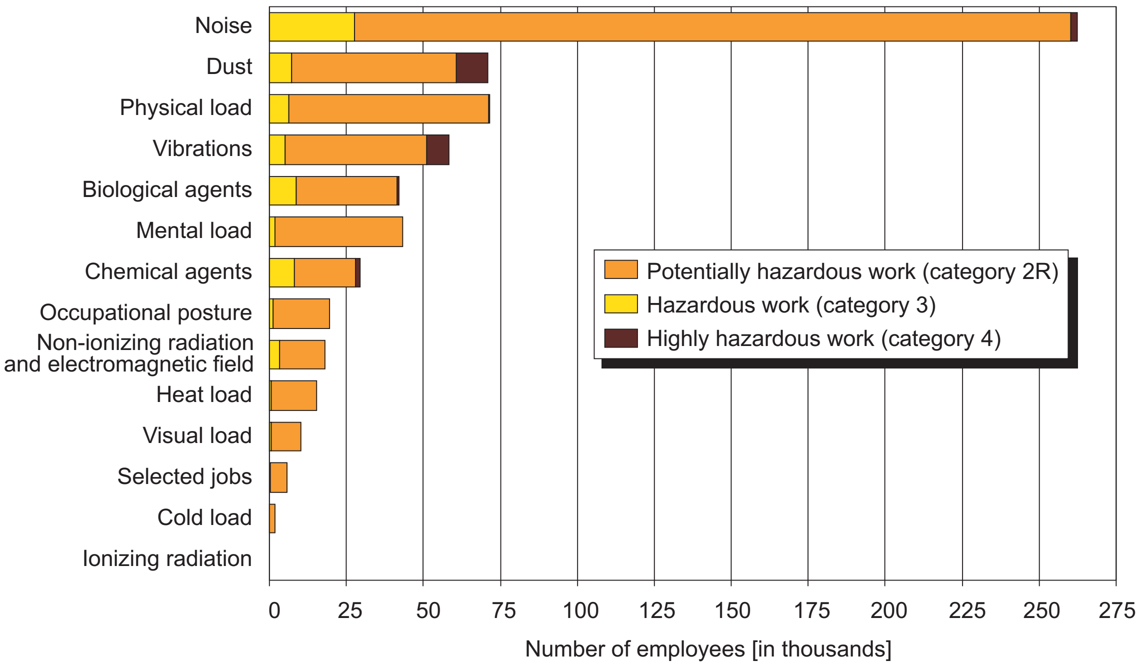
Source: Information system of work categorization

Fig. 10.1b Employees registered under the categories of potentially hazardous and hazardous work per 100,000 employees, on May 15, 2008



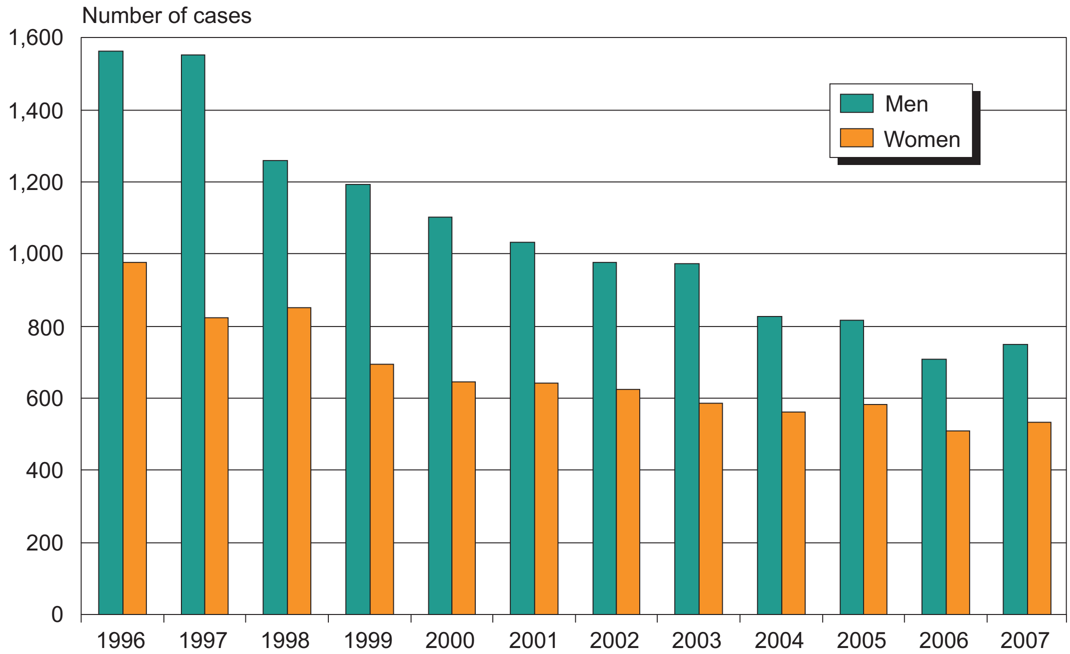
Source: Information system of work categorization

Fig. 10.1c Employees registered under the categories of hazardous work according to a risk factor, on May 15, 2008



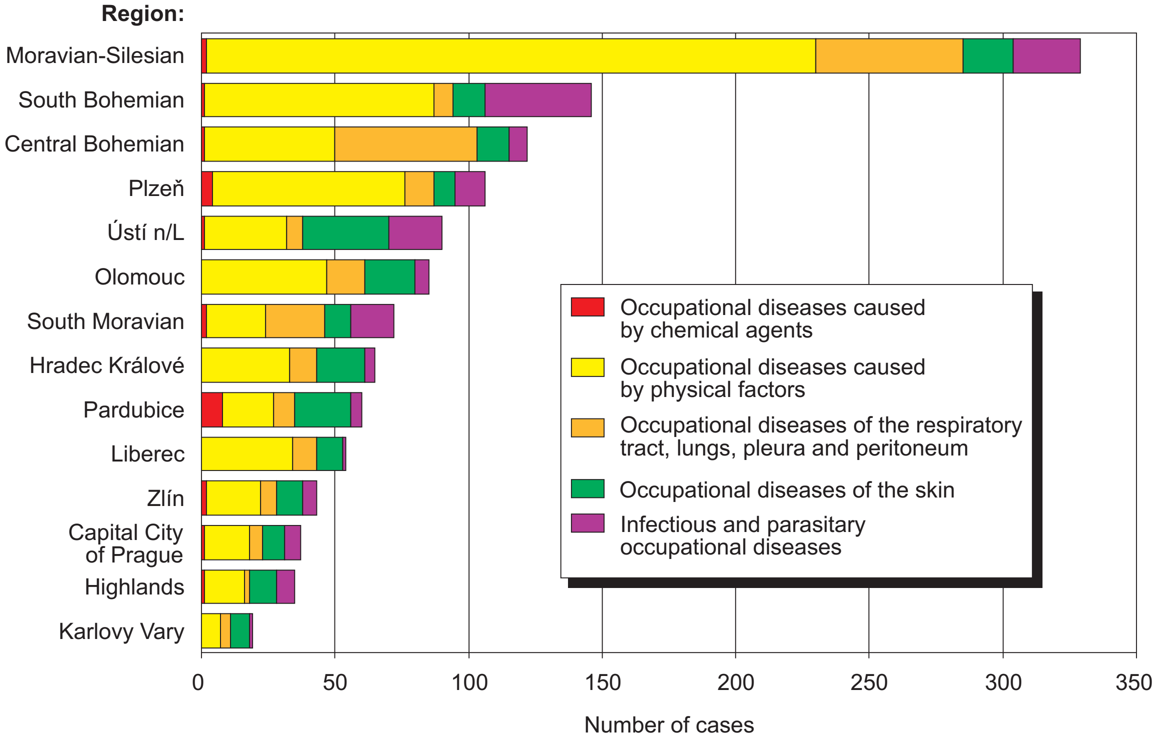
Source: Information system of work categorization

Fig. 10.2a Time trends in notified occupational diseases in the Czech Republic, 1996–2007



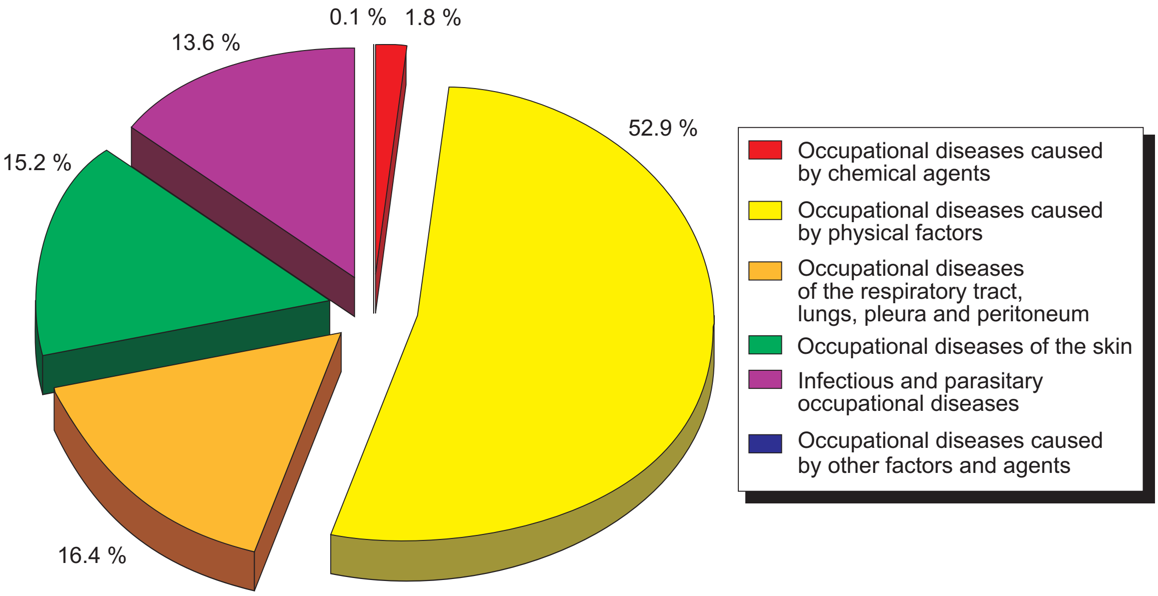
Source: National Register of Occupational Diseases

Fig. 10.2b Notified occupational diseases in regions, 2007



Source: National Register of Occupational Diseases

Fig. 10.2c Distribution of occupational diseases according to the List of occupational diseases



Source: National Register of Occupational Diseases

11. HEALTH RISKS FROM CONTAMINATED SOIL IN URBAN ENVIRONMENT

11.1 Organization of monitoring

The subsystem includes monitoring of urban upper soil contamination to assess the health risks resulting from the exposure to toxic substances from unintentional soil and dust consumption. Because preschool children are at the greatest risk, the project was focused on daycare playgrounds.

Over the monitoring period 2002–2006, the sampling in a total of 413 daycare centres in 38 cities was performed according to the Standard Operating Procedures for sampling, transport and soil sample analyses. Sampling was performed at a 10 cm depth from five sampling points on the outdoor daycare centre area. After homogenization of the samples from the sampling points, an analysis of composite samples was performed for selected contaminants. Each daycare was thus represented by one composite sample. The monitored chemicals were as follows: metals – lead, chromium, arsenic, cadmium, beryllium, vanadium, mercury and copper; polycyclic aromatic hydrocarbons – naphthalene, acenaphthalene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, 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[*g,h,i*]perylene. The elevated concentration values were mainly related to arsenic, lead, benzo[*a*]pyrene and locally also beryllium.

In 2007, the study was focused on a detailed evaluation of the children's risk from arsenic exposure in the most polluted daycare centres known from previous monitoring. Three such polluted cities were selected: Příbram (with old environmental burden due to mining activities), Teplice, and Klatovy (coal burning as probable source of As). The South Bohemia regional metropolis České Budějovice served as a "reference" city.

11.2 Methods of study

The study was performed in a total of 12 daycare centres (three daycares in each city), with a total number of 192 children. Forty two children were involved in Příbram, 59 in Teplice, 53 in Klatovy and 38 children in České Budějovice. The study was comprised of soil samplings and the analyses of soil arsenic concentration, as well as a determination of the arsenic level in the childrens' urine (as arsenic total). A supporting questionnaire was completed by the parents with the cooperation of the daycare's management after training by the staff of a relevant public health institute. The data necessary to estimate exposure levels and the health risk assessment were thereby obtained. Results of the analyses and the questionnaire data were statistically processed with the aid of an χ-quadrate independency test and a Kruskal-Wallis test. The tests were performed on the level of statistical significance $p < 0.05$.

11.3 Results

As expected, the highest arsenic concentration in the daycare's playground upper soil was determined in Příbram. An increased arsenic content was also found in Teplice. In one of three daycares in the "reference" city of České Budějovice the arsenic content was markedly enhanced in comparison with the other ones in this city. Soil arsenic concentrations in all monitored localities are shown in Tab. 11.3.1. The limit values of chemical content in non-contaminated residential soils for the purpose of health risk management are not available yet in the Czech Republic. The values obtained can be compared with standards set in the Decree of the Ministry of Health 135/2004 Coll. for sandpits (10 mg/kg), or with limit values valid in other European countries.

Tab. 11.3.1 Arsenic concentration in upper soil on the daycare playgrounds (in mg/kg)

	České Budějovice	Klatovy	Teplice	Příbram
Daycare centre A	17.9	9.7	44.3	59.9
Daycare centre B	9.7	10.3	32.8	105.8
Daycare centre C	8.6	15.5	35.0	165.0
Arithmetic mean	12.1	11.8	37.4	110.2
Standard deviation	4.1	2.6	5.0	43.0

Urine arsenic levels in children from Příbram were significantly higher compared to levels in children from the other monitored cities. The mean concentration there amounted to 7.9 µg arsenic per gram creatinine (95% confidence interval 7.1; 8.7). A significant difference in urine arsenic levels between children from the other three cities (Klatovy, Teplice and České Budějovice) was not found; the mean concentration amounted to 5.0 µg per gram creatinine in these three cities (95% confidence interval 4.0; 5.9). The urine arsenic levels in children from all monitored cities are shown in Tab. 11.3.2. In Příbram, the highest number of children (8 from the total of 42, i.e. 19 %) had urine arsenic levels in excess of the recommended value of 10 µg per gram of creatinine for the non-professionally exposed population. In other cities, this value was exceeded in only sporadic cases. The significant difference in urine arsenic levels between boys and girls was not confirmed.

Tab. 11.3.2 Urine arsenic levels in children (in µg/g creatinine)

	České Budějovice	Klatovy	Teplice	Příbram
Daycare centre A	N = 13	N = 24	N = 22	N = 11
Arithmetic mean	**4.0**	**5.0**	**5.3**	**9.7**
Range min-max	2.2–5.5	2.3–8.7	2.7–8.4	4.0–16.4
Daycare centre B	N = 6	N = 4	N = 15	N = 14
Arithmetic mean	**8.3**	**4.6**	**4.6**	**8.1**
Range min-max	4.3–15.4	2.8–5.9	2.0–18.0	4.4–14.0
Daycare centre C	N = 15	N = 16	N = 12	N = 17
Arithmetic mean	**5.3**	**4.2**	**5.0**	**6.6**
Range min-max	3.6–9.1	1.9–9.0	2.5–15.0	2.9–13.5

N – number of children in the study

For a health risk assessment of chemical intake due to unintentional soil consumption, an adjusted approach based on the US EPA[1] methodology have been used. Generally, it is intended for screening the potential hazard in a defined area, or for remedial programs of contaminated lands. The health risk assessment was performed with use of a conservative exposure scenario.

The health relevance of the metal exposure from soil contamination can be expressed as the relation between the estimated exposure and the exposure limit (e.g. recommended by the WHO – PTWI, PMTDI, TDI, etc.), or the reference dose (set by US EPA) – the so-called Hazard Index (HI). The default exposure factor for the amount of the consumed soil according to the methodology of US EPA was used, thus exceeding of the value “1” solely from soil as a pathway of exposure signifies a higher burden than is acceptable. In the study, only one daycare centre, in Příbram, moderately exceeded this threshold value.

[1] *Soil screening guidelines (http://www.epa.gov/superfund/resources/soil/index.htm), Superfund for risk assessment, Risk assessment exposure model (http://www.epa.gov/oswer/riskassessment/superfund_hh_exposure.htm).*

For a calculation of the theoretical increase of the probability of contracting cancer due to a chronic exposure to soil arsenic, a health risk assessment based on a linear non-threshold model of dose-response relationship was used. The calculation of an individual lifetime cancer risk (ILCR) was performed. A few daycares were identified with slightly increased ILCR values; organizational and remedial measures were recommended by regional the Public Health Authority there.

In a health risk assessment, there should be kept in mind that the exposure factors applied are always biased by a relatively large degree of uncertainty. Among the factors of uncertainty are the individual amount of soil ingested, the varying measure of biological availability of the contaminants, etc.

11.4 Partial conclusions

The highest arsenic content in the upper soil of daycare playgrounds was found in Příbram as a consequence of the “old environmental burden” in that region. Příbram had the highest urine arsenic levels in children out of all the monitored daycares. These levels were significantly higher than in children from other monitored cities. In Příbram, the highest number of children out of all the monitored daycares exceeded the recommended threshold urine arsenic level for the non-professionally exposed population; also, increased values of individual lifetime cancer risk were found there. In other cities, including Teplice, where upper soil arsenic content was enhanced as well, no meaningful health risk was identified based on the potential exposure to arsenic in the upper soil.

12. CONCLUSIONS

The results of the Environmental Health Monitoring System in the Czech Republic for the year 2007 expresses a comprehensive set of information collected during the fourteenth year of monitoring activities. The results document the levels of environmental pollution and public health risks. The results provide important background information to the national and regional authorities to facilitate health risk control and prevention, and is also made available to other specialists. Finally, they represent an important data source for the environmental health information system in Europe.

The most significant **health risk in urban air** is caused by pollutants associated with traffic; this is represented by **particulate matter, nitrogen dioxide and polycyclic aromatic carbohydrates**. A significant contributor are also emissions from local industries, namely in the Ostrava-Karviná region. Because of the air pollution caused by suspended **PM_{10}**, it has been estimated that the overall death rate in the Czech Republic has increased by 2.5 % in 2007. The ratio of premature deaths attributable to air pollution was determined by individual types of urban locations; it varied from insignificant numbers in localities with little traffic and no industry up to 12 % in localities with heavy traffic and industry burden.

It is difficult to determine the health effects of **nitrogen dioxide** from the effects of other simultaneously occurring pollutants, especially suspended particulate matter. In large cities with high traffic density, for example a capital city of Prague, we can expect an increased number of respiratory illnesses, asthma and allergies as well as lung functions decrease caused by nitrogen dioxide pollution in the air.

The levels of carcinogenic polycyclic aromatic carbohydrate **benzo[*a*]pyrene** are several-fold in excess of the target limit value in all measuring stations. In the urban localities with the highest burden, namely in the city of Ostrava with industry pollution, an increased risk of contracting cancer has been found in one out of every 1,000 persons due to the exposure to carcinogenic polycyclic carbohydrates.

Based on the results of the prevalence studies, the level of diagnosed **allergic illnesses** in children has increased from 17 % to 32 % in the past ten years. Not all children diagnosed with allergies throughout their lifetime suffer from allergic symptoms recently; only 65 % of the allergic children reported illness manifestation. This is because of the effective long term medical treatment. Eight percent of children suffer from asthma and half of these children have their asthma under full control. The increased number of diagnosed allergy cases is obvious in a younger age.

The quality of the **drinking water** from the public supply networks during the period 2002–2007 has remained without significant change. Overall, 78 % of the population in the Czech Republic (7.4 million people) was supplied with drinking water where none of the health relevant indicators exceeded the set limits. The most significant contaminants of drinking water are **nitrates** and **chloroform**. By consuming 1 liter of drinking water from the public supply network, 6 % of daily acceptable intake of nitrates and 1 % of tolerable intake of chloroform has been supplied. The consumption of drinking water could theoretically contribute to an increased risk of cancer in the Czech Republic by two new cases a year.

Food is a primary source of exposure for most chemical substances. Chronic exposure to chemical substances from the consumption of food for an average person has not surpassed set exposure limits and is therefore considered a positive from the point of view of non-carcinogenic effects. For example, the estimated average exposure dose to nitrates represents 20 % of the daily acceptable intake, cadmium 17 % and polychlorinated biphenyls 3 % of the tolerable intake. There is an insufficient intake of some essential elements, especially iron and copper and also calcium, potassium and magnesium.

It is not possible to determine a safe concentration or exposure limit for mutagenic and carcinogenic substances due to their non-threshold effects; only socially allowable limits of health risk 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's exposure to these chemicals and the negative factors or to keep them as low as "reasonably" achievable. To apply the strategy of reducing the health effects of environmental pollution where most needed, a systematic monitoring of the environmental pollutants have to be performed together with the monitoring of their health effects, and supplemented with the assessment of probable health risks. Such a monitoring of our environment and health 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, 10th 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	Subsystem					CasNo
	I	II	IV	V	VIII	
Acrylamide		x	x			79-06-1
Activity concentration sum, alpha		x				
Activity concentration sum, beta		x				
Activity concentration, Rn 222		x				
Aldrin			x			309-00-2
Aluminium (and compounds)		x	x			7429-90-5
Antimony		x				7440-36-0
Anthracene	x					120-12-7
Arsenic (and compounds)	x	x	x	x	x	7440-38-2
Aspergillus spp.			x			
Bacteria colif. [CFU/100 ml]		x				
Bacteria psychrofillic [CFU/100 ml]		x				
Barium (and compounds)		x				7440-39-3
Benzene	x	x				71-43-2
Benzo[*a*]anthracene	x				x	56-55-3
Benzo[*a*]pyrene-3,4	x	x			x	50-32-8
Benzo[*b*]fluoranthene	x				x	205-99-2
Benzo[*g,h,i*]perylene	x				x	191-24-2
Benzo[*k*]fluoranthene	x				x	207-08-9
Beryllium (and compounds)		x			x	7440-41-7
Boron		x				7440-42-8
Bromates		x				15541-45-4
Bromodichloromethane		x				75-27-4
Bromoform		x				75-25-2
Cadmium (and compounds)	x	x	x	x	x	7440-43-9
Calcium (and compounds)		x	x			7440-70-2
Calcium and Magnesium (and compounds)		x				
Carbon monoxide	x					
Clostridium perfringens [CFU/100 ml]		x				
Colour of drinking water		x				
Conductivity [mS/m]		x				
Copper (and compounds)		x	x	x	x	7440-50-8
Cyanides		x				57-12-5
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
DDTs – sum			x	x		
Di-benzo[*a,h*]anthracene	x				x	53-70-3
Dibromchloromethane		x				124-48-1
Dieldrin			x			60-57-1
Dichlorbenzenes – sum	x					
Dichloroethane-1,2		x				107-06-2
Dichloromethane	x					75-09-2
Endosulphane			x			115-29-7
Endrin			x			72-20-8
Enterococci [CFU/100 ml]		x				
Epichlorohydrine		x				106-89-8

Contaminant Factor	Subsystem I	II	IV	V	VIII	CasNo
Escherichia coli [CFU/100 ml]		x				
Ethylbenzene	x					100-41-4
Flavour of drinking water [grade]		x				
Fluoranthene	x					206-44-0
Fluorine (and compounds)		x		x		7782-41-4
Formaldehyde	x					50-00-0
Freon 11	x					
Freon 113	x					
Freon 12	x					
Heptachloroepoxide			x			1024-57-3
Hexachlorobenzene			x	x		118-74-1
Hexachlorocyklohexane – HCH, sum				x		
HCH alpha			x	x		319-84-6
HCH beta			x	x		319-85-7
HCH delta			x			319-86-8
HCH gamma (lindane)			x	x		58-89-9
Chlorides		x				
Chlorine free		x				7782-50-5
Chlorites		x				
Chlorobenzene	x					108-90-7
Chloroethene		x				
Chloroform	x	x				67-66-3
Chromium (and compounds)	x	x	x		x	7440-47-3
Chrysene	x				x	218-01-9
Indeno[*1,2,3-c,d*]pyren	x				x	193-39-5
Iodine (and compounds)			x			7553-56-2
Iron (and compounds)		x	x			7439-89-6
Lead (and compounds)	x	x	x	x	x	7439-92-1
Magnesium (and compounds)		x	x			7439-95-4
Manganese (and compounds)	x	x	x			7439-96-5
Mercury (and compounds)		x	x	x	x	7439-97-6
Methoxychlorine			x			72-43-5
Methyl chloride	x					74-87-3
Natrium (and compounds)			x			7440-23-5
Nickel (and compounds)	x	x	x			7440-02-0
Nitrates		x	x	x		14797-55-8
Nitrites		x	x			14797-65-0
Nitrogen dioxide	x					
Nitrogen monoxide	x					
Nitrogen oxides – sum	x					10102-44-0
Number of aberant cells				x		
Number of revertants				x		
Odour of drinking water [grade]		x				
Ochratoxin A			x	x		
Organic carbon total		x				
Organisms living [number/ml]		x				
Oxidability MnO_4^-		x				
Ozone	x	x				
Particulate matter – PM_{10}	x					
Particulate matter – TSP	x					

Contaminant Factor	Subsystem					CasNo
	I	II	IV	V	VIII	
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
PCDDs – sum of congeners			x	x		
PCDFs – sum of congeners			x	x		
Penicillium crustosum			x			
Pesticides total		x				
pH		x				
Phenanthrene	x					85-01-8
Polyaromatic hydrocarbons – sum[a]	x	x	x		x	
Potassium (and compounds)			x			7440-09-7
Pyrene	x				x	129-00-0
Selenium (and compounds)		x	x	x		7782-49-2
Silver (and compounds)		x				7440-22-4
Styrene	x					100-42-5
Sulphates		x				
Sulphur dioxide	x					
Temperature [°C]	x					
Tetrachloroethene-1,1,2,2,	x	x				127-18-4
Tetrachloromethane	x					56-23-5
Toluene	x					108-88-3
Tribromomethane		x				75-25-2
Trihalogenmethanes THM[b]		x				
Trichloroethane-1,1,1	x					71-55-6
Trichloroethene 1,1,2	x	x				79-01-6
Trimethylbenzenes – sum	x					
Turbidity of drinking water [NTU]		x				
Volatile org. comp. (US EPA TO14)	x					
Xylenes	x					1330-20-7
Zinc (and compounds)			x	x		7440-66-6

Notes:

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

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

[b] *– 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

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