ENVIRONMENTAL HEALTH MONITORING SYSTEM IN THE CZECH REPUBLIC

Summary report 2025
interim version

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1. INTRODUCTION

The Environmental Health Monitoring System in the Czech Republic is an established system for the regular collection and assessment of data on the exposure of the general population to harmful substances (environmental exposure) and on their potential impacts on public health. It comprises seven sub-programmes, including the assessment of exposure to traffic noise and surveys of the health status of population groups. The National Institute of Public Health (NIPH) has been implementing the Monitoring System continuously since 1994, in cooperation with other organisations, pursuant to Government Resolution No. 369/1991 and Act No. 258/2000 Coll., as amended. The Monitoring System also forms part of the objectives of the Health 2030 Strategic Framework.

Quality assurance and quality control (QA/QC) of the work performed by laboratories providing data within the Monitoring System are integrated into the laboratories' own work programmes, with support from their respective parent organisations. These laboratories include those operated by public health institutes, other institutions and private entities. The main elements of quality assurance in analytical work are laboratory accreditation or authorisation. Most participating laboratories have analytical methods accredited in accordance with ČSN EN ISO/IEC 17025.

Some data are obtained from national databases and registers, such as the Czech Hydrometeorological Institute's Air Quality Information System (ISKO), the Ministry of Health's Drinking Water Information System (IS PiVo), and national health registers. These data are subsequently further processed and evaluated.



2. HEALTH IMPACTS AND RISKS OF AIR POLLUTION IN CZ

Air quality monitoring includes evaluation of the impact of selected outdoor air quality indicators. Outdoor air quality is evaluated for the most health relevant pollutants: suspended particles PM_{10} and $PM_{2,5}$, nitrogen dioxide (NO_2), metals (arsenic, cadmium, nickel, lead), benzene and benzo[*a*]pyrene (BaP). Basic information on ambient air quality is obtained from a core network of about 150 measuring stations, most of which are managed by the Czech Hydrometeorological Institute (ISKO CHMI). The assessment included also data on the level of pollution in the national background, obtained primarily within the framework of relevant measurement programs at the EMEP stations. To assess the impact of traffic load, data from extremely busy stations ("traffic hot spots") in Prague, Brno, Ústí nad Labem and Ostrava were used.

In 2025, concentrations of most major air pollutants in the Czech Republic remained below national legislative limits, with the exception of benzo[a]pyrene. However, WHO guideline values for particulate matter and nitrogen dioxide (NO_2) were exceeded.

- Particulate matter ($PM_{2.5}$) and NO_2 remain the most significant air pollutants in terms of health impacts. Long-term exposure is associated with cardiovascular and respiratory diseases, reduced life expectancy and increased mortality. The combined exposure to $PM_{2.5}$ and NO_2 was estimated to account for approximately 7,000 premature deaths in 2025.
- Ozone (O_3) exposure contributed to an estimated 1–3% of all respiratory deaths, with health impacts comparable to those observed in 2024.
- Carcinogenic air pollutants, particularly polycyclic aromatic hydrocarbons (PAHs), represented a long-term health concern. Lifetime exposure to carcinogenic substances at concentrations measured in 2025 could theoretically increase cancer risk by approximately 2 cases per 100,000 to 3 cases per 10,000 inhabitants, depending on the type of location.
- Benzo[a]pyrene (BaP) remained the major contributor to estimated cancer risk. Although concentrations have declined over the past decade, elevated levels persist, particularly in industrial areas and some rural and suburban locations.
- Arsenic, nickel and cadmium generally posed low estimated cancer risks, although higher risks may occur in areas affected by historical pollution.

Overall, air pollution continues to represent a significant public health concern in the Czech Republic. Despite improvements in air quality, particulate matter, NO_2 and PAHs remain important contributors to adverse health effects. The estimates are subject to uncertainty, particularly due to the use of outdoor monitoring data as a proxy for actual personal exposure.

Fig. 2.1 Range of annual average concentrations of $PM_{2.5}$ and NO_2 in the Czech Republic and in the most significant types of urban locations, 2025

Locality type (73 measuring stations involved)	$PM_{2,5}$ (µg/m³)			NO_2 [µg/m³]		
	Min	AVG	Max	Min	AVG	Max
All locations of various types	4.5	12.9	18.4	1.4	13.6	36.0
Urban localities (settlements > 2,000 inhab.)	9.0	13.6	18.4	9.2	16.0	36.0
- residential areas without excessive burden	9.0	12.9	17.5	9.2	13.3	19.6
- residential areas with traffic burden	11.8	13.9	18.4	9.7	18.6	36.0
- urban industrial areas	11.7	15.3	17.8	9.6	16.0	26.7

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3. HEALTH IMPACTS AND RISKS OF DRINKING AND RECREATIONAL WATER POLLUTION

Chapter in preparation

4. DIETARY EXPOSURE IN THE CZECH REPUBLIC

The basic sub-project is a **food sampling system** based on methodological requirements for dietary exposure assessment based on the principles of the Total Diet Study (TDS) which is methodologically harmonised in the EU (EFSA). Sampling is carried out to represent the "usual Czech diet" and food sampling sites are continuously rotated to achieve proportional coverage of all regions of the Czech Republic.

Another part of the subsystem is devoted to monitoring **the occurrence of foods based on genetically modified organisms** (GMOs). In this case, the main concern is the implementation of the precautionary principle.

The essential project is long-term monitoring of **population dietary exposure to more than 200 harmful chemicals** and **saturation of the population by nutrients**. It differs from conventional food inspection in it covering the whole pattern of consumer behaviour (including culinary food preparation) and dealing with the whole range of foods normally consumed (not just the risk groups). In 2025, the exposure to chemical contaminants was explored.

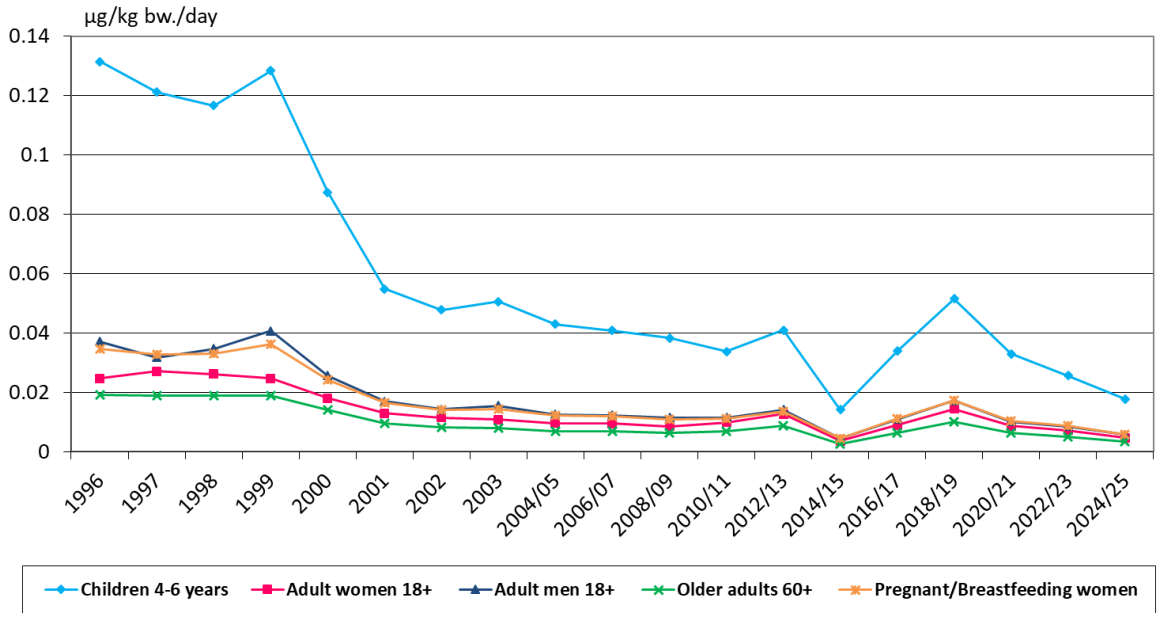
- Persistent organic pollutants (POPs): Legacy contaminants, including PCBs, DDT metabolites and other organochlorine pesticides, continue to be detected in food. Estimated exposure levels were generally low and did not indicate significant health risks when individual substances were assessed. However, potential effects of exposure to real-life chemical mixtures cannot be completely excluded.
- Inorganic contaminants: Dietary exposure to nitrites and cadmium accounted for the highest proportions of their respective health-based exposure limits. Lead concentrations in food have declined over time, and the associated dietary health risk was considered acceptable from a public health perspective.
- Children's exposure: Children aged 4–6 years generally had the highest estimated exposure per kilogram of body weight, reflecting their relatively high food consumption. Model-based estimates indicated elevated exposure to cadmium (172% of the tolerable weekly intake, TWI) and manganese (138% of the reference dose, RfD). The manganese estimate is difficult to interpret because its chemical form was not determined.
- Food contamination by moulds: Monitoring identified potentially toxin-producing moulds in several food categories. Aspergillus flavus was detected in 30% of the relevant samples, while

Aspergillus Niger was detected in 44%. These findings highlight the importance of continued monitoring of mycotoxin-producing fungi in food.

- Genetically modified organisms (GMOs): Screening of 96 rice-containing food products detected genetic screening elements in four samples (4.2%). The specific genetic modifications could not be identified, indicating a need for further targeted analyses.

Overall, the monitoring results suggest that dietary exposure to most individual chemical contaminants remains within acceptable levels for the general population. However, children, persistent environmental contamination, potential mixture effects and the occurrence of toxin-producing moulds remain important areas for continued surveillance.

Fig. 4.1 Model exposure to sum of 7 indicator congeners PCB (28, 52, 101, 118, 138, 153, 180) based on the recommended food pyramid, 1996 - 2025



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5. HUMAN BIOMONITORING

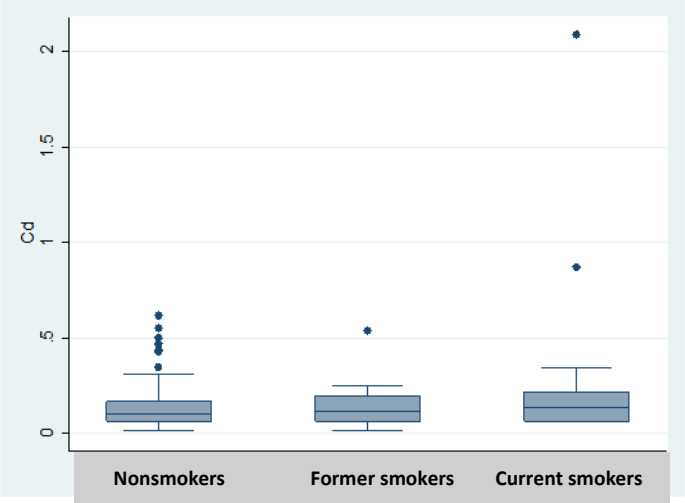
The NIPH Prague has been monitoring chemicals with hormone-disrupting effects since the launch of the Monitoring System in 1994. Since then, the human monitoring program has regularly monitored toxic metals, polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT metabolites, hexachlorocyclohexane, hexachlorobenzene). Based on the development of knowledge and laboratory methods, other substances with these effects, such as bisphenols, phthalates, per- and polyfluorinated substances (PFASs) and flame retardants, have been included in the monitoring. In the recent HBM studies supported by the PARC project, we also focus on so-called modern pesticides.

In 2025, the Czech National Institute of Public Health (SZÚ) conducted a human biomonitoring study within the European Partnership for the Assessment of Risks from Chemicals (PARC). The study assessed exposure to cadmium in urine among 200 adults aged 18–39 years from six Czech regions.

- Cadmium concentrations were generally low. In almost all participants, urinary cadmium levels were below the German HBM-I value of 1 µg/L. The value was exceeded in only one participant, an active smoker. No participant exceeded the HBM-II value of 4 µg/L.
- Smoking was associated with higher cadmium levels. Median urinary concentrations increased from 0.11 µg/L in never-smokers to 0.12 µg/L in former smokers and 0.14 µg/L in current smokers. However, the differences were not statistically significant.
- Age-related differences were small. Participants aged 29–39 years had slightly higher cadmium concentrations than those aged 18–28 years, but the difference was not statistically significant after excluding current and former smokers.
- Diet is the main source of cadmium exposure in the general Czech population, particularly through potatoes, bread and cereal products. Tobacco smoking is also an important source.

Overall, the findings indicate that cadmium exposure among young Czech adults was generally low, although continued monitoring is warranted, particularly given cadmium's long biological half-life and its potential effects on the kidneys, bones and cancer risk.

Fig. 5.1 Distribution of cadmium concentration values in urine among lifelong non-smokers, former tobacco smokers, and current tobacco smokers, in µg/l, 2025



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6. HEALTH RISKS FROM NOISE EXPOSURE

The health impacts of road traffic noise were assessed using the Environmental Burden of Disease (EBD) methodology, based on the population covered by Strategic Noise Mapping (SNM). This

population comprises approximately one-third of the Czech population and represents those exposed to high levels of road traffic noise.

- High noise annoyance: Approximately 5,600 healthy life years (DALYs) are lost annually in the assessed population due to high noise annoyance.
- High sleep disturbance: Approximately 1,600 healthy life years are lost each year due to high noise-related sleep disturbance.
- Ischaemic heart disease (IHD): Noise-related IHD accounts for approximately 16,000 DALYs annually. Of these, around 1,800 years are lost due to premature death (YLLs), while approximately 14,200 years are lived with impaired health (YLDs).
- Major contribution of IHD: Ischaemic heart disease accounts for approximately 70% of the total health loss attributed to road traffic noise.

The assessment was based on the fourth round of Strategic Noise Mapping and WHO dose–response relationships. The results apply only to the population covered by noise mapping and should not be extrapolated directly to the entire Czech population. Estimates are subject to uncertainties related to noise exposure modelling, dose–response relationships and the selection of health outcomes.

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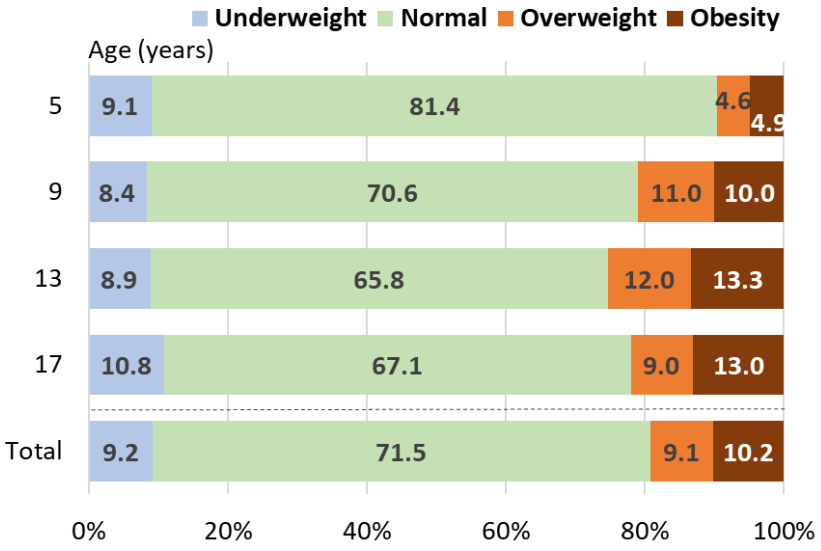
7. POPULATION HEALTH SURVEYS

The Czech National Institute of Public Health conducted a health survey of 5,252 children aged 5, 9, 13 and 17 years in cooperation with paediatricians across all 14 regions of the Czech Republic.

- Allergic diseases: Approximately one-quarter of children (24.9%) had a physician-diagnosed allergic disease. Seasonal allergic rhinitis was the most common (11.5%), followed by atopic eczema (8.2%) and asthma (5.0%). The prevalence of seasonal allergic rhinitis and asthma increased with age, whereas atopic eczema decreased.
- Postural disorders: Poor posture was identified in one-third of children (33.3%) and increased markedly with age, from 17.6% among 5-year-olds to around 41–42% among 13- and 17-year-olds. It was more common in children with obesity, long-term health problems and psychological distress.
- Overweight and obesity: Nearly one in five children (19%) had overweight or obesity. Obesity affected 10.2% of children, and approximately half of these had a BMI above the 99th percentile. The prevalence of overweight and obesity has remained broadly stable since 2016.
- Blood lipids: Among children examined because of a family history of cardiovascular disease or obesity, pathological total cholesterol levels were found in approximately 10%, while pathological triglyceride levels were found in 15.7%.
- Blood pressure: Screening measurements indicated blood pressure values in the hypertension range in approximately 9% of children aged 5–13 years. Among 17-year-olds, 4.2% had values corresponding to hypertension, and elevated blood pressure was more frequent in boys than girls.

The findings highlight the importance of continued monitoring of childhood health, particularly allergic diseases, postural disorders, obesity and cardiovascular risk factors. The blood pressure results are based on screening measurements and do not establish a clinical diagnosis of hypertension.

Fig. 7.1 Distribution of children by age and BMI categories, Children's Health Study 2024/2025



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8. OCCUPATIONAL HEALTH RISKS AND THEIR CONSEQUENCES

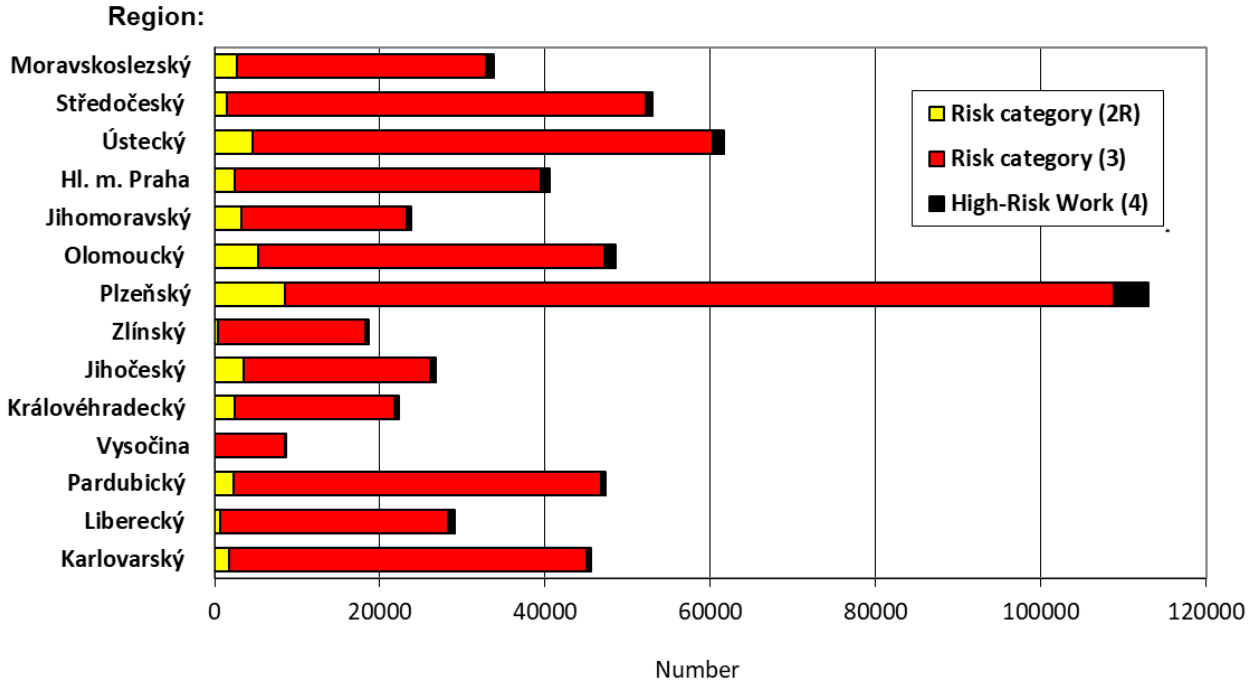
Occupational exposure to risk factors and their health effects are monitored through the Information System for Occupational Risk Categorisation (IS KaPr) and the National Registry of Occupational Diseases. The monitoring provides information on the prevalence of occupational risks and the occurrence of occupational diseases in the Czech Republic.

- **Occupational risk exposure:** At the end of 2025, 572,630 employees were classified in risk categories 2R, 3 and 4, including 13,961 in the highest-risk category 4. The highest number was recorded in the Moravian-Silesian Region.
- **Occupational risk factors:** Noise was the most prevalent risk factor, followed by physical workload, vibrations and dust. Excessive physical workload and awkward working postures were also common across all occupational categories.
- **Occupational diseases:** A total of 3,396 occupational diseases and threats of occupational disease were diagnosed in 2,909 individuals. The number of reported cases decreased by 35.8% compared with 2024.
- **COVID-19:** Communicable and parasitic diseases accounted for nearly 80% of occupational diseases. COVID-19 remained the most frequently reported diagnosis (2,488 cases), although only two new cases were recorded in 2025.

- **Other occupational diseases:** Important conditions included pneumoconiosis, carpal tunnel syndrome, allergic contact dermatitis and disorders associated with excessive physical workload and vibration exposure.
- **Occupational risk assessment:** Some occupational diseases occurred in jobs originally classified as non-risky, highlighting the importance of accurate risk assessment and regular review of workplace conditions.

Overall, occupational exposure to physical risk factors remains an important public health concern. The substantial decline in reported occupational diseases in 2025 was mainly attributable to the decreasing number of COVID-19 cases reported retrospectively. Physical workload, repetitive movements, vibration exposure and noise continue to be important occupational health risks.

Fig. 8.1 Number of employees classified into occupational risk categories in the Czech Republic, 2025



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