Human biomonitoring (HBM) directly measures the concentration of chemical pollutants or their metabolites in human fluids and tissues. As such, HBM is a reliable instrument for the assessment of human exposure to chemicals from different sources, by different pathways and during certain periods of life.

What is essential to know about chemicals?
- Every day throughout our entire lives, we are exposed to many chemicals, including hazardous chemicals in air, water, soil, food and consumer products.
- Some chemicals can cause serious negative health effects, such as reproductive disorders; cancers; neurological, respiratory, cardiovascular and immune defects; and diabetes and other metabolic problems.
- The societal costs of exposure to hazardous chemicals are high – exposure to lead alone causes 1.06 million deaths globally every year.
- Chemical production will continue growing and is projected to double by 2030.
- New chemicals enter the market almost every day.
- The need to protect human health from the negative impacts of chemicals is growing exponentially.

What is important questions can HBM help to answer?
- Is the level of population exposure of concern for health?
- What population groups are most exposed?
- What risks do the chemicals pose to human health?
- What factors influence exposure (lifestyle, age, other characteristics)?
- Should short-term or long-term risk-reduction measures be taken (restriction or prohibition of chemicals, remediation of contaminated sites, etc.) and if so, which ones?
- What chemicals (conventional and new) are of public health concern and from which sources are they taken up?

Why is this information critical?
- It helps decision-makers take targeted actions to protect environments and people, especially vulnerable groups such as children, pregnant women and older people.
- It identifies people with critically high exposures, enabling treatment to prevent irreversible health effects and deaths.
- It informs the development of policies on chemicals management to ensure the health of current and future generations.
- It enables evaluation of the success or failure of voluntary and obligatory regulations, and assessment of the need for additional measures.
- It creates transparency in communication with society and increases the credibility of governments.
- It contributes to international efforts to create green, toxic-free environments.

To what extent are chemical pollutants taken up by the human body, and will they lead to health problems?
To address these issues, carefully planned and conducted national HBM efforts are needed to identify critical exposures, derive effective measures, and ensure health and well-being. HBM demonstrates that all European residents are now exposed to hazardous chemicals. Among other substances, alarming concentrations of hazardous chemicals that can impact the health of the next generation have been found in mothers in European countries and the United States of America.
Box 1. Regulating exposure to phthalates, a component of plastics

Nine regulations aimed at reducing internal exposure to reprotoxic phthalates were adopted in the European Union (EU) between 1999 and 2020. HBM demonstrated that all policy actions and risk-reduction measures led to decreases in human exposure to phthalates: the time-trend analyses showed rapidly declining metabolite concentrations. (6)

Box 2. Geographical differences in exposure

HBM shows that concentrations of certain pesticides are higher in southern European populations than northern European ones. Conversely, exposure to some perfluorinated chemicals is higher in northern Europe. (9) Better coverage of available HBM data will create opportunities for national and local governments to take measures to ensure that all residents are protected from exposure to hazardous chemicals.

Box 3. PFAS in humans and the environment

HBM studies allow detecting a range of per- and polyfluoroalkyl substances (PFAS) in the blood of European citizens. Though the levels for the most prevalent, studied and regulated PFAS – perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) – are decreasing, levels of newer PFAS are increasing. In some areas, concentrations of PFOA and PFOS in the most exposed citizens were above proposed benchmark levels for adverse health effects. In these cases, specific needs were considered to protect the highly exposed populations, such as monitoring PFOA and PFOS in drinking-water. (10)

What are other benefits of HBM?

• HBM supports implementation of international agreements, as countries are obliged to report on human exposure to chemicals regulated by the Stockholm Convention on Persistent Organic Pollutants (7) and the Minamata Convention on Mercury (8).
• It generates new knowledge about chemicals, their sources, human exposure, effective protection measures and the fate of chemicals in the environment.
• It identifies the populations and countries most affected by certain chemicals and thus informs effective allocation of technical and financial resources at regional and global levels.
• Regular HBM programmes prepare authorities to implement effective interventions in response to environmental disasters and health concerns related to chemical exposures.

Are national HBM programmes widespread?

National HBM programmes exist within many countries, and at national, regional and global levels. They have a long history: in the United States since 1976 (11), in Germany since the early 1980s (12) and at the European Union level since 2010. In fact, HBM national programmes/surveys are implemented regularly in many countries globally and in all WHO regions. Most countries already have basic HBM infrastructure and knowledge from occupational, nutritional or health examinations, or from fragmented academic studies or national/regional studies.

What can policy-makers do?

• Initiate a discussion on setting up a national HBM programme in a country and support a positive decision.
• Initiate legal arrangements for using HBM for exposure and risk assessment.
• Ensure sustainable financing and human and technical resources for the HBM programme.
• Ensure the regularity of the HBM programme, which will allow for analysis of temporal changes in exposure, evaluation of the effectiveness of risk-reduction measures, and tracing of changes in the exposure of the population over time.
Box 4. Evaluation of effectiveness of risk-reduction measures using HBM

The reduction of blood level of lead (BLL) among the population of the United States is a result of the withdrawal of lead from gasoline and paints, a decision based on HBM results. The second campaign of the National Health and Nutrition Examination Survey (NHANES) demonstrated that lead exposure in the population decreased from 16 µg/dL to less than 10 µg/dL four years after the introduction of unleaded gasoline to the market. The reduction was much greater than expected, prompting the United States Environmental Protection Agency to accelerate total elimination of lead from gasoline. As a result, in 2013/2014, less than 1% of children had a BLL exceeding 5 µg/dL. (13)

Is HBM expensive?

Setting up a national HBM programme requires capacities for recruiting and informing study participants, measuring chemicals or their metabolites in analytical laboratories, analysing data, and carrying out reporting and communication, as well as relevant financial support. The costs depend on the survey’s objective and scale.

However, savings due to prevention of diseases and protection of human health are higher than the costs of HBM programmes. For example, a recent study estimated the health costs in the EU of the median annual disease attributable to exposure to endocrine disrupting chemicals to be €163 billion (1.28% of the EU’s gross domestic product). (14) This harm can be prevented and costs can be saved if relevant decisions on these and other chemicals are based on HBM.

Leaving no one behind – addressing the needs of most vulnerable

Commonly, young children have higher concentrations of most chemical pollutants per kilogram of body weight compared to older age groups. This holds true for a number of modern pesticides and plastic constituents. Young children are especially vulnerable to developing adverse health effects later in life when exposed in early years. HBM enables the measurement of concentrations of chemicals or their metabolites in vulnerable subpopulations such as young children, pregnant women and older people. HBM data can supply information according to population-specific characteristics such as socio-economic status, enabling the identification of more highly exposed subpopulations that may require targeted protection measures.
Endnotes


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