Why monitor the presence of chemicals in humans?

We are exposed to a complex mixture of chemicals in our daily lives through the environment, through the products that we use, the food that we consume, and at work. Human biomonitoring allows us to measure our exposure to chemicals by measuring either the substances themselves, their metabolites or markers of subsequent health effects in body fluids or tissues.

By collecting data from a representative sample of individuals under continuous surveillance programmes, health practitioners are able to evaluate the exposure of the general population to chemicals over time.

Such datasets can allow for the identification of hotspots of exposure linked to poor environmental quality. We can also monitoring the exposure of groups of individuals with specific vulnerabilities associated with their age, health or behavioural patterns. Targeted monitoring can be used to assess the health impacts of chemical accidents in the surrounding populations.

Cumulative effects and long-term exposure

Traditional chemical risk assessment investigates the direct cause and effect relation between exposure to a single chemical and a single disease outcome. However, the reality is that throughout their life humans are exposed to multiple chemicals through a wider range of different exposure pathways. These mixtures of chemicals can interact and produce synergistic effects on health that go beyond the impact anticipated from a single chemical acting in isolation.

Human biomonitoring provides a useful tool for assessing cumulative exposure to complex mixtures of chemicals. In particular, data can be used to assess cumulative exposure to mixtures of chemicals with similar modes of action that might act synergistically, such as endocrine disrupting chemicals.

Some groups of people are more vulnerable than others

Vulnerable groups of people, such as children, pregnant women and the elderly, have a higher risk of health impacts resulting from exposure to chemicals. In particular, exposure during critical periods of development in early life stages can lay the ground for disease later in adult life.

Biomonitoring of breast milk provides a picture of the exposures accumulated by the mother during her life and transmitted to the infant while breastfeeding, while the measurement of chemicals in cord blood and meconium can document foetal exposure.

How does it work?

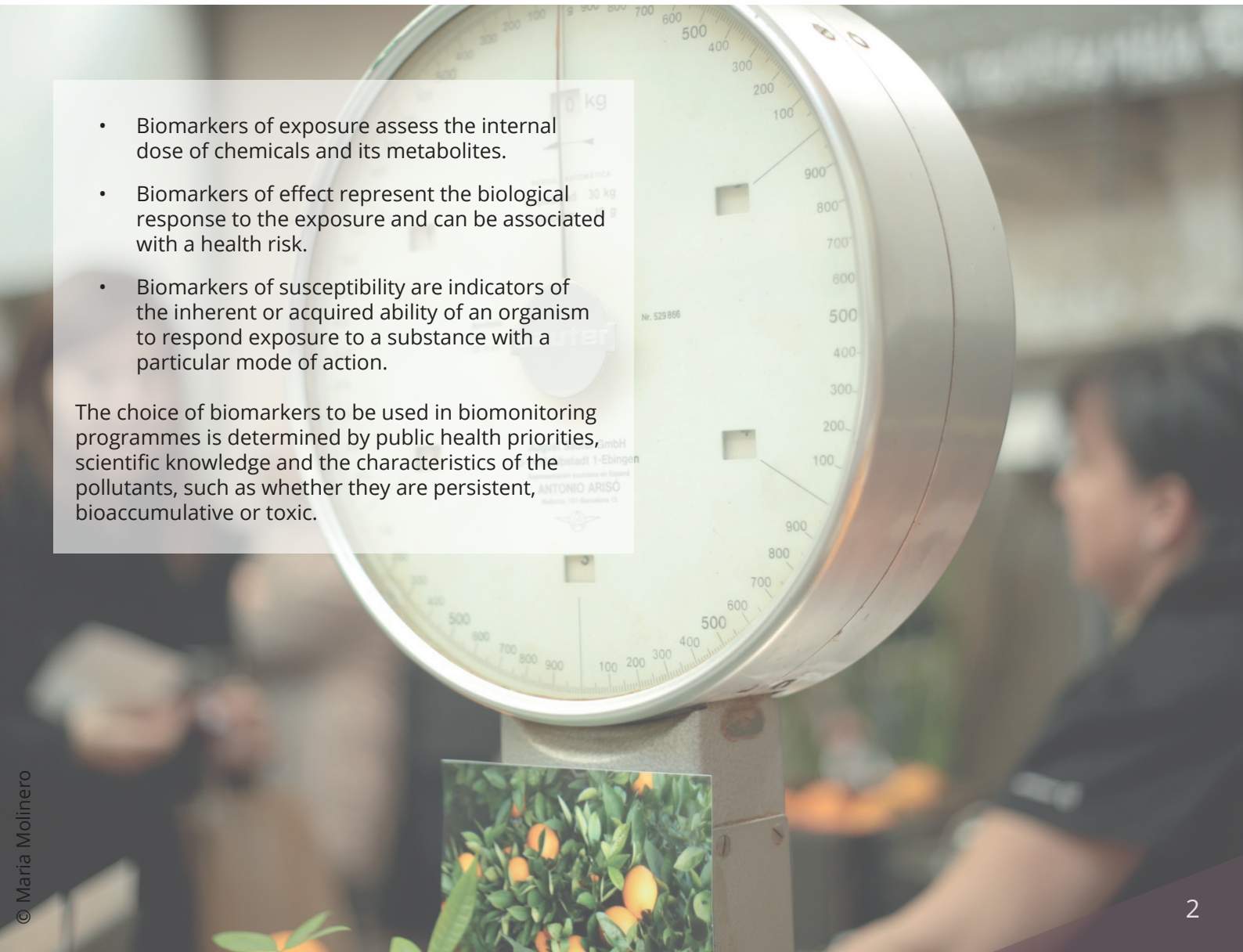
Biomarkers

Biomarkers are indicative of the presence of a chemical inside the human body and are used to explore exposures that might cause health problems.

Measuring the concentrations of biomarkers allows us to determine the internal dose of one chemical across all routes of exposure. The different types of biomarkers give us a range of information how the human body responds to chemical exposure.

- Biomarkers of exposure assess the internal dose of chemicals and its metabolites.
- Biomarkers of effect represent the biological response to the exposure and can be associated with a health risk.
- Biomarkers of susceptibility are indicators of the inherent or acquired ability of an organism to respond exposure to a substance with a particular mode of action.

The choice of biomarkers to be used in biomonitoring programmes is determined by public health priorities, scientific knowledge and the characteristics of the pollutants, such as whether they are persistent, bioaccumulative or toxic.



Generating comparable human biomonitoring datasets

There is a need for Europe-wide human biomonitoring data to support the implementation and further development of policies that minimise human exposure to hazardous chemicals.

The design and implementation of a human biomonitoring programme entails many challenges. Practitioners must consider the toxicity of the chemical substance and drawn on toxicokinetic models that describe how the chemical enters the human body and what happens to it in order to identify relevant biomarkers.

They must also take decisions on sample size, representativeness and any associated variables and determine whether specific population groups should be targeted for sampling.

A first step is to establish common selection criteria to be used in the identification of chemicals that should be the subject of large-scale human biomonitoring activities. These criteria will relate to which chemicals are of policies concern, but also to the availability of methods and laboratory capacities.

As a second step, and in order to ensure that data are comparable across countries, health practitioners must employ harmonised approaches to data harvesting. Harmonised protocols are available for some substances that cover various stages in the monitoring process, including sampling, chemical analysis and data interpretation. For other substances, including many substances of emerging concern, harmonised methods still need to be developed.

Finally, it is important to make the resulting data accessible to policy makers at European level, while at the same time respecting the data privacy rights of survey participants.

Integrated assessments

A major challenge in conducting reliable chemical risk assessment is the lack of harmonised information about human exposure and subsequent impacts on health. Human biomonitoring provides information on peoples' exposure to chemicals in their normal daily life over long time periods, and provides a starting point for more refined risk assessments.

If we map human biomonitoring data against data on chemicals in the environment, commercial products and food, we can start to trace the pathways by which chemicals enter the human body.

An additional step involves the use of health data to explore correlations between chemical exposure and negative health outcomes in the survey population. Such integrated assessments can support the design and development of environmental health policies by identifying priorities for further action.

How can the resulting data be used?

The interpretation of population health risks based on human biomonitoring studies remains challenging. An analysis of the role of associated variables such as living conditions, behavioural patterns, nutrition, socio-demographic data and political context must be an integral part of the assessment. The selection of voluntary participants can also bias results, since volunteers do not always represent a general population which usually also includes unhealthy individuals.

In interpreting human biomonitoring data, a reference value for a chemical substance in human biological material allows practitioners to compare the exposure of an individual or a population group against the background exposure of the general population. Reference values have only been defined for a limited number of chemicals so far.

Policy development

Human biomonitoring data can help decision-makers to identify priorities for new environment and health policies. With regards to existing policies that seek to limit human exposure to a specific chemical or groups of chemicals, human biomonitoring data can provide evidence with which to assess whether or not policies are working.

Surveys can also be used in horizon scanning, to identify emerging substances that might be of concern in the future. In addition, human biomonitoring data can trigger efforts to monitoring chemicals in other media, such as drinking water or indoor air, or to measure emissions from products or residues in food and feed.

Communicating outcomes to the public

Communication is an important part of human biomonitoring programmes, in particular due to the potential implications for individual health and the need to protect personal data. In some programmes participants are informed of their own personal individual results, in others only information and general conclusions are presented to the public. General conclusion may be publically communicated via a range of channels, including technical reports, presentations at conferences, lay publications and factsheets, and via the media.

Access to human biomonitoring data

In most cases, aggregated human biomonitoring data are available for further use. However, availability and ownership are strictly ruled by the EU Directive 95/46/EC on the protection of individuals with regards to the processing of personal data.

The establishment of a human biomonitoring framework-programme at the EU level would significantly increase the volume of data generated and should, at the same time, promote open access to data while respecting privacy requirements. Key activities at European level are presented below.

European human biomonitoring activities

The Consortium to Perform Human Biomonitoring on a European Scale (COPHES) involved 25 EU Member States as well as Norway and Switzerland. The project developed common sampling procedures and protocols for handling, analysing and bio-banking samples, as well as harmonised approaches for data analysis and interpretation.

Under the Demonstration of a study to coordinate and perform human biomonitoring on a European Scale (DEMOCOPHES), 17 countries tested the approach developed under COPHES to produce data on population exposure to mercury, cadmium, tobacco smoke and some phthalates, as well as related lifestyle data. Bisphenol A was added as an additional substance for a group of six countries. The project demonstrated the feasibility of adopting a harmonised approach to human biomonitoring surveys in order to obtain comparable results in Europe.

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