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Biomonitoring in Environmental Health

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Description

Biomonitoring is the use of organisms to determine the level of contamination in the environment, such as the air or water. It can be done in two ways: qualitatively, by observing and noting changes in organisms, or quantitatively, by measuring chemical accumulation in organism tissues. Pollution can be suspected or inferred by observing or measuring the effects of the environment on its resident organisms. Historically, public health regulations have been based on theoretical risk calculations based on known levels of chemical substances in the air, water, soil, food, and other consumer products, as well as other potential sources of exposure. Human biomonitoring allows for the simultaneous analysis of actual internal levels of bodily substances from all possible routes of exposure, potentially improving risk assessments. Scientific advances have enabled the detection of a greater number of chemical substances in lower concentrations in the body, with some chemicals detectable at parts per trillion levels. A single bio indicators evaluation is only a snapshot in time, and it may not properly represent the amount of exposure over time.

The presence of a chemical from the environment in the body does not always imply that it is harmful. The ability to detect chemicals through analytical chemistry has progressed faster than the ability to interpret the potential health consequences. Toxicity studies in laboratory animals and epidemiological evidence in humans are usually used to determine health risks. Lead is a well-studied chemical with a current CDC action level of concern of 10 g/dL (100 parts per billion) in blood; however, neurobehavioral impairment has been observed at levels lower than this. Only a few environmental chemicals have data to support these types of activity levels because this approach requires establishing cause and effect in epidemiological studies and a thorough understanding of human dose-response. The concept of Biomonitoring Equivalents (BEs) was created as a different way of interpreting and communicating biomonitoring results in the context of potential health risks.

Human Biomonitoring for Environmental Chemicals was published by the National Research Council of the United States in 2006. The report acknowledged the importance of biomonitoring for better understanding chemical exposure and included several findings and recommendations for improving the utility of biomonitoring data for health risk assessment. In conclusion, the report recommended that more rigorous health-based criteria be used to select chemicals for biomonitoring studies, as well as the development of tools and techniques to improve risk-based interpretation and communication of biomonitoring data, the integration of biomonitoring into exposure assessment and epidemiological research, and the exploration of bioethical issues surrounding biomonitoring, such as informed consent and confidentiality of results, among other things. Chemical exposure surveys typically do not include the number of chemical compounds detected per person as well as the concentration of each compound. This leaves important exposure scenarios untested, such as whether individuals with low concentrations of some compounds also have high concentrations of others. Analyses of a given compound's concentrations usually reveal that the majority of citizens have much lower concentrations than a small minority. More than half of the population had concentrations in the top quartile of 1 or more of the 19 Persistent Toxic Substances (PTS) (pesticides, PCBs) analyzed. PTS mixtures accumulated at high concentrations in significant subgroups of the population. For example, 48 per cent of women in their 60s and 70s had concentrations of 6 or more PTS in the top quartile; half of the population had levels of 1 to 5 PTS above 500ng/g, and less than 4% of citizens had all PTS in the bottom quartile. When each compound is

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examined separately, PTS concentrations appear low in the majority of the population. It is not accurate to say that the majority of the population has low PTS levels. The fact that most people are contaminated by PTS mixtures containing compounds at both low and high concentrations must be taken into account when assessing mixture effects.