Biomonitoring Equivalents

Interpreting Biomonitoring Data for Chemical Regulation

Biomonitoring Studies - What can they tell us?

Scientists have long recognized that our bodies can absorb, metabolize and excrete chemical substances in our environment but thanks to advances in analytical technology, it is possible to detect and measure incredibly small concentrations of natural and manmade substances within the human body.

Biomonitoring studies such as the CDC's biannual *National Report on Human Exposure to Environmental Chemicals* can provide valuable, powerful data on the presence of trace levels of chemicals in human blood or urine. Determining the presence of a chemical, however, is not enough to establish the potential risk to human health.

When looking at biomonitoring results, it is tempting to draw immediate conclusions and make assumptions about what the results mean. But to be most useful to the public and policymakers, the results must be placed in a public health risk context. Without such context, biomonitoring data are of limited value in efforts to protect public health.

Biomonitoring Equivalent – Scientific Tool for understanding the data.

Acting upon the recommendations of the National Research Council's report, *Human Biomonitoring for Environmental Chemicals*[2] *(2006)*, scientists developed **Biomonitoring Equivalents (BEs)** to understand population-based biomonitoring results in a public health risk context. BEs are tools that will allow agencies, lawmakers and the public to have a better understanding of what biomonitoring levels actually mean.

"The presence of a chemical does not imply disease. The levels or concentrations of the chemical are more important determinants of the relation to disease, when established in appropriate research studies, than the detection or presence of a chemical" (CDC, 2005) [1]

A Biomonitoring Equivalent (BE) is defined as the concentration of a chemical in blood or urine that corresponds to an allowable exposure guidance value, such as a reference dose (RfD) or tolerable daily intake (TDI), considered safe by regulatory agencies.

Background

In 2008, a multidisciplinary panel of experts published guidelines for developing BEs as tools to interpret biomonitoring data in scientific peer-reviewed literature. Since that time, BE values have been developed and published in scientific journals for over eighty chemicals, including Bisphenol A, Phthalates, Methylene Chloride, Benzene, Chloroform and Acrylamide. Researchers are currently working to develop BEs for additional chemicals in commerce.

Using BE values to assess biomonitoring data

BEs build upon existing government chemical risk assessments and they incorporate data on how humans and laboratory animals metabolize and eliminate chemicals. By relying on existing chemical risk assessments developed by EPA and other similar government agencies, BEs are efficient and effective tools for interpreting biomonitoring data in a public health risk context.

Using BEs, scientists can examine biomonitoring results and make determinations on how the levels of the chemicals *actually* found in humans compare to those levels that *would be expected* if people were exposed at levels equal to the current **safe exposure guidance values** set by regulatory agencies. Daily exposure to a chemical at these guidance values by the human population (including sensitive subgroups) is without appreciable risk of harmful effects during a lifetime. Such doses are not likely to be associated with adverse health risks, they are therefore of low regulatory concern.

BEs also can be used to evaluate and compare the levels of multiple chemicals detected in biomonitoring

studies thus enabling prioritization for follow up of the individual chemicals contributing most to potential risks. BEs allow scientists to make sense of biomonitoring results and inform policy makers about the potential risks a chemical may pose. By comparing biomonitoring data for chemicals to their corresponding BE values, scientists can identify chemicals that are of low, medium, or high priority for further investigation. If additional actions are deemed necessary, they could include activities such as in-depth exposure research, risk assessment re-evaluations or product stewardship actions.

Conclusion

Biomonitoring Equivalents are important tools for interpreting population-based biomonitoring data. They can help regulators and policy makers to identify chemicals of interest for risk management review, or to confirm that current efforts are effective at keeping exposures at acceptable levels. Lawmakers should continue to support funding for CDC's ongoing national biomonitoring efforts, which gather invaluable data on the public's exposure to chemicals used in commerce.

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In order to maximize the effectiveness of biomonitoring programs, it is critical that CDC and other public health and regulatory agencies, building upon existing risk information from the USEPA and the Agency for Toxic Substances and Disease Registry, make a concerted effort to develop and/or use effective methods such as BEs to interpret and communicate biomonitoring results in the appropriate context.

Example of a Biomonitoring Equivalent: 2,4-Dichlorophenoxyacetic acid (2,4-D)

The Figure contains the biomonitoring results for *2,4-Dichlorophenoxyacetic acid* urinary concentrations from participants of CDC's National biomonitoring study (NHANES) and a study by Morgan et al[3] in relation to the biomonitoring equivalent (BE) established based on a USEPA safe exposure guidance value (RfD) for chronic exposures to the chemical.

The regions labeled Low, Medium and High represent a ranking for further risk analysis.

As seen in the figure, the urinary concentrations of *2,4-Dichlorophenoxyacetic acid* found in participants are far below the BE values. Based on these findings, the authors (which included scientists from the USEPA, CDC, and Health Canada) concluded:

"...current use patterns and risk management efforts ...are likely keeping average exposure to 2,4-D ...to levels well below current non-cancer reference values"

The BE approach to interpreting biomonitoring data allows scientists to make clear statements regarding the significance of current levels of 2,4-D measured in the U.S. population and to confirm that existing risk management efforts are protective of the general population.

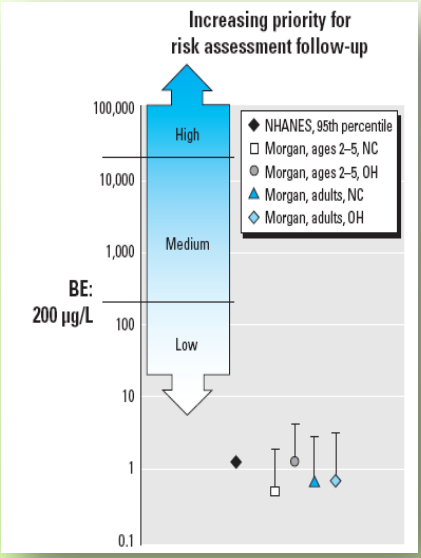

Figure adapted from Aylward et al. 2010; Environ. Health Perspect. 118:177-181.

[1]*Centers for Disease Control and Prevention (CDC), Third National Report on Human Exposure to 9Environmental Chemicals (2005), Interpreting Report Exposure Data: Important Factors, page 4.*

[2]*National Research Council of the Academies (NRC), Human Biomonitoring for Environmental Chemicals (2006).*

[3]*Morgan et al. (2004, 2008) recently examined the exposures of 135 preschool children and their adult caregivers to 2,4-D in their homes in North Carolina and Ohio. From the Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants (CTEPP) study.*

For additional information regarding Biomonitoring Equivalents, contact the American Chemistry Council at (202)249-6425 or visit www.biomonitoringequivalents.net.

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