Biomonitoring of Human Exposure to Environmental Chemicals in the Context of Exposome

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Long term, chronic exposure to environmental chemicals can interfere with hormone function and contribute to the development of diseases. To address the exposure to toxic chemicals to which people are exposed, many developed nations have implemented national biomonitoring programs. Biomonitoring is the direct measurement of people's exposure to toxic substances by measuring the substances or their metabolites in human specimens, such as blood or urine. Biomonitoring is one of the important tools in the study of exposome, which is the totality of human environmental exposures from conception onwards.

Our research integrates biomonitoring studies with environmental exposure assessment through the analysis of indoor air, dust, cosmetics, and food. Chemical exposure doses assessed through environmental sources are compared with those of biomonitoring to elucidate unknown sources of exposures. For example, biomonitoring of phthalate exposure in the United States yielded a median exposure dose of 500-600 μg/day. However environmental exposure assessment from known sources accounted for only 98 μg/day. This approach helped in the identification of novel metabolites of toxic chemicals in human specimens and unknown sources of phthalate exposure. Such an approach is novel in chemical exposure studies and help understand unknown sources and pathways of exposure. Several multinational studies were conducted to elucidate global exposure patterns of environmental contaminants as well as pathways of chemical exposures. Biomonitoring studies have been applied in population level exposure studies to elucidate association between chemical exposures and health outcomes. We also develop biomarkers of health effects in urine/blood to develop exposure-effect-disease continuum in pursuit of understanding adverse outcome pathways in disease pathogenesis.

Current research is focused on developing multiclass chemical analysis methods, identifying appropriate matrix and methods of biomonitoring, effect biomarker analysis, and emerging contaminant exposures. Efforts are made to link biomonitoring with exposomic studies and in developing human adverse outcome pathways in disease etiology. The exposure assessment studies are further advanced to the concept of exposome which includes biomonitoring and metabolomic analyses of human specimens.