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Biomonitoring of human
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Science for Environment Policy

Exposure to BPA derivatives: newer analogues may also have endocrine-disrupting effects

Bisphenol A (BPA) is a chemical that is widespread in the environment.

Researchers reviewed and critically discussed the sources and routes of human exposure to chlorinated derivatives (Cl_xBPA) and alternatives to BPA (BPF, BPS), as well as their metabolism, toxicity and concentrations in human tissues. The researchers suggest BPA alternatives and derivatives may have similar effects, and provide directions for future research.

BPA is present in many modern consumer products. It is found in common household equipment, food and drink cans, bottles and storage containers, CDs and vehicles, and has been found at high levels in cash-register receipts¹. Some scientific reports have linked exposure to BPA to endocrine (hormone) disruption, and lowered testosterone levels. In February this year, France proposed BPA as a [REACH](#) regulation candidate substance of very high concern².

As a result of these concerns, alternative substances have been introduced, with a similar but not identical structure to BPA. These analogues include bisphenol S and F (BPS, BPF), which have entered the consumer product market to provide the same functionality of BPA in a safer way. However, these compounds may still pose a risk to human health³.

When BPA comes into contact with chlorine in tap water, it forms chlorinated derivatives (Cl_xBPA), which humans may be exposed to through water use⁴. Findings on the health effects of Cl_xBPA have been based on *in vitro* and *in vivo* experiments and suggest a 10–40 times higher estrogenic activity than BPA. The health risks of BPA analogues have also been studied in the lab, which have shown links to endocrine disturbance⁵.

Measurement of chemicals in biological substances, such as urine or blood, is called biomonitoring, and is an important method of assessing human exposure to toxic compounds.

This study, which received support from [European Structural Funds](#), explored the findings of biomonitoring studies on Cl_xBPA and BPA analogues. The researchers carried out an extensive literature search to identify studies reporting biomonitoring of Cl_xBPA and BPA structural analogues in human samples. This led to the selection of 23 relevant articles.

The first reported human biomonitoring of Cl_xBPA was in 2005, while for BPA alternatives it was in 2010. Since then, 21 peer-reviewed studies have been published reporting internal exposure measurements of Cl_xBPA and BPA alternatives in various human samples. Articles reporting Cl_xBPA in human samples include fatty tissue, placenta, breast milk, urine, plasma and serum, while those reporting BPA alternatives included only urine and breast milk. The authors could not identify any studies looking at BPA analogues in other biological samples, reflecting their newer status.

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Exposure to BPA derivatives: newer analogues may also have endocrine-disrupting effects (continued)

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Overall, the evidence suggests that human exposure to Cl_xBPA and BPA alternatives is widespread. The compounds have been detected in a range of environmental media and consumer products. Although the sources and pathways of exposure remain unclear, evidence suggests that BPA and its chlorinated derivatives enter the body through the airways, skin contact and ingestion.

In vitro and *in vivo* studies suggest BPA alternatives and chlorinated derivatives may contribute to the development of diabetes and obesity. The authors say there is a need for studies that follow lots of people over time to better understand the human health effects. They discuss methodological advances in biomonitoring protocols, and explain the need for time- and cost-effective sample-preparation procedures, faster chromatography run times and smaller sample volumes. They also discuss the need to monitor other halogenated forms of BPA (in addition to Cl_xBPA), which have shown adverse health effects in some studies.

Studies on humans could help to close knowledge gaps, such as the pathways that lead to exposure, sources in the environment and the potential endocrine-disrupting properties of the aforementioned BPA compounds. The authors also recommend investigations into whether other phenols in the environment contribute to metabolic disorders.

