BRIEFING

PFAS exposure: information about biomonitoring for affected communities and clinicians

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The use of harmful per- and polyfluoroalkyl substances (PFAS) in consumer products and across industry applications is increasing, as is the amount of scientific evidence about the presence of high levels of those chemicals in our environment. Meanwhile the pace of regulation is alarmingly slow. For communities living in or around highly PFAS-contaminated areas, biomonitoring is a necessary tool for determining levels of human exposure, establishing trends over time, and interpreting those in relation to potential long-term health impacts.

What is biomonitoring?

Biomonitoring is the worldwide standard procedure for assessing people's exposure to chemicals that may be harmful to health, and responding to environmental public health issues. Biomonitoring involves measuring chemicals that are present in the environment, or their breakdown products (metabolites), in human tissues and fluids, such as blood and urine.

In areas contaminated with PFAS, biomonitoring to determine the extent of chemical exposure is an effective tool to support actions by community members and local authorities to stop further contamination, hold polluters accountable, and address potential health issues. For example, in Ronneby, Sweden, a court ruled that biomonitoring levels alone were enough to indicate personal injury from PFAS contamination and that harm in the form of ill health (which might not occur for many years) did not need to be proven.

Resources for people and their health professionals

Guidance on PFAS Exposure, Testing, and Clinical Follow-Up, from the US National Academies of Sciences, Engineering and Medicine

PFAS Exposure: Information for patients and Guidance for Clinicians to inform patient and clinician decision making, from the US PFAS-REACH Project

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PFAS biomonitoring in Europe

Hundreds of biomonitoring studies have been conducted around the world measuring PFAS in human blood. [1] In the European Union, the Human Biomonitoring Initiative HBM4EU has ongoing efforts to address PFAS exposure, including an inventory of biomonitoring studies in PFAS hotspots, engagement of regional and local risk managers, environmental health care workers, scientists, and regulatory authorities, and a guidance document for policy makers and scientists. [2]

A range of different PFAS have been measured in the blood of European citizens as a result of exposure to contaminated air, water and food. For some, such as PFOS and PFOA, which are subject to near-global restrictions, levels have been declining. This is good news for individuals, and it indicates that restrictions are effective.

However, levels of other (less documented) PFAS have been increasing over the past few decades. [3] For example, HBM4EU notes that in Sweden, Norway and Germany, PFOA and PFOS peaked around 2000, while concentrations of PFNA, PFDA, PFUnDA and other PFAS increased in all three countries. [4] Unfortunately, it appears that PFAS manufacturers are substituting one bad PFAS for another. This is a common practice known as "regrettable substitution". The risk of adverse health effects increases when people are exposed to different PFAS that can affect the same organs, or have similar health effects. To avoid regrettable substitution of one PFAS for another, scientists are calling for a class approach to stop further contamination by all PFAS. [5]

"Safe" levels of PFAS in human blood

Most people have some amount of PFAS in their bodies. But the risks of chemical exposures increase with large scale pollution events (hotspots) or for certain individuals, such as people who work in chemical factories. For chemicals like PFAS, which do not break down in the environment, the risk of exposure can continue for years, even decades after the initial pollution event and even if the pollution has been discontinued.

Measuring levels of PFAS in human blood is challenging, in part because the methods for detecting PFAS in blood have only been developed for a very small number of the thousands of PFAS people are exposed to. Thus overall PFAS exposure is always underestimated. Even more challenging is the process of identifying "safe" levels of exposure in human blood. Hence the case for an outright ban of all PFAS, and where not possible, strict regulations to drastically minimise exposure.

The German Environment Agency has identified the concentration of PFOA and PFOS in human blood, above which the risk for adverse health effects is estimated to increase (HBM-II), as 10 ug/l for PFOA and 20 ug/l for PFOS. [6] The HBM-II value is regarded as an intervention or action level, at which there is an acute need to reduce exposure and obtain medical advice.

In some areas across Europe, concentrations of PFOA and PFOS in the most exposed citizens were above thresholds for adverse effects in humans. [7] The table below indicates PFOA and PFOS levels among citizens studied in several contaminated areas in the EU (see www.env-health.org/BanPFAS for information on the sources of and responses to the contamination in each area).

PFAS levels in human blood serum in EU hotspots

	PFOA (ug/L)	PFOS(ug/L)	Reference
German HBM-II values*	**10**	**20**	
Veneto, Italy [m]	**14**	8.7	Ingelido et al. (2018) [8]
Dordrecht, Netherlands [m]	**10.2**	na	RIVM (2017) [9]
Antwerp, Belgium [gm]	1.39	**22.4**	VITO & PIH (2022) [10]
Ronneby, Sweden [gm]	6.8	**135**	Xu et al. (2021) [11]
Korsør, Denmark [gm]	1	**43**	HBM4EU Spreadsheet [12]
European population [m] (among adults)	1.9	7.7	EFSA (2020) [13]

*The HBM-II value is regarded as an intervention or action level, at which there is an acute need for exposure reduction measures and the provision of biomedical advice. Numbers in bold font indicate values at or above HBM-II. m = median; gm = geometric mean

The table shows that over half the people studied in selected hotspots in Italy and the Netherlands had levels of PFOA in their blood warranting protective action. Among people living in affected communities in Belgium, Sweden and Denmark, the average amount of PFOS exceeded action levels. Notably, in Ronneby, Sweden the average amount of PFOS was nearly seven times higher than the action level recommended by the German Environment Agency.

The studies presented in the table were conducted among people living in the affected areas. Higher risks often exist for workers in/around industrial facilities involved in PFAS manufacturing or processing, children, people who are pregnant, breastfeeding, or wish to become pregnant, and immunocompromised people. In some contaminated areas, data from high risk groups is available. Biomonitoring of 120 Miteni employees in Veneto, Italy found the average level of PFOA was 4,048 ug/L with one worker having 91,900 ug/L. [14] Among residents of Veneto, farmers had the highest concentrations, due in part to drinking well water and eating their own produced food. [15] In Antwerp, Belgium, researchers found that every child between three and nine years old living within a 2-10 kilometre radius of the manufacturing plant was exceeding the consumption standard after eating just two eggs a week. [16] Measuring blood concentrations in high risk groups has important implications for responding to such risks. For example, following identification of PFAS contamination in Antwerp, residents in the general population were advised to consume home grown vegetables in moderation. People at high-risk however, were advised not to consume home grown vegetables at all.

What you can do

Finding out that PFAS contamination has occurred near you is stressful. A study in Veneto, Italy showed that the strain of living with chronic exposure to PFAS contamination was a significant stressor for parents, as they moved from shock to adaptation, and worried about the future quality of life of their children and their ability to protect them. [17]

Good and timely communication from authorities is critical, but it often takes time to develop appropriate guidance and take action to protect citizens. Authoritative bodies in different hotspots have had widely varying responses to contamination. The good news is that resources have been created to help people who have had their blood tested and are concerned about their PFAS exposure.

These include the US National Academies of Sciences, Engineering and Medicine and the US PFAS-REACH Project. These can help people and their health care providers monitor and address potential health problems associated with PFAS exposure.

HEAL encourages everyone to take action against PFAS pollution in their own community and to call for strong EU-level legislation. Visit our website to read about examples of PFAS contamination sites and community action across Europe, and find out the various ways in which you can take action yourself, as concerned citizens, as health professionals, civil society organisations, or businesses.

NOTES

Other HEAL resources on PFAS and health include:

- HEAL campaign page (updated on a regular basis)
- Throwaway Packaging, Forever Chemicals – European wide survey of PFAS in disposable food packaging and tableware. Joint report by Arnika in cooperation with HEAL, CHEM Trust and six other non-profit organisations in Europe (May 2021)
- How PFAS chemicals affect women, pregnancy and human development: joint infographic and fact sheet by the International Federation of Gynecology and Obstetrics (FIGO), HEAL and the University of California in San Francisco - UCSF (May 2021).
- Turning the Plastic Tide – The chemicals in plastic that put our health at risk (September 2020)
- HEAL's vision for Europe leading the way towards a non-toxic environment, available in English, Dutch and French (June 2018)

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The Health and Environment Alliance (HEAL) is the leading not-for-profit organisation addressing how the environment affects human health in the European Union (EU) and beyond. HEAL works to shape laws and policies that promote planetary and human health and protect those most affected by pollution, and raise awareness on the benefits of environmental action for health.

HEAL's over 90 member organisations include international, European, national and local groups of health professionals, not-for-profit health insurers, patients, citizens, women, youth, and environmental experts representing over 200 million people across the 53 countries of the WHO European Region.

As an alliance, HEAL brings independent and expert evidence from the health community to EU and global decision-making processes to inspire disease prevention and to promote a toxic-free, low-carbon, fair and healthy future.

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