Tidsskriftet Tidsskrift for Den norske legeforening

Alarmingly high levels of environmental pollutants in Norwegian children

OPINIONS

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Most Norwegian children have blood concentrations of per- and polyfluoroalkyl substances that exceed the threshold values set for adults. This may have serious health implications.

Per- and polyfluoroalkyl substances (PFAS) have been produced by industry since the 1950s, and it is estimated that more than 10,000 such compounds now exist in the environment. These substances are persistent due to slow degradation, leading to accumulation in the environment, hence the nickname 'forever chemicals.'

A number of PFAS compounds are now included in the Stockholm Convention, a multilateral environmental agreement to limit persistent organic pollutants in the environment. Over the past 20 years, the threshold values for what is considered a safe intake of these environmental pollutants have been significantly lowered, as a number of studies indicate that these substances can have serious negative health effects.

PFAS compounds interfere with the effects of natural hormones and affect metabolism (1). They are associated with reduced fertility (in both sexes), asthma, high levels of total and LDL cholesterol, hypertension and obesity in children and adults (2–7). In newborns, increased PFAS concentration is associated with significantly poorer gross motor development, which in turn is a marker for cognitive function later in life (8). The diversity of infant gut microbiota may be adversely affected, and exposure through breast milk is associated with ADHD in girls (9, 10). The effects of PFAS on metabolism and lipid metabolism are well documented in both experimental animal models and human studies (1). Other adverse health effects have also been associated with PFAS levels in humans, but restricted to cross-sectional and small observational studies, limiting the interpretation of causality. More studies are needed to clarify the extent to which PFAS compounds contribute to the development of various diseases.

> ***«PFAS compounds are associated with reduced fertility (in both sexes), asthma, high levels of total and LDL cholesterol, hypertension and obesity in children and adults»***

High levels in Norwegian children

Several studies have examined PFAS levels in Norwegian children (Table 1) (8, 9, 11). In 2020, the European Food Safety Authority (1) established an intake threshold of 4.4 ng/kg body weight per week for the sum of the four most common PFAS compounds mentioned in Table 1. A continuous intake at this level is associated with a serum concentration of 6.9 ng/mL in adults. Table 1 shows that the majority of Norwegian children exceed this level: 78 % of six-month-old infants, 25 % of 12-year-olds in Oslo, and 87 % of teenagers in Tromsø.

Tabell 1

Serum concentrations of per- and polyfluoroalkyl substances in Norwegian children (*N* = 1 153) (8, 9, 11).

	Infants Bergen (n = 94)	12-year-olds Oslo (n = 154)	15–19-year-olds Tromsø (n = 905)
$\sum_4$PFAS[1], ng/mL			
Median (25-; 75-percentile)	9,32 (7,35; 12,75)	5,40 (4,20; 6,89)	9,90 (7,99; 21,68)
Max value	20,40	22,85	192,07

[1]The sum of the concentrations of the four most common compounds: perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS) perfluorohexane sulfonate (PFHxS) and perfluorononanoic acid (PFNA).

PFAS compounds are found in food and consumer products such as food packaging, impregnated textile fabrics, firefighting foam and ski wax. They are spread in the environment by water and wind currents, and the main source for humans is food and drinking water (12, 13). Several studies have reported that consumption of fish and seafood is significantly associated with higher PFAS concentrations in both children and adults (13-15). Fish intake was the strongest predictor of levels in Norwegian women of childbearing age (11). These compounds have been shown to pass from mother to fetus via the placenta, resulting in newborns having concentrations up to five times higher compared to their mothers (8). In the Fit Futures study of Norwegian teenagers, consumption of fatty fish more than once a week was associated with significantly higher PFAS concentrations in serum (14). Children from six European countries who consumed a lot of fish (≥ 3 times per week) had 37 % higher PFAS levels in their blood compared to children who ate less fish (< 1.5 times per week) (13). Intake of canned foods and fast food, such as soda, pizza and hamburgers, was also associated with higher PFAS levels in Norwegian teenagers (14). This is likely due to content of PFAS compounds in food-packaging or contamination of food products during production.

It is alarming that such a large proportion of Norwegian children have blood concentrations of PFAS exceeding the European recommended limit for adults. Norway has no industries that produce these compounds, and drinking water generally contains low concentrations (16). Therefore, the primary source of PFAS for Norwegian children must be the food they consume. It is imperative to implement measures to reduce PFAS contamination of food, and the public must be informed about PFAS levels in various food products to enable informed choices.

All the authors except Azemira Sabaredzovic are members of the board of Environmental Pollutants and Public Health' (Miljøgifter og folkehelse) and the first author is the chair of the board.

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Publisert: 2 December 2024. Tidsskr Nor Legeforen. DOI: 10.4045/tidsskr.24.0423
Received 12.8.2024, first revision submitted 3.9.2024, accepted 24.9.2024.