

Are environmental pollutants in the Norwegian diet harmful to children?

When giving dietary recommendations, the authorities state reference limits. Norwegian studies have identified negative health effects in children even though their mothers have an intake below the recommended limits. Something is clearly wrong.

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Environmental pollutants represent a global problem and pose a threat to animals as well as humans (1). The potential for harm is especially great in periods of life when there is rapid growth and development, such as during pregnancy and childhood (2). Persistent organic pollutants (POPs) is a collective designation for a group of organic environmental toxins that include dioxins, polychlorinated biphenyls (PCBs), brominated flame retardants and organochlorine pesticides. They degrade very slowly, are scarcely excreted from exposed organisms and therefore tend to accumulate in the food chain (bioaccumulate). Most of them are fat-soluble, and the highest concentrations in our diet are found in fatty foods, especially oily fish (3), while breast milk is the main source for infants (4). During the last ten years, the level of most, but not all such environmental pollutants has declined in foodstuffs, including in breast milk (5).

Many of the environmental pollutants are stored in the body's fatty tissue, where they may have a half-life of up to ten years. With pregnancy and breastfeeding, their level in women is reduced (6). However, while the amount of environmental pollutants in the mother declines, it increases in the child, and a considerable proportion of the mother's store of pollutants is transferred to the first-born (7). After one year of breastfeeding, the concentration of certain environmental pollutants in breast milk may be reduced by more than 90% (8). A recent study found that the plasma concentration of PCB in Norwegian infants was approximately 40% higher than in their mothers. The plasma concentration in the infant was related to

their mothers' intake of environmental pollutants through diet (9).

Effects in children

Numerous epidemiological studies have shown that environmental pollutants are associated with both acute and chronic injury to the liver, kidneys, endocrine system and central nervous system (10, 11). There is a correlation between pre- or post-natal exposure and later negative health effects in children. Exposure to environmental pollutants in the womb and early childhood is associated with neurocognitive injuries, including ADHD and autism as well as diabetes, obesity and cancer (12, 13). Cohort studies that include Norwegian children have shown negative health effects associated with intake and concentration of environmental pollutants in the mother, such as reduced birthweight, behavioural problems, impaired language development and immune response (14, 15).

Some environmental pollutants are so-called endocrine disruptors. The harmful effects of endocrine disruptors appear even at very low doses, and the effects can often not be predicted from studies conducted using higher doses (10). Exposure to endocrine disruptors has been linked to the obesity epidemic that also affects children and adolescents. Numerous studies point to an association between the maternal concentration of various endocrine disruptors and the risk of later obesity in the child (16, 17). It has been estimated that the development of obesity and diabetes caused by endocrine disruptors is likely to cost the EU more than EUR 18 billion per year, an estimate which is assumed to be modest (18).

A multi-centre study that included more than 26 000 pregnant women showed that a high intake of fish during pregnancy was associated with later development of obesity in the child (19). As a possible explanation, the authors noted that fish is a considerable source of environmental pollutants in the form of endocrine disruptors, and they concluded that pregnant women ought to reduce their intake of fish.

Reference limits

Toxic equivalents (TE) is an expression of the toxicity of dioxins and dioxin-like polychlorinated biphenyls (dl-PCB). Fifteen years ago, the tolerable weekly intake (TWI) of dioxins and dl-PCB was set at 14 pg TE per kilo bodyweight per week (5, 20). Such limits state the amount of toxin that a person can ingest per week throughout life with no assumed health risk. Most other persistent organic environmental pollutants have no established TWI.

Reference limits based on lifetime exposure provide no indication of how much toxin infants can tolerate during their first years of life without suffering any harm. A negative correlation between the mother's intake of dioxins and dl-PCBs and foetal development has been found even with an intake lower than TWI (21). In a sub-group of the Norwegian Mother and Child Cohort Study it was found that even though 97.5% of the mothers had an intake of dioxins and polychlorinated biphenyls which was below TWI, their intake of these environmental pollutants was associated with reduced immune response in their children (22). Other studies have also shown that the harmful effects of environmental pollutants cannot be related to a threshold value with any certainty (23).

The EU Commission has also defined reference limits for maximum levels of certain pollutants in food (24). However, the values vary between different kinds of food: the permitted concentrations for dioxins and dl-PCBs in fish are twice as high as in chicken and five times higher than in pork, despite the fact that the toxin is the same. In general, the content in Norwegian-made foods is far below the EU reference values, but some foodstuffs, such as oily fish and crustaceans, contain relatively much more than others (25–27) (Figure 1). However, there are more than 100 000 different environmental pollutants, and for the majority of them no reference limits have been established, because of limited evidence.

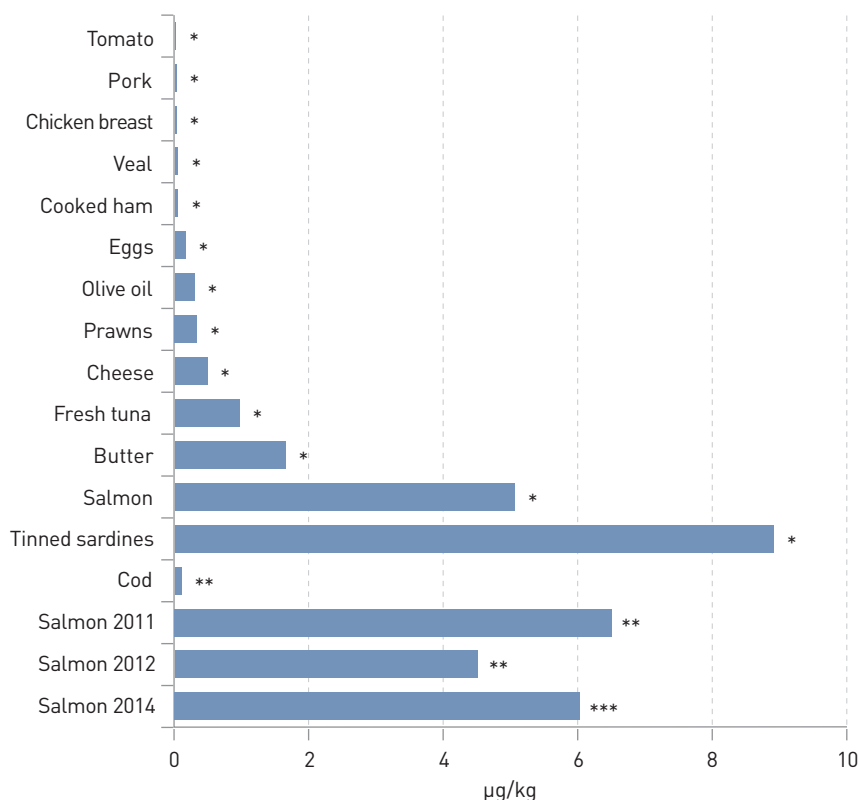


Figure 1 Sum of seven PCBs [-28, -52, -101, -118, -138, -153 and -180] in different foodstuffs from Catalonia, Spain, 2012 [26] (*), in cod and farmed salmon analysed by NIFES [27] (**), and the average for three Norwegian farmed salmon purchased at the Marché International de Rungis, France, 2014 by France 5 Television, analysed by Carso - Laboratoire Santé Environnement Hygiène de Lyon, France (***) [Baya Bellanger, Toni Comiti Productions, Paris, personal communication]

How much dioxins and dl-PCBs are Norwegians ingesting?

The Norwegian Institute of Public Health reports that the population has an estimated average intake of dioxins and dl-PCBs of 10 pg TE per kilo bodyweight per week (5). This is lower than the established limit of 14 pg TE per kilo bodyweight per week; the median value in Norwegian two-year-olds, however, is 18 pg per kilo bodyweight per week, i.e. above the limit (5). The highest intake of environmental pollutants, however, is found in the most vulnerable section of the population. According to pharmacokinetic studies, the amounts of pollutants ingested by infants through breast milk may be many times higher in proportion to their bodyweight when compared to the intake from diet in adults. It has been suggested that a separate factor of at least ten be applied in risk assessment of breastfed children (28). However, this factor encompasses only pharmacokinetic aspects and does not take into account that children are more vulnerable to the effects of pollutants than adults are (2).

The reference limits are based on studies of how a specific substance affects the organism, but environmental pollutants do not appear in isolation. They are ingested and

stored in the form of a cocktail, which may cause negative health effects even when the intake of each substance is lower than the recommended level (29). During the first months after birth, the brain grows rapidly and undergoes continuous restructuring. At the same time, the infant receives a large proportion of the mother's accumulated environmental pollutants, consisting of an unknown cocktail of organic environmental pollutants and heavy metals.

Special advisory units

Environmental pollutants represent a global health challenge. Many countries have established separate units, Paediatric Environmental Health Specialty Units (PEHSU), that teach and provide advice on environmental pollutants and their impact on the health of children (30). There seems to be a need for a similar organisation in Norway.

Many studies show that environmental pollutants may have negative health effects in children, even with our current relatively low background concentrations in food. In reality, we have no possibility for establishing safe reference limits for environmental pollutants in food. We all need to endeavour to reduce the concentrations of environmental pollutants in food and help

ensure that the population chooses a diet that has the lowest possible content of pollutants.

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