

HEALTH EFFECTS AND RISK ASSESSMENT

Dioxins, furans and dioxin-like polychlorinated biphenyls (PCBs) are persistent contaminants that may exert effects even at relatively low levels of prolonged exposure. Their health significance cannot be understood by considering only the amount in a single food: the toxic potency of individual congeners, total exposure and accumulation in the body must also be taken into account. The latest assessment by the European Food Safety Authority (EFSA), published in June 2026, confirms that dietary exposure is a public-health concern for Europeans. Nevertheless, this does not mean that every exposure or every exceedance of a reference value necessarily causes disease.

HOW THEY ACT IN THE BODY

The best-studied toxicological mechanism for dioxins and dioxin-like PCBs involves the aryl hydrocarbon receptor (AhR). Some congeners bind to this receptor, which helps regulate the expression of various genes. Activation can alter cellular and physiological processes, with consequences depending on the substance, dose and stage of life at exposure. 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is the reference compound used to compare the relative potency of dioxin-like substances.

The toxic-equivalent (TEQ) system combines individual congener concentrations using toxic equivalency factors (TEFs). It is useful for estimating a comparable measure of overall toxicity, but rests on assumptions and uncertainties: it is not a direct measure of every possible health effect. Non-dioxin-like PCBs have different toxicological profiles and are not included in the TEQ for dioxin-like compounds.

MECHANISM OF ACTION OF DIOXIN-LIKE COMPOUNDS

Conceptual diagram: activation of the AhR receptor



The effects depend on the dose, the substance and the stage of life; the pathway is simplified.

EFFECTS ON REPRODUCTION AND DEVELOPMENT

Effects on the development of the male reproductive system are the critical endpoint chosen by EFSA to derive its 2026 health-based guidance value. Particular attention is paid to exposure during pregnancy and early life, when some organs and biological systems are more vulnerable. Evidence comes from experimental animal studies and human investigations, but the strength of associations and attribution of specific effects to particular substances vary across studies.

In its 2018 assessment, EFSA placed particular weight on an epidemiological study of semen quality. In the 2026 update, recalculation using the WHO 2022 TEFs showed that the relationship was insufficiently robust when dioxin-like PCBs were also included. EFSA therefore selected as its main study a rat developmental experiment in which TCDD exposure was associated with reduced sperm production. Human studies remained supporting evidence. The choice of the pivotal study is essential for correctly interpreting the new guidance value.

THE IMMUNE SYSTEM, HORMONES AND OTHER EFFECTS

The scientific literature documents or suggests, with varying degrees of certainty depending on outcomes and exposure levels, changes in immune parameters, disruption of endocrine regulation, liver effects and developmental disorders. Characteristic skin effects, such as chloracne, have also been observed at high exposure levels. Not all these findings are equally well established at concentrations typical of dietary exposure in the general population.

In epidemiological studies it is often difficult to isolate the specific role of dioxins from that of other co-occurring contaminants and individual, dietary or environmental factors. A statistical association should therefore not automatically be interpreted as proof of causation for the particular outcome observed.

DIOXINS AND CARCINOGENICITY

The International Agency for Research on Cancer (IARC) has classified TCDD as carcinogenic to humans (Group 1). This is a hazard classification: it means that a substance can cause cancer under certain exposure conditions, not that it directly quantifies an individual's probability of developing cancer at concentrations found in their diet. The same classification should not automatically be extended to every dioxin or furan congener.

Studies of occupationally exposed populations and accidents involving high concentrations have provided important evidence. Estimating the risks associated with normal dietary exposure instead requires specific assessments of actual levels, exposure duration and uncertainties.

THE 2026 EFSA ASSESSMENT: WHAT HAS CHANGED?

On 10 June 2026, EFSA published a new assessment of the risks from dioxins, furans and dioxin-like PCBs in food and feed. It incorporates the WHO 2022 toxic equivalency factors and establishes a tolerable weekly intake (TWI) of 0.6 picograms WHO2022-TEQ per kilogram of body weight per week. This is a chronic-exposure reference value for the combined substances considered, not a legal limit for a particular food and not an analytical limit of quantification.

EFSA's previous 2018 assessment had established a TWI of 2 picograms WHO2005-TEQ/kg body weight per week. The new number is about three times lower numerically, but the comparison requires caution: the TEFs and derivation methodology have changed. Applying the new TEFs to food data, EFSA estimated TEQ exposure levels 27–35% below calculations based on the previous factors. It is therefore wrong to describe the update simply as a tripling of risk or proof that contamination has recently worsened.

For European adults, mean exposure estimated in the 2026 assessment ranges from 1.87 to 6.10 pg WHO2022-TEQ/kg body weight per week, depending on the data and assumptions used. EFSA reports exceedances of the new TWI across all age groups, with greater exceedances among children. These are population estimates, not measurements of any particular person's exposure. EFSA considers the overall picture a health concern while acknowledging substantial uncertainties.

WHAT DOES EXCEEDING THE TOLERABLE WEEKLY INTAKE MEAN?

A tolerable weekly intake is a toxicological guidance value designed to protect against long-term adverse effects, taking account of individual variability and gaps in knowledge. Exceeding it does not mean harm has already occurred, nor does it directly quantify an individual's clinical risk. Conversely, widespread and persistent exceedances cannot be dismissed as irrelevant: they indicate the need to reduce population exposure, especially over the long term.

EFSA uses a weekly scale because these substances remain in the body for long periods and day-to-day variations in intake matter less than the body burden built up over time. The value is also intended to limit accumulation in women before pregnancy and exposure of their children during early development. This does not imply a recommendation to stop breastfeeding: health authorities continue to recognise its benefits, while prevention should focus primarily on reducing environmental and dietary contamination.

REMAINING UNCERTAINTIES

Risk assessment is not an exact measurement of harm. Uncertainties remain concerning the TEFs applied to dioxin-like PCBs in humans, models reconstructing accumulation in the body, differences between individuals and data availability for certain foods, particularly those of plant origin. EFSA has explicitly assessed these uncertainties: some may alter numerical exposure estimates or the tolerable intake and thereby the strength of conclusions.

Scientific assessment nevertheless remains indispensable for prevention. Consumers should distinguish three levels: a substance's intrinsic hazard, the exposure arising from quantities ingested over time and the probability of harmful effects estimated from models and epidemiological or experimental data. Confusing these levels leads both to unjustified alarm and to underestimation of risk.

CONCLUSIONS

Dioxins and dioxin-like PCBs require particular attention because of their persistence, accumulation and the sensitivity of certain developmental stages. EFSA's 2026 update confirms the need to limit chronic exposure through food monitoring and, above all, by reducing emissions and contamination at source. A single analytical result must be interpreted in the context of congeners' relative toxicity, amounts consumed and overall exposure. The next chapter explains how these substances are measured and how analytical findings should be interpreted.

SCIENTIFIC AND REGULATORY REFERENCES

[EFSA CONTAM Panel \(2026\). Update of the risk assessment on dioxins and dioxin-like PCBs in feed and food. EFSA Journal, 24\(6\), e10103.](#)

<https://doi.org/10.2903/j.efsa.2026.10103>

[EFSA \(2026\). Update of the risk assessment of dioxins and dioxin-like PCBs in feed and food — Plain language summary.](#)

<https://www.efsa.europa.eu/en/plain-language-summary/update-risk-assessment-dioxins-and-dioxin-pcbs-feed-and-food>

[EFSA CONTAM Panel \(2018\). Risk for animal and human health related to the presence of dioxins and dioxin-like PCBs in feed and food. EFSA Journal, 16\(11\), 5333.](#)

<https://doi.org/10.2903/j.efsa.2018.5333>

[WHO \(2026\). Dioxins — Fact sheet, 11 August 2026.](#)

<https://www.who.int/news-room/fact-sheets/detail/dioxins-and-their-effects-on-human-health>

[IARC \(1997\). Polychlorinated Dibenzo-para-Dioxins and Polychlorinated Dibenzofurans. IARC Monographs, volume 69.](#)

<https://publications.iarc.who.int/87>