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Microplastics in brain tumour tissue: study does not allow conclusions regarding the development of cancer

A research team has carried out the detection of micro- and nanoplastics (MNP) in human brains. Healthy tissue was compared with diseased tissue. It was noted that the concentration of MNP in brain tumours and in the tissue surrounding brain tumours was higher than in healthy tissue. However, this does not prove that MNP have an effect on the growth of brain tumours or that they cause them. The authors also point out that the data do not show any causal links: whether MNP causes a brain tumour, or whether a brain tumour accumulates microplastics, cannot be demonstrated on the basis of the available data.

Previous detections of MNP in human brains are the subject of controversy due to methodological shortcomings (see https://www.bfr.bund.de/en/notification/microplastics-in-the-brain/). The study considered here differs from these, amongst other things, in that it examines a larger number of samples and the authors themselves point out limitations in the detection methods within their publication. It is also striking that significantly lower concentrations of microplastics were measured in the brain samples in the current study.

No link between MNP and the formation or growth of brain tumours can be derived from the study. Based on the current state of knowledge, there is no reliable toxicological evidence of health risks arising from the intake of microplastics via food. Further information on the current state of knowledge is provided by the BfR in its FAQs.

Link to the study: https://doi.org/10.1038/s44360-026-00091-4

For the study, a total of 191 tissue samples were analysed for micro- and nanoplastics (MNP). The majority – 156 samples – came from 113 patients with brain or meningial

tumours. For comparison, 35 samples were taken from five significantly older individuals who had died without having suffered from any brain disease. For MNP detection, the research team combined various measurement methods – including infrared spectroscopy, gas chromatography and scanning electron microscopy. The authors have transparently presented and described the methodological challenges and limitations, and have attempted to minimise them in line with the current state of the art. This includes an attempt to account for background contamination during sample collection and preparation. In addition, tests were carried out to determine how well the plastics can actually be detected in brain tissue (recovery experiments). However, no actual plastic particles were used for calibration; instead, plastics dissolved in solvents (solubilised polymers) were employed. In brain tissue, however, the occurrence of interactions between different materials was not taken into account in the calibration. Precise details regarding metrological parameters – such as the limits of detection and quantification (LOD, LOQ) – are also lacking.

In the recovery experiments, efforts were made to avoid confusion with the body's own substances, such as adipose tissue, during the evaluation of the signals. This is important because, according to the academic literature (Rauert et al. 2025), the measurement method used (pyrolysis-GC-MS) can produce inaccurate results with certain plastics, such as polyethylene. This can lead to false-positive signals and, consequently, to an erroneously elevated plastic detection rate. As the authors of the study make clear, despite all efforts, it is not currently possible to provide a reliable quantitative estimate. The study therefore does not provide precise particle counts, but rather illustrates, by way of example, the pitfalls that should be taken into account when determining microplastics in tissue samples. *A comprehensive review of all data and background information will therefore take further time.*

Amount and distribution of MNP in the brain

A key finding of the study is that plastic particles can be found in brain tumours. The tissues examined consist partly of healthy tissue and partly of components of various tumour types or surrounding tissue, located both in front of and behind the blood-brain barrier. It is striking that plastic does not appear to be distributed homogeneously throughout the brain as a whole, but is instead concentrated in specific domains. Consequently, extrapolations to the brain as a whole, based on individual biopsy results, would not be reliable.

It is important to note that the tissues examined cannot always be unambiguously classified post-mortem; in particular, at the interfaces between different tissues, there are domains that may lie either in front of or behind the blood-brain barrier. Consequently, it is not possible to prove beyond doubt that the blood-brain barrier has been crossed. Similarly, tumour tissue may be permeated by blood vessels, and a presence within the tissue could therefore not be distinguished beyond doubt from a presence at the walls of blood vessels.

The study calculates concentrations for individual tumour types and tissue types that are far (at least by a factor of 80) lower than the previous calculations (drawn from the study by Nihart et al., 2025). Consequently, the amount of plastic in the brain would not be 5 grams per kilogram (g/kg), but maximally 0.06 g/kg of brain mass, and only in the tumour tissues with the highest measured concentrations of microplastics. An extrapolation to the entire brain would not be meaningful for the reasons stated above.

The measured presence of larger particles (some over 20 micrometres) cannot be explained by current knowledge of systemic bioavailability. Possible reasons:

1. Contamination or misclassification during sample preparation or detection.
2. A route of administration whereby particles can bypass the body's barriers, such as intravenous injections or infusions.
3. A possible disease-related weakening and the associated increase in permeability of the body's barriers.
4. A transport mechanism across bodily barriers (persorption, immune cells) that remains unclear to date, but which, contrary to current understanding, nevertheless allows for systemic bioavailability.

Clarifying this issue should be a priority for future studies. A further point that should be clarified, investigated further and assessed for plausibility, is the finding of very high particle concentrations in the extra-axial domain (the peripheral region of the brain, beneath the skull – but not yet 'in the brain' or behind the blood-brain barrier) of healthy brains.

The accumulation of substances and also particles in tumour tissues is scientifically plausible and explainable due to the nature of tumours (neovascularisation, increased mass transport, the EPR effect (Enhanced Permeability and Retention effect)). The authors further postulate an even more pronounced accumulation in the adjacent tissues (peritumoural tissue). The process by which these substances cross bodily barriers, such as the blood-brain barrier, remains unclear.

Evaluation of the findings in tumour tissue

It is important to emphasise that the authors of the study do not claim that there is a link between tumour development and microplastics. They determine the possible presence of particles in tumours without postulating a causal link. Rather, their hypothesis has a rationale that the higher intake of plastic is due to the disease itself, as bodily barriers (particularly the blood-brain barrier) may be impaired as a result of the patient's health condition, thereby increasing the likelihood of enhanced permeability. Furthermore, a prolonged medical history involving numerous medical treatments is seen as a possible source of increased plastic intake (e.g. via medical devices, infusions, etc.). Nor is any temporal correlation with the course of the disease (tumour proliferation, etc.) postulated, as the analysis of biopsies does not allow such a correlation to be established. No toxicological studies were carried out.

Conclusions with respect to risk communication

In view of its statutory mandate for risk communication, the BfR continuously reviews the body of research on microplastics and derives conclusions from this for its own communication. The present study is characterised by a high level of awareness and a transparent acknowledgement of scientific and methodological limitations. For risk communication, it can therefore serve as a positive example of addressing and dealing with methodological challenges and scientific uncertainties in a transparent manner. However, the method validation for determining particle concentration still needs to be further refined.

It is important to emphasise that, for the reasons outlined above, the study does not postulate a causal link between microplastics and the development of cancer; rather, the

increased presence of particles is attributed to the disease. Furthermore, the routes of exposure for MNP particles remain unclear. A key subject of future research should be to determine whether, how and to what extent barrier penetration – particularly by larger particles – is possible.

Furthermore, taking into account that the authors emphasise the continuing high level of uncertainty in the identification of microplastic particles, the BfR does not regard the published data as accurate and universally valid information on the number, type and size of particles in the brain.

The study does not allow to derive any link between MNP and the formation or growth of brain tumours.

Further information on microplastics is available on the BfR website
Questions and answers on microplastics
https://www.bfr.bund.de/en/service/frequently-asked-questions/topic/microplastics-facts-research-and-open-questions/

BfR communication: Microplastics in the brain
https://www.bfr.bund.de/en/notification/microplastics-in-the-brain/

BfR podcast on microplastics (in German)
https://podcast.bfr.bund.de/3-mikroplastik-kleine-partikel-grosses-risiko-003

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