



OVERVIEW

for a clearer picture

No. 1

How does mobile communication affect people, animals and plants?



diagnose:funk
Use technology wisely

Overview No. 1

How does mobile communication affect people, animals and plants?

Updated: 16 September 2026

Summary

The diagnose:funk publication series "Overview for a clearer picture" reports on the state of research into the health effects of non-ionising radiation from mobile communications. Its research into scientific studies draws on the databases www.EMFdata.org and www.EMF-Portal.de.

Overview No. 1 presents the overall body of research. Drawing on sources, it shows that, for many medical endpoints such as fertility and cancer, peer-reviewed studies demonstrate harm to health at almost all frequencies used in mobile communications. This applies both to mobile phones, smartwatches, tablets and laptops used close to the body and to Wi-Fi routers and mobile phone base stations. Documents from the European Union and the German Bundestag now confirm these scientific findings. We provide an overview of the research, which subsequent publications in this series explore in greater depth.

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1 Is mobile phone radiation a health risk?

There is fierce debate about the risks of mobile phone radiation, smartphones and transmitter masts. In a 2020 interview about the debate over mobile communications research, Telefónica CEO Markus Haas stated:

*"We are very concerned about this discussion because it is devoid of facts. There are no scientifically sound studies that identify any health hazard whatsoever."*¹

Authorities and most media outlets circulate the following view of the state of research:

1. There is no evidence that mobile phone radiation has harmful health effects below the thermal threshold.
2. All studies that have demonstrated effects below the exposure limits are isolated cases, could not be replicated and fail to meet scientific criteria.
3. Non-ionising radiation does not have enough energy to damage cells.
4. Exposure limits protect against harm to health.

All four claims are false; more precisely, the opposite is true. We now have clear findings and statements on the potential harm caused by mobile phone radiation below the exposure limits, demonstrated by studies of the highest scientific standard and by major EU institutions.

In 2021, the European Parliament's technology assessment panel published the STOA study "Health Impact of 5G", a 198-page report on cancer and fertility to inform political decision-making.² This overview is a scoping review with high quality standards, produced by a highly qualified team at the Ramazzini Institute led by Prof. Fiorella Belpoggi. The search identified 1,861 cancer studies and 7,886 reproduction/development studies; 270 were assessed qualitatively using international criteria and described in short summaries.

The review goes far beyond a specialist journal article. The STOA study concludes that risks from frequencies already in use have been demonstrated; regarding 5G, it states that research is insufficient and that 5G must not be introduced.

In March 2022, the European Economic and Social Committee (EESC) published an opinion³ in the EU Official Journal (4 March 2022), drawing conclusions from the research and the debate surrounding it and calling for:

- protection against electromagnetic pollution, especially from 5G;
- recognition of the criticism voiced by citizens' initiatives;

¹ <https://www.tagesspiegel.de/wirtschaft/telefonica-deutschland-chef-im-interview-uns-beunruhigt-die-fakten-freie-diskussion-ueber-5g/25578250.html>, 24.02.2020

² Download the study: <https://diagnose-funk.org/1789>

³ Information on the EESC opinion: <https://diagnose-funk.org/1828>

- recognition of independent research findings;
- recognition of electromagnetic hypersensitivity as an illness;
- review and replacement of the inadequate ICNIRP exposure-limit guidelines with new guidelines drawn up by an independent body;
- compliance with **the precautionary principle**;
- recognition of ecological environmental risks and risks to data security.

1.1 The cancer-causing potential of mobile phone radiation

Worldwide, cancer cases among people under 50 rose by almost 80% between 1990 and 2019, according to a study in BMJ Oncology (September 2023).⁴ Global cancer cases in the 14-49 age group increased from 1.82 million in 1990 to 3.26 million in 2019. Recent international studies confirm this trend. An analysis of 42 countries shows annual increases of up to 3.6% for certain tumours (including colorectal, breast and thyroid cancer),⁵ with cases among under-50s sometimes rising faster than in older populations. This is linked to earlier biological ageing in younger generations.⁶ Experts appearing in the media puzzle over the causes. Media reports list many possible causes, but omit the increasing exposure to mobile phone radiation during this very period as a previously absent factor. This is despite the WHO having classified mobile phone radiation (= non-ionising radiation) as "possibly carcinogenic" (2B) back in 2011.⁷

The findings of the US NTP studies, the Italian Ramazzini studies and the extensive Austrian AUYA studies are clear: **mobile phone radiation can cause cancer**. The meta-analysis by Choi et al. (2020) confirms significant evidence of an increased tumour risk among heavy users - 17 minutes of daily mobile phone use over 10 years.⁸

4 <https://bmjoncology.bmj.com/content/2/1/e000049>

5 See <https://www.acpjournals.org/doi/10.7326/ANNALS-24-02718>

6 See <https://news.harvard.edu/gazette/story/2026/02/six-cancers-rising-faster-in-younger-adults-than-older-ones/> and <https://www.dkfz.de/aktuelles/pressemitteilungen/detail/auch-in-deutschland-anstieg-von-darmkrebs-bei-jungen-erwachsenen-aber-deutlich-unter-us-niveau>

7 diagnose:funk website: Wireless radiation possibly carcinogenic. WHO Interphone study completed, <https://diagnose-funk.org/929>

8 NTP (2018a): NTP Technical Report on the toxicology and carcinogenesis in Hsd: Sprague Dawley SD Rats exposed to whole-body radio frequency radiation at a Frequency (900 MHz) and modulations (GSM and CDMA) used by cellphones, https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/tr595peerdraft.pdf

NTP (2018b): NTP Technical Report on the toxicology and carcinogenesis in B6C3F1/N MICE exposed to whole-body radio frequency radiation at a Frequency (1,900 MHz) and modulations (GSM AND CDMA) used by cellphones, https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/tr596peerdraft.pdf

Falcioni L et al. (2018): Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission. Environ Res 2018; 165: 496-503
<https://www.emfdata.org/de/studien/detail?id=441>

ATHEM-2 (2016): Investigation of non-thermal effects of electromagnetic fields in the mobile communications range, AUYA Report No. 70; published by the Austrian Workers' Compensation Board
<https://diagnose-funk.org/1115>

For this reason, the internationally renowned expert and former ICNIRP member Prof. James C. Lin, speaking for the NTP study's peer-review panel of 14 scientists, calls in his article "Clear evidence of cell-phone RF radiation cancer risk" for exposure limits to be revised and radiation to be reclassified as "probably carcinogenic".⁹ Other scientists go further, calling for classification in the highest category, "carcinogenic".¹⁰

A systematic review by Mevissen et al. (2025), prepared for the WHO, confirms consistent indications of **genotoxic effects** of RF-EMF on the basis of the available animal studies. The results are consistent with the NTP and Ramazzini findings.¹¹

This is also confirmed by the new review by Weller et al. (2025), which shows that around 59% of investigations report **statistically significant DNA damage** following RF-EMF exposure, and that more than half of these findings occurred below current ICNIRP exposure limits, fundamentally challenging the WHO's previous narrative.¹²

In November 2018, BERENIS, the Swiss government's "Swiss expert group on electromagnetic fields and non-ionising radiation", presented an analysis of the NTP and Ramazzini studies. Its conclusion states: "In summary, based on the findings and their assessment, BERENIS supports **the precautionary principle** in regulating RF-EMF."¹³

On 14 February 2023, the German Bundestag published parliamentary paper 20/5646: "Technology assessment (TA) - Possible health effects of different frequency ranges of electromagnetic fields (RF-EMF)".¹⁴ This

Choi et al. (2020): Cellular Phone use and Risk of Tumor: Systematic Review and Meta-Analysis, International Journal of Environmental Research and Public Health, 2020, 17, 8079

<https://www.mdpi.com/1660-4601/17/21/8079/pdf>; from the abstract:

"In sum, the updated comprehensive meta-analysis of case-control studies found significant evidence linking cellular phone use to increased tumor risk, especially among cell phone users with cumulative cell phone use of 1000 or more hours in their lifetime (which corresponds to about 17 min per day over 10 years), and especially among studies that employed high-quality methods."

9 Lin JC (2018): Clear Evidence of Cell-Phone RF Radiation Cancer Risk, IEEE Microwave Magazine, September/October 2018, <https://doi.org/10.1109/MMM.2018.2844058>, see also <https://diagnose-funk.org/1508>

10 Carlberg M, Hardell L (2017) Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation, Review Article BioMed Research International, Volume 2017, Article ID 9218486, <https://doi.org/10.1155/2017/9218486>

Published in German translation as a diagnose:funk Brennpunkt: PDF download

11 Mevissen M et al. (2025): Effects of radiofrequency electromagnetic fields (RF EMF) on cancer in laboratory animal studies. [Effects of radiofrequency electromagnetic fields (RF-EMF) on cancer in laboratory animal studies.] Environ Int 2022; 161: 107106. <https://doi.org/10.1016/j.envint.2025.109482>. See also <https://diagnose-funk.org/2220>

Mevissen M et al. (2026): Corrigendum to "Effects of radiofrequency electromagnetic field exposure on cancer in laboratory animal studies, a systematic review" (Environ Int 199, 2025, 109482). Environment International, 110368 (in press).

12 Weller SG, McCredde JE, Leach VA, Chu C, Lam AK (2025). A scoping review and evidence map of radiofrequency field exposure and genotoxicity: assessing in vivo, in vitro, and epidemiological data. Frontiers in Public Health;13:1613353. <https://doi.org/10.3389/fpubh.2025.1613353>. See also <https://diagnose-funk.org/2321>

13 BERENIS - Swiss expert group on electromagnetic fields and non-ionising radiation, special newsletter issue, November 2018, <https://tinyurl.com/y33m3fxn>; see also: <https://diagnose-funk.org/1359>

14 Download the technology assessment report: <https://dserver.bundestag.de/btd/20/056/2005646.pdf>

TA report, which also assesses studies on mobile communications and cancer, documents more than 60 studies with significant findings. It considers the NTP and Ramazzini studies highly informative. Both are specifically highlighted, discussed in detail and described as "high-quality" in the Bundestag's TA report:

- "There are also a number of serious indications that RF-EMF increases the risk of certain tumours (heart, lung, liver, lymphatic system). These findings are currently being intensively discussed by specialists and assessment bodies in many countries, as the results of two large, high-quality studies were presented in 2020." (p. 120)
- "Both studies found that exposure to RF-EMF leads to an increased occurrence of heart and brain tumours." (p. 13)
- "Furthermore, two recent studies conducted with very large numbers of laboratory animals (rats and mice) and to a high scientific standard showed that exposure to RF-EMF signals of the kind used by mobile phones (GSM and UMTS) led to higher incidences of certain tumours or their precursors. Overall, these findings are among the most important of recent years [emphasis by diagnose:funk]. Since these are replicated indications of effects, they should be intensively investigated through further high-quality research. After all, they represent a significant aspect of risk assessment for humans." (p. 117)

On the basis of its own studies, Germany's Federal Office for Radiation Protection concludes that the radiation promotes cancer.¹⁵ These study findings are also presented as relevant in the TA report:

- "More recent findings from animal studies indicate the possibility of effects from EMF exposure. These concern cancer promotion in laboratory rodents, fertility and development." (p. 120)
- "Regarding cancer development, more recent animal studies can show increased incidences. Mice treated with a carcinogenic substance (in this case ethylnitrosourea) show more liver and lung tumours and higher rates of lymphoma when exposed to RF-EMF. However, no clear dose-response relationship could be established." (p. 120)

On the basis of this research, the advisory committee of the WHO's International Agency for Research on Cancer (IARC) recommends a high-priority review of whether new studies require the cancer risks associated with radiofrequency radiation to be placed in a higher hazard category than "possibly carcinogenic".¹⁶ To provide a sound basis for reassessment, the WHO has commissioned a series of comprehensive systematic reviews and

15 Lerchl A et al. (2015): Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. *Biochem Biophys Res Commun* 2015; 459 (4): 585-590; <https://diagnose-funk.org/522>, Lerchl A (2018): Synergistic effects of radiofrequency electromagnetic fields in combination with carcinogenic substances - co-carcinogenicity or tumour promotion? BfS research project 3615S82431, contractor: Jacobs University Bremen.

16 diagnose:funk (2019): Classification: "Probably carcinogenic" or higher? IARC to review radiofrequency cancer risk; <https://diagnose-funk.org/1397>

meta-analyses in recent years to assess worldwide research on various health endpoints. The results of the submitted meta-studies have prompted fierce controversy, which we document at diagnose-funk.org/forschung/entwicklungen-ereignisse/rueckblicke/historie-der-krebsdebatte.

Since revising its Preamble in 2019, IARC has refined its methodology and systematically assesses mechanistic evidence using the "10 Key Characteristics of Carcinogens", giving greater weight to biological mechanisms such as oxidative cellular stress. An IARC reassessment of radiofrequency EMF is expected by 2029 at the latest.¹⁷

In Italy, this potential for harm has been recognised in a higher-court ruling by the Turin Court of Appeal!¹⁸ The Bundestag's TA report explicitly notes this: "The evidence also has consequences in the courts: in 2020, the appeal court in Turin upheld a court decision which in 2017 recognised a connection between the claimant's acoustic neuroma and his frequent occupational use of a mobile phone" (p. 148).

Incidentally, the Italian courts excluded the key witnesses for safety - the ICNIRP experts - on the grounds of bias towards industry.

1.2 Pregnant women and children are particularly at risk

More than 130 studies demonstrate damage to embryos and sperm.¹⁹ In 2021, a research team led by Professor Yun Hak Kim of Pusan National University, Korea, conducted a new meta-analysis of the possible effects of mobile phones on sperm quality. The press release states:

"The results suggest that mobile phone use leads to reduced sperm motility, viability and concentration. Given that the results were consistent both in vivo and in vitro (cultured sperm), Dr Kim warns: 'Male mobile phone users should make an effort to reduce mobile phone use to protect their sperm quality.'"

The STOA study (2021) confirmed the risks to sperm through a comprehensive assessment of the research (see above). Two striking study findings in 2023 reinforce the negative effects on reproductive organs. An epidemiological study of soldiers by the University of Geneva for the Swiss government confirms the results of laboratory and animal studies. Soldiers who used their mobile phones more than 20 times

17 See IARC Technical Report (2025): "Key Characteristics-associated End-points for Evaluating Mechanistic Evidence of Carcinogenic Hazards", <https://monographs.iarc.who.int/wp-content/uploads/2025/06/KCW-FINAL.pdf>

18 Turin Court of Appeal confirms the connection between mobile phone use and brain tumours, see <https://diagnose-funk.org/1516>

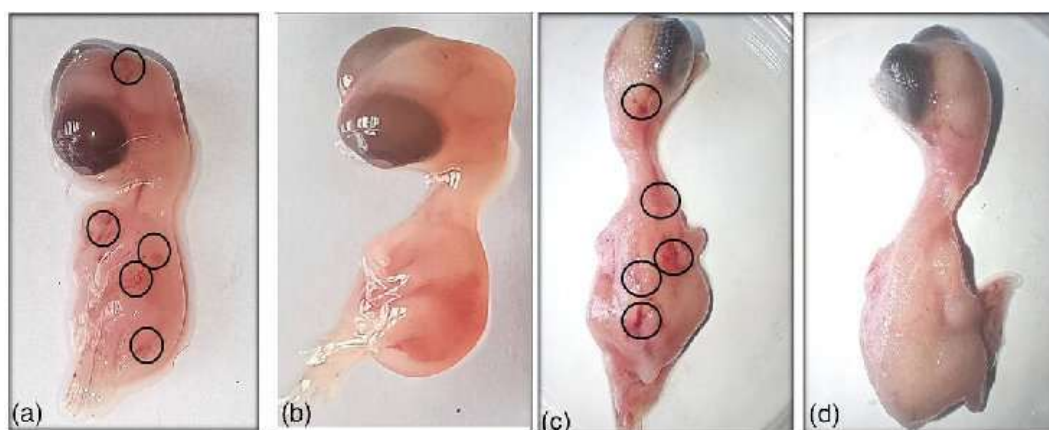
19 Mutter J / Hensinger P (2019): Declining sperm quality: environmental medicine causes, zkm 2019;1:48-55

per day had, on average, a significantly lower sperm concentration than soldiers who used their phones no more than once a week.²⁰

A study by Islam et al. published in 2023 examined the effects of the LTE frequency (4G) on chicken embryos. Chicken embryos are used as a biological model for human embryos because of their similar molecular, cellular and anatomical structure. In the study, 60 chicken eggs were exposed to radiation from an ordinary smartphone (Samsung Galaxy J5). Four 15-minute video calls were made daily, with the eggs positioned up to 12 cm from the radiating phone. After 7, 10 and 14 days, embryonic tissue and amniotic fluid were examined, with the following dramatic (and statistically significant) findings:

- bleeding beneath the skin;
- reduced weight and body length;
- elevated biochemical values in the amniotic fluid, indicating malfunction of the excretory organs, the liver and kidneys;
- pathological changes in liver tissue;
- more degenerated neurons and significantly fewer healthy neurons in the brain.

Various genes, including those relating to the immune system, did not function correctly.²¹



The figure shows chick embryos in the 4G-exposed group (a and c) with subcutaneous bleeding on days 7 and 10 respectively, marked with circles. In contrast, the control group (b and d) showed no signs of bleeding.

Source: <https://onlinelibrary.wiley.com/doi/10.1002/vms3.1273>

The review by Cordelli et al. (2024) for the WHO confirms that radiofrequency exposure negatively affects male fertility. Given the decline in male fertility in Western countries, the authors argue that the findings

20 Swiss study demonstrates: Mobile phone use harms fertility, <https://diagnose-funk.org/2020>

21 Islam MS et al. (2023) : 4G mobile phone radiation alters some immunogenic and vascular gene expressions, and gross and microscopic and biochemical parameters in the chick embryo model. Veterinary Medicine and Science, 1-12. <https://doi.org/10.1002/vms3.1273>, <https://diagnose-funk.org/2026>

of this meta-analysis should be taken into account by political decision-makers.²²

On the effects of smartphone use by pregnant women, Vienna professors Kundi and Hutter (environmental medicine, Medical University of Vienna) published the article "Risk assessment of children's exposure to electric, magnetic and electromagnetic fields". They write that "adverse health effects not only cannot be ruled out, but the evidence for such effects is increasing" (umwelt-medizin-gesellschaft, 3/2019).

The review by Ezgin (2026) concludes that prenatal and early-childhood exposure to Wi-Fi frequencies and other RF-EMF can influence neurobiological processes. The analysis of 65 experimental studies repeatedly identifies **oxidative stress, impaired synaptic plasticity, altered neurogenesis** and **increased apoptosis** as central mechanisms that may lead to cognitive, motor and behavioural changes.²³

With Overview No. 10, "Does mobile phone radiation affect the development of embryos and babies?", diagnose:funk presents a risk dossier with concerning findings. More than 90 studies we assessed, and 8 reviews, demonstrate risks from mobile phone radiation for pregnant women, embryos and babies.²⁴

1.3 Established evidence on the toxicity of Wi-Fi

More than 120 studies demonstrate harmful effects of Wi-Fi on sleep, concentration and learning, among other things. The video of diagnose:funk webinar No. 27²⁵ on Wi-Fi presents the current state of research and provides written documentation. Current Wi-Fi research is documented in Overview No. 6.

Three relevant study findings should also be mentioned here, illustrating, among other things, the interaction of frequencies. A study by Chinese scientists, based on a British database, examined the relationship between smartphone use and high blood pressure. It found that radiation exposure leads to a risk increase of up to 25%.²⁶ A clinical report in "Der Augenspiegel" by the well-known Ulm ophthalmologist Dr Hans-Walter Roth shows that intensive mobile phone use (several hours per

22 Cordelli E, Ardoino L, Benassi B, Consales C, Eleuteri P, Marino C, Sciortino M, Villani P, Brinkworth MH, Chen G, McNamee JP, Wood AW, Belackova L, Verbeek J, Pacchierotti F (2024): Effects of radiofrequency electromagnetic field (RF-EMF) exposure on male fertility: A systematic review of experimental studies on non-human mammals and human sperm in vitro. Environment International, 185, 108509. <https://doi.org/10.1016/j.envint.2024.108509>; detailed discussion: ElektrosmogReport 2-2024

23 Ezgin N (2026): Prenatal and Early-Life Exposure to Electromagnetic Fields: Impacts on Neurodevelopment and Behavior. Psikiyatride Güncel Yaklaşımlar, 18(4), 1552-1567. <https://doi.org/10.18863/pgy.1851473>

24 <https://diagnose-funk.org/2342>

25 Webinar No. 27: Wi-Fi in nurseries and schools - a risky hype, <https://diagnose-funk.org/1877>

26 Ye Z et al. (2023): Mobile phone calls, genetic susceptibility, and new-onset hypertension: results from 212 046 UK Biobank participants. European Heart Journal - Digital Health 00, 1-10; <https://www.emfdata.org/de/studien/detail?id=803>

day) can cause clouding of the lens in one eye.²⁷ According to Baldini et al. (2025), one hour of exposure to mobile phone and Wi-Fi radiation - despite very low field strengths - leads to a 55% drop in fertile sperm and a marked increase in infertile sperm forms.²⁸

For many medical endpoints, there are not only hundreds of individual studies but also **more than 150 reviews** documenting the potential for harm across the research as a whole. Is more evidence needed to initiate a precautionary policy with protective measures and public education? Even grounds for concern can justify precaution. Here, however, we have already reached the stage of proof, and thus of preventing harm. The Federal Office for Radiation Protection's reflexive response of downplaying every study that identifies risks, or discrediting it as poorly conducted, discriminates against dozens of scientists and institutes demonstrating risks.

1.4 Inflammatory diseases caused by oxidative cellular stress

Now to the claim that non-ionising radiation lacks the energy to damage cells.²⁹ If this were true, none of the study findings mentioned above could actually have occurred. Most of the observed effects occurred below exposure limits and are non-thermal effects. Non-ionising radiation does not directly damage cells or DNA in the way that ionising X-rays and gamma rays (radioactivity) do. Instead, it acts through changes in cellular metabolism, including provoking an overproduction of free radicals, i.e. triggering inflammatory processes.

Naziroglu M and Akman H (2014) presented an early review of ROS (reactive oxygen species) in a Springer reference book, demonstrating **oxidative stress** caused by Wi-Fi. In their review "Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation", Yakymenko et al. (2016) assessed 100 studies. Of these, 93 demonstrate EMF-related overproduction of reactive oxygen species (ROS):

"Radiofrequency radiation thus becomes a potentially hazardous factor for human health because of the extensive biological potential of ROS and other free radicals, including their mutagenic effects and their regulatory signalling potential." (Yakymenko et al. 2016)

According to Yakymenko et al., the increase in oxidative damage caused by EMF exposure occurs in the non-thermal range, at levels thousands of times below exposure limits: at a power density of $0.1 \mu\text{W}/\text{cm}^2$ ($= 1,000 \mu\text{W}/\text{m}^2$) and a specific absorption rate of $\text{SAR} = 3 \mu\text{W}/\text{kg}$.

27 <https://diagnose-funk.org/1969> 28 Baldini GM et al. (2025): Does Electromagnetic Pollution in the ART Laboratory Affect Sperm Quality? A CrossSectional Observational Study. *Toxics*. 2025;13(6):510. <https://doi.org/10.3390/toxics13060510>

29 Claims and specious arguments, Part I: "Mobile phone radiation has too little energy to damage cells. Oxidative stress is implausible": <https://diagnose-funk.org/1441>

In the conclusion of the largest review of ROS to date, Schürmann/Mevissen (2021), after evaluating 223 papers, the authors conclude:

"In summary, evidence of increased oxidative stress due to RF-EMF and ELF-MF was reported in the majority of animal studies and in more than half of cell studies ... Certainly, some studies have methodological uncertainties or weaknesses ... A trend is emerging that remains clear even when these methodological weaknesses are considered: EMF exposure, even at low doses, can indeed lead to changes in the cellular oxidative balance. Adverse conditions, such as diseases (diabetes, neurodegenerative disorders), impair the body's defence mechanisms, including antioxidant protective mechanisms, and people with such pre-existing conditions are more susceptible to health effects" (p. 23).

The review by Weller et al. (2025) focuses on **oxidative stress** as a central mechanism that makes reproductive and brain cells particularly vulnerable (see section 1.1). Lai & Levitt (2025) assess over 500 studies and consistently show that radiofrequency radiation acts as a biological stressor, triggering **oxidative stress**, DNA damage and repair processes - even far below current SAR exposure limits.³⁰

1.5 Recent research reviews send a clear message

The most reliable accounts of the state of research come from reviews - overviews written by experts in the relevant field. Diagnose:funk documents over 150 reviews demonstrating health hazards. All have been published after peer review, i.e. they represent recognised scientific knowledge.³¹

The largest quantitative narrative assessment of the research is being compiled by the international association of research scientists, the BioInitiative Working Group. Henry Lai's Research Summaries are published annually and document the following for 2022: a clear majority of studies report biological effects rather than "no effect".³² The trend continues: the vast majority report biological effects from low-intensity exposures, both for ELF-EMF³³/static fields and for RF-EMF/mobile phone radiation.

"Here are the results for 2022:

- Studies of genetic effects of radiofrequency radiation:
291 of 423 studies (68%) show biological effects.
- Studies of genetic effects of extremely low-frequency electric and magnetic fields:
257 of 307 studies (84%) show biological effects.

³⁰ See emfdata.org/de/studien/detail?id=912

³¹ Available at <https://diagnose-funk.org/1693>

³² <https://bioinitiative.org/research-summaries/>

³³ ELF-EMF = extremely low-frequency electromagnetic fields (1-300 Hz)

• Studies of neurological effects of radiofrequency radiation:
291 of 391 studies (74%) show biological effects.

• Studies of neurological effects of extremely low-frequency electric and magnetic fields:
283 of 311 studies (91%) show biological effects.

• Studies of free radicals (oxidative damage) from radiofrequency radiation:
263 of 288 studies (91%) show biological effects.

• Studies of free radicals (oxidative damage) from extremely low-frequency electric and magnetic fields:
270 of 298 studies (90%) show biological effects.³⁴

The updated 2024 version³⁵ greatly expands the study base (1990-2024) and offers a concise summary of the main biological endpoints:

- Genetic effects of radiofrequency radiation - 466 studies, 70% with effects.
- Neurological effects of radiofrequency radiation - 435 studies, 77% with effects.
- Oxidative stress from radiofrequency radiation - 354 studies, 89% with effects.
- Overall assessment of ELF fields - over 900 studies, 87% with effects.

2 Effects of continuous radiation from transmitters

2.1 Effects on humans

The main health hazard comes from smartphones, DECT cordless phones and tablets used close to the body. However, studies show that **continuous, 24-hour radiation** from mobile phone transmitters is also harmful to health:

The Naila physicians' study (2004): Cancer cases within 400 metres of a transmitter doubled between 1994 and 2004, and tripled between 1999 and 2004. Those affected were 8.5 years younger.³⁶

The Rimbach study (2011): Clinical parameters were tested over a year and a half, before and after a transmitter mast was installed. Result: the stress-system hormones adrenaline, noradrenaline and dopamine changed.³⁷

The study by Alazawi (2011): "Most health complaints, such as nausea, headaches, dizziness, irritability, discomfort, nervousness, depressive symptoms, sleep disturbances, memory impairment and reduced libido, were reported statistically significantly more often by people living within 300 m of a base station

³⁴ <https://bioinitiative.org/>

³⁵ See <https://www.saferemr.com/2018/02/effects-of-exposure-to-electromagnetic.html>

³⁶ <https://www.emf-portal.org/de/article/11420>

³⁷ <https://www.emfdata.org/de/dokumentationen/detail?id=8>, <https://www.emf-portal.org/de/article/19075>

*than by people living more than 300 m from a base station."*³⁸

The study by Zothansiam et al. (2017): DNA damage and reduced antioxidants in people living near mobile phone base stations.³⁹

The study by Zosangzuali et al. (2021): Radiation from mobile phone masts causes **oxidative stress**, i.e. an overproduction of free radicals. Oxidative cellular stress underlies many inflammatory diseases and weakens the immune system.⁴⁰

A new field study by Gulati et al. (2024), the German ATHEM-3 study, demonstrates that continuous radiation from transmitters has harmful cytogenetic effects on chromosomes. This supports earlier studies describing a cancer risk. The authors write: "Cytogenetic damage, i.e. chromosomal aberrations, was significantly increased in residents with higher RF-EMF exposure. It correlated negatively with distance from mobile phone base stations and positively with LTE and GSM signals from mobile phone base stations." In plain terms: the closer to the transmitter and the longer the exposure, the greater the likelihood of genetic damage.⁴¹

The review by Alfonso Balmori (2022): It assesses the entire body of research on transmitter masts - 38 studies - and concludes: "... Under the present circumstances, scientific experts in this field appear to be very aware of the serious problems we face and have expressed this through important appeals (Blank et al., 2015; Hardell and Nyberg, 2020). Yet the media, the responsible organisations (World Health Organization, 2015) and governments do not pass this important information on to the public, which remains uninformed. For these reasons, the current situation is likely to end in a crisis, not only for health but also for this technology itself, since it is unsustainable and harmful to the environment and to people."⁴²

The prospective cohort study by Setia et al. (2025) from Mumbai shows that higher domestic radiation exposure from digital devices and mobile phone masts correlates with significant developmental delays in infants.⁴³

The peer-reviewed study by Sailo et al. (2025) from Mizoram, India, shows a clear dose-response relationship between radiation exposure from mobile phone base stations

38 <https://www.emfdata.org/de/studien/detail?id=187>, <https://www.emf-portal.org/de/article/26456>

39 <https://diagnose-funk.org/1826> 40 <https://diagnose-funk.org/1826>

41 Gulati S et al. (2024): Evaluation of oxidative stress and genetic instability among residents near mobile phone base stations in Germany. [Evaluation of oxidative stress and genetic instability in residents near mobile phone base stations in Germany.] Ecotoxicol Environ Saf 2024; 279: 116486, <https://www.emfdata.org/de/studien/detail?id=847>

42 Balmori A (2022): Evidence for a health risk by RF on humans living around mobile phone base stations: From radiofrequency sickness to cancer. Environ Res 2022 Jul 14;214(Pt 2):113851, <https://doi.org/10.1016/j.envres.2022.113851>

43 Setia MS et al. (2025): Radiofrequency Electromagnetic Field Emissions and Neurodevelopmental Outcomes in Infants: A Prospective Cohort Study. Cureus. 2025 Jul 10;17(7):e87671, <https://www.emfdata.org/de/studien/de-tail?id=892>

and an increased prevalence of health complaints - even at exposures well below official limits.⁴⁴

The study by Chokeli et al. (2026) found a significantly increased micronucleus frequency, indicating genomic instability, in primary-school children near mobile phone base stations, although all RF measurements were below current exposure limits.⁴⁵

The database www.EMFdata.org contains **more than 50 studies** on the effects of transmitter masts.

2.2 Effects on insects and plants

Human cellular metabolism is influenced by non-ionising radiation. It stands to reason that the same applies to animal and plant cells.

2.2.1 Effects on insects and bees

We have created a website on the effects on insects and bees: www.insekten-schuetzen.info.

The study by Nyirenda et al. (2022) around a mobile phone mast in Zambia's Kafue National Park demonstrates: the closer to the mast, the fewer birds and insects. This applies both to the number of animals counted and to the number of species.⁴⁶ **The study by Adelaja et al. (2022)** demonstrates the same finding.⁴⁷

Treder et al.'s research group (2023) at the University of Hohenheim found that long-term RF-EMF exposure has a clearly negative effect on honeybees' homing ability.⁴⁸ In a further investigation (Treder et al., 2025), the group found that Wi-Fi frequencies significantly reduce bumblebees' flower visitation rate, potentially increasing their foraging and nutritional stress in urban areas.⁴⁹

Mallinson et al. (2025) demonstrate that even weak human-made electric fields - comparable to those 50-150 m from high-voltage power lines - markedly

44 Sailo L et al. (2025): Greater prevalence of symptoms associated with higher exposures to mobile phone base stations in a hilly, densely populated city in Mizoram, India. *Electromagnetic Biology and Medicine*, 44(4), 385- 404, <https://www.emfdata.org/de/studien/detail?id=891>

45 Chokeli R et al. (2026): Environmental radiofrequency exposure and genotoxic biomarkers in schoolchildren: a cross-sectional analysis. *Sci Rep* [Internet]. 2026 Jul 9; Available from: <https://www.nature.com/articles/s41598-026-60822-11> [Article in Press] 46 Nyirenda VR*, Namukonde N, Lungu EB, et al.: Effects of phone mast-generated electromagnetic radiation gradient on the distribution of terrestrial birds and insects in a savanna protected area, *Biologia* 77, 2237-2249 (2022), <https://diagnose-funk.org/1927>

47 Adelaja OJ et al. (2021): Distribution, diversity and abundance of some insects around a telecommunication mast in Ilorin, Kwara State, Nigeria. *Bulletin of the National Research Centre*. 2021 Dec;45(1):1-7. <https://www.emfdata.org/de/studien/detail?id=757>

48 Treder et al. (2023). Defined exposure of honey bee colonies to simulated radiofrequency electromagnetic fields (RF-EMF): Negative effects on the homing ability, but not on brood development or longevity. <https://www.emfdata.org/en/studies/detail?id=806>

49 Treder et al. (2025): Radiofrequency electromagnetic fields reduce bumble bee visitation to flowers. <https://www.emfdata.org/de/studien/detail?id=898>

reduce honeybee foraging behaviour and, depending on the field type, reduce their flower landings by more than half to over 70%.⁵⁰

The review by Mulot et al. (2022, University of Neuchâtel), "Effects of non-ionising radiation on arthropods", prepared for the Swiss Federal Office for the Environment, considers a link between mobile communications and insect decline probable. The radiation affects locomotion, reproduction, foraging, orientation, DNA damage, cellular stress and behaviour.⁵¹

The study by Molina-Montenegro et al. (2023) concludes that EMF significantly reduces honeybees' pollination services by disrupting their orientation and foraging, reducing flower visits and thus reducing seed production and plant diversity.⁵²

The most comprehensive account to date of research on EMF and insects is the review and meta-analysis by Thill, Cammaerts & Balmori (2023).⁵³ They assess international research on the effects on insects of electromagnetic fields (EMF) from high-voltage power lines and mobile phone transmitters, finding: "Non-thermal biological effects of EMF on insects are clearly demonstrated in the laboratory, but only partly in the field, so further ecological effects remain unknown." According to the authors, the findings indicate that EMF effects increase the level of threat to insects. Diagnose:funk created the websites www.insekten-schuetzen.info and www.protect-insects.info for this study.

In his comprehensive 2025 review, ornithologist Erich Bächler shows that non-ionising radiation can cause thermal and non-thermal stress in bird embryos and nestlings, disruptions of magnetic sensing, and **oxidative stress** in adult birds, and discusses the implications for bird conservation.⁵⁴

2.2.2 Effects on plants

The study by Ozel et al. (2021). The findings show that proximity to a base station significantly reduced the number of flowers and cones in pine trees (*Pinus brutia*).⁵⁵

50 Mallinson et al. (2025): Weak anthropogenic electric fields affect honeybee foraging. iScience. 2025 May 19;28(6):112550. <https://doi.org/10.1016/j.isci.2025.112550>

51 Mulot M et al. (2022): Effects of non-ionising radiation (NIR) on arthropods, report commissioned by the Federal Office for the Environment (FOEN), Neuchâtel, July 2022, <https://diagnose-funk.org/1938>

52 Molina-Montenegro MA et al. (2023): Electromagnetic fields disrupt the pollination service by honeybees. Sci Adv. 2023 May 12;9(19):eadh1455. <https://www.emfdata.org/de/studien/detail?id=805>

53 Thill A, Cammaerts M-C, Balmori A (2023): Biological Effects of Electromagnetic Fields on Insects: a Systematic Review and Metaanalysis, Reviews on Environmental Health. <https://www.doi.org/10.1515/reveh-2023-0072>, <https://www.emf-portal.org/de/article/52384>

54 Bächler E (2025): On the influence of non-ionising radiation (NIR) on birds: legal situation, state of scientific knowledge and recommendations for bird conservation. Ornithologischer Beobachter, 122. <https://diagnose-funk.org/2373>

55 Mobile phone radiation damages Turkish pines: <https://diagnose-funk.org/1830>

The study by Sharma et al. (2025) shows that radiation from mobile phone base stations measurably reduces pollen viability, with more heavily exposed plants having up to 12% fewer viable pollen grains - an indication that radiation impairs pollen-grain metabolism.⁵⁶

Further studies on effects on plants, published since 1934, are documented in the interview with Dr Cornelia Waldmann-Selsam on our website: diagnose-funk.org/2393.



The documentation "Tree damage caused by mobile phone radiation", featuring observations from 2005-2025, illustrates the effects of mobile phone radiation on trees at sites throughout Germany. It also sharpens readers' observation skills for walks in nature. Available from the diagnose:funk shop. An English PDF version is available at <https://esc-info.eu/tree-damage-caused-by-radiofrequency-radiation/>

Since 2005, Dr Cornelia Waldmann-Selsam has systematically observed trees at more than 1,500 mobile phone transmitter sites and assessed aerial photographs. Her field studies reveal recurring patterns of damage: one-sided crown damage, dried-out branches and clear differences between the sides facing towards and away from transmitters. In 2016, together with Alfonso Balmori et al., she published "Radiofrequency radiation injures trees around mobile phone base stations", which

⁵⁶ Sharma A et al. (2025): Study on evaluation of effects of electromagnetic radiation on pollen viability in some commonly occurring plant species following different staining methods. *Protoplasma*, 263(1), 231-246. <https://doi:10.1007/s00709-025-02093-7>

describes a statistically established relationship between RF exposure and one-sided tree damage.⁵⁷ A 292-page photographic documentation of her long-term investigations is now available, comprehensively documenting the characteristic damage patterns. "Since characteristic tree damage is visible around every mobile phone installation, it will not be possible to deny it much longer." (C. Waldmann-Selsam, 2026) Further background information, photographic documentation and an interview are available at <https://diagnose-funk.org/2393> and <https://diagnose-funk.org/2390>.

3 Does electromagnetic hypersensitivity exist?

If non-ionising radiation can trigger inflammatory processes (oxidative cellular stress), it is only logical that sensitive people can feel this: this is electromagnetic hypersensitivity. In opposition to discrimination against people with electromagnetic hypersensitivity and the attribution of their suffering to psychological causes, the EESC (European Economic and Social Committee) states:

"4.13. The European Parliament (9), the EESC (10) and the Council of Europe (11) have recognised that electromagnetic hypersensitivity or sensitivity is an illness. A number of people are affected, and with the introduction of 5G, which requires a much higher density of electronic installations, this condition could become more common."

In its 2021 statement, the Baden-Württemberg State Medical Association calls, among other things, for:

- "Creation of zones free from mobile communications, including in public facilities (buses, trains, schools, universities, administrative buildings, hospitals) and in private settings (bedrooms).
- Establishment of a coordination centre to collect reports of 'mobile communications side effects', including for electromagnetically sensitive people."⁵⁸

The current state of research on electromagnetic hypersensitivity is documented in Overview No. 5.

4 The political dimension

4.1 Exposure limits offer no real protection

ICNIRP (International Commission on Non-Ionizing Radiation Protection), whose exposure limits the BfS usually cites, is an industry lobbying organisation,

⁵⁷ Waldmann-Selsam C, Puente A, Breunig H, Balmori A (2016). Radiofrequency radiation injures trees around mobile phone base stations. *Science of the Total Environment*, 572, 554-569. <https://doi.org/10.1016/j.scitotenv.2016.08.045>

⁵⁸ Article series on EHS: <https://diagnose-funk.org/1837>

as four investigations have now demonstrated in detail.⁵⁹ They also demonstrate the inadequacy of the exposure limits. US expert Prof. James C. Lin speaks of an industry-regulatory complex.⁶⁰

ICNIRP exposure limits offer no medical protection. The German federal government confirmed this years ago:

*"The precautionary principle was not taken into account in deriving the current exposure limits on which site certification is based."*⁶¹

Nor do they protect vulnerable groups. ICNIRP explicitly confirmed this:

"Different groups within a population may differ in their ability to tolerate a particular NIR (non-ionising radiation) exposure. For example, children, older people and some chronically ill people may have a lower tolerance of one or more forms of NIR exposure than the rest of the population. In such circumstances, it may be reasonable or necessary to develop separate guidance levels for different groups within the general population, but it would be more effective to adjust the guidance levels for the general population to include these groups" (ICNIRP statement 2002, general approach, Health Phys. 82, 540-548 (p. 546)).

The exposure limits have never been adjusted in this way. Nevertheless, they continue to be cited as grounds for reassurance. This downplaying of risks continues with 5G. There are now four documents from EU bodies and institutions calling for radiation protection policies on the basis of the research and warning against the introduction of 5G.⁶² The German authorities have not taken

59 Paper on ICNIRP by MEPs Buchner / Rivas: <https://diagnose-funk.org/1580>

Investigation in Berlin's Tagesspiegel: <https://diagnose-funk.org/1335>

Hardell / Carlberg (2020): Health risks from radiofrequency radiation, including 5G, should be assessed by experts with no conflicts of interest, ONCOLOGY LETTERS 20: 15, 2020

60 Lin JC (2025): Health and safety practices and policies concerning human exposure to RF/microwave radiation. Front. Public Health 13:1619781. <https://doi.org/10.3389/fpubh.2025.1619781>.

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61 Bundestag parliamentary paper 14/7958, CDU major interpellation, 4 January 2002, pp. 14, 18:

"Question 22: 'How does the federal government ensure that previous and ongoing scientific findings from the numerous national and international studies of the health effects of electromagnetic fields are analysed and assessed promptly and kept up to date?'"

Answer: 'The federal government also supports the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in assessing new scientific findings. As part of this cooperation, six workshops on different issues in non-ionising radiation have been held in recent years. The results have been published as proceedings or as scientifically accessible publications. However, international bodies have so far refrained from incorporating precautionary considerations into their deliberations.'

Question 34: 'Do the current statutory radiation protection limits and the existing procedure for issuing site certificates adequately take account of the precautionary principle? What scientific investigations and studies on possible health hazards underpin the federal government's position?'"

Answer: 'The above-mentioned SSK assessments agree with those of international scientific expert bodies. The precautionary principle was not taken into account in deriving the current exposure limits on which site certification is based.'"

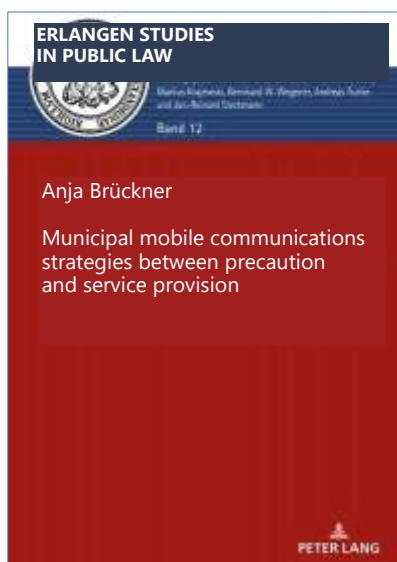
Source: <https://dip21.bundestag.de/dip21/btd/14/079/1407958.pdf>

62 The documents are the STOA study: <https://diagnose-funk.org/1740>
the EESC opinion: <https://diagnose-funk.org/1828>

notice. The Bundestag's technology assessment panel has also officially announced that the promised technology assessment report on 5G will not, after all, be produced.⁶³ This contradicts every notion of precaution and protective policy. Five studies of 5G frequencies are now available - discussed in the specialist journal *ElektrosmogReport*⁶⁴ - showing the same harmful effects as investigations of other frequency ranges.

The International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF) therefore calls for new exposure limits that reflect the state of research. In its article, ICBE-EMF demonstrates why existing limits are unscientific and provide no protection. The article exposes the rotten core of mobile communications policy: ICNIRP's setting of exposure limits was a pragmatic legitimisation of the mobile communications industry's business model. Diagnose:funk provides a German version of the ICBE-EMF article.⁶⁵

In a review article from July 2025, Prof. James C. Lin also criticises current exposure-limit recommendations as "controversial", "scientifically unjustified", "failing to provide effective risk precaution and disregarding central principles of radiation protection". The limits ignore the radiation's "chronic toxicity and carcinogenicity" and are therefore "unsuitable" for reliably protecting the public.⁶⁶



This is also confirmed by Anja Brückner's dissertation "Municipal mobile communications strategies between precaution and service provision" (2022).⁶⁷ She demonstrates that Germany's federal government ignores research findings on non-thermal effects of mobile phone radiation and commissions insufficient research of its own. The limits therefore fail to reflect the research, offer no protection and are untenable. Brückner criticises the federal government's "inaction" in fulfilling its "duty to improve" (p. 52) the limits, meaning that "the required protection objective cannot be achieved" (p. 50). More at: <https://diagnose-funk.org/2109>.

the EU briefing: "Studies suggest that 5G could affect the health of humans, plants, animals, insects and microbes!": <https://diagnose-funk.org/1530>, and the analysis by Blackman/Forge commissioned by the European Parliament's Committee on Industry, Research and Energy: "5G Deployment", <https://diagnose-funk.org/1388>

63 5G: Candid information from the Bundestag's technology assessment panel, <https://diagnose-funk.org/1628>

64 <https://www.emfdata.org/de/elektrosmogreport?&page=1>

65 Brennpunkt: International exposure-limit commission ICBE-EMF calls for stricter mobile communications limits, <https://diagnose-funk.org/1937>

66 Lin JC (2025): Health and safety practices and policies concerning human exposure to RF/microwave radiation. *Front. Public Health* 13:1619781. <https://doi.org/10.3389/fpubh.2025.1619781>

67 Anja Brückner: *Municipal mobile communications strategies between precaution and service provision*, ©2022. Dissertation, 194 pages, series: Erlanger Schriften zum Öffentlichen Recht, Volume 12.

4.2 Downplaying the research evidence is irresponsible

For 17 years, diagnose:funk has analysed the research, documented in our database www.EMFdata.org, which now contains more than 770 studies. Diagnose:funk also documents 159 reviews summarising risks.⁶⁸ The way government bodies downplay the evidence is intolerable. It is a scandal that, in September 2020, the German Association of Towns and Municipalities issued a paper for all municipalities written by IZMF, the propaganda centre of the four mobile network operators, denying risks and casting critics as conspiracy theorists. Its purpose: how to silence critics.⁶⁹ In an interview with the Stuttgarter Zeitung, Environment Ministry State Secretary Flasbarth said: "Lobbyists represent economic interests, not the common good. That is legitimate" (StZ, 21 October 2020). Whether this is legitimate is debatable, but authorities supporting it and allowing industry to write their papers is not legitimate; it is scandalous. It is equally scandalous that, since 2017, the federal government has no longer provided the EMF-Portal research database at RWTH Aachen with funding to assess individual studies. We know of no protests or requests from the Federal Office for Radiation Protection to continue this substantial foundational work.

5 Conclusion

The research proves the health risks posed by mobile phone radiation, both from the use of devices and from transmitter masts. Protecting the public and safeguarding the minority of people with electromagnetic hypersensitivity require a precautionary policy: educating consumers about risks and how to avoid them, implementing the many technical options for minimising radiation, and developing transmission technologies that are harmless to health.⁷⁰

The cosy collusion between industry and politics must end. A policy of radiation minimisation and precaution is needed, as called for in the STOA study and the European Economic and Social Committee (EESC) opinion. Policymakers must finally take notice of these documents.

68 diagnose:funk presents a list of 159 reviews: <https://diagnose-funk.org/1693>

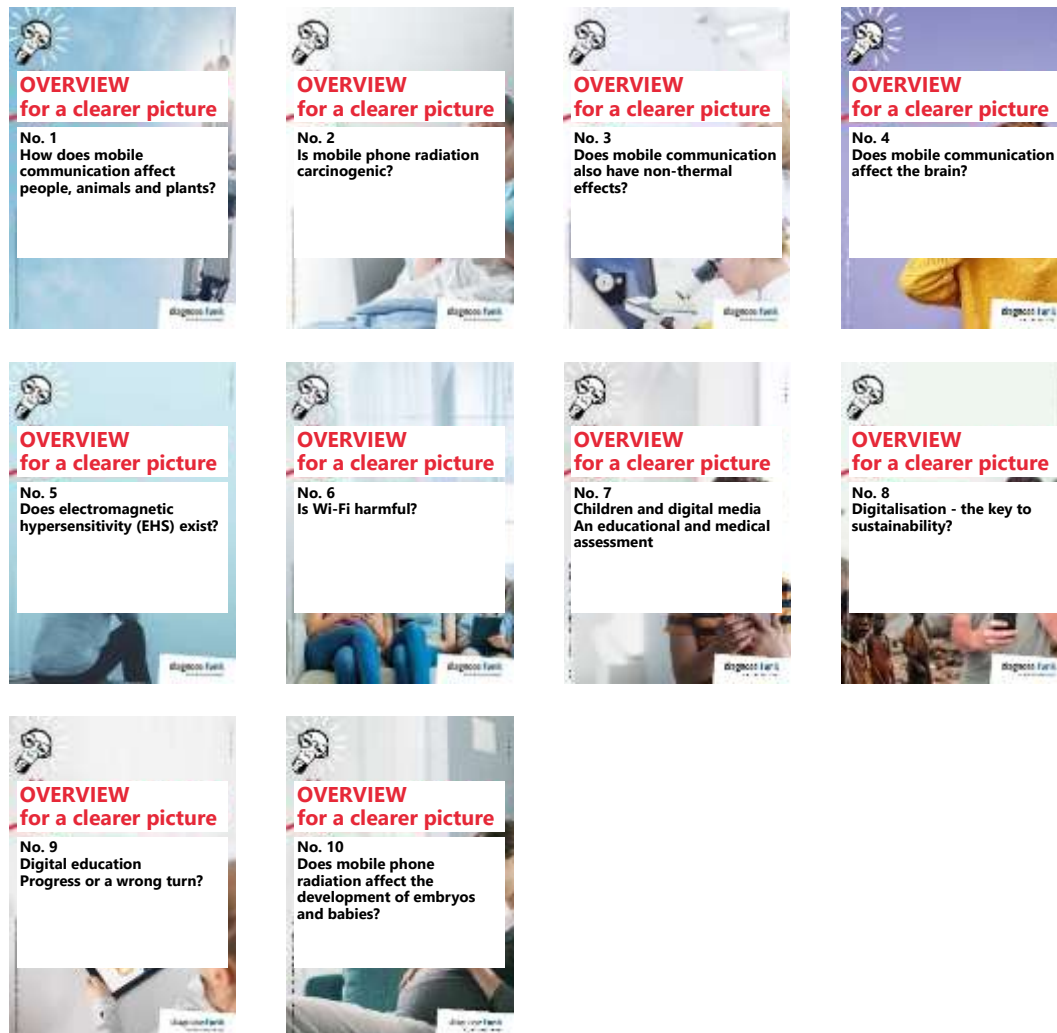
69 IZMF & DStGB (2020): Mobile communications information toolkit 1/4. Dialogue and communication: https://www.dstgb.de/Publikationen/Dokumentationen/Nr.%20156%20-%20Infobaukasten%20Mobilfunk/IZMF_Brosch%C3%BCre_Dialog%20und%20Kommunikation_DStGB_A4_final.pdf

70 Proposals in diagnose:funk (2024): Roaming - one network for everyone, <https://diagnose-funk.org/2071>

6 Further reading on the state of research

- Further issues of the OVERVIEW for a clearer picture series examine the research in greater depth. Download at <https://diagnose-funk.org/2090>
- The online research compass is continually updated: <https://diagnose-funk.org/1895>
- The specialist journal ElektrosmogReport discusses 12 new studies each quarter: <https://www.emfdata.org/de/elektrosmogreport?&page=1>
- Our database www.emfdata.org contains 773 studies showing biological effects, 587 of them reviewed (as of September 2026).
- Our review list documents 159 reviews covering all endpoints (as of September 2026): <https://diagnose-funk.org/1693>
- The series "Responses to mobile communications debate-stoppers" documents both the research and its distortions: <https://diagnose-funk.org/1446>
- The "Brennpunkt" publication series translates important reviews and discusses how research findings are interpreted: <https://diagnose-funk.org/publikationen/publikationen-zum-mobilfunk/magazin-brennpunkt>
- The d.f mobile communications chronology 1996-2026 documents important political and scientific documents: <https://diagnose-funk.org/1730>

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