

Health impact of 5G

CURRENT STATE OF KNOWLEDGE OF 5G-RELATED CARCINOGENIC AND REPRODUCTIVE/DEVELOPMENTAL HAZARDS AS THEY EMERGE FROM EPIDEMIOLOGICAL STUDIES AND IN VIVO EXPERIMENTAL STUDIES

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1. Background

- 5G is not a new technology, but an evolution of already existing 1G-4G technologies.
- 5G networks will work within several different frequency: about < 1 GHz – 3.6 GHz – 27 GHz
- Some of these frequencies have been or are currently being used for earlier mobile communication generations and were studied for their health impact.
- Much higher radio frequencies are planned to be used at later stages of 5G evolution.
- These latter bands have traditionally been used for radar and microwave links: few have been studied for their impact on human health.

2. Non-thermal effects

- The harmful effects of non-thermal biological interaction of radiofrequency electromagnetic fields (RF-EMF) with human and animal tissues have not been included in ICNIRP 2020 guidelines.
- Yet, we know that athermal bioresponses exist, and indeed some frequencies are being used for therapeutic purposes in medicine.

3. Methodology

The studies have been divided into 2 groups:

- **FR1: 450 to 6000 MHz**, which also includes the frequencies used in existing 2-4 generations of the broadband cellular network. The current evidence from 2G-4G studies is the best evidence currently available. The studies were evaluated using narrative methods.
- **FR2: 24 to 100 GHz**, the higher frequencies are new, previously not used for mobile communication and specific for the new 5G technology, which have particular physical characteristics and interactions with biological matter (lower penetration, higher energy, etc.). They were evaluated with a scoping review method.

4. Criteria of evaluation (based on IARC Preamble, 2019)

Evidence in humans	Evidence in experimental animals	Evaluation based on strength of evidence
Sufficient	Not necessary	Clear association between exposure and the adverse effect
Limited	Sufficient	Probable association between exposure and the adverse effect
Limited	Less than sufficient	Possible association between exposure and the adverse effect
Inadequate	Inadequate or limited	Not classifiable

5. Results: cancer in humans

FR1: 450 to 6000 MHz

There is **limited** evidence for carcinogenicity of RF-EMF in humans. Updating the results of the overall 2011 evaluation to 2020, positive associations have again been observed between exposure to radiofrequency radiation from wireless phones and both glioma (tumour of the brain) and acoustic neuroma, but the human evidence is still limited.

FR2: 24 to 100 GHz

No adequate studies were performed on the effects of the higher frequencies.

6. Results: cancer in experimental animals

FR1: 450 to 6000 MHz

There is **sufficient** evidence in experimental animals for the carcinogenicity of RF-EMF. New studies following the 2011 IARC evaluation showed a clear association between RF-EMF and tumours of the brain and Schwann cells of the peripheral nervous system, the same type of tumours also observed in epidemiological studies.

FR2: 24 to 100 GHz

No adequate studies were performed on the higher frequencies.

7. Results: reproduction/development effects in humans

FR1: 450 to 6000 MHz

There *is* **limited** evidence of adverse effects on the fertility of men.

There is **limited** evidence on developmental effects in offspring of mothers who were heavy users of mobile phones during pregnancy.

FR2: 24 to 100 GHz

No adequate studies were performed on the higher frequencies.

8. Results: reproduction/development effects in experimental animals

FR1: 450 to 6000 MHz

There is **sufficient** evidence of adverse effects on fertility, in male rat and mouse.

There is **limited** evidence of adverse effects on female mouse fertility.

There is **limited** evidence of adverse effects on the development in offspring of rats and mice exposed during embryo life.

FR2: 24 to 100 GHz

No adequate studies on non-thermal effects were performed on the higher frequencies.

9. Results: overall evaluation

➤ Cancer

FR1: 450 to 6000 Mz: probably carcinogenic to humans.

FR2: 24 to 100 GHz : No adequate studies were performed.

➤ Reproductive/developmental effects

FR1: 450 to 6000 MHz: These frequencies affect probably man and possibly woman fertility. They may possibly have adverse effects on the development of embryos, foetuses and newborns.

FR2: 24 to 100 GHz : No adequate studies were performed on non-thermal effects.

10. Policy options

- Opting for novel technology for mobile phones that enables RF-EMF exposures to be reduced.
- Revising the exposure limits for the public and the environment in order to reduce their RF exposures from cell towers.
- Adopting measures which reduce RF-EMF exposures wherever connections are needed in fixed sites: workplaces, houses, public buildings, etc.
- Promoting multidisciplinary scientific research to assess the long-term health effects of 5G and to find an adequate method of monitoring exposure to 5G.
- Promoting information campaigns on 5G.