

5G and health

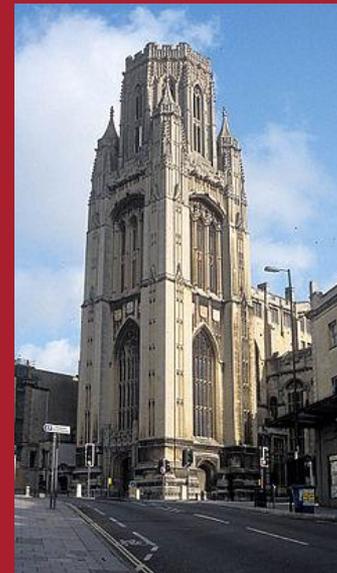
An epidemiological overview

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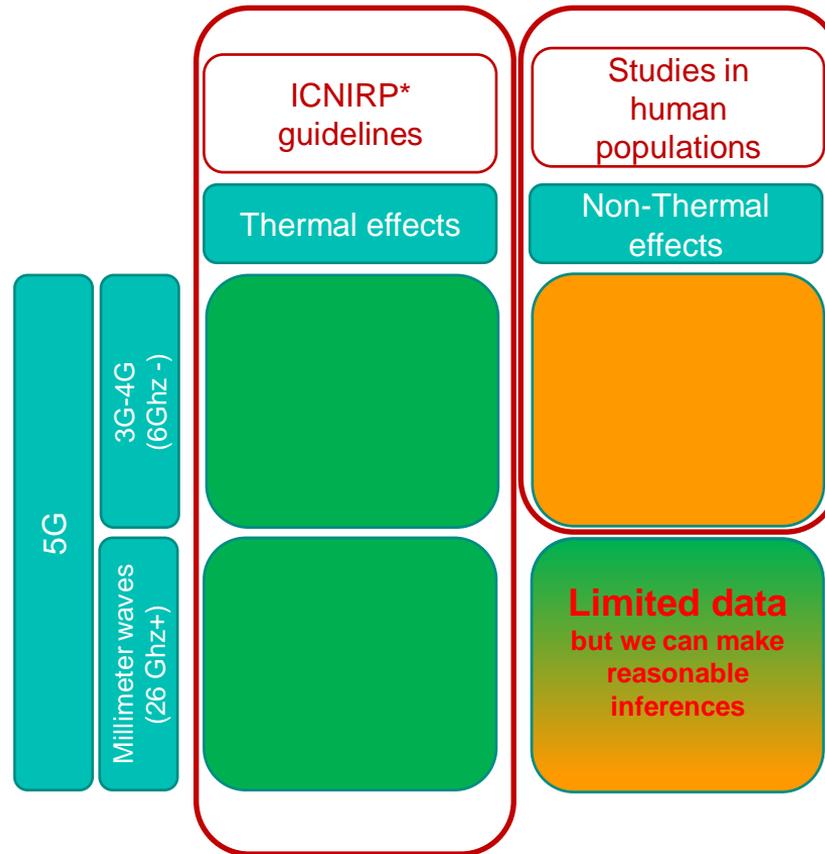


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5G and epidemiology: general concepts



An overview of RFR and health outcomes

- Cancer
- Fertility
- Birth outcomes
- Development and behaviour
- Immune system
- Electrohypersensitivity



+ the likely contribution of 5G GHz spectrum

Cancer



- To date no conclusive evidence that RFR causes cancer
- Indirect biological mechanisms proposed, but none sufficiently backed up by data or are convincing
- WHO-IARC classified RFR as ‘possibly carcinogenic to humans’ (Group 2B) in 2011
- Incidence trends do not confirm associations with RFR (despite some increasing trends)
- Small excess risk for very heavy users cannot be completely excluded, but increasingly unlikely RFR is an important cancer risk factor
- New studies in rats and mice (the ‘NTP’ and ‘Rammazzini’ studies) suggest increased risks of glioma and schwannoma, but problems with interpretation of these results
- 5G is unlikely to change that conclusion
- Mm waves will not penetrate far into human bodies, making additional contribution to cancers unlikely
- Possible (but not probable) exceptions are skin and ocular cancers

Fertility



- Evidence mainly from studies in cells and animals
- Human studies generally small, susceptible to biases and not representative of general population (mostly couples attending fertility clinics)
- Decline in sperm count since 1970s, especially in industrialised world, implies RFR, together with other potential environmental exposures, cannot be conclusively excluded
- No established non-thermal mechanism by which RFR could affect male fertility
- Sperm development sensitive to heat, and carrying a phone in trouser pocket carries a theoretical hazard (little evidence of risk)
- Potentially higher frequencies in 5G could result in sufficient heating of testicular tissue

Birth outcomes



- Results from animal studies inconsistent, but some showed effect on birth weight
- Human population studies suggest small effect on reducing pregnancy duration (could result in preterm birth), but not fetal growth or birth weight
- However, methodological issues of residual confounding (maternal stress) and weak exposure assessment
- Mathematical modelling indicates RFR exposure to fetus very low
- [Implausible that 5G millimeter waves will change this](#)

Development, cognition and behaviour



- Hyperactivity, behavioural problems, and effects on cognition associated with RFR *in utero* or during childhood reported
- Experimental data (adults) show cognition can be affected (positive and negative), and effects disappear after exposure has ended
- However, unclear whether effects caused by RFR or persistent use of mobile devices (sleep problems, concentration problems, depression)
- Associations with Alzheimer's disease and dementia suggested, but little evidence for this
- Causal relations cannot be excluded, but little concern that 5G can exacerbate this

Immune system



- Some *in vitro* and *in vivo* (few in humans) studies report effects (positive and negative) on immune system parameters
- Evidence mostly from small studies that have not been replicated, many with significant design issues
- No evidence of a relationship with health in human population
- No evidence or plausible theories how 5G mm-waves could directly impact on health via immune system
- Various indirect biological mechanisms proposed, but none sufficiently backed up by data or are convincing
- Nonetheless, this is the basis for the 5G/COVID-19 conspiracy theory, for example

Electrohypersensitivity

Idiopathic Environmental Intolerance attributed to Electromagnetic Fields (IEI-EMF)



- 1%-10% of the population self-diagnoses as suffering from IEI-EMF
- Remains unclear whether IEI-EMF should be attributed to
 - electromagnetic radiation
 - entirely psychosomatic
 - combination of both
- Conceivable some people may be more susceptible to radiation
- 5G: visible small cell networks and knowledge of MIMO technology likely to create obvious, and regular, triggers for nocebo effects

Summary



3-4G

- **Cancer risk:** Increasingly unlikely RFR is an important factor
- **Fertility and birth outcomes:** associations plausibly result from study weaknesses or other exposures
- **Development, cognition and behaviour:** Weak evidence associations, possibly attributed to excessive use instead
- **Immune system:** Possible immune parameter responses, but no evidence this results in human health effects

5G

- Exposure
 - <3Ghz environmental exposure similar or lower than 2-4G, so unlikely 5G will result in increased health risks
 - Mm-waves unlikely to exacerbate effects in humans
- Remain gaps in research in human populations for 3 Ghz+
- Areas of attention are cancers of the skin and eye, and possibilities of local heating (in particular testicular tissue)
- Roll-out of 5G will impact on EHS sufferers, regardless of aetiological mechanism

Take home messages



- i. RFR can result in biological responses
- ii. ...but evidence for health effects in humans in “real life” less convincing
- iii. In any case, if there are health effects, the fact they are so difficult to establish implies individual risks are small (at most)
- iv. Ultimate answer is human observational studies

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Links of interest (for info, without endorsements)

- *5G Health Fears: An Epidemiological Approach*. Cambridge Wireless Journal Nov 2019. <https://flickread.com/edition/html/5dc345f09c736#10>
- Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) Report https://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_041.pdf
- IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 102. Non-ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields: https://publications.iarc.fr/_publications/media/download/3143/6464cac7e8eca3fa20f11d4d134613e4870158c5.pdf
- ICNIRP Guidelines (100 KHz to 300 GHz): <https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf>
- BioInitiative Report: <https://bioinitiative.org/>