

Health Concerns of 5G and Setting Suitable Restrictions

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Abstract

This Mini Review has two aims. The first is to analyse six case reports on actual health effects of 5G radiofrequency radiation (RFR), comparing the results with concerns for similar RFR. The second is to relate these reports to setting restrictions suitable for all, including for persons with intolerance to environmental RFR. Adverse health effects from 5G RFR occur below current thermal restrictions. Therefore, restrictions need to be at non-thermal levels based on a threshold, as for a No Observable Adverse Effect Level (NOAEL). Ecological evidence suggests a suitable restriction including a safety factor of ten should be set at $0.06 \mu\text{W}/\text{m}^2$ ($0.005 \text{ V}/\text{m}$).

Key words: Non-thermal, No Observable Adverse Effect Level, public health protection, radiofrequency limits, threshold.

HEALTH CONCERNS OF 5G

There has been much debate and speculation about the health concerns of 5G RFR. 5G was not tested fully for actual health effects before it was deployed from 2019. Concerns included higher RFR exposure from massive MIMO (multiple-input, multiple-output), using multi-antenna technologies, and from beam-forming, using adaptive or switched phased-array antenna systems to focus wireless signals in one direction. In 2020 the ICNIRP raised its thermal restriction levels to meet the greater heating exposure levels expected from 5G. The greater modulation and complexity in 5G RFR were expected to be especially bioactive, like radar.

The first six studies on real health effects of 5G RFR were published in 2023, four years after 5G was deployed, in a series of case reports from Sweden (Table 1)¹⁻⁶. Like provocation studies, they included measurements of 5G RFR exposure and the health symptoms of the people affected, before 5G RFR exposure, during exposure, and, as a comparison, after its removal in other locations without 5G. These studies clearly refuted ICNIRP/FCC's $0.08 \text{ W}/\text{kg}$ thermal limit used to allow 5G⁷.

All six studies showed a consistent pattern. This comprised of (a) previously good health before the 5G

RFR exposure, (b) severe adverse health symptoms during 5G RFR exposure, and (c) their significant reduction after moving to a location without 5G. No other known change in environmental pollution occurred except 5G RFR exposure.

This pattern is consistent not only between the reports but also with established evidence. In 2021 a scientific consensus international report by 32 worldwide experts on what is variously called the Microwave Syndrome (MWS), RF Sickness (RFS) or Electrohypersensitivity (EHS) concluded that such cases are not nocebo responses. They stated that there is sufficient evidence for MWS/RFS/EHS to be acknowledged 'as a distinct neuropathological disorder'⁸. Indeed, it has been seen as proven 'beyond all reasonable doubt'⁹. Evidence for MWS/RFS/EHS has long been established¹⁰⁻¹³. In 1932 it was observed in Germany among workers in radio and electricity¹⁴. These six reports confirm that it is now also found among the general public too.

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Table 1. Summary of health status, symptoms and distance from 5G antennas for the six studies published in 2023.

Study	1	2	3	4	5	6
<i>Published</i>	10 Jan.	4 Feb.	10 April	30 June	13 Nov.	2 Dec.
<i>Subjects, age (years)</i>	man 63, woman 62	man 57, man 42	woman 52	woman 55, man 20, woman 19	man 49	man 39, woman 39, children 8,6,4
<i>Health status</i>	previously healthy	previously healthy	previously healthy	previously healthy	previously healthy	previously healthy
<i>Hypersensitive</i>	no, no	no, no	no	no, no, possibly	no	no (all)
<i>Time to onset of symptoms</i>	'a couple of days'	'a couple of weeks'	(a) ~1 month (b) <14 days	~ 6 weeks (woman 55)	hour(s), <7 days	3 days
<i>Some severe symptoms</i>	fatigue, tinnitus, headaches, insomnia, dizziness, skin rashes, blood pressure disorder, nose bleeds	headaches, arthralgia, tinnitus, dizziness, concentration problems, fatigue, skin rashes, insomnia, anxiety	headaches, dizziness, concentration problems, memory loss, fatigue, anxiety, cough, nose bleeds, lung problem	insomnia, headaches, concentration problems, memory loss, skin rashes, irregular pulse, photophobia, anxiety	headaches, dysesthesia, memory loss, irregular pulse, high pulse, skin rashes, fatigue, insomnia	insomnia, headaches, fatigue, irregular pulse, dysesthesia, diarrhoea, irritability, breathless, skin rashes
<i>Distance from 5G antennas</i>	5 m	5 m – 20 m	60 m	50 m, 70 m	20 m	125 m

The list of RFR symptoms in the six 2023 studies includes adverse symptoms known among researchers of electromagnetic fields (EMFs) from 1746 when the Leyden Jar provided higher levels of static electricity¹⁵. Symptoms in the 1740s included muscular weakness, nose bleeds, and arthralgia (pain in joints and muscles), the same as today. Also, as with 5G today, none of the EMF symptoms showed obvious body heating.

Of all the thirteen subjects in the six case reports, only one could be classified as already sensitised to RFR. The process of triggering this hyper-sensitivity through prolonged or severe RFR exposure is similar to the process of triggering it through prolonged or severe EMF exposures. This process, like the symptoms themselves, has long been known. In 1752 Benjamin Wilson, a Fellow of the Royal Society, became hypersensitive to 'a very small quantity of electrical matter'. Some 1.6 per cent of the population is estimated to have this disabling condition of hypersensitivity. A prevalence of one in thirteen fits with the approximate percentages estimated for the occurrence of moderate conscious symptoms of MWS/RFS/EHS¹⁶.

Subconsciously, RFR can affect all human tissues. RFR has been associated with cancer since 1953. In 2011 IARC classified RFR as a Group 2B possible carcinogen¹⁷. In 2018, the U.S. Food and Drug Administration's \$30m study through the National Toxicological Program found 'clear evidence' that RFR from cell phones is associated with malignant schwannomas in the hearts of male rats, linked with significant increases in DNA damage in the frontal cortex and hippocampus¹⁸⁻¹⁹. A commentary in 2022 concluded that of 261 studies on oxidative effects from RFR exposure, '240 (91%) showed damage. Of 346 studies on effects of RFR on genes, 224 (65%) reported genetic damage'²⁰. These are the two major mechanisms leading to cancer.

The six reports show that, for these previously healthy subjects, their severe adverse symptoms forced them all to stop living near the 5G antenna. The symptoms occurred relatively quickly, from about an hour of entering the exposure zone to all reacting adversely within six weeks. In contrast, many adverse symptoms abated within hours or days of the subject being removed from proximity

to the 5G antenna. This suggests that they were not yet sensitised. However, at least two subjects reported that their physiological responsiveness to RFR exposure increased or worsened as the result of the initial exposure, as happens when people become hyper-sensitised to RFR.

SETTING SUITABLE RESTRICTIONS

In all these six case studies, all 5G RFR exposures causing harm were far below current ICNIRP thermal restrictions, showing that the latter are not protective. ICNIRP assumes that RFR can adversely affect humans only through short-term effects and by heating in excess of one or four degrees averaged over six or 30 minutes. However, in 1930 it was recognised that the neurological effects of non-thermal RFR and heat were different²¹, while by 1960 a microwave dose ‘incapable of producing apparent effects when applied only once’ was shown as causing a lens opacity if applied repeatedly²². Secondly, RFR non-thermal mechanisms have been established since the 1970s. These include calcium flux, oxidative stress, breaches of the blood-brain barrier, reduced working memory and genomic instability. Likewise non-thermal effects on humans and wildlife from geomagnetic disturbance are well established.

The first restrictions on RFR, in the U.S.S.R. in the 1930s, were based on non-thermal effects. In 1943 RFR from radar was found to cause adverse symptoms¹³. Researchers in most U.S. universities were unwilling to compromise their scientific standards. However, in 1947 the U.S. Navy, which used radar on ships, recruited Herman Schwan, who had

worked under the Nazis, through the secret Operation Paperclip. In 1953 Schwan proposed restrictions using continuous, not pulsed, RFR based on the invalidated thermal hypothesis. This created the current anomalies, where ICNIRP recognises but ignores the need for non-thermal restrictions²³, and where ICNIRP/FCC restrictions for 5G are ~10²¹ to 10²³ -fold higher than the natural solar RFR in the 5G spectral range to which humans and wildlife have adapted²⁴.

This thermal hypothesis and dismissal of non-thermal adverse effects, described as a ‘conspiracy’²⁵, and ‘great cover up’²⁶, are still used by ICNIRP/FCC, despite a U.S. Appeal Court in 2021 requiring the FCC to assess non-thermal effects. ICNIRP raised some thermal restrictions to 40,000,000 μW/m² in 2020²⁷, while in 2018 even short exposures at its peak-to-average ratio of 1,000 were considered as potentially causing permanent damage²⁸. Thermal restrictions are irrelevant for people with non-thermal symptoms from MWS/RFS/EHS and for long-term effects like cancer. Public health requires non-thermal restrictions: it should both protect all people, not just some, from conscious adverse symptoms, and also protect all people subconsciously.

Although no manmade modulated environmental RFR exposure may be safe, current non-thermal restrictions begin from 0.01 μW/m² (power density) or 0.002 V/m (electric field). They also vary in the duration, persons and place to which they apply (Table 2).

Table 2. Some non-thermal Guidelines and Restrictions.

Guidelines	Duration, Persons, Place	Power Density μW/m ²	Notes
<i>Austrian Medical Association</i> ²⁹	>4 hours	≤1	Notes 1-3 under Building Biology
<i>Bioinitiative</i> ³⁰	Children	3	For chronic exposure to pulsed RF
	Adults	6	
<i>Building Biology</i> ³¹	Sleeping Areas	<0.1	No Anomaly/Concern (0.1-10: Slight; 10-1000: Severe; >1000 Extreme Anomaly/Concern) 1. For single RFR sources. 2. Not applicable to rotating-antenna radar. 3. ‘pulsed or periodic signals ... should be assessed more seriously ...’
<i>Burgerforum BRD</i>	Sleeping Areas	0.01	Proposed in 1999
	Waking Areas	1	

Guidelines	Duration, Persons, Place	Power Density $\mu\text{W}/\text{m}^2$	Notes
<i>EUROPAEM</i> ³²	>4 hours Sensitive	0.1	GPRS (2.5G) with PTCCCH (8.33 Hz pulsing), DAB+ (10.4 Hz pulsing), Wi-Fi 2.4/5.6 GHz (10 Hz pulsing)
		1	GSM (2G) 900/1800 MHz, DECT (cordless phone), UMTS (3G), LTE (4G)
		10	TETRA, DVBT. 100: Radio broadcast (FM)
	>4 hours Non-sensitive		Night-time: 10 x Sensitive Day-time: 100 x Sensitive
<i>IGNIR</i> ³³	Sensitive	1	0.1 Average
	Non-sensitive	10-100	10 Night; 100 Day; 1-10 Average
<i>Salzburg</i> ³⁴	Inside	1	GMS (3G)
	Outside	10	
<i>Seletun</i> ³⁵	Sensitive and non-sensitive	170	0.000033 W/kg Specific Absorption Rate (SAR)

However, for practical purposes, public restrictions on an environmental toxin like RFR need to apply to everyone, everywhere. For instance, a baby may be asleep in the line of a 5G beam or someone may look directly at a 5G antenna. Employers and head teachers need a precise limit to ensure that all employees and pupils are safe and have equal access to all areas. Therefore, imprecise RFR limits, such as As Low As Reasonably Achievable (ALARA), are unsatisfactory in legal and practical terms, and the World Health Organization rejected this³⁶. Indeed, the ALARA principle is inappropriate for 2B carcinogens like RFR as regards children and all who cannot control their environment. Similarly, human rights and equality principles require a single restriction, not three levels such as national, local and individual³⁷, since an individual cannot control the health effects of others' decisions on the level adopted.

The Precautionary Principle (PP) or Foresight Principle, part of the European Union's legal framework, was seen in 2021 as relevant to 5G³⁸. However, it no longer applies to the existence of the health risk³⁹, since these six reports confirm its existence. Under PP's degree of risk, RFR should, at most, be limited to designated areas, like smoking.

Since a single RFR exposure can cause severe adverse symptoms, all exposures should be restricted below the biological threshold. Many people with MWS/RFS/EHS are aware of the threshold level or NOAEL for their conscious adverse symptoms. This is typically about $6 \mu\text{W}/\text{m}^2$ (0.05 V/m), based on the author's contacts with sufferers over the last 17 years. This conscious level is supported by

handheld meters which use a colour traffic-light system in addition to a digital readout, where a green light is activated below about $6-10 \mu\text{W}/\text{m}^2$ (0.05-06 V/m), with yellow, orange or red for higher levels (e.g. Acoustimeter AM-11, EMFields Solutions, 2021; Safe and Sound Pro II RF Meter, 2021). Some other manufacturers still reference readings to thermal restrictions, but these are irrelevant to symptoms caused by non-thermal exposures.

This NOAEL threshold of $6 \mu\text{W}/\text{m}^2$ (0.05 V/m), for conscious adverse symptoms and possibly subconscious effects with delayed symptoms, matches evidence from a real-time ecological momentary assessment study, published in 2022, after the Guidelines in Table 2. For one subject, the biophysical association between conscious adverse symptoms and RFR/EMF was partly supported at or above $6 \mu\text{W}/\text{m}^2$ (0.05 V/m), whereas the other two subjects did not react consistently below this level (Supplementary Materials Table VI)⁴⁰. Based on this NOAEL threshold, a restriction of 10% of harmful concentration (HC10) gives a public safety restriction of $0.6 \mu\text{W}/\text{m}^2$ (0.02 V/m) for Power Density or, more appropriately for the Electric Field effects on the depolarisation of cell membranes, of $0.06 \mu\text{W}/\text{m}^2$ (0.005 V/m).

CONCLUSION

5G, like some other technologies, was deployed ahead of actual health studies. Health evidence, including six case reports of 2023, now shows that $0.06 \mu\text{W}/\text{m}^2$ (0.005 V/m) is a suitable interim non-thermal restriction and needs to be set by public regulators.

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Cite this article: Michael Bevington. *Health Concerns of 5G and Setting Suitable Restrictions. International Journal of Research in Biological Sciences; 2024;1(1);01-07.*

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