

**FOR POLITICIANS & GOVERNMENT
OFFICIALS - condensed from the
unabridged version**

EMF RADIATION -

Are you sure it's not affecting you & countless New Zealand citizens?



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M.A. 1st Class Hons. Ed.

Dip. Ed. Psych.

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Planetary electromagnetic pollution: it is time to assess its impact

Priyanka Bandara^a  David O Carpenter^bAffiliations & Notes  Article Info 

As the Planetary Health Alliance moves forward after a productive second annual meeting, a discussion on the rapid global proliferation of artificial electromagnetic fields would now be apt. The most notable is the blanket of radiofrequency electromagnetic radiation, largely microwave radiation generated for wireless communication and surveillance technologies, as mounting scientific evidence suggests that prolonged exposure to radiofrequency electromagnetic radiation has serious biological and health effects. However, public exposure regulations in most countries continue to be based on the guidelines of the International Commission on Non-Ionizing Radiation Protection¹ and Institute of Electrical and Electronics Engineers,² which were established in the 1990s on the belief that only acute thermal effects are hazardous. Prevention of tissue heating by radiofrequency electromagnetic radiation is now proven to be ineffective in preventing biochemical and physiological interference. For example, acute non-thermal exposure has been shown to alter human brain metabolism by NIH scientists,³ electrical activity in the brain,⁴ and systemic immune responses.⁵ Chronic exposure has been associated with increased oxidative stress and DNA damage^{6,7} and cancer risk.⁸ Laboratory studies, including large rodent studies by the US National Toxicology Program⁹ and Ramazzini Institute of Italy,¹⁰ confirm these biological and health effects in vivo. As we address the threats to human health from the changing environmental conditions due to human activity,¹¹ the increasing exposure to artificial electromagnetic radiation needs to be included in this discussion.

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 - Two experienced EMF Consultants; and
 - Several friends and colleagues with relevant subject matter expertise
- My dear wife for tolerating the thousands of hours I needed to research and write the unabridged monograph

THE BOTTOM LINE FOR MPs & GOVERNMENT OFFICIALS

If you read nothing else, please read this page. Every point below is documented and fully referenced in the body of this document.

- The World Health Organization's own cancer agency (IARC) classified radiofrequency radiation as a **Group 2B "possible human carcinogen" back in 2011** – and a WHO-backed systematic review in **April 2025** strengthened that concern to a probable cause of cancer ("moderate certainty") in animal studies.
- In March 2026, eminent scientists of the International Commission on the Biological Effects of Electromagnetic Fields concluded that current safety limits are **at least 15 to 900 times too high** to protect people from cancer risk.
- A large and growing body of peer-reviewed science shows the assumptions underlying the FCC and ICNIRP exposure limits – the same framework New Zealand relies upon – appear **invalid and so continue to pose a major public-health harm**. (The level and extent of health harm is believed to increase with accumulating exposure over time.)
- When residents living near a cell tower were tested, their chromosomal damage was very significantly elevated above levels of those living further away. The International Atomic Energy Agency confirmed such damage was **identical to the damage caused by ionising radiation** such as X-rays (though through different biological pathways), and this damage was likely **carcinogenic**.
- Children are markedly more vulnerable to wireless radiation – thinner skulls, developing brains – yet are exposed to Wi-Fi radiation all day at school; expert bodies say children's overall exposure limits should be **hundreds of times lower**.
- The serious health concerns raised is not a fringe view: **thousands of peer-reviewed studies** over more than two decades link man-made microwave (wireless) exposure to a wide range of **non-thermal** biological harms – with current standards only focused on thermal/heating safety limits.
- Electromagnetic hypersensitivity (EHS) is a **real, measurable and increasingly prevalent condition** that has been formally recognised internationally (International Classification of Diseases, 10th revision) since 1990 – and is now known to **not** be a psychological artefact.
- Recently in Australia, one in six randomly surveyed adults reported concerning health symptoms that readily fell with the symptom cluster for EHS. Without prompting, they ascribed the cause as ongoing exposure to man-made microwaves – such as Wi-Fi at work and cell tower microwave transmissions.

New Zealand's radiofrequency exposure limits assume non-thermal effects do not exist. The evidence summarised below strongly indicates otherwise. Please see Sections 14 and 15 for evidence, and Section 17 for recommended actions by Government.

As a senior elected official of the New Zealand public or senior public servant, you are charged with acting ethically and in the best interests of those you represent. Therefore, please seriously consider taking the short time needed to read at least Sections 2, 4, 14, 15 and 17, so you can understand how to better protect yourself, your loved ones, your local community, and the wider New Zealand public.

As legally required by our N.Z. Bill of Rights Act (1990), individuals have the right to be free from cruel treatment and to refuse medical treatment – including imposed wireless radiation exposures that can almost certainly be damaging to health. This document (and the unabridged version it is drawn from) provides extensive evidence indicating multiple negative health effects linked to ongoing exposure to wireless microwave systems and devices. (For example, from mobile cell towers, mobile phones, Wi-Fi, smart meters and a range of smart devices.) For the large majority of the population, this exposure is clearly occurring without their informed consent.

Based on research outlined in this document and the unabridged monograph, such large-scale human radiation exposure needs to be immediately curtailed, with a complete halt on the current roll-out of 5G mobile systems. Further, comprehensive, independent research ought to be urgently conducted to assess current levels of health impacts on the population in general, and on those most vulnerable in particular. The outcome of this research will more than likely require a major tightening of wireless safety regulations, to prevent what is expected to be increasingly widespread and deepening damage to population health. Such a revision of standards should help avert or limit an outbreak of lawsuits against responsible parties.

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4G-5G (macro-cell) mobile tower only about 40 metres from the boundary fence of Onerahi Primary (Whangārei) – photo by the author

About this document

This is an abridged version prepared specifically for **Members of Parliament** and **Government officials**. It condenses a much larger, fully-referenced work, referred to throughout as the “unabridged version” or “unabridged monograph”. The unabridged version contains the complete evidence, additional Sections not reproduced here, and the full set of citations. Where this document says “see the unabridged version”, the supporting detail can be found there.

The **Unabridged** version can be viewed and downloaded from these Websites:

The **Unabridged** version can be viewed and downloaded from these Websites:

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3. *Physicians and Scientists for Global Responsibility NZ* (Second Edition): <https://psgr.org.nz/component/jdownloads/send/1-root/222-lyon-2026-emf-radiation-nz>
4. *Federal Communications Commission* (FCC, USA) – responsible for regulating radio frequency emissions. (Original Edition) ECFS legal deposit at: <https://www.fcc.gov/ecfs/document/26110044093/1>
5. *SaferTech NZ* (Second Edition): <https://www.safertechnz.co.nz/research> and scroll down for the link

This version – for Politicians and Government Officials - can be viewed and downloaded from the Websites below (in PDF format):

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2. *SaferTech NZ*: www.safertechnz.co.nz/research and scroll down for the link



Erection of controversial cell tower in Havelock North (5 October 2021) NZ Herald Picture

1. IMPORTANT LEGAL NOTICE & DISCLAIMER

As author of this monograph, I, Mr David Robert Lyon, assert the following:

1. I am providing this information without prejudice & with the best of intent – that intent being to safeguard and enhance the health of all New Zealanders.
2. Information is provided entirely free of charge, and I have no financial ties with any product, service, treatment, person, or Company mentioned within. I do not expect (or plan) to benefit financially, or in any other material way, from information provided.
3. I am a registered psychologist and **not** a medical health practitioner, nor physicist, nor telecomm engineer, but I am a deeply concerned and well-informed citizen. I am not legally or ethically permitted to diagnose or treat any disease or health condition, or to provide health advice. I have conducted research over 7 years and submitted my research to the critique of medical and scientific experts in New Zealand and Australia. Further, I have endeavoured throughout this document to back all opinions with referencing to relevant research or literature.
4. This work does not constitute health or medical advice.
5. If the reader has any health concerns, it will be vitally important to consult with a suitably qualified medical (or health) practitioner who is credentialed or experienced in this subject.
6. As will be apparent throughout this monograph, I have concentrated on presenting evidence **supporting the established thesis that current exposure levels of man-made microwave (MMM) radiation are likely to be causing multiple health harms to substantial numbers of the public.** Extensive research and investigation over the last 7 years, has led me to conclude that such apparently supportive evidence is significantly underrepresented in public, medical-scientific, and regulatory domains.
7. All statements with casual-sounding language are to be read as my opinion and interpretation, with acknowledgement that this area of research and investigation is not settled science and that current Government regulations are not in agreement with at least some of my statements.
8. It is hoped that this document may spark widespread interest, and rigorous open discussion, including amongst: scientists, medical practitioners, mental health practitioners, Governmental regulatory and advisory entities, health advisors, epidemiologists, and practitioners in health and safety, occupational health and environmental medicine.
9. Although this monograph has been meticulously reviewed by medical and scientific experts, I readily concede that there may be some unintended factual errors or misinterpretations contained herein. Also, with input from multiple experts over many months, it is possible that some of the footnotes may have become dislocated from citations in the body of the monograph.
10. Anthropic's **Claude AI** was used during the final review of this monograph to help better integrate research paper conclusions, to verify sources and citations, and assist with copy-editing. All editorial decisions, conclusions, and final wording are the author's.
11. I welcome and encourage debate of the evidence and acknowledge that this field continues to evolve.
12. As science in this area continues to advance, it will be important for the reader to stay open to new findings.
13. This publication is a free-to-access, open access document. As the information contained within is difficult to unearth, collate and synthesize, I will welcome the receiver of this

document sharing it with others, should they decide to do so. For online access, please use the following document citation: Lyon, D.R. EMF RADIATION: Are you sure it's not affecting you and countless New Zealand citizens? ISBN 978-0-473-80055-0 [PDF VERSION]



Kensington (Whangārei) Shopping Centre – 2 dominating large (macro-cell) mobile cell towers – photo by author

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2. Summary Statement and Call to Action

Summary Statement

This research document finds that:

1. It appears that the New Zealand Government (including several preceding iterations) has incompletely considered the scientific evidence relating to the full range of risks associated with wireless communications that utilise man-made microwaves (MMMs). This technology includes mobile phone systems and handsets, smart devices, Bluetooth and Wi-Fi. (See information presented in [Section 12](#), [Section 13](#), [Section 14](#) and [Section 15](#)).
2. Based on available public information, the writer is concerned that relevant New Zealand Ministries and the key safety advisory committee ICHEF, may possess insufficient scientific expertise with the multidisciplinary capacity required, to assess the complex health risks associated with relevant man-made technologies. (See [Section 12](#))
3. Public and medical-scientific awareness of health risks increasingly documented in the scientific literature, appears low. ¹ That is, the predominating level of awareness the writer has encountered – even amongst those with tertiary qualifications - is that microwaves pertain only to one's microwave oven, and there is little understanding that microwaves are central to telecommunication systems for mobile phones, and that Bluetooth and Wi-Fi employ microwaves for their wireless communication. Further, when an understanding of the near-ubiquity of man-made microwaves does exist, the prevailing view is that such microwaves are of little or no threat to human health; a view still promoted by bodies such as the W.H.O., local and international Telecommunications Companies, and through online searching via Google, or as evinced on Wikipedia. ²
4. Evidence presented indicates that man-made microwave exposure - such as from mobile phone systems and handsets, smart devices and Wi-Fi – pose serious risks to health. These risks appear to vary according to a number of factors, including age (with high vulnerability during early developmental stages) and health status. For example, it has been long-known that children are more at risk, owing to thinner skulls, more water in their brains, and a higher ion content. ³ These differing biological characteristics are estimated to cause twice the radiation absorption in their brains, and 10 times the radiation absorbed by their skulls. ⁴ Further, as children are likely to be exposed to increasing levels of MMMs and for their entire lives, the accumulating risks they will face ⁵ go very far beyond risks to someone already in middle-age or adulthood. (See [Section 14](#) and [Section 15](#))
5. There are multiple key differences between man-made microwaves and naturally occurring ones. In the briefest of terms, MMMs appear to be biologically far more disruptive, owing to their higher power density, polarisation, and the chaotic nature of the pulses. Consequently, MMMs have much more potential to create accruing health damage, even at non-heating

¹ See for example: See: [Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect](#)

² See for example: <https://en.wikipedia.org/wiki/Microwave> ; [do man-made microwave transmissions from mobile systems, Wi-Fi or Bluetooth pose any significant risk to human health? - Google Search](#) ;and <https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/non-ionizing/hypersensitivity>

³ See: <https://pubmed.ncbi.nlm.nih.gov/23705297/>

⁴ See: <https://pubmed.ncbi.nlm.nih.gov/21999884/>

⁵ See: https://kompetenzinitiative.com/wp-content/uploads/2019/08/KI_Brochure-6_K_Hecht_web.pdf

(non-ionising) levels. Nine differing characteristics of MMMs are discussed, which are considered to be deleteriously active at a biophysical and/or biochemical level in the body. ([Section 13](#))

6. In [Section 14](#), multiple postulated pathways of action for MMMs are described in considerable detail. For example: a decrease in cerebral blood flow; systemic ion channel disruption to cellular function; mitochondrial damage; blood-brain barrier permeability; oxidative stress and inflammation; red blood cell aggregation ("Rouleaux Formation"); DNA damage; and neurotransmitter and endocrine perturbation.
7. In [Section 15](#) the apparent neuropsychological impacts of MMMs are explained, with 12 different key effects posited. These include: decrease in memory retention; slowed cognitive processing and degraded higher cognitive skills such as comprehension, planning and rational thought; chronic mental and physical fatigue; headaches; dizziness; ringing in the ears; agitation, aggression, hyperactivity and conduct challenges; anxiety, obsession-compulsion and trauma symptoms; low mood or depression; poor sleep; and reduced verbal expression.
8. Electromagnetic Hypersensitivity (EHS) is considered by the author to be a genuine medical condition, supported by the clinical and biomarker evidence developed by Professor Dominique Belpomme and colleagues over nearly two decades.
At the level of clinical documentation, ICD-10-AM (a diagnostic-coding classification used by Health N.Z.) contains the codes a clinician applies when recording an EHS-attributed presentation — W90 for the radio-frequency exposure context, with effect codes G43, R42, H93.1 for the typical migraine, dizziness, and tinnitus symptoms.
In the writer's opinion, in the interests of public health, this condition requires official public-health recognition, ongoing public education, and significant accommodations — for both prevention and treatment — by Government and by other key advisory and regulatory authorities.
9. An important regulatory anchor for this monograph's risk management / mitigation case is the 2011 classification of radiofrequency electromagnetic fields as **Group 2B — "possibly carcinogenic to humans"** — by the International Agency for Research on Cancer (IARC), the cancer-research arm of the W.H.O.¹ The April 2025 W.H.O.-backed systematic review of animal cancer studies (discussed in [Section 6.2](#)) reached a conclusion (in one study) that for several tumour types, **man-made microwaves were the probable cause** of those cancers. This finding provides empirical support for revisiting and tightening the IARC 2B classification. Even as it currently stands, the IARC **2B** classification of RF-EMFs itself is unambiguous, authoritative, and highly relevant to public health. (See [Section 6](#) for the more detailed picture.)
10. Based on research reviewed, there will likely be multitudes in our society who do **not** manifest symptoms severe enough for a diagnosis of EHS, while at the same likely suffering significant health impacts arising from ongoing exposure to man-made microwaves.²

Call to Action

If the reader finds information presented in this document to be significantly concerning (see especially research presented in [Section 14](#) and [Section 15](#)), it will be vital to public health for any of the below suggestions to be considered for urgent implementation. Importance of **individual action** is high, given that Governmental and public knowledge of potential harms from (man-made) microwave

² See: [IARC Monograph Vol 102 — Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields](#) (2013). The 2011 Group 2B classification press release: [Baan et al. 2011](#), Lancet Oncology.

² See: [Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect](#)

exposure is currently so limited, and that a major groundswell of concern throughout N.Z. is most likely to have a substantive effect.

Actions to consider taking include sharing this document with any of the following:

1. Family, friends and work colleagues
2. Other Members of Parliament within your political party and beyond – including the Prime Minister, Deputy Prime Minister, and leaders of all other Parties currently occupying Parliament
3. Further action could be at the Ministerial level, including the highly relevant: Minister for Broadcasting, Communications & Digital Media; Minister for Education; Minister for Health; Minister for Research Science & Innovation; Minister for Justice; Minister for Conservation; and Minister for the Environment
4. National-level and local-level Ministry of Education and Ministry of Health - senior officials
5. The Medical Council of New Zealand
6. Local G.P.s and Health Practitioners
7. Local municipal authorities such as City Councils and District Councils
8. Local or National Media
9. Local schools at all educational levels – Pre-school, Primary, Intermediate, Secondary and Tertiary
10. Your mobile phone provider – including the Company CEO, chief scientific/technical advisor, and your local Branch Manager
11. Relevant high-volume Websites and Social Media platforms
12. Local or National Human Rights agencies or organisations

Taking Action

For an extensive email contact list for MPs, DHB officials etc., please see the unabridged version.

If the reader chooses to forward this document to any public officials, requesting a follow-up, in-person meeting, could be expected to produce much added impact. Such a meeting would require no special expertise in this area, and might merely be to enquire:

1. If the official has read relevant Sections of the document? (If **not**, then by when this can be expected, and scheduling a follow-up appointment to fit this timeline.)
2. If the document **has** been perused, what was found to be important and to necessitate action?
3. What immediate and subsequent actions will be taken – with relevant timelines?
4. When the reader can next meet with the official to receive an update on progress made?

Taking notes during any such appointment is an added level of formalisation which could then include emailing the official a copy of the notes for her/his records.

Navigating this Document

Sections in this document that are most relevant to key sectors of society have been suggested in the **Executive Summary** below: [How to Navigate This Document](#)

The **Executive Summary** also includes recommended actions that can be taken by each specific sector.

Section 17 recommends immediate actionable steps available to be taken by a responsible Government.

“This [unabridged] Monograph makes an important contribution to understanding RF-EMF and its health effects in New Zealand. While non-thermal effects are well documented in the scientific literature, they remain unrecognised by public sector agencies, with no dedicated resourcing for independent scientific risk evaluation. When potential harms from technology are not formally acknowledged, society’s ability to act in a precautionary and protective way is undermined.”

The Physicians and Scientists for Global Responsibility New Zealand Charitable Trust

(23 June 2026)



Arrival of cell tower for installation in Tutukaka (27 March 2024)

<https://www.facebook.com/groups/tutukakacoastgroup/posts/1892141574607961/>

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3. Preamble

Intended Readership

The primary intended audience for this abridged monograph is elected public officials, public servants with responsibilities in this area, advisory and regulating entities throughout New Zealand, health practitioners, and concerned individuals. Many will be increasingly aware and concerned regarding the apparent deleterious environmental and health effects of ever-increasing exposure to electromagnetic radiation (EMR), including man-made microwave (MMM) transmissions and emissions. Health and medical advisors, and practitioners in the domains of occupational health, environmental medicine, and health and safety, may find the information and resources available in this document useful.

Another important audience that may obtain significant benefit from this (abridged) monograph and its information, is those individuals and patients who suspect they are being deleteriously affected by exposure to man-made microwaves. (The unabridged version contains much additional information that should prove helpful for such people.)

There may also be many who possess a general interest in health and wellbeing, who wish to increase their understanding of this rapidly encroaching and increasingly important area of adverse, high-likelihood, health impacts.

I dedicate this work to all those who may find benefit from this document, and gladly share it with you all.

Why I am Freely Sharing my Extensive Research

As I curated and reviewed more and more research on the potentially very harmful effects of man-made microwaves ([Section 14](#) and [Section 15](#)) I found the evidence compelling, alarming, and of likely interest and importance to all.

If the reader experiences a similar response, a valuable outcome would be their choice to share this research with others. Among these, consider for example, sharing with friends and family who are interested or concerned; your local health practitioners or other medical people you may know; local school Principals and teachers; Ministry of Education Managers; local government and municipal individuals; local Media; your local Council.; relevant high-traffic Websites; posting on Social Media; and discussing on reputable talk-back radio stations and/or Television programmes. Casting the information net as widely as possible will help raise the awareness of a much larger number of people to this near-omnipresent, invisible, silent, man-made, exposure risk.

A key reason for authoring this document is that owing to our population being continually bathed in increasing levels of man-made microwaves, I hold grave fears for the mid-to-long term health of all New Zealanders. My fears arise from relevant published research articles over the preceding 20 years, thousands of which have indicated that man-made microwaves are associated with a wide range of health impairments and damage. This damage usually accrues over time to exposed individuals, though at early stages of exposure, there is often no awareness of malaise, or accruing toxicity. Further, as research has demonstrated – and will be evidenced in [Section 14](#) and [Section 15](#) below -

during the developmental years of *in utero*, childhood and adolescence, brains are especially vulnerable to the apparent effects of chronic microwave radiation exposure.

After several years of research and extensive medical testing, I became fully convinced that my health had suffered severely owing to continual exposure to high levels of Wi-Fi microwaves in the workplace. Since this health-saving insight, I have experienced a strong need to document what I have learned, in order to warn fellow New Zealanders of what they could be facing.

My commitment to publishing my study and the arising insights, has been strengthened by a commensurate burgeoning awareness that the apparent health dangers of man-made microwaves is something that a wide range of New Zealanders are unaware of – including many health professionals with whom I have had contact regarding these issues.



4G- 5G (macro-cell) mobile phone tower directly opposite Onerahi Primary (Whangārei) – photo by the author

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4. Executive Summary

4.1 Introductory note

As will be apparent throughout this document, the author has concentrated on presenting evidence **supporting the thesis that current exposure levels of man-made microwave (MMM) radiation are likely to be causing multiple health harms to substantial numbers of the public.** This has been the chosen approach, as extensive research and investigation spanning the last 7 years, has led the author to conclude that such supportive evidence is significantly underrepresented in public, medical-scientific, and regulatory domains. (See [Section 14](#) and [Section 15](#)) for a wide range of likely health effects of MMMs.)

Evidence supporting this thesis is drawn primarily from published medical-scientific research, particularly from research where investigators are understood by the author to be fully independent of any commercial or political influence. Where relevant published (independent) research or reviews have not been readily available, the author has sometimes relied on resources such as YouTube or online Summit presentations, by physicians or scientists that the author considers to be recognised and established in the field. (Such sources are acknowledged as informal and not equivalent to peer-reviewed literature.)

As discussed in numerous instances in this document, the factors determining the possible effects of MMMs are manifold and complex, and often very difficult to accurately measure – at least over the short-term. Such difficulties are believed to be a key reason for the seemingly divergent findings when it comes to possible health effects of MMMs – with many research studies failing to find any significant link between exposure to MMMs and temporally subsequent health impacts. (See [Section 9](#) for a detailed discussion of these and other research challenges.)

Regarding the safety of current MMM radiation levels in our society, it is readily acknowledged that NZ regulators and some in the medical-scientific community, currently hold opposing views to those of the author. Likely reasons for **not** perceiving any potential risks from MMM radiation are discussed in [Section 9](#) and [Section 12](#).

4.2 Key findings

As per the reviewed literature below, a very wide range of negative health impacts appear to be closely linked to accumulating exposure to man-made Electromagnetic Radiation. Such radiation comes in many forms, including microwaves utilised in wireless technologies such as Wi-Fi routers, mobile phones, mobile cell towers (and the associated networks), Bluetooth devices, smart meters, computer devices (especially in Wi-Fi mode), smart home devices (such as T.V.s), modern home alarm and ventilation systems, most baby monitors, smart watches, and smart homes. Exposure to such man-made RF-EMFs is almost ubiquitous in all urban environments, including most domestic, employment and institutional environments.

Electromagnetic Hypersensitivity (EHS) - also known as "Microwave Sickness". "EMR Syndrome" and "Wireless Sensitivity" - is a genuine, biologically-based health condition apparently caused by chronic exposure to man-made electromagnetic fields (EMFs) and their radiation. ¹ The potential outcomes of

¹ See: [Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect](#)

exposure appear to be both dose and intensity dependent. (In some cases, very intense short-term exposure appears immediately and perceptibly deleterious.) Such near-ubiquitous exposure includes the predominating source of man-made microwaves – from technologies such as detailed in the above paragraph.

Man-made microwaves differ fundamentally from natural microwaves because they are polarized, irregularly pulsed, and chaotic, potentially making them biologically disruptive and damaging, even at low, non-heating power levels. ¹ That is, even at non-thermal levels, they appear to be physiologically disruptive when compared against natural background microwaves - that are normally non-disruptive to human (biological) structure and function. (See [Section 13](#) for a detailed discussion on this subject.)

The research presented contends that current safety standards appear to inadequately protect public health, particularly for children ² and vulnerable populations. ³

A call is made for urgent Government recognition of electromagnetic hypersensitivity and the non-thermal risks from EMFs, improved medical understanding, and implementation of risk management measures based on established (or suspected) biological mechanisms of harm. (Risk mitigation involves taking practical steps to reduce exposure where there is credible evidence of potential harm, even while limited scientific uncertainty remains.)

4.3 Five compelling pieces of evidence

4.3.1 International Medical Recognition with Objective Diagnostic Criteria

Electromagnetic Hypersensitivity (EHS) has been recognised by the WHO as a clinical syndrome since the 2004 Prague workshop, under the structured term, 'Idiopathic Environmental Intolerance attributed to Electromagnetic Fields' (IEI-EMF). The International Classification of Disease ICD-10 / ICD-11 coding combinations support clinical documentation, and Health N.Z. uses ICD-10-AM. ([Section 6.1](#) unpacks the W.H.O. position in detail).

For the risk management / mitigation case, a clinical-research framework has been developed by leading European researchers, Professor Dominique Belpomme (medical oncologist) and colleagues. They have built an extensive clinical database of EHS sufferers and demonstrated an objective and consistent range of key diagnostic symptoms, biomarkers, and imaging findings. (See [Section 6](#)) Their findings for establishing a diagnosis of EHS, include:

- a) Low-grade inflammation markers in peripheral blood
- b) Autoimmune response involving autoantibodies against O-myelin. (Myelin is an essential component of nerve cell sheaths throughout the body and vital to brain function.)
- c) Oxidative and/or nitrosative stress biomarkers present in 80% of EHS patients. (Such elevated ongoing stress is well-able to cause systemic damage to the body's structure and function – including vital organs.)

¹ [FCC Knew Phones Exceeded Radiation Limits, Hid Info From Public and Courts](#)

² [Wireless Radiation Exposure for Children Should Be 'Hundreds of Times Lower' than FCC Limits, Environmental Group Says • Children's Health Defense](#) ; and [Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks - ScienceDirect](#)

³ [New Report Contradicts Telecom Industry Claim That Wireless Radiation Is Safe](#)

- d) Cerebral blood flow abnormalities detected through specialized brain imaging, with significantly decreased blood flow to the middle cerebral artery, affecting key brain areas such as the thalamus – which is like “grand central station” for the brain.

Belpomme and colleagues found that objective findings establish EHS as "a neurologic pathological disorder which can be diagnosed, treated, and prevented" (Belpomme & Irigaray, 2020) ¹, refuting claims that EHS is purely psychological, or a psychological manifestation of the "nocebo effect." Further, in the same published research (see [Section 6](#) below), they emphatically state that: *"we show here there are objective pathophysiological changes and health effects induced by electromagnetic field (EMF) exposure in EHS patients **and most of all in healthy subjects**, meaning that excessive non-thermal anthropogenic EMFs are strongly noxious for health. In this overview and medical assessment we focus on the effects of extremely low frequencies, wireless communications, radiofrequencies and microwave EMFs. We discuss how to better define and characterize EHS. Taking into consideration the WHO proposed causality criteria, we show that **EHS is in fact causally associated** with increased exposure to man-made EMFs..."*

[bold emphasis added by the author]

4.3.2 Multiple Apparent Biological Mechanisms (or pathways) of Harm

The research documents fifteen postulated biological mechanisms grouped into four thematic categories ([Section 14](#)) through which man-made microwaves appear to cause bodily or psychological harm. This entails moving beyond simple correlation to explain how harm seems to occur.

Key apparent underlying mechanisms include:

- a) Systemic ion channel disruption to cellular function: Man-made microwaves activate voltage-gated calcium, sodium, chloride and potassium channels, leading to toxic ion influx into cells. This causes oxidative stress, cellular dysfunction, cellular damage, and early cell death throughout the body.
- b) Mitochondrial damage: Disruption of the body's cellular energy production centres, leading to fatigue and systemic health decline
- c) Blood-brain barrier permeability: Breakdown of the protective barrier between blood and brain tissue, allowing toxins and inflammatory chemicals to affect sensitive neural tissue
- d) Oxidative stress and inflammation: Generation of reactive oxygen and nitrogen species and damaging inflammatory cascades throughout the body. If unalleviated, this can lead to a range of serious chronic diseases.
- e) Blood cell aggregation: Under dark field microscopy, red blood cells are seen to clump together (Rouleaux Formation), much-reducing oxygen delivery to tissues, and thereby capable of tissue damage in sensitive areas such as the brain and kidneys.
- f) DNA damage: Cumulative genetic damage over time, potentially contributing to cancer development
- g) Neurotransmitter and endocrine disruption: Altered brain chemistry and hormone regulation, negatively affecting brain and systemic function.

This understanding of underlying physiological mechanisms is critical because it addresses a central criticism often levelled against man-made microwave health research, namely that there is an

¹ [Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It - PubMed](#)

absence of plausible biological pathways. Most of these apparent mechanisms operate at non-thermal levels, explaining why current safety standards (based solely on heating effects) are very likely inadequate and unsafe.

4.3.3 RF-EMFs as a “Possibly Carcinogenic to Humans” (2011), and Recent W.H.O.-Linked Scientific Review (2025)

In the author’s opinion, an important international classification for the risk management case is the 2011 IARC **Group 2B classification** of radiofrequency electromagnetic fields as “**possibly carcinogenic to humans**”. IARC is the cancer-research arm of the W.H.O. The classification was reached by a 30-person international working group on the basis of the Interphone study (2010) ¹ and the Hardell group’s case-control studies (1999–2010) ², both of which reported elevated odds ratios for glioma in heavy mobile-phone users. Group 2B is the same category that IARC applies to lead, DDT, gasoline engine exhaust, and other agents whose human carcinogenicity is supported by limited epidemiological evidence and limited animal evidence.

The classification has remained in force since 2011, and the April 2025 W.H.O.-backed review of animal cancer studies (see below paragraph) provides empirical grounds for IARC to consider upgrading the alert status — which several authoritative bodies including the ICBE-EMF have now formally requested.

In 2025, the World Health Organization partially commissioned 12 meta-analysis studies examining the relationship between radiofrequency electromagnetic fields (RF-EMFs) and health conditions. One of these studies, utilizing narrative analysis rather than purely statistical methods, found “moderate certainty evidence of an increased risk of some rare cancers” associated with RF-EMF exposure. While this represents only partial acknowledgment from an international health body, it marks a significant shift toward recognizing potential health risks that were previously dismissed. This development strengthens the argument that the precautionary principle with appropriate risk management, should guide policy decisions regarding man-made microwave exposure, particularly for children and vulnerable populations.

4.3.4 Personal Case Study with Documented Medical Evidence

The author’s own health journey provides a detailed, documented case study of apparent EHS development and semi-recovery. After 13 years of excellent health, the author developed severe, debilitating symptoms in 2018 while working in an environment with high Wi-Fi exposure. Extensive medical testing (N.Z. and U.S.A.) revealed:

- a) Elevated biomarkers consistent with inflammation and oxidative stress
- b) Cognitive, neurological and physical symptoms matching EHS presentation symptomatology
- c) Temporal correlation between significant exposure to (man-made) microwaves and onset of symptoms. And, with increasing microwave exposure levels, commensurate increase in symptom severity.
- d) Significant (gradual) improvement following EMF (microwave) reduction strategies

¹ Interphone Study. Results update. 2008. http://www.next-up.org/pdf/Interphone_IARC_Results_update.pdf

² IARC Monograph Vol 102 (2013); Hardell & Carlberg 2020 — [Health risks from RF radiation including 5G should be assessed by experts with no conflicts of interest](#) (Oncology Letters).

- e) A recent accidental, heavy exposure (daily) to Wi-Fi microwaves over 3 weeks, with a gradual increase in severity of my EHS-like symptoms. Also, a gradual improvement in most symptoms with the removal of this influence.

While personal experience is anecdotal, nevertheless a detailed case study forms part of the evidence hierarchy. It also provides a relatable narrative that many readers may recognize in their own experiences, or those of patients. The documented medical testing adds objective credibility to the personal account.

4.3.5 Extensive Research Foundation: Thousands of Studies

The research draws upon thousands of peer-reviewed studies from multiple databases including PubMed ([PubMed](#)), Google Scholar ([Google Scholar](#)), GreenMedInfo (www.greenmedinfo.com) and ORSAA (www.orsaa.org), spanning more than two decades of investigation by researchers. These studies collectively demonstrate strong associations between man-made microwave exposure and a wide range of harmful health effects ¹ that include:

- a) Acute symptoms: Fatigue, headaches, dizziness, tinnitus, sleep disturbances, cognitive impairment, anxiety, depression
- b) Chronic conditions: Neurodegenerative diseases, fertility issues, developmental disorders in children
- c) Severe outcomes: Increased cancer risk (particularly brain tumours and certain rare cancers)

The volume and consistency of findings across prominent independent researchers provide substantial weight to the argument that man-made microwaves pose genuine health risks that warrant serious consideration and urgent risk management action.

4.4 Key recommended actions for consideration by relevant sectors

Based on the collective findings presented in this document, the following recommendations are made:

4.4.1 Medical and Professional Education

Immediate actions for Government and the Medical regulatory agency to consider:

Mandate comprehensive EMF health education for healthcare providers, including GPs, occupational health practitioners, and specialists in neurology, environmental medicine, and public health. Based on the author's experience, many medical professionals in New Zealand appear to lack awareness of EHS as a recognized condition with objective diagnostic criteria. Such insufficient awareness can potentially lead to misdiagnosis, or worse, possible dismissal of symptoms of affected individuals.

Education could include:

- a) Recognition of EHS symptoms and clear diagnostic criteria
- b) Understanding of available biomarkers and testing methods
- c) Knowledge of mitigation and treatment strategies
- d) Awareness of vulnerable populations - such as children, pregnant women, and those with pre-existing conditions

¹ See: [5032457](#)

Rationale: Early recognition and appropriate intervention can prevent symptom progression and improve outcomes for affected individuals.

4.4.2 Risk Management Measures in Schools and Workplaces

Priority actions for Government and Employers to consider:

- a) Provide wired internet options in all schools, allowing Wi-Fi to be turned off when not truly needed
- b) Position Wi-Fi routers away from areas where students and staff spend prolonged time
- c) Limit cell tower proximity to schools, establishing specific distance guidelines - based on expert, independent, scientific advice
- d) Conduct microwave exposure assessments in workplaces and in schools
- e) Create microwave-reduced zones or "safe havens" for sensitive individuals – in schools and the workplace

Rationale: Children's developing brains and bodies appear particularly vulnerable to man-made microwave exposure. Implementing simple, low-cost risk management measures in educational and workplace settings, protects the most vulnerable population without compromising educational and workplace technology needs.

4.4.3 Independent Research Funding and Regulatory Reform

Immediate Actions for Government to consider:

- a) Fund independent, non-industry-influenced research on (man-made) microwave health effects, particularly long-term, low-level exposure studies
- b) Address possible conflicts of interest in regulatory bodies (notably ICHEF in New Zealand), where industry-promoting representation appears to the writer to be disproportionately high. Also, ensure that the multi-disciplinary expertise within the advisory Committee is sufficiently advanced and comprehensive to meet its entrusted responsibilities.
- c) Establish independent research programmes examining high MMM exposure environments and possible resulting health impacts — over the short and longer-term. This could be in schools at all educational levels, and at workplaces or residential housing within proximity of cell towers. Illustrative working figures pending such independent assessment: approximately within 400 metres for the larger main-lobe footprint of conventional 4G macro-cell sites, and approximately within 100 metres for the smaller-cell sites that often accompany 5G C-band (n78, 3.5 GHz) deployment. These approximate figures should be revised as the recommended independent research produces evidence on which distances offer meaningful risk management protection across the specific N.Z. operator-band mix (Section 8.1).
- d) Support longitudinal studies following children in high vs. low MMM exposure environments.

Rationale: Current regulatory frameworks and research funding may possibly involve industry influence that if real, could bias outcomes. Independent research is essential for establishing evidence-based safety standards that the public can have full confidence in, and that reliably protect public health.

4.4.4 Individual Protective Measures and Public Awareness

Public Education Initiatives for Governmental and relevant Health Agencies to consider:

- a) Provide accessible information about simple, cost-effective protective measures (using speakerphone, keeping devices away from body, turning off Wi-Fi at night, using wired connections, etc.)
- b) Make EMF meters available for public use or loan programmes
- c) Create educational materials for workplaces and community organizations
- d) Establish support networks for EHS-affected individuals

Rationale: Individual empowerment through knowledge and practical tools allows people to make informed decisions about their own exposure levels.

4.4.5 Recognition and Accommodation for Affected Individuals

Government Policy Changes to be considered:

- a) After impartial and expert review of the evidence, if warranted, to have EHS properly recognized under disability and employment legislation, requiring reasonable accommodations in workplaces
- b) Establish medical protocols for EHS diagnosis and management within the New Zealand health system
- c) Create pathways for affected individuals to request workplace accommodations without discrimination
- d) Support research into effective treatment and management strategies for EHS
- e) As per relevant recommendations above, provide similar support to those who already suffer from exposure to man-made microwaves, but who do not yet meet the level of symptom severity required for a diagnosis of EHS

Rationale: EHS has WHO recognition under the IEI-EMF terminology adopted in 2004¹, can be documented in New Zealand clinical practice via ICD-10-AM coding combinations, and is supported by clinical and biomarker evidence from the Belpomme group and ICBE-EMF. Affected individuals report significant quality-of-life impact, and proper recognition and accommodation are important for social justice and public health.

4.5 How to navigate this document

This document is reasonably comprehensive (80+ pages) and although directed towards politicians and Governmental officials, can serve multiple audiences. Readers may navigate Sections based on their interests, as each Section is more or less discrete and self-contained:

- **Policy makers and regulators:** May wish to review **Sections 10** (reputable, independent sources of additional information); **11** (EMFs of most concern); **12** (regulatory issues); **13** (potentially harmful characteristics of man-made microwaves); **14** (apparent pathways of harm to bodily structure and function); **15** (apparent neuropsychological and behavioural impacts); **21** (key findings); and **22** (policy recommendations)

- **Health practitioners:** May wish to focus on **Sections 6** (diagnostic criteria); **10** (reputable, independent sources of additional information); **13** (potentially harmful characteristics of man-made

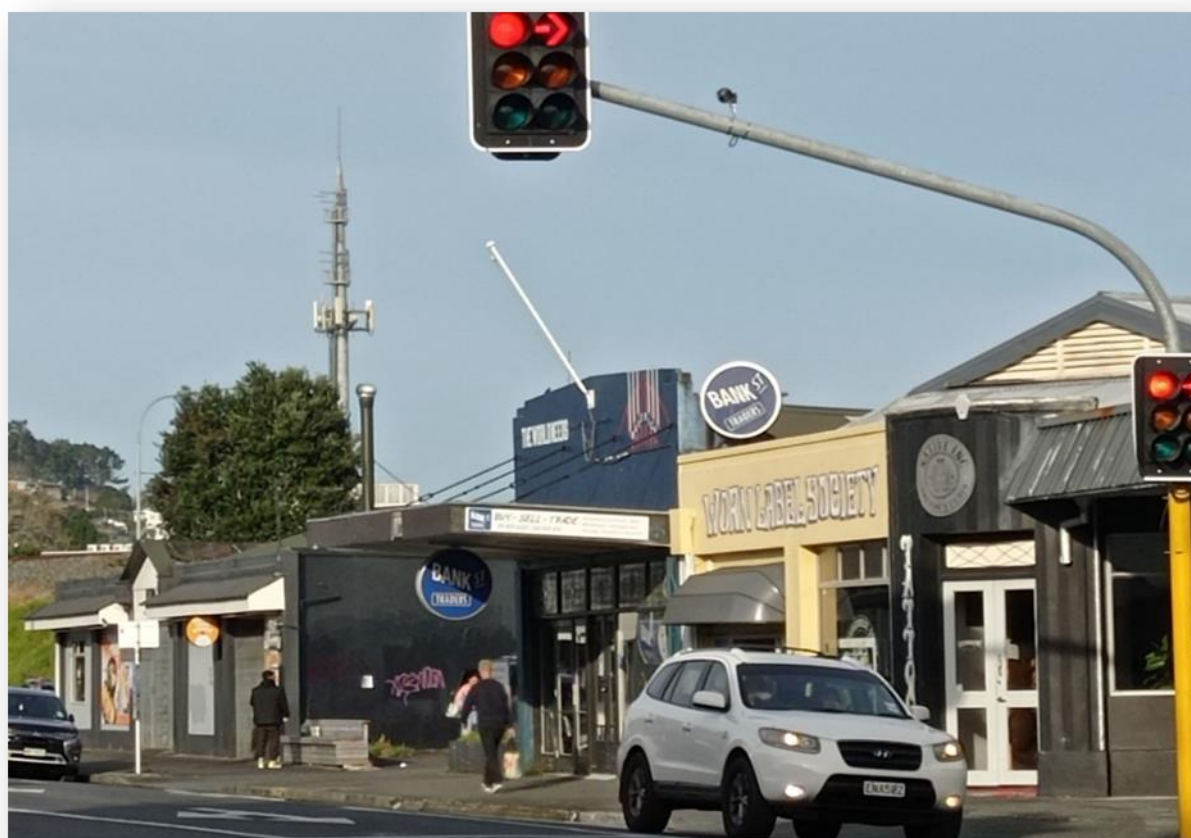
microwaves); **14** (apparent pathways of harm to bodily structure and function); **15** (apparent neuropsychological and behavioural impacts); **19** (clinical presentation); and **20** and **APPENDIX** (treatment strategies)

- **Individuals concerned about EMF exposure**: May wish to review **Sections 10** (reputable, independent sources of additional information); **14** (apparent pathways of harm to bodily structure and function); **15** (apparent neuropsychological and behavioural impacts); **17** and **APPENDIX** (protective measures); **18** (risk factors); and **20** (further mitigation strategies)

- **Those seeking scientific evidence**: May wish to examine **Sections 10** (reputable, independent sources of additional information); **12** (regulatory issues); **13** (potentially harmful characteristics of man-made microwaves); **14** (apparent pathways of harm to bodily structure and function); **15** (apparent neuropsychological and behavioural impacts); and **23** (extensive additional references)

Owing to the intention to make each Section as self-contained as possible, the reader will necessarily encounter a degree of repetition throughout the document.

The full document below provides detailed evidence, citations, and comprehensive discussion of each topic. This Executive Summary provides an overview for those who need key information quickly, or who want to understand the document's scope before diving deeper into specific Sections.



Whangārei Central City with large (macro-cell) 4G-5G mobile tower dominating the landscape – photo by author

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5. About the Writer

I have a strong background in education, psychology and health. I graduated as an Educational Psychologist in the early 1990s and apart from several years working in Thailand (in refugee camps), I have worked in the field of psychology ever since.

Regarding my psychology work, it has been predominantly in the area of education, but with many years working with survivors of trauma and torture, several years working with survivors of sexual abuse, and several years with clients with chronic pain conditions. I have also worked in numerous medical centres with clients presenting with a full range of mental health conditions (at a “moderate” level).

As a result of a serious (life-threatening) health challenge about 20 years ago, I have undertaken thousands of hours of online training in Naturopathy and Functional Medicine, although I do **not** possess a formal qualification as such.

Then, after enjoying 13 years of excellent health, in 2018 I unexpectedly developed a range of mysterious and debilitating health symptoms. This has led to an ongoing journey into learning about the very likely damaging health effects of (man-made) microwave radiation.

I have always loved science, technology and the latest gadgets, with my first PC computer in 1988, and I was an early “brick” cellphone owner. I also had a small (sole operator) computer business for several years. So, I am in favour of the advancement of technology, as long as any such innovation has been thoroughly safety tested, prior to roll-out in the public domain.

Several years ago, owing to ongoing personal health challenges, I undertook an online training course in remediating effects of man-made EMFs – including microwaves. (See: [Electrosmog Rx](#))

As per throughout this document, information presented is for informational purposes only, and any health decisions made by the reader need to be only after full and frank consultation with a qualified medical or health practitioner.

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6. Is EHS a Real Health Condition & what may be causing it? – An Introduction

In this document the author will be discussing the apparent health dangers of electromagnetic radiation (EMR), **focusing principally on microwave radiation** within this spectrum.¹ “Microwave sickness” - a term which has been in the public domain for many years - is formally known as “Electromagnetic Hypersensitivity” (EHS) and appears to arise from over-exposure to man-made microwaves in particular. While EHS is at the severe end of how people may be affected by man-made microwaves, there will very likely be a large group of people who are being adversely affected, but with symptom severity below the threshold for diagnosing EHS.

Back in 2022, Professor Belpomme and Dr Irigaray (who have researched EHS for nearly 20 years), explained in their published research how EHS involves a range of consistent, biomedical health impacts; and that such impacts are **casually** associated with exposure to man-made EMFs. (Those man-made EMFs were / are: extremely low frequencies; wireless communications radiofrequencies; and microwaves from cellular systems and devices.)

*“Since 2009, we built up a database which presently includes more than 2000 electrohypersensitivity (EHS) and/or multiple chemical sensitivity (MCS) self-reported cases ... EHS and MCS **can be characterized clinically by a similar symptomatic picture, and biologically by low-grade inflammation and an autoimmune response involving autoantibodies against O-myelin.** Moreover, **80% of the patients with EHS present with one, two, or three detectable oxidative stress biomarkers in their peripheral blood, meaning that overall these patients present with a true objective somatic disorder.** Moreover, by using ultrasoniccerebral tomosphygmography and transcranial Doppler ultrasonography, we showed that **cases have a defect in the middle cerebral artery hemodynamics, and we localized a tissue pulsometric index deficiency in the capsulo-thalamic area of the temporal lobes, suggesting the involvement of the limbic system and the thalamus.** Altogether, **these data strongly suggest that EHS is a neurologic pathological disorder which can be diagnosed, treated, and prevented.** Because EHS is becoming a new insidious worldwide plague involving millions of people, we ask the World Health Organization (WHO) to include EHS as a neurologic disorder in the international classification of diseases.”*

*“In this overview we distinguish the etiology of EHS itself from the environmental causes that trigger pathophysiological changes and clinical symptoms after EHS has occurred. Contrary to present scientifically unfounded claims, **we indubitably refute the hypothesis of a nocebo effect to explain the genesis of EHS and its presentation.** We as well **refute the erroneous concept that EHS could be reduced to a vague and unproven “functional impairment”.** To the contrary, we show here there are objective pathophysiological changes and health effects induced by electromagnetic field (EMF) exposure in EHS patients and most of all in healthy subjects, meaning that excessive non-thermal anthropogenic EMFs are strongly noxious for health. In this overview and medical assessment we focus on the effects of extremely low frequencies, wireless communications radiofrequencies and microwaves EMF. We discuss how to better define and characterize EHS. Taken into consideration the WHO proposed causality criteria, we show that **EHS is in fact causally associated** with increased exposure to man-made EMF, and in some cases to marketed environmental chemicals. We therefore*

¹ As already discussed above, man-made microwaves are emitted by a large range of devices and systems, including cell phone towers, mobile phones, Wi-Fi routers and devices, Bluetooth devices, smart devices, etc.

*appeal to all governments and international health institutions, particularly the WHO, to urgently consider the growing EHS-associated pandemic plague, and to acknowledge EHS as a mainly new real EMF causally-related pathology.”*¹

[Bold and underline emphasis added by the author]

6.1 W.H.O. Establishes EHS as a classifiable Functional Disability (International Classification of Diseases v.10, 1991)

As early as 1991, with the release of the ICD-10, the W.H.O. established EHS as a classifiable Functional Disability. In its 2005 advisory update, it noted that the symptoms are certainly real, and can vary widely in their severity. However, it believed (2025) that there was no scientific basis to link EHS symptoms to EMF exposure.²

*Electromagnetic hypersensitivity (EHS) is a claimed sensitivity to electromagnetic fields, to which adverse symptoms are attributed. EHS has no scientific basis and is not a recognized medical diagnosis, although it is generally accepted that the experience of EHS symptoms is of psychosomatic origin.*³

Our N.Z. Public Health site, [Te Whatu Ora](#), identifies the ICD-10-AM as one of the classification systems available to be used in New Zealand by medical practitioners to code diagnoses.⁴ Under this system, an EHS-attributed presentation is coded with a context code — W90 ("injury/illness resulting from exposure to radio-frequency radiation") — together with the relevant effect codes — G43 (migraine), R42 (dizziness and giddiness), H93.1 (tinnitus), and others as clinically appropriate.

6.2 Radio-Frequency EMFs as possibly carcinogenic to humans

In the author's opinion, an important international classification for the risk management case is the 2011 IARC **Group 2B** classification of **radiofrequency electromagnetic fields** as "**possibly carcinogenic to humans**".⁵ IARC is the cancer-research arm of the W.H.O. The classification was reached by a 30-person international working group on the basis of the Interphone study (2010)⁶ and the Hardell group's case-control studies (1999–2010)⁷, both of which reported elevated odds ratios for glioma in heavy mobile-phone users. Group 2B is the same category that IARC applies to lead, DDT, gasoline engine exhaust, and other agents whose human carcinogenicity is supported by limited epidemiological evidence and limited animal evidence. The classification has remained in force since 2011, and the April 2025 W.H.O.-backed review of animal cancer studies (Section 6.4 below) provides empirical grounds for IARC to consider an upgrade — which several authoritative bodies including the ICBE-EMF have now formally requested.

¹ (Why electrohypersensitivity and related symptoms are caused by non-ionizing man-made electromagnetic fields: An overview and medical assessment. Belpomme & Irigaray September 2022. PMID: 35537497 DOI: [10.1016/j.envres.2022.113374](https://doi.org/10.1016/j.envres.2022.113374))

² See: <https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/non-ionizing/hypersensitivity>

³ See: https://en.wikipedia.org/wiki/Electromagnetic_hypersensitivity

⁴ See: https://www.healthnz.govt.nz/about-us/data-management-and-standards/data-classification-and-clinical-coding?utm_source=chatgpt.com

⁵ International Agency for Research on Cancer. 2011. *IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans* [press release]. Lyon, France: International Agency for Research on Cancer. Available from: http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

⁶ Interphone Study. Results update. 2008. http://www.next-up.org/pdf/Interphone_IARC_Results_update.pdf

⁷ Hardell & Carlberg 2020 Stockholm 5G measurement campaign — [Aspects on the ICNIRP 2020 Guidelines on Radiofrequency Radiation](#) (World Academy of Sciences Journal).

6.3 April 2025 significant step forward by the W.H.O. on causal health dangers of man-made microwaves

The WHO-backed review, published online April 25 in Environmental International, determined radiofrequency-electromagnetic fields (RF-EMF) emitted by cell phones and other wireless devices were linked to an increased risk of malignant gliomas in the brain and malignant schwannomas, or nerve tumors, in the heart in studies on animals. Both tumor types were previously found in human studies, ICBE-EMF noted in a press release about the WHO study.

The WHO's review also concluded there is "moderate certainty" evidence that cellphone radiation exposure causes an increased risk of rare liver and adrenal gland tumors.

"The evidence is now clear — cell phone radiation can cause cancer in animals in concordance with the tumor types identified in human studies of mobile phone users. As animal studies are essential for predicting cancer risk in humans, governments should develop science-based safety standards to protect human health."

The WHO review prompted leading scientists with the ICBE-EMF on April 27 to call for "immediate policy action" to protect people from possible harm from wireless radiation exposure. "Given this high level of certainty," ICBE-EMF said in a press release, "government policymakers worldwide should immediately move to revise their RF radiation exposure limits to protect public health and the environment."

Although the above study outcome is a milestone in W.H.O. admission of "moderate certainty" that cellphone radiation exposure causes an increased risk of some cancers, it should be appreciated that the W.H.O. actually commissioned 12 systematic reviews in total, on possible harms caused by microwaves. These studies looked at a wide range of health issues, including: cancer, EHS, cognitive impairment, birth outcomes, male fertility and oxidative stress. All studies but one relied on a statistical meta-analysis of published study results – which independent evaluation has been very critical of ¹ - with only one being based on examining written outcomes of each individual study, and aggregating outcomes based on non-statistical results: a narrative review. It was this latter study that produced the above significant outcome regarding microwaves and cancers.

6.4 Very recent epidemiological study on widespread prevalence of EHS

Very recently (Vol. 8 June 26) there has been the publication (Science Direct) of a compelling epidemiological study on EHS, aka "wireless sensitivity." ² This study utilised nationally representative, population-based data, from Australia, Canada and the U.S.A. There were over 1,000 randomly selected individuals from each Country, with data collected via online surveys. The surveys were designed **not** to lead respondents to a conclusion of having EHS, or to influence them into believing that man-made microwaves (and other RF-EMFs) might be responsible. The study, with data averaged across three Countries, showed:

12.6% reported wireless sensitivity; 10.0% reported medically diagnosed electromagnetic hypersensitivity (EHS) and 14.0% reported either or both. Among all gender and age categories, males ages 25 to 34 reported the highest prevalence proportionally. In addition, among those with wireless sensitivity/EHS, 80.6% also reported chemical sensitivity/MCS, 73.2% reported asthma/ARCs, 53.8% reported autism/ASDs, and 84.8% reported fragrance sensitivity. Given these results, across the three countries, over 26 million adults would experience health problems from wireless

¹ See: [The WHO-commissioned systematic reviews on health effects of radiofrequency radiation provide no assurance of safety | Environmental Health | Full Text](#)

² [Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect](#)

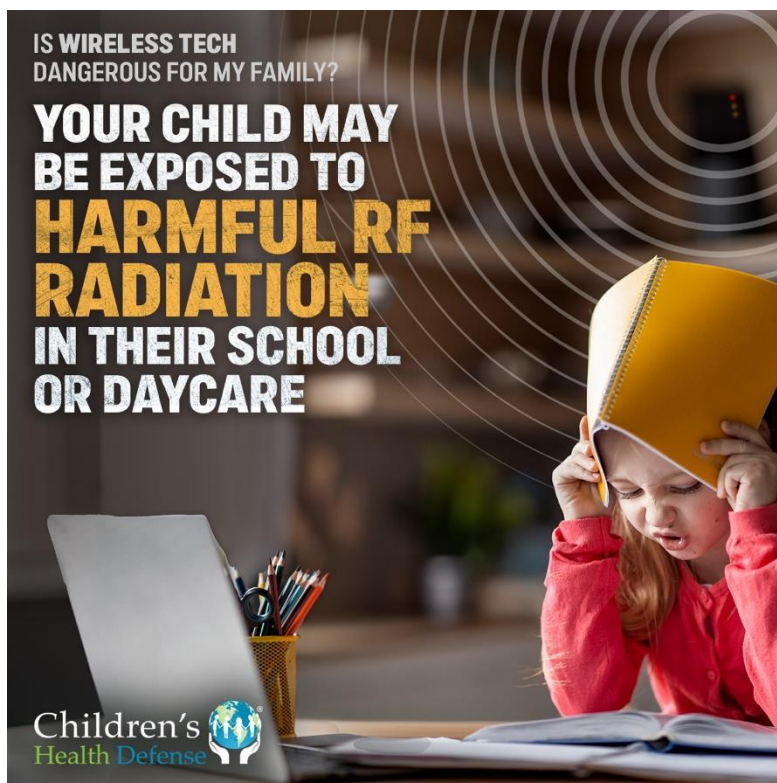
radiation. Results underscore the need for further research on ways to prevent and reduce exposures and associated adverse effects.

For unexplained reasons, Australians surveyed reported the highest incidence rate, with 1 in 6 of respondents affirming symptoms congruent with EHS, and attributed to wireless microwave exposure. The proportion in the U.S.A was 1 in 8 adults. ^{ibid}

Even though the prevalence of wireless sensitivity in this study is higher than in many previous studies in other countries, the authors believe that it could, nevertheless, **underestimate** the actual prevalence of wireless sensitivity in the population. The authors stated, "People experiencing symptoms of wireless sensitivity may not recognize wireless radiation as a possible cause." The authors additionally stated, "Medical professionals may not consider or diagnose wireless sensitivity/EHS. Further, the online format of the survey may preclude participation by individuals with wireless sensitivity/EHS." ^{ibid}

6.5 Summary of this Section

The Belpomme group's clinical and biomarker work (paragraphs above) is essentially a sustained challenge to the idiopathic (no-known-cause) part of the W.H.O.'s framing. The Belpomme group's position is that low-grade inflammation, autoantibodies against O-myelin, oxidative-stress biomarkers in 80% of patients, and cerebrovascular abnormalities on imaging do establish a measurable somatic basis for the syndrome and do support a causal connection to EMF exposure. The 2025 W.H.O.-backed review of animal cancer studies (Section 6.3) does not fully resolve the IEI-EMF causation question, but it represents partial movement in the W.H.O.'s broader RF (radio frequency band that microwaves lie within) position.



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7. Why is it Vital to Learn about Electromagnetic Hypersensitivity (EHS)?

1. Many people still believe that because we are not being told about health damage seemingly caused by man-made microwaves (MMMs), this damage may not exist. Such people (and possibly their doctors) will have no idea that chronic microwave exposure may be a key cause of at least some of their health concerns and issues.
2. Many people think that because our 5 senses can't detect MMMs, they are unlikely to be harming us. So again, such people will have little idea that chronic microwave exposure may be an important factor in their health concerns and issues.
3. Learning about EHS is vital, because apparent damaging effects of MMMs are likely to affect large numbers of people – with sufficiently intense, pervasive and chronic exposure. (See [Section 14](#) and [Section 15](#) below.) It remains unclear whether an overlapping and growing environmental toxicological burden expressed as Multiple Chemical Sensitivity (MCS), facilitates EHS or whether EHS aggravates subclinical consequences of MCS, or that they remain distinct and separate physiological challenges.
4. The information regarding the potential health risks of MMMs evident in the wider scientific literature does not appear to be currently recognised, formally rebutted or properly reflected by concerned policy makers in Government and the interested Telecommunication entities. This developing picture in NZ does not seem to represent a sufficiently full and balanced view of research outcomes over the last 20 years or more.
5. EHS is recognised by the W.H.O. as often having severe and disabling symptoms.¹ However, it currently does not accept that EMFs and their radiation – including MMMs - are a cause of such symptoms. ^{ibid} Based on the evidence presented below, in the writer's opinion it is highly likely that EHS is indeed caused by ongoing exposure to such radiation. Further, if this is actually so, it is likely that large numbers in the population are being affected by MMMs, but with the majority of these at a severity level below that accorded to EHS symptoms.

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¹ See: https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/non-ionizing/hypersensitivity?utm_source=chatgpt.com

8. Introduction to EMF Waves – including microwaves

Electric fields exist whenever charge is present and are measured in volts per metre (V/m). Magnetic fields arise from current flow. Their flux densities are measured in microtesla (μT) or millitesla (mT). At radio and microwave frequencies, electric and magnetic fields are considered together as the two components of an electromagnetic wave. Power density, measured in watts per square metre (W/m^2), describes the intensity of these fields, and this is closely associated with the heating intensity of the EMF wave. ¹

Electric and magnetic fields also occur naturally within the human body in association with nerve and muscle activity. We moreover experience the natural magnetic field of the Earth (to which a magnetic compass responds) and natural electric fields in the atmosphere. Human beings are very sensitive to these natural levels of EMFs which help to regulate and maintain the health of the body and brain. ²

The EMF spectrum embraces a vast frequency range, with radio waves (RFs) being one major segment of the full spectrum of EMF waves. (See diagram below.) This RF segment is often abbreviated to RF-EMFs. Microwaves comprise part of the RF frequency range. So cell phone towers, mobile phones, GPS and Wi-Fi, all operate using microwaves – similar in frequency to your microwave oven. The wavelength of microwaves is between 1 millimetre and 1 metre and with frequencies between 300 MHz (0.3 GHz) and 300 GHz. The higher the frequency of a wave, the shorter the wave length, and vice versa. ³

A note on terminology

This document uses "man-made microwaves" (MMMs) throughout, as a label for the physics-band electromagnetic radiation between approximately 300 MHz and 300 GHz that is now widely produced by wireless infrastructure and consumer devices. The term "microwave" in this physics-band sense is broader than its everyday association with the kitchen microwave oven — oven exposures are produced at a single frequency near 2.45 GHz at power densities many orders of magnitude higher than ambient wireless exposures, with a quite different exposure geometry. The shared name reflects shared physics rather than equivalent biological exposure: the discussion of mechanism and effect throughout this document concerns the broader physics-band, not the kitchen-oven case.

What '5G' actually is in New Zealand

All three carriers share the n78 C-band (3500 MHz) as their high-capacity 5G layer. Spark and One NZ also operate low-band 5G (n5 850 MHz and n8 900 MHz respectively) using dynamic spectrum sharing alongside their 4G traffic on conventional sector antennas. The 700 MHz band (B28) is heavily used in N.Z. but as 4G LTE only — it is not deployed for 5G. The millimetre-wave bands (24 GHz and above) often associated with 5G in international advocacy material are not deployed in N.Z. as of 2026 and are unlikely to be in the foreseeable future given population density.

N.Z. deployments have until recently been predominantly 'Non-Standalone' (NSA), meaning the 5G NR radio carries data while every connection runs over a 4G LTE 'anchor' on another band — so a phone reporting '5G' on its display is simultaneously receiving signal from a 4G band on the same site. Spark

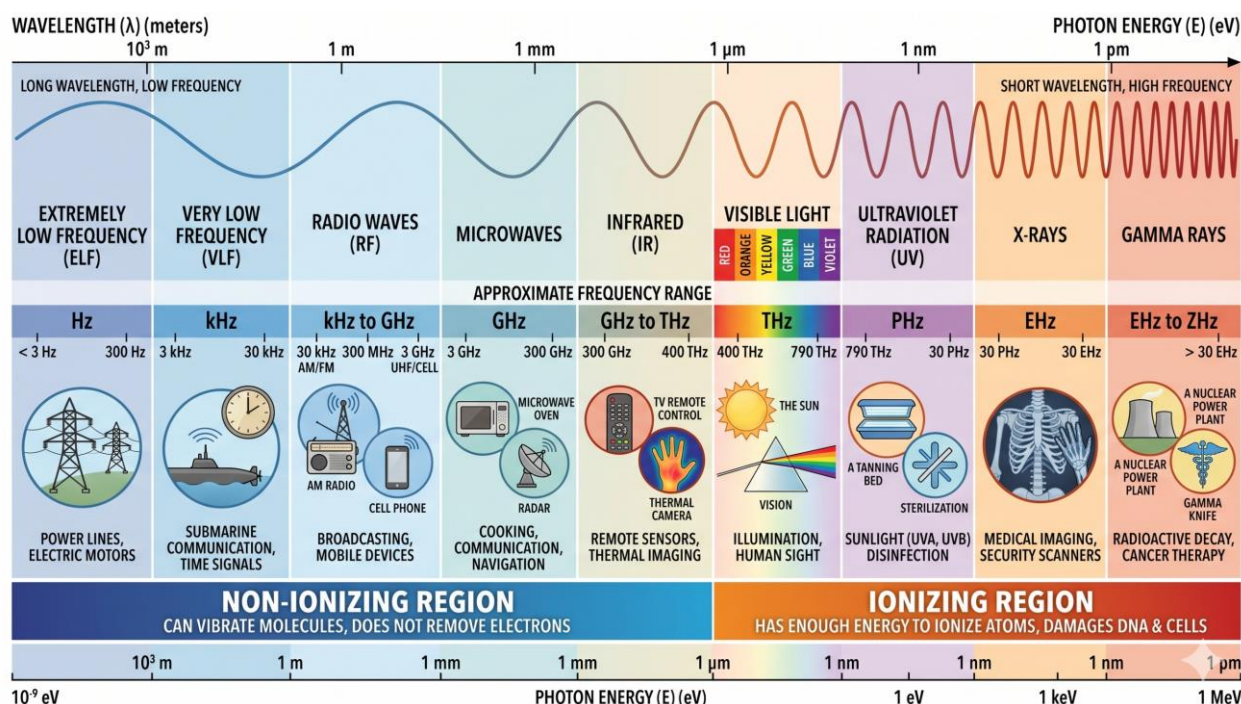
¹ See: [Radiation: Electromagnetic fields](#)

² See: [What are electric and magnetic fields? | EMFs; Resonance – Beings of Frequency – Movie.wmv](#) in [Resonance - Beings of Frequency - Movie 2016 - OneDrive](#)

³ See: [Cyberphysics: Microwave Radiation](#)

began commercial Standalone (SA) 5G rollout in 2024 with Ericsson and Red Hat (NZ\$40–60 M commitment), and is progressively migrating its network alongside the 3G shutdown that completed in March 2026. One NZ and 2Degrees remain primarily NSA as of this document's date. So 'a 5G connection' on different operators in N.Z. presently means somewhat different exposure profiles, depending on band, deployment mode, and traffic conditions.

These band-level differences matter because the exposure profile around an n78 C-band site (3.5 GHz, active phased-array antennas) differs in shape from that around a low-band n5 or n8 site (850–900 MHz, conventional sector antennas with dynamic spectrum sharing alongside 4G), and from an NSA connection where a 4G anchor is also active on a different band on the same site. Section 13 (Why MMMs are damaging) returns to these distinctions in detail, including how penetration depth, modulation patterns, and beam geometry vary across bands.



See: [232- _article1677474390.pdf](#)

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9. Cause for Confusion regarding Health Risks of Radio Frequency Electromagnetic Fields (RF-EMFs) – including man-made microwaves

Based on the author's experiences, a 15-minute Google search will find little documentary evidence regarding health damage potentially caused by RF-EMF radiation – including microwave radiation. Given that reputable websites such as www.orsaa.org hold over 5,000 published scientific papers on the subject, this apparent (Google) search engine selection bias seems self-evident.

There are clear requirements for establishing a **causal** relationship between RF-EMF exposure and subsequent health damage, with one key requirement being fulfilment of the established Criteria of Causality.¹

One of the challenges in this regard is as follows. Difficulties gaining ethical approval to experiment on human subjects, given that there is already significant concern that RF-EMFS could be damaging to health. Owing to such concerns, studies with rigorous methodology are usually animal studies – such as on rats. Human studies therefore, are usually prospective, cross-sectional, or retrospective, and can't have the same level of rigour as long-term RCT (blind or double-blind) studies on animals.

In addition to the above limitations, to establish a **causal** relationship between RF-EMF exposure and subsequent health damage, a key requirement is to demonstrate plausible pathways / processes of damage. Unfortunately, these are not simple or well-known in their function, and to identify them and describe them usually requires an advanced Degree in biophysics AND biochemistry – particularly related to human structure and function. (Or, at the least, having advanced knowledge in both areas, acquired via years of study and investigation.)

Such an advanced level of knowledge is seemingly quite rare, owing to the extensive time and money required to complete studies, and the current academic and economic Zeitgeist that funnels scientists down increasingly narrowed subfields of expertise.

Fortunately, there are (in the writer's opinion) some sufficiently qualified scientists presenting with the requisite breadth and depth of knowledge, who have been raising compelling concerns for decades. This includes the following (widely recognised) experts:

- Prof Martin Pall, Professor Emeritus of biochemistry and basic medical sciences at Washington State University, USA. He specialises in Chronic Fatigue Syndrome, Multiple Chemical Sensitivity and the effects of low-intensity microwave EMFs.
- Prof Paul Heroux of McGill University, Canada. He has a PhD in Physics and is Professor of Toxicology and Health Effects of Electromagnetism at the Faculty of Medicine.
- Prof Henry Lai of University of Washington (editor-in-chief of Electromagnetic Biology and Medicine)
- Dr (Prof) Dominique Belpomme, medical oncologist of Paris University (leads the European Cancer and Environmental Research Institute in Belgium – doing ongoing research on EHS)
- Dr Dimitris Panagopoulos of the Choremeion Research Lab, Medical School, University of Athens, Greece

¹ See: <https://www.acsh.org/news/2017/10/31/acsh-explains-hills-criteria-determining-causality-correlation-12013>

- Dr Magda Havas, Associate Professor of Environmental & Resource Studies at Trent University, Canada (She has served as an expert witness to the Canadian and US Governments on the health effects associated with EMF exposure.)
- Dr Devra Davis, a leading cancer epidemiologist and toxicologist, and founder and president of the Environmental Health Trust
- Dr Julie McCredden, PhD in Cognitive Science. (Over the last decade, she has been investigating the effects of EMFs on humans, particularly cognitive and emotional processes.) She is President of the Oceania Radiofrequency Scientific Advisory Association – ORSAA - Australia.
- Mr Victor Leach, radiation health physicist and atmospheric scientist for more than 40 years. Founding member of ORSAA. Former University Radiation Advisor at Queensland University of Technology and the University of Queensland, former member of the Radiation Laboratory, and QLD and NT State Health Departments.



Prof. Martin L Pall, Washington State University



Prof. Dominique Belpomme, Paris University

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10. Sources of Information on Likely Dangers of RF-EMFs – including man-made microwaves

1. Articles, papers or talks given by the above scientists and medical experts – such as on PubMed ([PubMed](#)) or YouTube. For example, see the excellent ORSAA paper titled, *“Wireless technology is an environmental stressor requiring new understanding and approaches in health care”*. This detailed paper is specifically designed to bring health professionals up to speed regarding known health impacts of this technology.¹
2. The International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF). This was founded as a result of the International EMF Scientist Appeal (<https://www.emfscientist.org/>), signed by many thousands of scientists, medical practitioners (etc.). ICBE-EMF have collectively published over 2,000 papers on EMF, biology and health. The Commission's primary purpose is to make international recommendations based on the best peer-reviewed scientific publications.
3. The Australasian non-profit Oceanic Radiofrequency Scientific Advisory Association (ORSAA), already referenced in “1” above. (See their Website www.orsaa.org.) ORSAA endeavours to curate only reasonable quality, peer-reviewed studies and has the largest database of its kind in the world. (The database is referred to as the ODEB database and contains thousands of published scientific studies.) ODEB allows for searches using multiple filters, including Exposure, Study Categories, Effects Categories and Study Statistics. See for example, *“Wireless technology is an environmental stressor requiring new understanding & approaches in health care”* McCredde et al. (2022)²
4. The excellent Website run by Dr Erica Mallory-Blythe in the U.K. Her Website <https://phiremedical.org/> has many expert resources for medical practitioners and patients, particularly on EHS and the numerous ways in which MMMs can impact on health. Her Website also details Court cases won by people suffering from EHS.
5. The excellent in-depth book (or e-book) by the internationally recognised health expert, Dr Joseph Mercola, *“EMF*D”: EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself : Mercola, Joseph: Amazon.com.au: Books* (If enquiring into Dr Mercola's work and reputation, please **don't** rely solely on Government-regulated mass media, a Google search, or websites such as Wikipedia.)
6. SaferTech NZ: <https://www.safertechnz.co.nz/>
7. The Environmental Health Trust: www.ehtrust.org
8. Physicians for Safe Technology: <https://mdsafetech.org>

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¹ See: [Frontiers | Wireless technology is an environmental stressor requiring new understanding and approaches in health care](#); and my OneDrive folder, [Papers on EHS & Effects of RF-EMFs](#)

² [Frontiers | Wireless technology is an environmental stressor requiring new understanding and approaches in health care](#)

11. What are the EMF Frequencies considered of Most Concern to Health?

As per the diagram in [Section 8](#), microwaves are electromagnetic radiation between the frequency of 300 MHz and 300 GHz. They are a major segment of the larger EMF band called Radio-frequency EMFs (RF-EMFs).

Many people are not aware that modern microwave transmissions carry information not as a smooth continuous wave but as bursts of microwave energy that switch on and off at characteristic low rates determined by the protocol. The microwave carrier itself sits in the GHz range, but the *envelope* of the signal — how its intensity varies in time — contains components at much lower frequencies, often falling within the Extremely Low Frequency (ELF) band. A growing body of research suggests these ELF-range envelope features may be biologically more relevant than the carrier frequency alone — that is, that the time-domain *pattern of pulsation* matters, not just the average power or the GHz-range frequency in isolation. (See [Section 14.1](#) below for a detailed discussion)

Health symptoms and apparent damage from microwaves were first noticed *en masse* during World War 2, when radar operators on ships came down with seemingly inexplicable neurological and mental health symptoms. These effects were effectively covered up by Navies as it was an inconvenience that could get in the way of winning the war. ¹

In 1977, investigative science journalist Paul Brodeur published the book, *"The Zapping of America: Microwaves, Their Deadly Risk, and the cover-up."* ^{ibid}

Industry-internal concerns about handset RF exposure emerged in the late 1990s. As BBC News reported in 2001, Nokia, Ericsson and Motorola had filed multiple patents from 1993 onwards for shielding technology designed to reduce the radiation absorbed by the user. Two Nokia patent applications, from 1995 and 1998, contained the explicit acknowledgement that "in the worst case, it has been suggested that malignant tumours could develop" — language difficult to reconcile with the industry's contemporaneous public position that no health concerns have been established. ²

The Moscow Signal exposure (1970s and 1980s)

During the 1970s and 1980s, there was the ongoing alleged Russian microwave attack on the US Embassy in Russia – and on other Embassies such as the Canadian and U.K. Embassies. Officials from the Embassies used a spectrum analyser to measure the microwave beams. Reported carrier frequencies in the declassified record fall in roughly the 2.5–4 GHz range. The signal's average power density at the Embassy is now generally placed in the region of 5 $\mu\text{W}/\text{cm}^2$ - substantial for sustained close exposure but well below contemporary safety limits, and orders of magnitude below earlier popular figures of around 10 mW/cm^2 . This signal is now usually referred to in the literature as the "Moscow Signal", and was the subject of the Johns Hopkins / Lilienfeld Foreign Service Health Status Study (contracted 1976, final report 1978), commissioned by the U.S. State Department, which compared health outcomes among Moscow embassy staff with control populations from comparable postings in Eastern Europe. ³

¹ Brodeur P (1977), 'The Zapping of America: Microwaves, Their Deadly Risk, and the Cover-up', W.W. Norton.

² BBC News (25 July 2001) — '[Mobile firms patent "brain shields"](#)'. The referenced 1998 Nokia application corresponds to [US Patent 6,088,579A](#) (granted 2000), specifying a shielding layer "between the antenna means and the user."

³ See: <https://pmc.ncbi.nlm.nih.gov/articles/PMC3509929>

The original report's headline finding was that no clear excess in cancer mortality was demonstrated, but elevated rates of several morbidity outcomes were observed; later reanalysis by Goldsmith (1995, 1997) argued the original report had under-reported some of the harm signals it documented. The source of these signals was never established, and long-term health consequences not followed up. However, there was high consistency in terms of the characteristics of the microwave radiation, and the abnormal symptoms reported by numerous staff in each Embassy. ¹

The Moscow Signal exposure put in the current-day context

The average power density measured at the U.S. Embassy is approximately 200× below current ICNIRP and FCC public-exposure limits, which sit near 1 mW/cm² in the 2–3 GHz range relevant to the Embassy's reported carrier frequencies. It is, however, in the same order of magnitude as ambient far-field exposures measured in publicly accessible areas around modern macro cell sites — median European measurements are around 1% of the ICNIRP limit (~10 µW/cm²), with peaks under 8% (~80 µW/cm²) per the systematic review by Sagar and colleagues of European personal-exposure measurements. ² For most members of the public the comparison is partial, because residents move during the day, change rooms at night, and leave the house, varying their position relative to dominant sources. The Moscow embassy staff did not have that mobility — they sat in the same offices, day after day, year after year, with sustained directional illumination from a single source.

Currently, multiple populations are receiving sustained directional RF radiation from a single source that is very similar to the Moscow signal exposure - though with the modern variable duty cycle and multiple bands, present-day exposures are likely to be more impactful. For example, a person spending twelve or more hours a day at a fixed location a few hundred metres from the panel antenna of a cell phone base station, a person working at home using Wi-Fi for connection, an elderly resident in a fixed chair near a smart-home Wi-Fi router, or an infant sleeping in a cot a few metres from that same router. The risk management recommendations of this document ([Section 17](#)) explicitly account for these populations.

The Cuban Havana Signal exposure

Between 2016 and 2018, a number of officials at the U.S. and Canadian Embassies in Havana, Cuba became unwell, with symptoms reminiscent of those reported during the Moscow Signal years. These effects were dubbed “Havana Syndrome”. More than 130 U.S. diplomats, intelligence officers, and their family members reported experiencing headaches, ear pain, dizziness, fatigue, cognitive issues, and difficulty sleeping. Some attributed these symptoms to a targeted attack using directed, pulsed electromagnetic energy or microwaves. A 2020 report by the U.S. National Academies of Sciences, Engineering, and Medicine concluded that “many of the distinctive and acute signs, symptoms and observations reported by [affected personnel]... are consistent with the effects of directed, pulsed radio frequency (RF) energy.” The U.S. Government has never released details of any measured microwave signal or its source, so the technical record of the alleged exposure remains incomplete. ³

¹ Goldsmith 1995 - [Epidemiologic evidence relevant to radar \(microwave\) effects](#) (Environmental Health Perspectives). Reviews the [Lilienfeld 1978 Moscow embassy study](#) (Foreign Service Health Status Study, Johns Hopkins).

² Sagar et al. 2018 — [RF EMF exposure in everyday microenvironments in Europe: A systematic literature review](#) (J. Exposure Science & Environmental Epidemiology). Median measured exposure around macro cell sites ≈ 1% of the ICNIRP public limit, peaks under 8%.

³ ODNI March 2023 — [Updated Assessment of Anomalous Health Incidents](#) (unclassified summary). Pierpaoli et al. 2024 — [Neuroimaging Findings](#) and Chan et al. 2024 — [Clinical and Biomarker Tests](#) in US Government personnel (JAMA).

Dr David Relman's two expert panels for the U.S. Government (referenced below) continued to conclude that "pulsed electromagnetic energy" was the most plausible explanation for a *subset* of cases, and the 2024 imaging studies do not address whether episodic RF exposure could produce transient neurological symptoms without leaving structural damage detectable months or years later. For the risk management argument of this document, the 1976 Lilienfeld study ¹, and the modern peer-reviewed RF biology literature does show that pulsed and sustained microwave exposure can produce measurable neurological effects under the right conditions.

Recently, in a CBS 60 Minute interview (8 Mar 26), two CIA whistle blowers stated that "Havana Syndrome" – and subsequent similar events - had more than likely been caused by man-made microwave radiation. Further, that a portable device of such capability (of Russian origin), is now in the possession of the Dept. of Homeland Security. They explained that pulsed microwave energy can cause havoc, including headaches, severe pain, cognitive dysfunction, disorientation, seizures, and loss of consciousness. Further, on medical examination, those who suffered such attacks very often demonstrated structural damage to the brain, heart, nervous system, muscles and bones. ²

In summary, thousands of published research studies outlining the very likely damaging effects of man-made microwaves exist. This research has been ongoing since World War 2, but has burgeoned considerably over the last twenty years. ³

Besides research on the likely damaging effects of man-made **microwaves** on humans, RF-EMFs that are outside the microwave band have also been researched, as have ELF's. Both these EMF bands appear to fairly consistently show predictable harms linked to exposure ⁴ – with the explanatory Panagopoulos *et al.* model discussed in detail in **Section 14.1** below. ⁵

¹ [Lilienfeld 1978 Moscow embassy study](#) (Foreign Service Health Status Study, Johns Hopkins

² <https://www.cbsnews.com/news/us-military-tested-device-that-may-be-tied-to-havana-syndrome-60-minutes-transcript/> and <https://www.saferemr.com/2021/11/the-havana-syndrome.html>

³ Belpomme et al. 2018 — [Thermal and non-thermal health effects of low intensity non-ionizing radiation](#) (Environmental Pollution); McCredden et al. 2022 — [Wireless technology is an environmental stressor](#) (Frontiers in Public Health).

⁴ See: Firstenberg A 2017 - The Invisible Rainbow: A History of Electricity and Life. Santa Fe and Sucre: AGB Press. ISBN 978-0-692-68301-9 (HB)

⁵ IARC Monograph Vol 102 (2013); Hardell & Carlberg 2020 — [Health risks from RF radiation including 5G should be assessed by experts with no conflicts of interest](#) (Oncology Letters); and Panagopoulos DJ, Yakymenko I, De Iulii GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441.



4G mobile cell tower outside homes (Onerahi, Whangārei) – photo by author

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12. Man-Made Microwave Dangers: with thousands of studies, why a seeming absence of interest from Media & from Governments?

12.1 Opening note

The intention of this discussion is **not** to impugn individuals or agencies, but to emphasise the importance of governance structures, advisory processes, and regulatory standards that are demonstrably comprehensive, independent, and fully aligned with the protection of public health. Given the potential scale of exposure to MMMs and the genuine possibility of long-term effects, continued scrutiny and transparent reassessment of safety standards remain both reasonable and necessary.

12.2 Governance, expertise, independence and current procedures

A frequently cited viewpoint in this field, is that advisory committees on technical risk, benefit from breadth of expertise across the disciplines relevant to their remit, from independence of their composition from the industries whose standards they set, and from periodic external review of that composition. ¹ A concern arising from this viewpoint is that current advisory bodies may include members drawn directly from industries that the committee's recommendations regulate, that the disciplines required to assess complex bio-electromagnetic health risks may be insufficiently represented on the relevant panels, and that potential conflicts of interest may arise. ²

12.2.1 Composition of the New Zealand Advisory Committee, ICHEF

Based on a May 2026 OIA response and publicly available information, ICHEF is comprised of a total of 26 members including 2 observers from ARPANSA, Australia. ARPANSA is the Australian Government's lead authority for radiation protection and nuclear safety. It is charged with safeguarding the public, workers and environment from the harmful effects of ionising and non-ionising radiation – through regulation, research and public education. ³

- Two members come from industries that the Committee's recommendations regulate, including telecommunications. (One of these – discussed below in 10.2.2 - does contracting work for both the Government and the telecommunications industry.)
- The Ministry of Business, Innovation & Employment has five representatives.

Given this Committee's Terms of Reference ⁴, it is very unclear to the writer why MBIE would need to have **five** representatives on ICHEF. Unfortunately, the high numbers from MBIE could provide the impression that an undue focus of ICHEF work is promoting the promulgation of wireless technologies for business purposes.

12.2.2 Does the current composition of ICHEF provide sufficient expertise to enable it to fulfil the key role of adequate emissions safety standards?

Among the Committee members, one individual appears to hold advanced qualifications in physics and medical physics and operates a private consultancy that provides electromagnetic field (EMF)

¹ See for example: See: https://www.orsaa.org/uploads/6/7/7/9/67791943/arpansa-who_is_misleading_who.pdf

² See: https://www.orsaa.org/uploads/6/7/7/9/67791943/arpansa-who_is_misleading_who.pdf

³ See: www.arpansa.gov.au

⁴ See: <https://www.health.govt.nz/system/files/2022-06/interagency-committee-health-effects-non-ionising-fields-report-ministers-2022-jun22.pdf> (Appendix G)

services to government agencies, telecommunications companies, and related infrastructure providers. While this individual has publicly acknowledged the possibility of conflicts of interest and has outlined strategies for managing them, as a generic governance issue, it is reasonable to question whether such arrangements can adequately reassure the public and maintain public confidence. This is particularly when the potential health impacts of chronic microwave exposure appear to be initially subtle, cumulative, and increasingly severe over the longer-term. (See **Section 14** and **Section 15** below.)

The two observers from ARPANSA (Australia) both appear to hold advanced scientific expertise that is pertinent to the tasked duties of ICHEF. This includes expertise in RF-EMFs of mobile phones, Wi-Fi, 5G and broadcast transmitters. However, some researchers – including at ORSAA Australia – have stated that ARPANSA is not a fully independent body, as it apparently receives some of its funding from the wireless industry via the Australian Communications and Media Authority (ACMA) funds. ¹ ACMA is tasked with helping to maximise the economic and social benefits of communications infrastructure, services and content in Australia. ² ARPANSA continues to deny any lack of independence, and any industry influence.

12.2.3 Is ICHEF reviewing the full range of relevant published research?

ICHEF's apparent practice — like that of analogous advisory committees in other jurisdictions — has been to anchor its recommendations on reviews published by major national and international health and scientific bodies, particularly I.C.N.I.R.P. ³ and the W.H.O.'s International EMF Project. ⁴ However, when considering the extensive body of experimental and observational research reporting apparent biological effects at exposure levels below current standards — including the large curated ORSAA database — a substantial discrepancy appears to exist between prevailing safety standards and the broader, research literature covering the last two decades. ⁵ This discrepancy is not best understood as a personal-incentives issue; rather, it appears to reflect the methodological choice to ground recommendations in the reviewed-by-major-bodies literature, rather than in the broader peer-reviewed literature. This methodological choice, and whether it is producing recommendations that adequately reflect current evidence – and sufficiently protect the public – is the appropriate subject of review.

12.2.4 Need for an urgent review of the comprehensiveness of ICHEF expertise and its procedures

Based on multiple concerns raised in this Section (and in **Section 14** and **Section 15** below), it would be reassuring for the writer (and others with similar concerns such as Physicians and Scientists for Global Responsibility, NZ ⁶) if Government commissioned an independent review of ICHEF's composition against the disciplines directly relevant to its remit. In the author's opinion, disciplines vital to adequate assessment of MMM biological and medical effects include — but are not limited to: human biophysics, medical physics, human biochemistry, human neurology, psychology, RF engineering, dosimetry, occupational health, environmental health, paediatrics, and building biology/EMF

¹ See: https://www.orsaa.org/uploads/6/7/7/9/67791943/arpansa-who_is_misleading_who.pdf

² See: <https://www.acma.gov.au>

³ See: PSGR NZ recent Substack article - The EMF Problem: RF Radiation Governance Without Democratic Risk Assessment, <https://psgrnz.substack.com/p/the-emf-problem-rf-radiation-governance>

⁴ See: <https://www.who.int/initiatives/the-international-emf-project>

⁵ Especially research supporting a likely casual link between man-made microwave exposure and subsequent health damage – as presented in this monograph

⁶ See: [EMF Sensitive? You May Not Be the Outlier You Think You Are](#)

remediation. While some of these fields of expertise are already represented on ICHEF, many of these fields of expertise appear to be absent.

So as to avoid the body assessing its own composition the review should be conducted by an independent body — for example, a panel convened by the Royal Society Te Apārangi, or by an analogous independent academy — rather than by ICHEF itself. To add to the prestige and expertise level of such a review body, the writer recommends the inclusion of two or more members from the list of independent experts denoted in [Section 9](#) above. So the review's purpose would be to test whether the disciplines represented are sufficient for the complexity of the Committee's task, and to recommend additions or substitutions on the basis of disciplinary need - rather than on the basis of position pre-selection. (If review outcomes indicate the need for the addition of more areas of expertise, the author recommends appointing two or more of the same independent experts to ICHEF.)

In the opinion of the author, there is clearly an **ongoing duty of care** for this Committee and for Government, with respect to public awareness and education, in this vital and ubiquitous field of public health.

The kind of structured public communication discussed above — which is increasingly standard for technical advisory bodies in comparable jurisdictions ¹ — would shift the framing of public engagement from “why has so little been communicated?” to, “here is the basis for the Committee's recommendations, and here is how to engage further.”

12.3 Repeated warnings from researchers and citizens

Numerous prominent scientists and researchers in this field report that they have repeatedly raised concerns with their own governments and others about potential health risks associated with wireless technologies, but report that these submissions have not resulted in substantive policy change. Examples include researchers affiliated with the Environmental Health Trust, ICBE-EMF, ORSAA, and several universities in North America and Europe. In parallel, large numbers of citizens — including in Australia — have made formal submissions and informational requests, with limited substantive response. ²

In addition, there are many thousands of signatures to an international appeal calling for a moratorium on the rollout of 5G until potential hazards are fully investigated. Signatories include thousands of scientists, engineers, medical doctors, other health professionals (such as dentists, pharmacists and psychologists) and thousands of related health agencies. ³ They cite research which they state shows harmful effects, including increased cancer risk, infertility, and neurological disorders.

12.4 Research funding asymmetries

Rigorous experimental and epidemiological research in this area is expensive, and researchers report that funding for studies investigating potential harms is difficult to obtain

¹ See: OECD (2021). *Governance of Regulators: Practices and Challenges*. OECD Publishing.
<https://www.oecd.org/gov/regulatory-policy/>

² See: [Why has there been no public consultation or appropriate risk assessment of 5G before the rollout in NZ? - a Official Information Act request to Jacinda Ardern - FYI](#) ; and [FOI 23-140 - Documents.pdf](#)

³ See: [5G Space Appeal | International Call to Halt 5G Deployment on Earth & in Space](#)

from governments or commercial sources.¹ Conversely, there appears to be comparatively greater availability of funding for research that supports the safety of existing technologies and exposure limits. This pattern is consistent with broader literature on industry influence over research agendas. ^{ibid}

12.5 Methodological challenges and weight of evidence

Due to acknowledged investigative and methodological challenges, research outcomes in this field vary, and synthesis across studies is complex. Nonetheless, when findings from animal studies, human observational studies, and laboratory research across physics, biology, physiology, medicine, psychology, and occupational health are considered together, a substantial and reasonably coherent body of evidence emerges that supports the legitimacy of major ongoing concern.² In the opinion of the writer, this breadth and depth of evidence supporting probable harm, warrants careful, risk management consideration and effective action, rather than dismissal.

12.6 Additional risks for children

It has been long-known that children are more at risk from exposure to MMMs, owing to thinner skulls, more water in their brains, and a higher ion content - in their brains.³ These differing biological characteristics are estimated to cause twice the radiation absorption in their brains, and 10 times the radiation absorbed by their skulls.⁴ Further, as children are likely to be exposed to increasing levels of MMMs and for their entire lives, the accumulating risks they will face go very far beyond risks to someone already in middle-age or adulthood.

¹ See: [Research on Industry Influence on EMF - Environmental Health Trust](#) and [The Influence of Industry Sponsorship on the Research Agenda: A Scoping Review - PMC](#)

² Belpomme D, Hardell L, Belyaev I, Burgio E, Carpenter DO (2018), 'Thermal and non-thermal health effects of low intensity non-ionizing radiation: an international perspective,' *Environmental Pollution* 242(Pt A):643–658; McCredden JE et al. (2022), *Frontiers in Public Health* 10:986315.

³ See: <https://pubmed.ncbi.nlm.nih.gov/23705297/>

⁴ See: <https://pubmed.ncbi.nlm.nih.gov/21999884/>



5G cell tower outside residences and about 80 meters from Whau Valley School (Kamo Rd, Whangārei) – photo by author

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13. Why Man-Made Microwaves can apparently be so damaging – even at non-heating (non-ionising) levels

Introductory Note

Please refer to the unabridged document for a fuller elaboration of these pathways, plus multiple additional pathways unable to be covered here – owing to brevity requirements.

1. MMMs are erratic and chaotic in their pulsing, with natural microwaves (NMs) being a continuous, regular “stream”. Therefore, MMMs are far more disruptive to human cellular biophysics and biochemistry – that require predictability to function.¹
2. NMs are natural sine-waves in their promulgation, whereas the (usually employed) low frequency modulation carrier waves for MMM's, are more disruptive biologically.² The apparent systemic negative effects of Extremely Low Frequency (ELF) waves have been thoroughly investigated by Panagopoulos and colleagues, who have explained in great biophysical detail how ion gates at cell walls throughout the body can be readily perturbed and dysregulated by such ELF's. This results in a chain reaction of massive influx of ions into the cells, chaotic cell and organ function, a rapid build-up of reactive oxygen species, early cell death, etc.³ (See Section 14.1 below for a more detailed discussion.)
3. MMMs appear to disrupt and overwhelm the essential micro-current communications within and between cells.⁴
4. Human bodies evolved to be able to tolerate low power density NMs. With MMMs we are continually exposed to more and more frequencies at high power densities, that the human body has never before encountered, and likely has little or no adaptive capacity to respond.⁵
5. Modern wireless protocols transmit information not as a smooth wave but as bursts of microwave energy that switch on and off in characteristic patterns. The microwave carrier itself sits in the MHz–GHz range. Within each burst, the microwave is modulated with subcarriers in the kilohertz range (LTE uses 15 kHz subcarriers; 5G New Radio scales from 15 kHz up to 240 kHz; Wi-Fi OFDM uses 312.5 kHz). The boundaries between bursts and frames produce envelope variations at much lower frequencies — millisecond timescales for LTE subframes, hundreds of milliseconds for Wi-Fi beacons. These low-frequency envelope components fall in or near the Extremely Low Frequency (ELF) band, and there is reasonable evidence that ELF-range biological effects can occur from this envelope content even when the GHz carrier is well below thermal damage thresholds.⁶

¹ [Electromagnetic Fields: Health Effects & Mechanism of Action - YouTube](#); and [Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity | Scientific Reports](#)

² See Dr P Heroux interview, [EMF Hazards Summit - The EMF Guy](#) 48hrs free viewing ; and Panagopoulos et al. 2025, . Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

³ See: Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

⁴ See Dr P Heroux interview [EMF Hazards Summit - The EMF Guy](#) 48hrs free viewing; and [Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity | Scientific Reports](#)

⁵ See Dr P Heroux interview [EMF Hazards Summit - The EMF Guy](#) 48hrs free viewing; and [Man-made-and-Natural-EMF-EMR-Dr.Leendert-Vries.pdf](#)

⁶ [Electromagnetic Fields: Health Effects & Mechanism of Action - YouTube](#); and [Health Freedom Event - Victor Leach](#) ; and Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

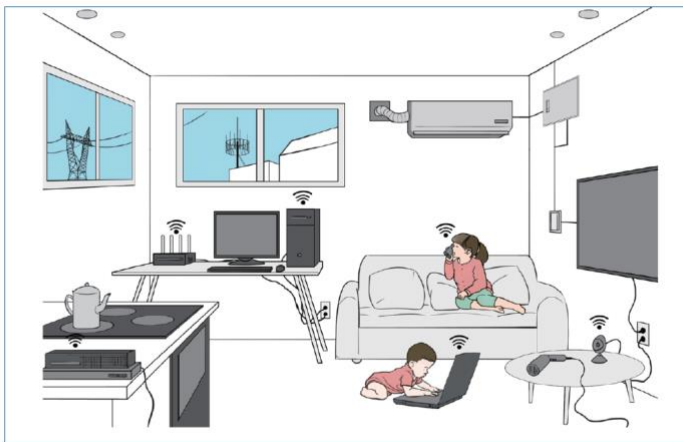
6. Different generations of mobile technology produce different exposure profiles, and the changes are not simply a matter of “higher frequency = more harm.” At microwave frequencies, the per-photon energy of any individual photon is far below the threshold for ionising chemistry and lacks sufficient photon energy to directly break covalent bonds. Proposed non-thermal mechanisms for non-thermal bioeffects are factors such as time-averaged and peak power density, the time-domain modulation pattern, and beam directionality.
7. With higher carrier frequencies, penetration depth in living tissue actually decreases — sub-6 GHz 5G bands penetrate similarly to 4G, while the millimetre-wave 5G bands (24–40 GHz and above) are absorbed within a few millimetres of the skin surface. ¹ The exposed organ profile therefore shifts toward skin, cornea, and superficial tissue – including peripheral nerves below the skin - and away from deep organs such as the brain. This is a different concern profile from the 4G profile, and the risk management issues are correspondingly different. For example, possible harmful 5G effects include on the eyes, skin biology, potential negative feedback effects of affected cutaneous / subcutaneous peripheral nerves on the central nervous system, and the contested sweat-duct antenna effects. ^{ibid} (See [Section 14.4](#) point 2 for further research study citations.)
8. Accepting the differing penetration depths of 4G c.f. 5G, nevertheless, current 5G transmission systems continue to rely on simultaneous transmission of the 4G microwave band, ² with the 4G link handling all signalling, handover management, and session control. ^{ibid} So, all the potential health concerns arising from 4G exposure will not go away with the establishment of 5G systems. Further, as far as the author is aware, there have been no quality studies examining the **combined** effects of 4G and 5G microwave radiation on the human body. And, with the recent deployment of 5G technology, it is impossible to know the mid-to-long-term effects on health.
9. A key geophysical change matters directly to most public exposure: with higher frequencies, transmission range falls off rapidly, requiring cell towers and small cells to be deployed in closer and closer proximity to one another, and to people’s homes. ³

¹ See: <https://www.nature.com/articles/s41370-021-00297-6> ; <https://pmc.ncbi.nlm.nih.gov/articles/PMC8300848> ; and <https://pmc.ncbi.nlm.nih.gov/articles/PMC8300848> and [The human skin as a sub-THz receiver – Does 5G pose a danger to it or not? by Noa Betzalel, Paul Ben Ishai and Yuri Feldman](#)

² See: “NR and LTE Coexistence Through Dynamic Spectrum Sharing” — Microwave Journal, December 2019, <https://www.microwavejournal.com/articles/33239-nr-and-lte-coexistence-through-dynamic-spectrum-sharing>

³ See: [The human skin as a sub-THz receiver – Does 5G pose a danger to it or not? by Noa Betzalel, Paul Ben Ishai and Yuri Feldman](#) ; [Overview of Millimeter Wave Communications for Fifth-Generation \(5G\) Wireless Networks-with a focus on Propagation Models by Theodore S. Rappaport et al.](#) ; and [Antennas for Body Centric Wireless Communications at Millimeter Waves by Nacer Chahat et al.](#)

EMFs in the home



Source: Moon 2020

ELF: Low frequency magnetic/ electric fields
Electronics, wiring, induction cooking, electric car, powerbox, power lines, MP battery, pulsing in phone signals

RF higher frequency electric fields / radiation
MP, MP tower, laptop, modem, baby monitor, smartwatch / fitbit, printer, speakers, smart x

Some common sources of EMF radiation in the home

13.1 Exacting German research shows damage to chromosomes from long-term cell tower exposure – when living within 160 metres to the closest tower

Despite the somewhat reassuring explanation in the above paragraphs which compared cell tower and cell phone exposure levels, important German-based research (2024) looked at whether or not living close to a cell tower might cause measurable health damage. Researchers meticulously analysed a huge range of health variables based on varying exposure levels to residential base cell towers. The study published in July 2024 compared those who lived in close proximity to mobile base towers (for 5 years or longer) with those who were significantly further away – again for 5 years or more in that area.¹ The Western European scientists conducting this research were all eminent in their fields. ^{ibid} The subject groups were drawn from neighbouring residential areas in Germany and all subjects reported being in good health.

The study was initiated to assess whether **non-thermal** (non-ionising) exposure levels over a long time period could damage individuals' health. Subjects were matched for possible confounders such as age, sex, nutrition, medical history, medication intake, life-exposure to ionizing radiation (X-Rays, CT scans etc.), occupational RF-EMF exposure, etc. All of the group that lived more distantly from the nearest cell tower were at least 490 metres from that tower and averaged 767 metres. The high exposure group was within at least 160 metres of the nearest tower, with average distance being 125 metres.

Research results showed that the close-proximity group had significantly more chromosomal aberrations such as dicentric chromosomes ($p=0.007$), chromosomal fragments ($p<0.001$) and the total chromosomal aberrations were very significantly higher at $p<0.001$. So, the rate of chromosomal damage reflected exposure intensity and "no potential confounder interfered with

¹ See: <https://www.sciencedirect.com/science/article/pii/S0147651324005621?via%3Dihub> ; and documentary made by these researchers at: <https://www.orsaa.org/exposure-mp-tower-video.html>

these findings.” ^{ibid} Further, the level of chromosomal damage in the high-exposure group was nearly double that of the low-exposure group. ^{ibid} Researchers concluded that these important differences between the two groups “point to the MPBS [Mobile Phone Base Station] signals (GSM, LTE) as cause of the observed genetic instability. Thus, our findings on chromosomal aberrations may provide a biologically plausible mechanism for the data on significantly increased risk of cancer among persons exposed to MPBS signals.” ¹ That is, as a possible result from living much closer to mobile base stations – or other RF-EMF transmission sources. ²

After consultation with the International Atomic Energy Agency (IAEA), researchers were informed that the chromosomal damage that the high-exposure group appeared to experience from non-ionising cell tower microwaves, was identical to chromosomal damage caused by **ionising** radiation – such as from exposure to atomic radiation, or multiple exposures to X-Rays. In other words, contrary to theoretical expectations, the human chromosomes “didn’t care” whether the radiation was ionising or non-ionising. ³ (The authors postulated that although end-result damage was the same, it was likely that different biological pathways were involved in producing this non-ionising outcome.)

So, despite the supposedly safe levels of cell tower microwave radiation – and the low intensity of such microwave power compared to handset use - those who had lived nearby for 5 years or more, were apparently experiencing significant health damage as a result. While subject numbers were low (12 in each group) the selection process for each subject was highly rigorous, eliminating all known confounding variables and ensuring that the two groups were as matched as humanly possible. Also, it is a well-accepted fact of statistical analysis that when comparing group outcomes, the smaller the number of subjects, the harder it is to achieve a statistically significant result. So, this makes such large statistical differences even more remarkable and concerning. In the opinion of the writer, given all the methodological constraints of human experimentation in the field of RF-EMFs, this was about as rigorous an outcome as would be scientifically (and pragmatically) possible.

¹ See Gulati et al. 2024, <https://www.sciencedirect.com/science/article/pii/S0147651324005621?via%3Dihub>

² See: Li et al., 2012, [A population-based case-control study of radiofrequency exposure in relation to childhood neoplasm - ScienceDirect](#) ; Eger et al. 2004, "The Influence of being Physically near to a Cell Phone Transmission Mast on the Incidence of cancer, Published in Umwelt-Medizin." <https://alliance4mra.org/wp-content/uploads/2021/05/37-increased-incidence-of-cancer-near-a-cell-phone-transmitter-station.pdf> ; Rodrigues et al. 2021, <https://www.mdpi.com/1660-4601/18/3/1229>

³ See documentary made by these researchers at: <https://www.orsaa.org/exposure-mp-tower-video.html>



*Kamo (Whangārei) – large (macro-cell) 4G-5G mobile tower less than 40 metres from residential housing –
photo by author*

[RETURN TO CONTENTS PAGE](#)

14. Apparent Pathways / Mechanisms of Harm by Man-Made Microwaves – on bodily structure and function

Introductory Note

Please refer to the unabridged monograph for a fuller elaboration of these pathways.

All statements in the bullet-points below with casual-sounding language are to be read as the writer's opinion and interpretation, with acknowledgement that this is not settled science and that current Government regulations are not in agreement with at least some of these statements.

14.1 Apparent direct biophysical mechanisms

1. Calcium-influx with an oxidative cascade; and the Ion Forced Oscillation Model:

Professor Martin Pall (Washington State University) has argued, in a widely cited line of work, that coherent MMMs at non-heating levels can disrupt the cellular potential difference, causing an abnormal influx of calcium ions through voltage-gated calcium channels (VGCCs) in the cell membrane.¹

Regarding **Pall's model**, the downstream chain — calcium overload triggering oxidative and nitrosative stress, with peroxynitrite as a particularly damaging end product — is independently well-supported as is the link to many of the secondary mechanisms described later in this Section.² Excess intracellular calcium is also directly toxic to the cell. *ibid*

However, cellular function encompasses not just calcium ion regulation (through the calcium channels/gates), but the wider voltage-gated channel family of sodium, potassium and chloride.³ These all share the same voltage-sensing protein architecture namely the **S4 voltage-sensing segment**. With the myriad of free mobile ions on the outside of cell walls, as per Coulomb's Law, the irregular oscillating force of the applied electric field will cause these ions to oscillate unnaturally, in harmony with the external EMF. This (ionic) unnatural and erratic oscillation generates forces on the S4 sensing segment, thereby causing the voltage-gated channels to dysregulate and substantially perturb cellular function. *ibid*

So, the S4 voltage-sensing segment is this universal transducer, a single biological mechanism that converts electromagnetic field oscillations into cellular biological effects across many frequencies, intensities, and tissue types.⁴ Importantly, Panagopoulos and colleagues found that man-made, polarised, coherent, pulsed electromagnetic fields are readily capable of perturbing ions at **non-thermal** intensities. *ibid* These same researchers showed that it was the slowly varying, polarised,

¹ Pall, M. L. (2018). Wi-Fi is an important threat to human health. *Environmental research*, 164, 405-416.

<https://www.sciencedirect.com/science/article/pii/S0013935118300355> and [5032457](https://www.sciencedirect.com/science/article/pii/S0013935118300355)

² See: *EMF*D* [book] by Dr J Mercola, *EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself* : Mercola, Joseph: Amazon.com.au: Books ; *EMF Risk Blindspot: The role of modulation in signal interaction*; <https://pubmed.ncbi.nlm.nih.gov/20649555/> ; <https://pmc.ncbi.nlm.nih.gov/articles/PMC2861541/> ; <https://pubmed.ncbi.nlm.nih.gov/12033431/> and <https://pubmed.ncbi.nlm.nih.gov/12676457/>

³ See: See: *EMF Risk Blindspot: The role of modulation in signal interaction* ; and Panagopoulos et al. 2002 — Mechanism for action of EMF on cells (Biochem. Biophys. Res. Commun.)

⁴ See: Panagopoulos et al. 2002 — Mechanism for action of EMF on cells (Biochem. Biophys. Res. Commun.); Panagopoulos et al. 2010 — Bioeffects of mobile telephony radiation in relation to intensity or distance from the antenna (Int. J. Radiation Biology); and Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. *Front. Public Health* 13:1585441. doi: 10.3389/fpubh.2025.1585441

coherent and pulsed modulation of EMFs that achieved this effect on the S4 voltage-sensor on cell walls. And, that in particular, it is the **modulation envelope**, the **ELF/ULF variation in the signal** that occurs at frequencies and intensities directly comparable to the cell membrane's own electrical activity. Further, it is the signal's irregularity of oscillation, not the energy of the carrier wave that disrupts cell membrane ionic function. ^{ibid}

Hence, according to these researchers, it is not the carrier frequency of a wireless signal that matters most. It is the **low-frequency pulsations and irregular modulations embedded within it**.

In sum, the **Ion Forced Oscillation Model** of Panagopoulos *et al.* appears to provide a comprehensive explanation for non-thermal effects on cellular function, effects that are achievable at a biophysical and biochemical level, at **non-heating** power intensities. Their 2025 paper cites a large body of existing published research which already supports their model. ¹ This model clearly invites attention and indeed demands action, by theoreticians in this field, by human and animal researchers in this area, and by agencies and Governments involved in the setting of acceptable safety standards.

2. Haemorheological effects (blood clumping / Rouleaux formation):

Even short exposure to MMMs appears to cause red blood cells (RBCs) in our body to lose their negative charge – and become positively charged. ² Such clumping of red blood cells can be quite extreme and results in poor ability of such clumped cells to carry oxygen to the extremities, or wherever there is very fine capillary cardiovascularity – such as in the brain and kidneys. However, more research is needed in this area to establish long-term effects of exposure in humans.

3. Protein misfolding and conformational disruption:

Mobile-phone-frequency RF exposure may interfere with intracellular protein folding. In vitro work by Mancinelli and colleagues (2004) ³ showed that 1.95 GHz RF — a typical mobile-phone carrier frequency — perturbs the conformational refolding of myoglobin, with the authors concluding their findings represent “a potential risk for protein ‘misfolding’.” Subsequent work (Lian *et al.*, 2018) ⁴ reported elevated generation of yeast prion [URE3] — a non-pathogenic prion model — under both 50 Hz ELF and 2.0 GHz RF exposure. Whether these *in-vitro* and model-organism findings translate to demonstrable misfolded protein burden in human cells remains an open research question; the mechanistic significance is that protein misfolding and pathological aggregation are central features of several neurodegenerative diseases.

4. Disruption of electron transfer:

All cells emit low-level photons as part of cell functioning and communication. ⁵ All cells have micro-electrical currents running within them and between them (due to movement of electrons and protons). MMMs appear to almost immediately disrupt and overwhelm this micro-current and

¹ See: <file:///C:/Users/hp/Downloads/fpubh-13-1585441.pdf>

² Brown, R. R., & Biebrich, B. (2025). Hypothesis: ultrasonography can document dynamic in vivo rouleaux formation due to mobile phone exposure. *Frontiers in Cardiovascular Medicine*, 12, 1499499 ; <https://pubmed.ncbi.nlm.nih.gov/16241488/> ; <https://www.frontiersin.org/journals/cardiovascular-medicine/articles/10.3389/fcvm.2025.1499499/full> ; Havas, M. (2013). Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system. *Reviews on environmental health*, 28(2-3), 75-84. <https://alliance4mra.org/wp-content/uploads/2021/05/53-havas-wifi-affects-blood-heart.pdf> ; and [Cellphone Radiation Causes Abnormal Blood Clumping in Just 5 Minutes, Study Finds](#)

Havas, M. (2013). Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system. *Reviews on environmental health*, 28(2-3), 75-84. <https://alliance4mra.org/wp-content/uploads/2021/05/53-havas-wifi-affects-blood-heart.pdf> ; and [Cellphone Radiation Causes Abnormal Blood Clumping in Just 5 Minutes, Study Finds](#)

³ Mancinelli *et al.* 2004 — [Non-thermal effects of EMF on protein refolding \(myoglobin\)](#) (J. Cellular Biochemistry)

⁴ Lian *et al.* 2018 — [Yeast prion \[URE3\] generation elevated under EMF](#) (Cell Stress and Chaperones).

⁵ Mould, R. R., Mackenzie, A. M., Kalampouka, I., Nunn, A. V., Thomas, E. L., Bell, J. D., & Botchway, S. W. (2024). Ultra weak photon emission—a brief review. *Frontiers in Physiology*, 15, 1348915 <https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2024.1348915/full>

photonic communication. ¹ (Also See: Dr P Heroux interview [EMF Hazards Summit - The EMF Guy](#) 48hrs free viewing)

5. Coherence (many small forces acting in concert):

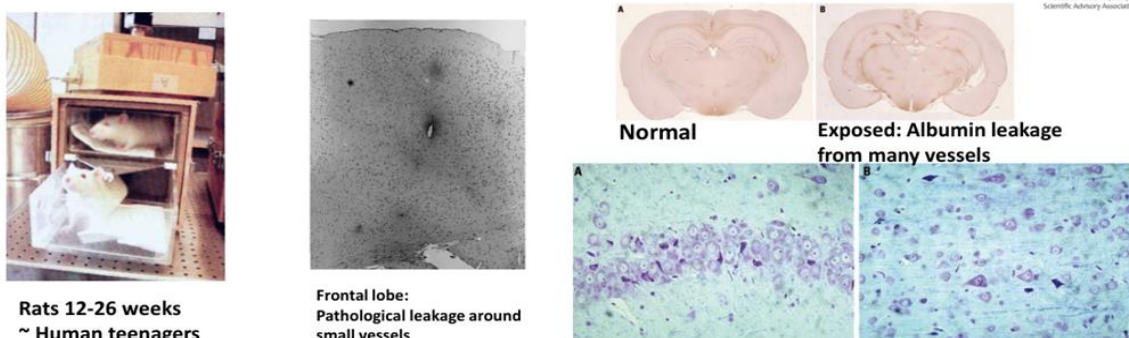
Natural background microwaves are diffuse, multi-directional in nature and of very low energy. Therefore, they mostly cancel each other out and cause no damage. In contrast, MMMs operate in a single plane, as determined by the oscillating electric current creating the wave and the direction and shape of the antenna emitting the signal. These waves act together in synchrony (with the same frequency, phase and orientation in the plane of polarisation). It is this synchronous behaviour of millions of small forces from these individual waves that collectively creates an overall significant force. This force can then cause neural/cellular bioelectric induction, disrupting moving charges in the body. ²

14.2 Apparent system-level damage routes

6. Blood-brain barrier disruption:

MMMs appear to create blood-brain-barrier (BBB) leakage, allowing blood-borne pathogens, toxins, heavy metals, and even parasites, ready access to the brain. ³ This is very inflammatory to the brain, which may develop a chronic inflammatory response. Such a response unfortunately causes very significant early cell death (apoptosis) of neurons in the brain. ⁴ (See below; and [Biological and health effects](#) slide pg52.)

Blood-brain barrier, neurons, hippocampus damage



**Rats 12-26 weeks
~ Human teenagers**

**Frontal lobe:
Pathological leakage around
small vessels**

Normal **Exposed: Albumin leakage
from many vessels**

Hippocampus, pyramidal cells **Cortex: Normal nerve cells
interspersed with black and
shrunken nerve cells / dark
neurons**

915 MHz Very weak exposures:
1997 1mW/kg SAR (greatest effects), 1W/kg to 8 W/kg; 2 to 16 hrs
2003: 2mW/kg, 20mW/kg, 200 mW/kg ; 2hr
higher exposures → more dark neurons

Damage to BBB, and neurons at 2 hours and 8 weeks
Salford et al, 1997 <https://link.springer.com/content/pdf/10.1023/a:1019150510840.pdf>
2003 <https://ehp.niehs.nih.gov/doi/abs/10.1289/ehp.6039>

*after some decades of (often) daily use, a whole generation of
users may suffer negative effects,
perhaps as early as in middle age
[e.g. early onset dementia from neurodegeneration]*



¹ Héroux, P. (2025). The collision between wireless and biology. *Heliyon*, 11(10). [https://www.cell.com/heliyon/fulltext/S2405-8440\(25\)00647-4](https://www.cell.com/heliyon/fulltext/S2405-8440(25)00647-4)

² Panagopoulos et al. 2002 — [Mechanism for action of EMF on cells](#) (Biochem. Biophys. Res. Commun.); Panagopoulos et al. 2010 — [Bioeffects of mobile telephony radiation in relation to intensity or distance from the antenna](#) (Int. J. Radiation Biology). Polarisation/coherence mechanism is contested in mainstream biophysics.

³ See: "Permeability of the blood-brain barrier induced by 915 MHz electromagnetic radiation, continuous wave and modulated at 8, 16, 50 and 200 Hz" by Leif G. Salford, Arne Brun, Jacob L. Eberhardt and Bertil R.R. Persson (Bioelectrochemistry and Bioenergetics 30 1993 293-301)

⁴ See: "Permeability of the blood-brain barrier induced by 915 MHz electromagnetic radiation, continuous wave and modulated at 8, 16, 50 and 200 Hz" by Leif G. Salford, Arne Brun, Jacob L. Eberhardt and Bertil R.R. Persson (Bioelectrochemistry and Bioenergetics 30 1993 293-301)

7. Myelin and central nervous system structural damage:

Ongoing MMM exposure appears to cause the breakdown of the indispensable myelin sheath that coats many of the brain's neurons.¹ This sheath is essential for nerve cells to function adequately. (Accruing damage to the myelin sheath is accepted as a core feature of **Multiple Sclerosis (MS)** and ongoing exposure to MMMs could therefore exacerbate symptoms in MS.) See below and [Biological and health effects](#) slide, pg52.

Damage to Myelin sheathing

DEMYELINATION

Myelin sheath

- important for electrical insulation
- 0-2 development of 1st layer
- 2+ continual development into adolescence and adulthood

Myelin degeneration and EMR

- 3GHz in guinea pigs and rabbits
- 2.4GHz rats 6 weeks after low dose

Baranski S. Histological and histochemical effects of microwave irradiation on the central nervous system of rabbits and guinea pigs. *Am J Physiol Med* 1972;51:182-90.

Switzer WG, Mitchell DS. Long-term effects of 2.45 GHz radiation on the ultrastructure of the cerebral cortex and hematologic profiles of rats. *Radio Sci* 1977;12:287-93.

Morgan, L. L., Kesari, S., & Davis, D. L. (2014). Why children absorb more microwave radiation than adults: The consequences. *Journal of Microscopy and Ultrastructure*, 2(4), 197-204.

Johansson, O., & Redmayne, M. (2016). Exacerbation of demyelinating syndrome after exposure to wireless modem with public hotspot. *Electromagnetic biology and medicine*, 35(4), 393-397.

EMF Hazards Summit April 2025, Dr Julie McCredde (ORSAA) presentation

In a multitude of animal studies going back several decades, exposure to MMMs during the developmental stage (including *in utero*) is strongly linked to subsequent deficits in brain structure and function.² These studies are most often with rats, with rigorous experimental controls: randomised controlled trials (RCTs). So, in essence, the only difference between exposure and non-exposure groups is the exposure group is subjected to one particular form of MMMs – such as cell tower emissions, or Wi-Fi emissions – and the non-exposure group receives no such subjection. Examples of evidenced exposure effects include:

- a) Changes in “somatometric characteristics” in rats, with hippocampal integrity being particularly affected.³ (The hippocampus in mammals – including humans – is centrally involved in learning, and in transferring short-term memories into long-term storage.)
- b) Exposed mammals demonstrated a large detrimental effect on motor activity functions, and a moderate detrimental effect on motor and sensory function.⁴
- c) Maternal exposure to Wi-Fi radiofrequencies led to various adverse neurological effects in the offspring by affecting neurodevelopment, cerebral stress equilibrium and cholinesterase activity.⁵

¹ Johansson, O., & Redmayne, M. (2016). Exacerbation of demyelinating syndrome after exposure to wireless modem with public hotspot. *Electromagnetic Biology and Medicine*, 35(4), 393-397. <http://www.iso.ro/documente/radiatii/Demielinizare.pdf>

² See: <https://www.sciencedirect.com/science/article/abs/pii/S0890623816303185>

³ See: <https://www.sciencedirect.com/science/article/abs/pii/S0890623816303185>

⁴ See: [Effects of Radiofrequency Electromagnetic Field \(RF-EMF\) exposure on pregnancy and birth outcomes: A systematic review of experimental studies on non-human mammals](#)

⁵ See: [Postnatal development and behavior effects of in-utero exposure of rats to radiofrequency waves emitted from conventional WiFi devices](#)

8. Genetic damage and routes to offspring effects:

MMMs appear to cause single-strand and double-strand DNA breaks, oxidative DNA damage, and chromosomal abnormalities — in both animal studies and in cultured human cells. The most extensively replicated single line of evidence is the comet-assay literature, where Lai's 2022 ¹ tally of the published RFR comet-assay studies found 78 of 125 studies (65%) reported significant DNA damage effects. Cellular DNA-repair pathways correct a fraction of this damage, but under chronic or repeated exposure the rate of new lesions can outstrip repair capacity, leading to accumulating somatic mutations, genomic instability, and downstream consequences for cell function and cancer risk.

Two routes can plausibly carry these effects from the exposed individual to their offspring. The first is *sperm-mediated*: RF exposure has been shown to cause DNA fragmentation, reduced motility, and oxidative damage in human sperm (De Iuliis et al. 2009; Agarwal et al. 2009; Adams et al. 2014 systematic review). ² By the same mechanism that makes paternal age an established risk factor for *de novo* mutations in children (older sperm carries more accumulated DNA damage, which can be mis-repaired or unrepaired after fertilisation and transmit as new mutations), RF-induced sperm damage is biologically plausible as a route to heritable mutations in offspring. The component links are well-supported; the direct end-to-end epidemiological demonstration in humans (RF-exposed fathers → measurably elevated *de novo* mutation rates in their children) has not been carried out at scale, though some animal studies have shown fertility and developmental effects in the F1 offspring of RF-exposed parents.

The second route is direct *in utero* exposure of the developing foetus, which can produce developmental and behavioural effects in offspring without needing to transmit through gametes. Aldad *et al.* (2012) in mice and Divan et al. (2008) in humans are the canonical references. ³ (See also point "7" above for animal-based evidence of damaging effects.)

¹ BioInitiative 2022 — [Lai tally \(74% of 391 RFR neurology papers report effects\)](#)

² De Iuliis et al. 2009 — [Mobile phone radiation induces ROS and DNA damage in human spermatozoa in vitro](#) (PLOS ONE); Agarwal et al. 2008 — [Effect of cell phone usage on semen analysis](#) (Fertility & Sterility); Adams et al. 2014 — [Effect of mobile telephones on sperm quality: systematic review](#) (Environment International).

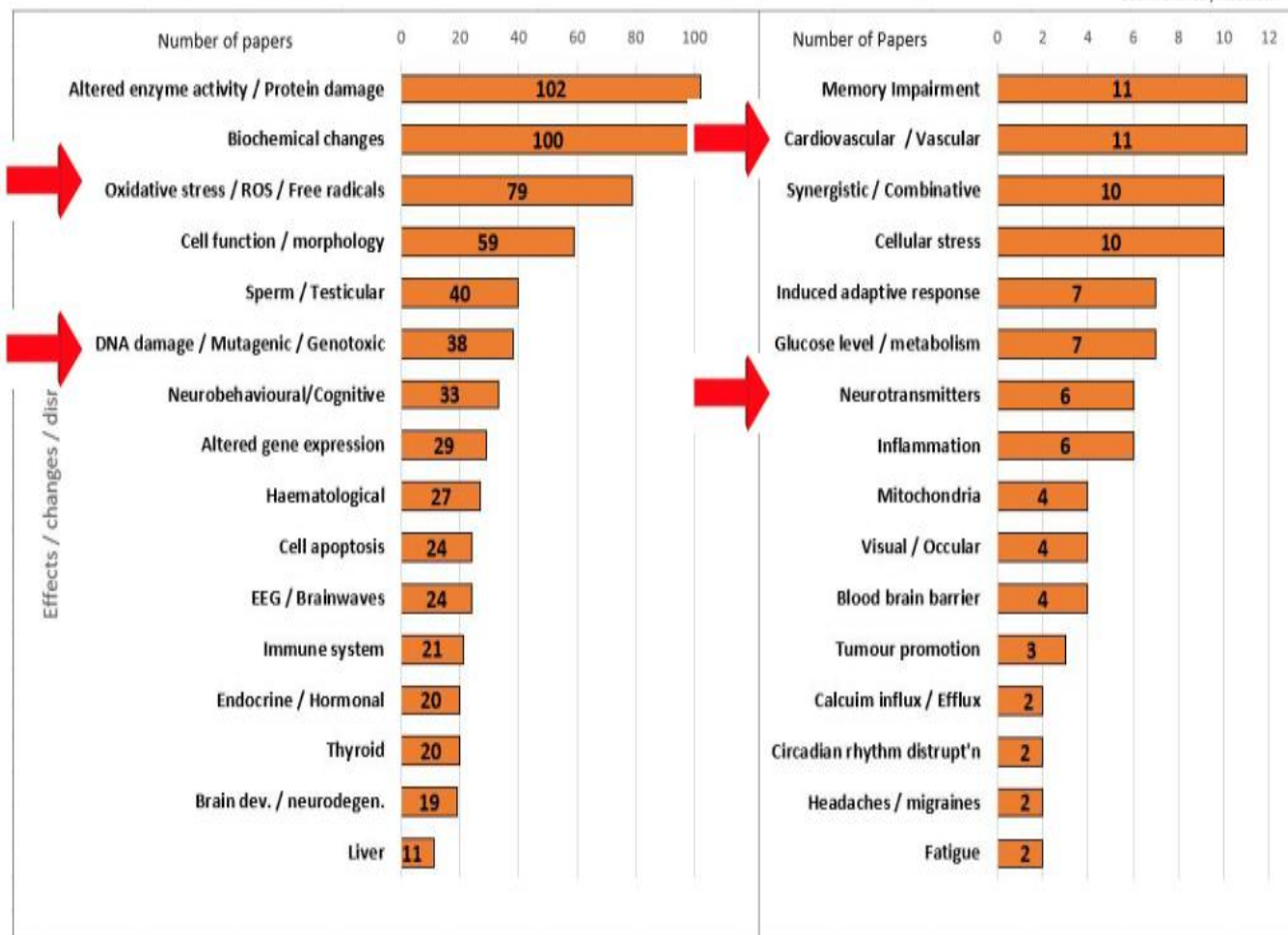
³ Aldad et al. 2012 — [Fetal RF radiation exposure affects neurodevelopment and behavior in mice](#) (Scientific Reports); Divan et al. 2008 — [Prenatal and postnatal exposure to cell phone use and behavioral problems in children](#) (Epidemiology).

Biological and health effects

from ODEB (3500+ papers: selected real world devices)



Oceania Radiofrequency
Scientific Advisory Association



McCredden JE, Cook N, Weller S, Leach V. Wireless technology is an environmental stressor requiring new understanding and approaches in health care.

Frontiers in Public Health. 2022 Dec 20;10:4893.

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

14.3 Apparent functional disruptions

9. Neurotransmitter, brain-wave, and cerebral blood-flow effects:

MMM exposure in humans appears to significantly reduce the flow of blood to the brain: neurovascular impairment. This appears so for even quite short exposure times. Again, it is unclear how long these effects last, and what chronicity of exposure is needed to create lasting effects. However, in animal studies, chronic exposures appear to lead to neuronal lesions, especially in the area of the temporal lobes.¹ (See also: [Biological and health effects](#) slide, immediately above.)

¹ See: [Research Review V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.

10. Endocrine and metabolic perturbation:

Ongoing MMM exposure appears to perturb the functioning of the endocrine system and adversely affect thyroid function. Elevated levels of hormones such as insulin and cortisol are known to consistently cause inflammation, with chronic elevated levels of inflammation leading to many chronic diseases. ¹ (See also: [Biological and health effects](#) slide above - pg52)

Longer-term MMM exposure appears to reduce heart rate variability (HRV) in humans – especially if mobile phones are carried near the heart, and/or with long-term substantial exposure to MMM (such as from nearby mobile towers). HRV is a key indicator of autonomic nervous system regulation, metabolic and immune system health, heart health, cognitive function, general health and psychological health. ² (The **HeartMath Institute** has produced age-based norms for HRV.) It is currently unclear how long-lasting these negative effects are, and what length of exposure would be needed to create permanent effects. ³

Medium-term exposure to MMMs from cell towers appears to consistently raise blood sugar levels – in high correlation with exposure level to the cell tower radiation. ⁴ Chronically raised blood sugar levels are inflammatory at a systemic level, usually leading to a range of serious chronic diseases. This can include diabetes, cardiovascular disease, neurodegenerative disorders and cancer. ⁵ (See also: [Biological and health effects](#) slide, pg52)

11. Pineal Gland impairment & melatonin reduction:

Some studies have reported that ongoing MMM exposure may disrupt melatonin production by the pineal gland (Burch et al. 2002 ⁶; Davis et al. 2006 ⁷ for related ELF findings); other studies have failed to replicate the effect. The current evidence base for an RF→melatonin link in humans is mixed rather than settled. The pineal gland sits below the blood-brain barrier and produces melatonin, which has well-established roles in circadian rhythm regulation, restorative sleep, and inflammation suppression. Melatonin also has documented anti-cancer effects in vitro (particularly on hormone-responsive cancers such as some breast cancers), and observational epidemiology shows shift workers — who have disrupted circadian rhythms and reduced overnight melatonin — at modestly elevated cancer risk for several cancer types.

Putting these elements into a single causal chain RF→reduced melatonin→increased cancer risk in humans is biologically plausible, but each link is contested and the chain has not been demonstrated end-to-end in human studies. The defensible point this document makes is the risk management one:

¹ [Non-thermal biological effects of radiofrequency electromagnetic radiation: Mechanistic insights into male reproductive vulnerability in the era of ubiquitous exposure - ScienceDirect](#); and [Research Review V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.)

² Bellieni CV, Tei M, Iacoponi F, Tataranno ML, Negro S, Proietti F, Longini M, Perrone S, Buonocore G (2012), ‘Is fetal autonomic function influenced by mobile phone use during pregnancy?’, *Acta Paediatrica* 101(1):e30–34, doi:10.1111/j.1651-2227.2011.02465.x.

³ See: [pdf-2236-2166; View of The Mobile Phone Electromagnetic Radiation Effects on Heart Rate Variability Function](#)); and [Research Review V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.

⁴ See: [Power Systems, Telecommunications, and Diabetes | 6 | The Impact of An](#); and, [EMR Radiation From Cell Towers, Wireless Devices Linked to Diabetes Epidemic](#)

⁵ See: [Research Review V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.

⁶ Burch et al. 2002: Melatonin metabolite excretion among cellular telephone users <https://pubmed.ncbi.nlm.nih.gov/12456290/>

⁷ Davis et al. 2006: Effects of 60-Hz magnetic field exposure on nocturnal 6-sulfatoxymelatonin, estrogens, luteinizing hormone, and follicle-stimulating hormone in healthy reproductive-age women: results of a crossover trial - <https://pubmed.ncbi.nlm.nih.gov/16458540/>

where RF exposure during sleep can be reduced at low cost — keeping Wi-Fi routers and mobile phones away from the bedroom, switching to wired Ethernet, turning routers off at night — doing so removes a candidate disruptor of overnight melatonin without requiring resolution of the upstream causal-chain question.

12. Reproductive and developmental effects:

Chronic exposure to MMMs appears to have a very noticeable negative effect on fertility – in both animal and human studies. ¹ and ² Male testes appear to be especially vulnerable to the effect of MMMs, with impaired structure and function – including lowering of male testosterone levels in animal studies. ³ Pathways of damage are believed to be via oxidative stress, lipid peroxidation and DNA damage. ⁴

13. Immune-system effects:

MMMs appear to compromise the functioning of the immune system. ⁵ (See also: [Biological and health effects](#) slide, pg52) In particular, Chronic EMF exposure appears to **reduce natural killer (NK) cell activity**, weakening cancer surveillance. ⁶ As was glaringly self-evident over the last few (pandemic) years, possessing a superbly functioning immune system (both innate and acquired) is critical to maintaining short-term and long-term human health. Further, as the immune, endocrinal and neurological systems are closely and dynamically intertwined, deleterious effects on immune function will rapidly undermine healthy function of the neurological and endocrinal systems. Owing to the integrated nature of all bodily systems, negative health effects will eventually become systemic.

14.4 Apparent observed clinical outcomes

14. Cancers and tumours:

Long-term MMM exposure appears to cause rare cancers or tumours in animal and human studies - including brain gliomas and meningiomas in human studies. ⁷ The Interphone Study published in 2010 ⁸ reported an elevated risk of brain glioma in the heaviest mobile phone users — an odds ratio of 1.40 (95% CI 1.03–1.89) for those whose cumulative call time exceeded 1,640 hours, approximately equivalent to 30 minutes of daily phone use sustained over a decade. The signal was stronger when the analysis was restricted to gliomas appearing on the same side of the head as the phone was usually held: an odds ratio of 1.96 (95% CI 1.22–3.16). The study authors cautioned that methodological limitations preclude firm causal conclusions from any single number, but the elevated risk in the heaviest-use subgroup, and the asymmetry favouring same-side-of-head tumours, both point in the same direction. The Hardell group's independent body of work reports higher odds ratios in similar long-term, high-use cohorts. ⁹

³ Jangid et al. 2025 — [Non-thermal biological effects of RF EMR: Mechanistic insights into male reproductive vulnerability](#) (Reproductive Toxicology).

² See: [Non-thermal biological effects of radiofrequency electromagnetic radiation: Mechanistic insights into male reproductive vulnerability in the era of ubiquitous exposure - ScienceDirect](#) and [5032457](#)

³ [View of Biological effects of electromagnetic waves with emphasis on radio and microwave: An environmental carcinogen](#)

⁴ See: [5032457](#) and [The Impacts of Wireless Communication Electromagnetic Fields on Human](#)

⁵ See: [Research Review V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.; and, [People Living Near Cell Towers at Greater Risk of Chronic Immune Stress • Children's Health Defense](#) ; and <https://pmc.ncbi.nlm.nih.gov/articles/PMC8580522/pdf/jclintranslres-2021-7-5-666.pdf>

⁶ See: <https://greenmedinfo.com/blog/emfs-linked-cancer-autoimmunity-immune-dysfunction>

⁷ See: [5032457](#)

⁸ Interphone Study. Results update. 2008. http://www.next-up.org/pdf/Interphone_IARC_Results_update.pdf

⁹ Hardell & Carlberg 2020 Stockholm 5G measurement campaign — [Aspects on the ICNIRP 2020 Guidelines on Radiofrequency Radiation](#) (World Academy of Sciences Journal).

With the significant increase in breast cancer in the Western world, it is hypothesized that as MMMs appear to lower melatonin production ¹, the reduced level in the body then allows cancers such as breast cancers, to proliferate. That is, melatonin is one of the body's chief anticancer (endogenous) biochemicals. ²

Gliomas in the brain are usually fast-acting and untreatable, and in humans are usually on the side of the brain most exposed to cell phone radiation. As already discussed in **Section 6.2**, the W.H.O. study in 2025 concluded there is “moderate certainty” evidence of an increased risk of some rare tumours in animal studies - such as [pheochromocytomas](#) in the adrenal glands and [hepatoblastomas](#) in the liver. ³ There is also a known link between females who carry their phones in their bras, and subsequent breast cancers in this exact area of high exposure. ⁴ (See also: [Biological and health effects](#) slide, pg52)

During development in the womb, high levels of exposure to MMMs appear to result in a significantly higher incidence of neurodevelopmental disorders such as Autism/ASD and ADHD. ⁵ For pregnant mothers with high levels of EMF exposure, this was associated with a trebling of miscarriage risk – compared to the low-level exposure group. ^{ibid} In human and animal studies, chronic exposure to MMMs is clearly linked with disruptions in brain structure, decreased brain (synaptic) plasticity, and decreased cognitive function. This is especially so during early developmental stages. ⁶

15. End-organ symptom presentations:

This entry collects four end-organ effect categories reported in association with MMM exposure. They are included here as observed presentations rather than as proposed mechanisms; their underlying mechanistic literature is less developed than the preceding mechanisms in this Section.

Visual effects.

MMMs (especially 5G waves) may heat the liquid inside the eyes (aqueous humour), potentially causing damage to the eyes and to vision. Also, visual perception disturbances are reported, and a sensation of “burning eyes” is common. ⁷ (See also: [Biological and health effects](#) slide, pg52)

Hearing effects.

More recent studies have identified damage apparently accruing from cell phone radiation. ⁸

Musculoskeletal effects.

Even shorter-term MMM exposure may cause joint and muscle pains, likely owing to inflammation and mitochondrial damage. ⁹ (See also: [Biological and health effects](#) slide, pg52)

¹ [Pineal melatonin level disruption in humans due to electromagnetic fields and ICNIRP limits - PubMed/; and Research Review V4 \(a037613\)](#)

² [View of Biological effects of electromagnetic waves with emphasis on radio and microwave: An environmental carcinogen](#)

³ [‘High Certainty’ Cellphone Radiation Linked to Cancer in Animals, WHO Study Finds • Children's Health Defense and 5032457](#)

⁴ [Health Freedom Event - Victor Leach; and Research Review V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.

⁵ Aldad et al. 2012 — [Fetal RF radiation exposure affects neurodevelopment and behavior in mice](#) (Scientific Reports); Divan et al. 2008 — [Prenatal and postnatal exposure to cell phone use and behavioral problems in children](#) (Epidemiology).

⁶ Salford et al. 2003 — [Nerve cell damage in mammalian brain after exposure to GSM microwaves](#) (Environmental Health Perspectives); Aldad et al. 2012 — [Fetal RF and neurodevelopment in mice](#) (Scientific Reports); [ORSAA ODEB database — Effects Categories](#).

⁷ See: [Behavioral and Health Impacts](#) slide; and [Research Review V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.

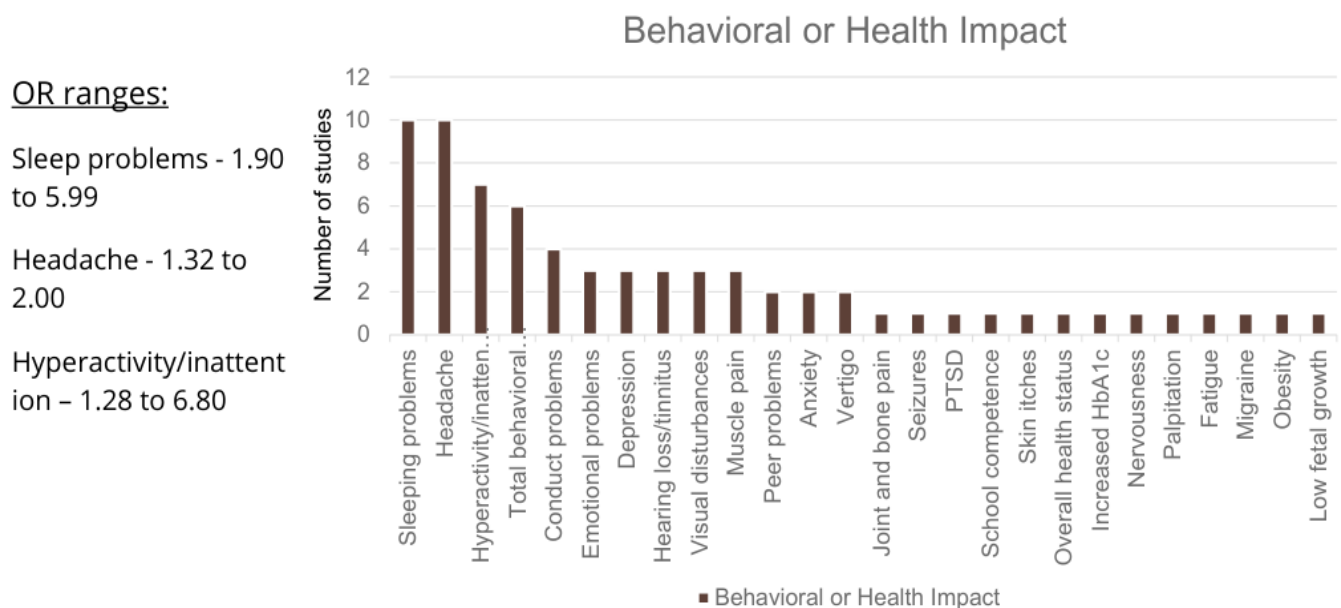
⁸ [View of Biological effects of electromagnetic waves with emphasis on radio and microwave: An environmental carcinogen](#)

⁹ See: [Behavioral and Health Impacts](#) slide; and [Research Review V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.

Dermatological effects.

MMMs (especially 5G) may cause skin abnormalities, itching, burning sensations, and even lesions. ^{ibid}
(See also: *Behavioral and Health Impacts* slide immediately below)

Behavioral and Health Impacts: Thirty-four out of 38 studies showed a statistically significant associations



EMF Hazards Summit April 2025, Bonnie Tucker presentation

For further investigation of the above mechanisms, see the ORSAA website (www.orsaa.org), and the work of Dr M Pall, Dr D Panagopoulos, Dr P Heroux, & Dr D Belpomme. See also the early, prescient *Lancet Planetary Health* 2018 article titled, *Planetary electromagnetic pollution: it is time to assess its impact*.¹

14.5 Authoritative research reviews conducted by established scientific experts

14.5.1 Oceania Radiofrequency Advisory Association (ORSAA) review of effects of use of real-world devices, and of living near to mobile phone base stations

ORSAA is a fully independent, not-for-profit Australian organisation that has zero ties to industry or government. One of its main purposes is to collate and disseminate quality, peer-reviewed scientific studies on the effects on humans from exposure to electromagnetic radiation – including the full spectrum of man-made microwaves. Scientists and researchers at ORSAA have made multiple submissions to the Australian Governments of the day, regarding concerns that current RF-EMF safety levels (including MMMs) are inadequate to protect public health. ORSAA scientists frequently publish studies and reviews in the scientific literature.²

¹ See: [Planetary electromagnetic pollution: it is time to assess its impact - The Lancet Planetary Health](#)

² <https://www.orsaa.org/about-us.html>

*... experiments investigating exposures from real-world devices and the epidemiology studies examining the effects of living near mobile phone base stations were extracted from ODEB [ORSAA database] and the number of papers showing effects was compared with the number showing no effects. The results showed that two-thirds of the experimental and epidemiological papers found significant biological effects. The breadth of biological and health categories where effects have been found was subsequently explored, revealing hundreds of papers showing fundamental biological processes that are impacted, such as protein damage, biochemical changes and oxidative stress.*¹

14.5.2 International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF) Research (2022)

The ICBE-EMF is a non-governmental, not-for-profit organization, formally recognized by the W.H.O.² (However, based on a current W.H.O. Web page, the W.H.O. clearly does not concur with many of the key findings determined by ICBE-EMF. *ibid*) ICBE-EMF is comprised of a multidisciplinary consortium of scientists and doctors (and related professionals) involved with research related to the biological and health effects of electromagnetic frequencies. Their investigations into EMF frequencies covers all the microwave frequencies³ ICBE-EMF's mission is to protect public and environmental health, and is focused on ensuring the protection of humans from the harmful effects of non-ionizing radiation. Its primary approach is to make global exposure recommendations, based on the best, peer-reviewed, scientific research publications. *ibid*

*In this paper, we show how the past 25 years of extensive research on RFR [radio frequency radiation] demonstrates that the assumptions underlying the FCC's and ICNIRP's [U.S. regulatory agencies] exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including electromagnetic hypersensitivity... Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies.*⁴

14.5.3 Pre-print authors (March 2026) argue that wireless radiation limits are 15-900 times too high to protect against cancer risks

According to a research study pre-published in March 2026,⁵ safety limits for radiofrequency (RF) radiation emitted by cell phones, Wi-Fi routers, cell towers and other wireless devices are at least **15-900 times too high** to protect people from cancer risk. Authors were scientists with the International Commission on the Biological Effects of Electromagnetic Fields⁶ (ICBE-EMF). *Current FCC and ICNIRP public exposure limits need to be reduced by at least 200 times to maintain an acceptable environmental cancer risk of 1 in 100,000.*⁷

¹ See: <https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2022.986315/full> ; and [Antennas for Body Centric Wireless Communications at Millimeter Waves by Nacer Chahat et al.](#)

² Radiation and health

³ [Who We Are - International Commission on the Biological Effects of Electromagnetic Fields](#)

⁴ [Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G - PubMed](#)

⁵ See: [Exposure limits to radiofrequency EMF do not account for cancer risk or reproductive toxicity assessed from data in experimental animals | Environmental Health | Springer Nature Link](#)

⁶ See: [Who We Are - International Commission on the Biological Effects of Electromagnetic Fields](#)

⁷ See: [press release](#)

The authors also concluded that current safety limits are **8 to 24 times too high** to protect against male reproductive harm, including decreased sperm count, sperm vitality and testosterone levels.

The researchers explained that the Federal Communications Commission (FCC) and the International Commission on Non-Ionizing Radiation Protection ¹ (ICNIRP) set their wireless radiation safety limits based on a handful of studies from the 1980s. The studies, which had small sample sizes, measured only the short-term impact of RF radiation at levels high enough to heat human tissue.

Ronald Melnick, Ph.D., a retired toxicologist from the National Institute of Environmental Health Sciences and the study's lead author, said in the ICBE-EMF press release ^{ibid} that governments need to “step up, abandon these obsolete guidelines, and conduct rigorous risk assessments using modern toxicological data.”

The study comes as the FCC continues to fail to comply with a 2021 Court order to provide a satisfactory explanation for how its current limits — which haven't been updated since 1996 — adequately protect human health. The Court order directed the FCC to review **11,000 pages of evidence** supporting claims that wireless radiation at levels currently allowed by the FCC, harms people — especially children.

14.6 Why the above mechanisms appear to be inadequately addressed in science and public policy

Accordingly, in this document the writer has avoided any absolute statements on a causal link between MMMs and resulting health damage, instead using “**appears** to cause”, or a similarly phrased caveat. This choice of wording by the writer is intended to signal the writer's grave-level concern, and to catalyse and indeed require, urgent Government-funded research.

Despite all the challenges and limitations discussed immediately above, the epidemiological precepts that establish causality are well known ² and in the opinion of the writer, the case for the **elevated probability that MMMs can cause multiple health harms**, has been reasonably established in this Section – and in the preceding **Section 13**.

The firm opinion of the writer is that the accumulative weight of evidence presented in this Section lies far beyond sufficient to invoke the **Precautionary Principle**, requiring an immediate embargo on increasing MMM exposures in New Zealand. This embargo must be in place until health risks for the entire population have been urgently, independently and critically assessed. In addition, there will be real urgency for relevant Health and Safety Legislation, to become coherent with the resulting hazard identification and risk analysis.

¹ **ICNIRP** is a self-selecting group with “longstanding industry ties that is accountable to no one,” according to the **Environmental Health Trust**. Many other countries base their limits on ICNIRP's recommendations.

² See: <https://pmc.ncbi.nlm.nih.gov/articles/PMC1898525/>



Woman storing her phone over her breast area (free public image)

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15. Man-Made Microwaves: Some apparent Neuropsychological and Behavioural Effects on Humans

Introductory Note

Please refer to the unabridged document for a fuller elaboration of these pathways.

All statements in the bullet-points below with casual-sounding language are to be read as the writer's opinion and interpretation, with acknowledgement that this is not settled science and that current Government regulations are not in agreement with at least some of these statements.

Some apparent neuropsychological effects on humans

A range of cognitive, mood and other brain-related effects on humans, apparently resulting from exposure to man-made microwaves, have been reported ¹:

1. **Poor short-term and long-term memory.** ² (See: [Cognitive function effects](#) slide, pg65; [Location of EMF Exposure and Type of Memory Decline](#) slide, pg66; [Biological and health effects](#) slide, pg67; [Mood, mental health and behavioral effects](#) slide, pg68; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Specific peer-reviewed support: Foerster et al. (2018) reported a dose-response association between cumulative RF brain dose from mobile-phone use and figural-memory performance decrement in 700 Swiss adolescents over one year. ^{ibid}
2. **“Brain fog”, with slower cognitive processing, poor ability to focus and concentrate, poor ability to follow conversations, poor ability to think rationally and sequentially, poor planning ability, etc.** ^{ibid} (See: “Brain effects” slide below - pg62; [EMF Exposure and Cognitive Decline](#) slide, pg65; [Cognitive function effects](#) slide, pg65; [Biological and health effects](#) slide, pg67; [Mood, mental health and behavioural effects](#) slide, pg68; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Note on citation strength: subjective cognitive complaints of this kind (“brain fog”) are commonly reported in EHS symptom surveys but the specific peer-reviewed primary literature on RF and subjective cognitive impairment is thin. The closest objective-measure study is the Foerster et al. (2018) figural-memory dose-response finding in Swiss adolescents already cited in the **Memory** point above.

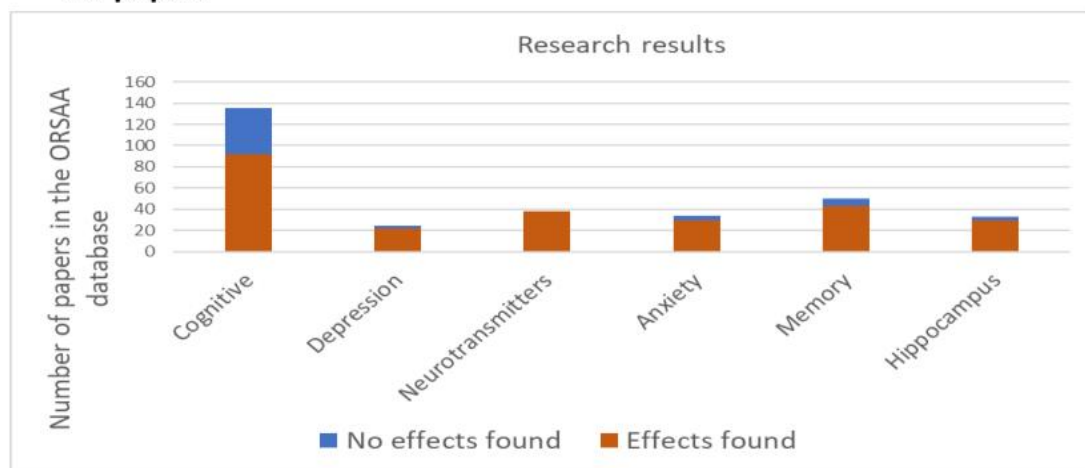
¹ Note: As per **Sections 13 and 14**, no attempt has been made to isolate specific (man-made) microwave characteristics – such as frequency, wave length and power density – that are apparently involved in producing the documented effects. Rather, any apparent effect will be delineated, as long as the microwaves involved were man-made.

² Foerster et al. 2018 — [Adolescents' memory performance and individual brain dose of microwave radiation from wireless communication](#) (Environmental Health Perspectives); [BioInitiative 2022 — Lai tally \(74% of 391 RFR neurology papers report effects\)](#).

Brain effects (ORSAA Database ODEB)



All papers



Children and adolescents

81 papers

- Effects 22
- No Effects 9
- Uncertain Effects 15

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

3. **Chronic mental and physical fatigue** ^{ibid and 1} (See: [Sleep and well-being effects](#) slide, pg62; [Cognitive function effects](#) slide, pg65; [Behavioral & Health Impacts](#) slide, pg66; [Biological and health effects](#) slide, pg67; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Specific peer-reviewed support: Hutter et al. (2006), Occupational and Environmental Medicine, surveyed 365 adults living within 600 m of mobile-phone base stations in three Austrian rural and urban areas. Fatigue, headache, and concentration difficulties were the most frequently reported symptoms, with prevalence correlating with measured RF field strength at the residence. The study is cross-sectional and self-report and does not establish causality, but it remains the most-cited single observational study on base-station residence and fatigue. ²
4. **Headaches** ^{ibid} (See: [Sleep and well-being effects](#) slide, pg62; [Behavioral & Health Impacts](#) slide, pg66; [Biological and health effects](#) slide, pg67; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Specific peer-reviewed support: Schreier et al. (2006), Swiss cross-sectional survey of 2,048 adults, reported headaches as the most frequent symptom attributed to mobile-phone use among self-reported EHS-affected individuals; Frey (1998) reviewed the historical microwave-headache literature. ³

¹ See: [Genotoxic Effects of Wireless Communication Electromagnetic Fields | 7](#)

² Hutter et al. 2006 — [Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations](#) (Occupational and Environmental Medicine).

³ Schreier et al. 2006 — [Prevalence of symptoms attributed to EMF exposure: Swiss cross-sectional survey](#) (Sozial- und Präventivmedizin); Frey 1998 — [Headaches from cellular telephones: are they real and what are the implications?](#) (Environmental Health Perspectives).

Sleep and well-being effects

Effects Summary	Study	Place	N	Ages
Headache/Migraine MP use was associated with a significantly increased adjusted odds ratio for headaches and migraine	Chiu et al 2014 Telephone interview	Taiwan	2042	11-15
Fatigue association between fatigue and MP usage	Zheng et al 2015 questionnaire	China	781	School age
Sleep and well-being Wireless MP and CP use: increased risk of headaches, feeling down/depressed, waking in the night, sleepiness at school, tinnitus (wired headsets)	Redmayne et al 2013	New Zealand	373	High school students
Sleep disturbances MP use after lights out: short sleep duration, subjective poor sleep quality, excessive daytime sleepiness, and insomnia	Munezawa et al 2011	Japan	94,777	High school students

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

5. **Agitation, aggression, hyperactivity and conduct difficulties**¹ (See: [Behavioral & Health Impacts](#) slide, pg66; [Mood, mental health and behavioral effects](#) slide, pg68; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Specific peer-reviewed support: this is one of the better-evidenced developmental-behavioural endpoints in the literature. Divan et al. (2008), *Epidemiology*, analysed data on 13,159 children from the Danish National Birth Cohort and reported a significantly increased risk of behavioural problems (hyperactivity, emotional problems, conduct difficulties) in children whose mothers regularly used cell phones during pregnancy and who themselves used cell phones in early childhood. The 2012 follow-up by the same group, with 28,745 children, confirmed and strengthened the association. Sudan et al. (2016) extended the cohort's follow-up to age 11 and reported that children whose cellphone exposures began prenatally or at age 7 had increased odds of emotional and behavioural difficulties at age 11 (OR 1.36–1.58 depending on exposure window), after socio-economic adjustment.² See also [Section 14](#) Mechanism 12 (Reproductive and developmental effects) for the *in utero* exposure pathway.
6. **Anxiety, nervousness, obsession-compulsion, post-trauma stress** (See: [Behavioral & Health Impacts](#) slide, pg66; [Brain effects](#) slide, pg61; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Note on citation strength: anxiety and related affective symptoms are commonly reported in EHS symptom surveys (see Hutter et al. 2006 at

¹ <https://childrenshealthdefense.org/defender/adolescents-cellphones-mind-health-well-being/> and 5032457

² Divan et al. 2008 — [Prenatal and postnatal cell phone exposure and behavioural problems in children](#) (*Epidemiology*); Divan et al. 2012 — [Cell phone use and behavioural problems in young children](#) (*J. Epidemiology and Community Health*); Sudan et al. 2016 — [Prospective cohort analysis: cellphone use and emotional/behavioural difficulties at age 11](#) (*J. Epidemiology and Community Health*).

the **Chronic Fatigue** bullet) but the peer-reviewed primary literature on RF-EMF and clinically-defined anxiety disorders is thin. The most-cited synthesis arguing for an RF→neuropsychiatric-effects link is Pall (2016), *Journal of Chemical Neuroanatomy*, which reviews mechanistic and observational studies on EMF and depression / anxiety / sleep disorders. Pall's specific VGCC mechanism, while generally accepted by experts in this field ¹, is not fully accepted in the mainstream literature (see Section 14 Mechanism 3); the review's literature collation remains a useful aggregator but is not itself a methodological replacement for the missing primary RCT-level evidence. ²

7. **Low mood or depression** ³ (See: [Brain effects](#) slide, pg61; [Behavioral & Health Impacts](#) slide, pg66; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Note on citation strength: as with anxiety (see above), depression is widely reported in EHS symptom surveys but the peer-reviewed primary literature on RF-EMF and clinically-defined depression is thin. The Pall (2016) review cited at the Anxiety bullet covers both endpoints. Observational support comes from cross-sectional symptom surveys (Hutter 2006) ⁴ and from the broader literature on RF effects on neurotransmitter systems ([Section 14](#) Mechanism 9).
8. **Poor sleep** ⁵ (See: [Sleep and well-being effects](#) slide, pg62; [Behavioral & Health Impacts](#) slide, pg66; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Specific peer-reviewed support: this is one of the better-evidenced symptoms in the literature. Mohler et al. (2010), *Bioelectromagnetics*, used personal RF dosimetry in a cohort of 1,375 adults and reported a small but statistically significant association between higher measured RF exposure (particularly from mobile-phone base stations) and self-reported sleep-quality impairment. Altpeter et al. (2006), *Environmental Health Perspectives*, reported substantial sleep-quality improvements among residents of Schwarzenburg, Switzerland, following the 1998 shutdown of a nearby shortwave broadcast transmitter — a natural-experiment design that is rare and methodologically informative in this literature. ⁶ At the polysomnography level, see also the EEG / sleep-spindle changes described at the **Cortical effects** bullet below and the broader pulse-modulated-RF sleep-architecture literature (Lustenberger et al. 2013 ⁷).
9. **Cortical effects, such as EEG changes in alpha waves and slow-wave sleep spindles.** These are among the more consistent and replicated effects in the human pulse-modulated-RF EEG literature (see review by Regel and Achermann, 2011 ⁸, and the broader literature cited at [Section 13](#) above). The EEG changes are typically small in magnitude (e.g., a few percent in

¹ See: *EMF*D* [book] by Dr J Mercola, *EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself* : Mercola, Joseph: Amazon.com.au: Books

¹ Pall 2016 - [Microwave frequency EMFs produce widespread neuropsychiatric effects including depression](#) (*J. Chemical Neuroanatomy*). Review article; contested mechanism (see [Section 14](#) Mechanism 3).

³ See: [Kids Who Get Cellphones Before Age 12 at Higher Risk of Obesity, Depression, Poor Sleep](#) and [Genotoxic Effects of Wireless Communication Electromagnetic Fields | 7](#)

⁴ Hutter et al. 2006 - [Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations](#) (*Occupational and Environmental Medicine*).

⁵ See: [Kids Who Get Cellphones Before Age 12 at Higher Risk of Obesity, Depression, Poor Sleep](#) and, [Kids' Sleeping Problems Linked to Wireless Radiation, Screens](#) ; and https://www.researchgate.net/publication/6124296_Regel_SJ_Tinguely_G_Schuderer_J_Adam_M_Kuster_N_Landolt_H-P_et_alPulsed_radio-frequency_electromagnetic_fields_dose-dependent_effects_on_sleep_the_sleep_EEG_and_cognitive_performance_J_Sleep_Res_16253

⁵ Mohler et al. 2010 — [Effects of everyday RF EMF exposure on sleep quality: cross-sectional study](#) (*Bioelectromagnetics*); Altpeter et al. 2006 — [Short-wave magnetic fields on sleep quality and melatonin cycle: Schwarzenburg shut-down study](#) (*Bioelectromagnetics*).

⁷ Lustenberger C et al. (2013), "Stimulation of the brain with radiofrequency electromagnetic field pulses affects sleep-dependent memory consolidation," *Brain Stimulation* 6(5):805–811.

⁸ See: <https://link.springer.com/article/10.1186/1476-069x-10-10> ; <https://pubmed.ncbi.nlm.nih.gov/21266038/> ;

alpha-band power) and have not been consistently accompanied by measurable cognitive changes on standard cognitive testing in the same subjects. Two readings of this pattern are defensible and the document leaves both on the table for the reader. The first reading is that detectable physiological response without functional cognitive impact suggests the body responds to RF in measurable ways but the responses do not necessarily translate to measurable harm at the exposure levels tested. The second reading is that small but reproducible EEG changes are an early-warning signal of cellular or neural stress that may precede measurable cognitive effects, particularly under longer-term exposure or in vulnerable populations not yet tested. Neither reading is conclusively supported; they reflect a genuine open question about the relationship between detected physiological change and clinical relevance. The document's risk management case does not depend on resolving this — it depends on the broader body of mechanism and outcome evidence presented in **Sections 13 and 14** — but readers should know that the EEG-effect literature, while consistent, has not yet shown the cognitive-impact bridge it would need to demonstrate harm directly.

10. **Reduced verbal expression and comprehension in children** (See: [Mood, mental health and behavioral effects](#) slide, pg68; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Specific peer-reviewed support: Birks et al. (2017), Environment International, pooled prenatal-cellphone-use data and child behavioural-problem outcomes from five European birth cohorts (Denmark, Korea, Netherlands, Norway, Spain), totalling 83,884 mother-child pairs, and reported a clinical-range odds ratio of 1.28 (95% CI 1.12, 1.48) for hyperactivity/inattention problems at age 5–7 among children whose mothers reported high prenatal cell phone use. Hyperactivity/inattention at this developmental window is associated with reduced expressive and receptive language performance. The effect persisted after adjustment for socio-economic and other potential confounders.¹ See also [Section 14](#) Mechanism 15 (Reproductive and developmental effects) for the broader prenatal exposure literature.
11. **Constant “ringing in the ears” (tinnitus)**² (See: [Sleep and well-being effects](#) slide, pg62; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Specific peer-reviewed support: Hutter et al. (2010), surveyed 412 mobile-phone users and reported an association between higher-intensity phone use and increased tinnitus prevalence; replicated in Medeiros & Sanchez (2016) systematic review.³
12. **Dizziness**⁴ (See: [Behavioral & Health Impacts](#) slide, pg66; and [Research_Review_V4 \(a037613\)](#) ORSAA database ODEB – “Effects Categories” etc.) Note on citation strength: dizziness is reported in symptom surveys of populations living near mobile-phone base stations (see Hutter et al. 2006 cited at the Chronic Fatigue bullet above) and is one of the symptoms most commonly reported by individuals self-identifying as EHS-affected. Specific peer-reviewed primary literature on RF and dizziness as a standalone symptom is thin; the broader case rests on the symptom-survey aggregation and on the plausible mechanistic connections to cerebral blood-flow changes ([Section 14](#) Mechanisms 2, 7 and 9) and vestibular system perturbations.

¹ Birks et al. 2017 — [Maternal cell phone use during pregnancy and child behavioural problems in five birth cohorts](#) (Environment International).

² See: [Genotoxic Effects of Wireless Communication Electromagnetic Fields | 7](#)

³ Hutter et al. 2006 — [Subjective symptoms, sleeping problems, and cognitive performance near base stations](#) (Occupational and Environmental Medicine) ; Medeiros & Sanchez 2016 — [Tinnitus and cell phones: role of RF radiation \(systematic review\)](#) (Brazilian J. Otorhinolaryngology).

⁴ See: [Genotoxic Effects of Wireless Communication Electromagnetic Fields | 7](#)

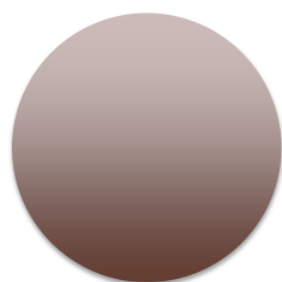
Cognitive function effects

Effects Summary	Study	Place	N	Ages
Reaction time, attention, focused attention, memory * RT longer for 9-12 yrs Memory capacity smaller boys and girls Motor reaction time greater for girls RT greater for girls	Kolodynski et al 1996 Exposure to pulsed radar vs non exposed vs control	Skrunda, Latvia	996	9-18
Perception (audio and visual), Neuromuscular and Cognitive functions 1. Increase in reaction time to sound and light 2. more errors in phonemic perception and recognition; 3. deterioration in arbitrary attention and semantic memory; 4. increased fatigue and decreased working capacity of muscle 5. safe mode of use devices statistically significantly improve ALL indicators	Grigoriev et al 2019 longitudinal use of MT over time 6 to 17 years	Moskow region	161 users 370 controls	6-17
Memory cumulative duration and of wireless phone use and RF-EMF dose negatively associated with memory (stronger for figural than verbal memory)	Schoeni 2015 questionnaire (recall last 6 months) + operators recorded use	Central Switzerland rural and urban	439	grade 7-9
Memory Decreased figural memory scores in association with an increase in RF-EMF brain dose scores for both CP and MP use	Foerster 2017	Switzerland	669	grade 7-9
EEG and memory task modulation of brain oscillatory responses in children in the approximately 4 - 8 Hz and approximately 15 Hz EEG frequencies during cognitive processing of auditory memory and memory search task	Krause et al 2009 Exposure or not to GPS pulsed 217Hz effects on 1 - 20 Hz event related brain oscillatory EEG	Finland	15	10-14

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

EMF Exposure and Cognitive Decline: Ten out of 11 studies showed a statistically significant association

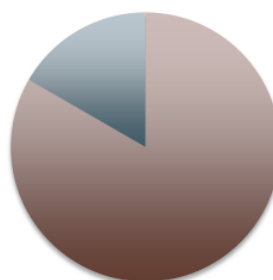
Longitudinal Studies



■ Association ■ No Association

5 out of 5 studies showed an association

Cross-Sectional Studies



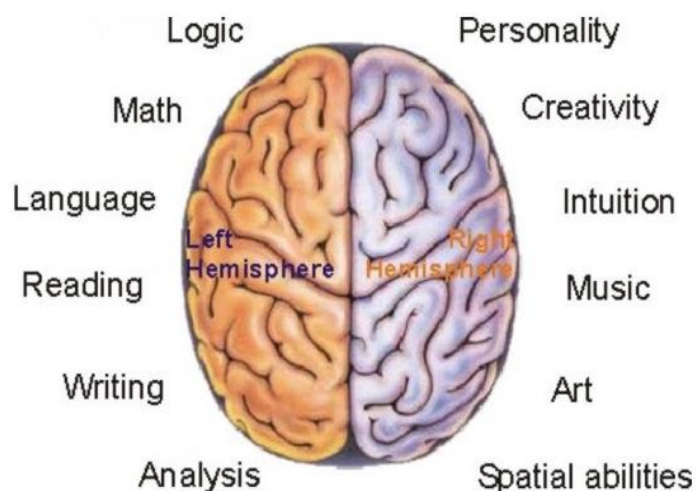
■ Associations ■ No Associations

5 out of 6 studies showed an association

EMF Hazards Summit April 2025, Bonnie Tucker presentation

Location of EMF Exposure and Type of Memory Decline

- Decrease in figural memory for students with right-side preference but no decrease in verbal memory
- Ride-side preference - holding phone in right hand up to right ear
- Spatial and figural memory functions concentrated on right side of brain



EMF Hazards Summit April 2025, Bonnie Tucker presentation

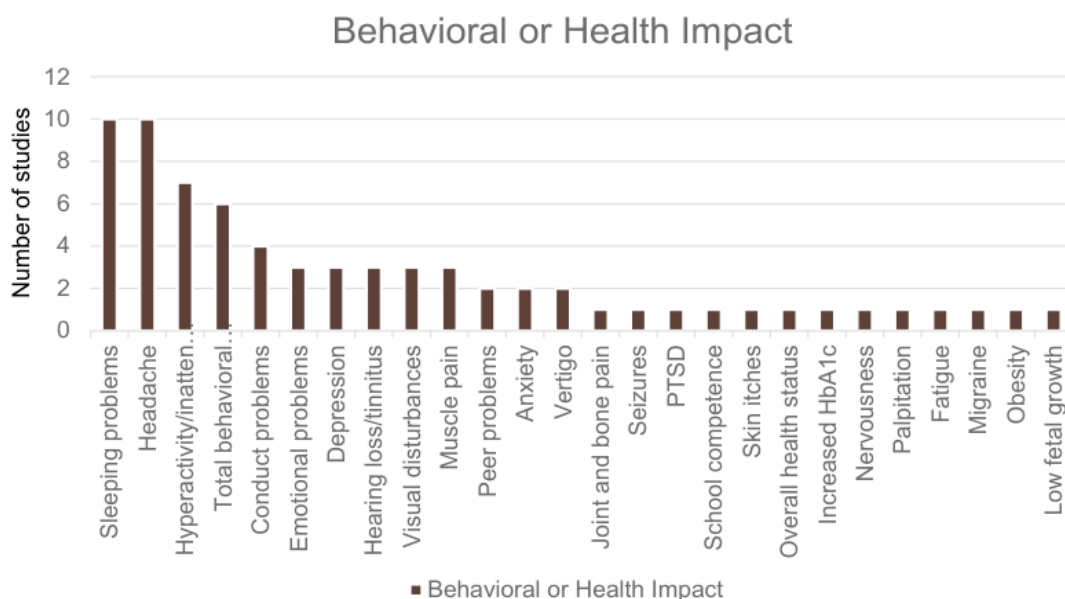
Behavioral and Health Impacts: Thirty-four out of 38 studies showed a statistically significant associations

OR ranges:

Sleep problems - 1.90 to 5.99

Headache - 1.32 to 2.00

Hyperactivity/inattention - 1.28 to 6.80



EMF Hazards Summit April 2025, Bonnie Tucker presentation

Biological and health effects

from ODEB (3500+ papers: selected real world devices)



Oceania Radiofrequency
Scientific Advisory Association



McCredden JE, Cook N, Weller S, Leach V. Wireless technology is an environmental stressor requiring new understanding and approaches in health care.

Frontiers in Public Health. 2022 Dec 20;10:4893.

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

Mood, mental health and behavioural effects

Effects Summary	Study	Place	N	Ages
Mental Health Issues An association between exposure and conduct problems for adolescents and children	Thomas et al 2010 personal dosimeter and Strengths and Difficulties Questionnaire (SDQ): emotional symptoms, conduct problems, hyperactivity-inattention, peer problems, prosocial behaviour	Bavaria	1 498 1 524	Children Adolescents
Behavioural Issues Exposure to cell phones both prenatal and postnatal was associated with more behavioural difficulties.	Divan et al 2008, 2010 questionnaire re MP use, (SDQ): hyperactivity-inattention, emotional symptoms, peer problems, conduct problems, and prosocial behaviour.	Denmark (Danish National Birth Cohort)	28 745	Mothers
ADHD (mice) Young exposed mice hyperactive, memory impairments and decreased anxiety neuropathology (dose-responsive impaired glutamatergic synaptic transmission onto layer V pyramidal neurons of the prefrontal cortex) Behaviours similar to ADHD in children	Aldad, Gan, Gao, & Taylor, 2012	Yale	82 79	Exposed in utero Control
Verbal and Behavioural Issues young boys who live near RF transmitters showed reduced verbal expression/comprehension and had higher scores for total problems, obsessive-compulsive and post-traumatic stress disorders than controls	Calvente et al., 2016	Spain	123 boys	9-11yrs

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

Concluding comments for this Section

Many apparent cognitive and behavioural effects have been found in animal studies (mostly with rats and mice), where structural and biochemical changes in the brain can be directly investigated. Most of the studies have shown many changes to the morphology and function of the brain.¹ Effects on the hippocampus in particular, are associated with reduced memory and spatial performance (see reviews by Lai et al., Narayanan et al.)² These multiple results give substantive support to the effects that have been shown in humans – though it is acknowledged that brain structure and function in animals does not always totally reflect human structure and function.

The further accumulation of evidence presented in this Section adds to the necessity for an **immediate embargo on increasing MMM exposures**. As per [Section 14](#) above, this embargo needs to be in place until health risks for the entire population have been urgently, independently and critically assessed. Relevant Health and Safety Legislation must become coherent with the resulting hazard identification and risk analysis. In addition, Government needs to consider immediately (and in good faith) beginning to implement the range of key strategies outlined in [Section 17](#) below:

[Recommendations: Immediate, Actionable Steps for the NZ Government to Urgently Consider.](#)

¹ <https://childrenshealthdefense.org/wp-content/uploads/rf-2018-neurological-lai-book-chapter.pdf>

² <https://childrenshealthdefense.org/wp-content/uploads/rf-2018-neurological-lai-book-chapter.pdf>
and <https://link.springer.com/article/10.1007/s11356-019-06278-5#citeas>

In the writer's opinion, In light of the combined evidence presented in this Section, **Section 13** and **Section 14**, the case for the high probability that **MMMs cause multiple health harms**, has been firmly established.

In the research review by Coskun & Demirel (2025) they concluded that, "Many biological mechanisms have been proposed for the effects of man-made EMFs on health, and thousands of studies have been published showing the non-thermal effects of low-intensity microwaves. However, these findings are mostly ignored."¹



AI-generated picture

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¹ See: [5032457](#)

16. Summary of Key Findings by Section

Section 6 - Is EHS a Real Health Condition & what may be causing it? – An Introduction

In this Section it was established that EHS is a long-standing (1991) diagnosis in the W.H.O.'s classification of diseases - the then ICD-10 - and remains in the current ICD-11. On its Website, Health N.Z (Te Whatu Ora) recognises this W.H.O. system of classification (ICD-10-AM) as being valid and currently extant for diagnostic purposes in New Zealand.

Leading researchers, Belpomme and Irigary have built a very extensive database of EHS sufferers, and thereby been able to demonstrate an objective and consistent range of key diagnostic symptoms and tests. They also state that, "... we show that EHS is in fact **causally** associated with increased exposure to man-made EMF."

Earlier in 2025, the W.H.O. partially commissioned 12 (meta-analysis) studies on a possible causal relationship between RF-EMFs and a range of health conditions and diseases. One of these studies uniquely utilised a **narrative** analysis of data – rather than statistical – and determined there is "moderate certainty evidence of an increased risk of some rare cancers ..."

Section 7 - Why is it Vital to Learn about Electromagnetic Hypersensitivity (EHS)?

The key takeaway in this Section was the impoverished level of knowledge amongst the general public regarding health risks apparently posed by man-made microwaves, and, why this continues to be so.

Section 8 - Introduction to EMF Waves – including microwaves

This Section explained the basic physics of EMF waves, with Radio Frequency EMF waves being one band within EMFs, and man-made microwaves being a narrow band of waves within Radio Frequencies.

Section 9 - Cause for Confusion regarding Health Risks of Radio Frequency Electromagnetic Fields (RF-EMFs)

This Section reviewed the multiple reasons why conducting research into man-made microwaves is so fraught with methodological challenges, and hence why there is much variation in research results. Further, why it is very difficult to uncover underpinning causal pathways to the effects obtained – with an in-depth knowledge of human biophysics **and** biochemistry being necessary. There appears to be only a small group of medical/scientific experts around the globe who have such extensive, cross-discipline knowledge.

Section 10 - Sources of Information on Dangers of RF-EMFs – including man-made microwaves

Based on the writer's extensive research, there appears to be a very limited number of medical/scientific experts with the multidisciplinary expertise to understand how MMMs could adversely affect humans. Some of these experts were delineated. Similarly, there is shortage of Websites that contain only reasonable quality (unbiased) material. Some of these sources were also listed. Other resources such as books and Internet Search Engines were enumerated. (There will certainly be other quality sources that the writer is yet to become aware of.)

Section 11 - What are the EMF Frequencies considered of Most Concern to Health?

This Section introduced man-made microwaves as appearing to be significantly harmful to humans. It also elaborated the large range of devices or systems that utilise microwave EMFs. At the same time, frequency bands above and below man-made microwaves, appear to frequently produce harm to humans.

Section 12 - If there are thousands of studies on negative outcomes of microwave exposure, why don't we hear more in the Media & from Governments?

This Section discussed why vastly resourced Telco companies around the world seem to have a powerful influence over local governmental advice, policies and relevant legislation.

Section 13 - Why Man-Made Microwaves are apparently so damaging – even at non-heating (non-ionising) levels

This important Section examined in depth, why man-made microwaves appear to frequently cause wide-ranging damage and dysfunction to the human organism. This is at a biophysical and biochemical level, and naturally occurring microwaves do not normally pose such potential for detrimental health effects.

Section 14 - Known (or Suspected) Pathways/Mechanisms of Man-Made Microwave Action

This key Section outlined the postulated pathways and mechanisms by which man-made microwaves appear to have a deleterious impact on human health, organised into sixteen postulated mechanisms across four thematic groups, with several connected stages of a common upstream cascade — including calcium-ion influx through voltage-gated channels, oxidative and nitrosative stress, mitochondrial dysfunction, blood-brain-barrier disruption, neurotransmitter changes, and others. The secondary effects are interconnected stages of a common upstream cascade rather than fully independent pathways.

Section 15 - Man-Made Microwaves: Some apparent neuropsychological effects on humans

This important Section outlined 12 different apparent effects on neuropsychological function that researchers have identified. These were, apparent: poor short-term and long-term memory; brain fog; chronic mental (and physical) fatigue; dizziness; headaches; ringing in the ears; agitation, aggression and hyperactivity; anxiety, nervousness and obsession-compulsion; low mood or depression; poor sleep; and reduced verbal expression and comprehension (in children).

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17. Recommendations: Immediate, Risk Management Steps for the New Zealand Government to Urgently Consider

1. Immediately place the 5G roll-out on hold until there has been a full and independent assessment of the safety of this technology. Rushing to deploy a multifaceted technology with likely health hazards would be short-sighted and risks undermining both public health and the long-term economic wellbeing of the Country.
2. Contract non-industry aligned independent scientists to conduct thorough research into health effects in areas where 4G and 5G cell towers have already been deployed. Existing, published questionnaires that assess symptoms of EHS could be used, along with blood samples from volunteers.
3. Conduct an urgent, thorough, independent inquiry into safety standards for all man-made emissions and transmissions of ELF, and Radio Frequency EMF - focusing in particular on the key microwave band of 300 MHz to 300 GHz. This would include 4G and 5G mobile cell towers, mobile phones, Wi-Fi routers, Bluetooth devices, smart meters, smart appliances, and other microwave-emitting devices.
 - a. The Inquiry would be prompted by the fact that electromagnetic-hypersensitivity is a serious health concern and that neurodevelopmental and cellular damage in early childhood would increase the risk for poor life outcomes. Current evaluatory and regulatory processes appear to the writer to have failed to conduct a comprehensive, balanced review of the evidence on these risks.
 - b. A fully independent version of ICHEF (possibly under a new name) to conduct ongoing clinical trials into the safety of man-made transmissions / emissions of microwaves and ELF. This would need to involve ongoing interaction with relevant Government Ministries and agencies at a senior level. (For example, interactions with the Ministry of Health, Ministry of Education and Health N.Z.) As findings emerge, these need to accurately and fully divulged to the public, in a form that is readily accessible and understandable.
 - c. For there to be a formal, well-advertised, transparent submission process for anyone in the public who believes they are being negatively impacted by ELF or RF-EMR. Investigative follow-up will need to be comprehensive and scientifically objective, with all such investigative results available to the public in the form of anonymised data, but data that does provide the street name of the complainant. (That would be so others in that neighbourhood are aware of suspected effects on neighbours.)
 - d. Adopt the FCC's stricter SAR limit (1.6 W/kg averaged over 1 g of tissue) for handset compliance testing in New Zealand, in place of the current ICNIRP-derived limit (2.0 W/kg averaged over 10 g). New Zealand currently follows ICNIRP via NZS 2772.1:1999, which sets the public mobile-phone SAR limit at 2.0 W/kg averaged over 10 g of tissue. The U.S. FCC sets the equivalent limit at 1.6 W/kg averaged over 1 g of tissue. The headline numbers (2.0 vs 1.6) suggest that ICNIRP is the stricter standard, but the reverse is true once the averaging volume is taken into account. According to Professor Akimasa Hirose and other dosimetry researchers, an SAR of 2 W/kg averaged over 10 g is approximately equivalent to 4–6 W/kg averaged over 1 g — meaning the FCC limit is roughly 2–3× more protective in effective terms when applied to the localised tissue regions that matter for phone-against-head exposure. India and South Korea have adopted the FCC limit on these grounds.¹

¹ ICNIRP 2020 Guidelines for limiting exposure to EMF (100 kHz – 300 GHz) (Health Physics); FCC OET Bulletin 65 — SAR for Cell Phones (47 CFR §§ 2.1093, 2.1091); Standards New Zealand NZS 2772.1:1999 — RF fields maximum exposure levels (3 kHz to 300 GHz).

Adopting the FCC standard does not require winning the broader scientific dispute over whether the thermal-mechanism framework is sufficient — it requires only choosing the more protective of two existing recognised international frameworks. This is risk management action that any government can take immediately and that aligns directly with the SAR-testing-vs-real-use point in the unabridged version (Section 18.1).

- e. Independently evaluate the sufficiency of **ICHEF** expertise - in the context of the wider risk environment and the myriad of scientific findings pointing to the raft of health dangers and damage posed by MMMs. ¹ This review (of ICHEF) would need to evaluate composition against the full range of disciplines required to meet its tasked duties. In the author's opinion, disciplines that bear directly on the biological and medical effects of chronic MMM exposure include: EMF (including man-made microwave) physics, human biophysics, human / medical biochemistry, human neurology, psychology, RF engineering, dosimetry, occupational health, environmental health, paediatrics, and building biology / EMF remediation.
 - f. Where the current ICHEF composition does not adequately cover any of these disciplines, the review ("c" above) should recommend specific roles to fill, and selection of individuals to those roles should be conducted by a body that is independent of the telecommunications industry. This process recommendation does not prejudge which specific researchers should serve on ICHEF; it ensures that whoever does serve covers the technical breadth the Committee's mandate requires.
 - g. It is reasonable to expect that a full report to Government will be delivered within a month of each of the (ICHEF) consecutive, six-monthly review meetings, with authorship of this review clearly denoted. Also, for each of these reports to be readily and immediately available to medical and health practitioners, scientists and the lay public.
 - h. ICHEF to also publish readily accessible, plain-language summaries of: the scientific reviews and studies it has considered in arriving at its current recommendations; the reasoning by which it has weighed considered evidence; reasons for excluding any peer-reviewed published research by established independent experts; the basis for its current exposure-limit recommendations; any updates over time; and its responses to public submissions, scientific challenges, and OIA queries.
 - i. ICHEF to regularly (6-monthly and at least a month before its scheduled meetings) seek submissions from informed (and independent) GPs and relevant health practitioners, qualified (independent) scientists, and apparently microwave-affected members of the public.
 - j. It would be acceptable (to the author) to have a maximum of 1 representative from local Telco companies on ICHEF, with representatives from all relevant Government Ministries – such as Health NZ, Ministry of Health and Ministry of Education – needing to be high-ranking and reasonably well-informed.
4. In the writer's opinion, for the Advisory Committee (ICHEF) to be fully effective, it would need to be legally mandatory for the Government of the day to entirely adopt the recommended safety standards - without political pressure or influence of industry lobbyists.
 5. For ICHEF or its successor to rigorously ensure that man-made sources of Electromagnetic Radiation meet safety, quality and performance standards, with a particular focus on safety. This would include licensing and regular auditing of companies and their EMR-emitting equipment.
 6. Based on the Precautionary Principle and effective risk management, to mandate that all Wi-Fi is removed from Pre-School-level facilities, and Primary and Secondary Schools, reverting back to safe optical fibre, with Ethernet cable connections to the Internet routers. At a minimum, Wi-Fi

¹ See: PSGR NZ recent Substack article - The EMF Problem: RF Radiation Governance Without Democratic Risk Assessment, <https://psgrnz.substack.com/p/the-emf-problem-rf-radiation-governance>

exposure in Primary and Secondary schools needs to be highly controlled and minimised. E.g., as per France, with no Wi-Fi in pre-school educational facilities (with children under 3 years present), and tightly restricted Wi-Fi use at the Primary School level: Wi-Fi access points (in Primary Schools) installed after the Abeille Law came into force (February 2015) must be switched off when they are not being used for digital educational activities. Also, any proposed Wi-Fi installation at a school must be approved by the School Board.¹

7. In New Zealand, where children are regularly in any confined public areas, these need to be mandated as Wi-Fi-free. In addition, undertake independent (Wi-Fi) emissions testing throughout the Tertiary education sector, and public institutions including libraries and hospitals.
8. Look to urgently amending relevant Laws and Regulations, so home owners and local authorities can challenge proposed nearby cell tower installations on the basis of likely (or proven) health harms, and/or environmental damage, and/or economic loss to the value of nearby houses. This would likely require City and/or Regional Councils to be involved in decision making, with Telco Companies needing to advise affected residents (and governing Councils) many months in advance of any proposed installation. It would also require an independent panel of qualified scientists and health practitioners to be central to the hearing process, with their advice being binding on the approval authority. (Such independent, established experts could be sourced at a national or international level, with comprehensively updated ICHEF safety guidelines as a key basis for assessment.)
9. Look to mandating cell-tower-free and Wi-Fi-free multiple zones in towns and cities, providing individuals and families some choice over their level of exposure to microwaves. These regions can act as a 'control' group, which can support scientific research on health risks in the future. (Just as N.Z. has mandated "green areas" for safeguarding and enhancing public health, in the writer's opinion, having MMM-free areas is at least equally important.)
10. Contract non-industry aligned, independent scientists to thoroughly research and establish the minimum safety distance from 4G and 5G towers. Such minimum distances must then be legally enforced. This would include removing 4G and 5G cell towers that are too close to schools, and/or in close, hazardous proximity to the general populace.
11. For these same experts (bullet-point 11) to determine safe distances from Wi-Fi microwaves in public areas. This would be based on key factors such as the frequency and power intensity of the microwaves, age and health of exposed individuals, and estimating the level of accumulating health damage to individuals from ongoing exposure across all public settings. Hospitals would need to receive high-level and regular evaluation, owing to the sick in hospital likely being even more vulnerable to microwave exposure from Wi-Fi (etc.) in these environments.
12. Look to the formal (public-health-level) recognition of EHS as a medical disease. Then, ensure that all medical and health practitioners are well-educated in electromagnetic hypersensitivity ("EMR Syndrome"), with skills to determine whether or not microwave exposure is a significant factor in presenting illness symptomatology. Relevant Government agencies to disseminate information and materials to assist clinicians and the public to recognise that EHS is a valid, recognised, and accepted, health condition.
13. Once medical doctors and relevant health professionals are well-educated on likely health harms of EMR, for there to be a formal submission process for reporting patients presenting with such concerns. This process would need to be streamlined – to minimise time demands on such busy professionals - and with the consent of the presenting patient.
14. Once a person presents to a health professional with symptoms that are deemed to be at least partially caused by EMR, there needs to be ongoing monitoring and recording of their health.

¹ See: <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000030212642>

15. Post diagnosis of EHS, where warranted, for Government financial compensation to be available, along with payment for needed remediation at home, school or work settings. Assessment of the level of affectedness, and required compensation and remediation, would need to be conducted by fully independent experts – that are Government approved. Where it is medically/scientifically confirmed that emissions from a specific Telco Company cell tower have at least partly contributed to a person's health decline, that Company could be legally required to immediately remove the offending cell tower.
16. Where possible, employers need to offer Wi-Fi-free (shielded) zones in the workplace. It may be that where there are 5 or more staff in a workplace, such a protected zone could be legally required.
17. In April 2023, Prof. Paul Heroux *et al.* provided an in-depth biophysical and biomedical analysis of why current cell phone technology safety limits appear to be fundamentally outdated and inadequate. ¹ At the end of the journal article, he and his colleagues outlined several reasonably inexpensive fixes that Governments could readily mandate to improve safety of this technology. ^{ibid} For example, software-based solutions controlling RFR emission levels, as well as hardware changes to antenna designs. He also explained that fibre-based connections perform better across every dimension and ought to be the default (rather than wireless), whenever feasible.



Dr Paul Heroux, Professor of Toxicology & Health Effects of Electromagnetism, McGill University, Canada ²

¹ See: [Cell Phone Radiation Exposure Limits and Engineering Solutions | MDPI](#)

² See: <https://emfconference2021.com/speaker/paul-heroux-phd/>



Onerahi (Whangārei) 4G mini cell tower directly outside residential home – photo taken by the author

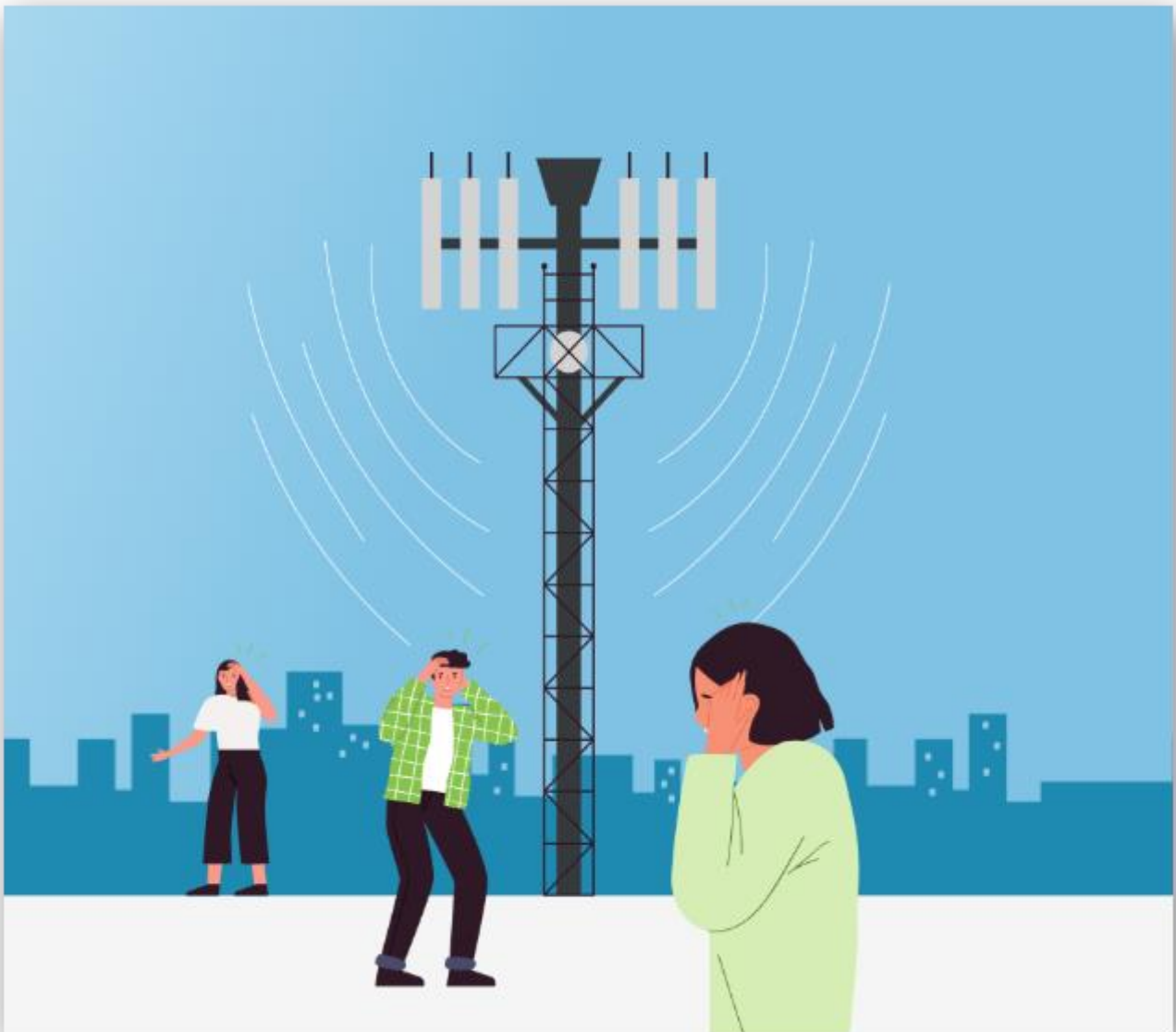
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18. Glossary

ARCs	Allergic Respiratory Conditions – such as Asthma
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency – Govt.-funded agency to advise on safety standards for Radio frequency EMFS (including MMM emissions and transmission)
ASD	Autism Spectrum Disorder
CHD	Children's Health Defense (USA) – a very active, not-for-profit health organisation in the USA, originally co-founded by Robert F. Kennedy Jnr. It is active on any issue believed to contribute to childhood ill-health or disease. (E.g., polluted ground water, unsafe public drinking water, MMMs)
DHB	District Health Board
EHS	Electromagnetic Hypersensitivity – A medical health condition with a clear set of symptoms, and biomarkers (blood and urine) that usually show a profile of oxidative and nitrosative stress, etc.
ELF	Extremely Low Frequency electromagnetic fields and signals, defined by a 3 Hz to 30 Hz frequency range. They are produced by natural atmospheric activity and human power systems. ELFs = plural form.
EMF	Electromagnetic Field - created by electric charges, electric currents, and changing magnetic or electric fields. EMFs = plural form.
EMR	Electromagnetic Radiation – always present in electromagnetic fields
FCC	Federal Communications Commission (USA) – Govt.-funded agency responsible for regulating radio frequency emissions – including MMMs - and electromagnetic energy in the USA
GPs	General Practitioners
ICBE-EMF	International Commission on Biological Effects of Electromagnetic Fields – Independent body of international experts advising on safety limits for man-made RF-EMFs (including MMMs) and non-ionising electromagnetic fields
ICD-10-AM	International Classification of Diseases, Tenth Revision, Australian Modification (produced by the W.H.O.). This is one of the diagnostic systems approved by Health NZ for use by GPs, etc.
ICHEF	Interagency Committee on the Health Effects of Non-Ionising Fields – NZ Govt.-appointed and Govt.-funded advisory committee on MMM emission and transmission safety standards

IARC	International Agency for Research on Cancer – provides advice to the W.H.O. on safety standards to prevent cancer. (It evaluates cancer-causing hazards and potential hazards.)
ICNIRP	International Commission on Non-Ionizing Radiation Protection – international self-appointed body that provides safety standard advice to the W.H.O. on electromagnetic fields spanning 0 Hz to 300 GHz (including static fields, extremely low frequencies, and radiofrequencies), as well as optical radiation.
IEI-EMF	Idiopathic Environmental Intolerance attributed to Electromagnetic Fields – term coined early on by the W.H.O. to capture the symptom profile of EHS, without attributing the cause to EMFs such as MMMs.
MCS	Multiple Chemical Sensitivity – medical condition that shares many symptoms with EHS and likely with some shared underlying causes. It is common for someone with EHS to also have MCS.
MMMs	Man-made Microwaves – such as emitted by cell phones, cell towers, smart devices, and Wi-Fi
NGO	Non-Governmental Organisation – aka not-for-profit organisation
NIH	National Institutes of Health (USA) – Governmental body charged with safeguarding and enhancing the health of Americans
NTP	National Toxicology Program (USA) – an interagency US Govt. programme, founded to evaluate potential human health hazards from environmental substances, coordinate toxicological testing, and provide the scientific basis for public health policies
NZ	New Zealand
ORSAA	Oceanic Radiofrequency Scientific Advisory Association - Australian NGO advising Govt. on transmission and emission safety standards for man-made electromagnetic fields and radiation (3 kHz to 300 GHz)
PC	Personal Computer
RF-EMFs	Radiofrequency Electromagnetic Fields – this ranges from 3 kHz up to 300 GHz and includes microwaves (300 MHz to 300 GHz.)
TV	Television
USA	United States of America
WHO	World Health Organization – international health body that is non-elected and is not accountable to any government. It appears to be increasingly trying to dictate health

standards (such as for pandemics) to governments around the world, essentially usurping governmental control over its own health policies and procedures.



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