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5G Safety – State of the art from scientific reviews and their findings

Steven Weller
PhD Student, MORSA



ARPS23

EXPANDING THE SCOPE OF RADIATION PROTECTION

SEA WORLD RESORT CONFERENCE CENTRE
GOLD COAST QUEENSLAND | 29 OCTOBER – 2 NOVEMBER 2023

Outline



5G - Public, Industry and Government Perceptions



5G Health and Safety Narrative – State of the art review



Balancing evidence vs the need to confirm harm



Funding Matters



Discussion



Many different voices are speaking into 5G technology health and safety narrative

- Some are suggesting 5G is safe
 - Government
 - Some health professionals and scientists
 - Industry



- Others are suggesting health risks can be expected
 - Hundreds of health professionals and scientists (global)

<https://www.saferemr.com/2019/07/international-scientist-appeal-on.html>

Public Reaction to 5G

2019 Roy Morgan survey of 626 Australians suggests:

- Majority of Australians were supportive of 5G technology

However

- 26% had health and safety concerns
- 20% were concerned about security (hacking, privacy etc.)

Missing was a question to gauge public awareness of IARC Group 2B classification
for all RF exposures

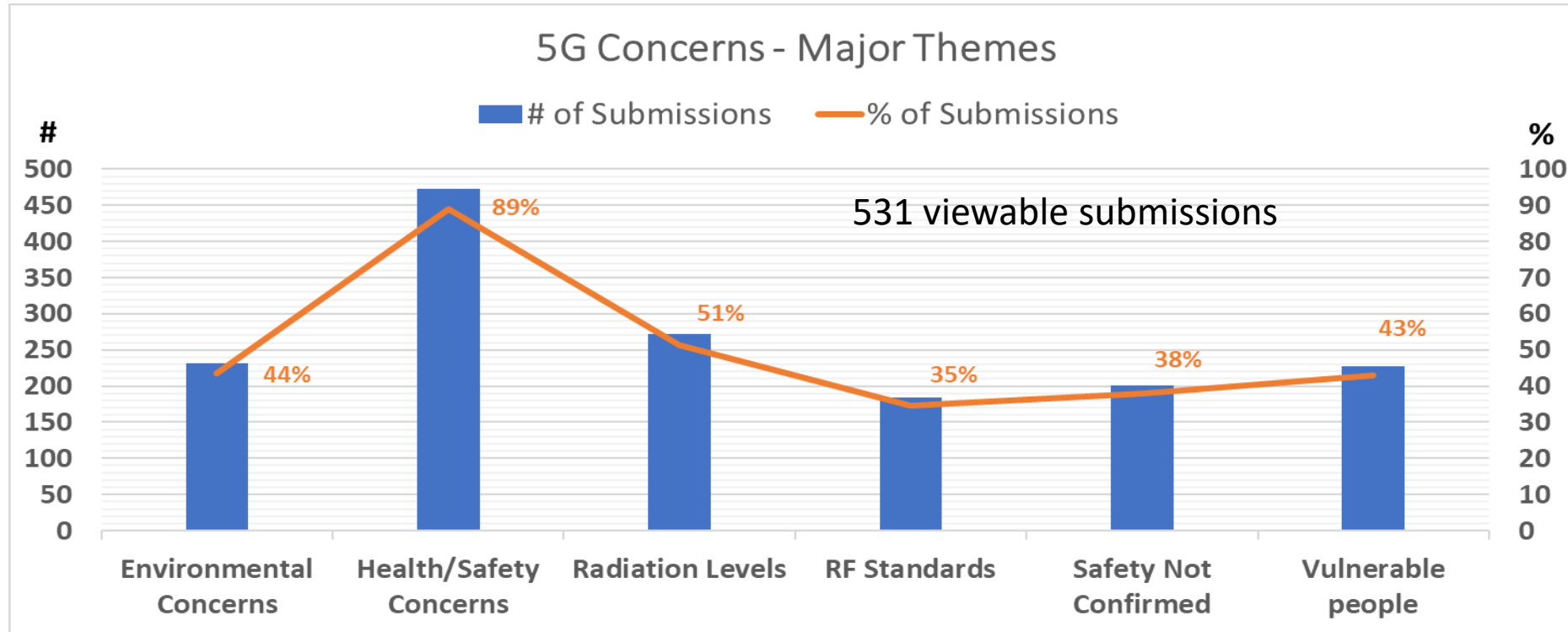
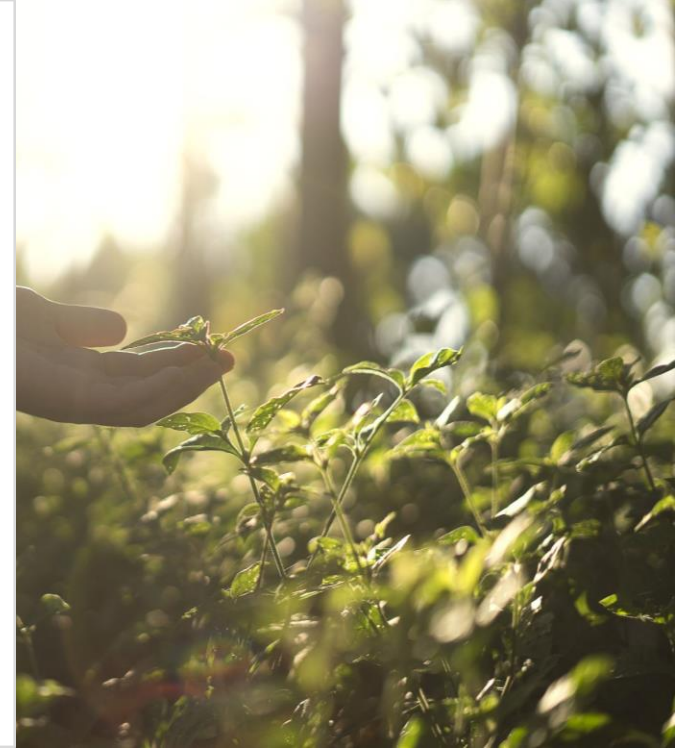


Parliamentary
Inquiry
5G Concern
Themes



5G Parliamentary Inquiry (2019/20)

Thematic and Quantitative Assessment



Concerns about misinformation and misunderstanding were expressed by both sides of the debate

- Industry expressed concern about public misunderstandings and called upon Government to assist in educating public
- Members of the public raised concerns of misinformation coming from Industry and from Government via ARPANSA

Most public submissions were rational

- 41% of submissions provided multiple references to peer reviewed research
- 2% of submissions made questionable claims without supporting evidence

ARPANSA's View

5G and Health

- No substantiated evidence

<https://www.arpana.gov.au/commentary-criticizing-icnirp-exposure-limits-falls-flat>

- No confirmed evidence

<https://www.arpana.gov.au/research-and-expertise/electromagnetic-energy-program/electromagnetic-energy-research/5g-mobile-networks-and-health-state-science>

- No health effects are expected – Dr Karipidis

<https://www.arpana.gov.au/news/5g-new-generation-mobile-phone-network-and-health>

- It is our assessment that 5G is safe and does not present any health concerns –
Deputy CEO Dr Gillian Hirth

<https://www.arpana.gov.au/news/arpana-contributes-5g-inquiry>

A European Parliament commissioned Research project Scientific Foresight Unit (STOA)

Cancer:

- **450 to 6 000 MHz:** EMF[s] are probably carcinogenic for humans, in particular, gliomas and acoustic neuromas;
- **24 to 100 GHz:** no adequate studies were performed on the higher frequencies;

Reproductive/Developmental effects:

- **50 to 6 000 MHz:** these frequencies clearly affect male fertility and possibly female fertility too. They may have possible adverse effects on the development of embryos, foetuses and newborns
- **24 to 100 GHz:** no adequate studies were performed on non-thermal effects of the higher frequencies.



**EUROPEAN
PARLIAMENT**

5G Research Reviews – A synopsis

de Vocht and Albers published an opinion on controlling the 5G narrative (Frontiers 2022)

Omitted

Important Papers
and Authors

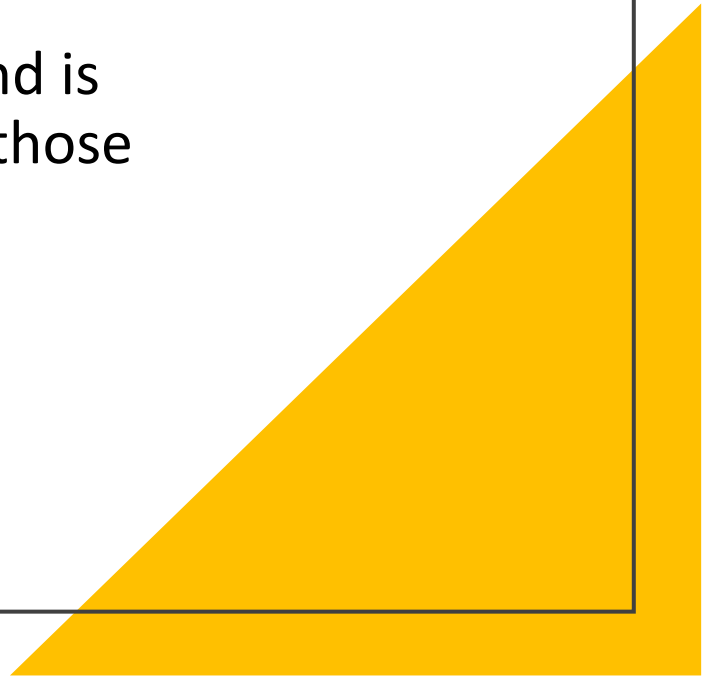
Author qualifications/
expertise in field

Risk assessment
approach

Health risks
identified

Research Analysis

- Researchers can be classified as
 - Those who advise **precaution** vs those that do not and is synonymous with those who suggest **health risks** vs those who do not





Researchers
Who
Recommend
Precaution

Publication Date of 5G article	First Author	Qualification	Publication Type	Expertise in microwaves and health	Funding and/or Associations	Effects found in past RF research	Identifies Health Risk
Feb 2018	Di Ciaula	Medical Doctor	Systematic-style review	Analyst	Independent/ Health Advocate	Reviews only	Yes
Apr 2018	Russell	Medical Doctor	Narrative review	Experienced Analyst	Independent/ Health Advocate 	Reviews only	Yes
Aug 2018	McClelland	Medical Doctor	Commentary	Novice Commentator	Independent 	N/A	Yes
Aug 2019	Miller et al.	Medical Doctor	Narrative review	Highly Experienced Epidemiologist	Independent/ Health Advocate 	Yes	Yes
Oct 2019 and Oct 2022	Belyaev	PhD Radiobiology, Doctor of Science - Genetics	Narrative review	Highly Experienced Biophysicist	Independent	Yes	Yes
Jan, Jun 2020 and Jun 2021	Hardell	Medical Doctor, Oncologist, Epidemiologist	Commentary	Highly Experienced Oncologist and Epidemiologist	Independent/ Health Advocate 	Yes	Yes
Jan 2020	Kostoff	PhD. Public Policy	Narrative review	Experienced Researcher / Analyst	Independent/ Health Advocate 	Reviews only	Yes
Mar 2020	Belpoggi	PhD. Oncology, Toxicology	European Parliament review report	Experienced Oncologist and Toxicologist	Independent/ Health Advocate 	Yes	Yes
Aug 2020	Leszczynski	PhD. Biochemistry / Cell biology	Systematic-style review	Experienced Biological Scientist	Past Institution/ Government Present - Independent	Yes	Too Early Insufficient Research
Jan 2021	Frank	Medical Doctor/ Epidemiologist	Essay	Analyst	Independent/ Health Advocate 	Review only	Yes
Jun and Dec 2021	Lin	PhD Electrical Engineering	Commentary	Highly Experienced Radiological Engineer	IEEE Member, Past ICNIRP Member Present -Independent	Yes	Yes

Key



Missed by de Vocht and Albers

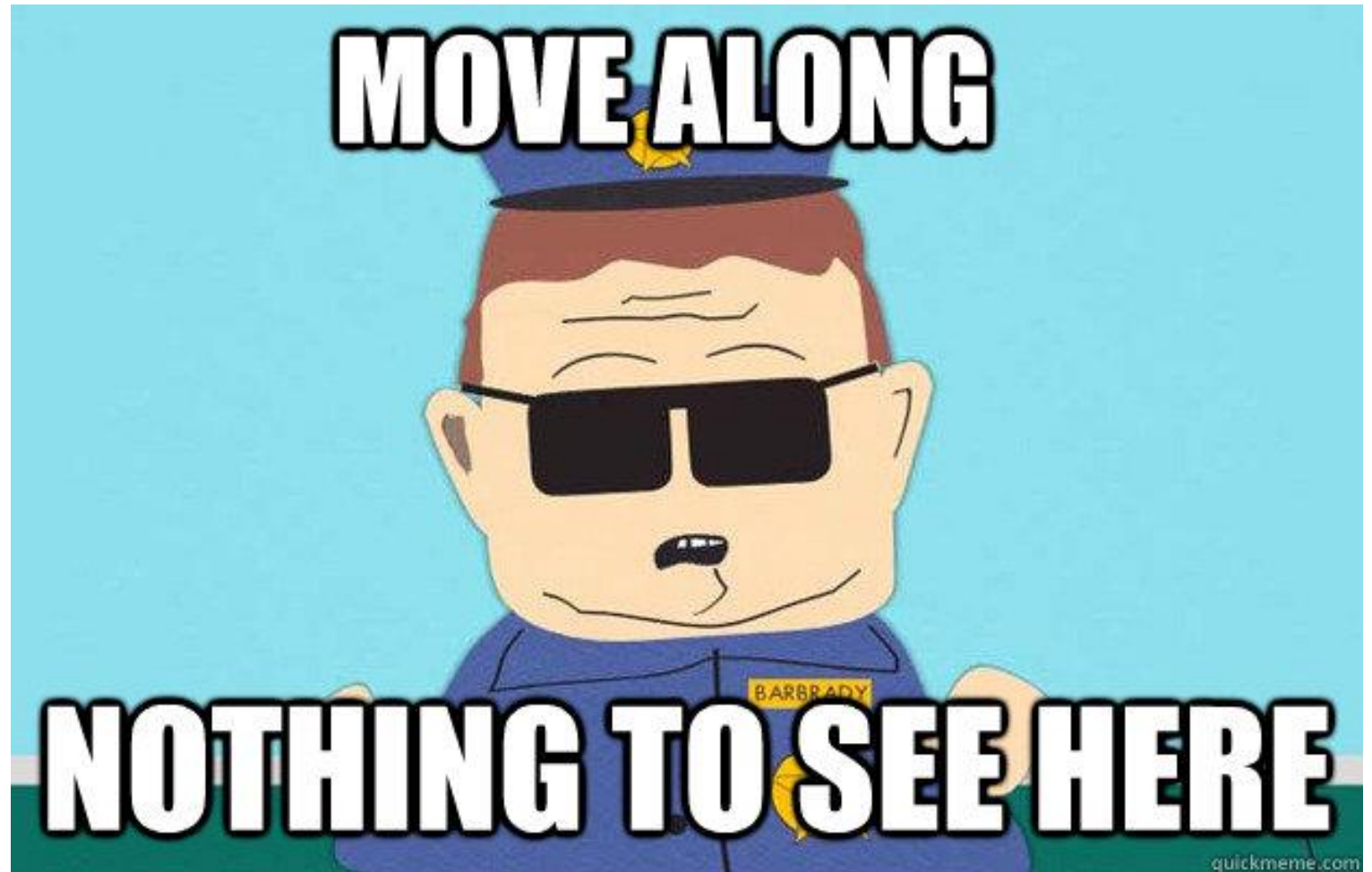


Mentions corporate profits used as determinate for acceptable exposure



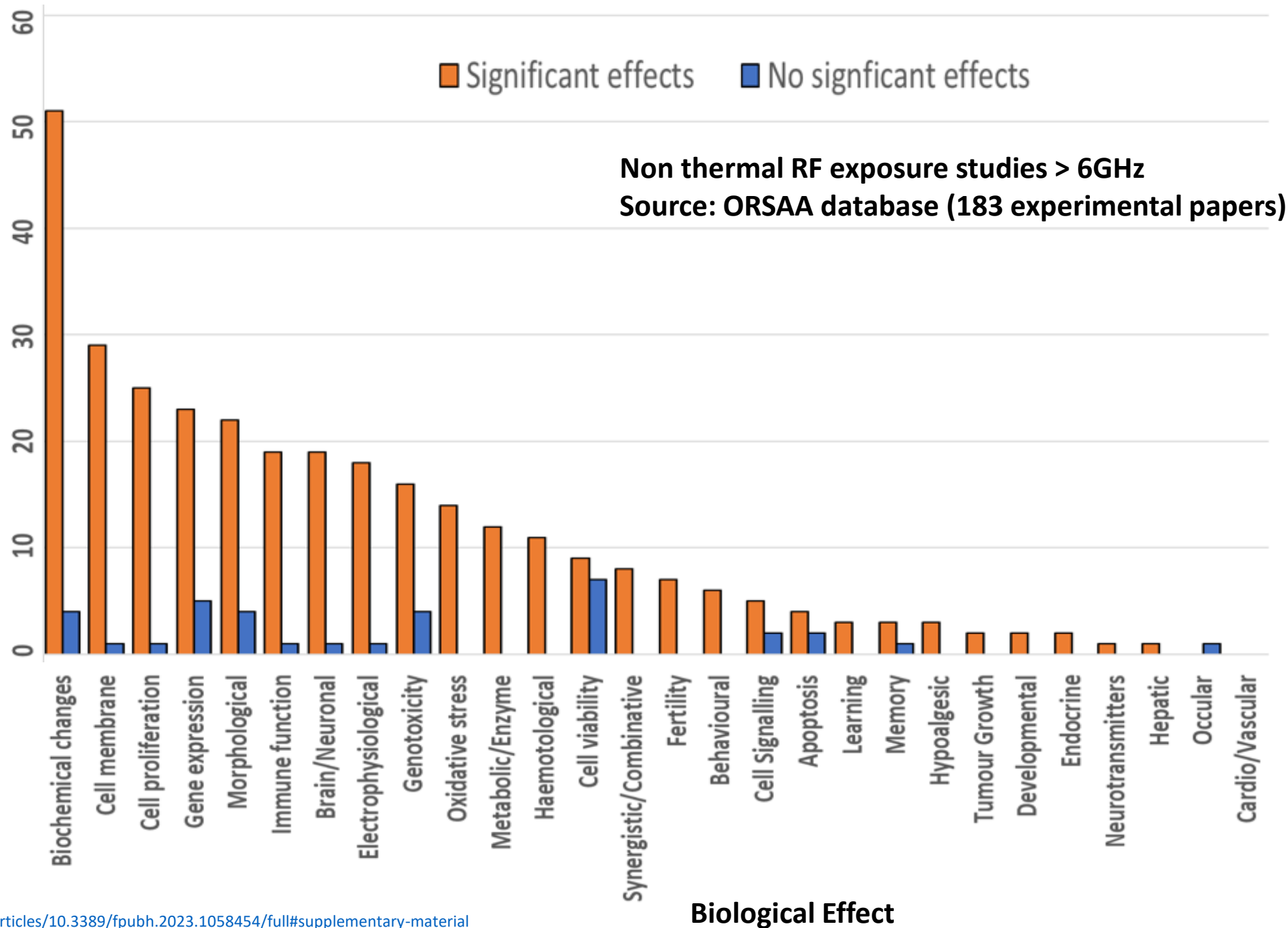
Identifies funding bias as an issue

Researchers
Not Using Risk
Assessment
Approach



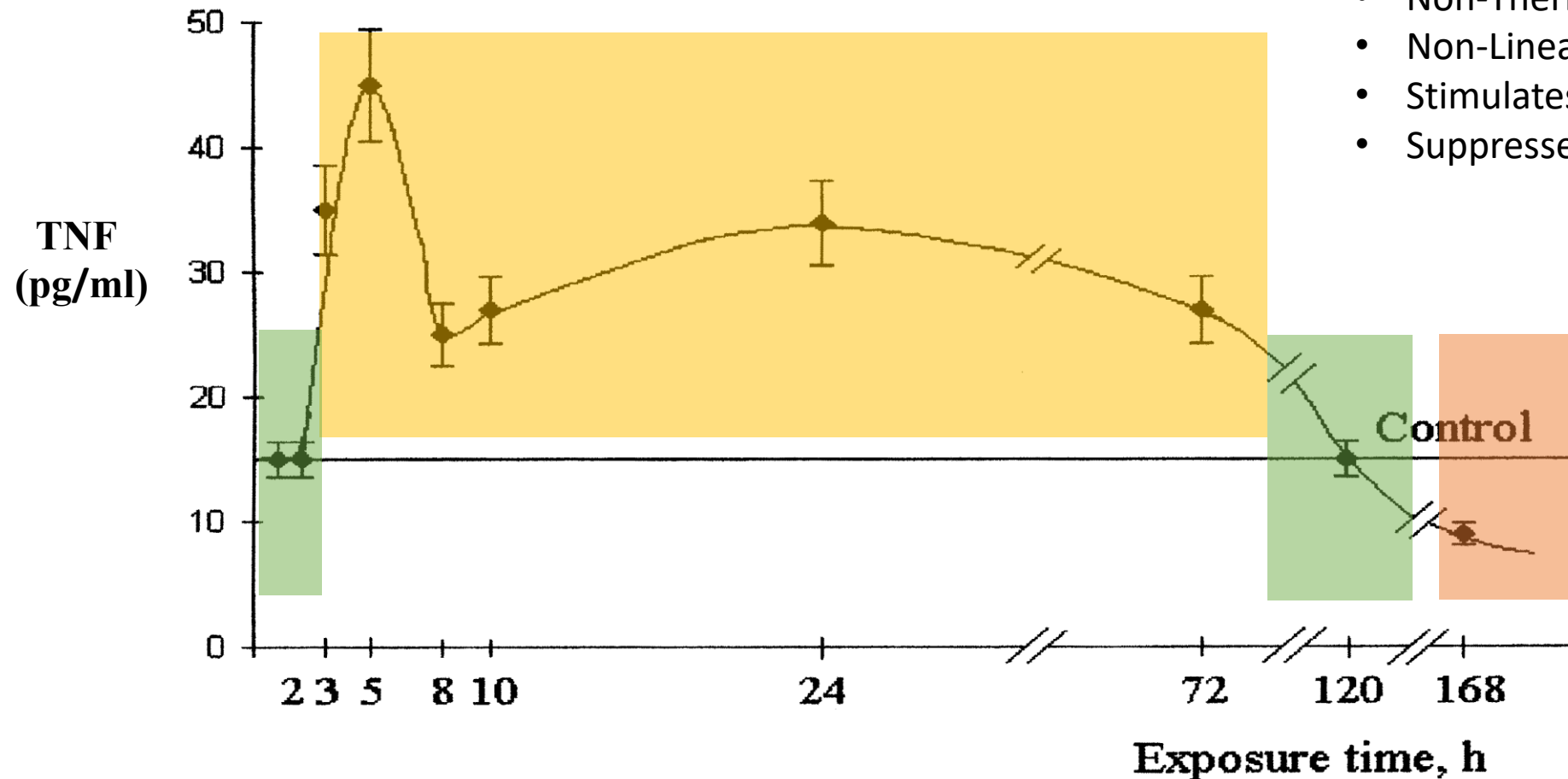
Publication Date of 5G article	First Author	Qualification	Publication Type	Expertise in microwaves and health	Funding and/or Associations	Effects found in past RF research	Identifies Health Risk	Risk Assess. Approach
Sep 2019	Simkó	PhD. Cell Biology	Systematic-style review	Highly experienced ELF Biophysicist (not RF)	Industry (SCENIHR)	Yes	No	No
Jun 2020	Bushberg	PhD Radiological Physics	Narrative review	Highly Experienced Radiological Physicist	Industry (IEEE/COMAR)	Review Only	No	No
Mar 2021	Jargin	Medical Doctor/ Pathologist	Letter to the editor	Novice Commentator	Independent	Review Only	No	No
Mar 2021	Karipidis	Physicist PhD. Epidemiology	Systematic-style review	Recent Epidemiologist	Government (ICNIRP member)	No	No	No
Mar 2021	Wood	PhD. Theoretical Biophysics	Meta analysis	Highly experienced in EMF theory and modelling	Institution/Industry partnership (Telstra) ICNIRP SEG	Yes	No	No

Number of Studies



Outcomes dependent on exposure time and other variables

TNF production in peritoneal macrophages from mice after exposure to 10 GHz microwaves at 1 mW/cm²



- Non-Thermal Exposure
- Non-Linear Response
- Stimulates Immune System (short exposure)
- Suppresses Immune System (long exposure)

Outcomes

- Significant Stimulatory Effect
- No Significant Effect
- Significant Inhibitory Effect

TNF – Tumour Necrosis Factor - is an adipokine and a cytokine used in cell signalling – inflammatory response

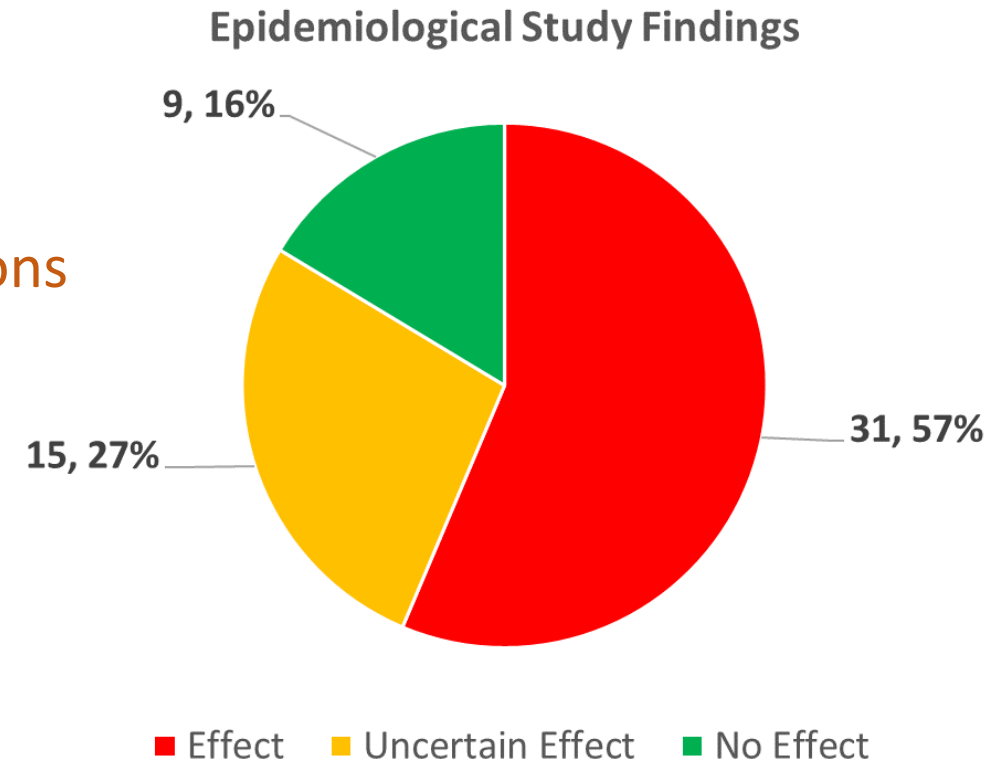
Cell biology does not respond linearly

Consequences

1. It is possible to game the science using specific parameters (exposure time, frequency, signal, intensity, cell type etc.)
2. Uncertainty or contradictory results can be due to time frames chosen – more data points needed to understand this
3. Public exposure standards assume heating is all that matter - **Not fit for purpose**

Potential Risks of >6GHz RF exposure Identified from Epidemiology

- Blood Cancers
- Testicular Cancer
- Fertility/Infertility
- Pregnancy Complications
- Birth Defects
- Stress Hormone level increases
- Ill Defined Symptoms (Headaches, Impaired Memory, Insomnia, Irritability)



Converging evidence with experimental studies –
i.e., genotoxicity (blood/sperm) and sperm defects/deficiencies

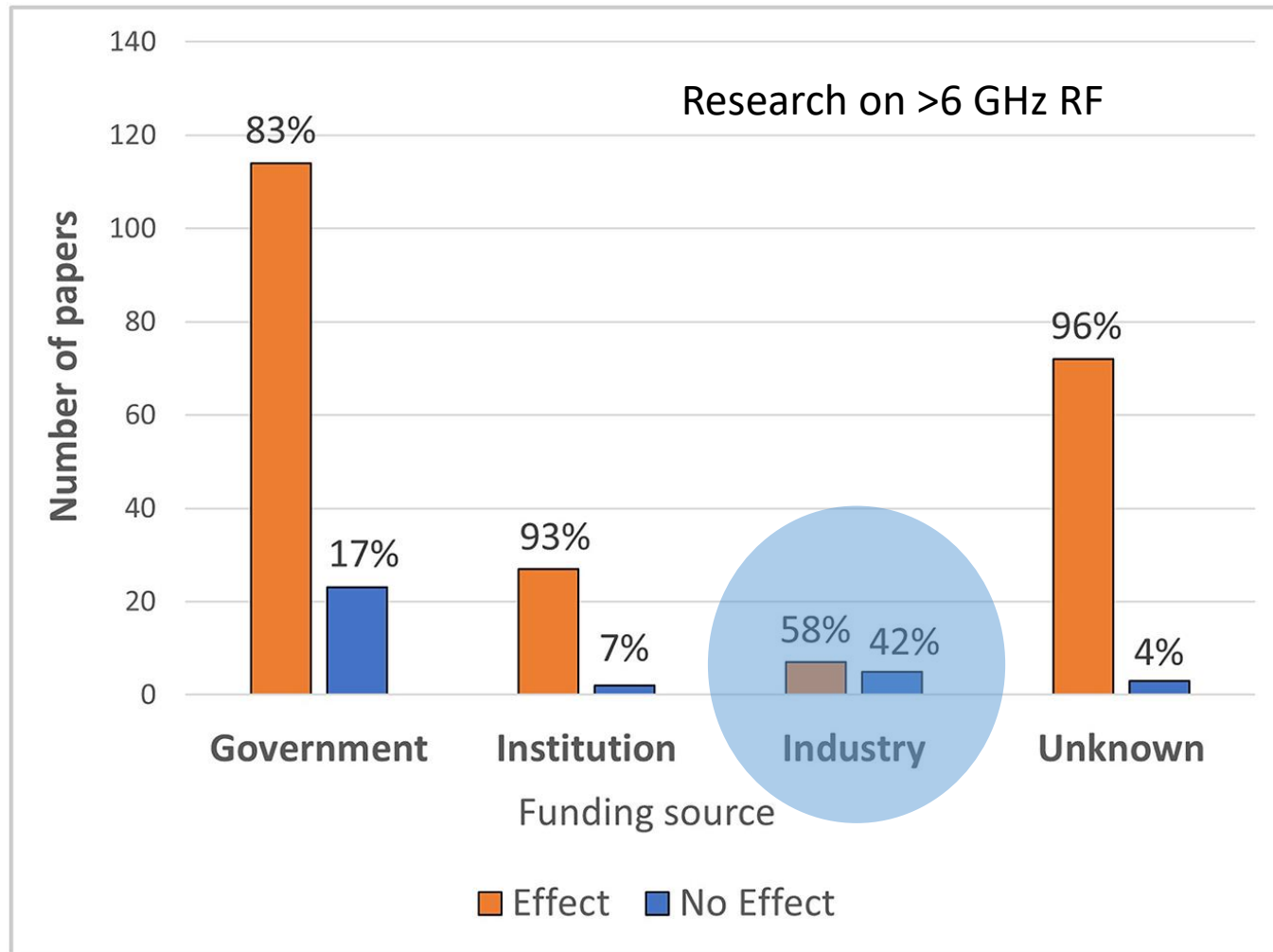
Outcomes related to Funding source

- Strong dependence of civilian and military economies on wireless radiation
- Minimal incentives for identifying adverse health effects and many disincentives (Kostoff 2019)
- Industry funded papers [as declared by authors] less likely to report significant effects (Huss 2007, Carpenter 2019)
- Funding bias overlooked in many research reviews



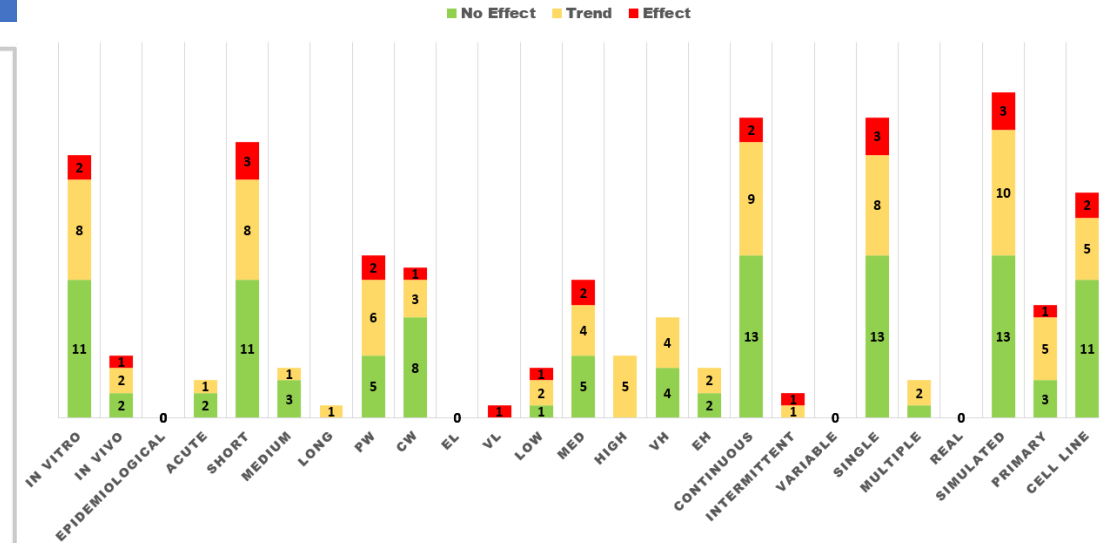
"You are completely free to carry out whatever research you want, so long as you come to these conclusions."

Funding Source Matters

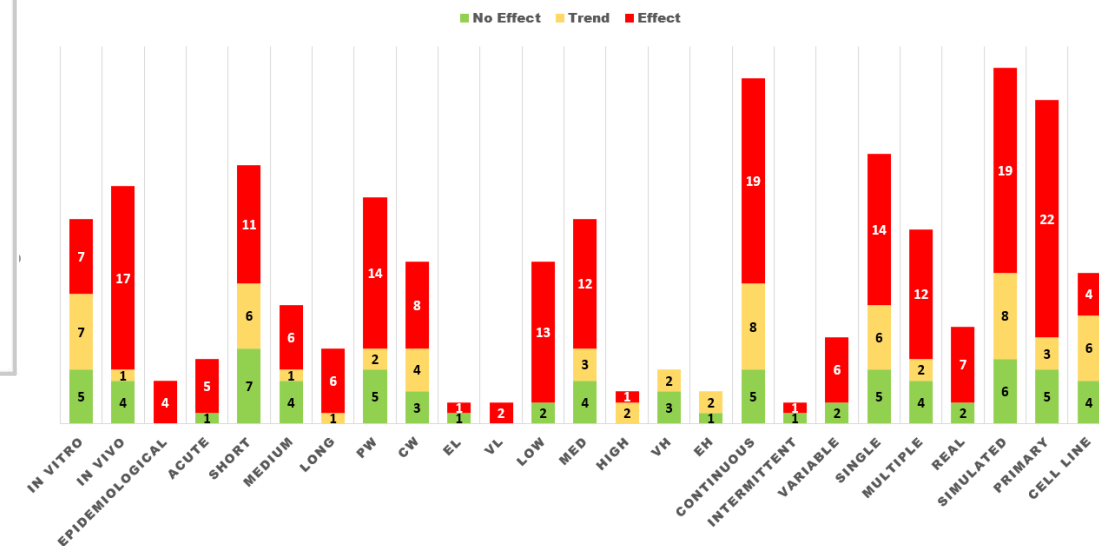


Source: <https://www.frontiersin.org/articles/10.3389/fpubh.2023.1058454/full#supplementary-material>

EXPERIMENT ATTRIBUTES - INDUSTRY FUNDED WITH PARTNERS



EXPERIMENT ATTRIBUTES - INSTITUTIONALLY FUNDED WITH PARTNERS

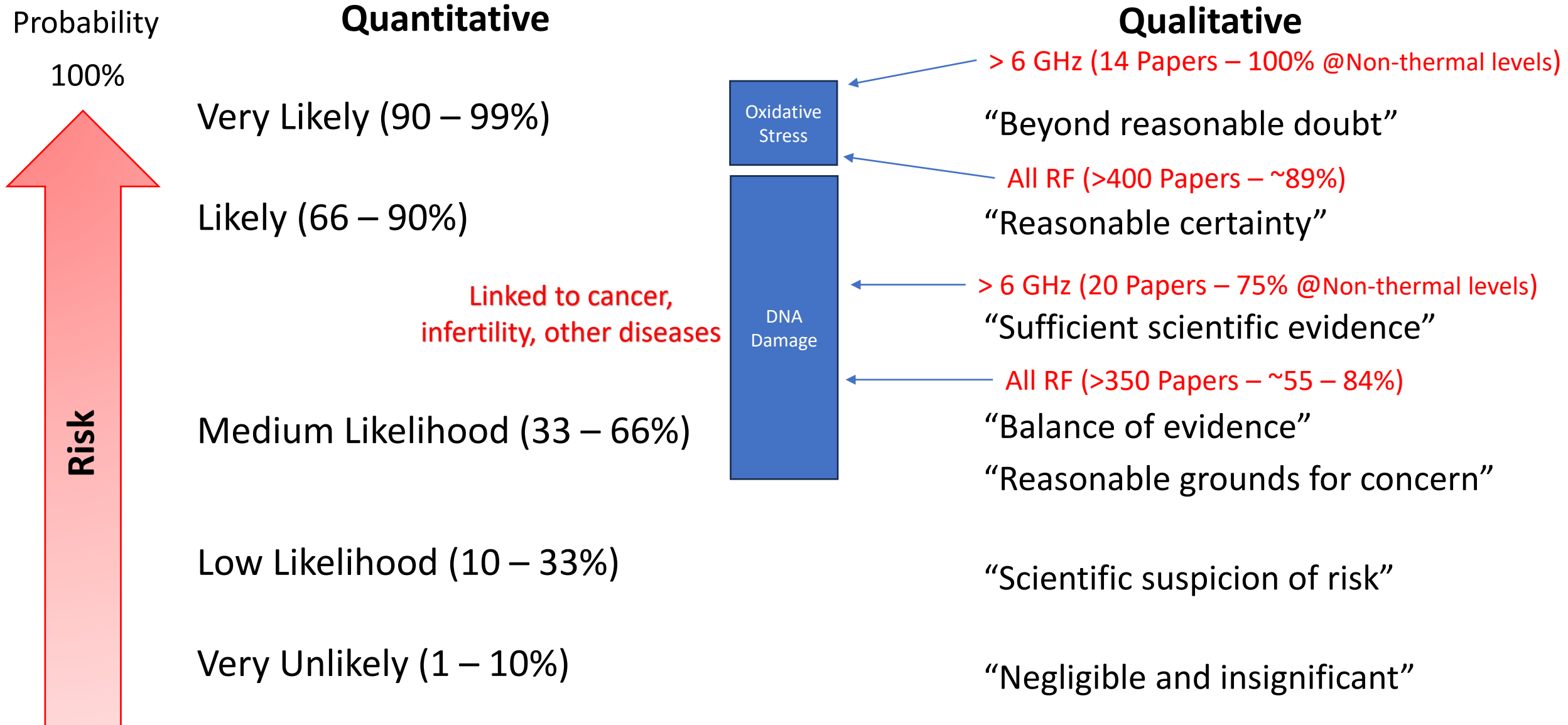


Source: https://www.researchgate.net/publication/369452089_Genotoxic_Potential_of_Radiofrequency_Exposures

Biases in reviews

- Systematic reviews are seen to be the gold standard
 - However, selection biases with inclusion/exclusion/quality criteria can be used to manipulate outcomes
- Both Simko et al. and Karipidis et al. listed significant effects in their reviews
 - Simko
 - Found 80% of in vivo and 58% of in vitro studies showed significant effects
 - BUT did not identify or discuss health risks from findings
 - Muted conclusion: “no confirmed evidence of harm” (Funded by Deutsche Telekom)
 - Karipidis et al. 2021 contained biases and fatal flaws
 - Omitted >70 experimental and 13 epidemiological relevant studies
 - >40 significant findings were not reported
 - Misstatements and misclassifications -> implications on Wood et al. meta-analysis
 - Concluded “no confirmed evidenceRF fields above 6GHz....are hazardous to human health”

Evaluating Health Risk



Closing Statements

- Assumption that 5G technologies are safe is not an evidence-based conclusion
- Risk assessment and precautionary approach not being applied
(Industry and government reviews, RF Standards, ICNIRP Guidelines)
- Economic benefits prioritised over health risks (Nyberg et al. 2022)
- More studies are needed:
 - 5G frequencies and modulations
 - Long term multiple exposures, different frequencies
 - Vulnerable populations, animals, insects and plants
- By scientists with no COI



Annexure

“Body scanners used at Australian airports for passenger screening are safe and do not pose a health risk”

<https://www.arpsa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/airport-passenger-screening>

Fact Check:

No independent studies performed to validate this claim – particularly for Airport security staff (operators)

Based on assumptions:

- Exposure levels are too low to cause heating and penetration is limited to skin
- mmWaves are non-ionising and cannot damage DNA

Question: How do we determine if there is a health and safety problem if no-one is doing the research?





relation to Police radar and Airport body scanners ARPANSA



“These uses have been thoroughly tested and found to have no negative impacts on human health”

<https://www.arpansa.gov.au/comm/consulting-icnirp-exposure-limits-falls-flat>



No supporting evidence was provided and is an example of an “appeal to authority” fallacy



“No health impact” claim ignores two independent police radar studies revealing a possible increased risk for testicular cancer (Davis et al. 1993 and Finkelstein et al. 1998)



Inputs into the 5G Health and Safety Narrative

Journal of Exposure Science & Environmental Epidemiology

www.nature.com/jes

COMMENT

OPEN

 Check for updates

Comment on “5G mobile networks and health—a state-of-the-science review of the research into low-level RF fields above 6 GHz” by Karipidis et al.

Steven Weller ^{1,2}, Murray May², Julie McCredde², Victor Leach², Dung Phung³ and Igor Belyaev⁴

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 **frontiers** | Frontiers in Public Health

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EDITED BY

Dariusz Leszczynski,
University of Helsinki, Finland

REVIEWED BY

Yael Stein,
Hadassah Medical Center, Israel
Wolfgang Kainz,
HPC for MRI Safety, United States

*CORRESPONDENCE

Victor Leach
✉ victor.leach@orsaa.org

The assumption of safety is being used to justify the rollout of 5G technologies

Julie E. McCredde¹, Steven Weller^{1,2} and Victor Leach^{1*}

¹Oceania Radiofrequency Scientific Advisory Association Inc. (ORSAA), Scarborough, QLD, Australia, ²Centre for Environmental and Population Health, School of Medicine and Dentistry, Griffith University, Brisbane, QLD, Australia

Experimental Studies (>6GHz)

- Evidence for genotoxicity – micronuclei, chromosome aberrations, DNA breaks, aneuploidy – All provide a plausible pathway to cancer (a possible mechanism to explain epidemiological evidence for cancer, congenital abnormalities and pregnancy complications)
- Significant evidence for cell proliferation and viability changes
- Membrane effects – Permeability changes (Therapeutic opportunities but also cell health implications)
- Oxidative stress – can cause genetic damage and involved in disease pathways
- Cell signalling effects, nerve action potential changes, neuron firing inhibition
- Apoptosis/necrosis – cell death
- Sperm and testicular effects – implications for fertility, pregnancy complications, congenital abnormalities
- Morphological and/or histopathological changes
- Evidence for behavioural changes, anxiety, memory and learning impairment
- Therapeutic effects – Anti-inflammatory, hypoalgesic action, immune system activation i.e., natural killer cells, tumour suppression (exposure duration sensitive as opposite action can occur)
- Ocular damage - Corneal epithelial damage, blepharedema (eye lid), inflammation
- Melatonin level changes
- Individual sensitivity

Epidemiology – Evidence of Risk (>6 GHz)

- Infertility – dose response relationship seen in radar operators (Baste et al. 2008, Mollerlokken et al. 2008)
- Sperm effects (reduced sperm counts and motility, morphological changes etc.) (Weyandt et al. 1996, Hjollund et al. 1997)
- Still Born, Congenital abnormalities (Mageroy et al. 2006)
- Perinatal mortality and Preeclampsia (Baste et al. 2012)
- Cancer (Stein et al. 2011, Peleg et al. 2018 and 2023, Richter et al. 2000) – Case Series/Case vs Case
- Testicular cancer (Davis 1993, Finkelstein 1998)
- Leukaemia (nonlymphocytic leukemia and ALL Leukemia) (Groves et al., Degraeve et al. 2009, Cano et al. 2001, Peleg et al. 2018, Savitz 1987)
- Non-Hodgkin's lymphomas (Cano et al. 2001, Peleg et al. 2023)
- Brain tumours (Degraeve et al. 2009, Grayson et al. 1996, Santana et al. 1999)
- Blood Genetic Damage - Micronuclei and DNA strand breaks (Garaj-Vrhovac et al. 2011), Chromosome aberrations (Lalic et al. 2001, Magdy 2002)
- Psychological symptoms and intermittent hypertension (Forman 1982)
- Melatonin and stress hormone level changes (Vangelova et al. 2002 and 2006), plasma catecholamine levels (Singh 1987)

Health risks identified in >6 GHz research reviews

- Alters gene expression, promotes cellular proliferation and synthesis of proteins linked with oxidative stress, inflammatory and metabolic processes, could generate ocular damages and affect neuro-muscular dynamics (Di Ciaula 2018)
- Antibiotic resistance/sensitivity in bacteria (Di Ciaula 2018, Russel 2018)
- Skin is a major target for MMW and affecting systemic signalling that can result in physiological effects on the nervous system, heart, and immune system mediated through neuroendocrine mechanisms (Russell 2018)
- Ocular effects including risk for cataracts, lens opacity, reversible and irreversible changes (Di Ciaula 2018, Russel 2018)
- Increased cancer risk – Group 2B potential carcinogen (IARC /WHO2011)
- Oxidative stress and altered gene expression, effects on skin and systemic effects such as on immune function, resonance with human sweat ducts, acceleration of bacterial and viral replication (Miller 2019)
- Haemolymphatic Cancer risks such as Leukaemia's and Non-Hodgkin's Lymphoma (Weller 2022, Peleg 2023)
- Male fertility risks (Di Ciaula 2018, Weller 2022)



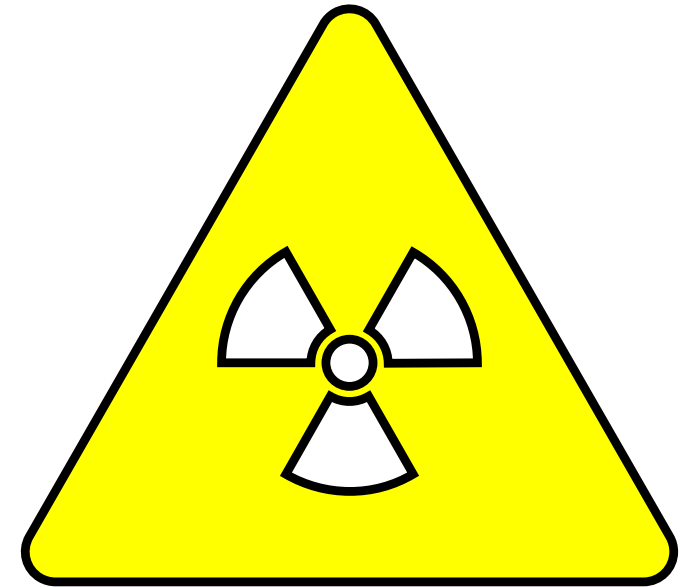
Existing Study Limitations

- Most laboratory experiments not designed to elicit adverse effects
 - Not reflective of real-life environment
 - Often single short-term exposures
 - Use of a signal generator and not real-world wireless devices
 - Non-inclusion of signal information or missing important signal attributes (pulsing and modulation) i.e., conduct testing with carrier wave without sending real data/voice information
 - Use of single stressors only (very few investigate synergistic/combinative effects e.g., other environmental toxins)
- Many experimental studies neglect delayed responses
 - Cells rarely respond instantaneously or in a linear manner
 - Takes time from when a signal transduction pathway is invoked to when a protein is expressed, including all the intermediary steps of mRNA transcription from DNA and translation of the mRNA to protein
 - Latent changes can appear many hours later, which assays won't pick up if they are performed during or immediately after exposure ceases



Existing Research Deficiencies

- Combinative and additive effects of multiple frequency exposures simultaneously
- Synergistic and combinative effects with other environmental toxins
- Long term chronic exposures
- Real life exposure studies (using real life wireless devices)
- 5G specific frequencies and modulations
- Limited investigations on environmental impacts



Discussion



Systematic reviews are important but depend on the skills of the researcher, interpretation of information, and criteria used for selection

Can be gamed and subject to bias via author opinions, quality and exclusion criteria



Narrative reviews can be comprehensive, but reviewer's background and experience also require consideration (novice vs seasoned expert)

Are less prescriptive than systematic reviews and can be susceptible to reviewer bias and COI



Sufficient evidence (not conclusive evidence) is all that is needed

Risks are potential hazards and not proof or confirmed evidence of harm (which is too late!)



Justification based on economic opportunities and consumer demand is not good enough – Health and Environment need consideration

Environmental and human health should take precedence over economics

Follow on questions in relation to expert opinions

- 
- Which scientists have received the bulk of the funding?
 - Which scientist are given media coverage?
 - Which scientists are being promoted or offered positions on research councils, committees and commissions? e.g., IARC, WHO EHC, SCENIHR.....
 - Which scientists found potential health effects and then had future funding denied?
 - Which scientists have been made redundant or had labs closed?
 - What position has been taken on health and safety by each of the above?
 - What relationships do each of the above have with industry/military/ government?

Vulnerable population ignored



ICNIRP RF Guidelines classify everyone under a general population group umbrella

- No consideration for vulnerable portions of the population
- Many studies are focused on healthy individuals, people with other co-morbidities are typically excluded
- RF is an environmental stressor and individual responses can vary (health status, genetic/epigenetic differences, other environmental factors - all have a role to play)



Fallacies in the communication of science

- mmWaves are assumed to be safer because they do not penetrate more than a few millimetres of the skin
 - Red Herring Fallacy as it does not consider skin function and properties
 - Rich in nerves connected to central and autonomous nervous system and blood vessels
 - Bodies first line of defence, contains protective bacteria and is part of body's immune, waste management and endocrine systems
 - Very little research investigating mmWave exposure and skin
- No replication or inconsistent results used to downplay findings
 - Straw Person Fallacy
 - Low number of mmWave studies
 - Complexity of available parameter combinations
 - Funding bodies typically do not fund replications – looking for original research
 - A lack of replication and inconsistencies between studies is to be expected
 - Should not disqualify or dismiss important findings

The fallacy of “Appeal to Authority”

- When claims are believed because they are made by alleged authorities, however, not all the following are true:
 - They are making claims within their field of expertise;
 - They are presenting facts about which there is some agreement;
 - They can be trusted

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