Peer-reviewed Publications on the Health Effects from Exposure to Radio Frequency Radiation

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This summary synthesizes 18 peer-reviewed scientific publications co-authored by Joel M. Moskowitz, PhD, for formal submission to the Department of Health and Human Services (HHS) and the Federal Communications Commission (FCC).

Much of this work was conducted on behalf of the International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF).

ICBE-EMF was founded in 2021 after being commissioned by the advisors to the **International EMF Scientist Appeal**, a petition signed thus far by more than 250 scientists who have published over 2,000 papers on EMF, biology, and health. The commissioners have endorsed the Appeal's recommendations to protect public and environmental health and, moreover, is dedicated to ensuring the protection of humans and other species from the harmful effects of non-ionizing radiation.

Our primary purpose is to make recommendations, based on the best peer-reviewed scientific research publications, that include, and go beyond establishing numerical exposure guidelines. ICBE-EMF is made up of a multidisciplinary consortium of scientists, doctors and related professionals who are, or have been, involved with research related to the biological and health effects of electromagnetic frequencies up to and including 300 GHz.

For more information see the submissions made on behalf of ICBE-EMF, the International EMF Scientist Appeal, as well as my other submissions.

Executive Overview & Regulatory Implications for the HHS & FCC

- **Inadequacy of Existing Exposure Limits:** Scientific evidence invalidates the health assumptions underlying the thermal-based RF-EMF exposure limits enforced by the FCC and guided by ICNIRP, particularly regarding non-thermal biological effects and 5G deployment risks.

- **Epidemiological Risk Evidence:** Rigorous meta-analyses demonstrate that long-term cellular phone use (≥ 10 years or $\geq 1{,}000$ cumulative hours) is associated with statistically significant increased risks of brain tumors (such as glioma) and acoustic neuroma.
- **Methodological Flaws in Flawed Industry & WHO Reviews:** Recent large cohort studies (COSMOS, MOBI-Kids) and WHO-commissioned systematic reviews (e.g., Karipidis et al., 2024) contain serious methodological flaws, exposure misclassifications, and unaddressed conflicts of interest that mask true health risks.
- **Disregard of Animal Toxicology Data:** Regulatory bodies fail to incorporate compelling experimental animal evidence demonstrating RF-EMF-induced carcinogenicity and reproductive toxicity into exposure limits.
- **Clinical & Policy Actions Required:** Federal authorities must establish biologically based safety standards, mandate hardware exposure-mitigation engineering, and address electromagnetic hypersensitivity (EHS) as a recognized biological condition using diagnostic biomarkers.

Detailed Thematic Summary of Publications

1. Meta-Analyses and Epidemiological Evidence on Tumor Risks

- **Myung et al. (2009) — *Journal of Clinical Oncology***
    - Conducted a meta-analysis of 23 case-control studies examining mobile phone use and tumor risk.
    - Found a statistically significant association between long-term mobile phone use (≥ 10 years) and increased risk of brain and head tumors, particularly among studies with high methodological quality.
- **Myung et al. (2010) — *Journal of Clinical Oncology***
    - Rebutted criticisms from Stang et al., Rowley et al., and Samkange-Zeeb et al.
    - Defended the meta-analytic methodology, selection criteria, and statistical sensitivity analyses confirming the link between cell phone use and tumor risk.

- **Choi, Moskowitz, et al. (2020) — *International Journal of Environmental Research and Public Health (IJERPH)***
    - Performed an updated systematic review and meta-analysis of 46 case-control studies.
    - Demonstrated that cumulative cell phone use of $\geq 1{,}000$ hours (approximately 17 minutes per day over 10 years) was associated with a 60% increased risk of brain tumors.
- **Myung et al. (2021) & Moskowitz et al. (2021) — *IJERPH***
    - Issued two formal scientific replies addressing comments on the 2020 Choi et al. meta-analysis.
    - Reaffirmed that methodological rigor and quality weighting confirm elevated tumor risks among mobile phone users.
- **Moskowitz (2022) — *Journal of the National Cancer Institute (JNCI)***
    - Critical commentary on the UK Million Women Study update.
    - Highlighted exposure misclassification, brief exposure durations, and failure to track heavy usage, which compromised the study's ability to evaluate brain tumor risk.

2. Methodological Appraisals of Cohort Studies and WHO Reviews

- **Hardell & Moskowitz (2022) — *Reviews on Environmental Health***
    - Evaluated the MOBI-Kids study on wireless phone use in children and adolescents.
    - Uncovered major methodological defects, including inappropriate selection of controls with conditions affecting wireless device use, leading to underestimated brain tumor risks.
- **Moskowitz et al. (2024) — *Environment International***
    - Critiqued the multi-country COSMOS cohort study.
    - Identified severe exposure misclassifications, short follow-up periods, and analytical flaws that render its conclusions regarding mobile phone health safety invalid.

- **Frank, Melnick, & Moskowitz (2024) — *Reviews on Environmental Health***
    - Appraised the WHO 2024 systematic review on RF-EMF exposure and non-specific symptoms (headaches, migraine, tinnitus).
    - Identified flaws in study inclusion criteria, risk-of-bias evaluations, and statistical synthesis that obscured health effects.
- **Frank, Moskowitz, et al. (2024) — *Environment International***
    - Analyzed the Karipidis et al. (2024) WHO systematic review on RF-EMF exposure and cancer.
    - Demonstrated that critical methodological errors, omitted data, and improper study selections invalidly claim no link between RF-EMF and cancer.
- **Melnick, Moskowitz et al. / ICBE-EMF (2025) — *Environmental Health***
    - Comprehensive review showing that the WHO-commissioned systematic reviews offer no assurance of safety.
    - Documented working group authors' conflicts of interest/industry ties and detailed fundamental methodological defects in the meta-analyses.
- **Melnick, Moskowitz, & Héroux (2026) — *Environmental Health***
    - Commentary analyzing conflicting methodologies and validity issues in follow-up experimental carcinogenesis studies on RF radiation.

3. Invalidation of RF-EMF Regulatory Limits and Engineering Solutions

- **ICBE-EMF (2022) — *Environmental Health***
    - Demonstrated that the physical and biological assumptions underlying FCC and ICNIRP exposure guidelines are scientifically invalid.
    - Highlighted that thermal-only thresholds ignore non-thermal biological damage, DNA disruption, and risks associated with 5G technologies.
- **Héroux et al. / ICBE-EMF (2023) — *IJERPH***
    - Outlined cell phone radiation exposure limits alongside concrete engineering solutions.
    - Proposed technical design standards for wireless hardware to reduce user RF-EMF exposures.

- **Melnick & Moskowitz / ICBE-EMF (2026) — *Environmental Health***
    - Demonstrated that current regulatory exposure limits fail to account for cancer risk and reproductive toxicity documented in experimental animal studies.

4. International Calls for Protection, Exposure Measurements, and Clinical Biomarkers

- **Kelley et al. (2015) — *European Journal of Oncology***
    - Published the International EMF Scientist Appeal signed by global researchers.
    - Called on the UN, WHO, and national governments to enact stricter protective guidelines against non-ionizing electromagnetic fields.
- **Sagar et al. (2018) — *Environment International***
    - Evaluated RF-EMF exposure levels across everyday microenvironments across multiple international cities.
    - Provided real-world comparative spatial data on public wireless exposure levels.
- **Belpomme et al. (2021) — *International Journal of Molecular Sciences***
    - Scientific consensus report on electromagnetic hypersensitivity (EHS).
    - Established the diagnostic importance of objective molecular biomarkers and neuroimaging in identifying and managing EHS.

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Supplementary Material 1. "Examples of Working Group Authors' Ties to Industry" (1 page)
Supplementary Material 2. Moskowitz: "The Meta-Analyses in the WHO RF-EMF Systematic Reviews Yielded Unreliable Results" (31 pages)

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