



Health Matters

World Health Organization's EMF Project's Systemic Reviews on the Association Between RF Exposure and Health Effects Encounter Challenges

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Recently, the World Health Organization's EMF Project (WHO-EMF) has published several of its commissioned systematic reviews on health effects of radio frequency (RF) radiation that are employed by cellular mobile and wireless communication systems and devices. They are published as part of a special series in the journal *Environment International*, with Paul Whaley as the handling editor (See "Note").

The WHO-EMF project was established to assess the health and environmental effects of exposure to electromagnetic fields and radiation in the frequency range of 0–300 GHz. While it asserts that its funding is provided by contributions from WHO member states, it does not disclose what fractions of WHO-EMF funding are derived from government or industry sources [1]. It has been acknowledged that up to half of the funds raised for the



WHO-EMF project came from industry sources and that others had contributed staff time. From time to time, the staff time appears to have involved individuals with close ties to the International Commission on Nonionizing Radiation Protection (ICNIRP). The major source of funding for ICNIRP comes from the German Federal Office for Radiation Protection [2].

Note: Whaley appears to have presented on the proposed reviews as a WHO-EMF team member alongside Emilie van Deventer, Martin Rössli, and Jos Verbeek at a Navigation Guide workgroup webinar, hosted by University of California at San Francisco on December 17, 2021.

The protocol for the WHO-EMF systematic review was released in 2021 [3]. The systematic review study methodology employs a protocol for grouping, summarizing, and evaluating all relevant published studies on a research topic. The methodology involves defining the topic, setting inclusion and exclusion criteria, assessing the quality of the studies, analyzing the data, and reporting the results. However, improperly assessed quality of study or data in systematic reviews could lead to distorted conclusions. Therefore, various guidelines have been suggested for conducting systematic reviews to help improve the scientific quality, outcome, and usefulness of systematic reviews. The objective is to mitigate the likelihood of any subject matter that could mislead the unexperienced reader. Additionally, accepting the conclusions of a systematic review without proper appraisal to ascertain its limitations, transparency, and credibility can be precarious.

Case in Point

- 1) The WHO-EMF systematic review on the association between RF exposure and adverse health effects

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pertaining to reproductive health (pregnancy and birth outcome) concluded that in utero RF exposure does not have a detrimental effect on fecundity but likely affects offspring health at birth [4]. Regarding the possible delayed effects of in utero exposure, RF radiation probably does not affect offspring brain weight and may not decrease female offspring fertility. Also, RF exposure may have a detrimental impact on neurobehavior functions, but these findings are very uncertain.

A detailed assessment of the quality of this systematic review and evaluation of the relevance of its conclusions to pregnant women and their offspring shortly followed in a peer-reviewed publication [5]. The quality and relevance were checked using the review's selection of papers and chosen statistical methods. While the WHO-EMF systematic review presents itself as thorough, scientific, and relevant to human health, numerous issues were identified, suggesting the WHO-EMF review was severely flawed. The found flaws skewed the results in support of the review's conclusion that there is no conclusive evidence for effects other than RF-induced tissue heating. It showed that the underlying data, when relevant studies are cited correctly, support the opposite conclusion: "There are clear indications of detrimental non-thermal effects" from RF exposure. The authors identified a multitude of flaws in the methodology. To those scientists, the methodology and low quality of the systematic review were highly concerning "as it threatens to undermine the trustworthiness and professionalism of the WHO-EMF project in the area of human health hazards from man-made RF radiation."

2) The WHO-EMF systematic review of human observational studies on the occurrence of migraine, headaches, tinnitus, sleep disturbances, and nonspecific symptoms in the

general and working population [6] stated that the body of scientific evidence reviewed supports the safety of currently promulgated ICNIRP guidelines for RF exposure [7].

An ensuing critical appraisal by three accomplished senior researchers documented major problems with the WHO-EMF-commissioned review and called for its retraction [8]. The meta-analysis for the handful of very heterogeneous primary studies identified for each of the analyzed exposure and outcome combinations appeared fundamentally inappropriate. The number is very small, and the methodological quality of the relevant primary studies is low. In contrast, this peer-reviewed publication concluded that the body of evidence reviewed is inadequate to either support or refute the safety of current exposure limits.

3) Some skepticism has been expressed regarding a third WHO-EMF systematic review on RF-induced oxidative stress [9]. The study identified 11,599 studies on oxidative stress in the frequency range 800–2,450 MHz and then eliminated 11,543 of them as not meeting the criteria for inclusion. Of the remaining 56 papers, there were 45 animal studies and 11 in vitro cellular studies. The conclusion was that a majority of the included studies provided high heterogeneity. The oxidative stress effects were inconsistent across the experimental preparations studied. There may or may not be an effect of RF exposure, but the certainty of the evidence is very low.

For many years, Henry Lai, a leading researcher in RF oxidative responses and professor emeritus at the University of Washington, Seattle, has maintained a bibliography of RF-oxidative stress papers. As of mid-August, his list includes 367 studies, published between 1997 and 2024. By his count, 89% showed significant effects. Lai's assessment of the WHO-EMF review

is that it left out a large portion of RF-oxidative effect studies and appears to have only considered oxidative molecular reactions among the possible oxidative effects [10]. As reported, others have opined that "this systematic review methodically excluded most of the relevant research."

4) The latest WHO-EMF systematic review comes with a subtitle of "most researched outcomes" [11]. The purpose of this review was to assess the quality and strength of the evidence provided by human epidemiological studies for a causal association between RF exposure and risk of the most investigated neoplastic diseases. The study selected 63 papers, published between 1994 and 2022. It concluded that RF exposure from cellular mobile phones was not associated with an increased risk of glioma, meningioma, acoustic neuroma, pituitary tumors, or salivary gland tumors. The conclusion suggested that there was not an observable increase in relative risk for the most investigated neoplasms (glioma, meningioma, and acoustic neuroma) with increasing time since the start of the use of cellular mobile phones, cumulative call time, or cumulative number of calls. The message is clear: there is little evidence to justify continued concern over a possible cancer risk.

This WHO-EMF review was picked up and reported on by many Western media outlets. Actually, there are truly few data that are new in this review. For sure, the assessment of scientific evidence in this subject has been controversial and less than uniform. The question is, "Is this review really the definitive word on the long-standing issue of whether cell phone radiations pose a cancer risk?" My answer is, far from it!

Microwave News [12] published a meticulously researched investigative report in the historical context of the latest WHO-EMF cancer review. Five years ago,

the lead author [13] with some members of the same team made similar efforts to terminate the RF–cancer debate with basically the same no-risk message. However, “it was not well received” by the scientific community, since the analysis excluded some people older than 59 years of age, the largest segment of the brain cancer population.

The International Agency for Research on Cancer (IARC), WHO’s specialized agency, in 2011 classified exposure to RF radiation as a possible carcinogen in humans on the strength of human epidemiological evidence [14]. The WHO-IARC deemed epidemiological observations in humans exhibiting higher risks for the glioma type of malignant brain cancer and a benign vestibular schwannoma of the vestibulocochlear nerve among heavy or long-term users of cellular mobile phones are satisfactorily robust to approve the classification.

Significantly, subsequent results from animal experiments provided by the U.S. National Institutes of Health’s National Toxicology Program (NIH-NTP) showed two types of cancers in laboratory rats that were exposed, lifelong, to cell phone RF radiation [15], [16]. The research finding was complemented by another well-conducted, large RF animal exposure study involving lifelong exposures of the same strain of rats in the same year (2018). This consistent set of carcinogenicity results was reported from the Cesare Maltoni Cancer Research Center of the Ramazzini Institute in Bologna, Italy [17].

The WHO-IARC, NIH-NTP, and Ramazzini outcomes, under normal circumstances, would likely have provided the justification for raising WHO-IARC’s current possible cancer risk designation to the probable cancer-causing classification, if not higher.

The criticisms and challenges encountered by the published WHO-EMF systematic reviews are brutal, including calls for retraction. Rigorous examinations of the reviews reveal major concerns. In addition to the

scientific quality, they appear to have a strong conviction of nothing but heat to worry about with RF radiation. The unobvious message that cellular mobile phones do not pose a cancer risk is clear. The reviews exhibit a lack of serious concerns for conflicts of interest and display unequivocal support for the recently promulgated ICNIRP RF exposure guidelines for human safety.

From its inception, WHO-EMF had close ties with ICNIRP, a private organization, frequently referred to as the WHO-EMF project’s scientific secretariat [18]. What may not be as apparent for the WHO-EMF systematic reviews is the lack of diversity of views. A large number of ICNIRP commissioners and committee members are listed as authors for the WHO-EMF systematic reviews; some also served as lead authors. These concerns advance issues of reviewer independence and potential for conflicts of interest.

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