Letter to the Editor

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Comments on the article by Dariusz Leszczynski: Review of the scientific evidence on the individual sensitivity to electromagnetic fields (EHS). Rev Environ Health 2021

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In the article “Review of the scientific evidence on the individual sensitivity to electromagnetic fields (EHS)” [1], Dariusz Leszczynski criticizes previous research for not being able to reveal factors causing non-specific symptoms that some people experience when being exposed to electromagnetic fields (EMF). He therefore proposes types of studies and methods to overcome previous limitations. While a critical review and suggestions for further research are useful, there are several inconsistencies and misinterpretations in this article. We will comment on two main issues: 1) research of relevance to explore a potential relation between EMF exposure and the condition of EHS and 2) some misunderstandings regarding the methodological conduct of our systematic review [2]. In the following, instead of EHS, we will use the more neutral term “Idiopathic environmental intolerance attributed to electromagnetic fields” (IEI-EMF).

Research of relevance to explore a potential relation between EMF exposure and EHS

According to their claims, people with IEI-EMF mainly associate non-specific symptoms and reduced well-being

with EMF exposure situations. Therefore, the investigation of symptoms should be of primary interest. Leszczynski recognizes the importance of assessing symptoms since he suggests that symptom registration should be considered along with registration of objective outcomes in experimental studies. However, he repeatedly seems to invalidate studies with subjective outcomes by e.g., stating: “Experimental data collected in such studies is likely biased because of the strong individual dependent subjectivity of responses provided by each study subject. Relying solely on such subjective database of effects might lead to bias in evaluation of the results of the studies and cause dismissal of the EHS because the feelings-based data is too diverse and has too much of internal variability to provide statistically significant results.” It is true that there may be large variability with subjective outcomes like symptoms, which are self-reported. Therefore, it is important to ensure sufficient statistical power by design and by including a high number of participants or repeated trials. It is unfortunate that most studies did not consider this key requirement, while only few studies did, (e.g. [3–6]). Leszczynski specifies that further studies should “have double-blind set-up”, which we agree to because effective blinding of the exposure status is an essential component in decreasing risk of bias. However, in his evaluation he included studies where participants were fully aware of the exposure status (e.g. [7, 8]), but Leszczynski left uncommented this methodological limitation. With non-blinded experimental studies, it is not possible to differentiate between the effect of EMF and the effect of being aware of the exposure status.

We also agree with Leszczynski that effects of exposure on objective outcomes are of interest in addition to effects on symptoms. It should be noted that effects on such outcomes may indicate a physical relation between EMF exposure and IEI-EMF if the effects are larger in individuals with IEI-EMF than in healthy controls. If similar physiological or biochemical responses

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are observed in the two groups, the hypothesis of a physical effect of EMF exposure on the condition of IEI-EMF would be supported only if there is a known link between the objective outcome measure and the symptoms experienced by the IEI-EMF individuals. In the supplementary material, Leszczynski provides two tables with descriptions of provocation studies. Although he repeatedly claims that there are very few studies with objective outcomes, he lists around 37 such studies that included IEI-EMF participants (note that the number is not exact since information about participants is missing for some studies). Also, many of the described studies assessed objective outcomes in healthy participants, e.g. through EEG recordings and by testing cognitive performance. Still, Leszczynski did not make any attempt to compare the results obtained with healthy participants and those obtained with participants with IEI-EMF. A systematic review on the relation between EMF exposure and objective outcomes was published in 2011 by Rubin et al. [9]. While a few of the evaluated studies reported effects on physiological or cognitive responses in participants with IEI-EMF or in healthy controls, the review authors did not find evidence that the responses to EMF exposure differed systematically between the two groups. However, additional studies with objective outcomes have been published after 2011, and some included individuals with IEI-EMF. Therefore, an updated systematic review may provide new insight.

In addition to provocation studies, Leszczynski refers to survey studies. While it is of interest to explore whether higher exposure to EMF over time may result in symptoms attributed to EMF, the results of such observational cross-sectional studies cannot be used as evidence for causality between EMF exposure and adverse health effects. They can only provide the basis for hypotheses to be tested with causal research. To test acute effects, we recommend controlled experimental setups. More appropriate to assess symptom development over time are prospective observational studies or long-term intervention studies.

Misunderstanding of eligibility criteria and quality assessment in our systematic review

Under the headline “Quality of the EHS research” Leszczynski refers to our systematic review in which we evaluated methodological limitations in experimental

studies on symptom development in IEI-EMF individuals and analyzed whether these limitations might have given rise to false positive or false negative results [2]. In his review, Leszczynski lists the 13 key questions that we used as the basis to critically assess risk of bias in each study, but he then states: “Only 28 of the to-date published EHS psychological provocation studies was considered by the review authors to be of sufficient quality for the inclusion in the review. These 28 studies were considered to be methodically sound. ... This review [254] shows how very imperfect is the research on EHS because of the identified 845 studies only 28 were selected as of eligible quality, after fulfilling the 13 criteria.” It is not correct that the 13 key questions served as inclusion criteria. They were instead applied to assess the methodological quality of the included 28 studies, while the criteria for study selection are presented transparently in our systematic review under “eligibility criteria”.

Furthermore, it is a misunderstanding that all 845 articles (“hits”) identified during the literature search were relevant regarding IEI-EMF. Non-relevant hits are common in database literature searches, and the vast majority of the identified studies did not match our *a priori* specified eligibility criteria. The number of studies excluded in the various stages of the systematic study selection process and the reasons for exclusions are detailed in our Figure 1 in [2]. To reduce risk of bias in our systematic review, we specified clear criteria for study eligibility and for the assessment of the methodological quality of the included studies. The review by Leszczynski lacks both a notation regarding the criteria for the literature selection and a description of the methodological approach for reviewing the selected studies. This leaves the review's conclusions open to bias due to potential subjective selection of the included studies and due to nonconformity in the extraction and evaluation of data from each study.

We welcome further critical debates on IEI-EMF research, but these should be based on systematic reviews that adhere to international guidelines defining precise standards for collecting, analyzing and reporting the evidence.

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