



Bundesamt
für Strahlenschutz

Spotlight on EMF Research

Spotlight on “Exposure perception and symptom reporting in idiopathic environmental intolerance attributed to electromagnetic fields using a co-designed provocation test” by Ledent et al. in Bioelectromagnetics (2025)

Category [across frequencies, human study]

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Competence Centre for Electromagnetic Fields (KEMF)

1 Putting the paper into context by the BfS

Idiopathic Environmental Intolerance Attributed to Electromagnetic Fields (IEI-EMF), also called electro-sensitivity or electrohypersensitivity (EHS), is a condition in which subjects attribute various unspecific symptoms such as headache, sleep disturbances, fatigue, or difficulty concentrating to the presence of electromagnetic fields (EMF) in their environment. Available evidence based on provocation studies under double-blind conditions consistently suggests that individuals considering themselves electrosensitive are unable to perceive acute exposure to EMF, and that their symptoms are not provoked by EMF exposure [2]. However, the IEI-EMF population is heterogeneous concerning reactions to various kinds of exposure, perceived symptoms, and time course of the reaction. Therefore, high-quality studies at the individual level were suggested [3].

2 Results and conclusions from the perspective of Ledent et al.

The study protocol for this double-blind randomised experimental laboratory study [1] was developed in collaboration with IEI-EMF individuals over several meetings and workshops (co-designed protocol [4]). Participants were habituated to the study conditions during an open-label session, i.e., they knew their exposure status. Measures were taken to reduce anxiety and discomfort. To reduce burden, the exposure duration and the number of sessions were tailored to each individual. Each participant underwent either three or twelve sessions, each assigned to predefined sequences alternating between real and sham exposures. Session duration was either 40 minutes per session, or only a few minutes down to seconds for very sensitive individuals. The first three sessions were used for between-participants (collective level) and all twelve for within-participants (individual level) comparisons. Before and after each session (sham or real), participants reported perceived symptoms. After each session, they reported their certainty of having been exposed, which contributed to an exposure certainty level ranging from -10 (complete certainty of no exposure) to +10 (complete certainty of exposure).

The exposure consisted of a mixture of real-life exposures, including RF-EMF from various mobile communication standards (LTE, UMTS), Wi-Fi, and DECT, as well as 50 Hz magnetic field exposure. The exposure was continuously monitored during the experiment.

The study enrolled 47 individuals of which 27 remained after the habituation session. Using a questionnaire, they were divided in three subgroups: IEI-EMF++ with a high sensitivity score, IEI-EMF+ with a lower sensitivity score [5], and IEI-EMF? who questioned their sensitivity to EMF, i.e., they were not sure if they are IEI-EMF or not.

Ledent et al. tested the following hypotheses:

1. Exposure perception is consistent with the exposure status (at collective and individual level).
2. IEI-EMF volunteers report more symptoms after real exposure compared to sham (at collective and individual level).
3. Symptom reporting depends on exposure perception (at collective and individual level).
4. Using refined criteria [5] to define IEI-EMF individuals results in improved performance at subgroup level.
5. The co-designed protocol is acceptable to IEI-EMF individuals.

At the collective level, no statistically significant differences were observed in subjective exposure certainty level or symptom reporting by exposure status (real or sham). Results were similar in the IEI-EMF++ subgroup.

At the individual level, none of the 16 volunteers who completed all 12 sessions could correctly distinguish real from sham exposures. IEI-EMF++ volunteers did not display a higher ability to discriminate between real and sham. Surprisingly, three volunteers showed statistically significant results in their certainty of exposure

perception, but in the opposite direction than expected: they were more certain of being exposed during sham sessions. One person was able to recognise the actual exposure correctly in most cases, but did not achieve statistical significance. There was no difference in the increase in symptom reporting between real and sham exposure sessions.

In all individuals, the certainty of exposure perception was positively correlated with the post-session increase in symptom reporting. In eight out of 16 volunteers, the correlation was statistically significant. Overall, only 20% of sessions showed no association between exposure perception and symptoms. At the collective level, there was also statistically significant positive correlation between the certainty of exposure perception and symptom reporting in both the combined IEI-EMF+/IEI-EMF++ group and the IEI-EMF++ subgroup.

Participants expressed varying degrees of acceptability of the study protocol. In particular, those classified as IEI-EMF++ were dissatisfied that the results did not support their hypothesis of a link between real exposure and symptoms. Despite the negative results of this study, participants did not question their attribution of symptoms to EMF exposure.

Ledent et al. conclude that they found no evidence of an association between real exposure and either symptoms or exposure perception. In contrast, a strong relationship was found between subjective exposure perception and symptoms. Restricting analyses to the most sensitive subgroup did not change the results. However, the authors also point to the small number of participants and the wide variability in individual sensitivity, which limit the generalisability of the results. The acceptability of the protocol was only partial. Therefore, only hypothesis 3 could be affirmed.

3 Comments by the BfS

This hypothesis-driven study [1] followed recent recommendations [3] to perform studies at the individual level. Several improvements to the study protocol [4] were made with the involvement of IEI-EMF individuals to better address the needs of the IEI-EMF population, but this also introduced some limitations. The attempt to reproduce real-world exposure conditions was defined in agreement with IEI-EMF individuals in the co-designed study protocol. This resulted in a mixture of frequencies and exposure intensities, making a comprehensive dosimetry assessment virtually impossible. However, the exposure was monitored during the experiments, and a sufficient exposure contrast was documented. Furthermore, the number of participants was quite low and there was considerable individual variability among them. It must be assumed that the sample examined was not representative for the IEI-EMF population. It was not possible to identify a subgroup of highly sensitive IEI-EMF individuals by using improved questionnaires [5] (hypothesis 4). There is still a need for improved identification of IEI-EMF individuals using objective methods, e.g., biological markers, but no such markers have been discovered [6].

The results confirm the recent state of knowledge [2] and suggest that neither reported symptoms nor subjectively perceived EMF exposure correlate with real exposure. However, there appears to be a strong relationship between perceived exposure and reported symptoms. This supports the hypothesis that, at least for short-term effects, a nocebo effect is involved.

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Bundesamt für Strahlenschutz
Postfach 10 01 49
38201 Salzgitter

www.bfs.de

Tel.: +49 30 18333-0
Fax: +49 30 18333-1885
E-Mail: spotlight@bfs.de

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