

BRIEF REPORT on the EHS provocation studies

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Note: This is not a comprehensive review of the published EHS provocation studies

Part of the population considers themselves as sensitive to radiation emitted by the wireless communication devices and networks. Different studies have indicated that ca. 0.5 – 11% of the population might be experiencing sensitivity symptoms. This ailment, called either electromagnetic hyper-sensitivity (EHS) or idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF), is currently not considered by the World Health Organization as being caused by the exposures to electromagnetic fields (EMF). While the symptoms experienced by some persons are acknowledged as health impairment, the cause of these symptoms is considered to be unknown.

Numerous experimental provocation studies (see **Appendix Table**) were executed to determine whether EMF exposure causes EHS. In provocation studies, volunteers are exposed to radiation emitted by the wireless communication devices, in controlled conditions, and asked whether they get health symptoms and whether they recognize when the radiation is on/off. Answers provided by the study subjects are *subjective* and not *objective* experimental data. Collectively, the provocation studies have indicated a lack of causality between the EHS symptoms and exposures to EMF.

All of the to-date executed EHS provocation studies provide unreliable results because of several drawbacks in the design and execution of the experiments.

Using, as it is done now, of such '*subjective*' and scientifically unreliable data to support health policy decisions concerning the EHS/IEI-EMF is a mistake.

Any attempts at improving the methodology of the provocation studies will not lead to the generation of '*objective*' and reliable scientific data. The data will remain to be '*subjective*' and scientifically unreliable.

The Question: is EHS caused by EMF?

There is no scientific reason why the EMF could not cause EHS in some part of the human population. There is a well-known, and scientifically well-established, phenomenon of the individual sensitivity (Foray et al. 2012). Individual sensitivity means that, because of the genetic and the epigenetic differences between people, different persons have different sensitivity to the same exposing factor (radiation or chemicals).

The phenomenon of the individual sensitivity to radiation is well known for ionizing radiation (Bourguignon et al. 2005a, 2005b), for non-ionizing ultraviolet radiation (Rees 2004, Kelly et al. 2000) and for ultrasound (Barnett et

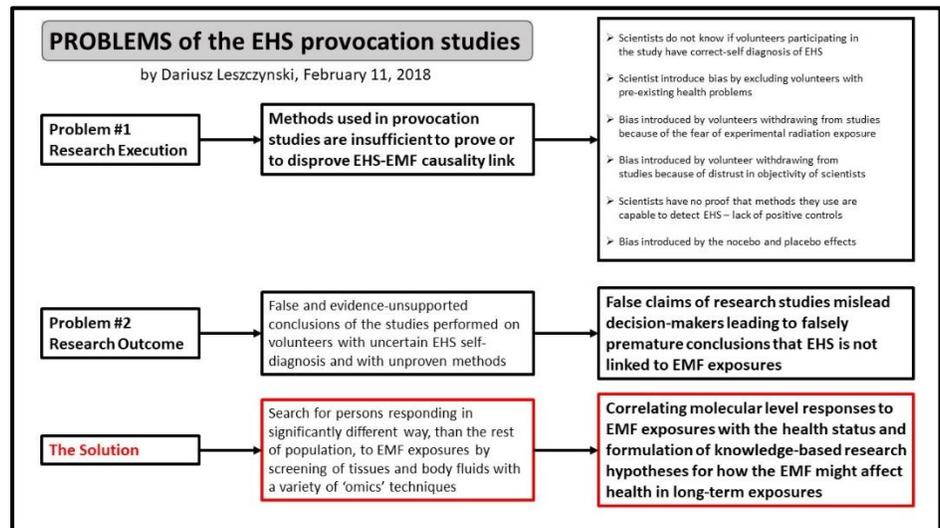
al. 1997).

Therefore, it is scientifically justified to suspect (assume) that the individual sensitivity exists also for the EMF exposures. However, the essential, but still unanswered questions are:

- what are the levels of EMF that are tolerated without any adverse health effects by the majority of the population and,
- what are the physiological pre-conditions for the higher sensitivity to EMF.

Drawbacks in the design of the EHS provocation studies

Below is the list of several drawbacks in the design and execution of the EHS provocation studies that effectively invalidate the conclusions of the EHS provocation studies.



Drawback #1. False claim concerning experimental volunteer group

The scientists executing provocation studies claim to be examining a causality link between EHS and EMF in volunteers suffering from the EHS. However, the scientists do not know how many, if any at all, actual EHS persons are present in the experimental group of the volunteers.

In all provocation studies the experimental group has been assembled from the persons that responded to a recruitment announcement by the scientists. Because there is not existing any objective method to diagnose the EHS, the scientists rely completely on the volunteers' self-diagnosis.

Correctness of the self-diagnosis is very uncertain because the symptoms of the EHS are very non-specific and similar to symptoms experienced in e.g. allergy or emotional stress. The self-diagnosis, made by the EHS person, might be in error. The self-diagnosed EHS volunteer might assume that the symptoms are caused by the EMF exposure when, in reality, these symptoms might be caused by other, non-EMF factor(s) present in the environment.

This means that the group of the volunteer EHS persons might be contaminated, to an unknown degree, by erroneously self-diagnosed EHS persons. In fact, in extreme case, it might be that none of the EHS volunteers has a correct self-diagnosis of the EHS. Because the volunteer groups in the provocation studies are small, or extremely small, as in the recent study from the Wollongong group (n=3!)(Verrender et al. 2017), the potential impact of the 'contamination' by the falsely self-diagnosed EHS will have significant impact on the study outcome.

Drawback #1 is the major problem that invalidates conclusions of the all EHS provocation studies. In all of the studies the authors claim that

- EHS volunteers are unable to correctly feel when the radiation exposure is turned on and when it is turned off, and
- EHS volunteers experience EHS symptoms at random and not only when exposed to EMF.

However, the scientists do not know if any of the EHS-volunteers has really EHS or the symptoms, self-diagnosed by the volunteer, are caused by something else than the EMF.

Any conclusions made by the scientists who were using in their studies such un-defined groups of volunteers are either misleading or completely false.

Drawback #2. Bias introduced by exclusion of persons with prior health problems

In the selection of the volunteers for the EHS provocation studies process, performed by the scientists, persons with the pre-existing health problems are excluded. This might be a bias-introducing factor. The scientists do not know whether any pre-existing health impairment(s) might pre-dispose a person to become the EHS sufferer. Therefore, exclusion of persons based on pre-existing health condition(s) is incorrect at this discovery stage. Persons with pre-existing health problems that claim to be self-diagnosed EHS sufferers should be included in the study but might be analyzed as a separate sub-group.

Drawback #3. Bias introduced by fear and by reputation of the research group

An additional bias might be introduced, seemingly independently of the scientists, when the volunteers who expressed interest in participation in the study, withdraw or are not responding to scientists' inquiries. E.g. in the case of Verrender and co-workers' study (Verrender et al. 2017) the number of volunteers who withdrew from the study was very high - 16 persons out of the initially agreed 25. The withdrawals might be caused by fear of the health effects caused by the voluntary radiation exposure in the experiments. However, there might be also a scientists' reputation-dependent withdrawal. This aspect has not been mentioned or examined in any of the provocation studies. When the initially agreeable volunteers become aware of the publication record of the scientists and their publicly expressed opinions about the EHS, it might cause withdrawal of some of the volunteers, who might 'distrust the scientists'.

Drawback #4. Unproven methodology of the provocation studies – lack of positive controls

Another problem with the EHS provocation studies is the experimental set-up and methodology. None of the experimental exposure set-ups and methods to analyze volunteers' responses to exposures have been proven to be sufficient and adequate to detect a causal link between the EMF exposures and EHS. Assuming that the EHS phenomenon exists, as presented above, the scientists have had no positive controls in their experiments to show that their experimental approach works correctly. It is unclear whether the methods, assumed to be adequate for detecting EHS, have indeed had the capability to do so. Furthermore, the design of all provocation studies has been set to detect only an acute EHS, hence being unsuitable to detect delayed or chronic EHS outbreaks.

Drawback #5. *Placebo & nocebo* effects

It is likely that the conclusions of EHS provocation studies are invalidated by the *placebo* and *nocebo*

effects. *Placebo* and *nocebo* show the ability of the human mind and beliefs to alter the physiology of the human body (Benedetti et al, 2011, Tinnermann et al. 2017). All persons volunteering in the EHS provocation studies certainly have an opinion about the possible effects of EMF on human health, no matter what this opinion is. The responses given by the self-diagnosed EHS, given in the course of the experiments, have certainly been influenced by the volunteers' pre-existing opinions about the EHS and by the emotional stress caused by the participation in an experiment. Furthermore, the experiment-associated emotional stress will not be eliminated by performing experiments at the home of the volunteer instead of the laboratory.

Thus, data collected in the EHS provocation studies is not reliable and *objective* but it is unreliable and *subjective*, because it is based on *subjective* feelings and beliefs. Claiming that such *subjective*, beliefs-contaminated, data is scientifically reliable is incorrect.

The above-listed methodological drawbacks clearly indicate that the data obtained in all to-date executed EHS provocation studies is unreliable and insufficient, neither to prove nor to disprove, the existence of causal link between the EHS and EMF.

What next with the EHS research?

The provocation approach needs to be replaced. It is a high time to stop research efforts focused on provocation tests, being of low sensitivity and producing subjective data, and move on to the physiology-based research. Physiological studies, examining the molecular level responses of human tissues and organs to EMF exposures, will provide the evidence of individual sensitivity and basis for further research (Leszczynski 2014).

Research on sensitivity to EMF needs re-focusing

Finally, the discussion about human sensitivity to the EMF has been severely skewed not only by the demands and attitudes of the self-diagnosed EHS persons but also by the attitudes of the scientists who "*blindly*" followed in their footsteps and conducted, nearly solely, provocation studies, instead of considering other scientific approaches.

The research and the debate should shift from the issue of the validity of the self-diagnosis of the EHS to the more general problem of whether the current EMF exposure limits are sufficiently protective for all users, no matter their age or health status. Are some persons more sensitive to EMF exposures?

Efforts should be focused on finding, through physiological means, whether different subsets of human population have different sensitivity to the EMF and whether differences in the sensitivity to EMF will translate, in due time, into health risks or whether human bodies will adapt and become resilient. This can be achieved by using modern methods of proteomics, transcriptomics and other 'omics' technologies to find proteins, genes and metabolites that are affected by the EMF exposures. This detailed molecular level response information should be then used to formulate the knowledge-based hypotheses concerning possible effects of EMF exposures on human health.

References

- Barnett SB, Rott HD, ter Haar GR, Ziskin MC, Maeda K. 1997. The sensitivity of biological tissue to ultrasound. *Ultrasound Med Biol* 23:805-812.

- Benedetti F, Carlino E, Pollo A. 2011. How Placebos Change the Patient's Brain. *Neuropsychopharmacology* 36:339-354.
- Bourguignon MH, Gisone PA, Perez MR, Michelin S, Dubner D, Di Giorgio M, Carosella ED. 2005a. Genetic and epigenetic features in radiation sensitivity. Part I: Cell signalling in radiation response. *Eur J Nucl Med Mol Imaging* 32:229-246.
- Bourguignon MH, Gisone PA, Perez MR, Michelin S, Dubner D, Di Giorgio M, Carosella ED. 2005b. Genetic and epigenetic features in radiation sensitivity. Part II: implications for clinical practice and radiation protection. *Eur J Nucl Med Mol Imaging* 32:351-368.
- Foray N, Colin C, Bourguignon M. 2012. 100 Years of Individual Radiosensitivity: How We Have Forgotten the Evidence. *Radiology* 264:627-631.
- Kelly DA, Young AR, McGregor JM, Seed PT, Potten CS, Walker SL. 2000. Sensitivity to Sunburn Is Associated with Susceptibility to Ultraviolet Radiation-induced Suppression of Cutaneous Cell-mediated Immunity. *J Exp Med* 191:561-566.
- Leszczynski D. 2014. The Grand Challenge: Use of a New Approach in Developing Policies in the Area of Radiation and Health. *Front Public Health* 2:50.
- Rees JL. 2004. The Genetics of Sun Sensitivity in Humans. *Am J Hum Genet* 75:739-751.
- Tinnermann A, Geuter S, Sprenger C, Finsterbusch J, Büchel C. 2017. Interactions between brain and spinal cord mediate value effects in nocebo hyperalgesia. *Science* 358:105-108.
- Verrender A, Loughran SP, Anderson V, Hillert L, Rubin GJ, Oftedal G, Croft RJ. 2017. IEI-EMF provocation case studies: A novel approach to testing sensitive individuals. *Bioelectromagnetics* DOI: 10.1002/bem.22095.