

## Summaries and assessments of selected studies

In the period from mid of July to mid of October 2022, 115 new publications have been identified, and six of these were discussed in depth by BERENIS. Based on the selection criteria, three of these publications were selected as the most relevant ones. Their summaries and assessments are provided below.

### 1) *Experimental animal and cell studies*

*Effects of exposure to an extremely low frequency magnetic field on the tumour suppressor p53 (Martínez et al. 2022).*

This *in vitro* study presents new observations based on a previously published study. The same research group has reported changes in signaling cascades and cell proliferation caused by extremely low frequency magnetic fields (100  $\mu$ T, 50 Hz) in human brain tumour cells (NB-69 neuroblastoma cells) ([see BERENIS Newsletter No. 7](#)). In the latter study by Martínez and colleagues (2022), NB-69 cells were acutely exposed for 30 to 120 minutes to investigate the influence of the ELF-MF on the tumour suppressor p53. The p53 protein plays a central role in the cellular stress response and regulates, for example, gene activities, repair of DNA damage, controlled cell death (apoptosis) and cell proliferation. After 90 minutes of exposure of the cell cultures, a transient increase in p53 proteins and gene expression was observed. After two hours of exposure, however, the amount of p53 was reduced to levels comparable to control cells. This increase was not due to the normally structured form of p53, but to more unfolded and therefore non-active p53 protein in the cytoplasm as well as in the nucleus. This kind of response also occurs for instance after chemical stress. The proportion of cells with normally structured p53 in the cytoplasm was reduced. In the cytoplasm, p53 interacts with the anti-apoptotic protein Bcl-2 to regulate apoptosis. The authors observed that ELF-MF exposure, regardless of the duration, led to an increase in the proportion of cells with detectable Bcl-2 protein.

The study by Martínez *et al.* (2022) was conducted in a well-controlled manner and provides new insight into the process and consequences of ELF-MF exposure on cells. However, it remains to be investigated whether this is a general cellular mechanism that is potentially relevant with regard to health effects or rather a reaction of this specific cell type.

### 2) *Epidemiological studies*

*Temporal trends of mobile phone use and incidence of brain tumours in men in the Nordic countries from 1979 to 2016 (Deltour et al. 2022)*

In the study by Deltour *et al.* (2022), national cancer registry data in Denmark, Finland, Norway and Sweden were used to investigate how many brain tumour cases (gliomas) were diagnosed in men aged 40-69 years between 1979 and 2016. This group was selected because it represented the main user group in the Nordic countries in the early days of mobile phone use and a potentially increased brain tumour risk could manifest itself first in this age group. Further, it was analysed to what extent observed glioma case numbers correspond to hypothetical risks as published in previous epidemiological studies. The hypothetical risk calculations used for comparison were taken from

various case-control studies in which increased risks were observed (Coureau *et al.* 2014<sup>1</sup>, Hardell & Carlberg 2015<sup>2</sup>, Momoli *et al.* 2017<sup>3</sup>, Interphone Study Group 2010<sup>4</sup>). It was demonstrated that the actually observed case numbers in the population group in question were not compatible with the risks reported in any of these studies. For men aged 40-59 years, a relative risk of 1.08 or higher with 10 years of latency, a relative risk of 1.2 or higher with 15 years of latency, and a relative risk of 1.5 or higher with 20 years of latency can be excluded based on the observed number of glioma cases. For the age group 60-69 years, the same applied for relative risks of  $\geq 1.4$ ,  $\geq 2$  and  $\geq 2.5$  for latency periods of 10, 15 and 20 years, respectively. The authors conclude that increased risks of the magnitudes observed in some case-control studies are not plausible.

The study suggests that the observed number of glioma cases in the Nordic countries is not compatible with a substantial risk due to mobile phone use. Although individual exposure data were not available in this study, it is undisputed that a risk from mobile phone use would have to manifest itself in an increase in brain tumor incidence, as there are few other risk factors for brain tumours that have changed over time and could compensate for any potential risk. A comprehensive report with data on other age groups and women has been published in German by the Federal Office for Radiation Protection in Germany<sup>5</sup>.

*Health complaints attributed to electromagnetic hypersensitivity over time - results from a Dutch cohort study (Traini *et al.* 2022)*

The study by Traini *et al.* (2022) investigated which factors play a role in attributing individually existing health complaints to electromagnetic hypersensitivity (EHS) with regard to RF-EMF, and how this attribution has possibly changed over ten years. For this purpose, 892 participants of a cohort study in the Netherlands were interviewed at three time points, first in 2011/2012, then again in 2013, and finally in 2021. The mean age at the beginning of the study was 50 years (52% women), and self-reported data on RF-EMF exposure, RF-EMF risk, non-specific symptoms, sleep problems, and self-declared EHS were collected. At each of the three survey time points, about 1% of the participants attributed health complaints to RF-EMF exposure. While the prevalence remained the same over the study period, the individual attribution of EHS was much more dynamic over time. After 10 years, only 5% of the self-declared EHS persons still reported health complaints due to EMF. In the last survey in 2021, the study participants were asked to which extent they considered themselves as electromagnetic hypersensitive on a scale of 0-6. Out of 892 respondents, 12.1% indicated a score

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<sup>1</sup> Coureau G, Bouvier G, Lebailly P, Fabbro-Peray P, Gruber A, Leffondre K, Guillamo JS, Loiseau H, Mathoulin-Pelissier S, Salamon R, Baldi I (2014): **Mobile phone use and brain tumours in the CERENAT case-control study.** *Occup. Environ. Med.* 71 (7), 514–522. <https://doi.org/10.1136/oemed-2013-101754>.

<sup>2</sup> Hardell L, Carlberg M (2015): **Mobile phone and cordless phone use and the risk for glioma - Analysis of pooled case-control studies in Sweden, 1997–2003 and 2007–2009.** *Pathophysiology* 22 (1), 1–13. <https://doi.org/10.1016/j.pathophys.2014.10.001>.

<sup>3</sup> Momoli F, Siemiatycki J, McBride ML, Parent ME, Richardson L, Bedard D, Platt R, Vrijheid M, Cardis E, Krewski D (2017): **Probabilistic Multiple-Bias Modeling Applied to the Canadian Data From the Interphone Study of Mobile Phone Use and Risk of Glioma, Meningioma, Acoustic Neuroma, and Parotid Gland Tumors.** *Am. J. Epidemiol.* 186 (7), 885–893. <https://doi.org/10.1093/aje/kwx157>.

<sup>4</sup> Interphone Study Group (2010): **Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study.** *Int. J. Epidemiol.* 39 (3), 675–694. <https://doi.org/10.1093/ije/dyq079>.

<sup>5</sup> Schüz J, Deltour I (2022): **Nutzung von Mobiltelefonen und Verlauf der Gliom-Inzidenz seit 1979 - Vorhaben 3618S00000.** Bundesamt für Strahlenschutz (Bfs) 2022, Ressortforschungsberichte zum Strahlenschutz, Bfs-RESFOR-198/22: 1-70. <https://doris.bfs.de/jspui/handle/urn:nbn:de:0221-2022063033222>

between 4 and 6 and were classified as EHS. Participants who perceived their EMF exposure and the associated risk as high were more likely to declare themselves as EHS.

The survey shows that the way of asking about EHS has a big influence on the prevalence. A weakness of the study is the small number of people at the start of the study (9 people) who attributed symptoms to RF-EMF. Random errors could therefore have influenced the results. The results are consistent with data from Switzerland. After one year, out of 96 self-declared EHS subjects, only 52 (54%) still reported suffering from RF-EMF. It thus seems that EHS is not necessarily a stable attribution, but often changes over time, even though the overall proportion in the population appears to be quite constant. According to the authors, a better understanding of the influencing factors and dynamics in the attribution of symptoms to EMF is helpful for future risk communication.

### **3) Further information**

#### *BERENIS newsletter search tool*

A new [search application](#) enables to search the studies evaluated and published in the BERENIS newsletters according to subject areas, keywords and other search criteria. This is a first version of the application, for feedback or suggestions for improvement, please contact the BERENIS secretariat.

### **References**

Deltour I, Poulsen AH, Johansen C, Feychting M, Johannesen TB, Auvinen A, Schüz J (2022): **Time trends in mobile phone use and glioma incidence among males in the Nordic Countries, 1979-2016.** Environ Int. 2022 Aug 24;168:107487. doi: 10.1016/j.envint.2022.107487. Epub ahead of print. <https://pubmed.ncbi.nlm.nih.gov/36041243/>

Martínez MA, Úbeda A, Martínez-Botas J, Trillo MÁ (2022): **Field exposure to 50 Hz significantly affects wild-type and unfolded p53 expression in NB69 neuroblastoma cells.** Oncol Lett. 2022 Jul 5;24(3):295. doi: 10.3892/ol.2022.13415. <https://pubmed.ncbi.nlm.nih.gov/35949615/>

Traini E, Martens AL, Slottje P, Vermeulen RCH, Huss A (2022): **Time course of health complaints attributed to RF-EMF exposure and predictors of electromagnetic hypersensitivity over 10 years in a prospective cohort of Dutch adults.** Sci Total Environ. 2022 Oct 6:159240. doi: 10.1016/j.scitotenv.2022.159240. <https://pubmed.ncbi.nlm.nih.gov/36209879/>

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Additional information:

[BERENIS - Swiss expert group on electromagnetic fields and non-ionising radiation](#)

[List of abbreviations \(pdf\)](#)