

Results Of Lifespan Exposure To Extremely Low Frequency Electromagnetic Fields And Mobile Phone Radiofrequency Field Representative Of A 1.8 GHz GSM Base Station Environmental Emission In Sprague Dawley Rats.

Fiorella Belpoggi

Cesare Maltoni Cancer Research Center, Ramazzini Institute, Via Saliceto, 3, 40010 Bentivoglio (Bologna) Italy

belpoggif@ramazzini.it

BACKGROUND:

Up to now, experimental studies on rodents have failed to provide definitive confirmation of the carcinogenicity of extremely low frequency electromagnetic fields (ELFEMF) and radiofrequency radiation (RFR). The International Agency for Research on Cancer (IARC) currently classifies both ELFEMF and RFR as a possible human carcinogen (Group 2B). Two recent studies performed in our laboratory on Sprague-Dawley rats reported a statistically significant increase in malignant tumors of different sites (mammary gland, C-cells carcinoma, hemolymphoreticular neoplasia, and malignant heart Schwannoma) when ELFEMF exposure was associated with exposure to formaldehyde or acute low dose of γ -radiation (Soffritti *et al*, 2016a) (Soffritti *et al*, 2016b). In 2016, the National Toxicology Program (NTP) published the first results of its long-term bioassays on near field RFR, reporting increased incidence of malignant glial tumors of the brain and heart Schwannoma in rats exposed to GSM - and CDMA - modulated cell phone RFR (Wide *et al*, 2016). The tumors observed in the NTP study are of the type similar to the ones observed in some epidemiological studies of cell phone users.

OBJECTIVES:

The Ramazzini Institute (RI) conducted a lifespan whole-body exposure study to evaluate the possible carcinogenic effects of ELFEMF exposure administered alone to Sprague-Dawley rats, as part of the integrated project of the RI for studying the effects on health of ELFEMF alone or in combination with other known carcinogens (Bua *et al*, 2018).

The Ramazzini Institute (RI) performed a life-span carcinogenic study on Sprague-Dawley rats to evaluate the carcinogenic effects of RFR in the situation of far field, reproducing the environmental exposure to RFR generated by a 1.8 GHz GSM antenna of the radio base stations of mobile phones. This is the largest long-term study ever performed in rats on the health effects of RFR, including 2448 animals. The final results regarding brain and heart tumors were reported (Falcioni *et al*, 2018).

METHODS:

ELFEMF: Male and female Sprague-Dawley rats were exposed 19 h/day to continuous sinusoidal-50 Hz magnetic fields (S-50 Hz MF) at flux densities of 0 (control group), 2, 20, 100 or 1000 μ T, and to intermittent (30 min on/30 min off) S-50 Hz MF at 1000 μ T, from prenatal life until natural death.

RF: Male and female Sprague-Dawley rats were exposed from prenatal life until natural death to a 1.8 GHz GSM far field of 0, 5, 25, 50 V/m with a whole-body exposure for 19 h/day.

RESULTS:

ELFEMF: The incidence and number of malignant and benign tumors was similar in all groups. ELFEMF exposure alone did not significantly increase the incidence of neoplasias in any organ, including those sites that have been identified as possible targets in epidemiological studies (leukemia, breast cancer, and brain cancer).

RF: A statistically significant increase in the incidence of heart Schwannomas was observed in treated male rats at the highest dose (50 V/m). Furthermore, an increase in the incidence of heart Schwann cells hyperplasia was observed in treated male and female rats at the highest dose (50 V/m), although this was not statistically significant. An increase in the incidence of malignant glial tumors was observed in treated female rats at the highest dose (50 V/m), although not statistically significant.

CONCLUSIONS:

Life-span exposures to continuous and intermittent sinusoidal-50 Hz ELFEMFs, when administered alone, did not represent a significant risk factor for neoplastic development in our experimental rat model. In light of our previous results on the carcinogenic effects of ELFEMF in combination with formaldehyde and γ -radiation, further experiments are necessary to elucidate the possible role of ELFEMF as cancer enhancer in presence of other chemical and physical carcinogens (Bua *et al*, 2018).

The RI findings on far field exposure to RFR are consistent with and reinforce the results of the NTP study on near field exposure, as both reported an increase in the incidence of tumors of the brain and heart in RFR-exposed Sprague-Dawley rats. These tumors are of the same histotype of those observed in some epidemiological studies on cell phone users. These experimental studies provide sufficient evidence to call for the re-evaluation of IARC conclusions regarding the carcinogenic potential of RFR in humans (Falcioni *et al*, 2018).

REFERENCES

Bua L, Tibaldi E, Falcioni L, Lauriola M, De Angelis L, Gnudi F, Manservigi M, Manservisi F, Manzoli I, Menghetti I, Montella R, Panzacchi S, Sgargi D, Stollo V, Vornoli A, Mandrioli D, Belpoggi F (2018) Results of lifespan exposure to continuous and intermittent extremely low frequency electromagnetic fields (ELFEMF) administered alone to Sprague Dawley rats. *Environ Res* 164:271-279

Falcioni L, Bua L, Tibaldi E, Lauriola M, De Angelis L, Gnudi F, Mandrioli D, Manservigi M, Manservisi F, Manzoli I, Menghetti I, Montella R, Panzacchi S, Sgargi D, Stollo V, Vornoli A, Belpoggi F (2018) Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission. *Environ Res* 165:496-503.

Soffritti M, Tibaldi E, Padovani M, Hoel DG, Giuliani L, Bua L, Lauriola M, Falcioni L, Manservigi M, Manservisi F, Belpoggi F (2016a) Synergism between sinusoidal-50 Hz magnetic field and formaldehyde in triggering carcinogenic effects in male Sprague-Dawley rats. *Am J Ind Med* 59(7):509-21

Soffritti M, Tibaldi E, Padovani M, Hoel DG, Giuliani L, Bua L, Lauriola M, Falcioni L, Manservigi M, Manservisi F, Panzacchi S, Belpoggi F (2016b) Life-span exposure to sinusoidal-50 Hz magnetic field and acute low-dose γ radiation induce carcinogenic effects in Sprague-Dawley rats. *Int J Radiat Biol* 92(4):202-14

Michael Wyde, Mark Cesta, Chad Blystone, Susan Elmore, Paul Foster, Michelle Hooth, Grace Kissling, David Malarkey, Robert Sills, Matthew Stout, Nigel Walker, Kristine Witt, Mary Wolfe, John Bucher (2016) Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposure). bioRxiv 055699; doi: <https://doi.org/10.1101/055699>