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Cellphone toxicology, exposure assessment and epidemiology—an update

Interagency Task Force on Radiofrequency Radiation

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Thank You! Collaborators

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- Suleyman Kaplan, Ondokuz Mayıs Medical Univ.
- Lukas Margaritis and Adamantia Fragopoulou, University of Athens, Greece
- Lloyd Morgan, Susan F. Dixon, Ron Herberman, EHT
- Nesrin Seyhan, Gazi University, Ankara
- Hugh Taylor, Yale University

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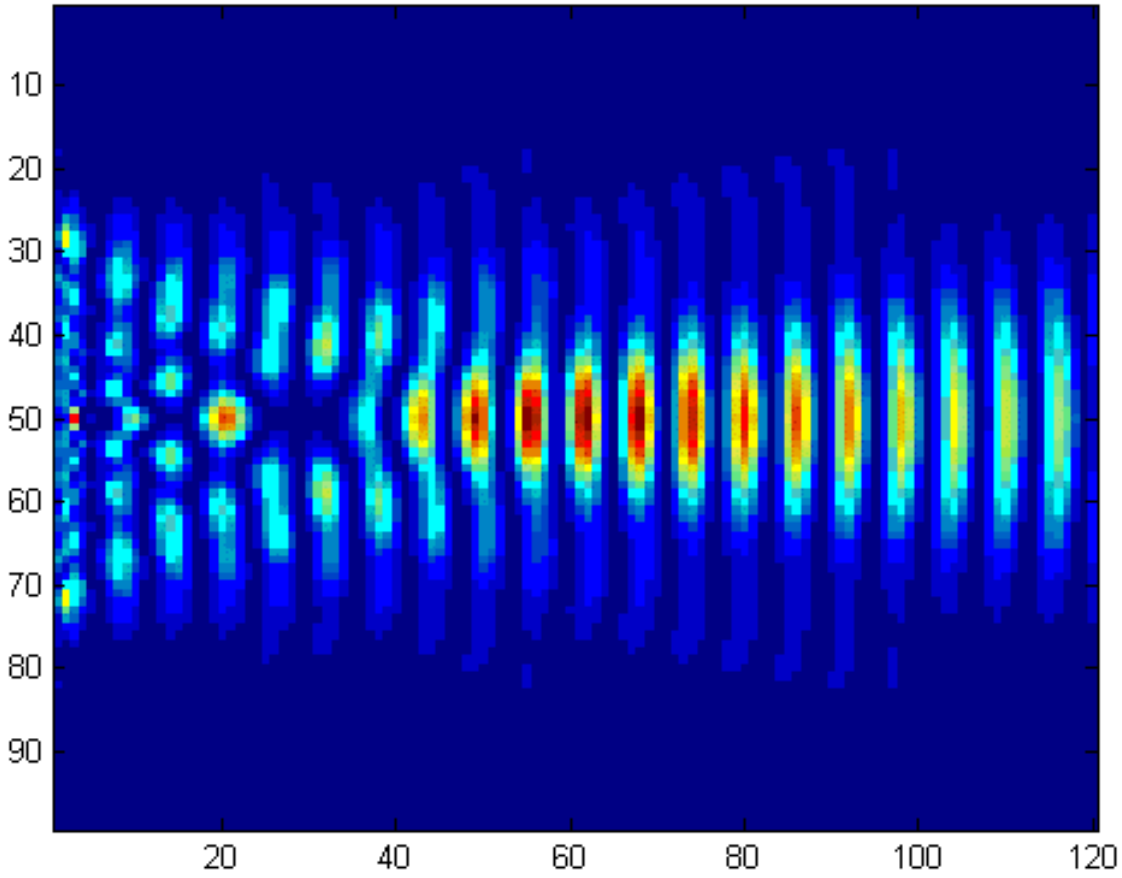
Microwave (MW) exposure safety standards

- Current safety standards are most often based on **thermal effects** of microwaves in **acute** exposures, 2 W/kg **ICNIRP** (International Commission for Non-Ionizing Radiation Protection)
- Power flux density (PD) or specific absorption rate (SAR, "dose rate") is often used for guidelines.
- Dose = (SAR × exposure duration) is not used for assessment of microwave exposures
- Safety standards significantly, up to 1000 times, vary between countries
- Why?

The impact of non-thermal mobile phone radiation depends on the nature of the waves and conditions of exposure

- Frequency
- Modulation
- Polarization
- Coherence time
- Dose and duration
- Intermittence
- Electromagnetic environment



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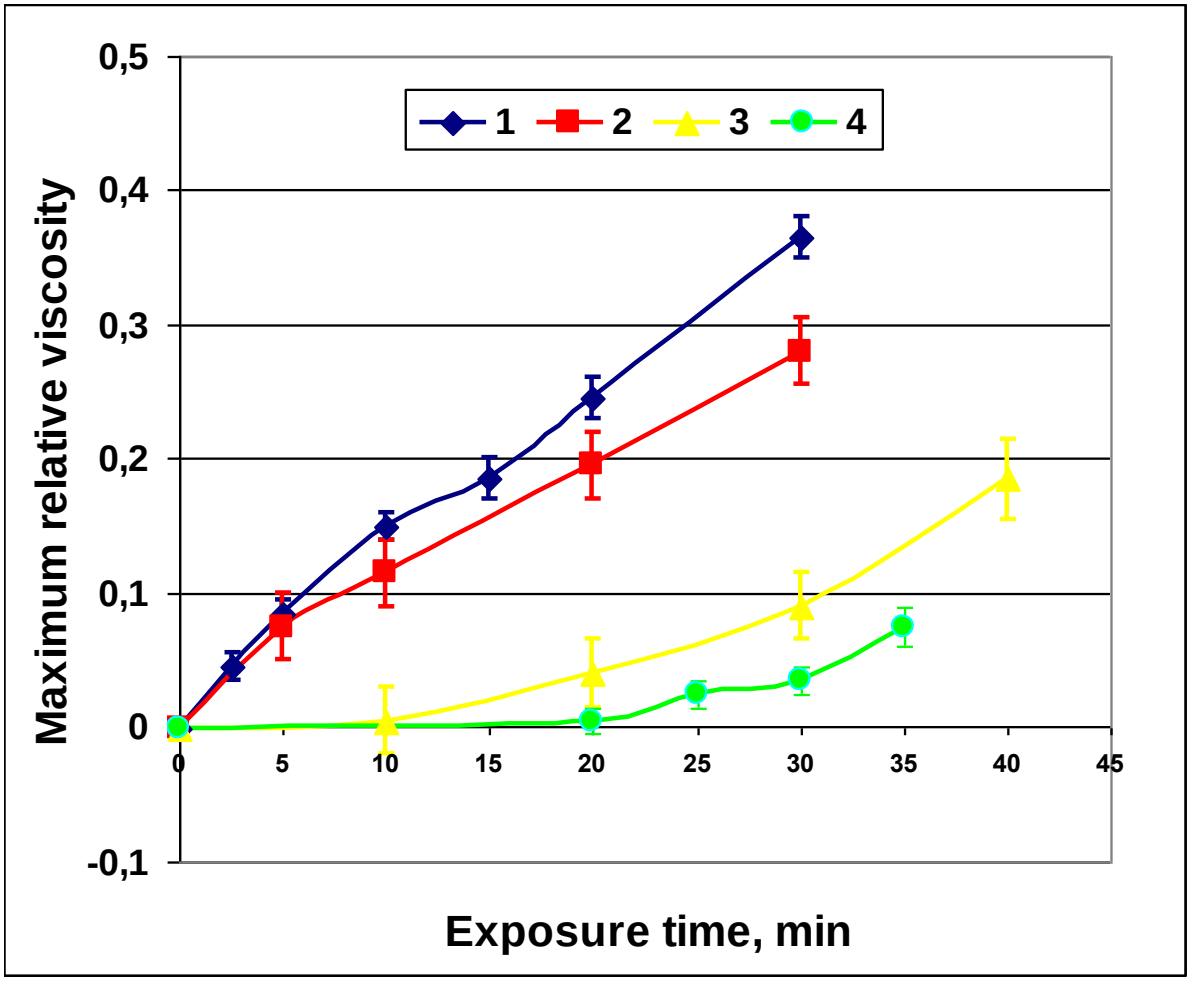
Decreasing of intensity by orders of magnitude was compensated by 4-fold increasing of exposure time



(1) 10^{-14} W/cm^2;

(2) 10^{-16} W/cm^2;

(3) 10^{-17} W/cm^2;

(4) 10^{-18} W/cm^2;

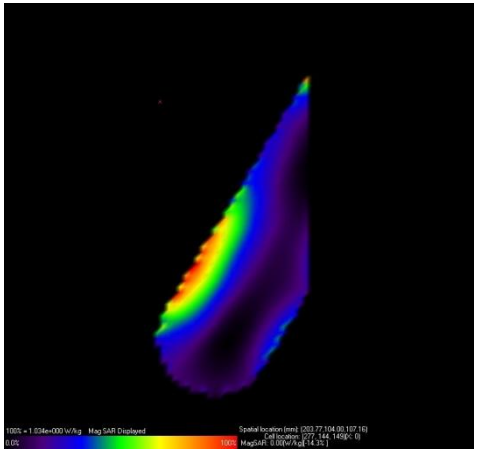
I. Y. Belyaev, Y. D. Alipov, V. S. Shcheglov, V. A. Polunin, and O. A. Aizenberg, *Electro- and Magnetobiology*, vol. 13, pp. 53-66, 1994.

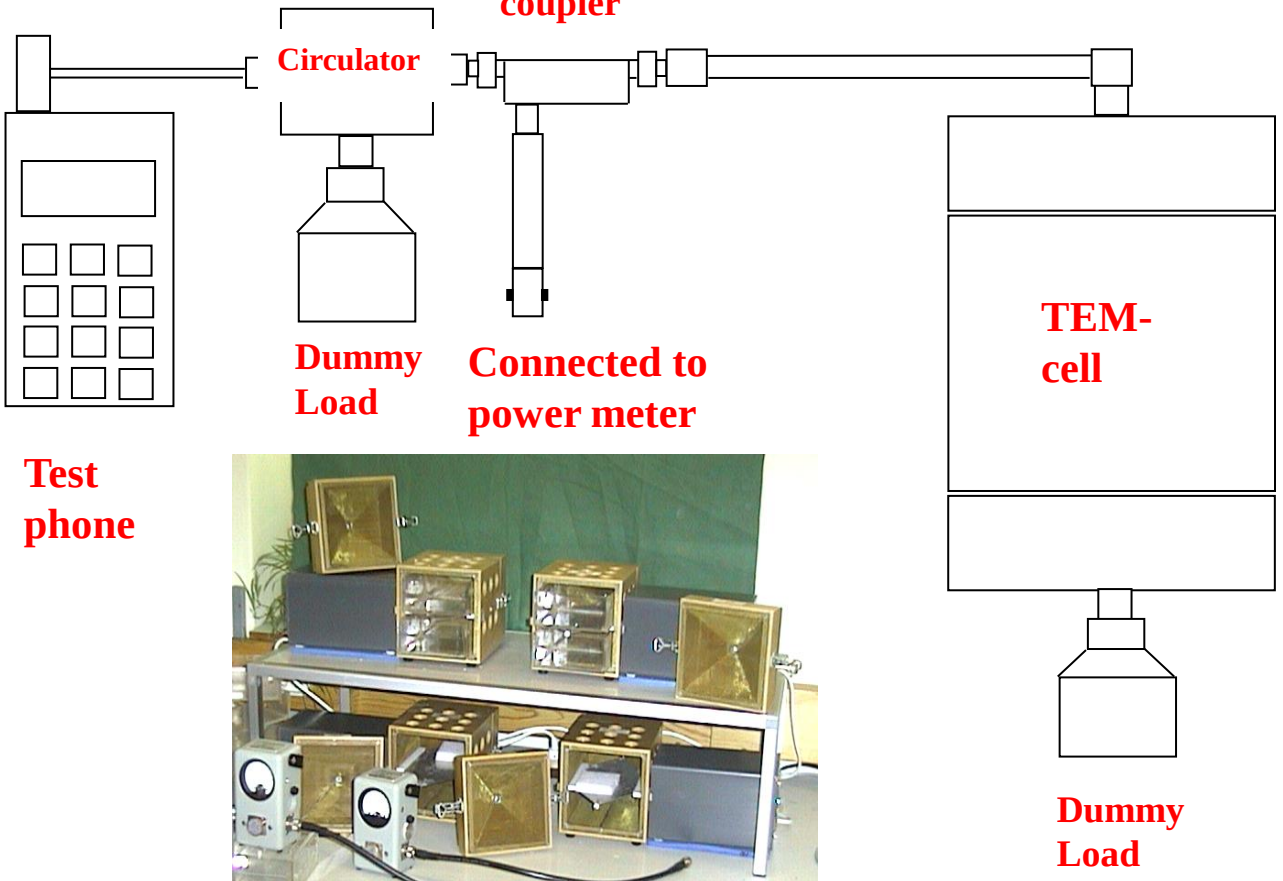
During a single call, GSM users are exposed to microwaves at different frequencies

•There are 124 different channels/frequencies, which are used in GSM900 (Global System for Mobile Communication). They differ by 0.2 MHz in the frequency range between 890 MHz and 915 MHz. Frequency is supplied by base station to a mobile phone user depending on the number of connected users. The frequency can be changed by base station during the same call.

Non-thermal microwave exposure of human differentiated and stem cells in different frequency channels

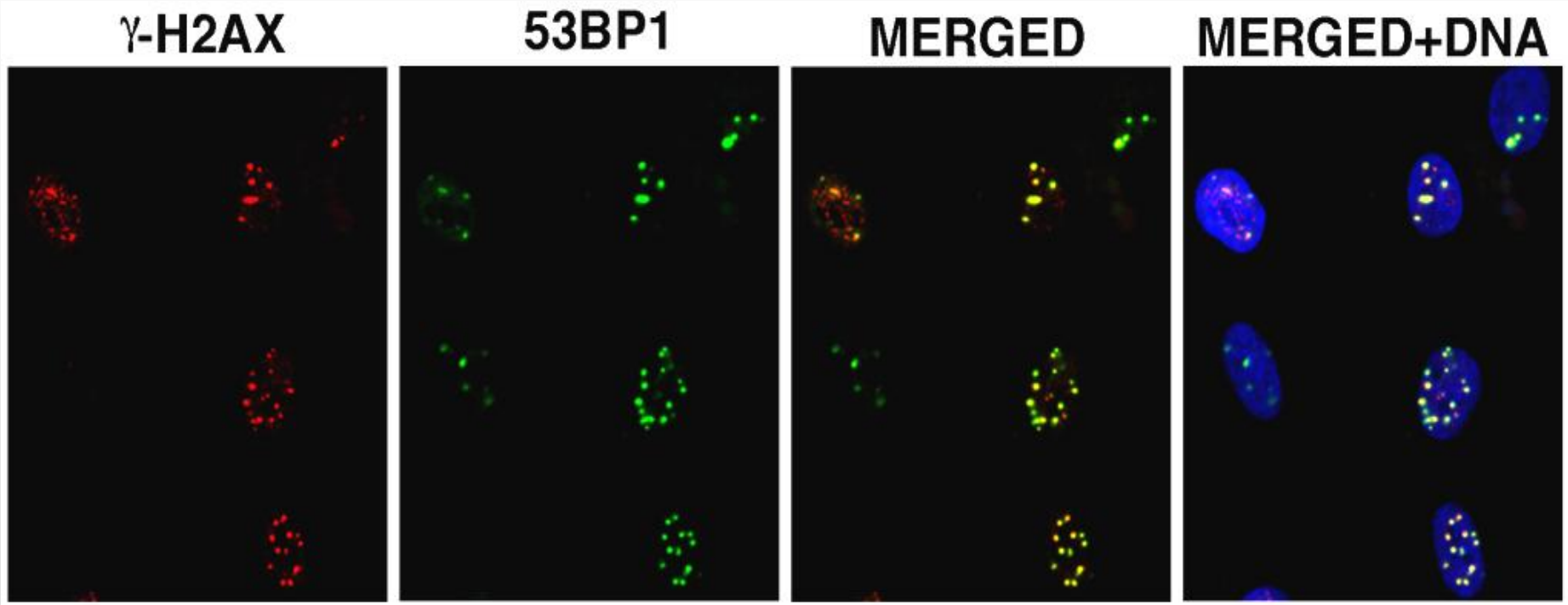
The test-mobile phone is programmed to select a GSM/UMTS frequency channel, and 0.25 W output power.





Distribution of specific absorption rate (FDTD-METHOD)

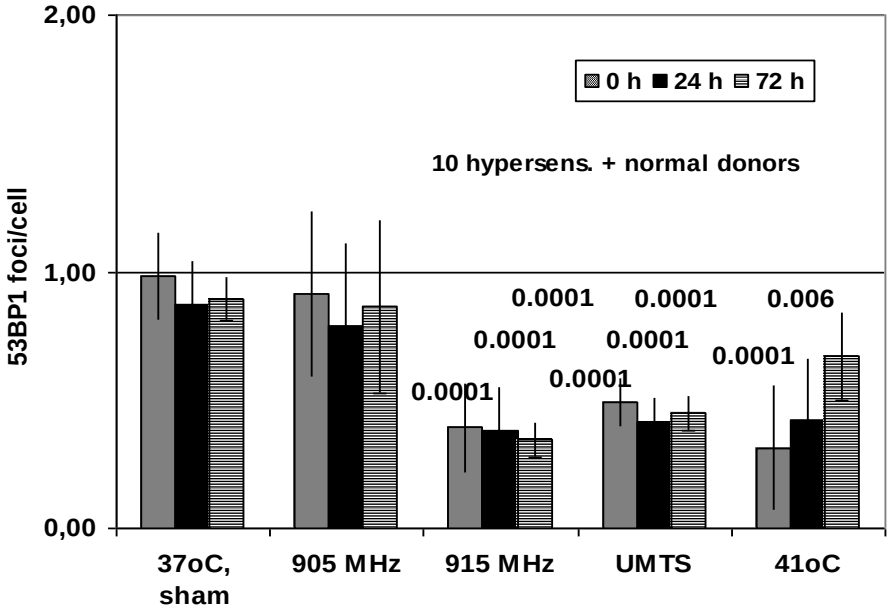
Molecular markers (γ-H2AX, 53BP1) of DNA double-strand breaks (DSB), which are used to visualize and quantify double strand breaks (DSB) by enumeration of DNA repair foci by means confocal laser microscopy and immunofluorescence

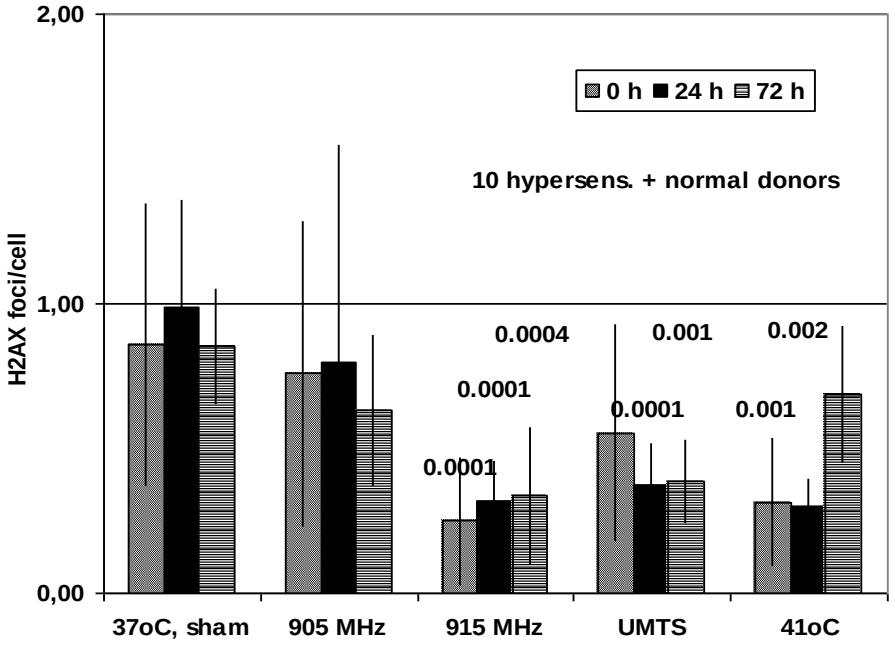


VH-10 cells, 12 h following irradiation with 3 Gy

E. Markova, N. Schultz, and I. Y. Belyaev, *Int J Radiat Biol,* vol. 83, pp. 319-329, May 2007.

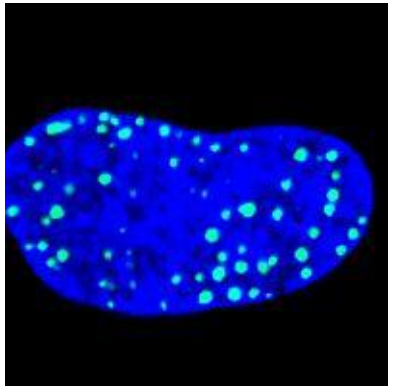
Inhibitory effects of 915 MHz GSM and UMTS on DNA repair foci remain 72 h after exposure of human lymphocytes to MW. No effect at 905 MHz

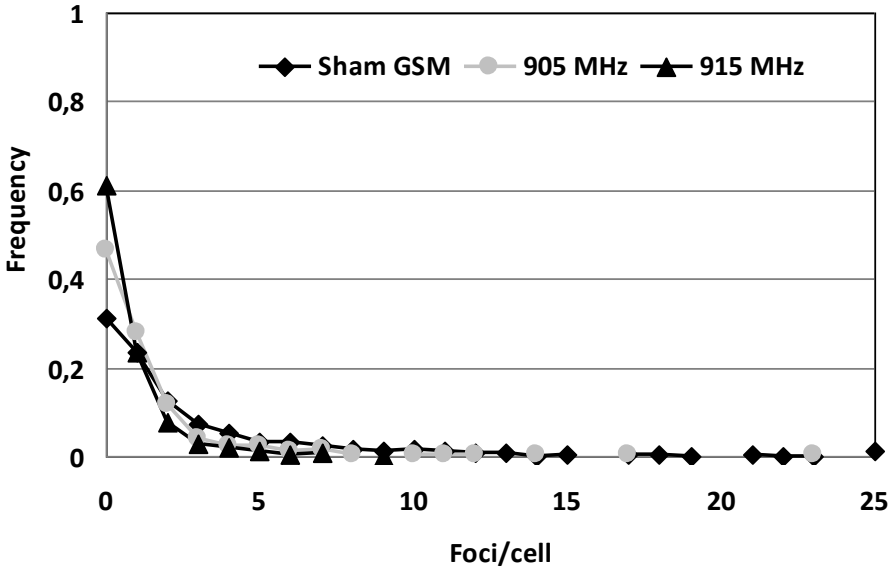


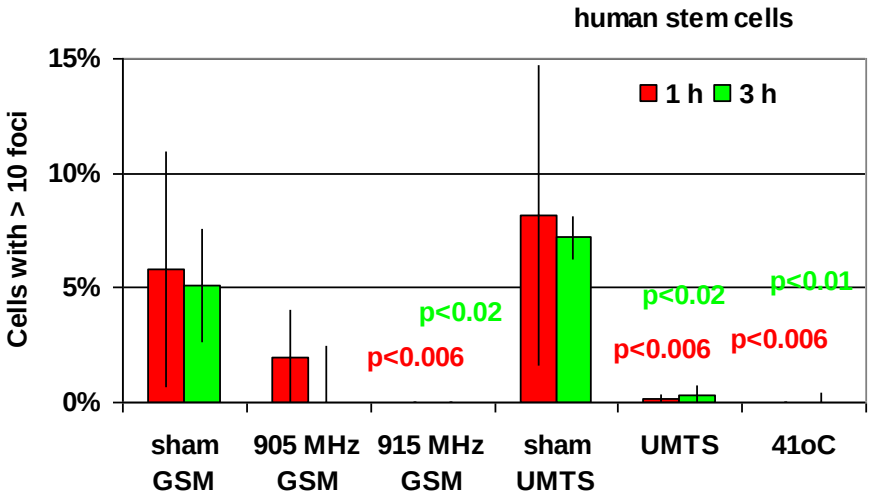


Both molecular markers, γ-H2AX и 53BP1, show the same results

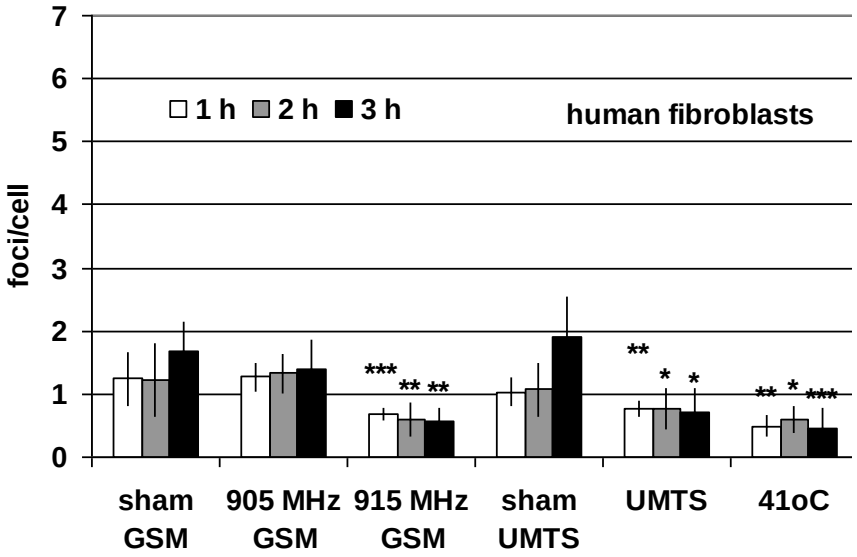
Microwaves completely blocked DNA repair foci in stem cells with multiple DNA damage

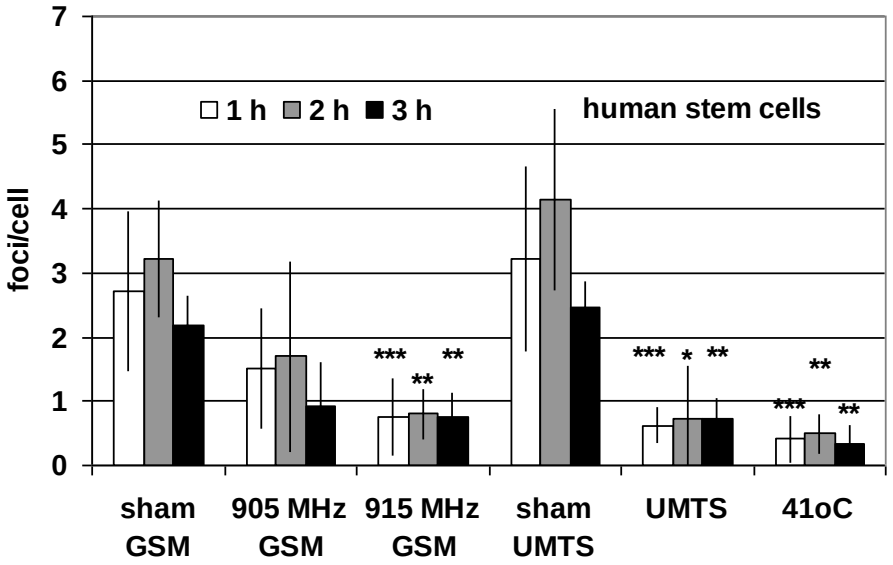






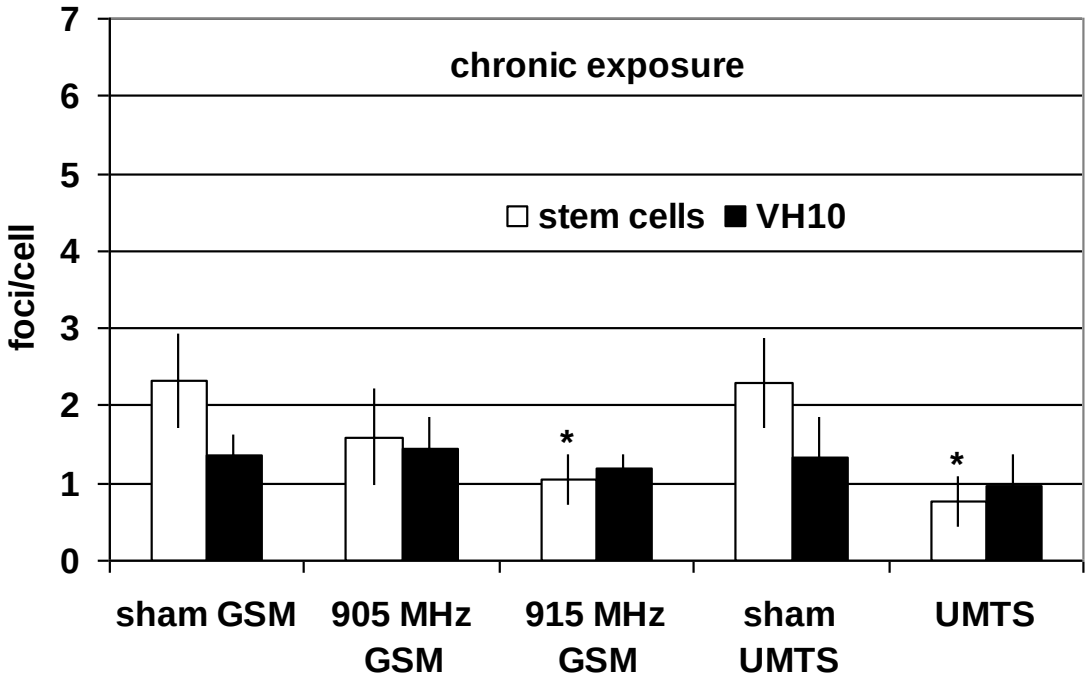
Human stem cells were more sensitive to microwave exposure than differentiated human cells and more responsive to GSM frequency channels



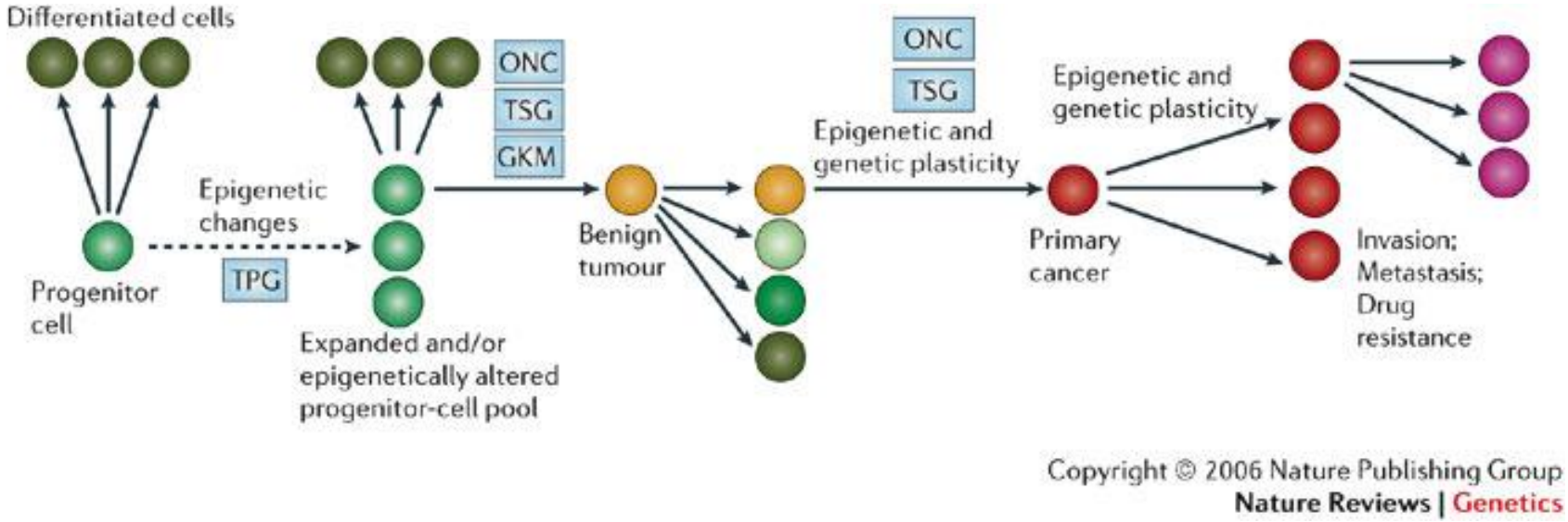


Contrary to differentiated cells, human mesenchymal stem cells did not adapt to effects of MW during chronic exposure

Exposure during 2 weeks, 1 hour daily



Results with stem cells may be especially important because different cancer types (tumors and leukemia) originate from stem cells by well-known genetic and recently suggested epigenetic mechanisms



Feinberg AP *et al.* (2005) The epigenetic progenitor origin of human cancer
Nat Rev gene. **7:** 21–33 doi:10.1038/nri1748

nature REVIEWS GENETICS

Key References

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Markova, E., L. O. G. Malmgren, et al. (2010). "Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells More Strongly Than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk." Environmental Health Perspectives **118**(3): 394-399.

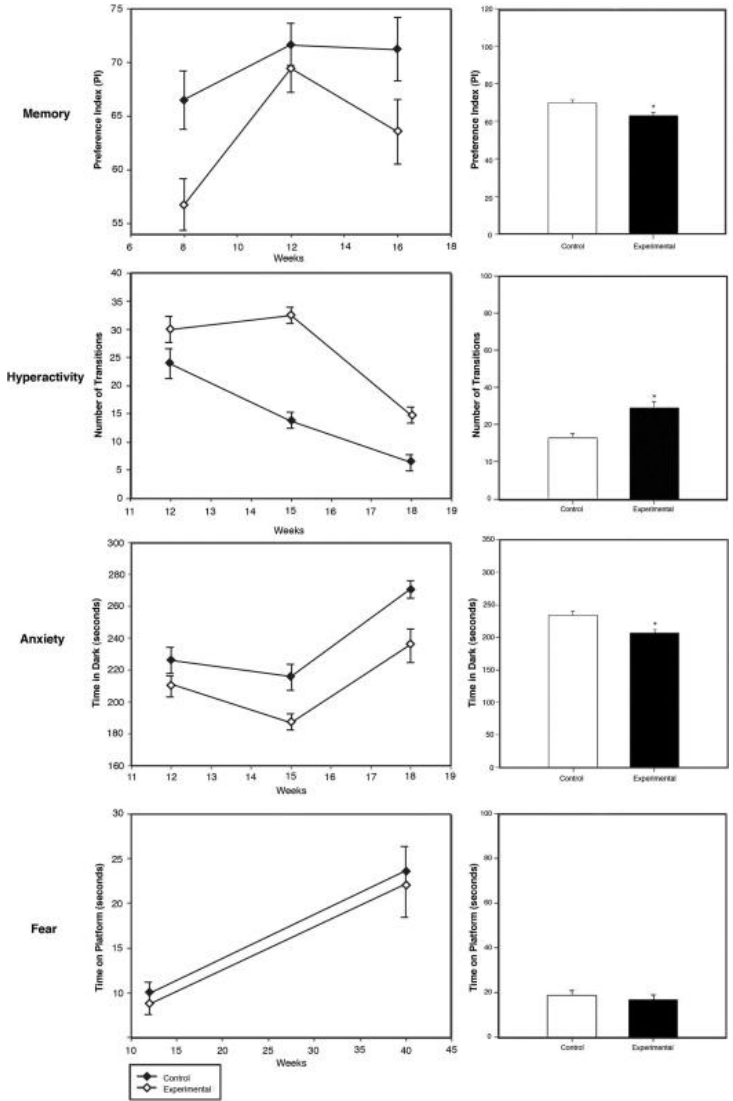
Sarimov, R., E. D. Alipov, et al. (2011). "Fifty hertz magnetic fields individually affect chromatin conformation in human lymphocytes: dependence on amplitude, temperature, and initial chromatin state." Bioelectromagnetics **32**(7): 570-579.

Fetal Programming Evaluated

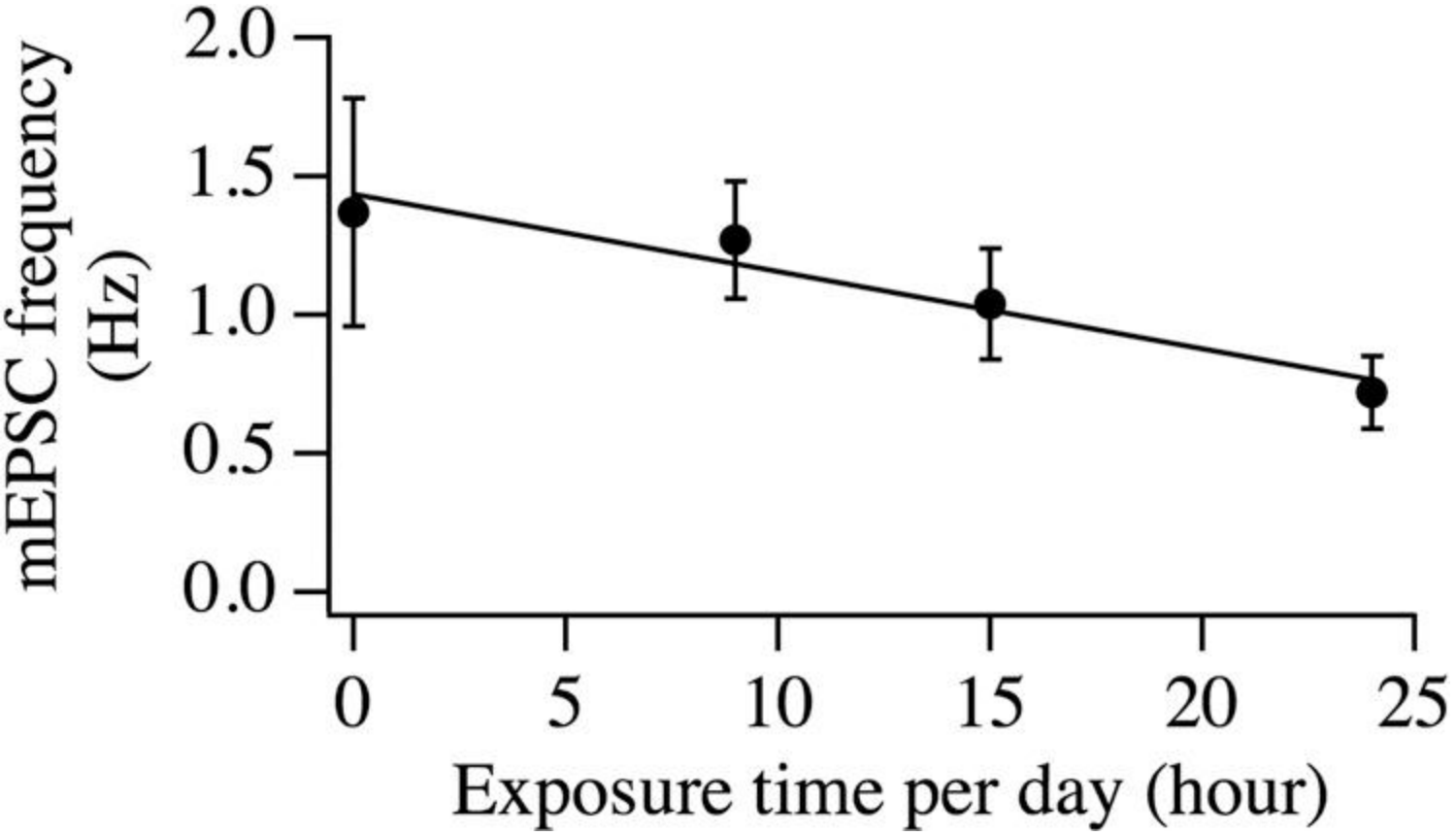
Radiation exposed 33 pregnant mice

42 pregnant controls

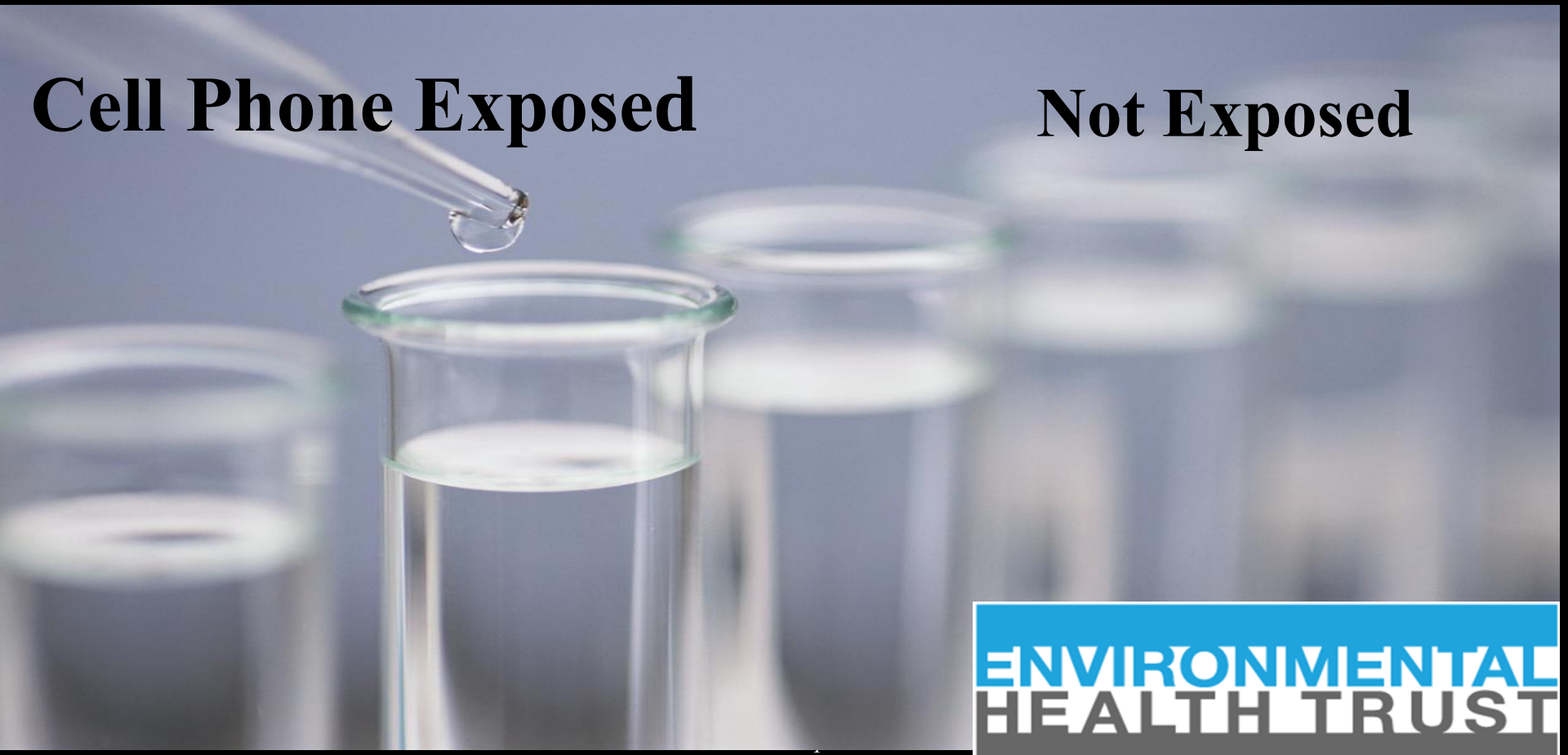
Hyperactivity, Diminished Memory and Reduced Anxiety



Diminished Effect with Decreased Exposure



Controlled Experiments with Human Material--sperm



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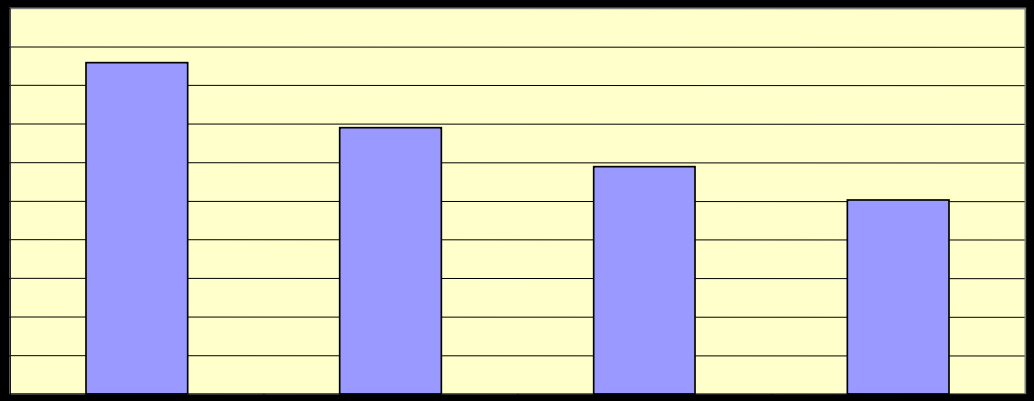
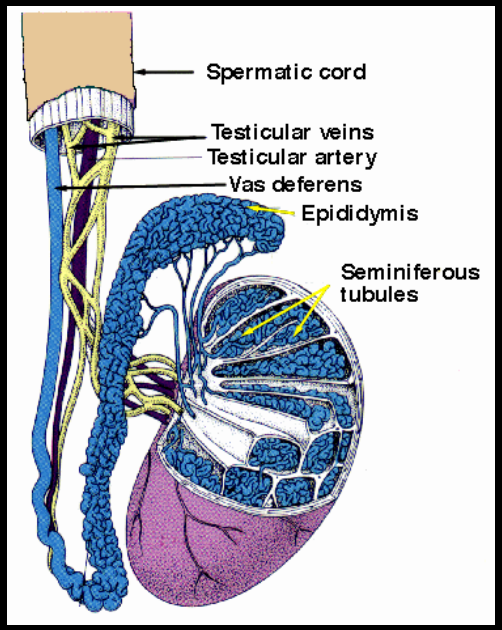
Cross-sectional analysis finds Reduced Sperm Count in Heaviest cellphone users



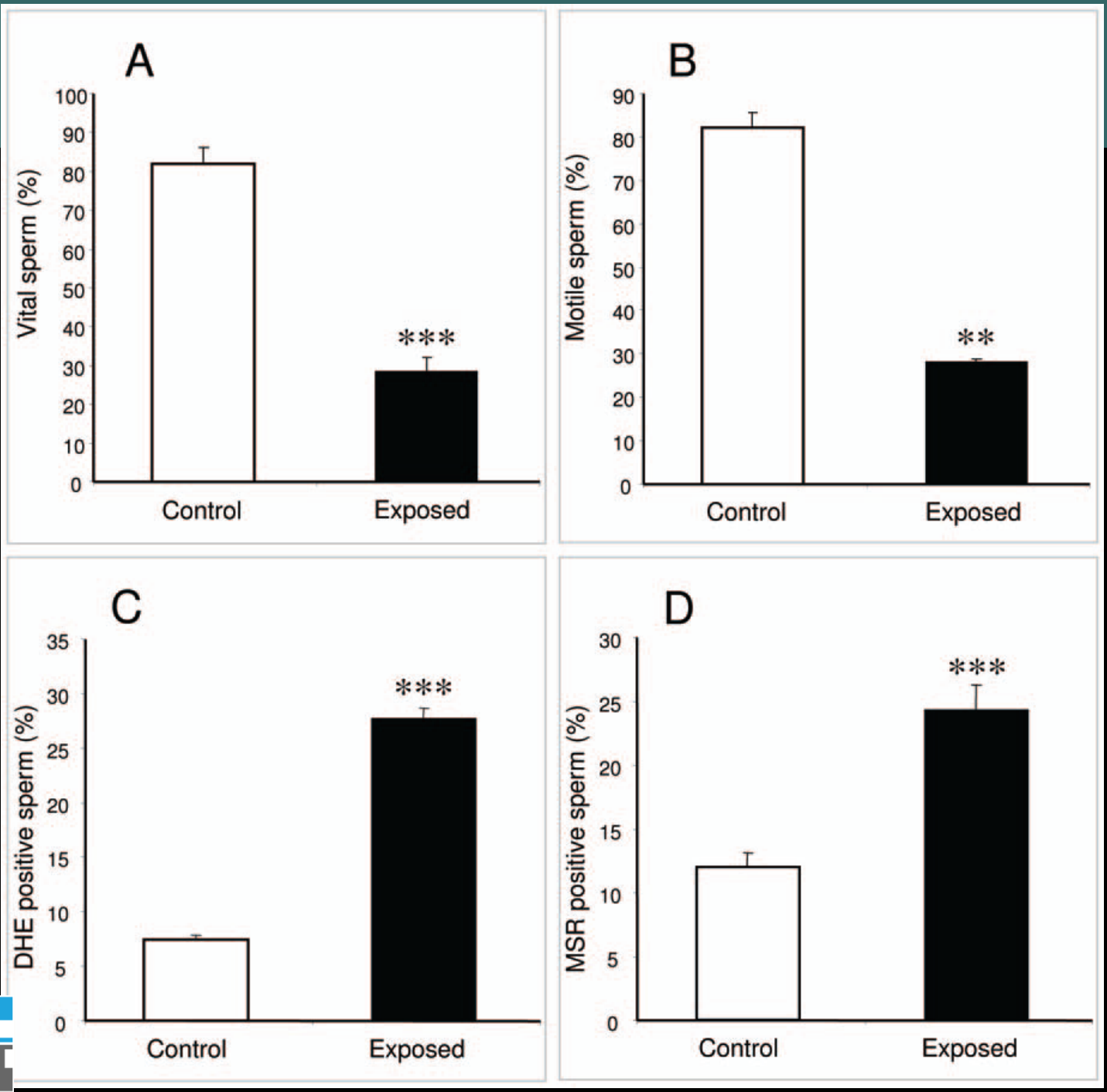


Agarawal, Cleveland Clinic, 2008; and 4 other studies

www.environmentalhealthtrust.org

Laureate Professor John Aitken

Exposed Sperm were Significantly Reduced & damaged



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Controlled Experiments Find Sperm Count and Vitality Significantly Worsened by RF

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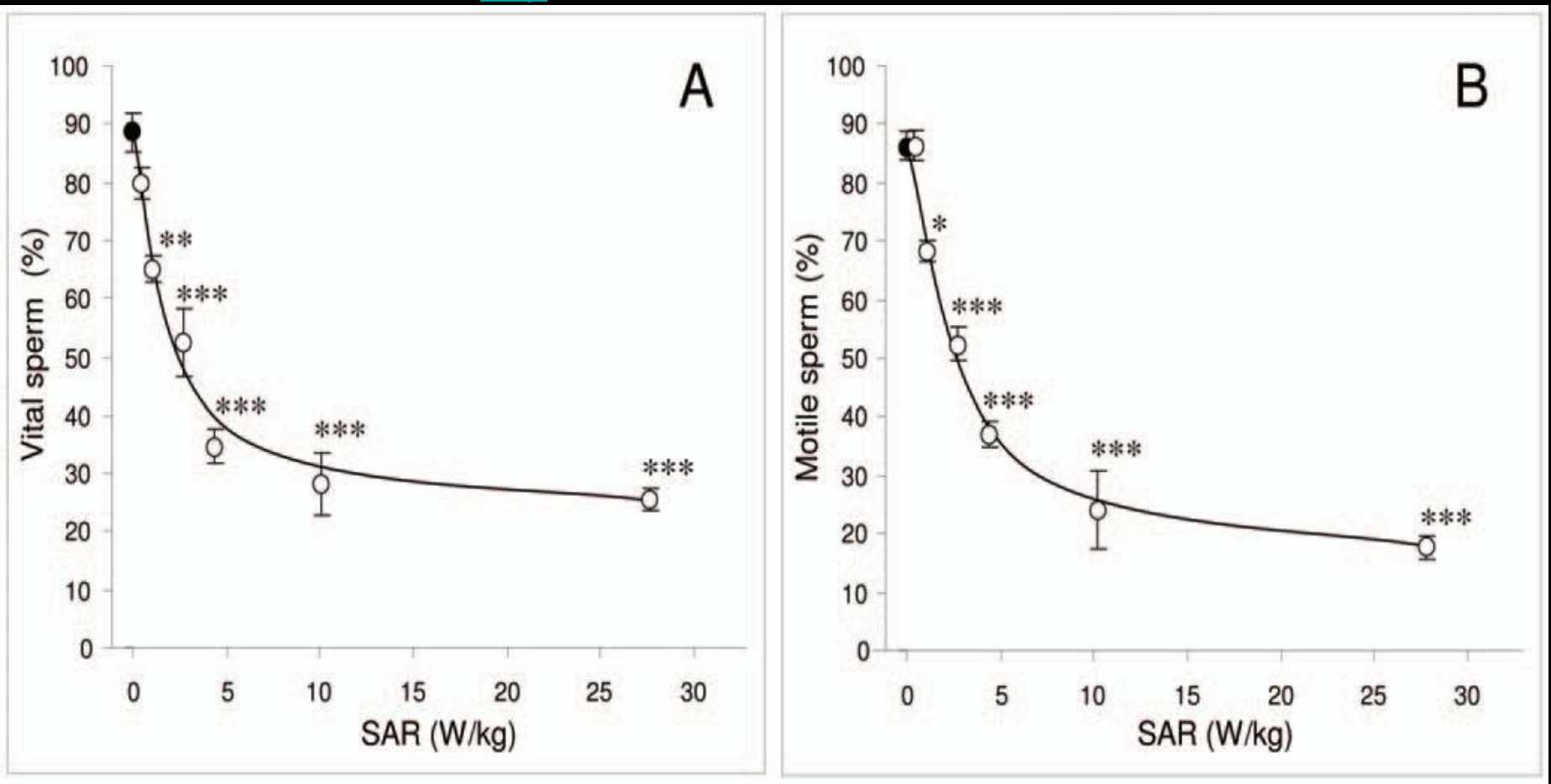
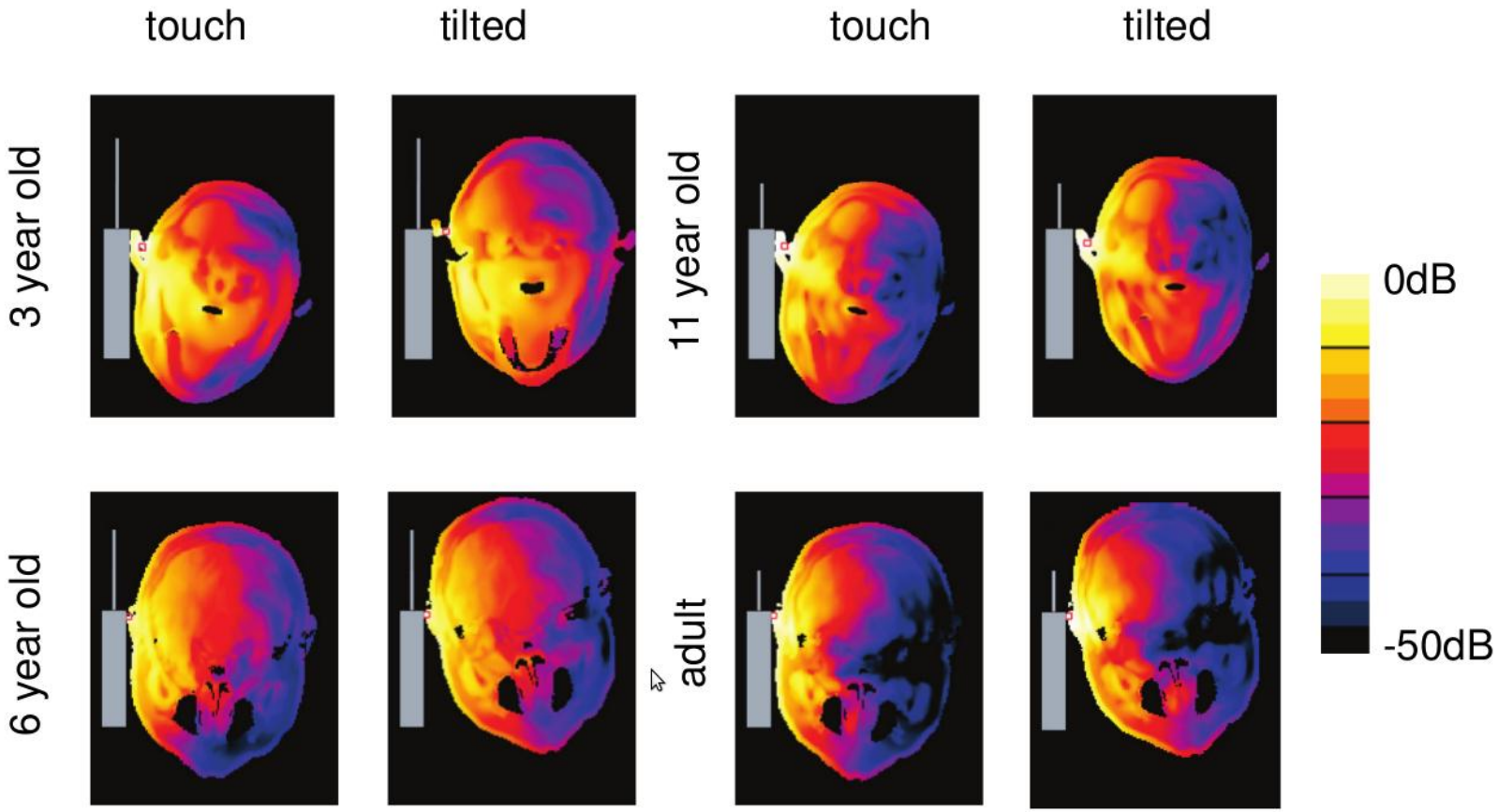
Aitken group, 2009, PLOS

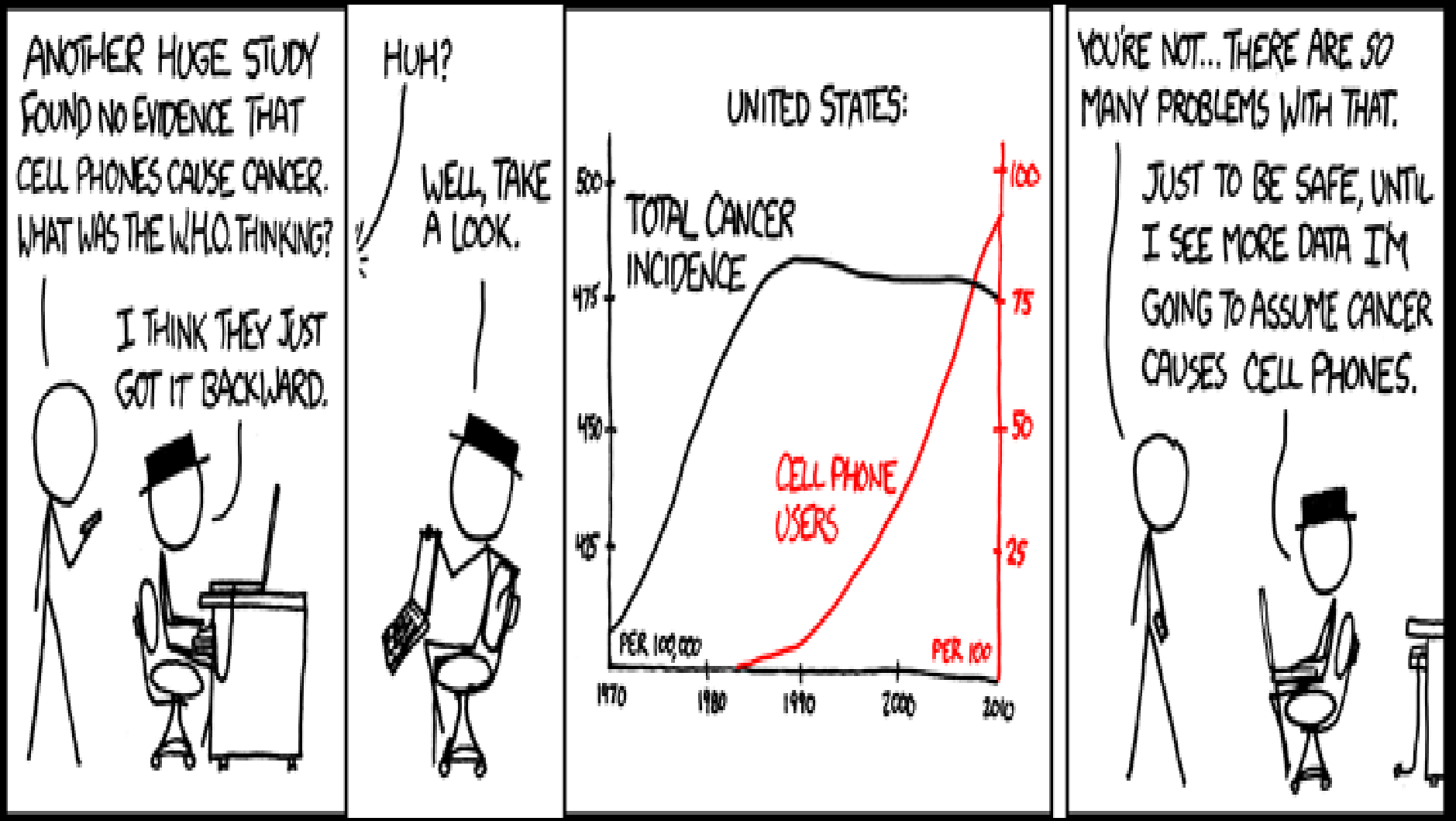
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2714176/pdf/pone.0006446.pdf

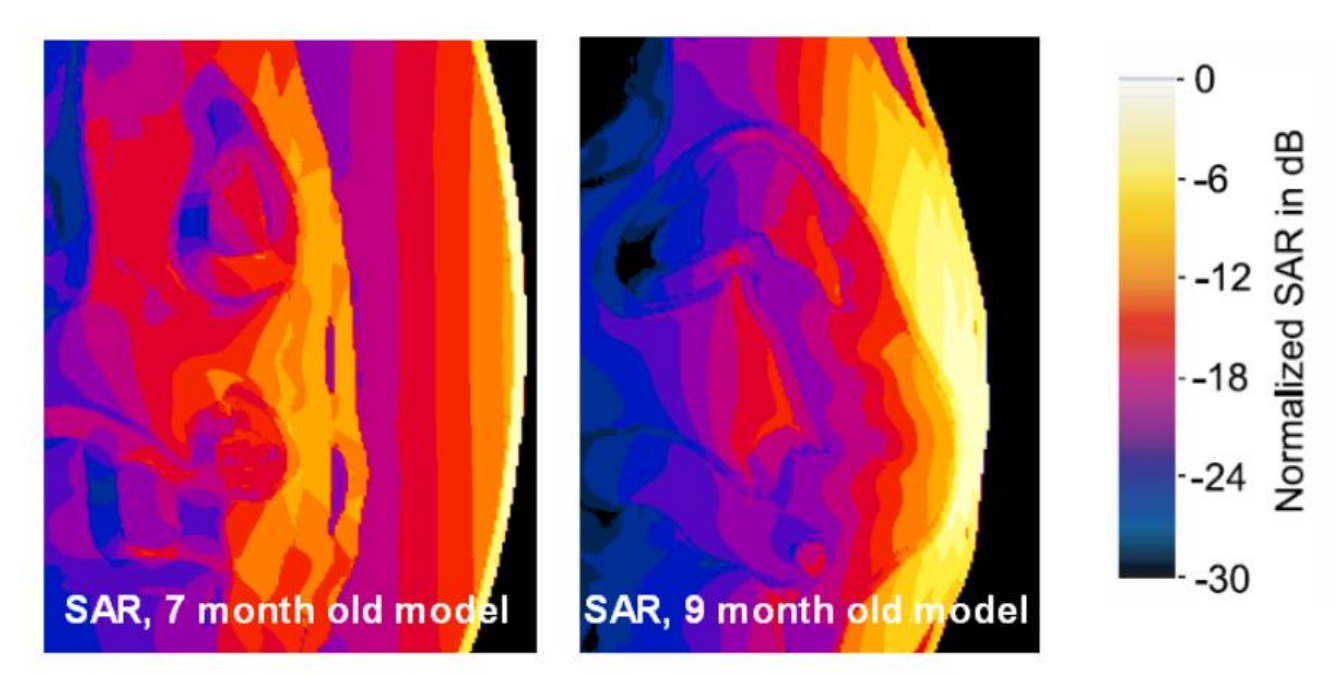


SAR Distribution in the Head Models at 1800MHz



No Regrets Policies





Normalized SAR for the mother and the fetus exposed to a dipole antenna in front of the abdomen (frequency is 450 MHz because of larger penetration depth (courtesy Andreas Christ)

Brief Update from Monte Verita

- Non-thermal effects are demonstrated
- Inadequate protection of children/pregnancy/testes
- Increasing RF/EMF medical applications
  - Novocure.com
  - Pasche cutting edge therapy

    http://www.novocure.com/ttf_therapy.php?ID=16

Public Service Announcments

- **Mayor Mark Barron:** Hi, this is **Mayor Mark Barron**. The town of Jackson recently initiated
- ***The Cell Phone Safety Awareness Campaign*** promotes safe cell phone use in our schools. But we want everyone to be
- safe. We understand that when it comes to how we use our cell phones, *it's better to be safe than sorry*. The
- *World Health Organization* says, "The radiation from cell phones can be a possible cause of cancer". It's easy to
- be safe with your phone. Keep it away from your head and your body. Use a headset or speakerphone. And if
- you're not driving, then text. For more information, go to www.environmentalhealthtrust.org Remember,
- *distance is your friend*. Keep your phone away from your head.