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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- Nesrin Seyhan, Gazi University, Ankara
- Hugh Taylor, Yale University
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
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$^2$;

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

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

Distribution of specific absorption rate (FDTD-METHOD)
Molecular markers ($\gamma$-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

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/nrg1748
Key References


Fetal Programming Evaluated

Radiation exposed 33 pregnant mice

42 pregnant controls
Hyperactivity, Diminished Memory and Reduced Anxiety
Diminished Effect with Decreased Exposure

![Graph showing the relationship between mEPSC frequency and exposure time per day. The graph indicates a decrease in mEPSC frequency as exposure time increases.]
Controlled Experiments with Human Material--sperm

Cell Phone Exposed

Not Exposed
Cross-sectional analysis finds Reduced Sperm Count in Heaviest cellphone users

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<th></th>
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<th>&lt;2 h/day</th>
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<th>&gt;4 h/day</th>
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<td>Millions/ml</td>
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Agarawal, Cleveland Clinic, 2008; and 4 other studies

www.environmentalhealthtrust.org
Laureate Professor John Aitken

Exposed Sperm were Significantly Reduced & damaged
Controlled Experiments Find Sperm Count and Vitality Significantly Worsened by RF

Aitken group, 2009, PLOS


http
SAR Distribution in the Head Models at 1800MHz

- 3 year old
- 6 year old
- 11 year old
- Adult
No Regrets Policies

Another huge study found no evidence that cell phones cause cancer. What was the WHO thinking? I think they just got it backward.

Huh?

Well, take a look.

United States:

Total Cancer Incidence

Cell Phone Users

PER 100,000


PER 100

You're not... there are so many problems with that. Just to be safe, until I see more data I'm going to assume cancer causes cell phones.
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

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.