Wireless Technology & Public Health: Health & Environmental Hazards in a Wireless World

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International EMF Scientist Appeal

• Petition calls for precautionary health warnings & stronger regulation of electromagnetic fields
• Submitted to UN & WHO (May 11, 2015)
• Signed by 218 EMF scientists from 40 nations
• EMFscientist.org
• European Journal of Oncology

Why have 218 scientists signed the petition?

• Proliferation of wireless technology
• Scientific evidence suggests health risks
• Government regulations fail to protect humans and other species

USA: Rapid growth in cell phone use

355 mil. connections
208 mil. smartphones
298,055 cell sites
$188 bl. annual revenue
$430 bl. investment
CTIA: Dec. 2014

Adolescent cell phone use

Older teens more likely to own cell phones
The percentage of teens who have a cell phone, by age (2004-2009)

<table>
<thead>
<tr>
<th>Age of teen</th>
<th>2004</th>
<th>2006</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>18</td>
<td>24</td>
<td>27</td>
<td>32</td>
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<td>13</td>
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<td>17</td>
<td>54</td>
<td>63</td>
<td>74</td>
<td>88</td>
</tr>
</tbody>
</table>

88% of 13-17 year olds in US have cell phones
73% have smartphones
 Pew Internet (http://www.pewinternet.org), 4/9/2015

Demise of the landline telephone

88% of 13-17 year olds in US have cell phones
47.4% wireless-only
14.6% wireless-mostly
26.9% mixed-use
7.7% landline-only
3.4% no phone
NHIS. NCHS, CDC. Dec., 2015.
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How do cell phones work?

FDA (1999)

- “The existing exposure guidelines are based on protection from acute injury from thermal effects of RFR exposure, and may not be protective against any non-thermal effects of chronic exposure.”
- “A significant research effort is needed… to provide the basis to assess the risk to human health of wireless communications devices.”

http://1.usa.gov/1Mzz6UM

Electromagnetic spectrum

Glioma risk: Case-control studies

IARC working group press release

Press release

IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use.
Hardell Research Group:
Case-control studies since IARC

- Wireless phone use 25+ years
  - Glioma: OR = 3.3 (95% CI: 1.6 – 6.9)

- Wireless phone use 20+ years
  - Acoustic neuroma: OR = 4.4 (95% CI: 2.2 – 9.0)


Child’s brain absorbs 2X the radiation

![Image](Figure 1. Evaluation of the penetration of electromagnetic radiation from a cell phone based on age. (Frequency GSM 900 MHz) On the right: a scale showing the specific absorption rate at different depths, in W/kg.[1] Gandhi et al., 2012)

Children’s brain tumor risk (CEFALO)

- Case-control study – Denmark, Sweden, Switzerland, Norway (2004-2008)
- Youth 7-19 years of age
  - 352 cases, 646 controls
- "Regular" cellphone use: OR = 1.36 (0.92-2.02)
  - 3 nations (OR’s = 1.49 to 1.73); Norway (OR = 0.51)
- Cell phone company records – 2.8+ years cellphone use: OR = 2.14 (1.07-4.29)


Recent increases in brain cancer incidence over time

- **USA:** frontal lobe in adults 20-29 years of age; GBM in frontal & temporal lobes & cerebellum (overall population)
- **Norway & Finland:** overall population
- **Denmark:** GBM for males
- **England:** frontal & temporal lobes (overall)
- **Australia & New Zealand:** over age 70
- **Sweden:** no increase; registry unreliable

Existence of biologically plausible mechanisms

- Pall (2013) review paper
  - ELF & RF stimulate voltage-gated calcium channels (VGCC) to increase intra-cellular Ca²⁺ & nitric oxide synthesis
  - Calcium channel blockers eliminate EMF-induced effects (23 studies)
- Blood-brain barrier penetration (Salford)
- See slides at end of presentation for references to other mechanisms

Oxidative stress from low-intensity radiofrequency radiation

**Yakymenko et al. (2015) review**

- Oxidative stress = imbalance between free radical production & body’s ability to counteract harmful effects via antioxidants
- 93 of 100 studies (16 cellular, 73 animal/plant, 4 human) → significant oxidative stress
- Effects: disrupted cell signaling, stress proteins, free radical formation, DNA-damage → carcinogenicity, neurologic disorders (e.g. ADHD, electrohypersensitivity)
Three-fourths of biologic studies yield significant effects

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Number of Studies w/ Significant Effects</th>
<th>Number of Studies w/ No Significant Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurologic</td>
<td>163 (71%)</td>
<td>68 (25%)</td>
</tr>
<tr>
<td>Genetic</td>
<td>31 (66%)</td>
<td>14 (44%)</td>
</tr>
<tr>
<td>Free Radical</td>
<td>115 (87%)</td>
<td>18 (13%)</td>
</tr>
<tr>
<td>Overall</td>
<td>359 (75%)</td>
<td>122 (25%)</td>
</tr>
</tbody>
</table>

Other potential health risks in humans from wireless phone use

- **Tumors**: acoustic neuroma, meningioma, parotid, pituitary & thyroid glands; breast
- **Reproductive harm**: sperm damage, male infertility
- **Fetal development**: memory, ADHD, autism?
- **Children**: headaches, hearing, memory, ADHD
- **Electromagnetic hypersensitivity**: headaches, dizziness, fatigue, insomnia, tinnitus, skin rashes, heart palpitations

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US government: Radio Frequency Interagency Work Group

- **WHO**: "To date, no adverse health effects have been established as being caused by mobile phone use."
- **FCC**: "currently no scientific evidence establishes a causal link between wireless device use and cancer or other illnesses."
- **FDA**: "The scientific evidence does not show a danger to any users of cell phones from RF exposure, including children and teenagers."
- **NCI**: "currently no consistent evidence that non-ionizing radiation increases cancer risk ... The only known biological effect of radiofrequency energy is heating."

Federal government position

- **Wait and see**: wait for conclusive evidence yet make minimal investment in research
  - "the overlap of federal agency responsibilities … leaves leadership unclear and encourages a pass-the-buck attitude." (Cities of Boston & Philadelphia, 2013) http://bit.ly/1kAYS07
  - "the electromagnetic radiation standards used by the FCC continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today." (U.S. Dept. of Interior, 2014) http://1.usa.gov/1jn3CZg
Organizations & agencies promote FCC policy changes

- American Academy of Pediatrics
- Amer. Academy of Environmental Medicine
- California Medical Association
- US Department of the Interior
- US General Accountability Office
- Boston and Philadelphia
- Environmental Working Group
- Consumers Union

Consumer Reports magazine: November, 2015 issue

Cell phone personal & policy recommendations

- Consumer Reports agrees with Amer. Academy of Pediatrics & the GAO that FCC should develop new cell phone tests that account for children’s vulnerability as children’s brains absorb more radiation
- Cell-phone manufacturers should prominently display advice on how to reduce cell-phone radiation exposure

Industry influence: CTIA—The Wireless Association

CTIA:
“Leading global health organizations such as the American Cancer Society, National Cancer Institute, World Health Organization and the U.S. Food and Drug Administration all concurred that wireless devices are not a public health risk.”

Fierce Wireless, June 9, 2015

Alarmism vs. denialism – what about precaution?

Precautionary principle

“Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”


European Union: Policy recommendations

- Governments: adopt more stringent radiation standards & fund research (European Environment Agency [EEA], 2011)
- Manufacturers: improve cell phone design & issue warning labels (EEA, 2011)
- Consumers: reduce exposure (especially children); hands-free use (EEA, 2011)
- Schools: restrict Wi-Fi & mobile phone use (Council of Europe, 2011)
Berkeley: Cell phone “right to know” ordinance

- City Council unanimously adopted cell phone consumer disclosure law (May 12, 2015)
- CTIA filed lawsuit in Federal court
- City adopted minor revision
- Court cleared way for implementation (Jan 27, 2016)
- Saferemr.com: updates & media coverage

References

Tumor risk review papers

References

Tumor risk case-control studies

Breast cancer case series

References

Brain tumor incidence trends
Mechanisms

- Pall (2013) EMFs act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. http://1.usa.gov/VulzLm

Reproductive Health Effects


Exposure


Other