Radiofrequency Radiation (RFR), the evidence on cancer

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Conflicts of Interest

None to declare

IARC Working Group Review (2011)

1. Cancer in Humans

There is *limited evidence* in humans for the carcinogenicity of radiofrequency radiation.

Positive associations have been observed between exposure to radiofrequency radiation from wireless phones and glioma, and acoustic neuroma.

2. Cancer in Experimental Animals

There is *limited evidence* in experimental animals for the carcinogenicity of radiofrequency radiation.

3. Overall Evaluation

Why do we now believe RFR causes Brain Cancer?

Three important sets of case-control (human) studies:

- Interphone – 2-fold increased risk for 10+ years use
- Hardell in Sweden – several studies showing 2-5 fold increased risk after prolonged use, especially when exposure begins early in life
- Cerenat France, 5-fold increased risk for 5+ years use

Interphone – Appendix 2 for Glioma

Time since start of regular use (years)	Cases	Controls	OR	95% CI
1–1.9	93	159	1.00	
2–4	460	451	1.68	1.16–2.41
5–9	468	491	1.52	1.06–2.22
10+	190	150	2.18	1.43–3.31

Relative Risk Estimates for Glioma Associated with Ten or More Years of Mobile Phone Use

Study	Exposure, in years of use	RR/OR	95% CI	Design
Benson et al, 2013 (UK)	>10	0.8	0.5–1.1	Cohort
Hardell et al, 2013 (Sweden)	10–15 >25	1.4 3.0	1.3–3.5 1.7–5.2	Case-control
Coureau et al, 2014 (France)	≥ 10	1.6	0.8–3.1	Case-control

Cerenat (France)- 231 cases, 446 control (Coureau et al, 2014)

Brain cancer	Exposure period	OR	95% CI
Glioma	After 2 years	2.9	1.4-5.9
	After 3 years	3.03	1.5-6.3
	After 5 years	5.3	2.1-13.2
Ipsilateral glioma	All	2.1	0.7-6.1
Meningioma	All	2.6	1.0-6.1

Relative risk for Acoustic Neuroma associated with Ten or more years of Mobile Phone use

Study	Exposure in years of use	RR/OR	95% CI	Design
Benson et al (2013) – UK	>10	2.5	1.1–5.6	Cohort
Moon et al (2014) – Korea	≥ 10	1.0	0.9–1.0	Case-control
Hardell et al (2015) – Sweden	10–15	2.1	1.3–3.5	Case-control

Case-control study of brain tumors in adolescents using *operator records* for exposure in Nordic countries (Aydin et al. 2011).

Years since initial subscription	Cases	Controls	OR	95% CI
Never regular user	134	259	1.0	
<1.8	19	51	0.8	0.4–1.4
1.8–2.8	19	25	1.7	0.8–3.4
>2.8	24	25	2.2	1.1–4.3

3G modulation appears to be more carcinogenic than 2G (Hardell et al, 2015)

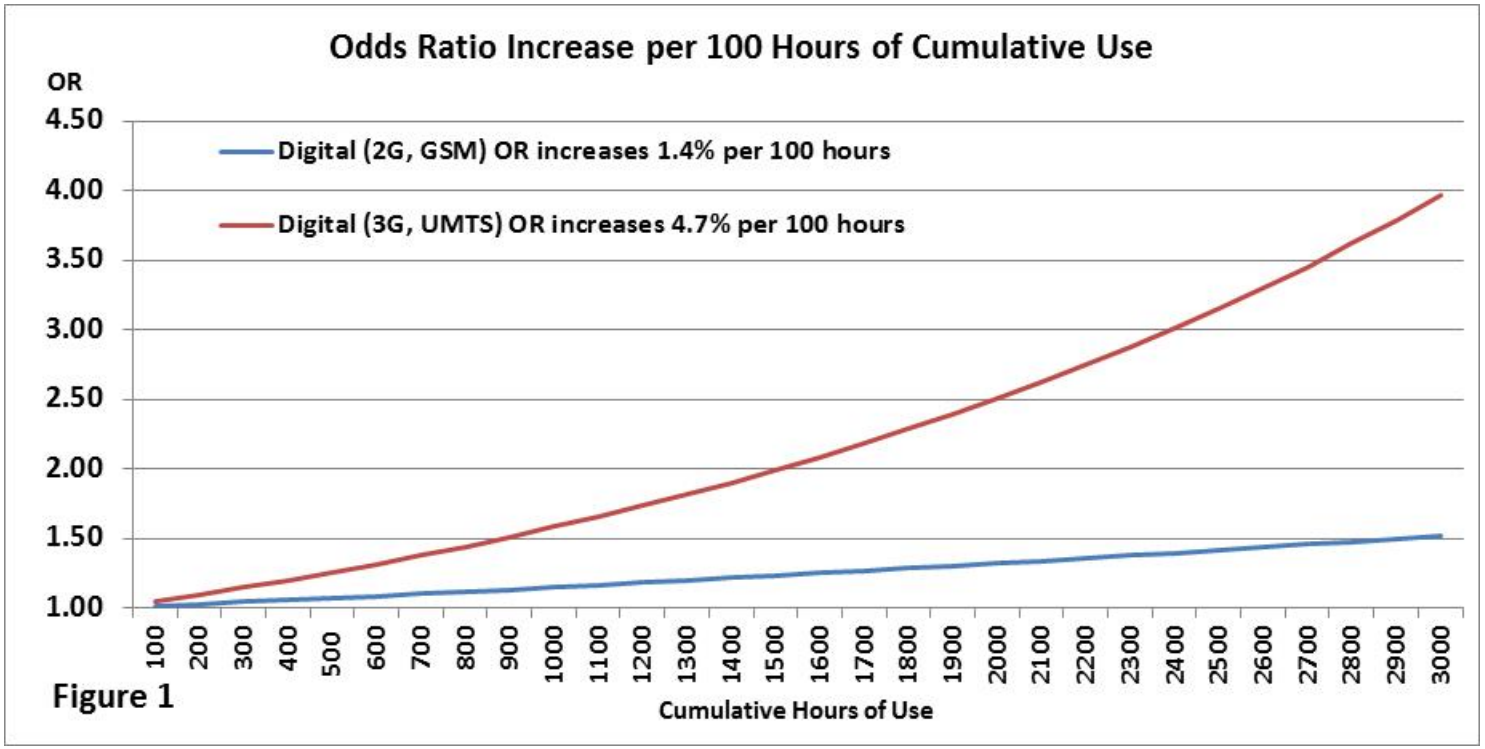
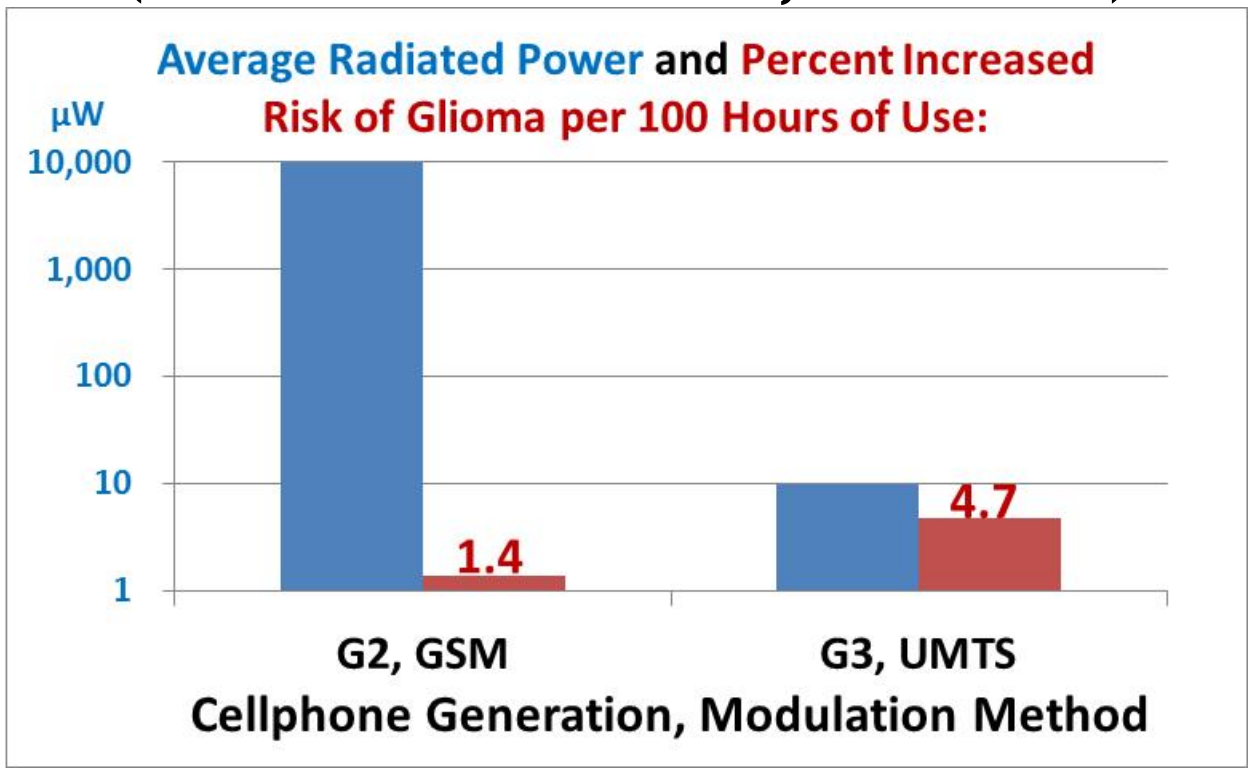


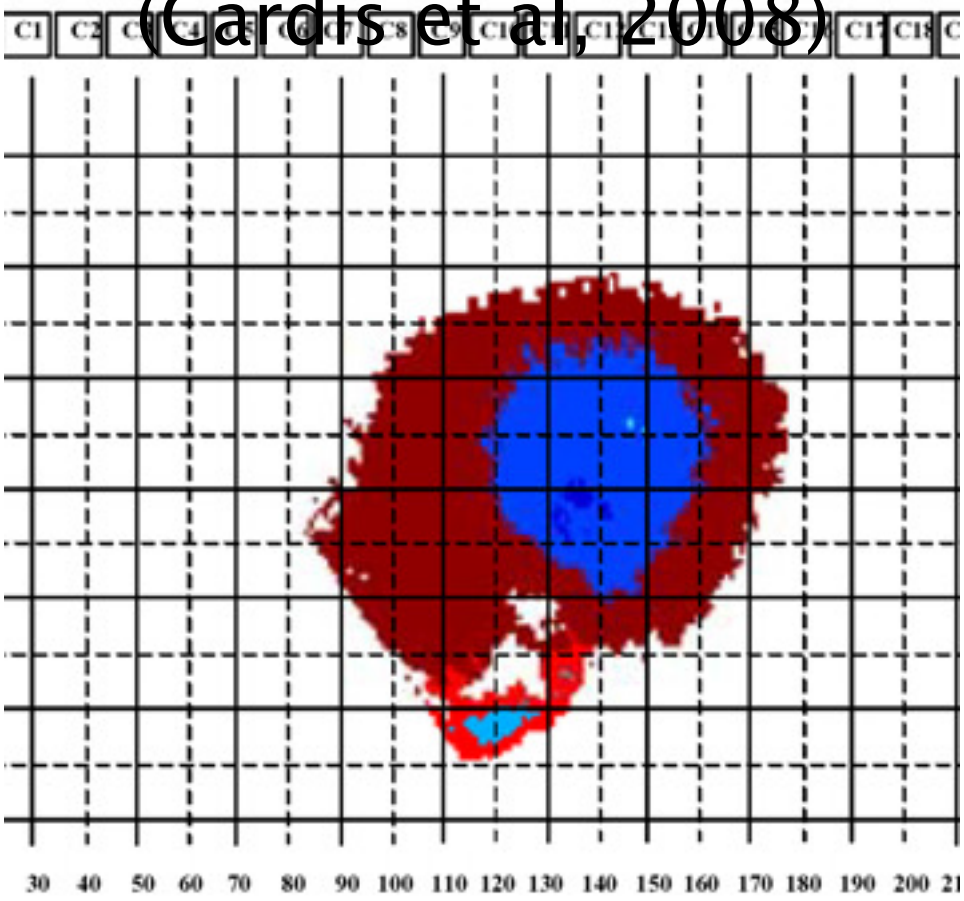
Figure 1

3G modulation appears to be more carcinogenic than 2G (Hardell et al, 2015)



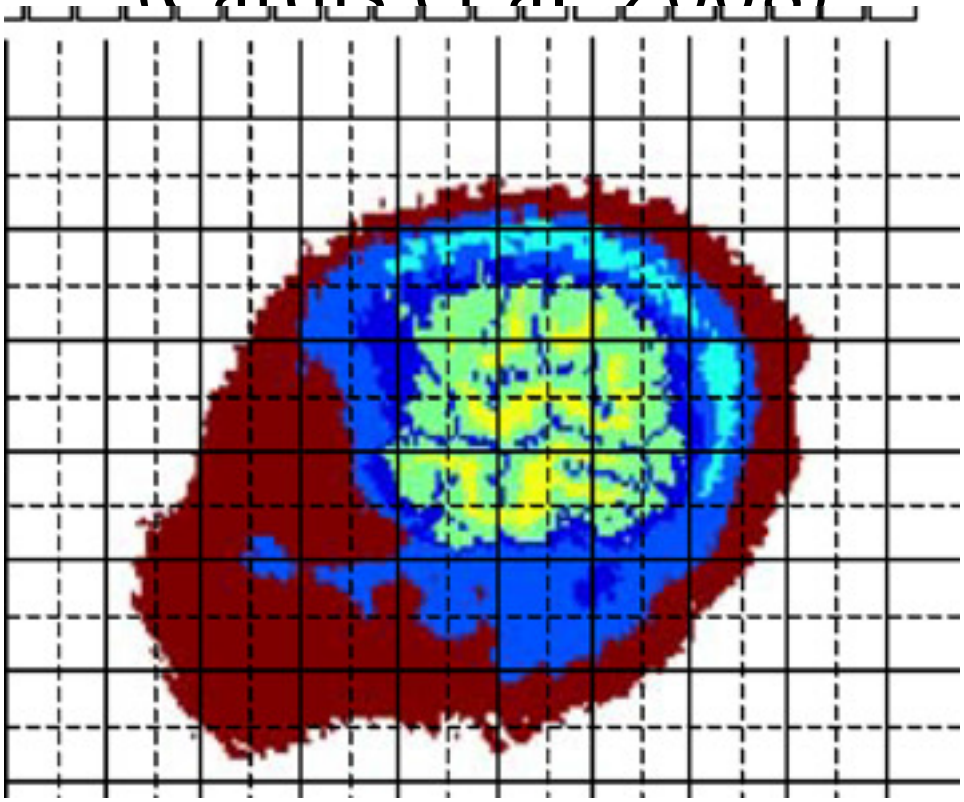
Cell phone 15mm from side of head

(Cardis et al, 2008)



Cell phone 25mm from side of head

(Cardis et al. 2008)

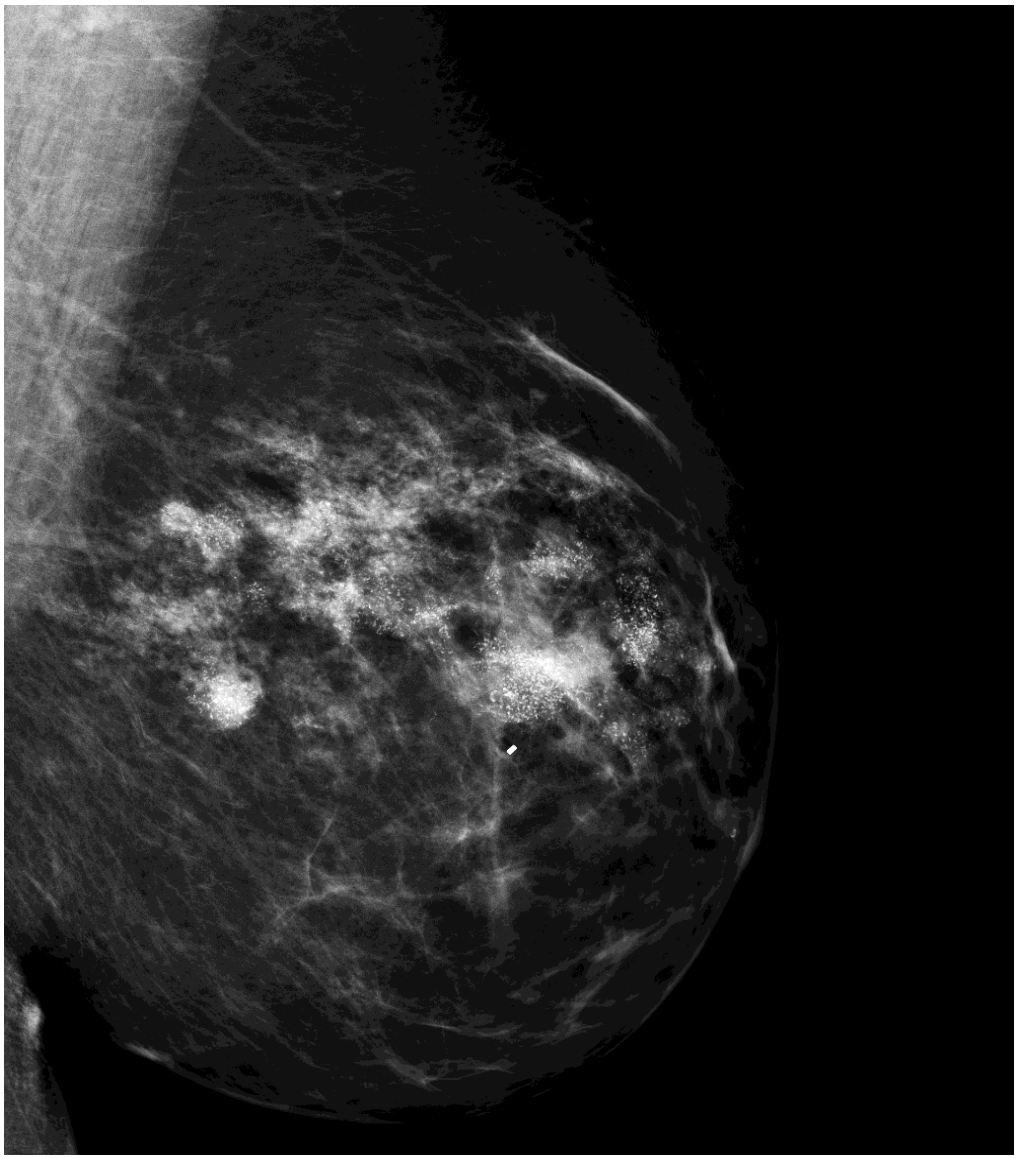


Radiofrequency Radiation is probably an avoidable cause of Breast Cancer

- Ø7 unusual clinical case reports
- ØExposure modeling
- ØToxicology
  - in vitro with human and animal cells
  - in vivo

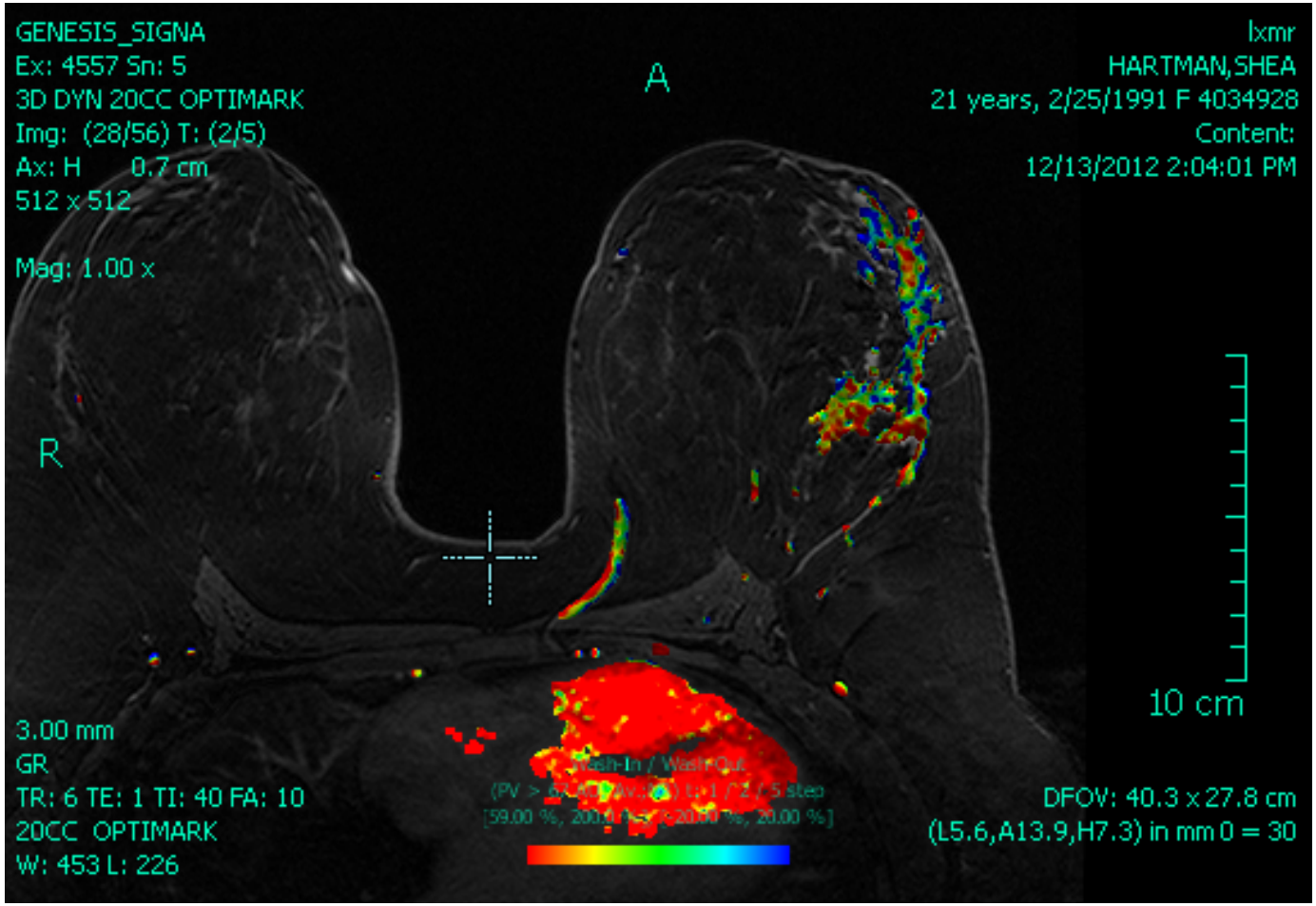
Marketing for Cell Phones to be kept in Bras

First case reported by Robert Nagourney, MD, 2009

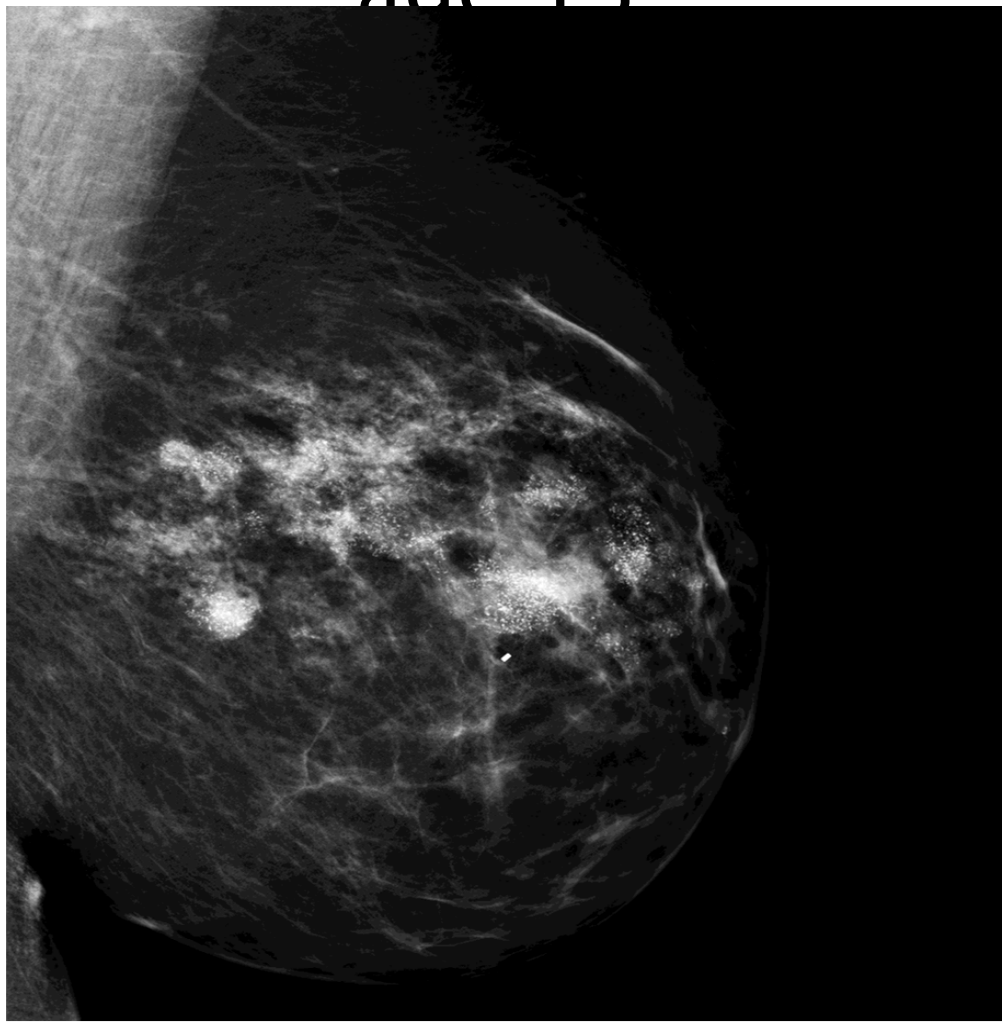


Invasive multiple primary tumors in 34 year old, avid runner, Chinese-American woman who had kept a cellphone 4 hours a day in her bra for 10 years

Case Report—21 yr old. Multi-focal tumors linked to cellphone kept in bra (West et al, 2013)



Two cases age 21 with multi-focal tumors
linked to cellphones kept in bra from age 13



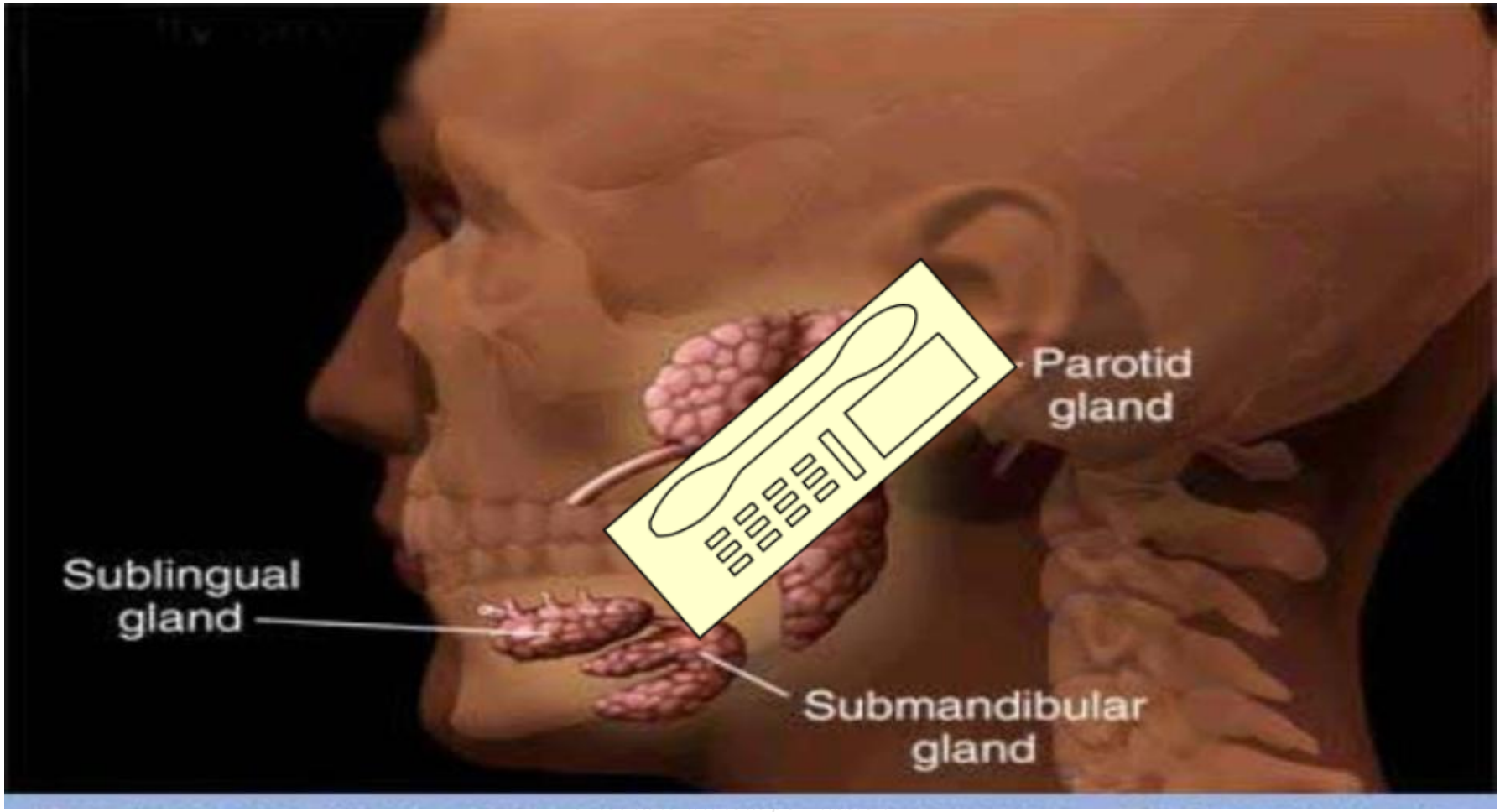
Summary of 7 cases

- Ø Negative for genetic risk factors
- Ø No family history or other risk factors
- Ø Unusual location of multi-focal tumors where phones were kept
- Ø No significant histology away from the areas of cellular phone use
- Ø Two with metastases

Other reasons for deducing that radiofrequency radiation causes breast cancer

- Exposure Information
- In vitro toxicology
  - RFR stimulates cell death in normal fibroblasts
  - RFR impedes efficacy of tamoxifen
  - RFR interferes with melatonin
  - RFR is a xenoestrogen
- In vivo toxicology studies

Parotid or Salivary Gland Tumors Tripled in Israel:
1 in 5 under age 20



Increase in Parotid Gland Tumors in Israel over 30 Years

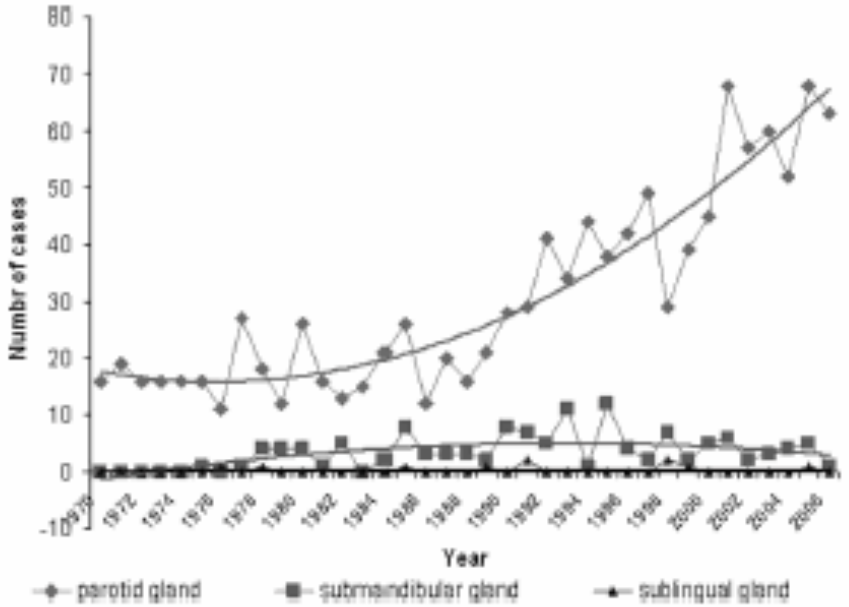


FIGURE. For trend analyses, we added regression lines and calculated R^2 values. Parotid gland cancer: $R^2 = 0.83$; Submandibular gland cancer: $R^2 = 0.36$; Sublingual gland cancer: $R^2 = 0.02$.

Source: Epidemiology, 22, p.130, January 2011

Israeli Dental Association Warning

- One in every five rare malignant tumors of the cheek occurs in someone under age 20
- Young people should use headsets and speakerphones and limit direct exposure of the head to radiofrequency fields from cell phones

Concerns about Children

- Children have developing brains and other organs
- There are reasons to believe that children may be particularly susceptible to the effects of RFR
- Even if ongoing studies (e.g. Mobi-Kids) are negative, exposure early in life could increase cancer risk in adulthood.

Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans.

- Tumor-promoting effects of RF-EMF exposed mice were first reported in 2010.
- Lerchl et al (2015) replicated the study with higher numbers of mice per group.
- They could fully confirm the previous results.
- No clear dose-response relationship was evident.
- Lerchl et al (2015) hypothesized that metabolic changes are responsible for

NTP Animal Carcinogenicity Study (2018)

Male Hsd:Sprague Dawley SD rats, exposed to GSM-modulated cell phone RFR at 900 MHz:

- Clear evidence of carcinogenic activity based on incidence of malignant schwannoma in the heart.
- Some evidence of carcinogenic activity based on incidence of malignant glioma in the brain.

Male Hsd:Sprague Dawley SD rats, exposed to CDMA-modulated cell phone RFR at 900 MHz:

- Clear evidence of carcinogenic activity based on incidence of malignant schwannoma in the heart.
- Some evidence of carcinogenic activity based on incidence of malignant glioma in the brain.

Multiple organs (e.g., brain, heart) also had evidence of DNA damage.

Ramazzini Institute Life-span Carcinogenic Study

2448 male and female Sprague-Dawley rats had whole-body exposure for 19 h/day to a 1.8 GHz GSM far field of 0, 5, 25, 50 V/m from prenatal life until natural death.

- This reproduced the environmental exposure to RFR generated by 1.8 GHz GSM antenna of radio base stations of mobile phones.

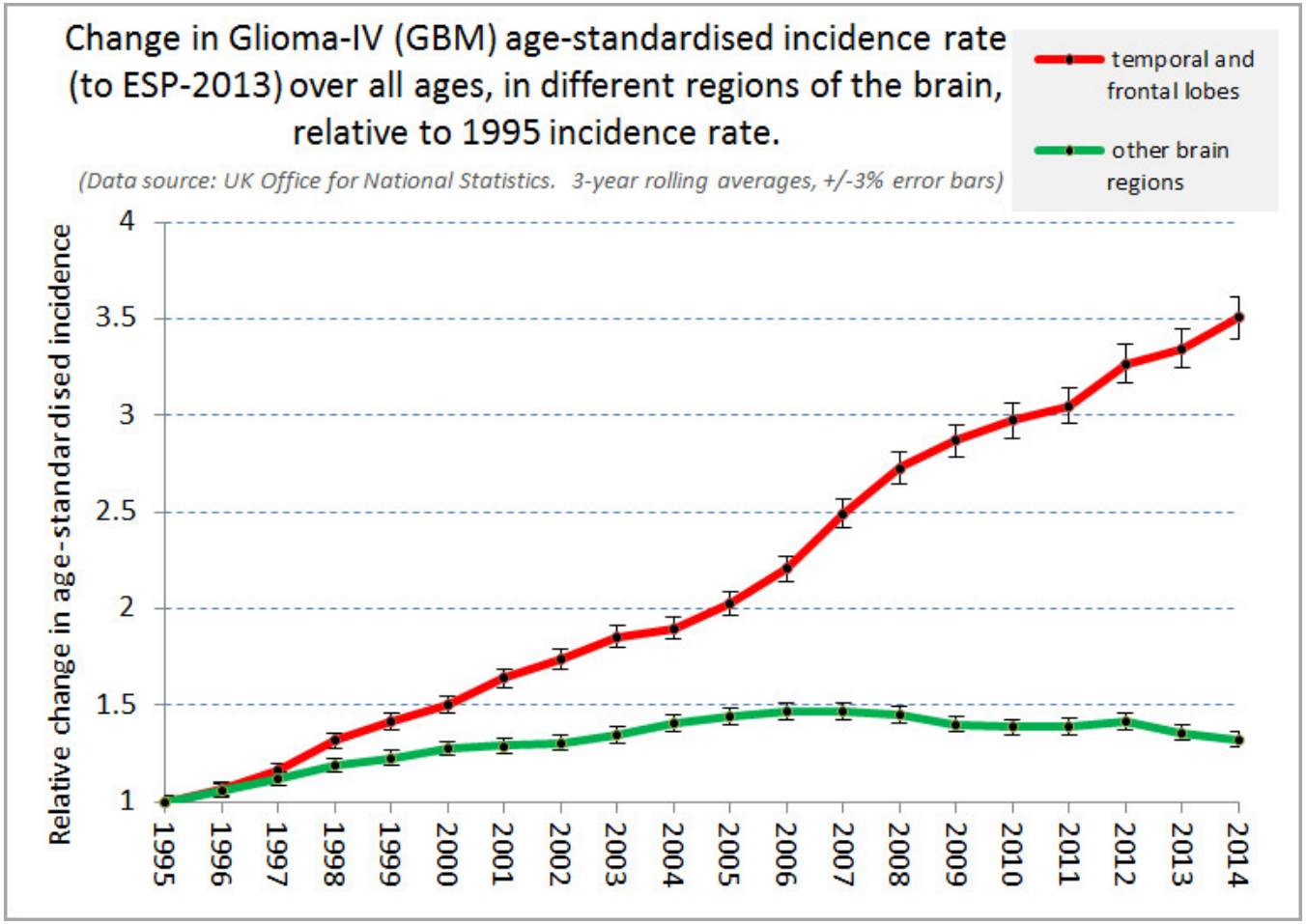
Results:

Ø A statistically significant increase in the incidence of heart Schwannomas in treated male rats at 50 V/m.

Ø A non-significant increase in the incidence of heart Schwann cells hyperplasia in treated male and female rats at 50 V/m.

Ø A non-significant increase in the incidence of malignant glial tumors in treated female rats at 50 V/m

Rise of Glioblastoma in the UK



Other changes in rates of brain cancer

- The incidence of neuro-epithelial brain cancers has significantly increased in all children, adolescent, and young adult age groupings from birth to 24 years in the United States (Gittleman et al, 2015; Siegel et al 2018).
- The mortality from brain cancers in Brazil has increased by 90% in 25 years (from 56.11 per 100,000 in 1990 to 106.63 in 2015)

The Public do not Understand

- Ø There is enormous ignorance over the adverse health effects of RFR
- Ø E.g. Mobile phones, Apple watch, Driverless cars
- Ø Manufacturers of products that depend upon RFR for functioning ignore the risks
- Ø But they do so at their peril – they cannot obtain Insurance coverage against the risks of RFR

Overall conclusions

- Ø Radiofrequency radiation is a Human Carcinogen (IARC Category 1)
- Ø Radiofrequency radiation is now ubiquitous
- Ø Even if the risk per individual is low, it is widely distributed and could become a major public health problem
- Ø The Precautionary Principle must be applied now.
- Ø Canada's Safety code 6 must be revised