Occupational and environmental epidemiology of EMF
St. Pölten 3 October 2020

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The Environment and Cancer Research Foundation

www.environmentandcancer.com

(Present address)

Environment & Cancer
Research Foundation

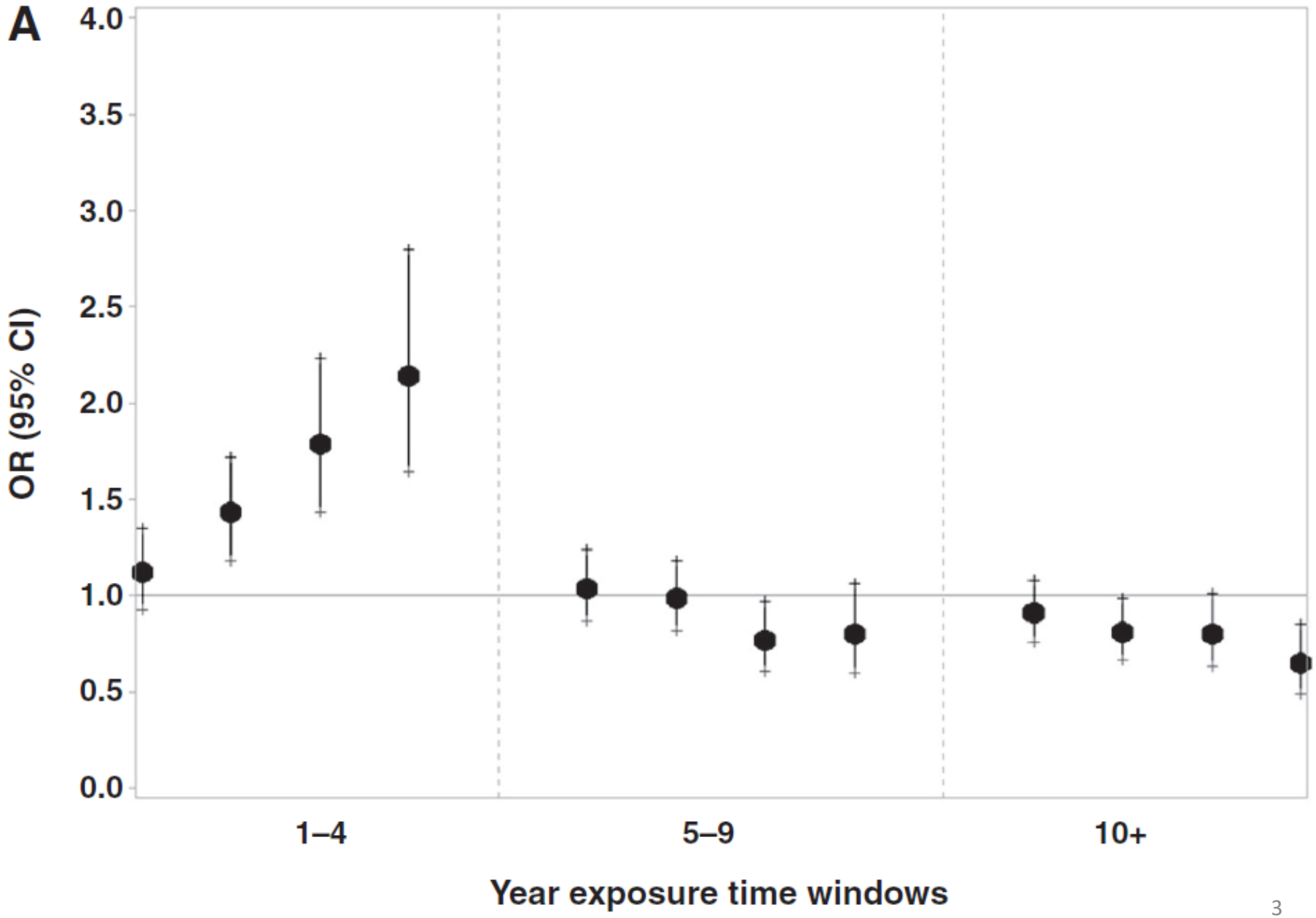
Universitetssjukhuset Örebro
ÖREBRO LÄNS LANDSTING

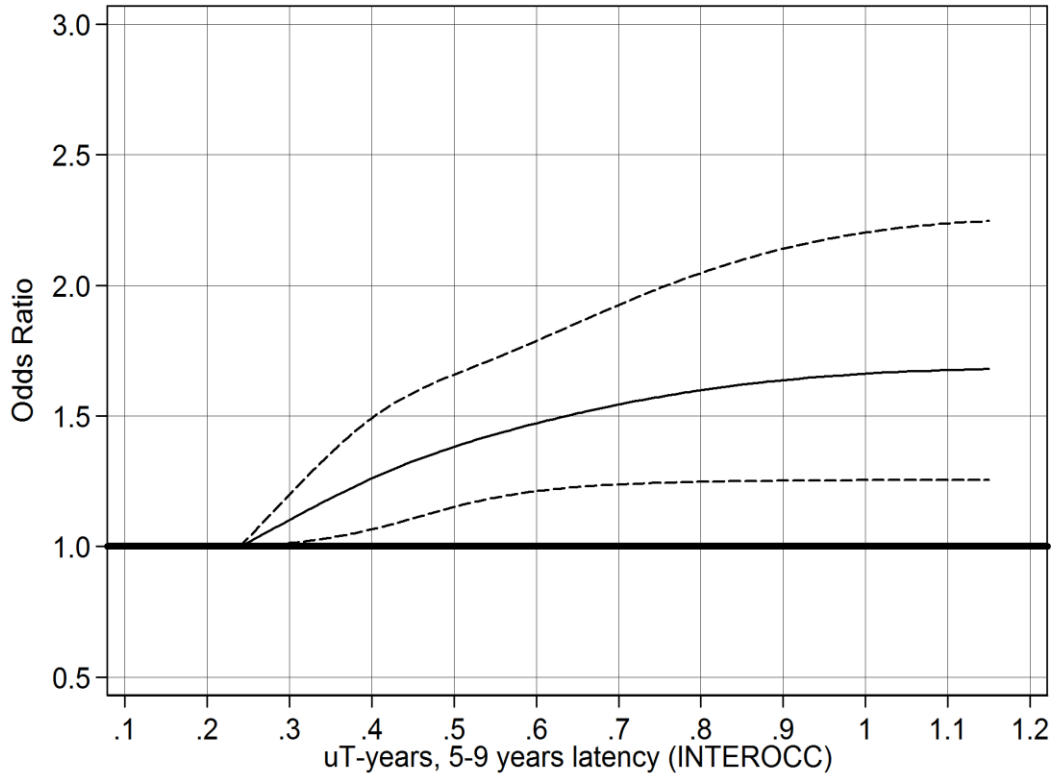
ÖREBRO UNIVERSITY

Extremely low-frequency electromagnetic fields (ELF-EMF)

In 2002 International Agency for Research on Cancer (IARC) classified extremely low-frequency electromagnetic fields (ELF-EMF) as “possibly carcinogenic to humans”, Group 2B based on an increased risk for childhood leukemia

Figure 1. A, adjusted ORs (95% CIs) for glioma in relation to categories of cumulative occupational ELF exposure in the 1- to 4-, 5- to 9-, and 10+-year time windows before the date of diagnosis/reference date from a simultaneous exposure time windows model with cut points based on the 25th, 50th, 75th, and 90th percentiles, INTEROCC study, 2000 to 2004, Australia, Canada, France, Germany, Israel, New Zealand, and the United Kingdom.





Restricted cubic spline plot of the relationship between cumulative exposure to ELF-EMF in µT-years and astrocytoma grade IV in the 5-9 years latency group. The solid line shows the OR estimate and the broken lines represent the 95 % CI. Adjustment for age at diagnosis, gender, SEI-code, and year of diagnosis was made. Population based controls were used.

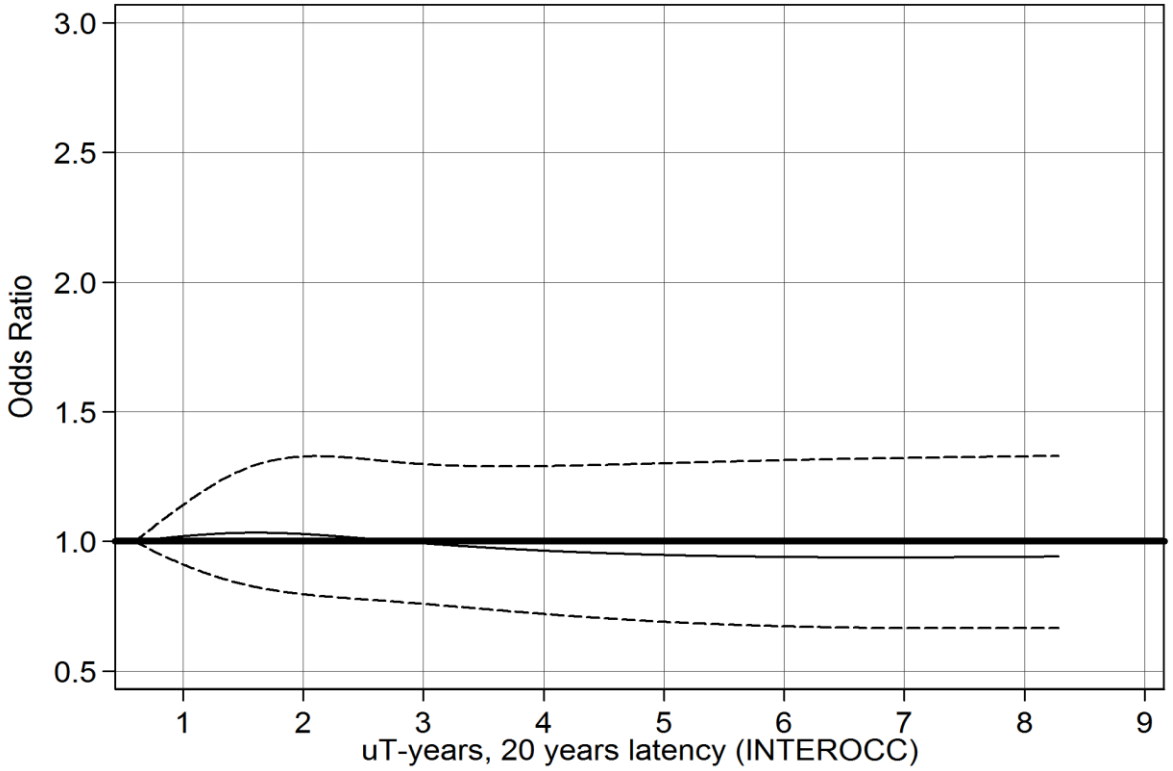
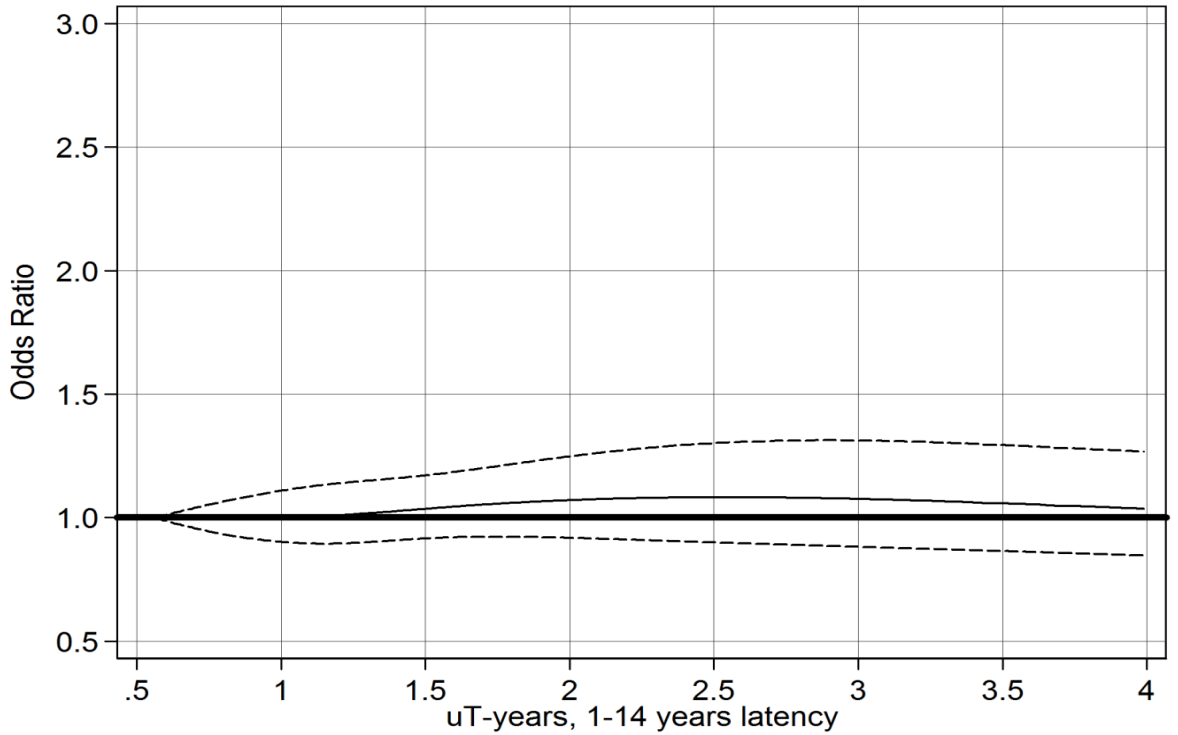


Figure 2. Restricted cubic spline plot of the relationship between cumulative exposure to ELF-EMF in µT-years and astrocytoma grade IV in the ≥ 20 years latency group. The solid line shows the OR estimate and the broken lines represent the 95 % CI. Adjustment for age at diagnosis, gender, SEI-code, and year of diagnosis was made. Population based controls were used.

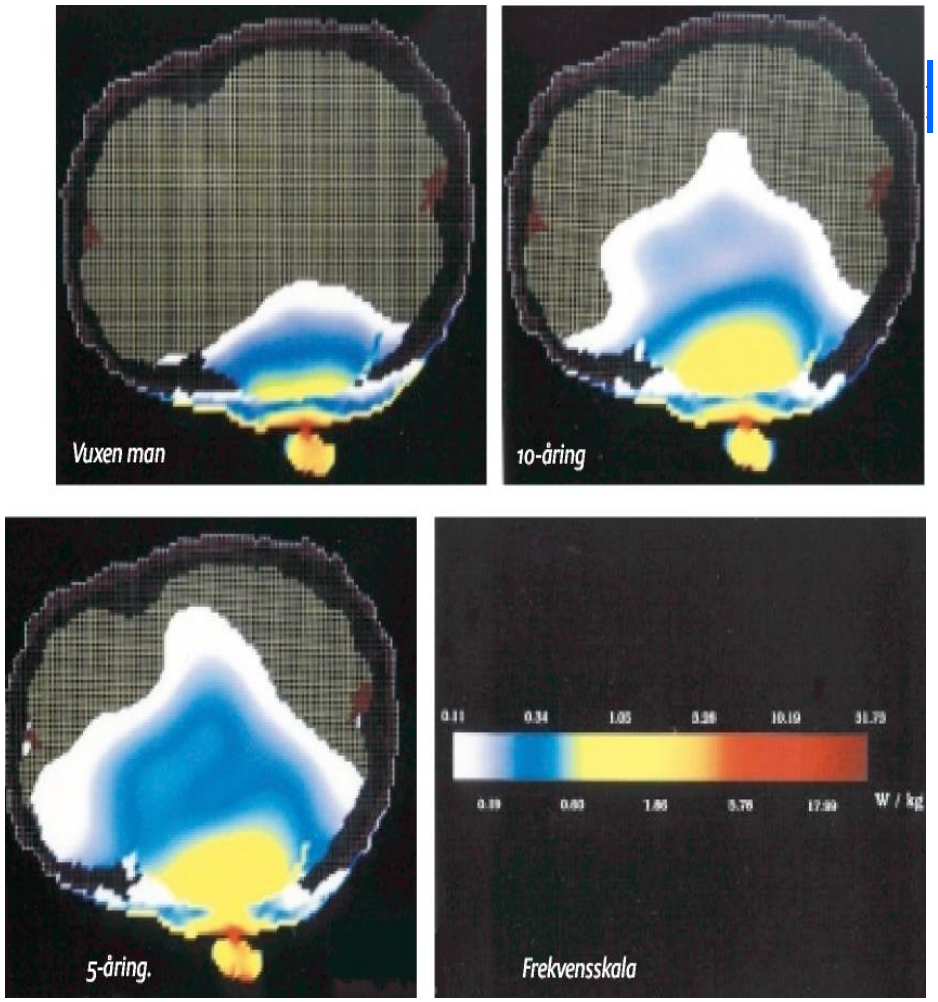
Restricted cubic spline plot of the relationship between cumulative exposure to ELF-EMF in μT-years and meningioma in the 1-14 years latency group. The solid line shows the OR estimate and the broken lines represent the 95% CI. Adjustment for age at diagnosis, gender, SEI-code, and year of diagnosis was made.



Radiofrequency (RF) radiation

In May 2011 IARC evaluated RF radiation in the frequency range 30 kHz–300 GHz to be a possible human carcinogen, Group 2B

New evaluation within a few years due to further studies on the carcinogenicity

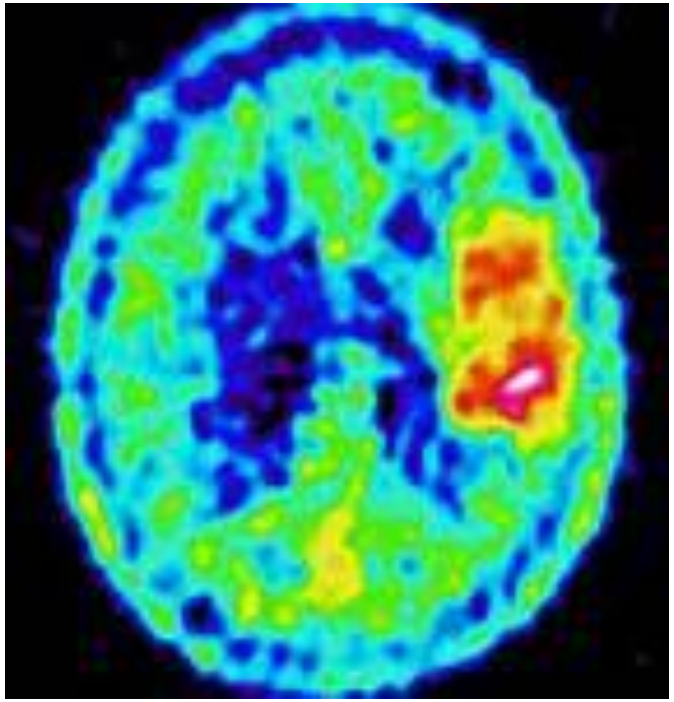


Adult man, 10 years child, 5 years child, frequency scale.

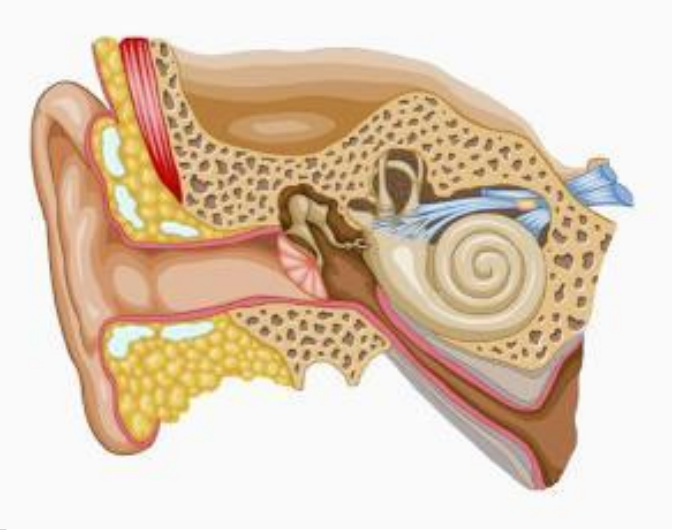
GSM phone 835 MHz with SAR in Watt/kg.

Professor Om Gandhi with courtesy.

GLIOMA	Ipsilateral		
	Cases/controls Numbers of exposed	Odds Ratio	95 % Confidence Interval
Interphone 2010			
Cumulative use ≥1,640 h	100/62	1.96	1.22 – 3.16
Coureau et al 2014			
Cumulative use ≥896 h	9/7	2.11	0.73 – 6.08
Hardell, Carlberg 2015			
Cumulative use ≥1,640 h	138/133	3.11	2.18 – 4.44
Meta-analysis			
Cumulative use ≥1,640 h*	247/202	2.54	1.83 – 3.52



Acoustic neuroma	Ipsilateral		
	Cases/controls Numbers of exposed	OddsRatio	95 % Confidence Interval
Interphone 2010			
Cumulative use ≥1,640 h	47/46	2.33	1.23 – 4.40
Hardell et al 2013			
Cumulative use ≥1,640 h	19/133	3.18	1.65 – 6.12
Meta-analysis			
Cumulative use ≥1,640 h	66/179	2.71	1.72 – 4.28



Pathology findings – Brain

Hyperplastic Brain Lesions in Male Rats

	Control		GSM Modulation			CDMA Modulation		
	0 W/kg		1.5 W/kg	3.0 W/kg	6.0 W/kg	1.5 W/kg	3.0 W/kg	6.0 W/kg
Number examined	90		90	90	90	90	90	90
Malignant glioma‡	0*		3 (3.3%)	3 (3.3%)	2 (2.2%)	0	0	3 (3.3%)
Glial cell hyperplasia	0		2 (2.2%)	3 (3.3%)	1 (1.1%)	2 (2.2%)	0	2 (2.2%)

‡ Historical control incidence in NTP studies: 11/550 (2.0%), range 0-8%

* Significant SAR-dependent trend for CDMA exposures by poly-6 ($p < 0.05$)

Pathology findings – Schwannomas

Schwannomas Observed in Male Rats

	Control	GSM Modulation			CDMA Modulation		
	0 W/kg	1.5 W/kg	3.0 W/kg	6.0 W/kg	1.5 W/kg	3.0 W/kg	6.0 W/kg
Number examined	90	90	90	90	90	90	90
Heart‡	0*	2 (2.2%)	1 (1.1%)	5 (5.5%)	2 (2.2%)	3 (3.3%)	6** (6.6%)
Other sites	3 (3.3%)	1 (1.1%)	4 (4.4%)	2 (2.2%)	2 (2.2%)	1 (1.1%)	2 (2.2%)
All sites (total)	3 (3.3%)	3 (3.3%)	5 (5.5%)	7 (7.7%)	4 (4.4%)	4 (4.4%)	7 (7.7%)

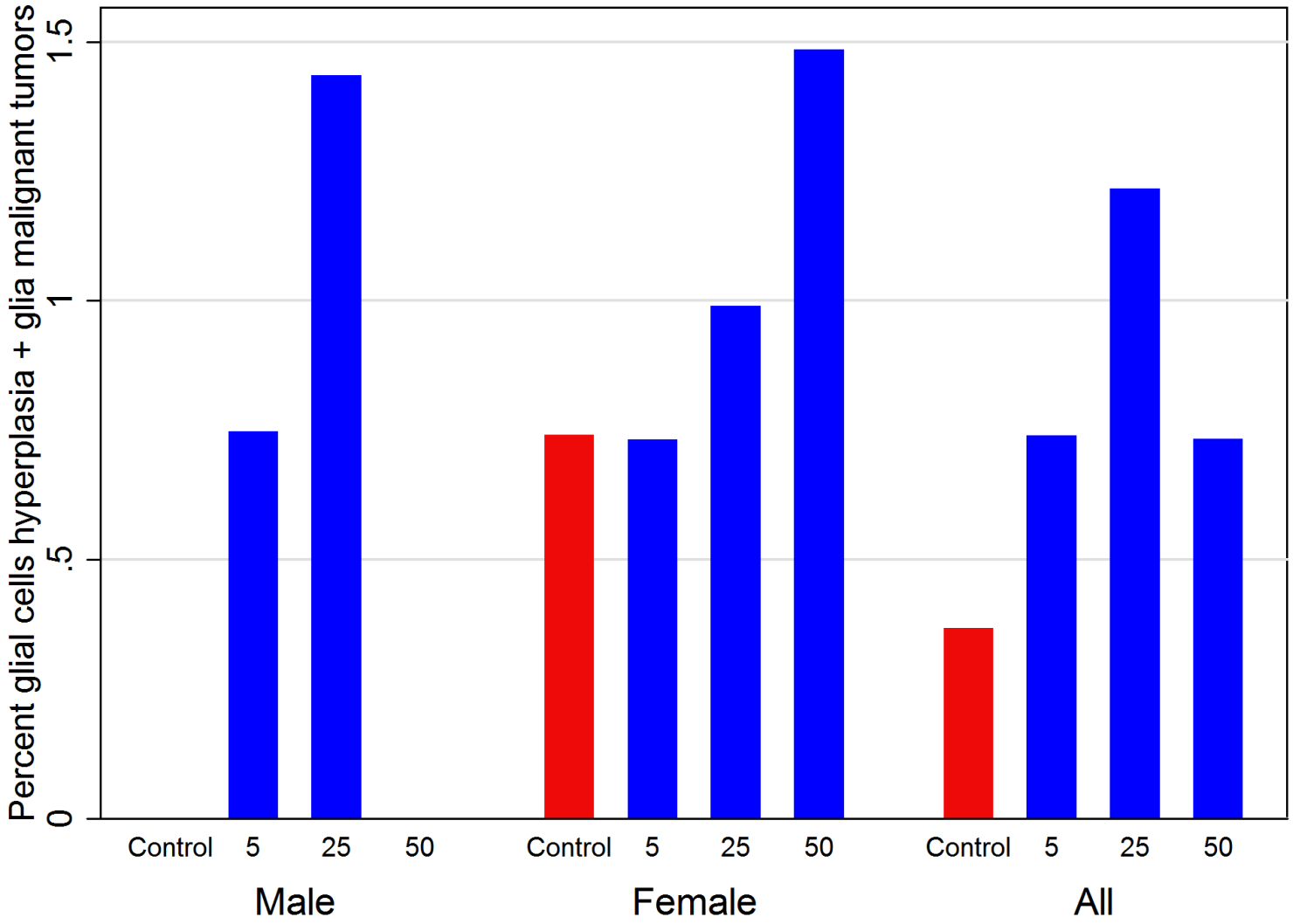
‡ Historical control incidence in NTP studies: 9/699 (1.3%), range 0-6%

* Significant SAR-dependent trend for GSM and CDMA exposures by poly-3 ($p < 0.05$)

** Significant different than controls poly-3 ($p < 0.05$)

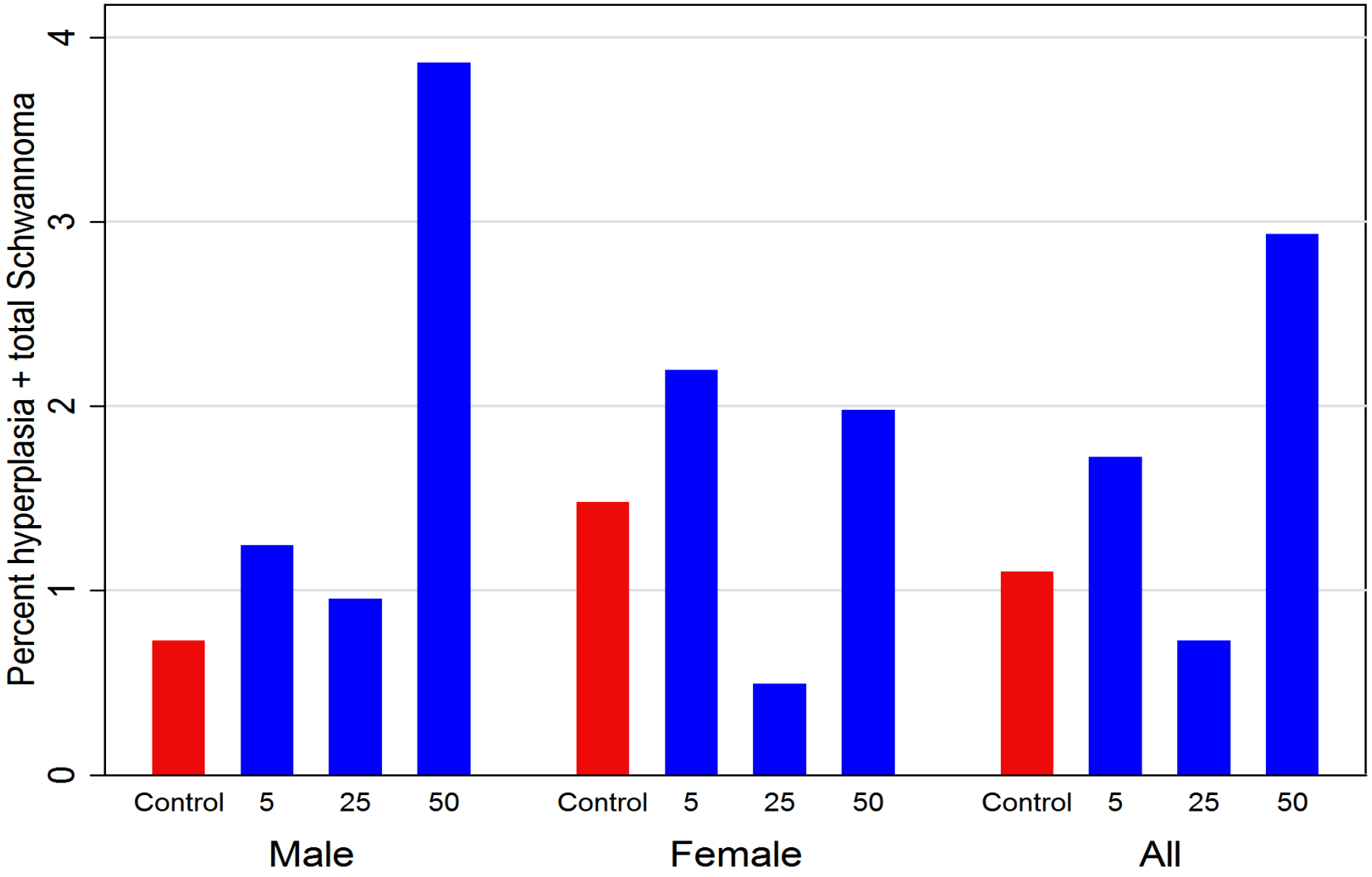
Ramazzini Institute Italy Rat Study

Glia cell proliferation, glioma (V/m)



Ramazzini Institute Italy Rat Study

Schwann cell proliferation + Schwannoma ('acusticus neurinoma') V/m



ICNIRP (International Commission on Non-Ionizing Radiation Protection)

Commission (until 2020, elected every 4 years)

Eric van Rongen, chair – vice chair from 2020
Maria Feychting, vice chair – SEG from 2020
Rodney Croft – chair from 2020
Adèle C. Green, MD
Akimasa Hirata
Guglielmo d'Inzeo
Carmela Marino
Sharon Miller
Gunhild Oftedal
Tsutomu Okuno
Martin Röösli
Zenon Sienkiewicz
Soichi Watanabe

ICNIRP

ICNIRP is registered in Germany and located in Munich at the same address as the German Federal Office for Radiation Protection

Started in 1992 as an “independent commission”.

Continues the previous work by the International Non-Ionizing Radiation Committee (INIRC) of the International Radiation Protection Association (IRPA).

According to ICNIRP’s statues, the commission shall submit its recommendations for comment by the IRPA prior to publication.

ICNIRP maintains the same attitude to health effects from RF-radiation as the Institute of Electrical and Electronics Engineers (IEEE) and its standards setting committee, the International Committee on Electromagnetic Safety (ICES).

ICES is dominated by industry and military representatives.

ICES within IEEE also sets limits for RF exposure which are in line with the ICNIRP opinion that there are only immediate thermal effects and no effects below those that cause immediate effects due to increased temperature.

This perception was established in the 1950's and a decade later used when the first thermal based standard for radiofrequency radiation was set in the USA in 1966

WHO 2014 core group	ICNIRP	IEEE	EU	SSM	EMF Scientist Appeal	The 5G Appeal EU
Emilie van Deventer, project leader	X	X	-	X	-	-
Simon Mann	X	-	-	-	-	-
Maria Feychting	X	-	-	X	-	-
Gunnhild Oftedal	X	-	-	-	-	-
Eric van Rongen	X	X	X	X	-	-
Maria Rosaria Scarfi	X	-	X	X	-	-
Denis Zmirou	-	-	-	-	-	

Eric van Rongen, chair of the Commission, claimed in a press release of the new ICNIRP guidelines 2020 that the 1998 version was "*conservative in most cases"* and *"still provide adequate protection for current technologies"*. He also argued that: *"The most important thing for people to remember is that 5G technologies will not be able to cause harm when these new guidelines are adhered to"*

Regarding animal studies yielding a promoting effect from RF radiation ICNIRP states that "*interpretation of these results and their applicability to human health [is] difficult, and, therefore, there is a need for further research to better understand these results".*

The NTP studies and Ramazzini Institute results are disregarded stating that "*no consistency was seen across these two studies"* and "*within the context of other animal and human carcinogenicity research…, their findings do not provide evidence that radiofrequency EMFs are carcinogenic".*

ICNIRP ‘evaluation’ of Interphone

Regarding the 13 country Interphone study on glioma and acoustic neuroma ICNIRP concludes that the studies do “*not provide evidence of an increased risk*.”,

ICNIRP ‘evaluation’ of the Hardell group studies

Regarding the Hardell group studies ICNIRP writes: ….”*a set of case-control studies from the Hardell group in Sweden report significantly increased risks of both acoustic neuroma and malignant brain tumors already after less than five years since the start of mobile phone use, and at quite low levels of cumulative call time*.”

Latency Hardell group studies

Facts:

In the shortest latency time >1- 5 years period mobile phone use yielded for glioma OR = 1.2, 95 % CI = 0.98-1.5 increasing to OR = 2.3, 95 % CI = 1.6-3.4 in the latency period > 20 years (p trend = 0.01).

For acoustic neuroma use of wireless phone (mobile and/or cordless phone) with latency time >1-5 years yielded OR = 1.2, 95 % CI = 0.8-1.6 increasing to OR = 4.4, 95 % CI = 2.2-9.0 (p trend = 0.003) for latency > 20 years

Recall bias

ICNIRP claims that the Hardell group results may be caused by recall bias. For meningioma no statistically significant result was found in the same study.

Using meningioma cases as “controls” (the comparison entity) still yielded statistically significant increased risk for glioma and mobile phone use; ipsilateral use OR = 1.4, 95 % CI = 1.1-1.8, contralateral OR = 1.0, 94 % CI = 0.7-1.4.

For cordless phone use ipsilateral OR = 1.4, 95 % CI = 1.1-1.9, contralateral OR = 1.1, 95 % CI = 0.8-1.6.

Similar results were found for acoustic neuroma using meningioma cases as the comparison group

ICNIRP Note: Critical evaluation of two radiofrequency electromagnetic field animal carcinogenicity studies published in 2019. Health Phys 118(00), 2020

- No verified mechanism for RF radiation carcinogenesis

  But:

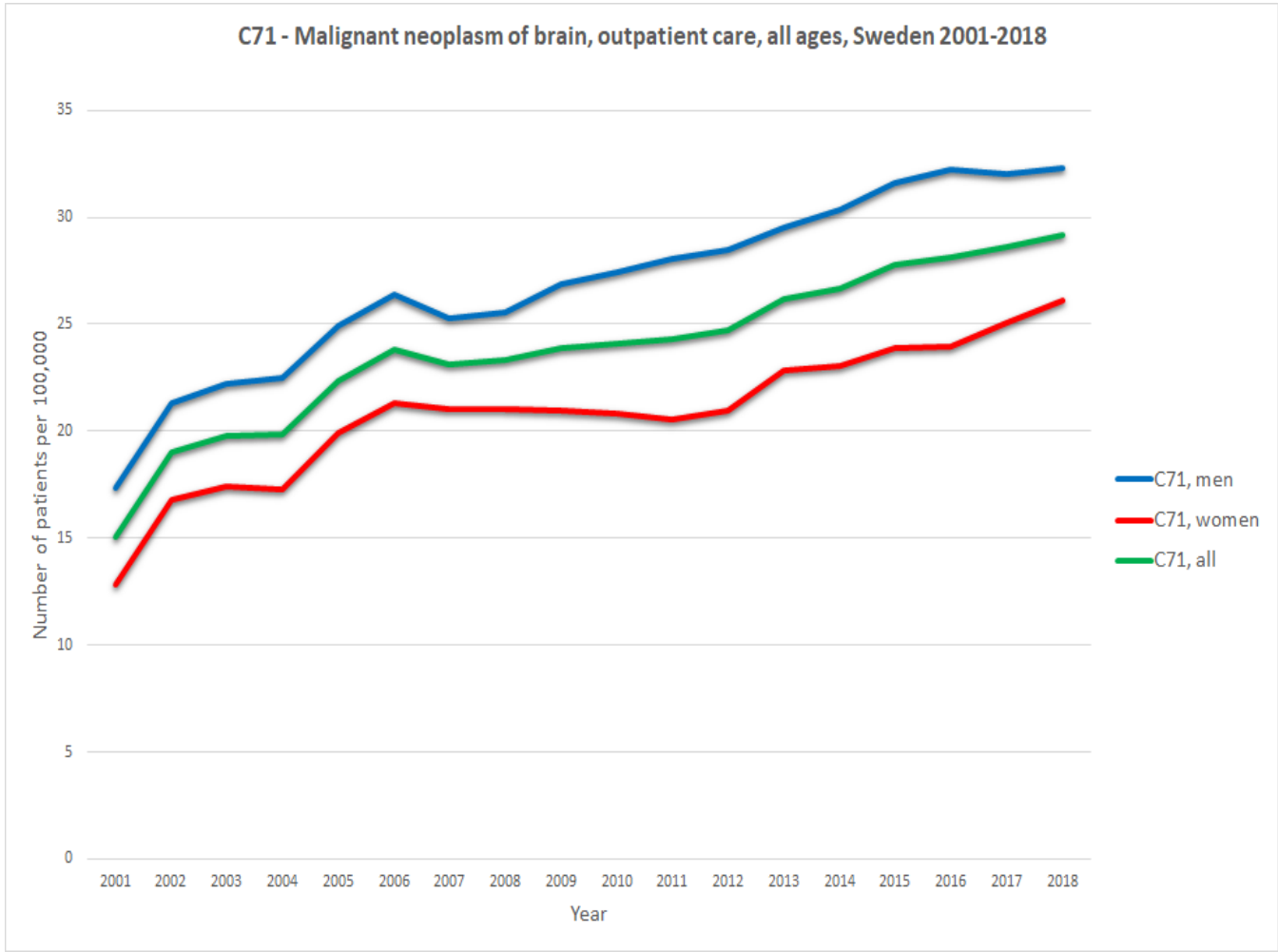
  -oxidative stress

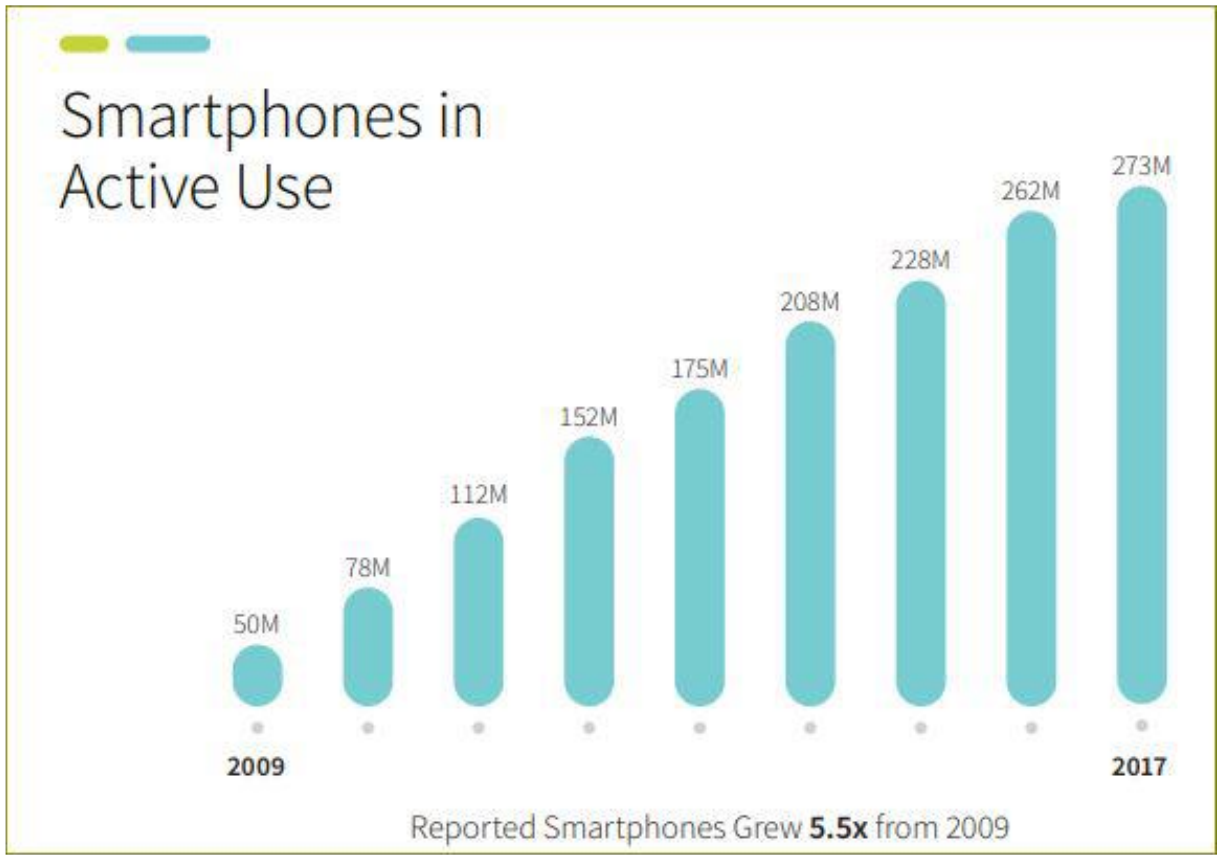
  -DNA damage

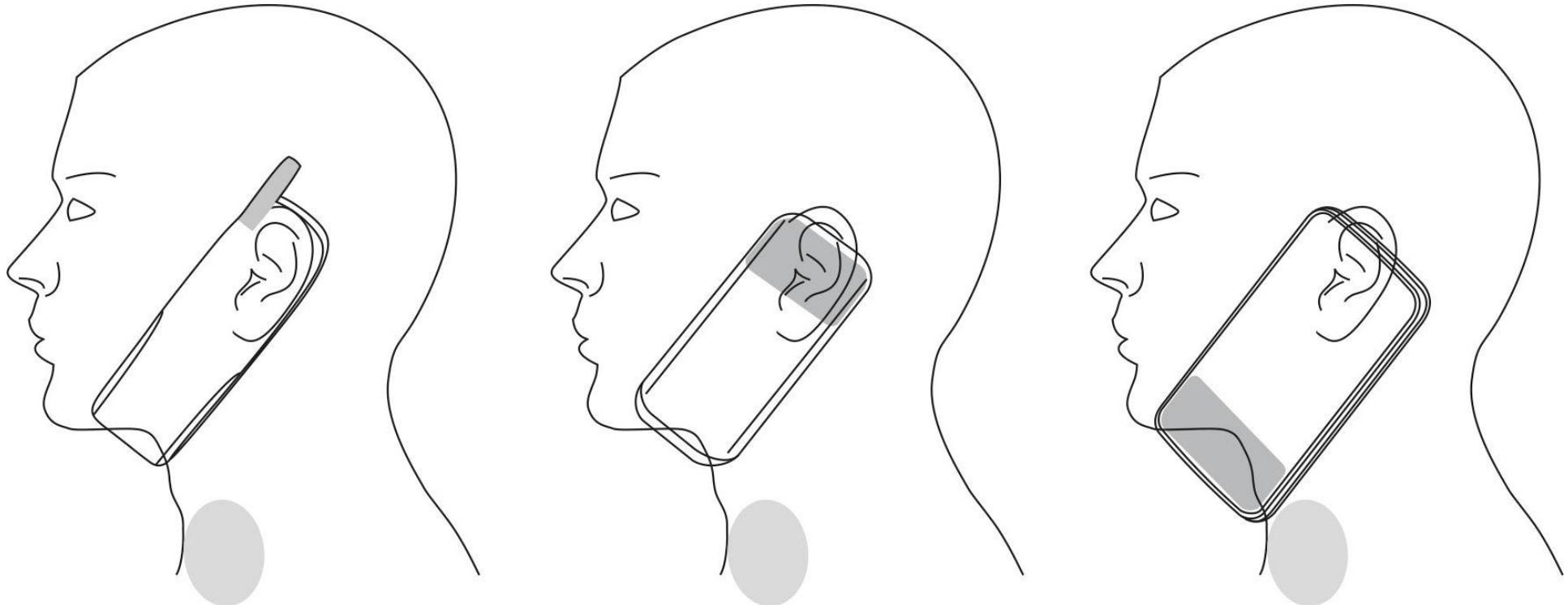
- Histopathology evaluation was not blinded
- Increased body temperature in NTP = the cancer risk
- Only Hardell group showed increased acoustic neuroma risk

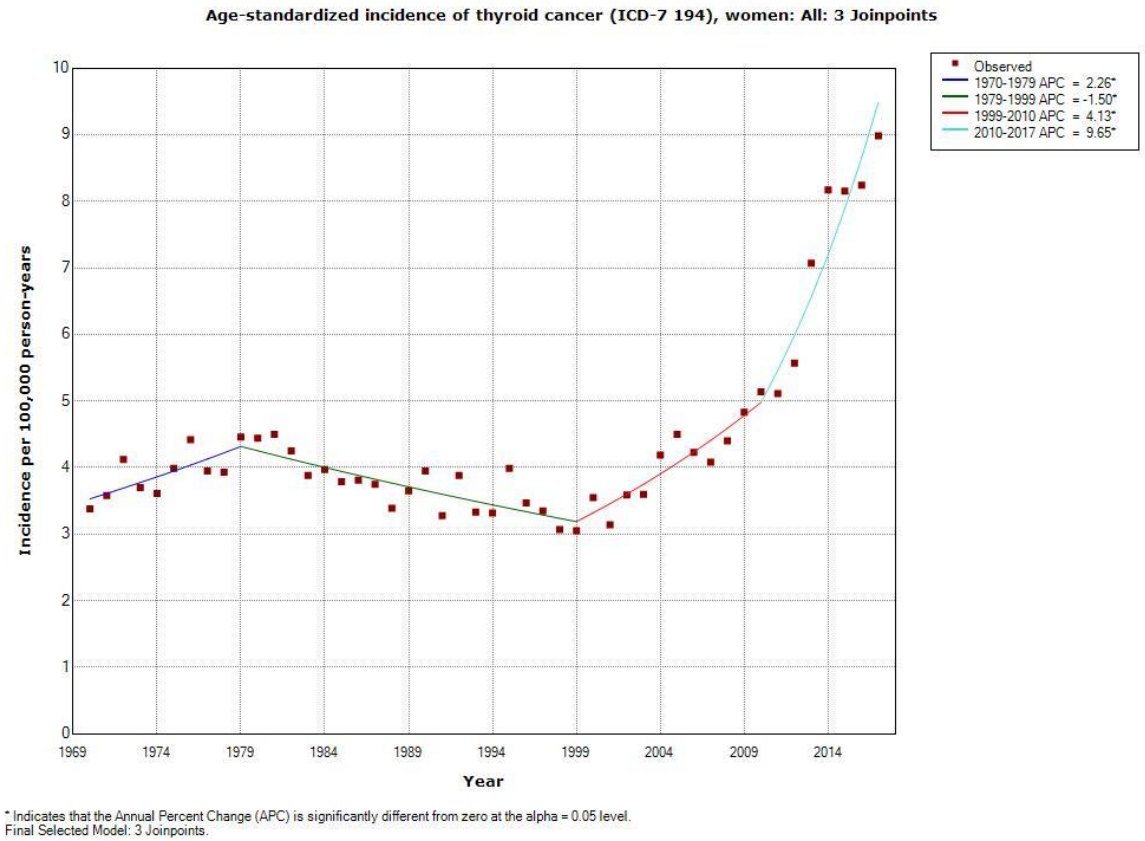
  -Note similar findings in Interphone

- Ignores the concordance between the tumour types found in human epidemiology and animal studies.


C71 - Malignant neoplasm of brain, outpatient care, all ages, Sweden 2001-2018
Number of patients per 100,000
35
30
25
20
15
10
5
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Year
C71, men
C71, women
C71, all

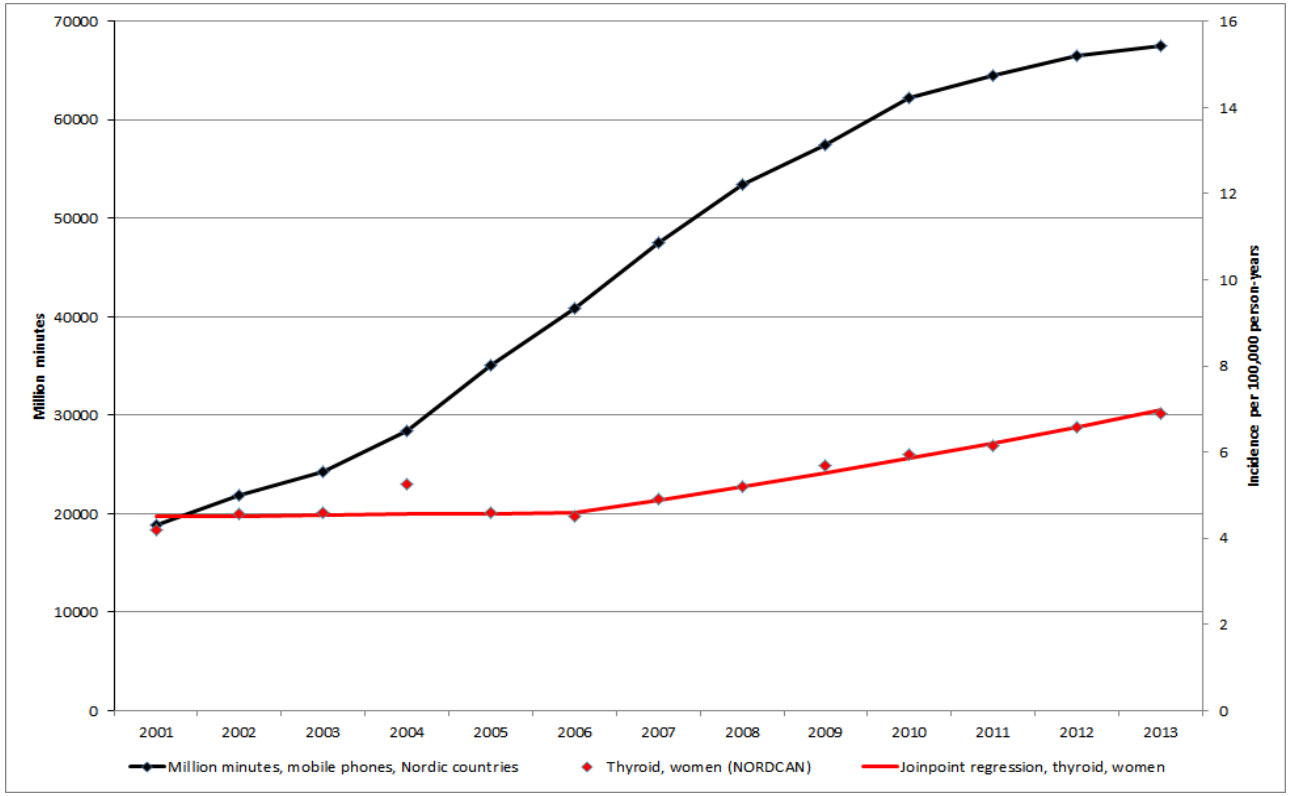

Smartphones in Active Use
50M
78M
112M
152M
175M
208M
228M
262M
273M
2009
2017
Reported Smartphones Grew **5.5x** from 2009





* Indicates that the Annual Percent Change (APC) is significantly different from zero at the alpha = 0.05 level.
Final Selected Model: 3 Joinpoints.

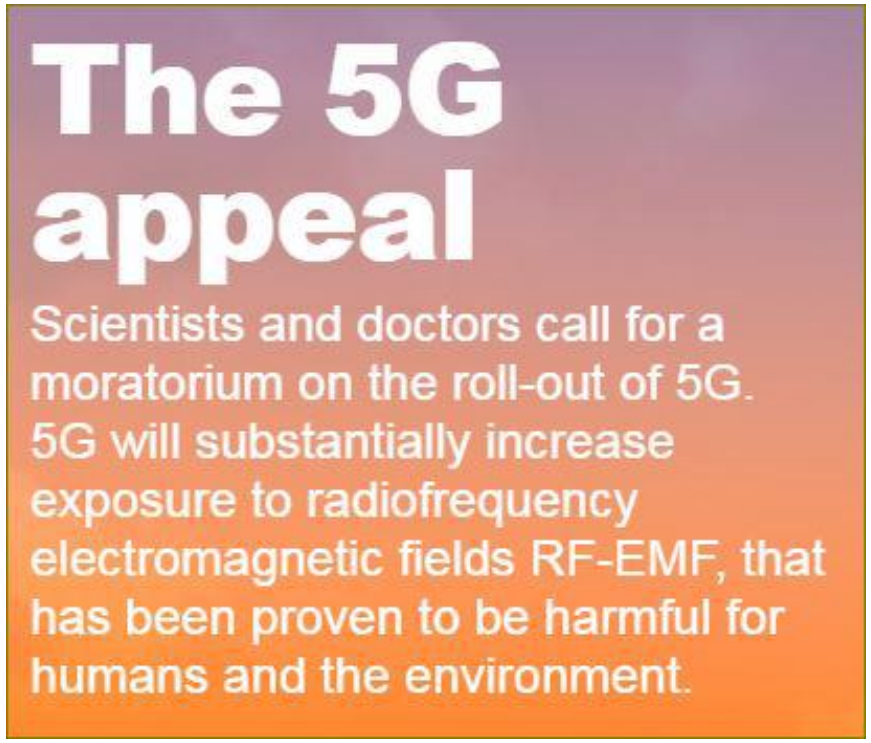
Million minutes use of mobile phones in Nordic countries and incidence of thyroid cancer (ICD-7 194) in women (ICD-7 194).



Luo et al (2019). Cell phone use and risk of thyroid cancer: a population-based case-control study in Connecticut. *Annals of Epidemiology*. http://bit.ly/saferEMRthyroid(2010-2011 data)

Luo et al (2020). Genetic susceptibility may modify the association between cell phone use and thyroid cancer: A population-based case-control study in Connecticut. *Environmental Research*.

Are there any health risks?



5G appeal: Scientists & doctors call for moratorium on deployment

2017: Submitted to European Commission

Signed now by >400 scientists & physicians from 47 nations including ~100 EMF scientists.

www.5gappeal.eu

5G (5th generation cellular technology)

Internet of Things (IoT) Smart appliances, TVs, thermostats, etc.

Smart cities

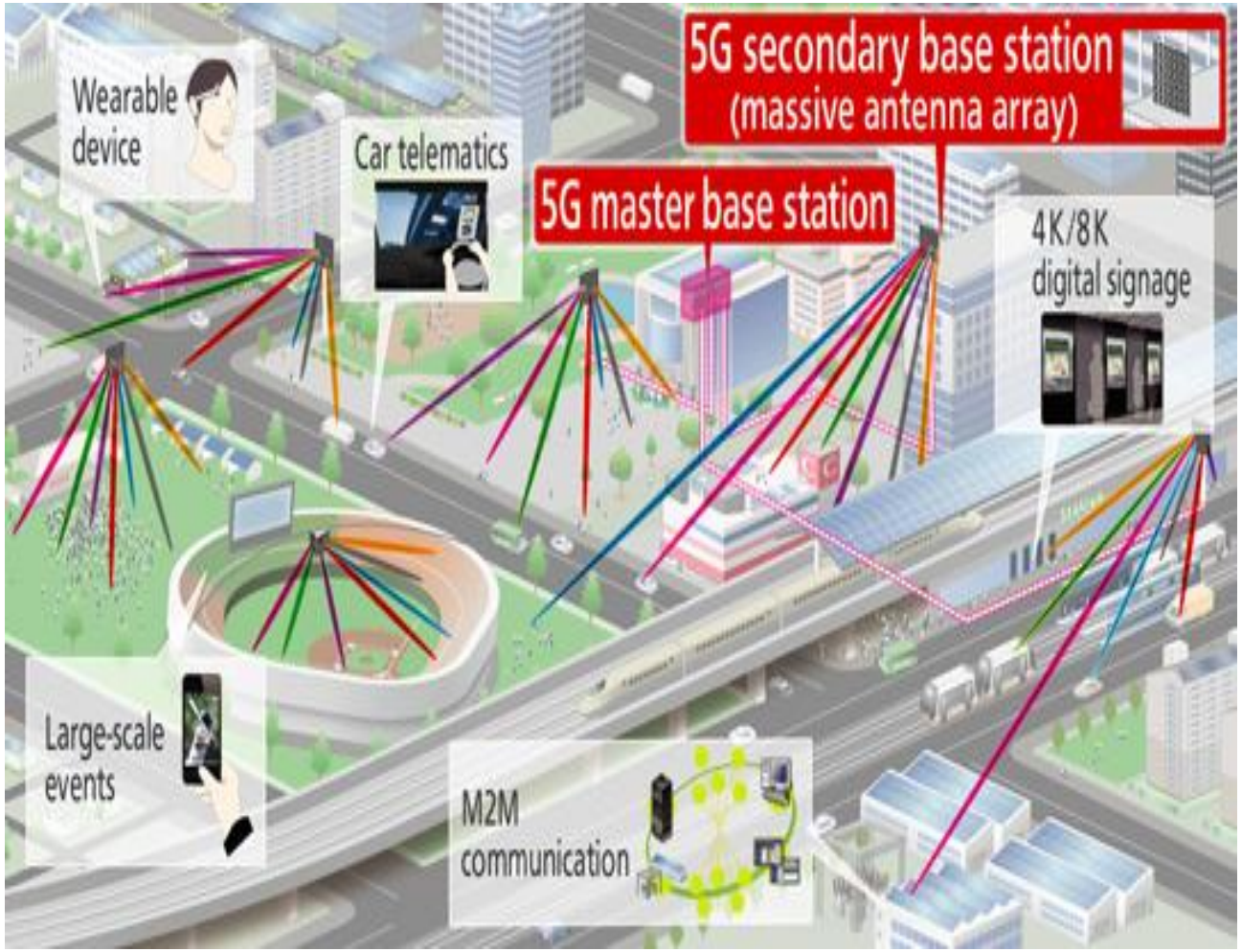
Autonomous motor vehicles

Wearable wireless devices: Watches, glasses, ear buds, medical implants, etc.

Radiofrequency radiation

- 90 MHz Radio
- 300 MHz TV
- **700 MHz 5G**
- 800 MHz 4G
- 900 MHz 2G, 3G
- 1800 MHz 2G
- 1900 MHZ DECT Cordless phone

- 2000 MHz 3G
- 2600 MHz 4G
- 2450 + 5200 MHz Wifi
- **3400-3600 MHz 5G**
- **26500-27500 MHz (26,5-27,5 GHz) 5G**



Two-way communication

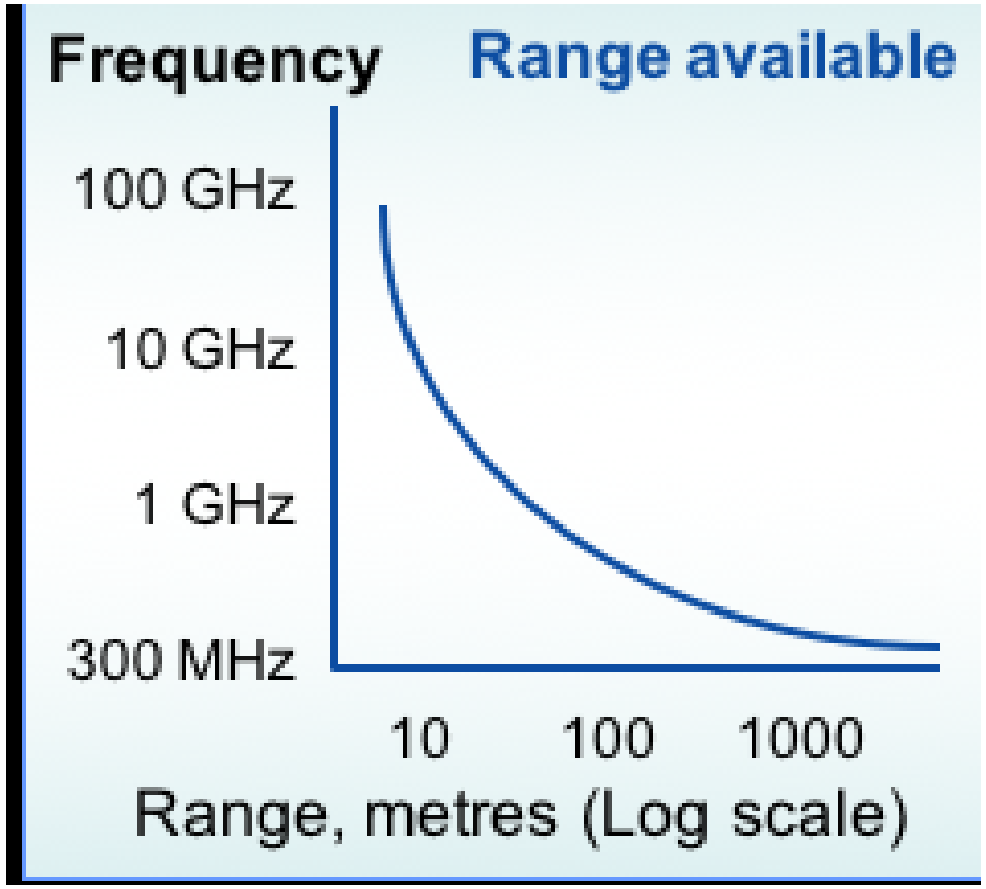
Always trying to get best connection. Higher radiation level when buildnings, trees, vegetation, now, rain, fog etc. are involved

May need indoor antenna

The technologies involved with 5G are much more complex.

One aspect, for example, that is not well understood today is the unpredictable propagation patterns that could result in unacceptable levels of human exposure to electromagnetic radiation.

Range reduced by square of distance



Problems
-rain
-snow
-fog
-trees, vegetation (especially during rain)
-buildings, walls, etc

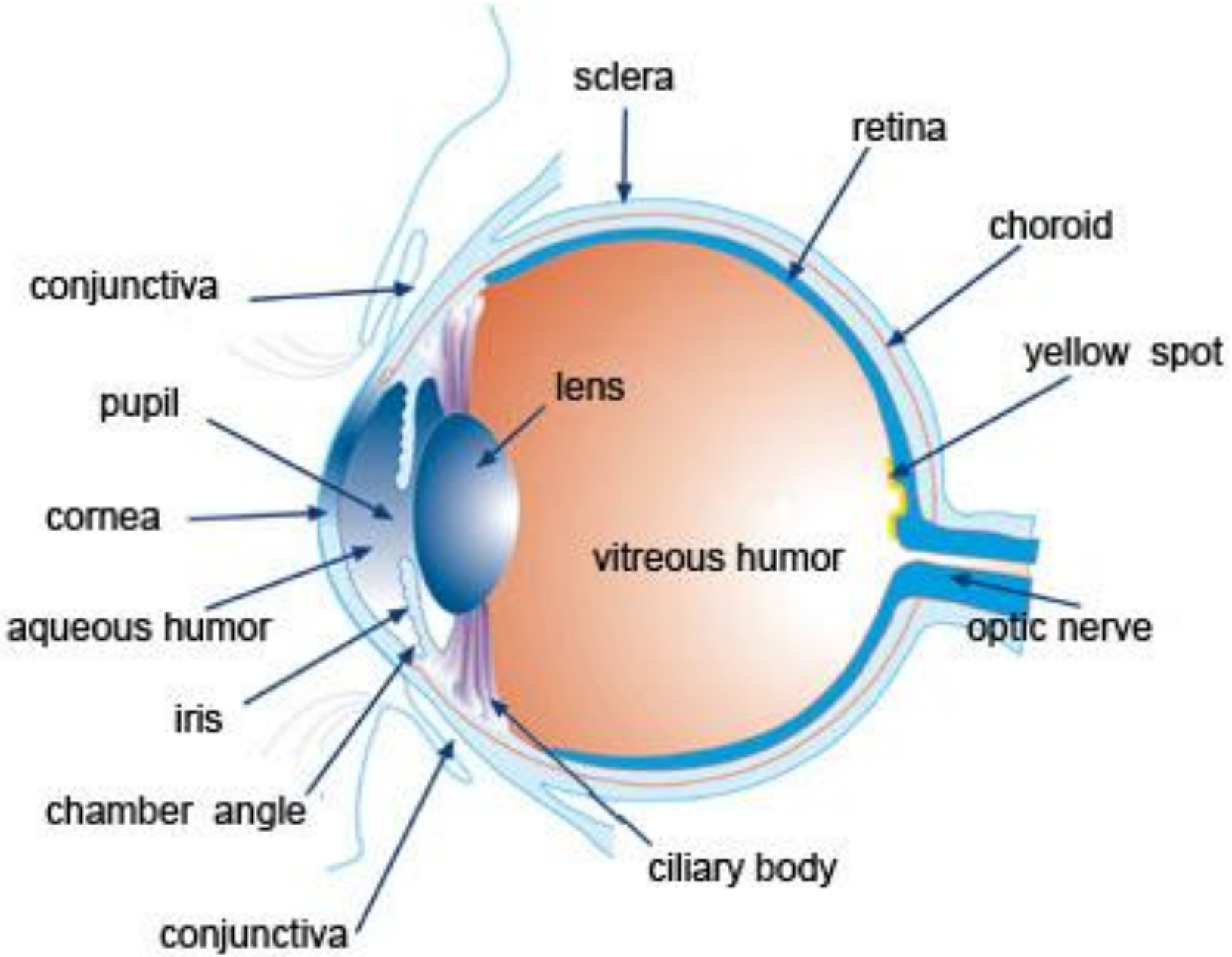
5G

- Skin
- Eyes
- Sweat glands – antenna effect
- Effects on bacteria
- Antibiotic resistance

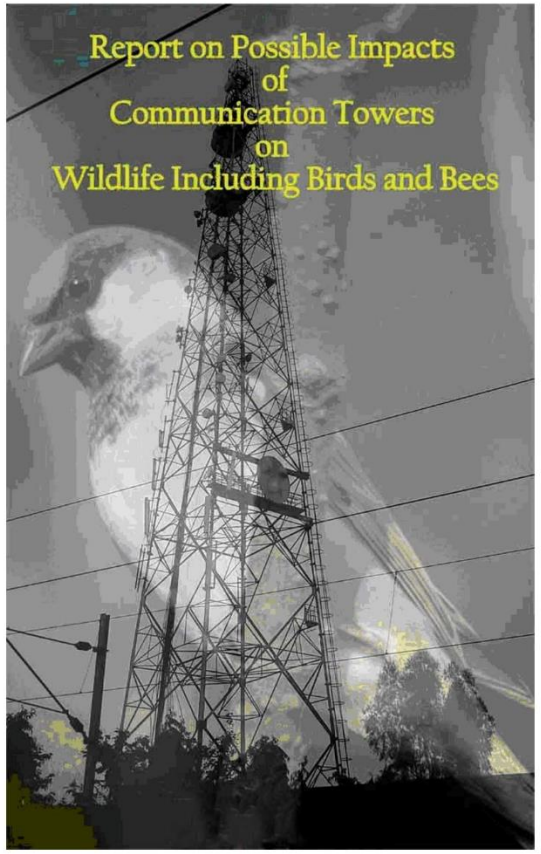
Permanent tissue damage

The results also show that the peak-to-average ratio of 1,000 tolerated by the International Council on Non-Ionizing Radiation Protection guidelines may lead to permanent tissue damage after even short exposures, highlighting the importance of revisiting existing exposure guidelines.

Neufeld, Kuster, Health Phys. 115(6):705–711; 2018


sclera
retina
choroid
conjunctiva
yellow spot
lens
pupil
cornea
vitreous humor
aqueous humor
optic nerve
iris
chamber angle
ciliary body
conjunctiva

Effects on bees, birds and plants by radiofrequency radiation



Three reviews show damage:

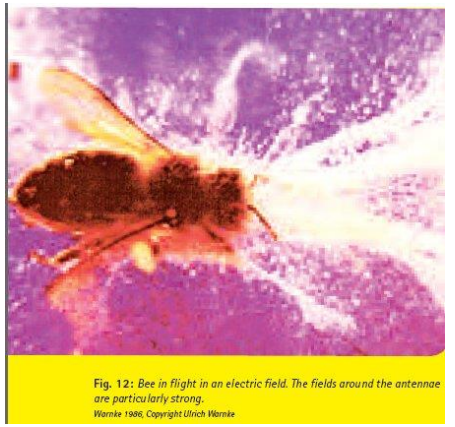
Cucurachi *et al.* (2013).
http://www.ncbi.nlm.nih.gov/pubmed/23261519

Balmori (2009):
http://www.ncbi.nlm.nih.gov/pubmed/19264463

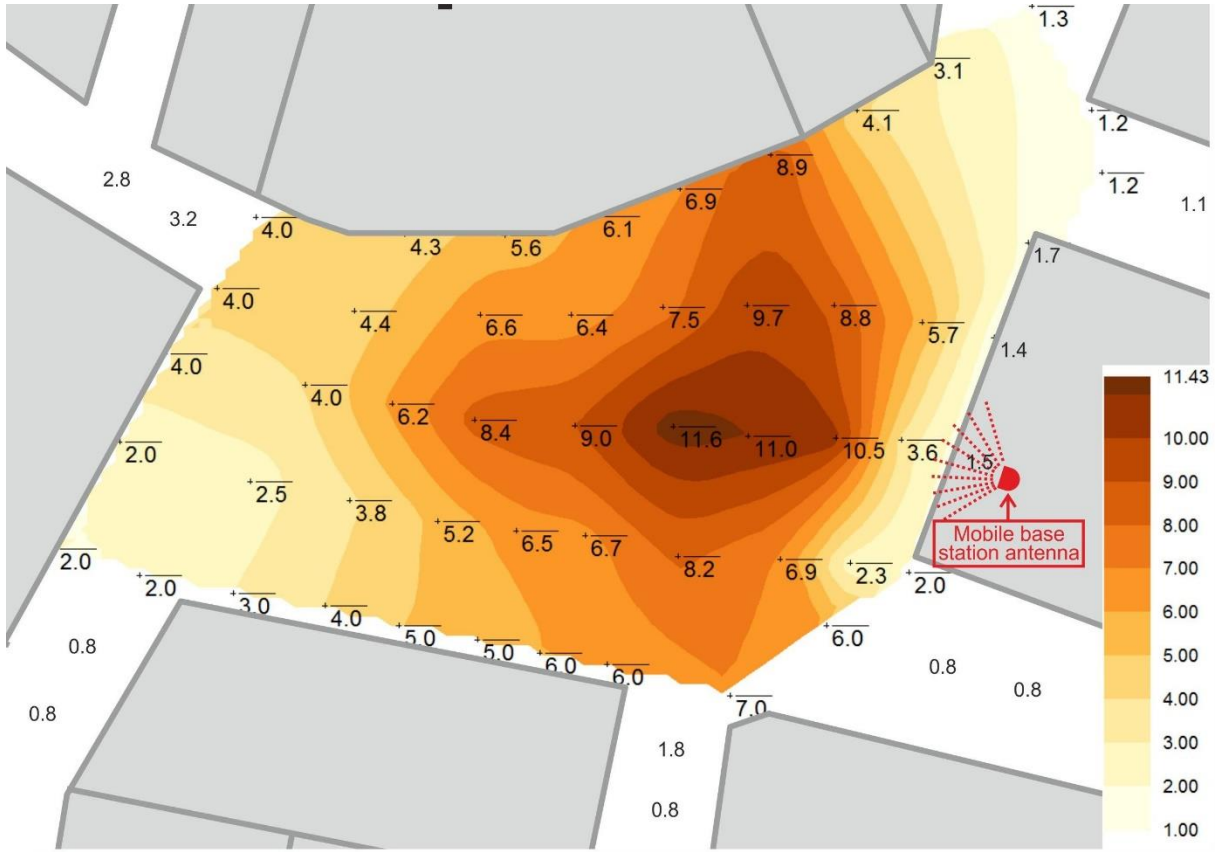
Sivani & Sudarsanam (2012).
http://www.biolmedonline.com/Articles/Vol4_4_2012/Vol4_4_202-216_BM-8.pdf

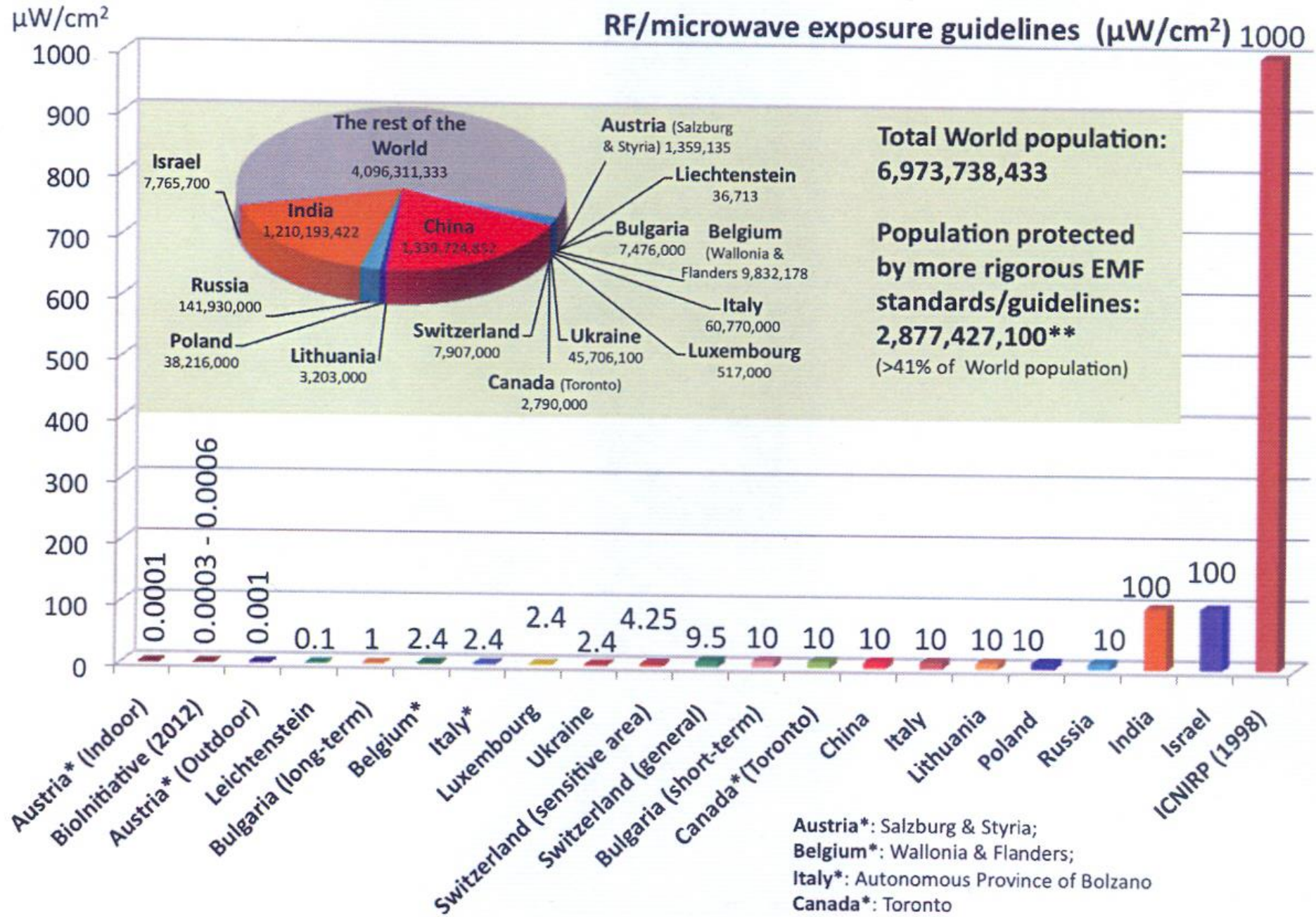
+ http://www.indiaenvironmentportal.org.in/files/file/final_mobile_towers_report.pdf

http://www.ncbi.nlm.nih.gov/pubmed/23915130

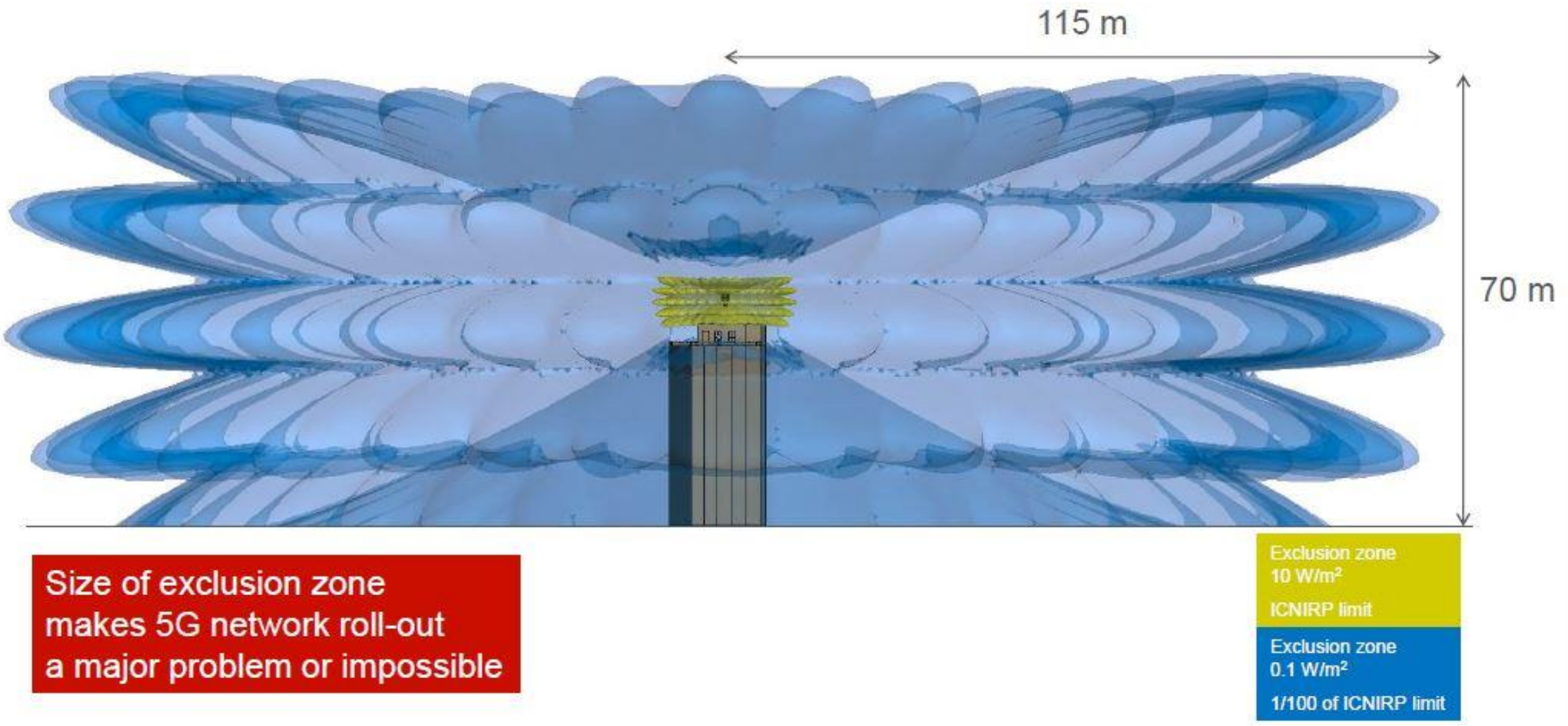


Järntorget square radiofrequency E-field distribution, units in Volts per meter (V/m), 5.05.2018 12:00, measured by a broadband meter Wandell&Goltermann EMR-300 covering 100kHz-3GHz.




µW/cm²
RF/microwave exposure guidelines (µW/cm²)
1000
900
800
700
600
500
400
300
200
100
0
The rest of the World 4,096,311,333
India 1,210,193,422
China 1,339,724,852
Israel 7,765,700
Russia 141,930,000
Poland 38,216,000
Lithuania 3,203,000
Switzerland 7,907,000
Canada (Toronto) 2,790,000
Ukraine 45,706,100
Luxembourg 517,000
Austria (Salzburg & Styria) 1,359,135
Liechtenstein 36,713
Bulgaria 7,476,000
Belgium (Wallonia & Flanders 9,832,178
Italy 60,770,000
Total World population: 6,973,738,433
Population protected by more rigorous EMF standards/guidelines: 2,877,427,100**
(>41% of World population)
0.0001
0.0003 - 0.0006
0.001
0.1
1
2.4
2.4
2.4
2.4
4.25
9.5
10
10
10
10
10
10
100
100
Austria* (Indoor)
BioInitiative (2012)
Austria* (Outdoor)
Leichtenstein
Bulgaria (long-term)
Belgium*
Italy*
Luxembourg
Ukraine
Switzerland (sensitive area)
Switzerland (general)
Bulgaria (short-term)
Canada*(Toronto)
China
Italy
Lithuania
Poland
Russia
India
Israel
ICNIRP (1998)
Austria*: Salzburg & Styria;
Belgium*: Wallonia & Flanders;
Italy*: Autonomous Province of Bolzano
Canada*: Toronto

Exclusion zone makes 5G impossible in countries with lower guidelines; 0.1 W/m^2 gives 115 m exclusion zone!



Size of exclusion zone makes 5G network roll-out a major problem or impossible

Källa: https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20171205/Documents/S3_Christer_Tornevik.pdf

Comparison of ICNIRP 1998 and 2020 reference levels across common mobile communication frequencies (W/m^2).

Frequency (MHz)	Example usage	ICNIPR 1998 reference level, 6 min	ICNIPR 2020 reference levels, whole body exposure, 30 min	ICNIPR 2020 reference levels, local exposure, 6 min
800	LTE	4	4	18.2
900	GSM, UMTS	4.5	4.5	20.1
1,800	GSM	9	9	36.6
1,900	DECT	9.5	9.5	38.3
2,100	UMTS	10	10	40
2,400	WiFi 2G	10	10	40
2,600	LTE	10	10	40
3,500	5G, WiMax	10	10	40
5,500	WiFi 5G	10	10	40
26,000	5G	10	10	30.9

In October 2018 there was a call to dismantle ICNIRP and replace the organization with independent scientists: "*ICNIRP's mandate to issue exposure guidelines needs to be seriously questioned. ICNIRP is not independent of industry ties as it claims. Its opinions are not objective, not representative of the body of scientific evidence, but are biased in favor of industry.*" Nevertheless, the ICNIRP 2020 guidelines show that the misuse of science continues.

The EMF Call: Scientists and NGOs call for truly protective limits for exposure to electromagnetic fields (100 kHz to 300 GHz). Available online: https://www.emfcall.org/

ICNIRP cannot be regarded as an independent organization setting guidelines for RF radiation based on sound science. It behaves more like a front-group organization for the industry than a scientific commission.

Thank you for your attention!

The Environment and Cancer Research Foundation

www.environmentandcancer.com

Environment & Cancer
Research Foundation