Radiofrequency Electromagnetic Energy and Health: Research Needs

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8 May 2018

ARPANSA TR 178 Synopsis

Issues and Concerns

- TR-178, much like TR-164, misrepresents what the science is actually showing
- Suggests 'no established' evidence (proof) of harm
- Each study topic comes with a pretext that EMR is not established to be harmful and/or there are gaps in knowledge
  - Creates the perception that there is nothing really to be concerned about
  - Evidence that is contrary to ARPANSA's opinion is not acknowledged
- Heavy reliance on SCENIHR opinions
  - SCENIHR used the wrong benchmark for evaluating potential harm
  - Ignored and/or misrepresented evidence (cherry picking papers for evaluation)
  - Some SCENIHR scientists are known to have industry connections
- ARPANSA's narrative is biased and one sided
  - Effectively ignores (majority) available scientific evidence that suggest RF standards are not protective against a range of bio-effects

TR 178 Synopsis continued…

- TR 178 claims that overall science does not indicate a causal relationship between exposure and wellbeing
  - What about tumours? The recent NTP study suggests there is a decisive relationship
  - IARC made a classification of 2B potential carcinogen in May 2011 based on the available papers at the time (primarily Interphone and Hardell studies)
  - There have been numerous epidemiological and meta-analysis studies since IARC (CERENAT 2014, Moon 2014, Hardell 2015 & 2017, Sato 2016, Grell 2016, Yang 2017) further qualifying the relationship between exposure and brain tumour development
  - ORSAA has 53 scientific papers in its database suggesting a link between EMR exposure and brain tumours
  - However, brain tumours are not the only wellbeing challenge that microwave exposure introduces
- We do however have agreement with ARPANSA's suggestion for more studies with prospective design being required, although:
  - There is a significant challenge of finding unexposed controls
  - Retrospective cohort studies also need to be considered

Epidemiological Studies

Cohort Studies

Problem

- R 178 recommendation is missing cohort studies looking at long term exposures to RF sources other than mobile phones
  - Wi-Fi, Mobile phone and NBN fixed wireless tower emissions and smart meters must be investigated

Recommendation

- Study recommendations need to be extended to investigate:
  - Other cancers (thyroid, breast, pancreas, leukemia, liver, kidney, prostate etc.)
  - Cardiovascular disease - particularly those with no family history or no risk factors
  - Neurodegeneration - MS, Alzheimer's, Dementia, Parkinson's etc.
  - Mental illness – depression, anxiety disorders, changes in mood etc,
  - Emotional and behavioural issues – ADHD, hyperactivity
  - Sleep disorders – insomnia
  - Subjective symptoms – Dizziness, concentration difficulties, headaches, tinnitus etc.
  - Infertility
  - Allergies
  - Diabetes

Ecological Studies

- **ISSUE:** TR 178 demonstrates study selection bias and misleads readers
  - Reference to Chapman (2016), a poor study that misses (purposefully?) that *glioblastoma* multiforme (GBM), an aggressive brain tumour associated with heavy usage of cell phones, has more than doubled in some countries
  - Does not mention that Dobes (2011) found that other brain tumours not associated with cell phone usage was decreasing and masking the rise of GBM's in Australia

Question:

Why are we again limiting studies to brain tumours – which are very rare?

- Cardiovascular disease, other cancers, diabetes, neurodegeneration, mental issues are more common and also very important topics that deserve investigation – they are costing the health system billions of dollars each year
- Many of the aforementioned health issues can be linked to chronic RF exposure as evidenced by studies available in ARPANSA's own RF database

Recommendation

- Ecological studies should also look at populations at different distances from cell phone/NBN towers and aforementioned disease endpoints

Studies on Children

- **Issue:** Again the focus on Brain tumours – Although being diagnosed with a brain tumour is terrible it is very rare

Recommendation

- Further studies are required covering the following important topics:
  - Other cancers
  - Brain development effects – especially if there is exposure during pregnancy and/or throughout childhood development
  - Cognitive and behavioural effects
  - Learning deficiencies
  - Allergies
- The above studies need to look at long term exposures – i.e. not 30 – 60 minute exposures like many past behavioural studies
- The ORSAA database has hundreds of papers indicating cognitive, behavioural, learning and spatial memory deficiencies as a result of exposure of animals to RF EMR

Human Studies

- More useless provocation studies are suggested especially when psychologist researchers in Australia are ignoring recommendations from EHS sufferers for better study designs –
  - allowing longer recovery times;
  - tracking symptoms over a longer period; and
  - incorporating objective biological tests etc.
- Exposures will be predefined and not likely to be representative of typical exposures a person is subject to day to day
- Any study performed on this topic will be based on short term exposures (possibly single exposures) i.e. 30 minutes which will demonstrate nothing convincing when it comes to health effects
- Long term exposures are considered to be unethical yet it is happening every day without consent

Recommendation

- **Health Surveillance studies need to be conducted**

Human Studies – What is really needed

Recommendation

- Studies need to include objective biological tests looking at
  - DNA damage
  - biochemical changes – especially oxidative stress
  - metabolic effects
  - endocrine changes
  - circadian rhythm changes
  - immunological changes
  - cardiovascular effects
  - cognitive function and behavioural changes
  - fertility effects
  - pancreas, liver, thyroid and kidney function
  - Neurotransmitter level changes and neurological damage
  - Sleep disorders
  - Subjective symptoms – headaches, concentration difficulties, tinnitus etc.

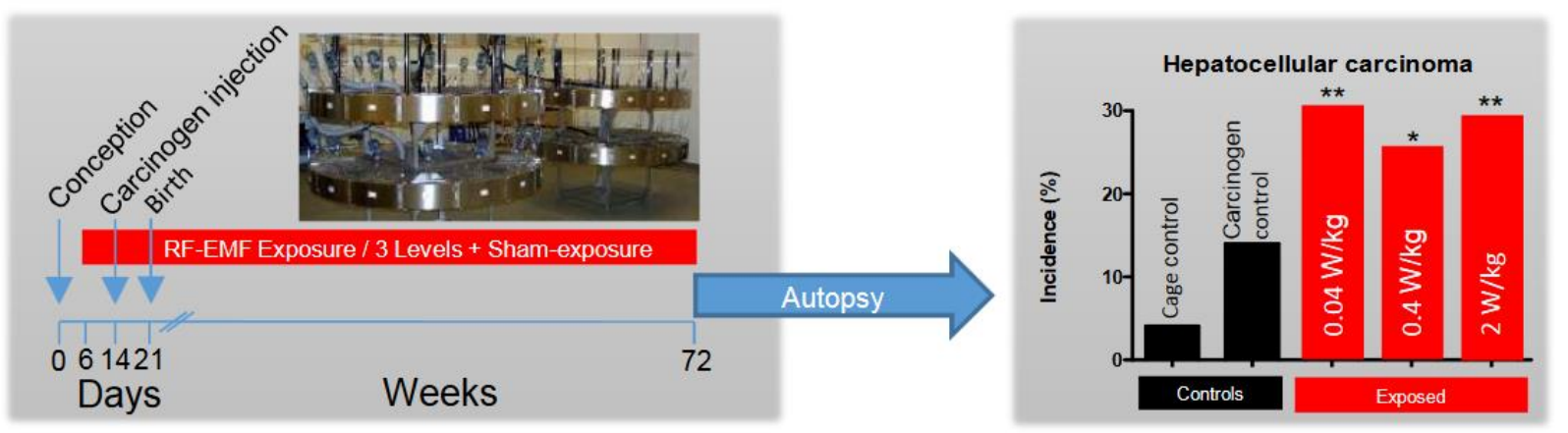
Animal Studies

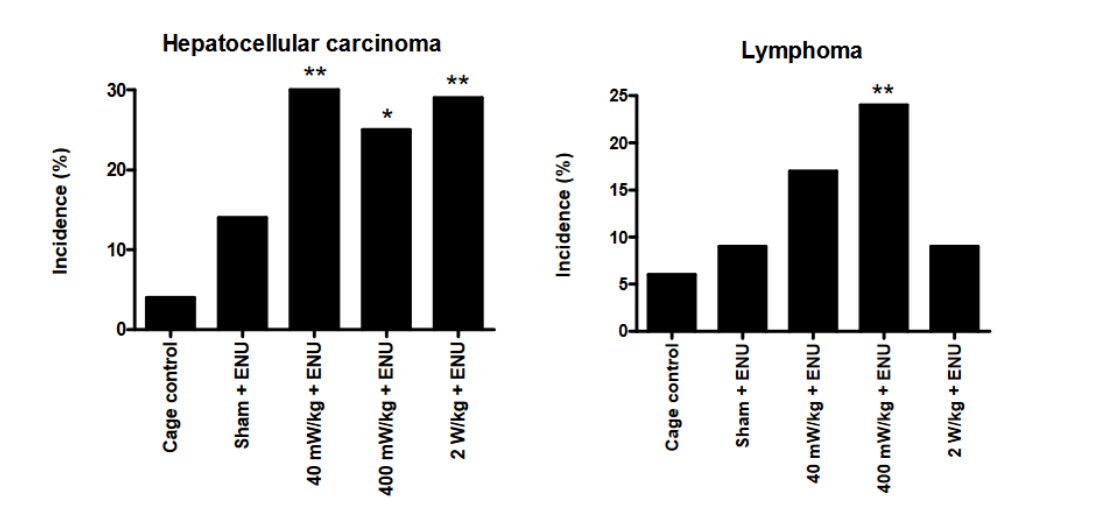
Cancer

Problem

- ARPANSA claims in TR-178 that a large number of animal studies have not established a carcinogenic effect. This is a misrepresentation of the science
  - ~60% of scientific papers investigating genotoxicity found that RF can cause DNA damage
  - NTP study also demonstrated increased rare nerve tumours in male rats and that a higher level of DNA breaks were found in those exposed rats
  - RF may not have sufficient energy to break an ionic bond but free radicals do
  - 90% of papers show RF exposure causes an increase in free radical products
  - Free radicals can damage DNA
  - Comet Assay shows DNA damage in cells exposed mobile phone radiation
  - Some studies suggest RF may affect(inhibit) the DNA repair process
  - Tillman (2010) and Lerchl (2015) demonstrated that RF acts as a tumour promotor and interestingly it did not follow a linear dose response relationship
- More studies are needed but the available evidence already suggests RF is a carcinogen

Tumour promotion by exposure to RF-EMF below exposure limits for humans (non linear)





Biological systems are renowned for feedback loops and multiple pathways which introduce non-linearity

Source: Biochemical and Biophysical Research Communications

Non cancer outcomes

- Probably the only research request that is actually tackling some of the important issues
- Although ARPANSA has again misrepresented the scientific evidence
  - In animals there **is** convincing evidence of biological effects that are potential harmful
  - Study design issues and poor dosimetry are offered as excuses to dismiss studies making unexpected or unwanted findings
  - Effect papers outweigh "no effect" papers in most endpoints tested by 75:25
  - Inconsistencies in research can often be linked to who is funding the research. Tobacco science anyone?
  - Replication maybe seen as a problem. However, many papers are presenting the same bio-effects despite using different animals, frequencies and varying study protocols
- The suggested studies are acceptable although there should be specific mention of long term exposure studies and additional endpoints covered
  - Such as oxidative stress, DNA damage, immune system function, neurotransmitter levels and metabolic changes

Cellular Studies

Cellular Studies

Problem

- Uncertainty in findings is certainly more prominent when compared to in vivo studies. Although again the outcome is close to 70:30 in favour of effect
- Different cells types react differently to EMF exposures
- Study outcomes can be manufactured if one has a basic understanding of:
  - Cell adaptive response characteristics
  - Understanding how different exposure durations and power levels effect cells
  - Performing assays at specific time intervals
- Short one off exposures are not useful to building an understanding of potential health implications
- The statement "numerous cellular studies have been carried out … on both genotoxic and non-genotoxic end-points the majority of which have not shown an effect at non-thermal levels (SCENIHR 2015)" is a false statement and does not match what the scientific evidence is suggesting

Recommendation

- More studies investigating RF and chemical synergistic effects are required such RF exposure and Glycophosphate (roundup)
- More studies required looking at RF exposure on microorganisms and antibiotic resistance

Exposure assessment and dosimetry

Appropriate limits in the RF Standard

Problem

- TR 178 was written 3 years after TR 164. ORSAA showed that TR-164 was misrepresenting the science and many of the claims baseless at ARPS 2017
- TR 164 is being used to support the relevance of ARPANSA's RF Standard
- ARPANSA still believes thermal effects is all that we need to be concerned about and the RF Standard provides a high level of protection against them
- ARPANSA suggests more studies are needed however, is missing the big picture
  - Requires established evidence of harm before acting – Precaution and risk management are missing in action
  - Counter to ARPANSA's claim, the RF Standard is not providing biological protection nor is it protecting those deemed sensitive or vulnerable (ICNIRP 2002)
  - Biological effects are observed at levels below public limits in >70% of effect papers
  - Non of these biological effects have been shown to be safe in the long term

Recommendation

- Perform an unbiased risk assessment using all available evidence
- Ensure assessment of risks includes specialists with biological and medical science expertise

Special areas of research

Electromagnetic hypersensitivity

Problem

- TR-178 suggests provocation studies are well conducted and not showing a link
- Unwillingness to admit that there is evidence linking RF exposure to subjective symptoms

Recommendation

- Research needs to focus on objective biological responses and genetic markers that differentiate EHS sufferers from healthy individuals
- Studies should not exclude those with other medical issues because these issues may be a trigger for sensitivity or make them vulnerable to RF exposure
- Requires research by those with medical qualifications not psychologists
- Research needs to be performed completely independent of industry influence
- Research should use technologies that are relevant to the sufferer rather than using frequencies and intensities that do not exist in real life
- Symptom development and recovery times need to be sufficient
- Symptoms scored and tracked until they are remediated

Risk perception and communication

- A topic for potentially spinning the science
  - Findings likely to suggest it creates unnecessary panic and anxiety possibly leading to a communicated illness via nocebo mechanisms
  - Justify current position of not being transparent to the public of potential risks
  - Designed to protect the industry and government from public enquiry
  - Seems to be a topic specifically set up for Professor Croft and his team
- Perhaps these scenarios should be studied instead
  - Understanding the benefits of having a robust risk management policy along with the adoption of a precautionary approach on public health and wellbeing
  - Why the majority of the public have a low concern of adverse health effects from this technology? Could it be because they are ignorant, not having been informed of the risks by the authorities and sellers of the equipment?
  - Using the experience of past failures by Government authorities to alert the public about health risks from Tobacco smoking and Asbestos. If risks for RF exposure were to become true – what is the projected cost – liability, treatment and compensation for those impacted?

Summary and Recommendations

- TR 178, although inaccurate in many claims, it is a starting point
- For research to provide more insight into RF exposure and well being, further expansion is required:
  - More long term (life time) exposure studies as well as clinical studies
  - Should not be solely focusing on brain tumours – other well-being endpoints need to be considered
  - Studies need to explore the mechanism of how observed bio-effects are occurring
  - Studies need to be designed to specifically look at health outcomes, particularly in the case of long term chronic exposures
  - EHS studies need to include objective biological tests and performed by **medical science** researchers
  - Systematic reviews of current available scientific evidence needs to be performed with specialist biological and medical sciences (not just psychologists and physicists) who must be free from industry influence
  - Studies need to look at multigenerational exposures to see if there are teratogenic effects, whether RF induced DNA damage is being passed on to subsequent generations
  - Animal studies should focus on confirming non linear dose response bio-effects – more data points covering not just intensities close to or just above the limit but also much lower levels
- New Technologies (mm wave) should not be introduced until they are shown to cause "zero harm"

Annexure

Manufacturing Uncertainty? Real Signals vs Simulated Signals

Research Categories	Real Mobile Phone used in Experiments			Simulated Mobile Phone Signals used in Experiments					
Wave form	Pulsed			Pulsed			Continuous		
Outcome	#Effect	#No Effect	#Uncertain Effect	#Effect	#No Effect	#Uncertain Effect	#Effect	#No Effect	#Uncertain Effect
in-vivo	120	18	11	69	49	8	6	4	0
In-vitro	28	8	1	60	63	7	10	17	2

Source: ORSAA Database May 2018

Find Search Summary Totals

Peer Reviewed Studies Showing Biological Effects Number of records used : 2186 of 3009

Auditory Dysfunction / Hearing loss / Tinnitus	40	Apoptosis (Programmed Cell Death)	95	Brain Tumours	45
Blood Brain Barrier Permeability Changes	16	Breast Cancer	10	Cellular Stress	62
Brain Development / Neuro Degeneration	52	Biochemical Changes	342	EEG changes / Brain Waves	105
Neuro Behavioural Effect / Cognitive Effects	192	Cell Irregularities/ Damage/ Morphological Changes	193	Effects on Mitochondria	39
Calcium Influx / Efflux	18	Fatigue	45	Altered Enzyme Activity / Protein Levels / Protein Damage	363
Circadian Rhythm Disruption	13	Altered Gene Expression	144	Headaches/Migraines	67
DNA Damage / Mutagenic / Genotoxic	145	Altered Glucose Level / Glucose Metabolism	21	Inflammation	22
Endocrine / Hormone Effects	68	Cardiovascular/Vascular Effects	72	Hepatic Effects (Liver)	24
Miscarriage / Spontaneous Abortion / Foetus Resorption	4	Immune System Effects	71	Impaired / Reduced Healing/ Bone Density Changes	5
Memory Impairment	63	Oxidative Stress / ROS/ Free Radicals	240	Speech Impairment	4
Sperm /Testicular Effects	89	Sleep Effects	63	Haematological Effects	52
Tumour Promotion	37	Neurotransmitter Effects	34	Synergistic/Combinative Effects	56
Thyroid Effects	14	Visual Disturbances/ Ocular Effects	44	Autism	9
Leukemia	4	Parotid Gland Malignancy	4	Neoplasis/ Hyperplasia (Abnormal Tissue Growth)	5
Depression	24	Induced Adaptive Response	52	Dizziness / Vertigo / Vestibular Effects	24

Continue

In vitro study review – TR 164

Topic	Y (TR-164)	Y (ORSAA/ARPANSA DB)	N (TR-164)	N (ORSAA/ARPANSA DB)
Genotoxic	16	34 (+9 Synergistic Effect with mutagen and +1 Effect DNA Repair)	32	39 (+2 Effect Positive)
Proliferation/Apoptosis	25	Apoptosis 26 Proliferation 33 (+1 Uncertain) Combined 59 (+1 Uncertain)	30	Apoptosis 22 (+1 Effect Positive) Proliferation 35 Combined 57 (+1 Effect Positive)
Gene Expression	4	61 (+6 Uncertain Effect)	10	14
Stress Response/Heat Shock Proteins (HSP)	4	28 (3 at thermal levels) (+1 Uncertain Effect)	17	19
Intracellular Signalling	1	10 (+1 Uncertain Effect – synergistic with potassium-induced depolarization)	3	2
Membrane Effects	17	27	4	4 (+1 Effect Positive)
Direct Effects On Proteins	15	77 (+5 Uncertain Effects)	1	3
Oxidative Stress	N/S	17	N/S	11
Totals	82	313	97	149

TR-164
Effect 46% vs No Effect 54%

ORSAA
Effect 68% vs No Effect 32%

Source: ORSAA Database

In vivo study review – TR 164

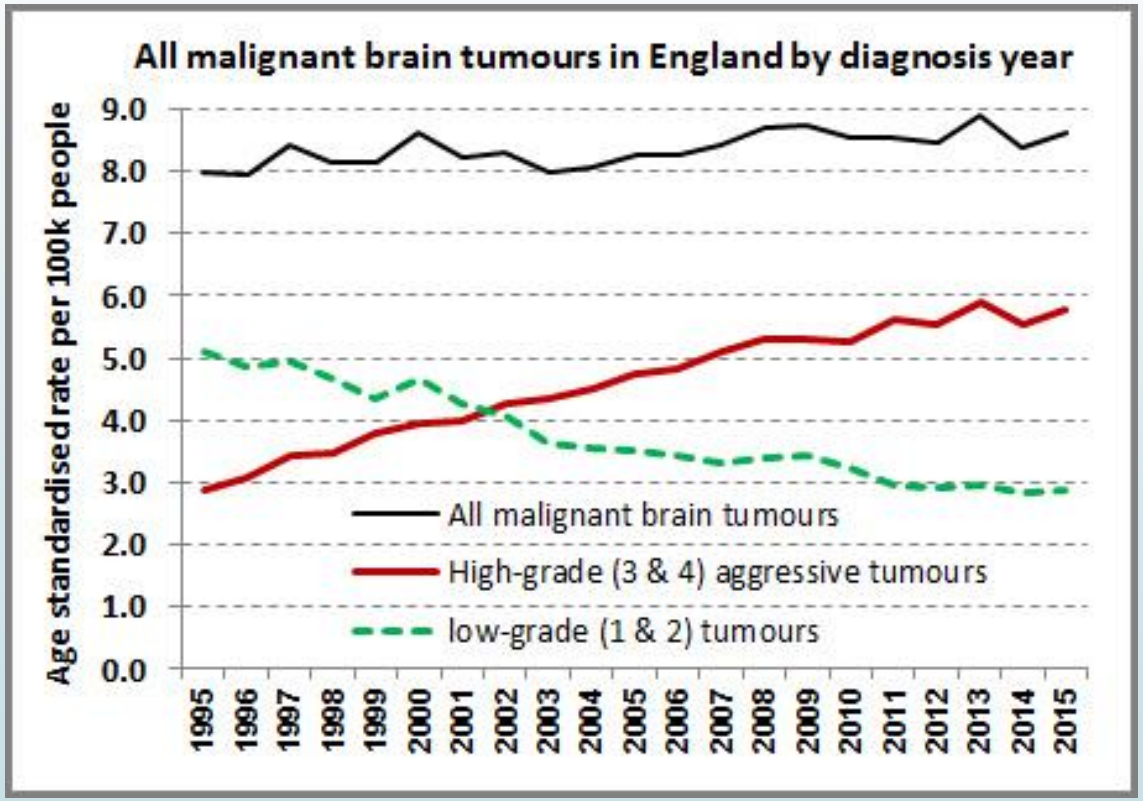
Topic	Y (TR-164)	Y (ARPANSA/ORSAA DB)	N (TR-164)	N (ARPANSA/ORSAA DB)
Cell Physiology, Injury, Apoptosis	21	72 (+1 Uncertain Effect)	17	16 (+2 Positive Protective Effect)
Neurotransmitters	1	10	1	1
Brain Electrical Activity	3	13	2	2
Blood Brain Barrier and Micro Circulation	4	10	8	15
Endocrine System	3	27	5	7
Autonomic Function	0	2 (+1 Uncertain Effect)	2	0
Spatial Memory	7	15	4	10
General Learning	4	13 (+1 Effect – Thermal Levels)	5	9
Auditory Function	4	4 (+1 Uncertain Effect)	7	8
Genotoxicity and Mutagenesis	8	34	10	20 (+1 Protective Effect/ γ-Radiation)
Immune System and Haematological Effects	5	37 (+2 Uncertain Effect) (+13 Positive Effects)	3	16
Testicular Function	8	25 (+1 Uncertain Effect)	5	4 (+1 Positive Effect)
Pregnancy and Foetal development	9	17 (+2 Uncertain Effect)	10	23
Oxidative Stress	Not Stated	124 (+2 Uncertain Effect)	Not Stated	10
Totals	77	403	79	141

TR-164
Effect 49% vs No Effect 51%

ORSAA
Effect 74% vs No Effect 26%

Source: ORSAA Database

Brain tumours: rise in Glioblastoma Multiforme incidence in England 1995–2015



Source: Microwave News

Brain tumours: rise in Glioblastoma incidence in Netherlands 1989–2015

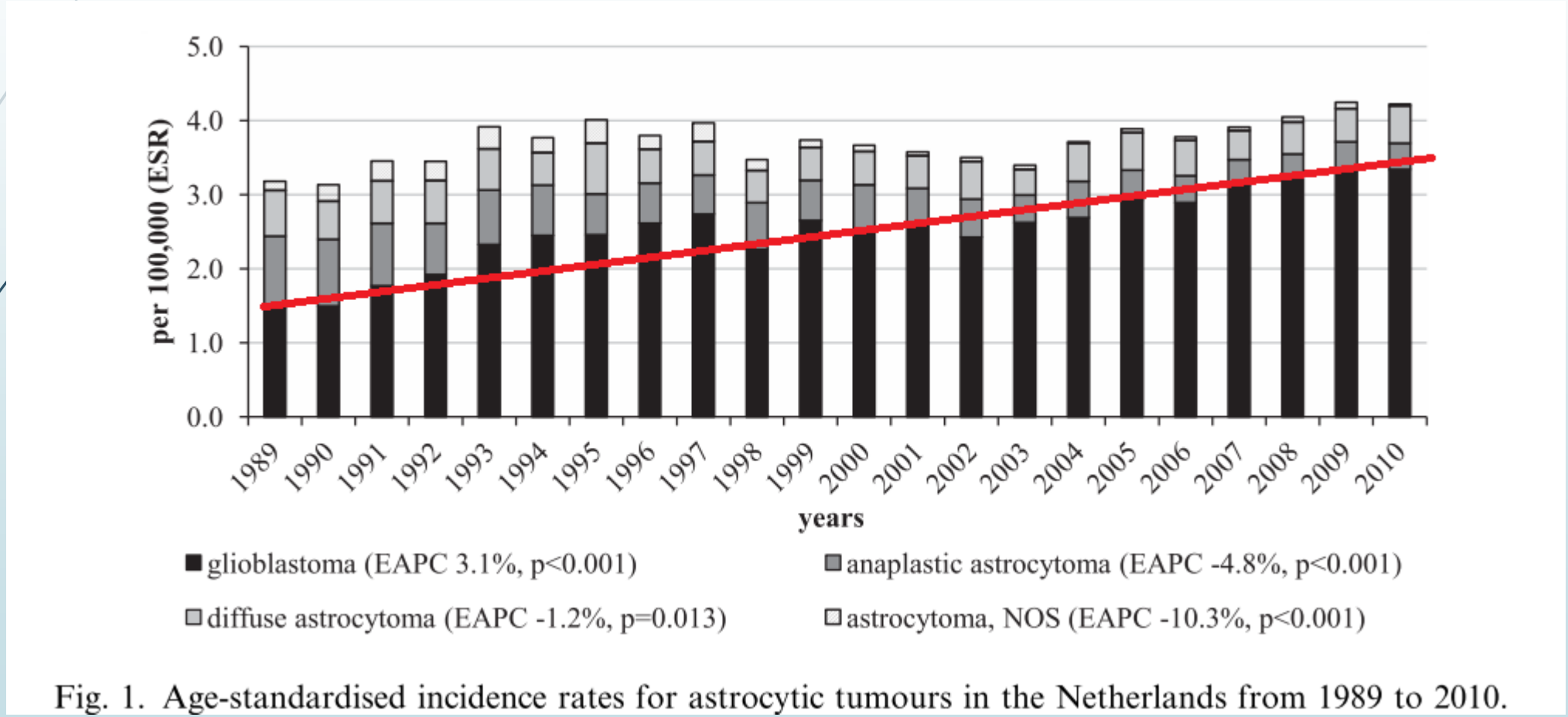


Fig. 1. Age-standardised incidence rates for astrocytic tumours in the Netherlands from 1989 to 2010.

Source: European Journal of Cancer (2014) 50, 2309– 2318

Why Provocation Studies are not the Gold standard for evaluating EHS

Most provocation studies suffer experimental design, methodological and statistical deficiencies, examples include:

- Not representing real life exposure situations as studies focus on a single or narrow frequency range, power level and often lack signal variability
- Symptoms may not be tracked for long enough and symptoms may vary between test subjects by type, onset time, intensity and duration
- The way the symptoms are recorded and the method for constructing a numerical differential score can introduce bias
- Environments are not always controlled - EMR leakage from the environment or even the test device can contaminate testing
- Other confounders are not considered – many EHS people have also been found to be sensitive to odours and noise as well as different chemicals (not controlled)
- Are subjective tests that are often not supplemented with useful objective tests (HRV, blood and urine chemistry changes, skin voltage, nerve conductivity etc.)
- Do not always identify and test genuine EHS sufferers separately (pooling of data tends to wash out potential findings)
- Affected by memory recall issues when comparing feelings to past exposures