SENSE ABOUT SCIENCE

MAKING SENSE OF RADIATION

A GUIDE TO RADIATION AND ITS HEALTH EFFECTS

/introduction/

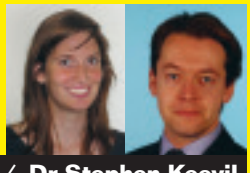
Public discussion about radiation is a frustrating mixture of truths, half-truths and conjectures. As a result, some people are being made to worry unnecessarily about electric fields from pylons and radiation from mobile phones and computers. Discussion about nuclear power often confuses radioactive materials and radiation. There are frequent references in newspapers and on websites to 'electrosmog' polluting us, causing illnesses and even hanging around in our bodies. Proposed EU regulations affecting MRI have added to confusion about the kinds of radiation used in medical scans and their associated risks. The fact that research is carried out on a precautionary basis to establish whether risks exist has been presented by some commentators as evidence of danger, and a growing range of 'protective' products make implausible claims about how electromagnetic radiation behaves. So how do we make sense of all that?

Sense About Science drafted in scientists working in the field – including medical physicists, radiologists, epidemiologists, nuclear physicists, pathologists, hospital doctors, psychologists and electrical and mechanical engineers – to explain the different kinds of radiation, their impact on health, and why some claims in news, commentary and advertising are wrong.

Their main concern is that people can't tell which claims are well-founded. The consequences are far reaching; people sometimes don't consider the real risks of exposure to radiation, for example through non-urgent medical procedures such as 'MOT' body scans. Parents, teachers, councillors and others have become incredibly anxious about exposure to non-ionising forms of radiation, and some schools have now removed Wi-Fi from the classroom. Such anxiety helps no-one but sellers of anti-radiation products. What's more, the scientists say, policy and public discussion can't advance without a clearer picture of the science involved.

Sense About Science has worked with these scientists to identify tools and insights that might help others. For example: that there are different types of radiation; that 'cancer clusters' are unusual; and that when you picture what radiation is really like you can see that the 'electrosmog' pollution metaphor is misleading.

We are grateful to the volunteers who have helped us to understand a complicated subject. This briefing doesn't cover everything. But we hope it equips people with tools and questions that deliver a clearer picture of what radiation is, what it does and what it can't do.



Dr Leonor Sierra / Dr Stephen Keevil

A full list of contributors is found on page 19

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A word on words

Radiation is the emission or transfer of energy, either as electromagnetic waves or alpha and beta particles. Radiation mostly exists as waves, known as electromagnetic radiation (EM radiation). There are different types of EM radiation, shown in the spectrum on page 4, which can be grouped into ionising and non-ionising. This briefing talks a lot about radio frequency radiation (RF radiation) used by mobile phones.

Electromagnetic Fields (EM field or EMF) are generated whenever EM radiation is present, for example when you use a mobile phone. It is possible to have a separate electric or magnetic field, for example the earth has a magnetic field. 'EMF Radiation' isn't a term used in science and muddles together EM fields and EM radiation.

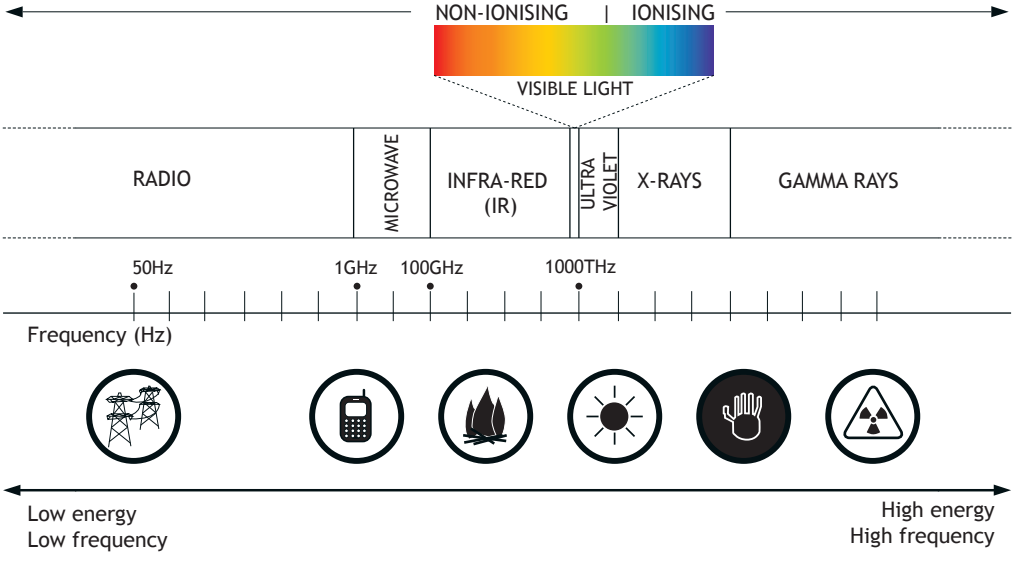
Dr Paddy Regan

section
01.

/ the general picture /

1. RADIATION CAN BE IONISING OR NON-IONISING

The radiation discussed in this briefing is represented in the electromagnetic spectrum (below), which groups radiation according to the amount of energy it has. At one end the radiation is ionising and needs to be carefully controlled to produce benefits, such as x-rays. At the other end it is non-ionising and includes visible light and radio waves.



2. WHETHER RADIATION IS DANGEROUS DEPENDS ON WHICH TYPE IT IS AND YOUR EXPOSURE TO IT

Ionising and non-ionising radiation have very different effects. Exposure to high levels of ionising radiation can be dangerous and is known to increase the risk of cancer. Non-ionising radiation can cause harm if sufficiently intense, the heat from an electric fire can cause burns for example, but it has not been shown to have longer-term ill effects. Knowing what type of radiation you might be exposed to helps you to decide whether or not it's necessary to be protected from it.

"The effect of ionising radiation can be likened to throwing a cricket ball at a fairground coconut shy. Sometimes the ball hits the coconut – this is like ionising radiation hitting a cell. The coconut may fall to the ground – the cell is killed. Other times the coconut just wobbles but then straightens up again – analogous to the cell repairing itself.

The effect of non-ionising radiation is like throwing a ping-pong ball at the coconut. It does not have sufficient energy to knock it over or make it wobble. Increasing the power of the radiation is like throwing more ping-pong balls every second – they still won't knock the coconut over – so the cell remains undamaged.

Prof Anthony Barker

Ionising radiation is of high energy, and can change the structure of the DNA within the cells in a way that may kill the cell or leave it permanently damaged, so that the cell may become cancerous. Non-ionising radiation does not have enough energy to damage or kill the cell, and so cannot cause cancer.

3. IONISING RADIATION DOESN'T ALWAYS CAUSE HARM

Ionising radiation is used to treat cancer effectively. About half of cancer patients have radiotherapy, during which very large doses of ionising radiation are directed at cancerous cells to kill them, taking care that surrounding healthy cells only receive low doses so that they are not damaged.

"As with other medical treatments, radiotherapy can have side effects and occasionally mistakes are made. These are rare and therefore highly publicised in the media. To put things into perspective: over 100,000 courses of radiotherapy are given to cancer patients in Britain each year; errors with serious clinical consequences occur in around 0.003% of these treatments.[1] The risk of death as a direct result of a treatment error is around one in 200,000 (there were only two such cases in the UK in the ten-year period 1995-2005).[2]

Dr Stephen Keevil

4. RADIATION AND RADIOACTIVITY ARE NOT THE SAME

Radiation and radioactivity are often confused in media reports. News of a "radiation leak" is usually a leakage of radioactive material. Radioactive material releases radiation in the form of alpha particles, beta particles or gamma rays (these last are in the ionising part of the electromagnetic spectrum). Alpha and beta particles can be very harmful if released inside the body by ingesting radioactive material, as in the case of Litvinenko being poisoned by radioactive polonium in coffee.

Ionising radiation is always moving and can't linger in the environment or build up in the body but radioactive materials can. In areas with high levels of naturally occurring radon gas, for example, it is advised to ventilate the house to stop the radioactive gas accumulating.

"People often don't realise that they are naturally radioactive. We all contain a very small amount of a radioactive isotope of potassium. The rather strange consequence of this is that people who sleep together will be irradiating each other to a very low level continuously through the night – not generally the first thing we think about when sleeping with someone! **Dr Stuart Green**

5. 'ELECTROSMOG' IS A POOR DESCRIPTION OF THE ELECTROMAGNETIC RADIATION AROUND US

There is no such thing as 'electrosmog' but it has become a popular term to describe the amount of radio frequency (RF) radiation around us. By evoking the London smog of the 1950s, which killed many people, it suggests that RF radiation is harmful when there is no evidence that it is. It also implies that radio waves somehow linger in the environment when they are actually constantly moving and are not something that can or need to be eliminated, by airing a room for example.

[1] *Towards Safer Radiotherapy.* The Royal College of Radiologists, Society and College of Radiographers, Institute of Physics and Engineering in Medicine, National Patient Safety Agency, British Institute of Radiology. London: The Royal College of Radiologists, 2008

[2] *Hidden danger, obvious opportunity: error and risk in the management of cancer.* Munro AJ. Br J Radiol **80** 955-966, 2007

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/ radiation and health effects /

6. CANCER CLUSTERS ARE UNUSUAL; MOST REPORTED CLUSTERS TURN OUT TO BE FALSE

A cancer cluster is a greater-than-expected number of cancer cases occurring within a population in a geographic area over a period of time. They make for great headlines but are almost always due to chance. True cancer clusters are very rare and usually well investigated.

There are pitfalls in identifying true cancer clusters:
a. Identifying clusters by defining the geographic area according to where cases arise, rather than first defining the area and then identifying the cases.
b. Cancer is a common disease, so even if cases occur at random, some clusters will occur by chance (as will clusters with significantly *fewer* cancer cases than expected).
c. Aside from chance occurrences, people living close to each other are likely to share characteristics, such as to be smokers or elderly, which might increase their risk of cancer and so give rise to an apparent cluster.

Most suspected cancer clusters turn out to not be clusters at all when investigated. A cluster is more likely to be a true cluster, if it involves one specific type of cancer, particularly a rare type, or if the age group affected is not usually prone to that type of cancer. A few true cancer clusters have been documented, but they have mostly occurred in groups of people exposed to high levels of occupational carcinogens. Classic examples of clusters include the scrotal cancer in chimney sweeps exposed to soot and coal, and mesothelioma and lung cancer in workers exposed to asbestos.

Dr Hannah Kuper

7. CHILDREN ARE MORE VULNERABLE TO IONISING RADIATION

Children's exposure to ionising radiation is strictly limited. Children with cancer are often successfully treated with radiotherapy but as a result of the ionising radiation received in treatment, they, like all patients cured of cancer, are then at an increased risk of developing another cancer later in their lives. Children have more years in which this might happen, so are prioritised for the most advanced forms of radiotherapy which provide the lowest levels of radiation to non-diseased tissues.

However, public discussion about children being more vulnerable to radiation often refers to non-ionising radiation, from a mobile phone, mast or Wi-Fi network. Although a government review[3] recommended the precaution of restricting children's mobile use to "essential use", there is no evidence to show that they are adversely affected by radio frequency radiation. Because a child's lifetime exposure will be greater than that of people who started using the phones as adults, as an additional precaution, research is under way to see if long term use is associated with any health risks. The Mobile Telecommunications and Health (MTHR) programme has conducted further research into the incidence of childhood cancers near mobile phone masts. The results are expected in 2009.

[3] The report of the Independent Expert Group on Mobile Phones (the Stewart Report) **www.iegmp.org.uk/report/index.htm**

"It has been said that children are more vulnerable to non-ionising radiation because they have thinner skulls, the implication being that radiation can penetrate more deeply. Whilst it's true that children's skulls are thinner, the inner ear is embedded in the densest part of the skull and the auditory nerve, on which an acoustic neuroma (a type of slow growing tumour) may develop, is embedded deep in the bone and well protected. **Prof Colin Berry**"

8. RADIATION FROM MOBILE PHONES DOES NOT CAUSE HARMFUL HEATING EFFECTS

After talking on a mobile for a while both your phone and ear feel hot. Concerns have been raised that this heating can cause long-term harm. We know that at very high levels radio frequency (RF) radiation causes heating effects – this is how microwave ovens cook food – but mobile phones emit far less power and consequently don't cause damaging heating effects in people. The warmth we feel comes mostly from the electrical components in the phone and not the RF radiation.

9. THERE ARE NO KNOWN BIOLOGICAL EFFECTS FROM MOBILE PHONES' RF RADIATION

A concern often raised by campaign groups is that mobile phones can have biological effects (affect our cells) despite being too weak to cause significant heating. Because non-thermal effects cover everything except heating it is a very broad term – it can refer both to cancer and insomnia – but there is no evidence that RF radiation causes harmful non-thermal effects.

10. CORONA IONS AREN'T HARMFUL TO HEALTH

Some campaigners suggest that charged ions or particles (corona ions) – caused by the electric field which surrounds a pylon's cable – can attach themselves to pollutants in the environment making them more likely to accumulate in the body. Research by the World Health Organisation (WHO) and the National Radiological Protection Board (NRPB) concluded that this effect is small and does not cause harm.

11. THERE IS NO EVIDENCE THAT 'PULSING' IS DANGEROUS

'Pulsing' is used by anti-EMF campaigners to mean the rate at which a signal from an EM radiation source is turned off and on. They say low frequency 'pulsing' might be dangerous since one research paper found that human's cell functions might be affected at a frequency of 16 Hz. TETRA handsets (not masts), the mobiles used by the emergency services, 'pulse' at 17.6 Hz so possible effects were investigated but further research did not support the original finding. It is likely that the initial result was an artefact probably due to experimental error.

12. REPLICATION OF EXPERIMENTAL RESULTS IS ESSENTIAL

"How an experiment is performed can affect the results. This usually becomes clear to researchers if an unusual pattern occurs that isn't supported by other data. This is why repeating an experiment is important in determining what is a true result and what is an **artefact** of the study design.
Prof Jim Al-Khalili"

"Repeating experiments and getting the same results is important to verify scientific findings. One or two early studies linked mobile phones with adverse cognitive effects but several large-scale replication studies have since been done and have not found the same effects. These have been verified by meta-analysis, studies which give a statistical overview of multiple studies.
Prof Elaine Fox"

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/debates about mobile phones, pylons and wi-fi radiation/

Mobile phones, Wi-Fi and masts use radio frequency (RF) radiation and are in the non-ionising end of the electromagnetic spectrum. Some people are concerned that such radiation may cause long-term health problems, such as cancer, in the same way that ionising radiation can. Although RF radiation at high levels can cause burns (microwave ovens operate using RF radiation) no biological mechanism has been found to show they can cause cancer.

However potential long-term health effects of these kinds of non-ionising radiation are still being investigated. This isn't because there is evidence or a strong scientific suspicion that they cause harm, as some commentators have said, but because people are worried and because of the widespread use of RF-based technologies. To consider every factor, for example taking into account that tumours can take several years to develop, research will continue for many years. In the meantime, speculative stories about health risks and RF radiation often go uncorrected, leaving a trail of confusion. This section covers some claims about risks from mobile phones, masts, Wi-Fi and pylons and whether there is any scientific evidence to support them.

"Media reports often quote members of lobby groups or individual scientists who discuss unverified work and do not represent the consensus view. An implied 50:50 split on findings is perpetuated because TV and press coverage feel the need to be 'balanced' and therefore give equal time and credence to opposing views, implying that the evidence is strong on both sides."
Prof Averil Macdonald

13. THE RELATIONSHIP BETWEEN RADIATION AND CANCER CAN BE STUDIED BY EPIDEMIOLOGISTS

As an epidemiologist I study how often diseases occur in different groups of people and try to find reasons for these patterns. When considering whether there is a relationship between mobile phones and cancers for example, I assess whether a relationship has been shown repeatedly in different studies and in different settings and what the strength of the association is. I then look to see whether there is a biological rationale for the relationship and then if there is a clear dose-response pattern, whereby increasing exposure is related to increasing risk of disease. Take for example smoking and lung cancer. It is now known that if someone smokes they have approximately a 20-fold increased risk of lung cancer, and the risk is highest among the heaviest smokers. This has been shown, through epidemiology studies, in men and women all over the world. The biological effect, that the carcinogens in smoke damages cells, has also been demonstrated in a laboratory setting so we know with certainty that smoking causes lung cancer.

In the case of mobile phones, a number of large studies have been carried out in different countries, and they do not show a consistent relationship between mobile phone use and the development of brain tumours. Despite people looking very hard, there is no biological rationale provided by laboratory or animal studies that would lead us to make the conclusion that mobile phones cause cancer. The weight of evidence therefore does not support a causal relationship between mobile phone use and brain tumours.

Dr Hannah Kuper

cc Gaeten Lee

14. MOBILE PHONE USE AND BRAIN CANCER – THE INTERPHONE STUDY

The International Agency for Research on Cancer (IARC) is coordinating epidemiological research in 13 countries. The project – INTERPHONE – is assessing whether RF radiation from mobile phones is associated with an increased risk of brain cancer. The final report has not yet been published but most of the countries have found no causal relationship between mobile phone use and brain tumours. The data is available at www.iarc.fr/en/content/download/2213/18246/file/INTERPHONEresultsupdate.pdf.

Some data from the Nordic countries and the UK suggested an increased risk of developing certain kinds of brain tumour (glioma and benign acoustic neuroma) in people who have used a mobile phone for over ten years. However, there are serious concerns about the interpretation of these results and the IARC warns that the data do not show a causal link between mobile phone use and brain tumours.

The data suggest that mobile phone users are more likely to develop tumours on the side of the head where they hold their phone, but *less* likely than the rest of the population to develop a tumour on the other side. No-one would suggest that radiation from mobile phones can protect against cancer on the opposite side of the head, so it seems likely that something is wrong with the way the study was performed. One problem may have been **recall bias**. Researchers asked mobile phone users to remember how much they had used their phones over the past ten years, and on which side of the head they held their phones. Detailed recall over a ten year period is difficult, and some people who had developed a tumour on one side of the head may have been unconsciously biased towards saying that they had held their phone that side.

COSMOS an international study is now starting in the UK. It plans to collect data from mobile phone users over the next 25 years to avoid the problem of relying on people's memories.[4]

[4] For more see www.mthr.org.uk/research_projects/COSMOS.htm

15. NUCLEAR POWER STATIONS AND CANCER CLUSTERS

Between 1955 and 1983 there were five cases of leukaemia in children under ten years old living in the town of Seascale, many of whose parents worked at the nearby Sellafield nuclear power station. This is about ten times as many as the expected number of cases for a town this size, making it a genuine cancer cluster. However, the amount of radiation Seascale residents were exposed to was about 200 times too small to account for this and no evidence was found to suggest that it was caused by the parents' radiation exposure at work. Large studies from the USA also failed to show a link between living near nuclear power stations and an increased risk of childhood leukaemia. This indicates that in Seascale radiation exposure was not responsible for the cancer cluster. It may instead be due to chance or an unidentified risk factor such as a rare response to a virus.

16. MOBILE PHONE MASTS AND HARMFUL HEALTH EFFECTS

There have been many media reports of cancer clusters around mobile phone masts, which on investigation turn out not to be clusters at all – the presence in the same place of people with cancer is not necessarily a cluster. Masts can be very visible and people are concerned that being near one exposes them to high doses of RF radiation. However, the exposure from a mast doesn't happen quite as people think. If you stand 50m away from a mast you are exposed to 5,000 times less radiation than if you are 2.2cm from the antenna of a mobile phone. In fact, the average exposure of members of the public to RF radiation from mobile masts is 0.002% of the recommended guidelines.[5]


cc Harald Hubich


cc Yummifruitbat

When a mast is put on a building, especially a school, there are often concerns that people in the building will be greatly exposed to radiation from it. The antenna, though, is at the top of the mast and the signal goes out almost horizontally, so in a radius of about 50m around the base of the mast its signal is barely detectable. The Stewart Report suggested that schools should not be in the 'beam of greatest intensity' from a mast, which corresponds to the region between 50m and 200m from the base of the mast. Even within this 'beam of greatest intensity' the RF radiation will be hundreds of times less than the recommended limit.

There have been over 30 scientific reviews in recent years[6] and none have found evidence that mast emissions have harmful health effects. In the UK, more than 500 base stations close to hospitals and schools have been investigated and found to emit radiation far below recommended levels.[7]

17. PYLONS AND LEUKAEMIA

A study published in 1979[8] reported an increased incidence of leukaemia among children living next to pylons and other more recent studies have found a similar association. The most recent, the Draper study[9] published in 2005, found a relationship between the chances of developing leukaemia and the distance a person lived from power lines in the UK, which would account for no more than five cases in England and Wales (of the c.400 that occur annually).

[5] The Stewart Report www.iegmp.org.uk/report/index.htm

[6] 26 of these reviews were analysed in the *Mobile Phones and Health 2004* report by the Board of the NRPB and since then, more have been published, eg. the MTHR progress report, the SCENIHR report or the IET report. For more information contact Sense About Science.

[7] Sitefinder – Mobile Phone Base Station Database www.sitefinder.ofcom.org.uk

[8] *Electrical wiring configurations and childhood cancer.* Wertheimer N, Leeper E. Am J Epidemiol; **109**:273-84, 1979

[9] *Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study.*Draper G et al. BMJ; **330**:1290, 2005 www.bmj.com/cgi/content/abstract/330/7503/1290

This does not show, however, that the pylons are *causing* cancer. The Draper study showed that the risk remained high even at distances where the magnetic field from the pylon was weaker than EMF from electrical wiring in the home, and even at distances where no EMF from the pylon can be measured at all. The increased risk may be because the children shared some other risk factor for leukaemia perhaps due to exposure to some other environmental conditions or carcinogens.

Pylons and EMFs have not been established as a cause of childhood leukaemia. Laboratory trials using animal models and other tests have found no biological mechanism to explain how EMF exposure from power lines could cause cancer.

cc Jarkko Laine

18. WI-FI IN SCHOOLS

Some 70% of secondary and 50% of primary schools are Wi-Fi enabled.[10] The effects of emissions from wireless devices have not been investigated as extensively as mobile phone emissions but the frequencies at which they operate (2.4GHz) are close to those from 3G mobile phones (2.1GHz). Wi-Fi devices only transmit when they are sending data (not continuously) and operate at very low power – 0.1 watts at most. Someone sitting in a Wi-Fi 'hotspot' for a whole year, according to the Health Protection Agency, would be exposed to the equivalent radiation dose of a 20-minute call on a mobile phone,[11] which studies have shown does not cause harm.

Dr Eric de Silva

[10] www.becta.org.uk

[11] www.timesonline.co.uk/tol/life_and_style/health/features/article665419.ece

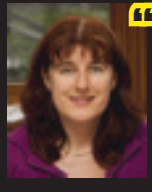
19. 'ELECTROSENSITIVITY' AND EM RADIATION

About 3% of the UK population believe that mobile phones, masts and Wi-Fi affect their health, reporting a range of symptoms within minutes of being near a mobile phone or mast emitting a radio frequency. The media coined the term 'electrosensitives' to describe them and they have been the subject of several large-scale scientific investigations.

The group led by Professor Elaine Fox at the University of Essex tested hundreds of people over five years and found no evidence that mobile phone radiation is linked to subjective symptoms or physiological,[12] such as blood pressure, or cognitive ones,[13] such as memory or attention. Professor Fox's team went on to conduct a laboratory-based study to investigate how symptoms arose. They found that when people who classified themselves as 'electrosensitive' knew that a mast emitting RF was turned on the number of symptoms they experienced increased dramatically compared to the control group. However, under double-blind conditions – when no-one knew whether the mast was on or off – there were no differences in how they felt when the radiation was present and when it was absent. Although the symptoms are real and measurable they are not caused by the presence of the RF radiation.


cc Jannie-Jan

The vast majority of research on the short-term health effects of mobile phones and masts indicates that the health effects are not due to the radiation emitted but to worrying about the impact it might have.



"Psychologists have long known that worry and anxiety can lead to strong physical changes in the body and that seems to be what is happening to 'electrosensitives'. Further research is needed but unless well-conducted double-blind studies do show effects of electromagnetic fields on health and well-being, it appears that the worry about mobile phone technology is more dangerous than the electromagnetic fields themselves."
Prof Elaine Fox

[12] *Does short-term exposure to mobile phone base station signals increase symptoms in individuals who report sensitivity to electromagnetic fields? A double-blind randomized provocation study.* Eltiti S et al. Environmental Health Perspectives; **115** (11) 1603-1608, 2007 www.essex.ac.uk/psychology/psy/people/fox/Eltiti(EHP).pdf

[13] *Does acute exposure to mobile phones affect human attention*. Russo R et al. Bioelectromagnetics; **27**, 1-6, 2007

MAGNETIC RESONANCE IMAGING (MRI)

20. THE USE OF MRI
Magnetic fields are used safely for medical imaging – MRI is a technique developed over the past 25 years and now in common use.


cc KasugaHuang

It gives images of unprecedented quality of the brain, heart, joints and cancerous tumours, sometimes providing information that cannot be obtained in any other way, helping diagnosis. Doctors are now starting to use 'interventional' or 'intraoperative' MRI to guide procedures such as catheterisation of the heart and even brain surgery.

Unlike x-ray imaging, MRI does not use ionising radiation. It uses a combination of EMFs, mostly magnetic fields – a very strong magnet and additional magnetic fields that are switched on and off rapidly – and also EM radiation in the form of radio waves. Hundreds of millions of people have been imaged using MRI without any ill effects being found. Safety procedures in MRI are mainly intended to avoid accidents that might occur if metal objects, like a watch or pacemaker, are brought too close to the strong magnet.

Recently, new European regulations were passed, designed to limit exposure of workers to EMF. These regulations threatened to restrict the use of MRI scanners and reduce the benefits for patient care. After a long campaign by the MRI community in Europe, the regulations have been postponed to allow time for reconsideration, but the problem has not yet been solved. This is an example of what can happen when policy-makers simply react to fears and rely on poor scientific evidence.

Dr Stephen Keevil

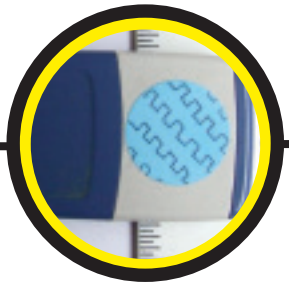
section
04.

/‘protective’ products/

A range of products capitalise on public concerns about radiation, claiming to measure or protect us from non-ionising radiation. These products perpetuate the idea that radio frequency radiation (referred to in marketing literature as EMFs) in particular should be avoided. Many of these products claim to work using mechanisms that don’t exist and can’t do what they promise to.

Some products claim to protect the user by screening incoming electromagnetic radiation – though most of the literature promoting the products fails to mention that visible light is also EM radiation. They may reduce some of the radiation within the screened space but their cost effectiveness is questionable and there is no established evidence that they produce any benefits. Some of the more remarkable (and expensive) devices claim to offer protection from ‘bad’ radiation and other invisible and unmeasurable phenomena, while themselves generating beneficial ‘energy fields’ of a type unknown to science, which also cannot be measured or detected. **Prof Anthony Davies**

product 1



product 2

cc Rvcrewe

Here the scientists respond to the claims made by the products:

1) PHONE SHIELDS

Products and claims: There are shielding devices that attach to your phone and claim to absorb radiation or electromagnetic waves. The marketing claims say that reception will be unaffected or even improved, which suggests that the devices do not work very well, as this radiation is essential to phone reception! These devices play on fears, with one claiming to "reduce the dangerous radiation, and health risk of brain cancer". Prices for these products start at about £10.

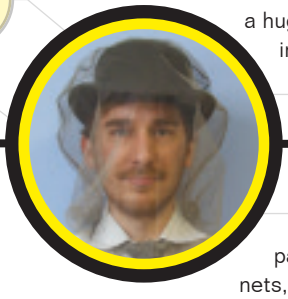
Conclusion: Mobile phones operate at much lower power levels than the recommended safety limits. These products may absorb some radiation, but if they work would also weaken signal reception, meaning your phone works harder to make and receive calls. This leads to higher levels of radiation exposure – defeating the object of using them.

2) MEASURING DEVICES

Products and claims: There are many devices on the market that claim to measure EM radiation. These are commonly sold as EMF detectors or 'electrosmog' detectors. Some can be rented, but buying one will set you back about £100.

Conclusion: These products measure something, but it is not clear what. The intensity levels of RF can vary a lot from one part of a room to another, so moving the measuring device can have a huge effect on the reading. You also need to be able to interpret what you have measured and assess what it represents. There is radiation all around us; being able to measure it does not make it dangerous.

product 3



3) PAINTS, NETS, AND OTHER PRODUCTS TO PROTECT YOUR HOUSE

Products and claims: Products include anti-EMF paint (electric field carbon screening paint), bed-nets, curtains, head nets, etc. They all claim to keep out harmful radiation. A head net like the one in the picture costs £27.

Conclusion: These products attempt to create a Faraday cage – a continuous cage of metal that stops some EM radiation from coming through. To work the cage needs to completely surround you, with no large gaps. These products don't do this and are unlikely to be effective. As RF radiation is not known to cause harm there is no need for these products.

4) BIO-RESONANCE PRODUCTS

Products and claims: Some products claim to provide biological protection – pendants you can wear, stickers or patches for you and the appliances, sprays or computer programmes. These products use words like bio-resonance or bio-field. Some of these devices claim to work by emitting extremely low frequency (ELF) signals to intercept the radiation from your phone and neutralise it, claiming that the EMFs interfere with your brain and that these 'shields' can restore balance and relieve 'geopathic stress'. They cost from £20 to £200.

Conclusion: There is no reason why producing an ELF signal would neutralise EMFs – it will simply introduce another EMF to the area. There is no scientific basis to these products and no evidence is given for their claims.

"One website says "it is important to understand that no regulatory agency or scientist has ever stated, without caveats, that these (EMF) emissions are safe." This is a misleading sentence. Neither scientists nor regulatory bodies can ever state categorically that anything is absolutely safe. Science works in terms of probabilities, so there is no such thing as 100% safe. But we can say that there is no evidence to suggest that they are not safe. If you feel that websites are deliberately using such language to make you feel nervous about EMFs, and so buy their products, the alternative is to not to buy them and save your money. **Dr Mark Miodownik**"

product 4

Ben Goldacre (badscience.net)

"QUESTIONS YOU SHOULD ASK BEFORE PARTING WITH YOUR MONEY

a. Is this kind of radiation something that needs to be avoided? How does the product protect me? (If you are working with ionising radiation your employer should provide protective equipment. If you are going for medical treatment appropriate protective clothing will be given.)

b. Are you concerned about radiation exposure because of something you read somewhere? What is the source of that claim? (E.g. did the website or article about the dangers of radiation sell 'protective' products or refer to another where such products are sold?)

c. What evidence do you have that the product does what it claims to do? How has it been tested? Is there any independent, peer-reviewed[14] evidence to support the use of this product?

Dr Tim Fox"

[14] To find out more about peer review please see 'I don't know what to believe… Making Sense of Science stories' www.senseaboutscience.org.uk/peerreview

USEFULinks

Identifying the environmental causes of disease: how should we decide what to believe and when to take action? - An Academy of Medical Sciences working group report, 2006. See: www.acmedsci.ac.uk/p99puid115.html.

The Health Protection Agency's (HPA) www.hpa.org.uk looks at the public health risks of ionising and non-ionising radiation.

The World Health Organisation (WHO) has information about EMFs on their website: www.who.int/topics/electromagnetic_fields/en.

Summary of the INTERPHONE study from the **International Agency for Research on Cancer (IARC)** www.iarc.fr/en/content/download/2213/18246/file/INTERPHONEresultsupdate.pdf.

The Institution of Engineering and Technology (IET) has an expert policy advisory group on the biological effects of electromagnetic fields See: www.theiet.org/publicaffairs/mobile/index.cfm.

The British Institute of Radiology (BIR) www.bir.org.uk is an independent multidisciplinary organisation and a registered charity open to everyone with an interest in radiology and radiation oncology.

The Institute of Electrical and Electronics Engineers (IEEE) www.ieee.org is the world's largest technical professional society, with more than 360,000 members. One of its committees (COMAR) examines and interprets the biological effects of radiation.

The Institute of Physics and Engineering in Medicine (IPEM) www.ipem.ac.uk is dedicated to the advancement of science and engineering in medicine and biology so as to improve health.

The Institution of Mechanical Engineers (IMechE) www.imeche.org is the leading body for professional mechanical engineers and the United Kingdom's qualifying body for Chartered and Incorporated mechanical engineers.

Sense About Science
www.senseaboutscience.org
is an independent charitable trust that responds to the misrepresentation of science and scientific evidence on issues that matter to society. We work with scientists and civic groups to share the tools and insights of scientific reasoning.

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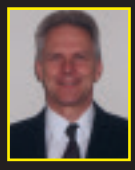

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